T.O. 1B-52E-1

B-52E & B-52F FLIGHT MANUAL

USAF SERIES AIRCRAFT

AF 34(601)-21277

Commanders are responsible for bringing this publication to the attention of all Air Force personnel cleared for operation of subject aircraft.

CHANGE NOTICE

LATEST CHANGED PAGES SUPERSEDE THE SAME PAGES OF PREVIOUS DATE

Insert changed pages into basic publication. Destroy superseded pages.

This change replaces Safety Supplements -71, -87, and -98. See Technical Order Index T.O. 0-1-1-2A for current status of Flight Manuals, Safety and Operational Supplements, and Flight Crew Checklists.

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THIS PUBLICATION IS INCOMPLETE WITHOUT T.O. 1B-52E-1A, T.O. 1B-52B-1-2, T.O. 1B-52E-1-2, T.O. 1B-52B-1-5, T.O. 1B-52E-1-6-1, T.O. 1-1C-1, AND T.O. 1-1C-1-5. SUPPLEMENTARY PUBLICATIONS ARE PROVIDED TO SUPPLY OPERATIONAL COVERAGE IN NON-STANDARD CONFIGURATIONS. SEE T.O. 0-1-1-2 FOR NUMERICAL INDEX OF BOMBER TECHNICAL PUBLICATIONS.

Air Force OC, 7 May 65-5850

1 NOVEMBER 1962

CHANGED 30 APRIL 1965

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INSERT LATEST CHANGED PAGES. DESTROY SUPERSEDED PAGES.

LIST OF EFFECTIVE PAGES

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CURRENT FLIGHT CREW CHECKLISTS

T. O. 1B-52E-1CL-1	1 Nov 62	Changed 30 Apr 65
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T. O. 1B-52E-1CL-3	1 Nov 62	Changed 1 Feb 65
T. O. 1B-52E-1CL-4	1 Nov 62	Changed 1 Feb 65
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The above checklist dates are effective at the time of preparation of this page but are subject to change by safety supplements or supplemental publications which affect the checklist.

*The asterisk indicates pages changed, added, or deleted by the current change.

ADDITIONAL COPIES OF THIS PUBLICATION MAY BE OBTAINED AS FOLLOWS:

USAF ACTIVITIES. — In accordance with T.O. 00-5-2.

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SAFETY SUPPLEMENT SUMMARY

Safety Supplements are identified by the addition of "-SS-" and consecutive dash numbers to the basic publication number. A supplement number will never be used more than once. Supplements issued prior to 1 April 1963 are designated Safety of Flight Supplements, identified by "-SF-" instead of "-SS-", with no break in the numbering sequence. The supplements you receive should follow in sequence and if you are missing one, check the Weekly Index of Bomber Aircraft Safety Supplements T. O. 0-1-1-2A to see if it was issued and, if so, is still in effect. That supplement may have been replaced or rescinded before you received your copy. If it is still active, see your Publication Distribution Officer and get your copy.

SAFETY SUPPLEMENTS IN THIS CHANGE

Number	Date	Short Title	Disposition
-71	12 Jul 63	Thrust Balancing	Not Applicable
-87	16 Jul 64	Turbulence Restrictions	Sections II, III, V, VI, and IX
-88	23 Sep 64	Radar Altimeter Restrictions	Rescinded 31 Mar 65
-98	6 Jan 65	Icing Terminology	Not Applicable
-99	15 Jan 65	Landing Gear Shuttle Valve	Rescinded 3 Mar 65
-100	8 Feb 65	Flutter with External Tanks Off	Replaced by -101
-102	13 Mar 65	Takeoff RCR	Replaced by -103

SAFETY SUPPLEMENT STATUS

This portion to be filled in by you when you receive your flight manual and to be added to as you receive additional supplements. Refer to Weekly Index of Bomber Aircraft Safety Supplements T. O. 0-1-1-2A for latest information if any questions arise. Supplements outstanding at the time of preparation of this page have been listed below for your convenience.

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-94	10 Dec 64	Fuel Sequences	
-97	31 Dec 64	ALE-20 Ground Safety	
-101	23 Feb 65	Flutter with External Tanks Off	
-103	26 Mar 65	Takeoff RCR	
-104	6 Apr 65	Gunner's Survival Kit Release	

OPERATIONAL SUPPLEMENT SUMMARY

Operational Supplements are numbered by adding "S" and consecutive dash numbers to the basic publication number. Example: 1B-52E-1S-1, -2, -3, etc. A supplement number will never be used more than once. The supplements you receive should follow in sequence and if you are missing one, check the Weekly Index of Bomber Aircraft Safety Supplements T.O. 0-1-1-2A to see if it was issued and, if so, is still in effect. That supplement may have been replaced or rescinded before you received your copy. If it is still active, see your Publication Distribution Officer and get your copy.

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APPENDIX 2	performance data B-52F	T.O. 1B-52E-1-2
	alphabetical index	I

*REFER TO CONFIDENTIAL SUPPLEMENT T.O. 1B-52E-1A FOR ADDITIONAL INFORMATION

SCOPE. This manual must be used with T.O. 1B-52E-1A, T.O. 1B-52B-1-2, and T.O. 1B-52E-1-2 to obtain the necessary information for safe and efficient operation of the B-52E and B-52F aircraft. T.O. 1B-52E-1A is a supplement to this manual containing classified information. T.O. 1B-52B-1-2 and T.O. 1B-52E-1-2 are appendices providing performance data respectively for B-52E and B-52F aircraft. In addition, it will be necessary to refer to T.O. 1B-52C-30-1 for information on operation with AGM-28 missiles installed, to T.O. 1B-52G-1-2 and T.O. 1B-52E-1-4 for information on operation with ADM-20B and -20C missiles installed respectively, and to T.O. 1B-52B-34-2-1 for information on conventional munitions delivery. For inflight maintenance data and general instructions on the AN/ASQ-38(V) Weapons Control System - Offensive, refer to T.O. 1B-52E-1-6-1. For inflight maintenance malfunction procedures on that system, refer to T.O. 1B-52E-1-6-2. For inflight operating procedures and general overall technical information on the MD-9 Fire Control System, refer to T.O. 1B-52B-1-5. These instructions provide you with a general knowledge of the aircraft, its characteristics, and specific normal and emergency operating procedures. Your flying experience is recognized; therefore, basic flight principles are avoided.

SOUND JUDGMENT. Instructions in this manual are for a crew inexperienced in the operation of this airplane. This manual provides the best possible operating instructions under most circumstances, but it is a poor substitute for sound judgment. Multiple emergencies, adverse weather, terrain, etc may require modification of the procedures.

PERMISSIBLE OPERATIONS. The Flight Manual takes a "positive approach" and normally states only what you can do. Unusual operations or configurations (such as asymmetrical loading) are prohibited unless specifically covered herein. Clearance must be obtained from the Flight Manual Manager (OCAMA - OCNEOH) before any questionable operation is attempted which is not specifically permitted in this manual.

STANDARDIZATION AND ARRANGEMENT. Standardization assures that the scope and arrangement of all Flight Manuals are identical. The manual is divided into ten fairly independent sections to simplify reading it straight through or using it as a reference manual. The first three sections must be read thoroughly and fully understood before attempting to fly the airplane. The remaining sections provide important information for safe and efficient mission accomplishment.

letters "OS" for operational supplements printed around the borders of the pages. The currency of safety and operational supplements affecting your aircraft and flight manual can be determined by referring to the Weekly Index of Bomber Aircraft Safety Supplements (T.O. 0-1-1-2A). The title block of each supplement and the title page of this manual should also be checked to determine the effect they may have on existing supplements. You must remain constantly aware of the status of all supplements—current supplements must be complied with, but there is no point in restricting your operation by complying with a replaced or rescinded supplement. As a further aid, supplement summaries are included in this manual following the A pages for both safety and operational supplements; however, this summary can be only as current as this manual.

CHECKLISTS. The Flight Manual contains only amplified checklists. Abbreviated checklists have been issued as separate technical orders. See the back of the title page for T.O. number and date of your latest checklist. Line items in the flight manual and checklists are identical with respect to arrangement and item number. Whenever a Safety or Operational Supplement affects the abbreviated checklist, write in the applicable change on the affected checklist page. As soon as possible, a new checklist page incorporating the supplement will be issued. This will keep hand-written entries of Safety and Operational Supplement information in your checklist to a minimum.

HOW TO GET PERSONAL COPIES. Each flight crew member is entitled to personal copies of the Flight Manual, Safety and Operational Supplements, and Checklists. The required quantities should be ordered before you need them to assure their prompt receipt. Check with your supply personnel—it is their job to fulfill your Technical Order requests. Basically, you must order the required quantities on the Numerical Index and Requirement Table, Bomber Aircraft Technical Orders (T.O. 0-1-1-2). Technical Orders 00-5-1 and 00-5-2 give detailed information for properly ordering these publications. Make sure a system is established at your base to deliver these publications to the flight crews immediately on receipt.

FLIGHT MANUAL AND CHECKLIST BINDERS. Loose leaf binders and sectionalized tabs are available for use with your manual. These are obtained through local purchase procedures and are listed in the Federal Supply Schedule (FCS Group 75, Office Supplies, Part 1). Binders are also available for carrying your abbreviated checklist. These binders contain plastic envelopes into which individual checklist pages are inserted. They are available in three capacities and are obtained through normal Air Force supply under the following stock list numbers: 7510-766-4268, -4269, and -4270 for 15, 25, and 40 envelope binders respectively. Check with your supply personnel for assistance in securing these items. Normally a checklist will be contained in one binder but, if not feasible, additional binders may be used as required.

WARNINGS, CAUTIONS AND NOTES. The following definitions apply to "Warnings," "Cautions," and "Notes" found throughout the manual.

WARNING — Operating procedures, techniques, etc, which will result in personal injury or loss of life if not carefully followed.

CAUTION — Operating procedures, techniques, etc, which will result in damage to equipment if not carefully followed.

NOTE — An operating procedure, technique, etc, which is considered essential to emphasize.

MISSILE REDESIGNATION. Designations ADM-20 and AGM-28 will replace GAM-72 and GAM-77 respectively, when pages are changed for other reasons. The new designation will apply to all models of the missile except when a suffix is required to identify differences.

YOUR RESPONSIBILITY — TO LET US KNOW. Every effort is made to keep the Flight Manual current. Review conferences with operating personnel and a constant review of accident and flight test reports assure inclusion of the latest data in the manual. However, we cannot correct an error unless we know of its existence. In this regard, it is essential that you do your part. Comments, corrections, and questions regarding this manual or any phase of the Flight Manual program are welcomed. These should be forwarded through your Command Headquarters to OCAMA, Tinker AFB, Okla, Attn: OCNEOH.

AIRPLANE CODING

The information in this manual covers all B-52E and B-52F airplanes. Code symbols are used to distinguish information related to one airplane or group of airplanes from that which is applicable to the other airplanes. When code symbols appear by a paragraph or illustration, the information applies only to the airplanes represented by the code symbols. Where no code symbols appear on a paragraph or illustration, the information is applicable to all airplanes. Two kinds of airplane code symbols are used. The first kind consists of airplane model code blocks, **B-52E** and **B-52F** . These code blocks are used only when differentiating between airplane models. The second kind of coding is airplane unit coding. Two separate unit codings are used throughout the manual, one for Seattle-built airplanes and the other for Wichita-built airplanes, as follows:

SEATTLE AIRPLANES

Symbol AF Serial No.

B-52E

190 56-631	**197** 56-638	**204** 56-645	**211** 56-652	**218** 57-016	**225** 57-023
191 56-632	**198** 56-639	**205** 56-646	**212** 56-653	**219** 57-017	**226** 57-024
192 56-633	**199** 56-640	**206** 56-647	**213** 56-654	**220** 57-018	**227** 57-025
193 56-634	**200** 56-641	**207** 56-648	**214** 56-655	**221** 57-019	**228** 57-026
194 56-635	**201** 56-642	**208** 56-649	**215** 56-656	**222** 57-020	**229** 57-027
195 56-636	**202** 56-643	**209** 56-650	**216** 57-014	**223** 57-021	**230** 57-028
196 56-637	**203** 56-644	**210** 56-651	**217** 57-015	**224** 57-022	**231** 57-029

Symbol AF Serial No.

B-52F

232 57-030	**240** 57-038	**248** 57-046	**255** 57-053	**262** 57-060	**269** 57-067
233 57-031	**241** 57-039	**249** 57-047	**256** 57-054	**263** 57-061	**270** 57-068
234 57-032	**242** 57-040	**250** 57-048	**257** 57-055	**264** 57-062	**271** 57-069
235 57-033	**243** 57-041	**251** 57-049	**258** 57-056	**265** 57-063	**272** 57-070
236 57-034	**244** 57-042	**252** 57-050	**259** 57-057	**266** 57-064	**273** 57-071
237 57-035	**245** 57-043	**253** 57-051	**260** 57-058	**267** 57-065	**274** 57-072
238 57-036	**246** 57-044	**254** 57-052	**261** 57-059	**268** 57-066	**275** 57-073
239 57-037	**247** 57-045				

▶ "thru" or "and on"
EXAMPLE: Information applicable to airplanes AF57-139 thru AF57-154 will be coded **W128**▶ **W143**
Information applying to airplanes AF57-038 and on and AF57-155 and on will be coded **240**▶ **W144**▶

WICHITA AIRPLANES

Symbol AF Serial No.

B-52E

W70	56-699	W80	56-709	W90	57-101	W100	57-111	W110	57-121	W119	57-130
W71	56-700	W81	56-710	W91	57-102	W101	57-112	W111	57-122	W120	57-131
W72	56-701	W82	56-711	W92	57-103	W102	57-113	W112	57-123	W121	57-132
W73	56-702	W83	56-712	W93	57-104	W103	57-114	W113	57-124	W122	57-133
W74	56-703	W84	57-095	W94	57-105	W104	57-115	W114	57-125	W123	57-134
W75	56-704	W85	57-096	W95	57-106	W105	57-116	W115	57-126	W124	57-135
W76	56-705	W86	57-097	W96	57-107	W106	57-117	W116	57-127	W125	57-136
W77	56-706	W87	57-098	W97	57-108	W107	57-118	W117	57-128	W126	57-137
W78	56-707	W88	57-099	W98	57-109	W108	57-119	W118	57-129	W127	57-138
W79	56-708	W89	57-100	W99	57-110	W109	57-120				

Symbol AF Serial No.

B-52F

W128	57-139	W136	57-147	W144	57-155	W152	57-163	W159	57-170	W166	57-177
W129	57-140	W137	57-148	W145	57-156	W153	57-164	W160	57-171	W167	57-178
W130	57-141	W138	57-149	W146	57-157	W154	57-165	W161	57-172	W168	57-179
W131	57-142	W139	57-150	W147	57-158	W155	57-166	W162	57-173	W169	57-180
W132	57-143	W140	57-151	W148	57-159	W156	57-167	W163	57-174	W170	57-181
W133	57-144	W141	57-152	W149	57-160	W157	57-168	W164	57-175	W171	57-182
W134	57-145	W142	57-153	W150	57-161	W158	57-169	W165	57-176	W172	57-183
W135	57-146	W143	57-154	W151	57-162						

PERSONNEL CODING

Where necessary to distinguish between crew members, the following code letters will be used:

(P)	Pilot	(G)	Gunner	(IP)	Instructor Pilot
(CP)	Copilot	(RN)	Radar Navigator	(IN)	Instructor Navigator
(N)	Navigator	(EW)	EW Officer	(GC)	Ground Crew

RETROFIT CODING

The following code symbols, along with the words "Less" and "Plus" are used to distinguish information related to aircraft that have the described retrofit change incorporated from that which is applicable to aircraft not yet retrofitted. This list contains only TCTO's that are applicable to the manual. Effective 1 August 1963, asterisks are used to denote completed TCTO's.

EXAMPLE: **FE** T.O. 1B-52-784, Installation of Fire Detector System in the Fuselage. Information applicable to aircraft AF56-631 thru AF56-634 until they are modified in accordance with T.O. 1B-52-784 will be coded **190 ▶ 193 Less FE**. Information applicable to aircraft AF56-699 thru AF56-705 and aircraft modified in accordance with T.O. 1B-52-784 will be coded **W70 ▶ W76 Plus FE**.

★Denotes work completed.

SYMBOL	T.O. NO.	TITLE	DATE
★	1B-52E-502	Installation of Provisions for Spare AN/ASB-4 BNS Components **B-52E**	27 Jun 58
★	1B-52-955	Replacement of Bomb Salvo Relay Bank **B-52E**	22 Jan 60
	1B-52-955A	Same as Basic	17 May 61
★	1B-52-985	Revision of Circuit Protection for Small Power Transformers	5 Sep 58
	1B-52-985A	Same as Basic	31 Oct 58
★	1B-52-979	Revision of Landing Gear Control Lever and Quadrant **B-52E**	28 Nov 57
	1B-52-979B	Same as Basic	28 Mar 58
★	1B-52-1039	Installation of Type MA-1 Accelerometer **B-52E**	5 Aug 58
★	1B-52-1045	Deactivation of Bombardier's Escape Hatch External Handle **B-52E**	1 Jul 58
★	1B-52-1073	Modification of Crew Seats and Installation of Integrated Harness	13 Feb 59
	1B-52-1073C	Same as Basic	22 Jun 62
★	1B-52-1098	Installation of ME-5 Servo Machmeter	13 Mar 59
★	1B-52-1099	Installation of MM-4 Remote Flight Attitude Indicators	11 Mar 60
	1B-52-1099A	Same as Basic	29 Jun 62
★	1B-52-1105	Installation of External Flap on Upper Aft and Lower Escape Hatches	6 May 60
	1B-52-1105A	Same as Basic	29 Jun 62
★	1B-52-1122	Installation of Water Sensor **B-52E**	20 Nov 59
	1B-52-1122B	Same as Basic	17 May 61
★	2J-J57-586	Installation of a Compressor Bleed Valve Air Metering Baffle (-43W and WA Engines) **B-52F**	24 Oct 58
★	1B-52F-501	Relocation of Wing Tip Gear Door Ground Handling and Taxi Light **B-52F**	3 Jun 60
	1B-52F-501A	Same as Basic	25 Nov 60
	1B-52F-501B	Same as Basic	13 Dec 60
★	1B-52-1040	Installation of AN/ARN-21 Airborne Radio Navigational Receiver (TACAN)	16 Sep 60
	1B-52-1040B	Same as Basic	17 Nov 61
	1B-52-1040C	Same as Basic	20 Jul 62
★	1B-52-1173	Installation of Automatically Operated Switch for Bailout Warning Lights	25 Mar 60
	1B-52-1173A	Same as Basic	17 Jun 60

SYMBOL	T.O. NO.	TITLE	DATE
*	1B-52-1135	Installation of Provisions for VGH Recorder	7 Apr 61
*	1B-52-1057 1B-52-1057A	Installation of Improved Lighting at Bombardier-Navigator's Station Same as Basic	4 Dec 59 8 Apr 60
*	1B-52-1156 1B-52-1156C	Installation of Sonic Vibration Suppressors for J57-P-43W Engines B-52F Same as Basic	13 May 60 17 Mar 61
JW	1B-52-1200 1B-52-1200A	Installation of "Last Resort" Bombsight Same as Basic	1 Aug 60 29 Jun 62
*	1B-52-1241 1B-52-1241C	Installation of Stub Antenna for Primary UHF Radio System Same as Basic	14 Apr 61 21 Dec 62
*	2J-J57-639	Installation of Closed-Open-Closed Bleed Valve System B-52F	28 Jun 61
*	1B-52-1092	Revision to AN/ASB-4 Tie-In with MA-2 Autopilot Aileron Circuit	19 Jan 59
KG	1B-52-1226	Installation of Provisions to Improve 28V DC Excitation for O-32 or KS-32A Camera System	10 Aug 62
*	1B-52-1261 1B-52-1261A	Reinforcement of Horizontal Stabilizer Center Section Same as Basic	15 Apr 60 29 Jun 62
*	1B-52-1262 1B-52-1262A	Reinforcement of Stabilizer Support Bulkhead Same as Basic	18 Mar 60 29 Jun 62
*	1B-52-1231 1B-52-1231A	Installation of Three-Pole Switch for Remote Indicating Magnetic Compass System Same as Basic	18 Aug 61 22 Jun 62
*	1B-52-1260 1B-52-1260A	Installation of Readiness Switch for Nuclear Safety Same as Basic	10 Jun 60 29 Jun 62
*	1B-52-1259 1B-52-1259A	Incorporation of Single Motion Ejection Control on Downward Ejection Seats Same as Basic	9 Sep 60 29 Jun 62
*	1B-52-1160 1B-52-1160C	Installation of Armament Provisions AGM-28 Same as Basic	27 Sep 63 1 Nov 63
KS	1B-52-1161	Installation of Clip-In Penetration Provisions (ADM-20)	18 Jan 63
*	1B-52-1183	Installation of Spare Fuses for MD-1 Astrocompass	15 Apr 59
KZ	11B12-20-3 -504	Replacement of Panel on 6147300, Data Setting Control Unit, AN/ASB-4, and AN/ASB-9 BNS	4 Aug 61
*	5A1-2-19-505 5A1-2-19 -505C	Addition of Detents to Flight Controller and Installation of Amplifier Same as Basic	1 Feb 60 3 Mar 61
LB	2J-J57-670	Decrease in Minimum Fuel Flow for JFC-12-3 Fuel Controls Installed on J57 Engines	25 Feb 60
*	1B-52-1164	Structural Modification for Low Level Flight	8 Nov 63
*	1B-52-1300 1B-52-1300A	Revision of Yaw Damper for Low Level Flight Same as Basic	7 Apr 61 29 Jun 62
LE	1B-52-1301	Installation of Improved Doppler Radar Components	12 Apr 63
*	1B-52-1302	Installation of Improved Cabin Air Conditioning	2 Aug 63
LH	1B-52-1304	Installation of Advanced Capability Radar	10 Jan 64

RETROFIT CODING [CONT]

SYMBOL	T.O. NO.	TITLE	DATE
LJ	1B-52-1289	Installation of Static Line on Tail Gunner's Seat	21 Oct 60
	1B-52-1289B	Same as Basic	18 Oct 62
LK	1B-52-1288	Revision of Fin Scoop Anti-Icing System	12 May 61
	1B-52-1288A	Same as Basic	22 Jun 62
*	1B-52-1199	Installation of Special Weapons Emergency Separation System	22 Sep 61
	1B-52-1199A	Same as Basic	22 Jun 62
*	1B-52-1220	Provision of Constant Bleed Air for External Tank Pressurization System	6 May 60
	1B-52-1220A	Same as Basic	17 May 61
LQ	1B-52-1294	Deactivation of AN/APN-22 Radar Altimeter	8 Jul 60
*	1B-52-1346	Revision of VGH Gust Recorder Control	3 Mar 61
LT	1B-52-1339	Revision of Electronic Cables for Low Level Capability	22 Mar 63
	1B-52-1339A	Same as Basic	23 Aug 63
	1B-52-1339C	Same as Basic	25 Oct 63
*	1B-52-1179	Replacement of Thermal Radiation Protection Curtains	25 Sep 59
	1B-52-1179C	Same as Basic	22 Jun 62
*	1B-52-1291	Installation of Provisions for Positive Man-Seat Separation During Downward Ejection	3 Nov 61
	1B-52-1291A	Same as Basic	22 Jun 62
MK	1B-52-1372	Revision of Forward Generator Cooling Ducts B-52E	10 Nov 61
	1B-52-1372B	Same as Basic	29 Jun 62
ML	1B-52-1378	Relocation of Upper Deck Access Ladder for Improved Bailout Capability	21 Jul 61
	1B-52-1378A	Same as Basic	22 Jun 62
*	1B-52-1379	Revision of Instrument Light Power Source	2 Mar 62
	1B-52-1379A	Same as Basic	22 Jun 62
MQ	1B-52-1373	Provision for MD-9 and A-3A FCS Inflight Evaluators	29 Jun 62
MT	1B-52-1371	Installation of A-3A and MD-9 Fire Control System Bird-Fly Modification	8 Sep 61
	1B-52-1371A	Same as Basic	29 Jun 62
	1B-52-1371B	Same as Basic	27 Feb 63
*	1B-52-1391	Incorporation of Engine Start Capability without use of an Electrical Ground Cart	1 Dec 61
	1B-52-1391A	Same as Basic	22 Jun 62
ND	1B-52-1395	Modification of Electrical Power System B-52F	26 Apr 63
NE	1B-52-1396	Incorporation of Increased Rating Circuit Breakers for AGM-28 A-C Power Feeder	20 Oct 61
	1B-52-1396A	Same as Basic	22 Jun 62
	1B-52-1396B	Same as Basic	21 Dec 62
NF	1B-52-1358	Installation of Phase II ECM Capability	5 Jun 64
NM	1B-52-1399	Installation of Pitch Attitude Control Force Switching	26 Jan 62
	1B-52-1399A	Same as Basic	29 Jun 62
*	1B-52-1398	Relocation of Tail Turret Jettison Initiator Safety Pin	22 Sep 61
	1B-52-1398A	Same as Basic	22 Jun 62
NP	1B-52-1407	Installation of Vortex Generators on the Upper and Lower Surfaces of the Horizontal Stabilizer	12 Jan 62
	1B-52-1407A	Same as Basic	22 Jun 62
	1B-52-1407B	Same as Basic	21 Dec 62

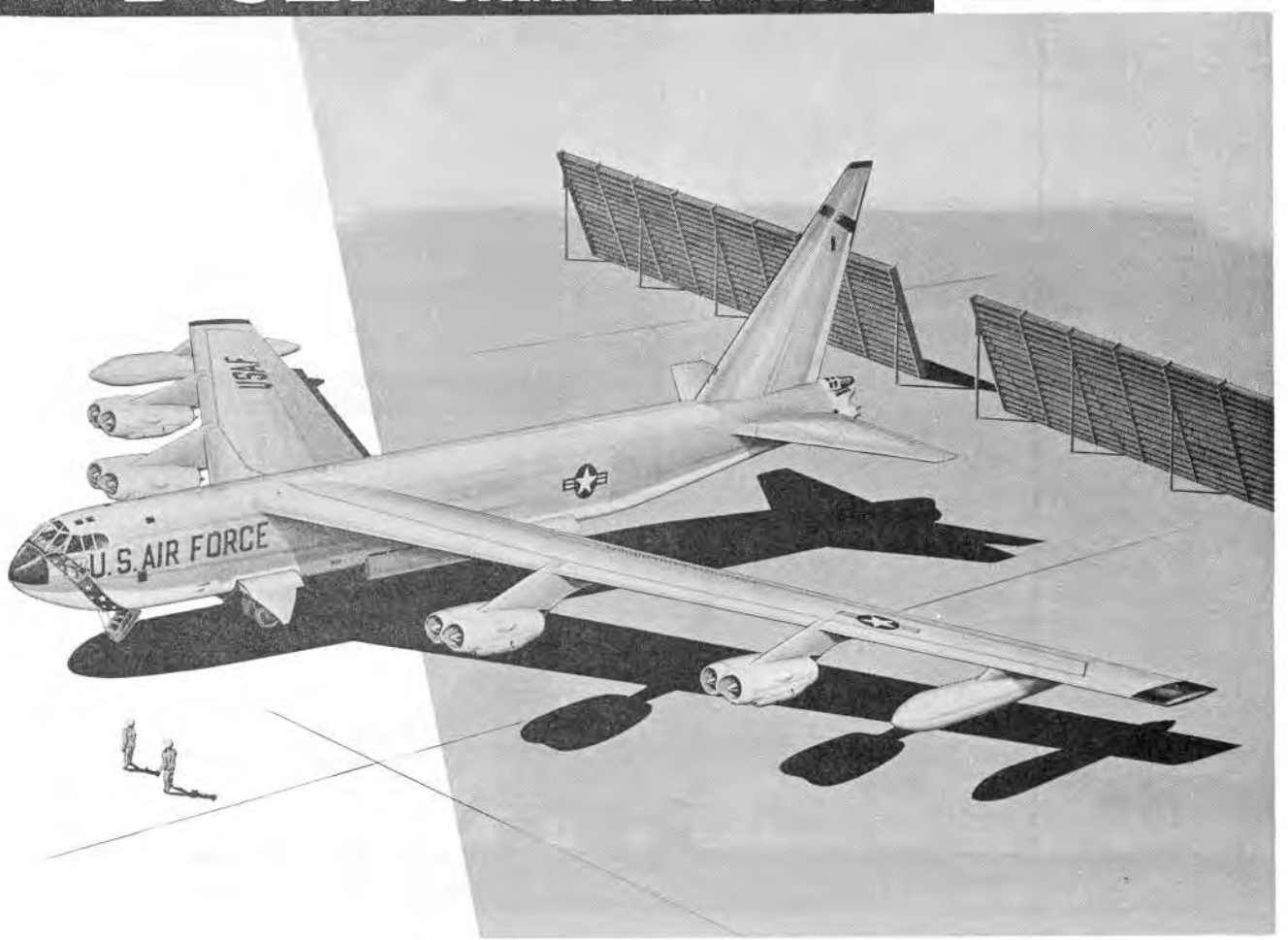
SYMBOL	T.O. NO.	TITLE	DATE
*	1B-52-1409	Extended Outboard Spoiler for Aerial Refueling	17 Nov 61
	1B-52-1409B	Same as Basic	22 Jun 62
PH	1B-52-1411	Deletion of ACR Up-Look Clearance Plane Setting	19 Apr 63
*	1B-52-1425	Deactivation of Water Injection Sensor System B-52E	14 Aug 61
PP	1B-52-1441	Pitot Tube Replacement	1 Mar 63
	1B-52-1441C	Same as Basic	15 Nov 63
PQ	1B-52 1410	Installation of Circuit Protection Devices and Installation of Modified Terrain Display Control, P/N 6211200, and MD-1 Terrain Display Indicator, P/N 6210800	11 May 62
	1B-52-1410A	Same as Basic	29 Jun 62
PR	1B-52-1467	Installation of Special Weapon Release Circuits Disconnect	19 Apr 63
PU	1B-52-1471	Installation of ACR and Instrument Flying Hood for Pilot and Copilot	1 Jun 62
	1B-52-1471A	Same as Basic	21 Dec 62
PW	1B-52-1474	Revision of AN/ARC-34A Circuit Protection	27 Dec 63
*	1B-52-1456	Deletion of Dimming Feature "Pilot's Call" and "Cabin Low Pressure Warning" Lights	15 Jun 63
*	1B-52-1475	Installation of Altimeter Correction Card and Holder	3 Aug 62
QE	1B-52-1478	Installation of Balance Weights on Pilot's and Copilot's Control Columns	7 Feb 64
QJ	1B-52-1480	Installation of AGM-28B Radar Altimeter Confidence Check Panel Provisions	19 Apr 63
	1B-52-1480D	Same as Basic	27 Dec 63
QL	1B-52-1436	Incorporation of Improved AN/ALE-20V Flare Ejector System	27 Dec 63
QN	1B-52-1443	Installation of Cartridge-Pneumatic Starters	6 Sep 63
QP	1B-52-1485	Installation of AN/AJM-14(V) Monitoring Set	Pending
QU	1B-52-1489	Main Landing Gear Shuttle Valve Plumbing Revision	19 Jul 63
*	1B-52-1416	Deletion of SWESS Hydro Pack Start Control Circuit	14 Jul 61
RD	1B-52-1494	Installation of Provisions for Food Warming Oven	23 May 62
RG	1B-52-1506	Modified Elevator Stick Force Gradient	8 Feb 63
RE	1B-52-1528	Transfer of Power Source for ADM-20 Fire Warning System	15 Feb 63
*	4W1-7-524	Installation of Heat Shields and Thermal Screws in Landing Gear Wheels	15 Apr 60
RT	1B-52-1465	Installation of Improved Emergency Aft Cabin Pressure Relief Provisions	27 Jul 62
RU	1B-52-1491	Installation of Crew Compartment Air Conditioning System Spray Bar	28 Dec 62
	1B-52-1491A	Same as Basic	25 Jan 63
RU	1B-52-1500	Installation of Crew Compartment Air Conditioning System Spray Bar	15 Mar 63
SA	1B-52-1460	Installation Provisions for Clip-In Bomb Release Pulse Indicator Panel Assembly	6 Jul 62
	1B-52-1460A	Same as Basic	25 Feb 63
SN	1B-52-1438	Removal of VGH Recorder	10 Nov 61
	1B-52-1438A	Same as Basic	5 Dec 61
	1B-52-1438B	Same as Basic	9 Jan 62
	1B-52-1438C	Same as Basic	2 Nov 62

RETROFIT / CODING [CONT]

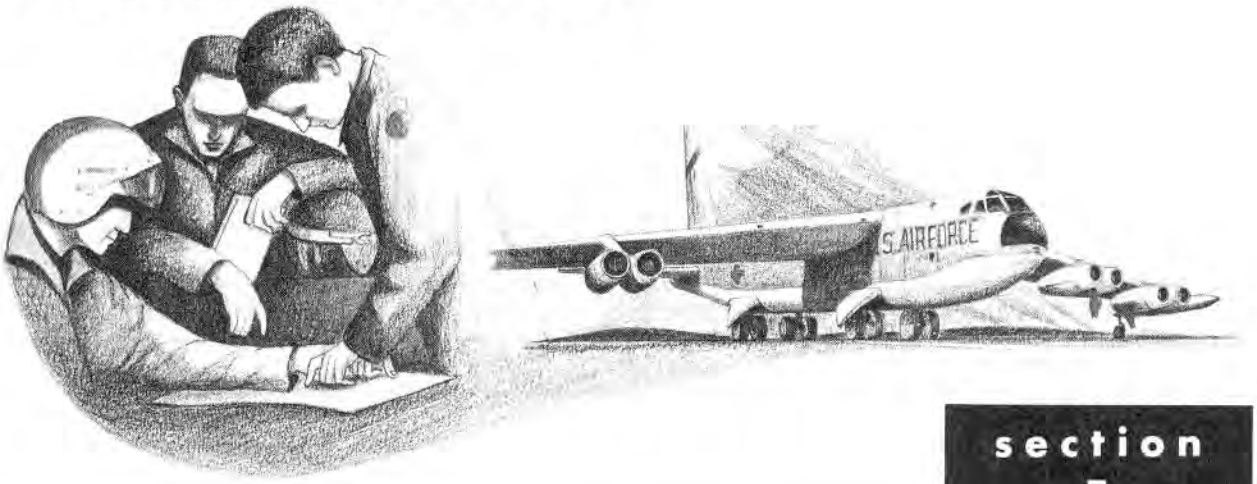
Symbol	T.O. No.	Title	Date
SP	1B-52-1522 1B-52-1522C	Installation of Crew Rest Provisions Same as Basic	9 Aug 63 25 Oct 63
SQ	1B-52-1570	Installation of AN/APN-150 Radar Altimeter	12 Jun 64
SS	1B-52-1582	Fuel System Revisions for Improved Wing Fatigue Life	22 Nov 63
ST	11W1-21-7-501	Modification of Valve (FCS), Kidde Type C-2	8 Feb 63
SX	1B-52-1595	Installation of Provisions for A/A42G-11 Automatic Flight Control System	22 Nov 63
SY	1B-52-1596	Installation of Electro-Mechanical Yaw Damper	17 Jan 64
SZ	1B-52-1597	Installation of Steering System (A/A42G-11)	17 Jan 64
TB	1B-52-1598	Installation of Pneumatic Starter Cartridge Stowage Bracket	12 Jun 64
TF	1B-52-1593	Installation of Safety Guard on Radar Navigator's and Navigator's Emergency Hatch Release Lever	24 Jul 63
TH	1B-52-1608 1B-52-1608C	Installation of Terrain Computer Power Cut-Off Capability Same as Basic	31 Jan 64 20 Feb 64
TK	1B-52-1621	Installation of Stabilizer Trim Actuator Incorporating Improved Drive Pin	26 Sep 63
TP	1B-52-1601 1B-52-1601C	Installation of Provisions for Modified ACR Components Same as Basic	17 Jan 64 24 Jan 64
TR	1B-52-1538	Installation of Miniature Chaff Dispenser System	6 Nov 64
★	1B-52-1603	Inspection of MA-2 Autopilot Command Selector	28 Aug 63
TX	1B-52-1610	Installation of Modified ACR Components	17 Dec 63
TY	1B-52-1620	Installation of QRC-218A-(T)	6 Mar 64
UF	1B-52F-514	Installation Provisions for Accelerated Normal Bomb Release	24 Apr 64
UH	1B-52-1664 1B-52-1664C	Installation of EW Officer Instructor Seat Same as Basic	26 May 64 12 Nov 64
UJ	1B-52-1661	Installation of External Gun Charger Switch A-3A MD-9 Gun Turrets	22 May 64
UL	1B-52-1662	Installation of AGM-28 AJM-14(V) (MADREC) Tie-In	20 Nov 64
UM	1B-52F-515	Installation of External Bomb Racks	9 Oct 64
UN	1B-52-1669	Modification of Thermal Curtains	Pending
UQ	11B78-3-509	Modification of Terrain Relay Frame	15 May 62
UR	1B-52-1635	Increased Strength and Body Fatigue Improvements	26 Mar 65
UT	21M-AGM-28A-633	Missile Cross-Slaving Capability	Pending
UW	1B-52-1659	Relocation of the Last Resort Bombsight	1 Jul 64
UX	1B-52-1693	Deactivation of the Navigator's Emergency Hatch Manual Jettison Lever	26 Sep 64
UY	1B-52-1633	Installation of a Pressurization Isolation Valve for the AN/ASQ-38-48 BNS and Doppler Radars	19 Oct 64
UZ	1B-52-1694	Modification of the Navigator's and Radar Navigator's Emergency Hatch Manual Release Levers	20 Nov 64
VD	1B-52-1700	Installation of Improved "D" Ring Safety Pin, Downward Ejection Seats	20 Nov 64
VE	1B-52-1689	Modification of Emergency Alarm Switch	30 Sep 64
VG	1B-52-1695	Installation of Mounting Clip for Navigator's Watches	Pending
VL	1B-52-1708	Inspection of Aileron Control System and Balance Cavity	24 Mar 65

THE B-52E STRATOFORTRESS

THE B-52F STRATOFORTRESS



DESCRIPTION



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THE AIRPLANE

The Boeing B-52E and B-52F "Stratofortress" airplanes are of the land-based heavy bombardment class designed for long range flight at high speed and altitude. The tactical mission is the destruction of surface objectives by bombs and missiles. All aircraft are equipped to carry two AGM-28 (Hound Dog) air-to-surface missiles to within tactical range of the objective and launch them. In addition, aircraft [redacted] are equipped to carry four

ITEM	B-52A	B-52B	B-52C	B-52D	B-52E	B-52F	B-52G	B-52H
J-57-P-1W ENGINES	✓							
J-57-P-1WA, -1WB, -19W, OR -29WA ENGINES		✓						
J-57-P-19W OR -29WA ENGINES			✓	✓	✓			
J-57-P-43W, -43WA OR -43WB ENGINES						✓		
J-57-P-43WB ENGINES							✓	
TF33-P-3 ENGINES								✓
PNEUMATIC-DRIVEN ALTERNATOR PACKS	✓	✓	✓	✓	✓			
ENGINE-DRIVEN A-C GENERATORS						✓	✓	✓
PNEUMATIC-DRIVEN HYDRAULIC PACKS	✓	✓	✓	✓	✓	✓		
ENGINE-DRIVEN HYDRAULIC PUMPS							✓	✓
LATERAL CONTROL BY SPOILERS AND AILERONS	✓	✓	✓	✓	✓	✓		
LATERAL CONTROL BY SPOILERS ONLY							✓	✓
JETTISONABLE EXTERNAL TANKS - 1000 GALLONS	✓	✓						
JETTISONABLE EXTERNAL TANKS - 3000 GALLONS			✓	✓	✓	✓		
FIXED EXTERNAL TANKS - 700 GALLONS							✓	✓
AUXILIARY TANK FUEL TRANSFER TO MAIN TANK	✓	✓	✓	✓	✓	✓		
AUXILIARY TANK FUEL FEED DIRECTLY TO ENGINES							✓	✓
TALL VERTICAL TAIL	✓	✓	✓	✓	✓	✓		
SHORT VERTICAL TAIL							✓	✓
OCCUPIED TAIL COMPARTMENT	✓	✓	✓	✓	✓	✓		
REMOTELY-OPERATED TAIL TURRET							✓	✓
AGM-28 CAPABILITY			✓	✓	✓	✓	✓	✓
ADM-20 CAPABILITY					✓	✓	✓	✓
EXTERNAL STORES (CONVENTIONAL MUNITIONS RACKS)						✓		

main differences table

Figure 1-1.

ADM-20 missiles simultaneously with other loads to within tactical range of the objective. The airplane has a six-man crew comprising a pilot, copilot, radar navigator, navigator, EW (Electronic Warfare) officer, and gunner.

SPECIAL FEATURES

The airplane is characterized by swept wings and empennage, four underslung nacelles housing eight turbojet engines, a quadricycle main landing gear, and a tip gear near each outboard engine nacelle. On B-52E airplanes, the engine configuration is clean and free of accessories due to the use of an air bleed (pneumatic power supply) system. Engine bleed air is used on all airplanes to drive hydraulic packs and to provide the air supply for air conditioning and anti-icing. In addition, engine bleed air is used on B-52E airplanes for driving four a-c alternators. Primary airplane electrical power is 205-volt ac on all aircraft. On B-52F aircraft, this power is generated by four gear-driven alternators; each of the four is driven by the left engine of each nacelle. Cartridge starters are installed on engines 2 and 8 to provide for engine starts without assistance from an auxiliary air cart or auxiliary electrical power cart. Hydraulic pressure is supplied by 10 individual hydraulic power supply systems. Primary control of the airplane is accomplished by tab-operated floating control surfaces. The entire stabilizer is moved by a hydraulic mechanism to provide pitch trim. The ailerons are small and are located between the two wing flap sections on the trailing edge of each wing. Lateral control is augmented by hydraulically actuated spoilers. By varying the method of control, these same spoilers serve as airbrakes. A steering and crosswind crab system provides steering of the forward main landing gear and also properly positions both forward and rear main landing gear for crosswind landings. A white undercoating on the airplane exterior provides increased heat reflectivity and weapons capability. Provisions are installed for mounting and controlling two AGM-28 missiles. The missiles are mounted on pylons attached to the left and right wings between the fuselage and the inboard engine nacelles. The copilot has the controls and indicators for missile engine operation and the missile fire warning system switches and indicators. The navigator has the controls and indicators for missile arming, launch, and guidance. The pilots and the radar navigator have jettison switches. The radar navigator can release the missile by means of the BNS. In addition, airplanes KS have a quick-load type launch gear in the aft bomb bay compartment for mounting and launching four ADM-20 missiles. The radar navigator's additional duties consist of operating the missile launch and control panels. For emergency operation, a ADM-20 jettison switch on the pilots' overhead panel is available for the pilot or copilot to jettison the missile launch gears.

DIMENSIONS

Wing Span	185 feet
Fuselage Length (including guns)	156 feet 6 inches
Height (to top of fin)	48 feet 3 inches
Height (fin folded)	21 feet 6 inches
Tread (C_L outboard main tires)	11 feet 4 inches
(C_L tip gear to tip gear)	148 feet 5 inches

For airplane turning radius and minimum ground clearance, see figure 2-5.

GROSS WEIGHT

The airplane is in the 400,000-pound gross weight class. For specific weight and loading information, see "Weight Limitations," Section V.

INTERIOR ARRANGEMENT

All crew members, except the gunner, perform their normal crew duties in the control cabin. The gunner is located in the tail compartment. The control cabin extends from a forward pressure bulkhead ahead of the pilots' stations to a pressure bulkhead aft of the EW officer's station. There is an upper and a lower deck in the cabin. Pilots' stations are located at the forward end of the upper deck. A celestial navigation station and EW officer's station are on the upper deck aft of the pilots' stations. The radar navigator's and navigator's stations, left and right respectively, are on the lower deck directly above the forward entry door (62, figure 1-2). An auxiliary crew member's station is located aft of the navigator's station. The gunner sits facing aft in a pressurized tail compartment.

MOVEMENT OF FLIGHT PERSONNEL

Movement of the crew between the upper and lower decks in the control cabin is facilitated by a ladder on the right side of the cabin. Movement through the entire length of the airplane is possible during unpressurized flight via a crawlway (figure 1-2) on the right side of the fuselage which extends from a pressure door (52, figure 1-2) in the control cabin aft pressure bulkhead to the aft equipment compartment. From this compartment, access to the tail compartment is gained by crawling under the center section of the stabilizer and entering through a pressure door (80, figure 1-2) in the tail compartment forward pressure bulkhead. Entrance to the tail compartment from the exterior of the airplane is gained through an aft entry door (79, figure 1-2) on the right side of the fuselage. Windows are provided in bulkheads along the crawlway to allow inspection of the forward equipment bay, forward wheel

REVERSE SIDE INTENTIONALLY LEFT BLANK

well, bomb bay, and aft equipment compartment during flight. Movement of personnel between the control cabin and the tail compartment is not generally required for normal flight operations and will be avoided, particularly at high altitudes. If an inflight emergency requires such movement, see "Emergency Inflight Movement Between Control Cabin and Tail Compartment."

ENGINES

Eight Pratt and Whitney Model J-57 series Turbo Wasp engines (figure 1-3) are used to power the airplane. The engines are mounted in pairs within four nacelles suspended below the wings and are numbered in the conventional manner from left to right 1 through 8. The nacelles are also numbered in this manner with engines 1 and 2 in No. 1 nacelle, engines 3 and 4 in No. 2 nacelle, engines 5 and 6 in No. 3 nacelle, and engines 7 and 8 in No. 4 nacelle. On B-52E airplanes, J-57 -P-19W or -29WA engines are used, and on B-52F airplanes, J-57-P-43 series engines are used. The J-57 -P-43 series consists of -43W, -43WA, and -43WB engines which, except for installation requirements and trim procedure differences, are interchangeable. WA and WB engines are different from W designated engines in that the engine accessory mounting pads are reinforced for installation of 60KVA generators in place of 40KVA generators which are presently installed. WB engines differ from WA engines in having the fuel control unit modified and the fuel pump changed to provide increased flow during a wider range of temperature (OAT) conditions while at "wet" takeoff rated thrust power setting. The -43WB (flat rated) engine maintains its constant wet rated thrust by manipulation of the throttle according to the required EPR indication. WB engines are trimmed per "flat rated" engine trim procedures and would require retrimming per standard trim procedures if installed on the same airplane with either -43W or -43WA engines. However, if all eight engines on the same airplane are WB's, they should be flat rated. Within each nacelle the left and right engines are identical with exception of engine-mounted accessories. On B-52F airplanes, the left engine of each nacelle is equipped with a turbine-driven water injection pump operated by bleed air direct from the engine. The left engine on B-52F airplanes is also equipped with an engine-driven a-c alternator for which rpm is maintained by use of a constant speed Sundstrand drive installed on the same engine. On B-52E airplanes, the water injection pumps and the a-c alternator packs are not engine-mounted accessories and are different in that the source of driving power is provided by air extracted from all eight engines and furnished to the airplane air bleed (pneumatic power supply) system. The right engine of each nacelle on B-52F airplanes does not have an alternator installed but is equipped with a water injection pump which is mechanically driven by the engine. On both B-52E and B-52F airplanes, a pneumatic starter is installed on the engine starter pad located at the accessory drive section of each engine. On B-52F aircraft, the engine tailpipes are fitted with three internal lobes which serve as sonic vibration suppressors to reduce the damaging effect on the wing trailing edge structure caused by wet operation of the aircraft engines. For engine thrust rating information, see figure 1-3.

NOTE

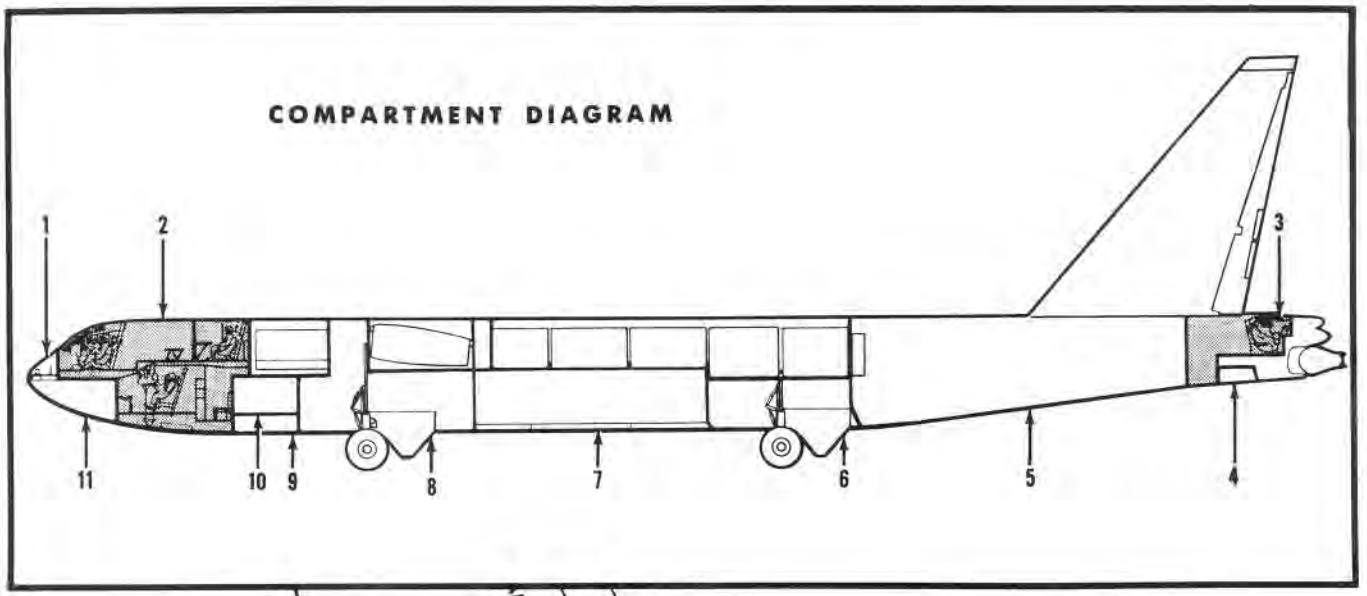
The letter "P" in the engine designation has been used throughout the Flight Manual to indicate the engine manufacturer as Pratt and Whitney; however, the letter "F" will be found on some engines, indicating the Ford Motor Co as the manufacturer.

ENGINE AIR BLEED

Pneumatic power for operating the airplane hydraulic and air conditioning packs (and alternator packs on B-52E airplanes) is derived from air bled from the engine compressors of each engine and supplied to the "Air Bleed (Pneumatic Power Supply) System" manifolds for distribution. High pressure hot air which is independent of the air bleed system is directed to heat exchangers from the compressor section of each engine to provide anti-icing of fuel lines supplying respective engine fuel pumps. High pressure hot air direct from the engine compressors is used to anti-ice engine compressor sections on all airplanes. For further information on the uses of engine bleed air, see "Air Bleed (Pneumatic Power Supply) System," this section.

ENGINE FUEL HEATERS

A fuel heater is installed upstream of each low pressure engine fuel filter for maintaining fuel temperature between 33° and 47° F before being supplied to the fuel control unit by the engine-driven fuel pump. Within each nacelle, the fuel heaters are located on the upper outboard side of each engine. High pressure hot air is supplied direct from the compressor section as a heat source for each engine fuel heater. All of the engine fuel flows through the heater without the restriction of valves or moving parts. The heaters are equipped with a temperature regulating valve beyond which an air outlet port exhausts the hot air overboard. Control of fuel temperature is automatic in that the heater has a thermostat which senses fuel flow out temperature and opens or closes an air valve to regulate hot air flow. The thermostat is not affected by changes or fluctuations in air inlet pressure.



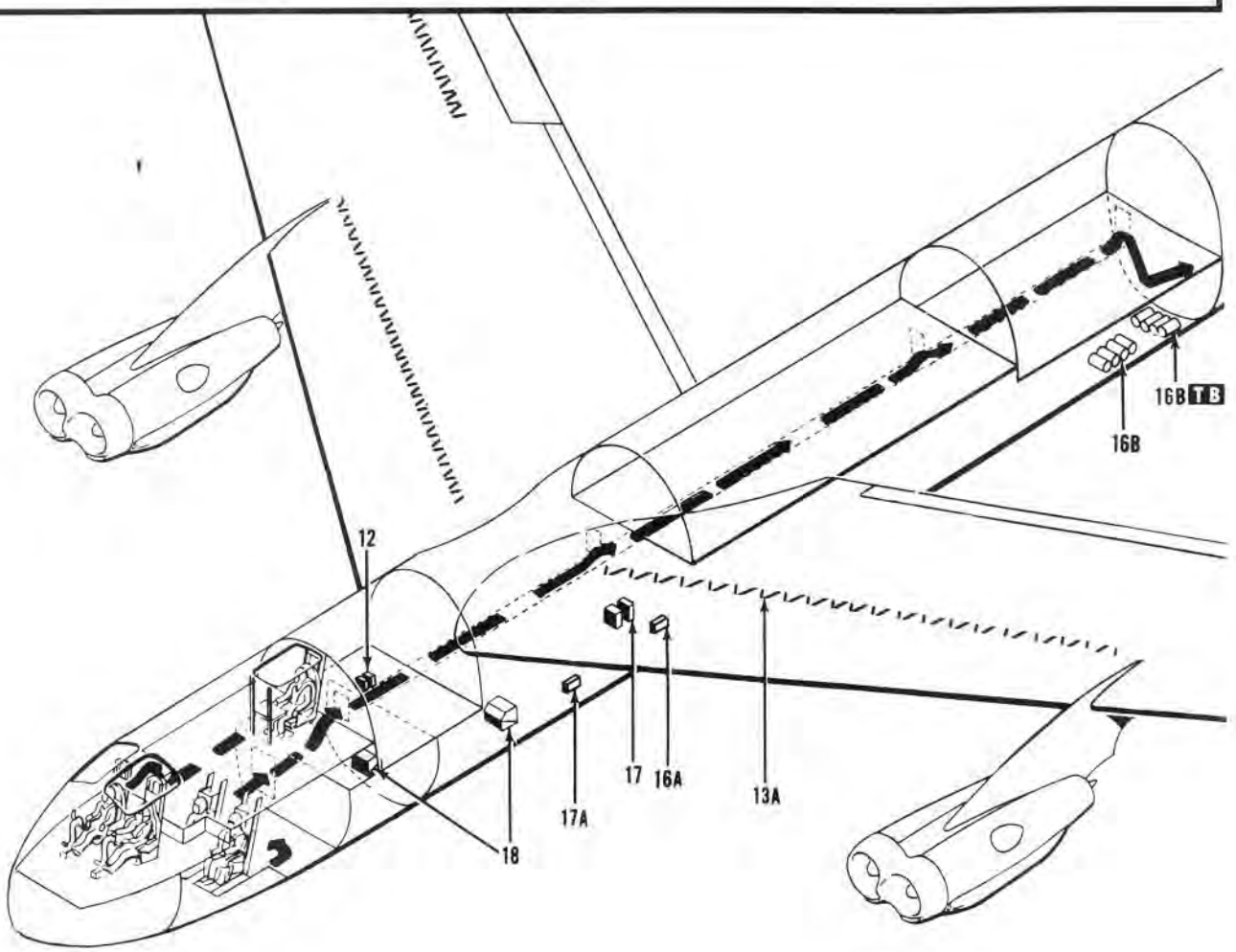
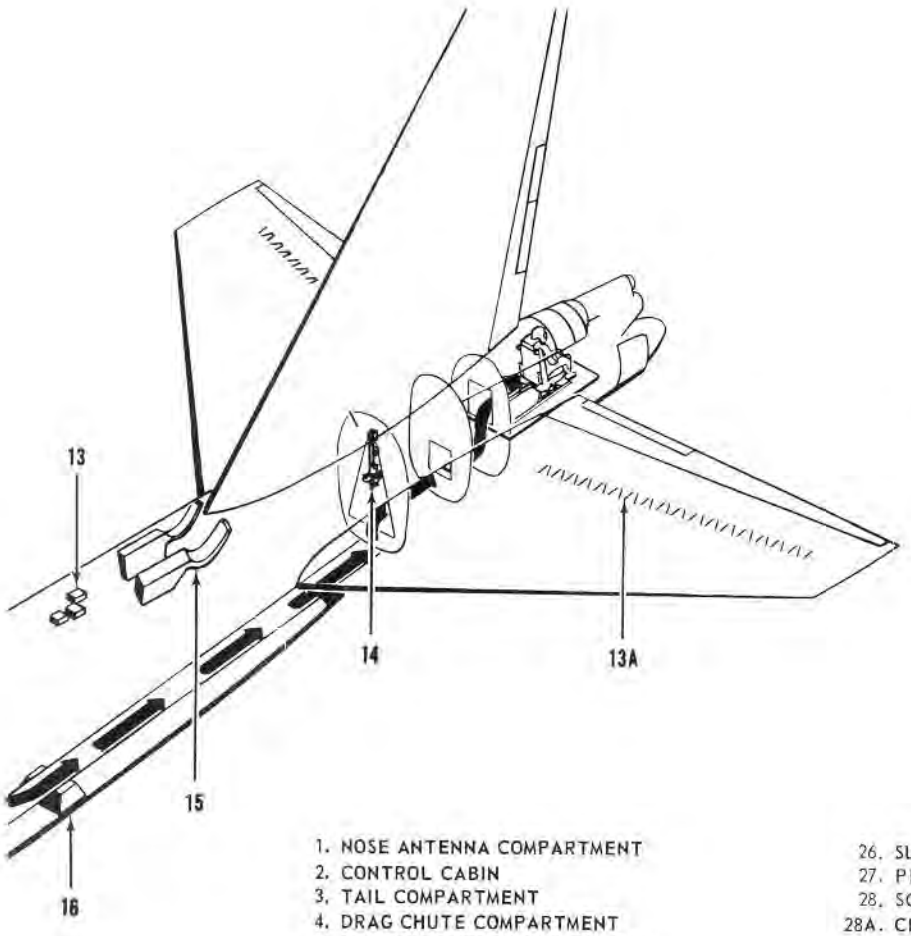
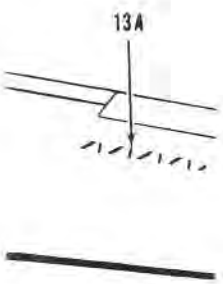


Figure 1-2 (Sheet 1 of 4).



PRESSURIZED CREW COMPARTMENTS

CREW MOVEMENT



1. NOSE ANTENNA COMPARTMENT
2. CONTROL CABIN
3. TAIL COMPARTMENT
4. DRAG CHUTE COMPARTMENT
5. AFT EQUIPMENT COMPARTMENT
6. REAR WHEEL WELL
7. BOMB BAY
8. FRONT WHEEL WELL
9. FORWARD ECM ANTENNA COMPARTMENT
10. ALTERNATOR DECK **B-52E**
    FORWARD EQUIPMENT BAY **B-52F**
11. NOSE RADOME COMPARTMENT
12. FORWARD TRANSFORMER-RECTIFIER (TR) UNITS 2 AND 3
13. AFT TRANSFORMER-RECTIFIER (TR) UNITS
13A. VORTEX GENERATORS
14. STABILIZER TRIM JACKSCREW
15. CHAFF DISPENSERS
16. STRIKE CAMERA
16A. SWESS BATTERY
16B. STARTER CARTRIDGE STOWAGE
17. FORWARD TRANSFORMER-RECTIFIER (TR) UNITS 4 AND 5
17A. GAM-77 ARMAMENT PROVISIONS BATTERY
18. BATTERIES
19. EW OFFICER'S SEAT
20. PORTABLE OXYGEN BOTTLE
21. DELETED
22. DELETED
23. EW OFFICER'S CONSOLE
24. CELESTIAL NAVIGATION SEAT
25. FILTERS FOR SCANNING LAMP
26. SUNSHADES
27. PERISCOPIC SEXTANT
28. SCANNING LAMP
28A. CREW BUNK **SP**
29. PERISCOPIC SEXTANT CARRYING CASE
29A. FOOD WARMING OVEN
30. INSTRUCTOR PILOT'S SEAT
31. SAFETY BELT
32. PILOT'S SEAT
33. CREW HOODS
34. ASSIST HANDLES
35. PILOT'S INSTRUMENT PANEL
36. WINDSHIELD WIPERS
37. DATA CASE
38. DELETED
39. RADAR NAVIGATOR'S CONSOLE
40. DELETED
41. RADAR NAVIGATOR'S SEAT
41A. RELIEF TANK
42. COPILOT'S SIDE PANEL
43. PILOT'S OVERHEAD PANEL
44. COPILOT'S SEAT
45. NIGHT FLYING CURTAIN
46. BLACKOUT CURTAIN
47. SPARE LAMP STOWAGE
48. DELETED
49. DELETED
50. EW OFFICER'S SIDE TABLE
51. CUP DISPENSER
52. CONTROL CABIN PRESSURE BULKHEAD DOOR
53. FOOD STOWAGE AND SHELF
54. INSTRUCTOR NAVIGATOR'S SAFETY BELT

••••••••••••••••••••general arrangement (typical)

Figure 1-2 (Sheet 2 of 4).

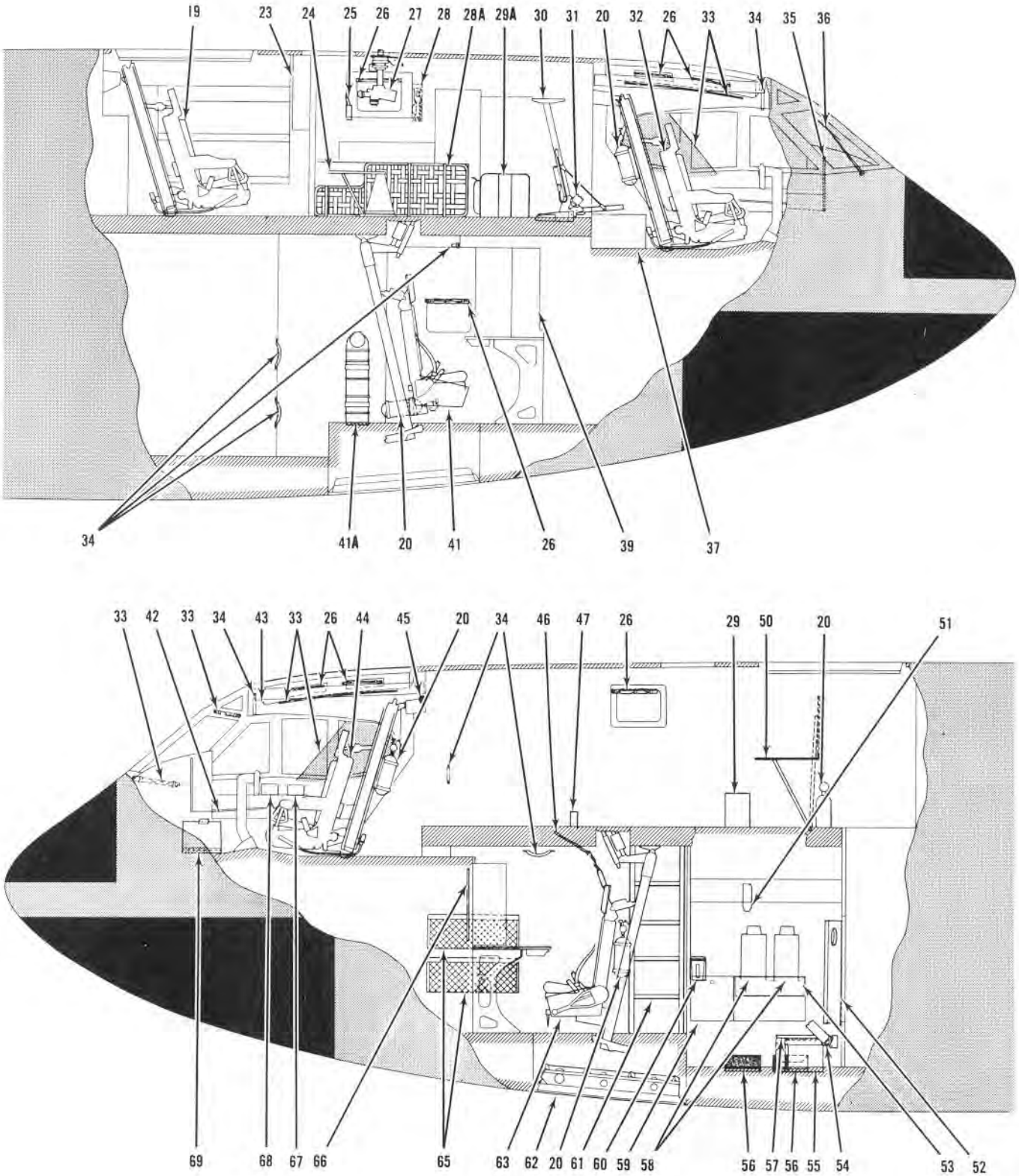
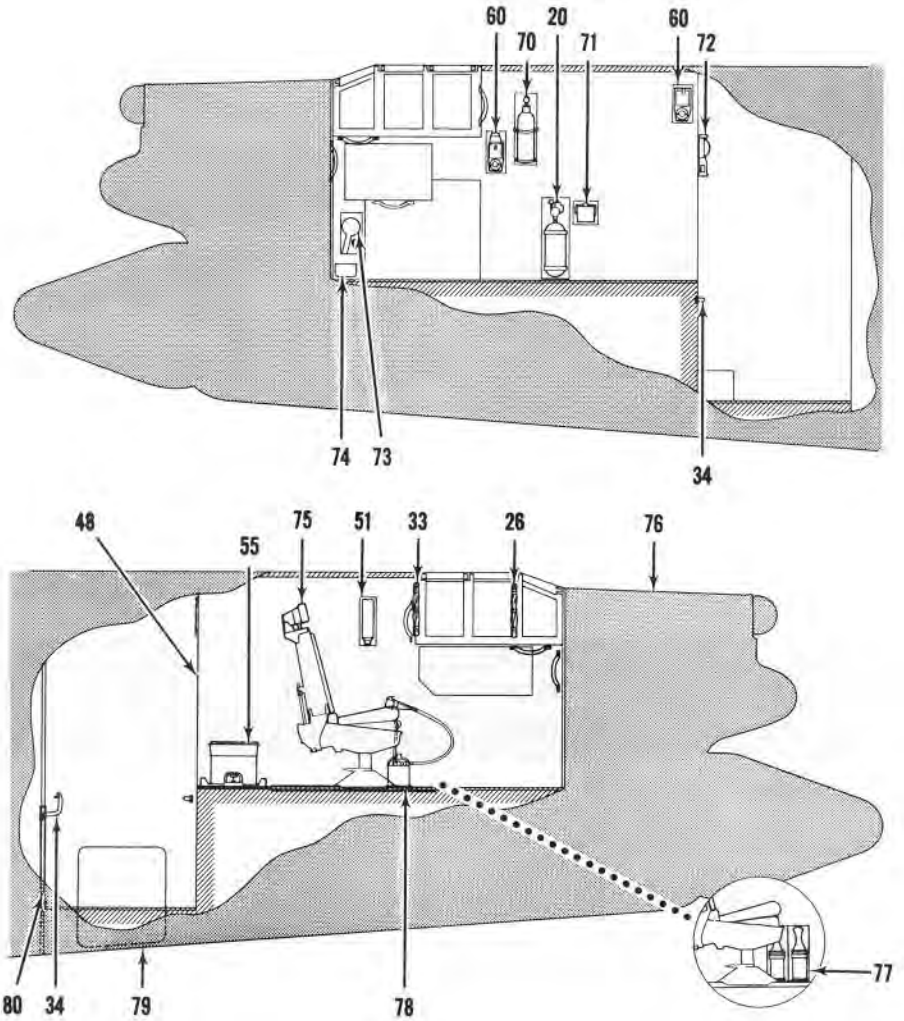


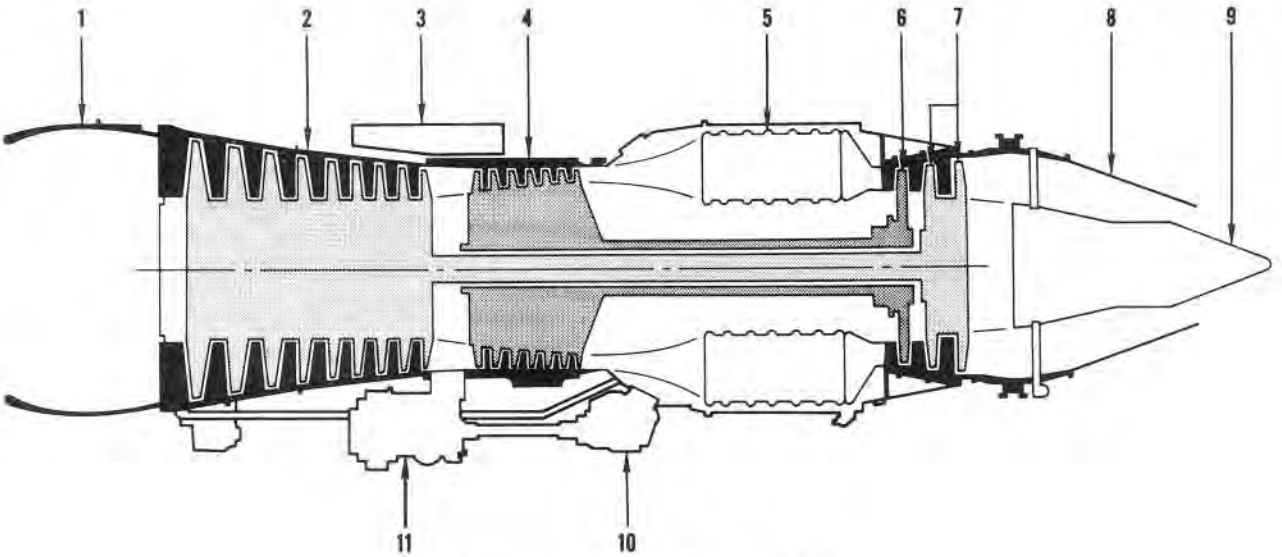
Figure 1-2 (Sheet 3 of 4).



55. CHEMICAL TOILET
56. LANDING GEAR LOCK PIN STOWAGE
57. INSTRUCTOR NAVIGATOR'S SEAT
58. DRINKING WATER CONTAINERS
59. TRASH CONTAINER
60. HOT CUP
61. LADDER
62. MAIN ENTRY DOOR
63. NAVIGATOR'S SEAT
64. DELETED
65. STOWAGE HAMMOCKS
66. NAVIGATOR'S CONSOLE
67. FLARE SPEED CHART
68. CHECK LIST
69. COPILOT'S CLIP BOARD
70. THERMOS BOTTLE
71. TOILET PAPER HOLDER
72. SIGNAL LIGHT
73. SIGNAL LIGHT ALTERNATE LOCATION
74. SAFETY PIN AND STREAMER STOWAGE
75. GUNNER'S SEAT
76. TURRET
77. GUNNER'S INDIVIDUAL URINALS 255 ▶ W144 ▶
78. URINAL 232 ▶ 254 W128 ▶ W143
79. AFT ENTRY DOOR
80. TAIL COMPARTMENT PRESSURE BULKHEAD DOOR

.....general arrangement (typical) (cont)

Figure 1-2 (Sheet 4 of 4).



J-57-P-19W AND J-57-P-29WA B-52E

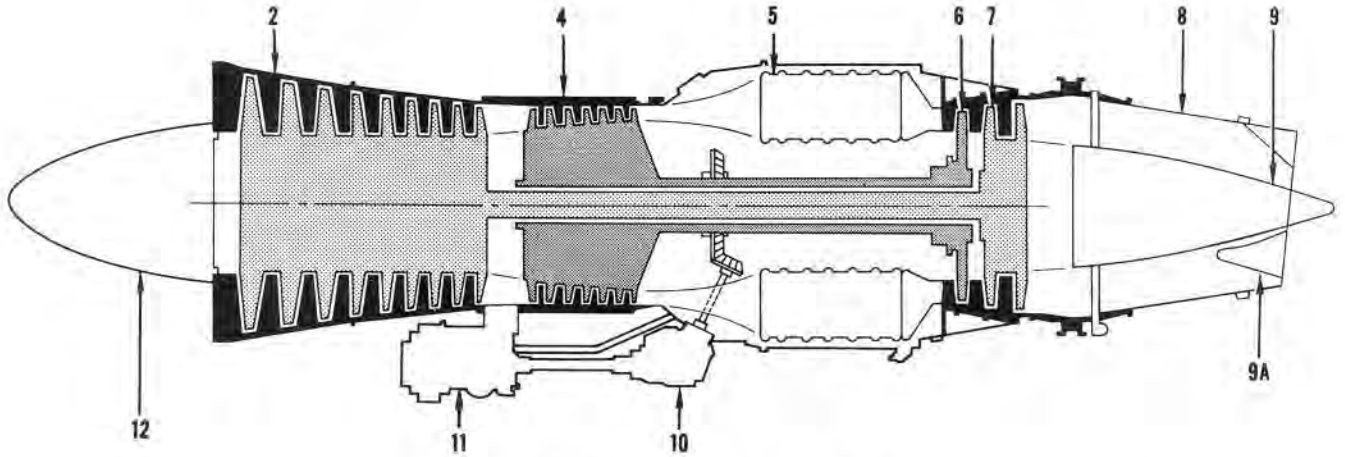
ENGINES	THRUST IN POUNDS AT SEA LEVEL NACA STANDARD DAY			MATERIAL
	TAKEOFF RATED THRUST FULL WATER INJECTION TEMPERATURE LIMIT 40° F	MILITARY RATED THRUST (NO WATER)	NORMAL RATED THRUST	
J-57-P-19W	12,100	10,500	9,000	TITANIUM
J-57-P-29WA	12,100	10,500	9,000	STEEL
J-57-P-43W	13,750	11,200	9,500	TITANIUM
J-57-P-43WA	13,750	11,200	9,500	TITANIUM
J-57-P-43WB	13,750	11,200	9,500	TITANIUM

NOTE

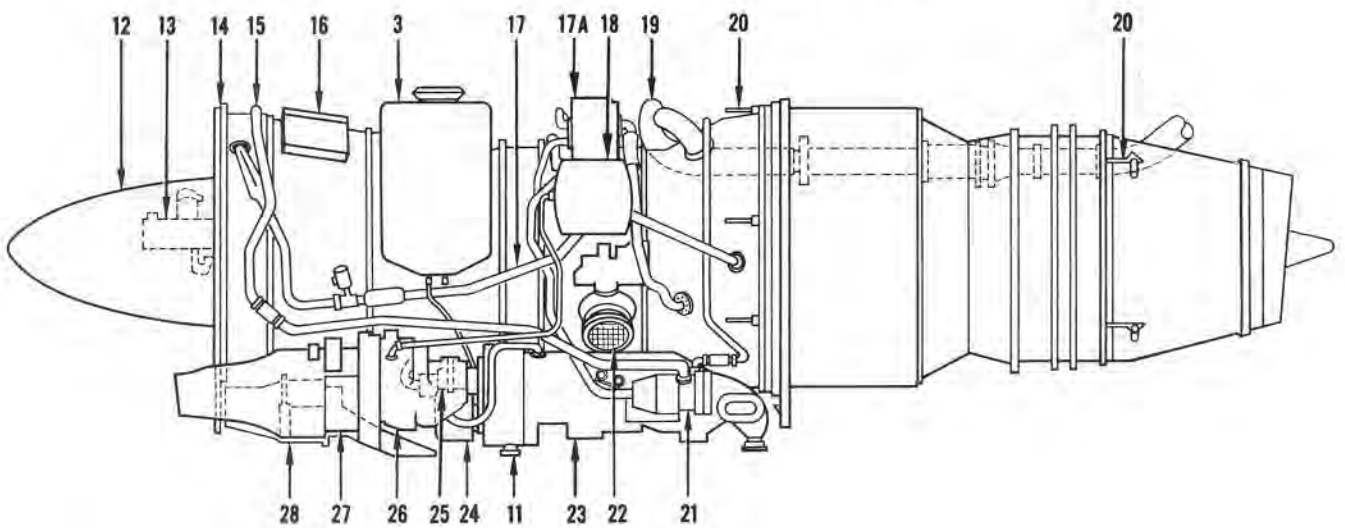
The letter "P" in the engine designation has been used throughout the Flight Manual to indicate the engine manufacturer as Pratt & Whitney; however, the letter "F" will be found on some engines, indicating the Ford Motor Co. as the manufacturer.

1. AIR INLET DUCT
2. LOW PRESSURE (N_1) COMPRESSOR
3. OIL SUPPLY TANK
4. HIGH PRESSURE (N_2) COMPRESSOR
5. BURNER CANS
6. FIRST STAGE TURBINE
7. SECOND AND THIRD STAGE TURBINE
8. TAIL PIPE
9. EXHAUST CONE
9A. SONIC VIBRATION SUPPRESSORS
10. ACCESSORY DRIVE
11. ACCESSORY CASE
12. NOSE DOME
13. SURGE BLEED VALVE GOVERNOR
14. NOSE COWL SEAL

Figure 1-3. (Sheet 1 of 2).

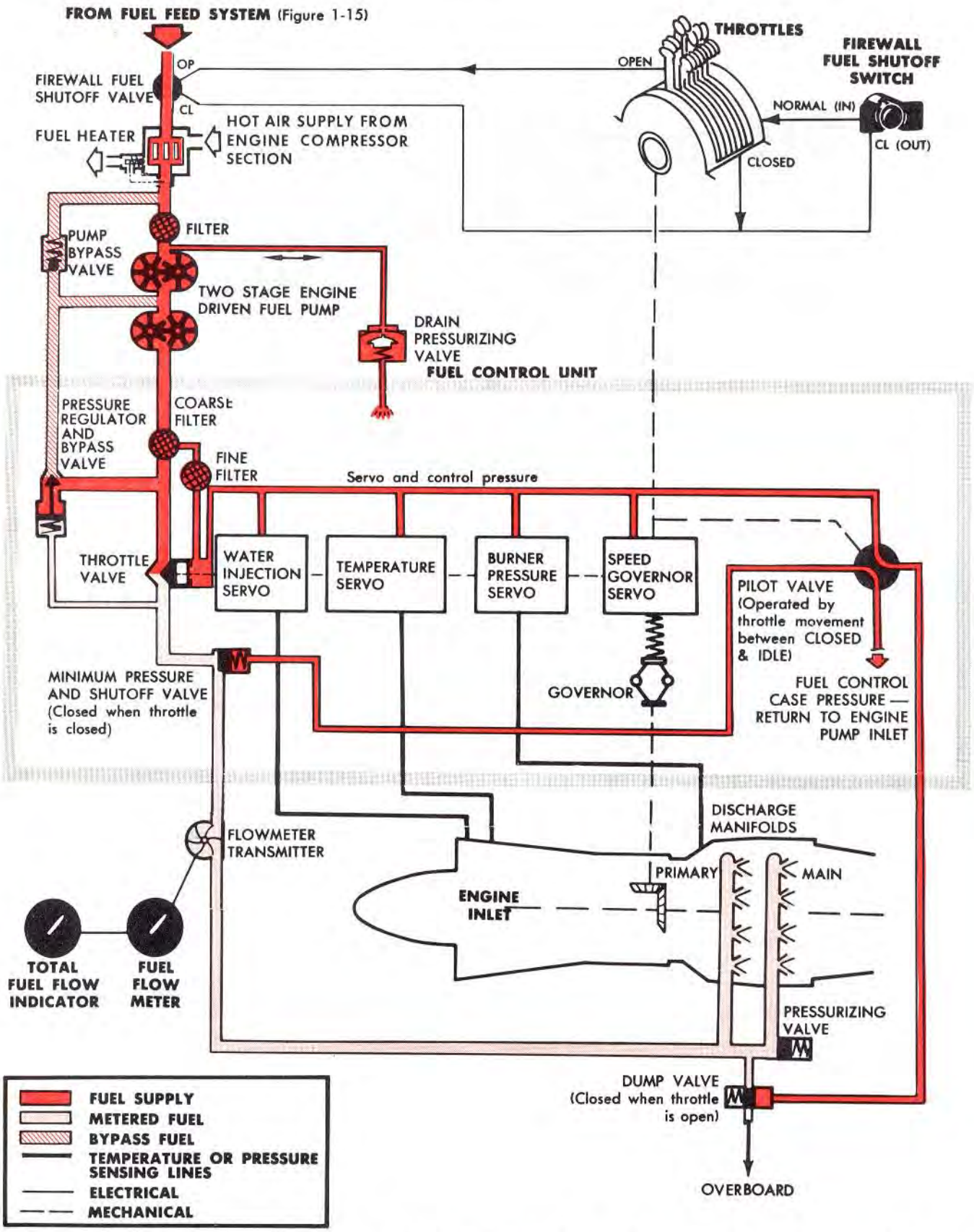


J-57-P-43W, WA AND WB B-52F



15. WATER INJECTION LINE
16. IGNITION UNITS
17. INLET ANTI-ICING LINE
17A. FUEL HEATER
18. CONSTANT SPEED DRIVE OIL TANK
19. BLEED AIR DUCT
20. FIRE DETECTOR
21. TURBINE DRIVEN WATER PUMP (ENGINES 1, 3, 5, AND 7)
22. SURGE BLEED VALVE
23. FUEL CONTROL UNIT
24. STARTER
25. ENGINE DRIVEN WATER PUMP (ENGINES 2, 4, 6, AND 8)
26. CONSTANT SPEED DRIVE UNIT (ENGINES 1, 3, 5, AND 7)
27. ALTERNATOR (ENGINES 1, 3, 5, AND 7)
28. OIL COOLER

Figure 1-3. (Sheet 2 of 2).



engine fuel control system

Figure 1-4.

THROTTLES POSITION	PERCENT RPM	FIREWALL FUEL SHUTOFF VALVE POSITION	IGNITION	MANIFOLD DRAIN (DUMP) VALVE	WARNING HORN	WATER INJECTION
CLOSED	0%	CLOSED	Not Available	Open		Inactive
Advanced		Open unless firewall fuel shutoff switch is pulled	Available when throttle is advanced from CLOSED with engine starter switch in START			
18° approx	(Starting)			Closed. Metered fuel under pressure is supplied to primary manifold		
IDLE	58% to 65%				Energized if throttle is retarded when landing gear is not down and locked	
80° approx					Energized if airplane is on the ground and the flaps are not fully extended	
85° approx B-52F						Initiated (de-activated by retarding throttle) provided the water injection system switch is in the ON position
OPEN B-52E						
Cruise	85% to 97%					
OPEN B-52F	102% max					
B-52E	105% max					

throttle positions chart

Figure 1-4A.

ENGINE FUEL CONTROL SYSTEM

An engine fuel control system (figure 1-4) on each engine automatically provides optimum engine performance for any throttle setting. This system makes it unnecessary to make throttle adjustments to compensate for variations in inlet temperature, altitude, or airspeed. Fuel from the main tanks is routed through

the fuel feed system to fuel control units which meter fuel to each engine. The throttle provides basic engine power control and operates through the fuel control unit to position a throttle valve. Engine fuel from the fuel feed system is also controlled by an electrically operated firewall shutoff valve. This valve is supplied power to open by the firewall fuel shutoff switch when the throttles are moved from CLOSED position. This allows fuel under boost pump pressure to reach a two-stage engine-driven fuel pump. Output from the pump is delivered to the fuel control unit.

Fuel Control Unit

The fuel control unit is of the hydro-mechanical type and provides a means of obtaining optimum engine performance at any power setting. This unit contains a speed setting governor and pressure, speed, and temperature sensing servos which act in conjunction with the throttle to position the throttle valve. Fuel pressure at the throttle valve is maintained by a pressure regulator which bypasses fuel to the inter-stage area of the fuel pump. The amount of fuel metered to the engine by the throttle valve is determined by a combination of compressor discharge pressure, engine inlet temperature, engine rpm, water pressure, and throttle position. A minimum pressure and shutoff valve, downstream from the throttle valve, is opened by metered fuel pressure from the throttle valve. When the throttle is closed, a pilot valve is opened which allows high pressure fuel to close the minimum pressure and shutoff valve. A flowmeter transmitter, flowmeter, and total fuel flow indicator are also provided. Metered fuel under pressure flows to the primary discharge nozzles and, when fuel pressure is sufficient, a pressurizing valve is opened which allows fuel to flow to the main discharge nozzles. A manifold drain valve, which is held closed by fuel pressure, is opened by return spring pressure when the throttle is moved to CLOSED position, shutting off fuel pressure to the valve. The opening of this valve as fuel pressure drops allows fuel to drain from the fuel manifolds.

Engine Fuel Control System Controls

THROTTLES. Eight throttles (18, figure 1-12) on the aisle stand control the firewall fuel shutoff valves and throttle valves. In addition to these functions, the throttles control water injection. The throttle quadrant is marked CLOSED--IDLE--OPEN. In CLOSED position, 24-volt d-c switched battery power is supplied to close the firewall fuel shutoff valves. With the throttles advanced approximately 18° from CLOSED, fuel pressure closes the manifold drain valves and metered fuel under pressure is then supplied to the primary manifold. Advancing the throttles from CLOSED position provides power to open the firewall fuel shutoff valves provided the firewall shutoff switches have not been pulled. At the same time, provided the engine starter switch is in START position, 24-volt d-c switched battery power is supplied to the engine ignition circuit. Advancing the inboard nacelle engine throttles to approximately 80% NRT completes the flaps up warning circuit which sounds the warning horn if the airplane is on the ground and flaps are not fully extended. When the throttles are advanced to OPEN with the water pump switches in ON position, 24-volt d-c TR power will be supplied to provide water injection. Retarding a throttle near IDLE position when the landing gear is not down and locked completes a circuit providing 24-volt d-c TR power to the landing gear warning horn. Each throttle has a different height and is separated from the others by being slightly bent outboard for selectivity and ease of operation of individual engines. This facilitates ground handling of the airplane and power settings at pilot's discretion. A mechanical stop is provided on the throttles which prevents their being retarded to CLOSED position unless the upper knobs are raised approximately 1/4 inch. An individual smaller throttle lever and knob is integrally connected to each large throttle to serve as a one-hand multiple grip for operation of the eight engines simultaneously. These are located aft of the large throttles and are spaced close together for convenience of use by the pilots.

THROTTLE BRAKE LEVER. A throttle brake lever (6, figure 1-12) on the aisle stand to the right of the throttles is used to adjust the amount of force necessary to move the throttles. When in OFF (aft) position, the throttle brake is released. Moving the throttle brake lever in the INCREASE (forward) direction increases throttle friction.

FIREWALL FUEL SHUTOFF SWITCHES. Eight firewall fuel shutoff switches are provided on the pilots' instrument panel. For a complete description of these switches, see "Emergency Equipment," this section.

Engine Fuel Control System Indicators

FUEL FLOWMETER. Fuel flow to the engine is shown by eight fuel flowmeters (27, figure 1-13 and 23, figure 1-13A) on the pilots' instrument panel. These indicators read in pounds per hour and on **B-52E** airplanes operate on 28-volt a-c power through a circuit breaker marked "Flow" on the "Fuel Indicators" portion of the copilot's circuit breaker panel. On **B-52F** airplanes, the indicators are provided power through circuit breakers marked "Fuel Flow 28V D-C" and "Fuel Flow 115V A-C" on the "Fuel Indicators" portion of the copilot's circuit breaker panel.

TOTAL FUEL FLOW INDICATOR. A total fuel flow indicator (13, figure 1-16) is located on the pilots' instrument panel. A-C power is used to electrically add the flow rates indicated on the eight individual fuel flowmeters. On **B-52E** airplanes, the indicator utilizes 28-volt a-c power through a circuit breaker marked "Total Flow" on the "Fuel Indicators" portion of the copilot's circuit breaker panel. On **B-52F** airplanes, the indicator utilizes 115-volt a-c power through a circuit breaker marked "Fuel Flow 115V A-C" on the "Fuel Indicators"portion of the copilot's circuit breaker panel.

WATER INJECTION SYSTEM

A water injection system (figure 1-5) is provided which allows water to be sprayed into the compressor air inlet of each engine to furnish increased thrust for takeoff.

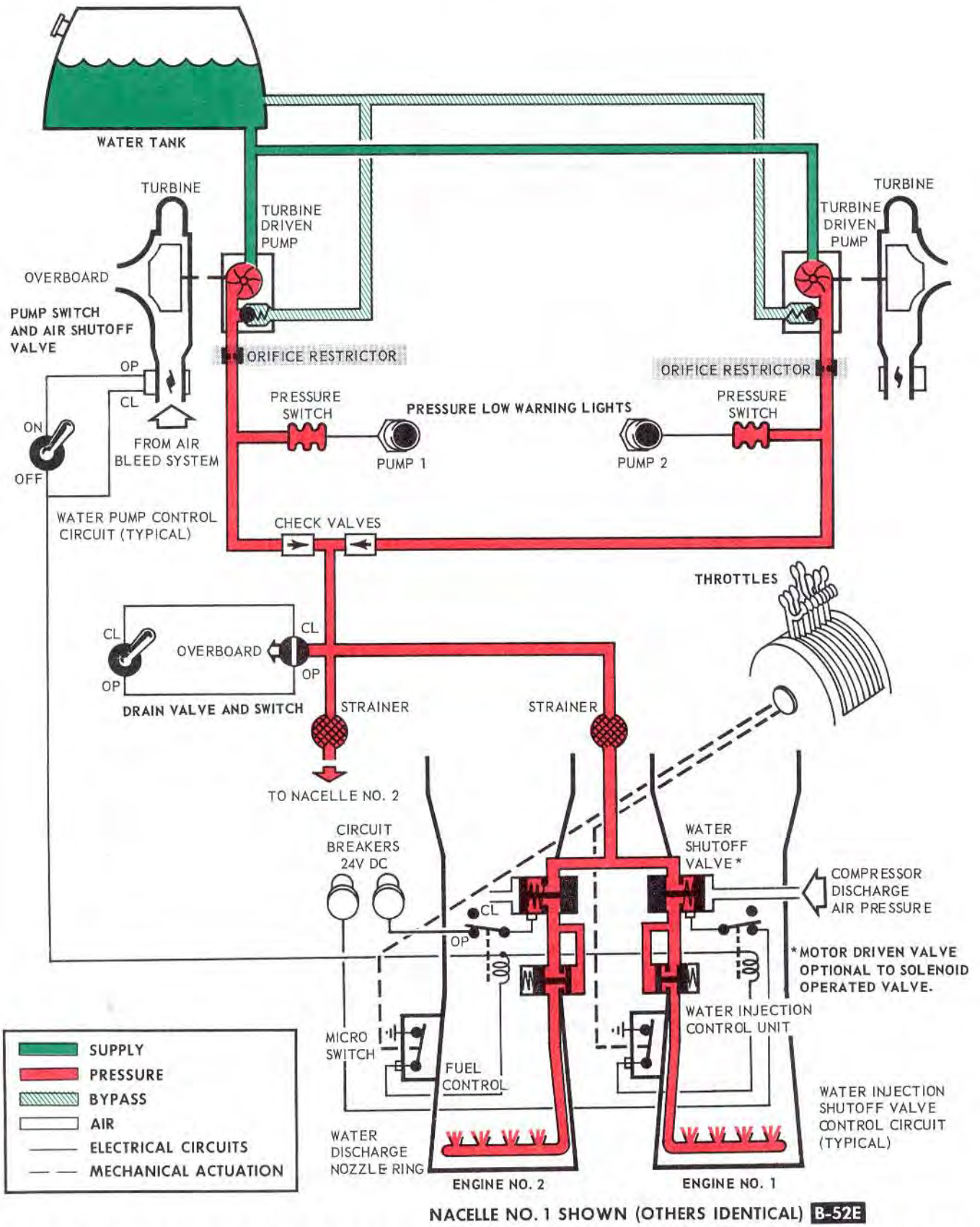
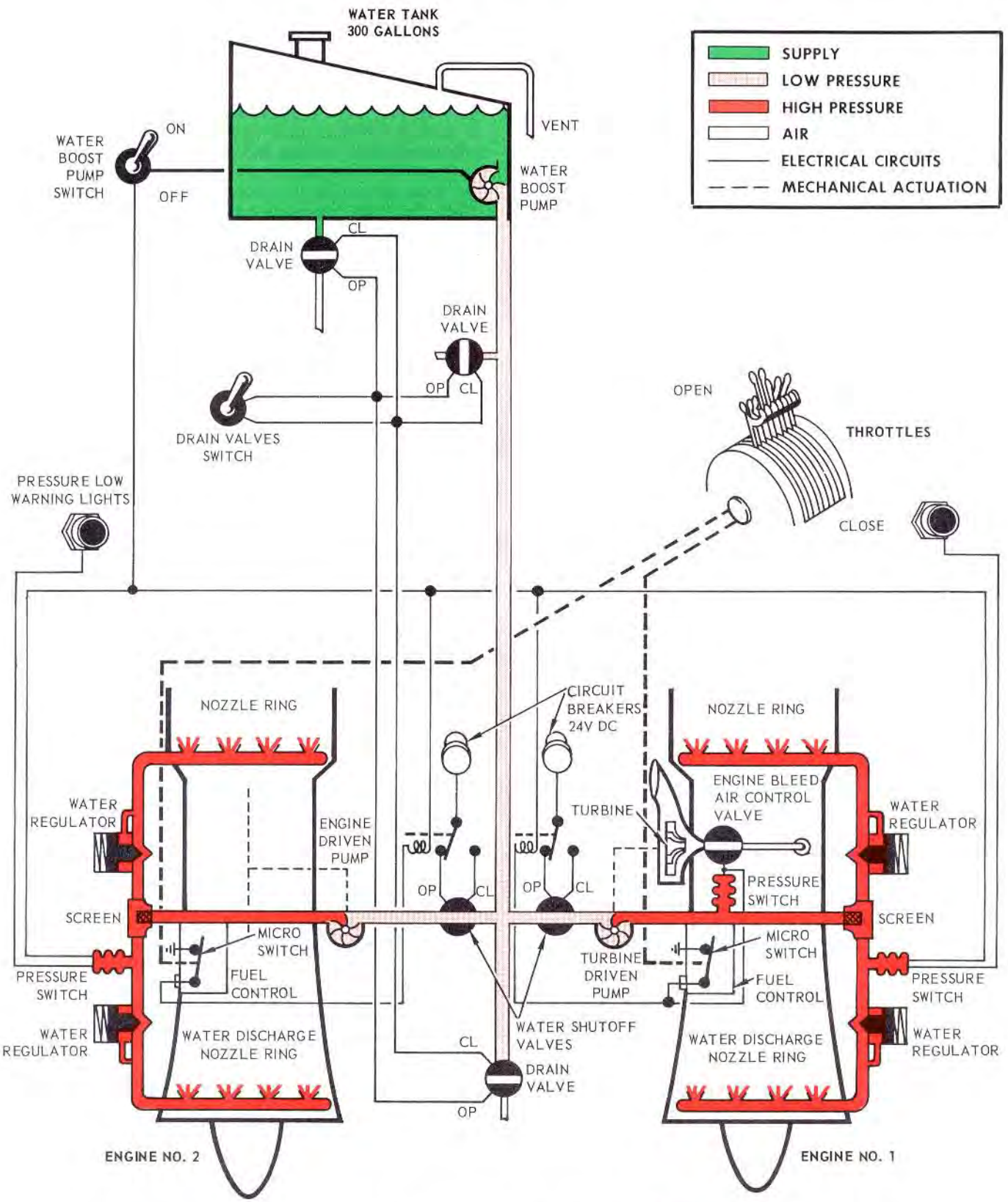


Figure 1-5. (Sheet 1 of 2).



NACELLE NO. 1 SHOWN (OTHERS IDENTICAL) B-52F

water injection system (typical)

Figure 1-5. (Sheet 2 of 2).

The primary effect of water injection is to cool the air, increasing the density and mass airflow through the engine. This permits burning of an increased fuel flow which is automatically augmented to provide added thrust during water injection. With the water pumps switch(es) in ON position, a mechanical linkage at the engine fuel control unit is actuated as the throttles are advanced to OPEN position; this allows pressurization of the water injection speed reset servo. The maximum speed limit control is thereby repositioned to permit an increased setting above the usual maximum speed.

B-52E

The water supply consists of two tanks with a total capacity of 300 US gallons. A tank is located in the leading edge of each wing to provide water for obtaining maximum wet rated thrust from the J-57-P-19W or -29WA engines. The engines of each wing are supplied by two water pumps which are driven by the air bleed (pneumatic power supply) system and are controlled by a solenoid-operated water pump shutoff valve. Operation of the four pumps is required for full water injection to all eight engines at takeoff rated thrust; however, a pump bypass valve allows excess water to be bypassed back to the water tanks while the pumps are operating. Water flows from the pumps through a strainer to a water shutoff valve at each nacelle. Advancing the throttles to OPEN position provides TR power to open the water shutoff valves and allow compressor discharge pressure to position the water injection control units. Water is then regulated to the discharge nozzles in the engine compressor air inlet. Orifice plate restrictors are incorporated in the water discharge tube immediately downstream of the pump outlet port. These restrictions reduce high surge pressures to an acceptable level.

B-52F

Four tanks with a total capacity of 1200 US gallons provide the water supply for water injection. Two tanks are located in the leading edge of each wing to supply J57-P-43W, -43WA, or -43WB engines for obtaining maximum wet rated thrust. An electric motor operated boost pump is installed in each tank. The boost pumps are controlled by a pump switch located on the water injection panel and, when energized, water is delivered from the tanks to motor-operated water shutoff valves within the nacelles. The shutoff valves are controlled by throttle-operated switches and are opened when the throttles are advanced to OPEN with the water pumps switch in ON position. In each nacelle, the right engine is equipped with an engine-driven water injection pump while the left engine is equipped with a turbine-driven pump operated by bleed air direct from the engine. Bleed air lines and valves for the pumps are completely separate from the airplane air bleed (pneumatic power supply) system. By means of pressure switches and bleed air shutoff valves, the turbine-driven pumps are started and stopped automatically as required. From the water pumps, water flows through filter screens and water flow regulators to nozzle rings in both the compressor air inlet case and the diffuser section of the engines. Drain valves are provided on all airplanes to drain the system after use to prevent freezing of the remaining water in lines and valves. A system of pressure switches and lights is installed to indicate when the water pressure is inadequate for water injection. When the water tanks are fully serviced, sufficient water is available for 110 seconds of water injection at takeoff rated thrust. See "Water Limitations," Section V and figure 1-60 for water servicing information.

Water Injection System Controls

B-52E

WATER INJECTION PUMPS SWITCHES. Two ON--OFF pumps switches (3, figure 1-6) located on the water injection panel control air pressure from the air bleed (pneumatic power supply) system for operating two separate turbine-driven water pumps. Turning the switches ON supplies TR power to open the air shutoff valves and allow the turbine-driven pumps to pressurize the water injection system. Pump switch circuit breakers are designated "Nac 2 & 3" and "Nac 1 & 4" on the pilot's auxiliary circuit breaker panel. Water does not reach the engines until the throttles are advanced to OPEN position, at which time compressor discharge air pressure positions the water injection control valves to initiate water injection. Each turbine is supplied with overspeed trip protection and speed regulation. To reset a turbine tripped by overspeeding, move the water injection pumps switch momentarily to OFF position.

B-52F

WATER INJECTION PUMPS SWITCH. An ON--OFF switch (3, figure 1-6) on the water injection panel controls the water boost pumps in the water tanks. Turning the pumps switch ON supplies 205-volt a-c power to operate the pumps. Individual circuit breakers, marked "Water Injection Pump Cont," "No. 1," "No. 2," "No. 3," and "No. 4" are located on the pilot's auxiliary circuit breaker panel. The single-speed three-phase boost pump motors are submerged and operate in water which provides lubrication and cooling. The pumps build up water pressure in the supply line between the tanks and the water shutoff valves on each engine.

B-52E

THROTTLES. Advancing engine throttles to OPEN supplies TR power to open the solenoid- or motor-operated water shutoff valves. This allows compressor discharge air pressure to position the water

injection control valves and permit water to flow to the discharge nozzles. The water shutoff valves are controlled by microswitches installed at each engine fuel control unit. The microswitches are actuated by mechanical linkage when the throttles are advanced to the full power position. In throttle positions other than OPEN, the solenoid-operated water shutoff valves are not energized for operation. When energized, the solenoid-operated valves receive operating force from engine compressor discharge air pressure. On airplanes with electric motor operated water shutoff valves, the valves are a sliding-gate type and are closed when the throttles are retarded from OPEN position.

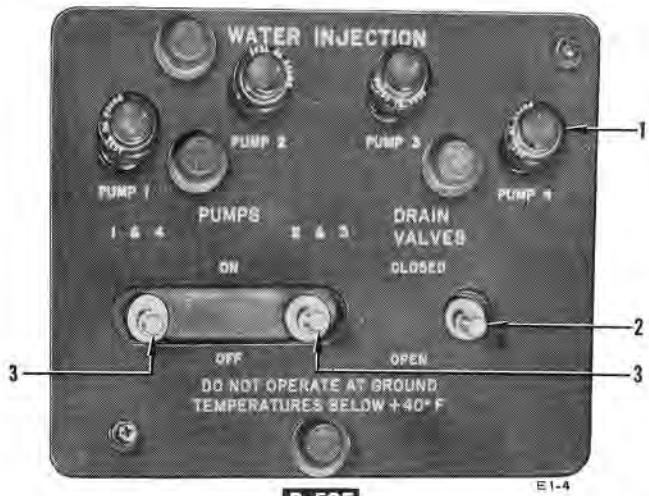
B-52F

THROTTLES. Advancing the throttles to a position within 15° of full OPEN actuates switches which supply 24-volt d-c TR power to open motor-operated water shutoff valves at the engines provided the water injection pump switch is in ON position. Under tank boost pump pressure, the water flows through the valves to the engine-mounted water pumps which pump the water through screens and flow regulators into the engines. On the left engine of each nacelle, a pressure switch is located downstream from the engine-mounted pump and will close the water and pneumatic shutoff valves when actuated by decreasing water pressure regardless of the OPEN throttle position. Retarding the throttles below 15° from full OPEN closes the water shutoff valves, cutting off water flow to the engines.

WATER INJECTION DRAIN VALVES SWITCH. An OPEN--CLOSED drain valves switch (2, figure 1-6) is located on the water injection panel. In OPEN position, TR power is supplied to open the motor-operated drain valves. In CLOSED position, the drain valves remain in their normally closed position. There are 12 drain valves on B-52E airplanes (20 on B-52F airplanes) controlled by a single switch for the purpose of draining unused water from the system to prevent freezing. When part or all of the water is not used during takeoff, the remaining water may be drained rapidly by turning the pumps switch(es) ON while the drain valves switch is in OPEN position. Drain valve circuits on B-52E airplanes are controlled through two circuit breakers marked "Drain Valves L Wing" and "Drain Valves R Wing" located on the pilot's auxiliary circuit breaker panel. Drain valve circuits on B-52F airplanes are controlled through four circuit breakers marked "Drain Valves," "Left Wing Outbd," "Left Wing Inbd," "Right Wing Outbd," and "Right Wing Inbd" located on the pilot's auxiliary circuit breaker panel.

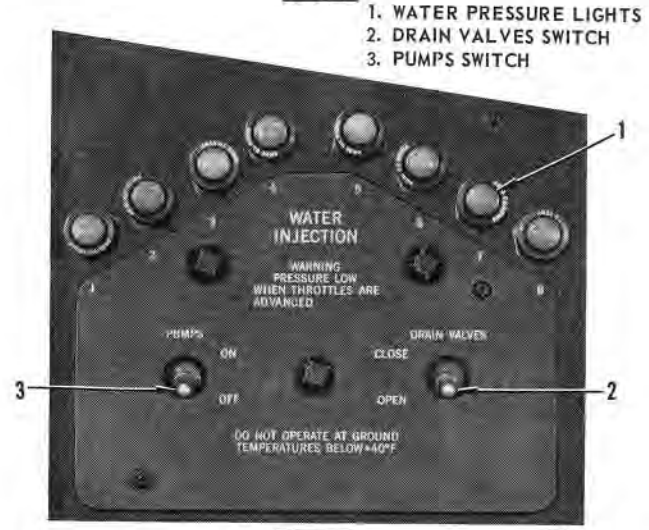
CAUTION

During water drainout on B-52E airplanes with pumps switches in ON position, regulate throttles to maintain 125 psi minimum air bleed manifold pressure. This prevents pumps damage by insuring immediate shutdown of the turbine-driven pumps after water depletion.

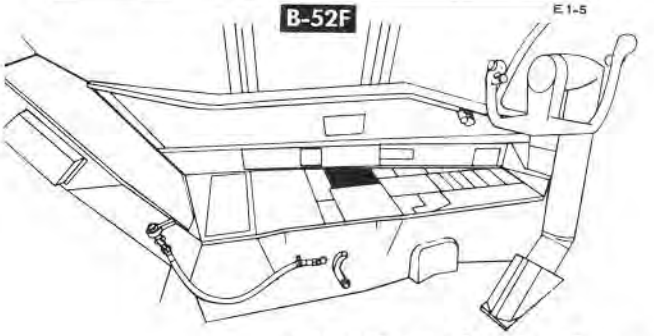


B-52E

1. WATER PRESSURE LIGHTS
2. DRAIN VALVES SWITCH
3. PUMPS SWITCH



B-52F



water injection panel (typical)

Figure 1-6.

Water Injection System Indicators

B-52E

WATER PRESSURE LIGHTS. Four red water pressure lights (1, figure 1-6) on the water injection panel illuminate when water pressure is too low for water in-

jection. The lights operate on TR power controlled by pressure switches located immediately downstream from the water injection pumps and will illuminate when water pressure from the pumps is inadequate. The water pressure lights circuit breaker is marked "Pump Ind Lts" on the pilot's auxiliary circuit breaker panel.

NOTE

B-52E

The water pressure light system indicates water pressure only. The light system does not indicate quantity of water available or flow of water into the engines.

B-52F

WATER PRESSURE LIGHTS. Eight amber water pressure lights (1, figure 1-6) located on the water injection panel are provided to indicate when water pressure is too low for water injection. The lights are controlled by the ON position of the water pump switch and by pressure switches located downstream from the engine-mounted water injection pumps. When the water injection pump switch is turned to ON and the throttles are retarded below 15° from OPEN position, the amber lights will illuminate. When the throttles are advanced to within 15° of OPEN and the water injection system is operating normally, the lights will not illuminate. When the throttles are retarded after takeoff or if water pressure is inadequate for water injection, the lights will stay illuminated until the water pump switch is turned off. The lights receive TR power through a circuit breaker marked "Pumps Ind Lts" on the pilot's auxiliary circuit breaker panel.

NOTE

B-52F

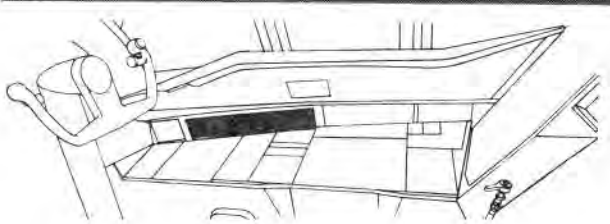
The water pressure light system does not give an indication of quantity of water available for injection.

ENGINE IGNITION AND STARTING SYSTEM

A turbine-driven starter is provided on each engine. Air obtained from a ground air source or from an operating engine can be routed through the air bleed system to drive each engine starter. See "Air Bleed System," this section, for further information about the use of this system. On airplanes QN, the starters installed on engines 2 and 8 are combination cartridge-pneumatic starters which can be energized by firing a solid propellant (gas generating) cartridge or by compressed air from an auxiliary air supply or from another engine. A pneumatically operated starter air valve controlled by a solenoid valve regulates bleed air supplied to the starter turbine. Engine ignition is accomplished by spark ignitors located in the combustion chambers of each engine. Switched battery power for engine ignition is supplied through circuit breakers marked "Norm Ignition" - "1," "2," "3," "4," "5," "6," "7," and "8" on the "Engine Control" portion of the copilot's circuit breaker panel.

Pneumatic Starters

Each pneumatic engine starting unit consists of an air turbine driven starter, a starter control valve, and the electrical components necessary for starter control. Each starter is geared to the high pressure compressor of the engine on which it is installed. The control valve is installed in the starter air inlet duct and functions as an air pressure regulating and shutoff valve. A solenoid within each control valve is energized when the respective engine starter switch (see "Starter Switch," this section) on the copilot's auxiliary side panel is placed in START position, allowing the valve to be opened by high pressure air supplied by an operating engine or an external pneumatic ground source. When the maximum starting rpm is reached during engine start, an overspeed device in the starter housing breaks the circuit to the solenoid, allowing the control valve to close and shut off the starter air supply.



1. ENGINE STARTER SWITCHES
2. STARTER SELECTOR SWITCH
3. STARTER NOT OFF WARNING LIGHT
4. CARTRIDGE START SWITCH

engine ignition and starting controls (typical)

Figure 1-7.

Cartridge Starters QN

Cartridge starters installed on engines 2 and 8 are comparable in operation to the MB-10 starters installed on engines 1, 3, 4, 5, 6, and 7. The cartridge starter may be energized by gas from a burning Air Force Type MXU-4/A solid propellant cartridge or by compressed air from an auxiliary air cart or from an operating engine. The primary purpose of these starters is to provide for engine starts without assistance from an auxiliary air cart or auxiliary electrical power cart. Starter operation is basically the same for cartridge or pneumatic operation with the major difference being the temperature of the two gases. The cartridge-produced gas enters the starter turbine at a temperature in excess of 2100° F while the compressed air enters the starter turbine at a temperature of 500° F or less. The cartridge starter is composed of the same basic parts as the MB-10 starter; i.e., turbine, gear train, overrunning clutch with a speed sensing device, and an overspeed disengagement mechanism with shear pin. In addition, the cartridge starter has a breech chamber with breech cap and locking handle, a two-stage pressure relief valve, an aerodynamic brake, and the necessary electrical components for cartridge ignition. Actuation of a cartridge starter switch (see "Cartridge Start Switch," this section) located on the copilot's side panel initiates the start by completing the electrical circuit to ignite the cartridge. The cartridge cannot be ignited unless the breech is properly installed and the lock handle is in the proper position. The two-stage pressure relief valve maintains proper operating pressure and, in case of malfunction, relieves pressure to safe limits. As engine rpm exceeds starter rpm, the overrunning (sprag-type) clutch releases to prevent the starter turbine from being driven to an overspeed condition. Should the overrunning clutch not release, the overspeed disengagement mechanism will isolate the starter turbine from the starter gear train. An aerodynamic brake is attached to the starter turbine to prevent turbine overspeed. When starting with compressed air, a centrifugal switch monitors rpm at the starter mounting pad and, as a specified rpm is reached, breaks the circuit to the starter control valve solenoid, allowing the valve to close and shut off the starter air supply. Since the primary purpose of the cartridge-pneumatic starter is to provide for operation without need for auxiliary air and electrical power supply, provision (16B, figure 1-2) has been made to carry four (eight TB) spare cartridges in the aircraft.

Engine Ignition and Starting System Controls

STARTER SELECTOR SWITCH. A FLIGHT START--GROUND START starter selector switch (2, figure 1-7) is located on the copilot's auxiliary side panel. The position of this switch determines whether ignition only or both starter and ignition are provided when the starter switch is operated. In FLIGHT START position with a starter switch in START, only power for engine ignition will be provided and the starters are not operable. With the switch in GROUND START position, TR power is supplied on engines 3, 4, 5, and 6 to allow opening of the starter air valves when each circuit is completed by use of the engine starter switch. Forward switched battery power is supplied for opening starter air valves on engines 1 and 2 and aft switched battery power is supplied for opening starter air valves on engines 7 and 8. Circuit breakers are marked "Engine Starter," "1 & 2," "3 & 4," "5 & 6," and "7 & 8" on the pilot's auxiliary circuit breaker panel. The starter selector switch circuit breaker is marked "Sw Pos" on the pilot's auxiliary circuit breaker panel.

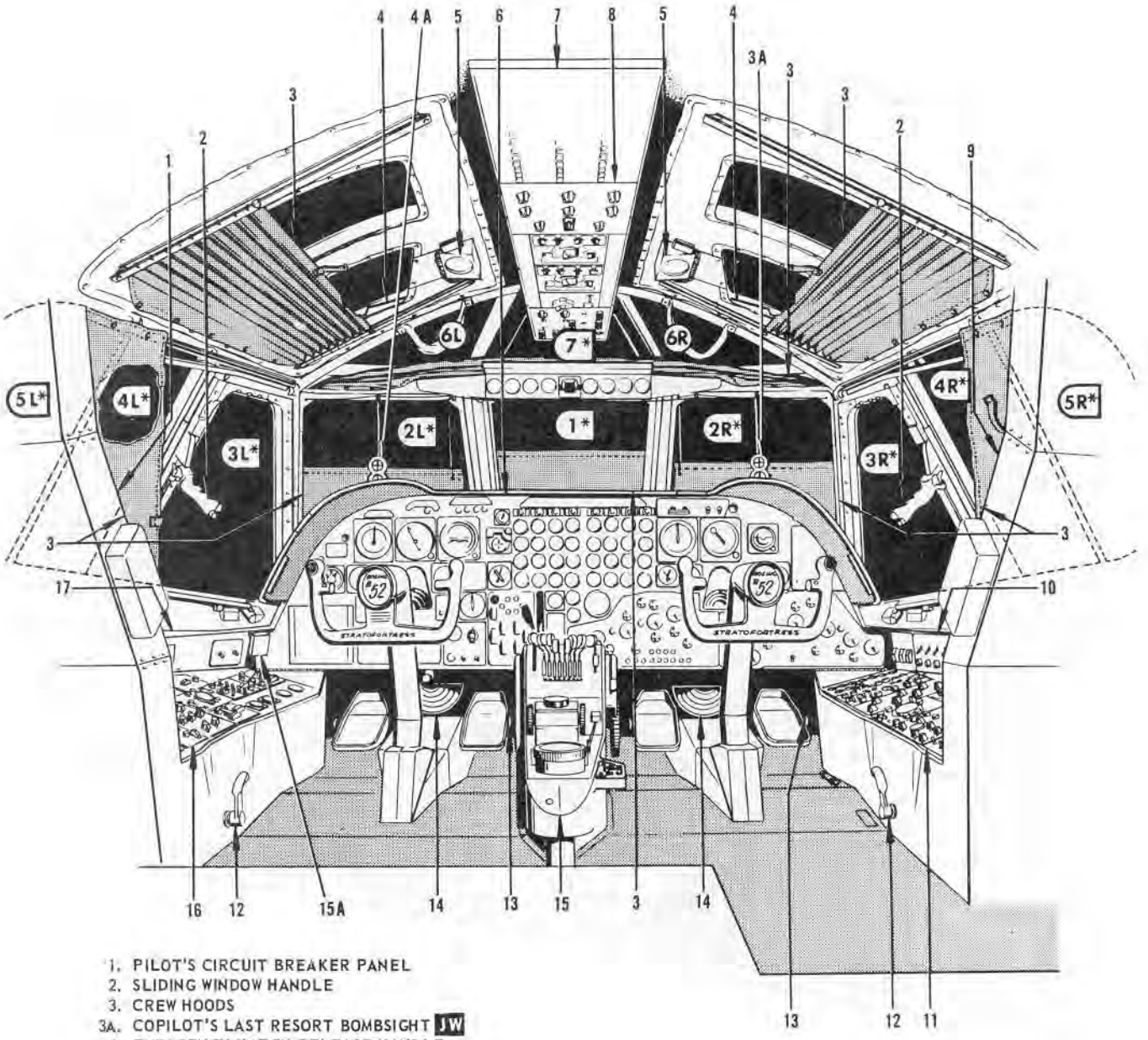
STARTER SWITCH. Eight START--OFF starter switches (1, figure 1-7) are provided on the copilot's auxiliary side panel. These switches electrically control bleed air for starter turbine operation and electrical power for engine ignition. Placing the starter switch in START position with the starter selector switch in GROUND START supplies TR power for engines 3, 4, 5, and 6 and switched battery power for engines 1, 2, 7, and 8 to open the starter air valve and switched battery power to energize the ignition circuits. With the above conditions, advancing the engine throttles out of CLOSED provides power to the engine spark igniters. Placing this switch in START position with the starter selector switch in FLIGHT START provides power for engine ignition only when the throttles are advanced. With throttles at or above IDLE, continuous ignition will occur until the starter switch is placed in OFF position.

QN

CARTRIDGE START SWITCH. Two momentary-type cartridge start switches (4, figure 1-7) with ON--OFF positions are located on the copilot's side panel. The switches marked "Cartridge Start," "Eng 2" and "Eng 8" supply switched battery power to initiate firing of respective No. 2 and No. 8 engine starter cartridges. The controlling circuit breakers marked "Ctg Start Eng 2" and "Ctg Start Eng 8" are located on the pilot's auxiliary circuit breaker panel. In ON position, power is supplied to fire the respective cartridge and to de-energize the starter air valve circuits for that starter. The cartridge start switches also supply the respective engines with switched battery power for ignition; however, ignition circuits are not completed until No. 2 and 8 throttles are moved from CLOSED to IDLE position, at which time fuel is also supplied. After the cartridge start switches are released to OFF position, ignition is no longer supplied through the cartridge start switch; however, ignition may be energized through the engine starter switches as required. Engine shutdown, when desired, may be accomplished by returning the throttles to the CLOSED position.

Engine Ignition and Starting System Indicators

STARTER SWITCH NOT OFF WARNING LIGHT. An amber starter switch not off warning light (3, figure 1-7) on copilot's auxiliary side panel is illuminated by forward switched battery power when a starter switch is left in the START position. The light receives power through a circuit breaker marked "Sw Pos" on the "Engine Starter" portion of the pilot's auxiliary circuit breaker panel.



1. PILOT'S CIRCUIT BREAKER PANEL
2. SLIDING WINDOW HANDLE
3. CREW HOODS
3A. COPILOT'S LAST RESORT BOMBSIGHT JW
4. EMERGENCY HATCH RELEASE HANDLE
4A. PILOT'S LAST RESORT BOMBSIGHT JW
5. DOME LIGHT
6. PILOTS' INSTRUMENT PANEL
7. PILOTS' OVERHEAD CIRCUIT BREAKER PANEL
8. OVERHEAD PANEL
9. COPILOT'S CIRCUIT BREAKER PANEL
10. COPILOT'S AUXILIARY SIDE PANEL
11. COPILOT'S SIDE PANEL
12. CONTROL COLUMN DISCONNECT LEVER
13. RUDDER PEDAL ADJUSTMENT LEVER
14. HEATED AIR OUTLET
15. AISLE STAND
15A. ALTIMETER CORRECTION CARD AND HOLDER QA
16. PILOT'S SIDE PANEL
17. PILOT'S AUXILIARY SIDE PANEL

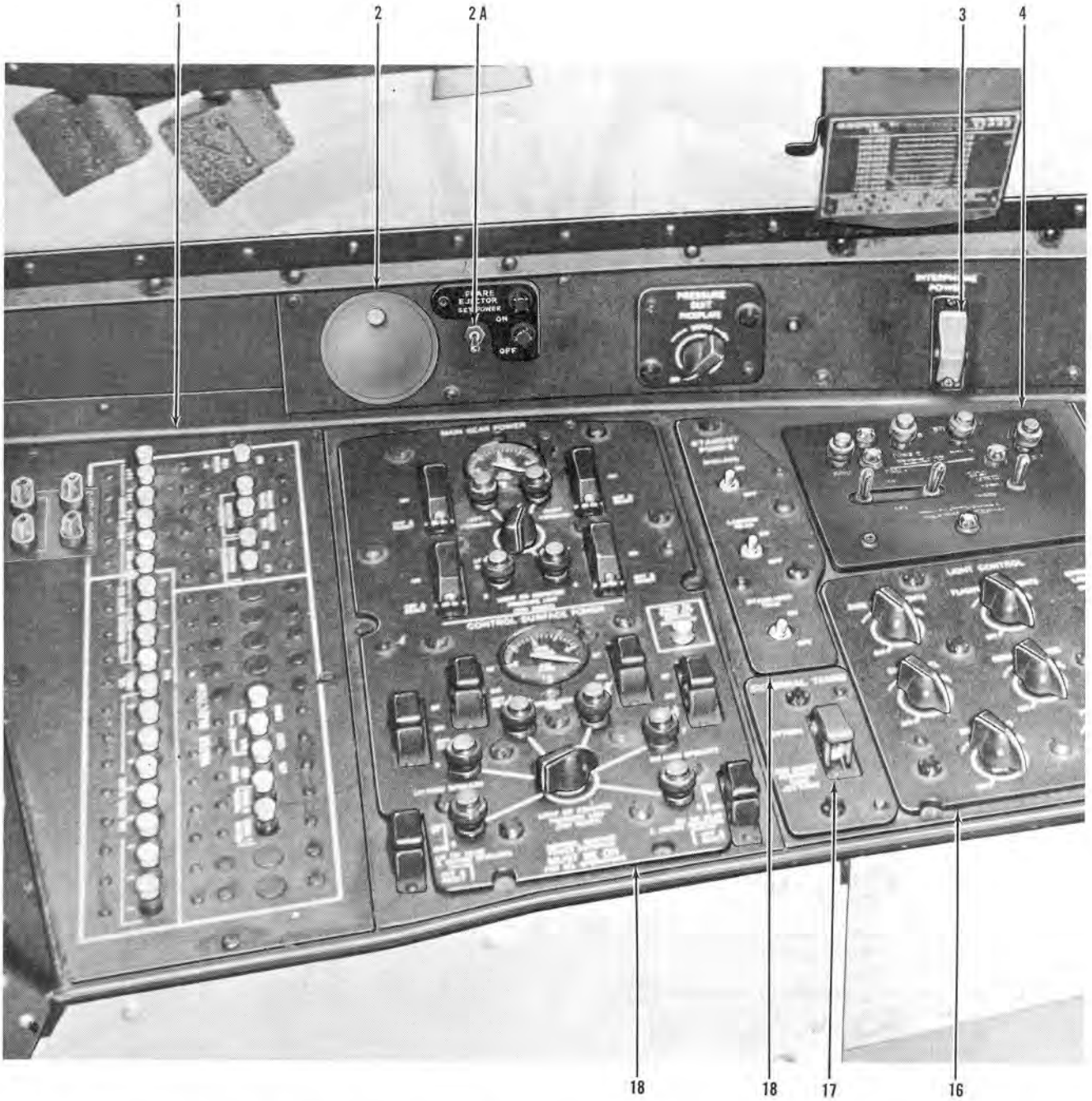
(*) Window number corresponds with anti-ice control circuit breaker number.

NOTE

Windows 6L and 6R do not have anti-icing incorporated.

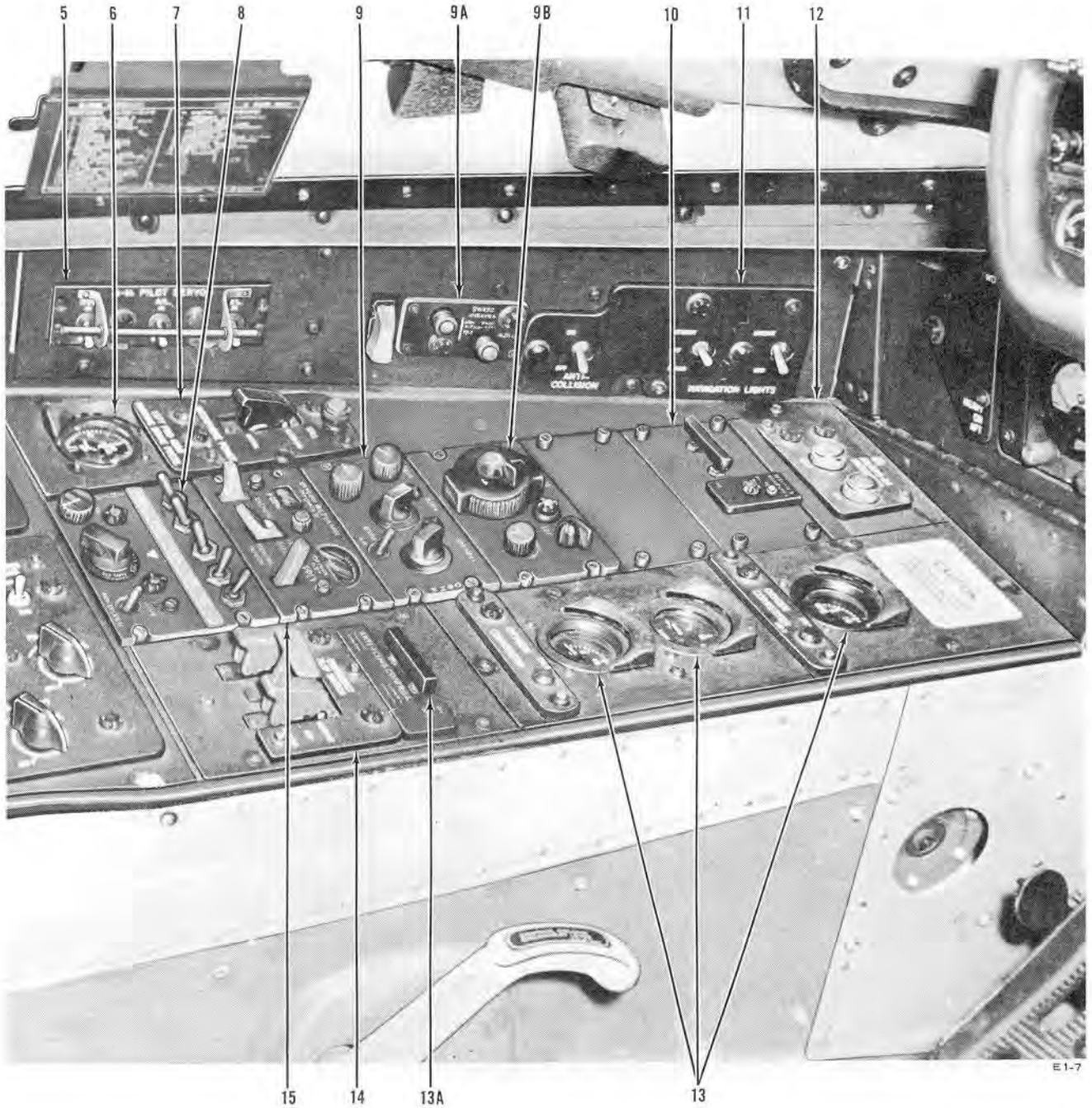
pilots' station (typical)

Figure 1-8.



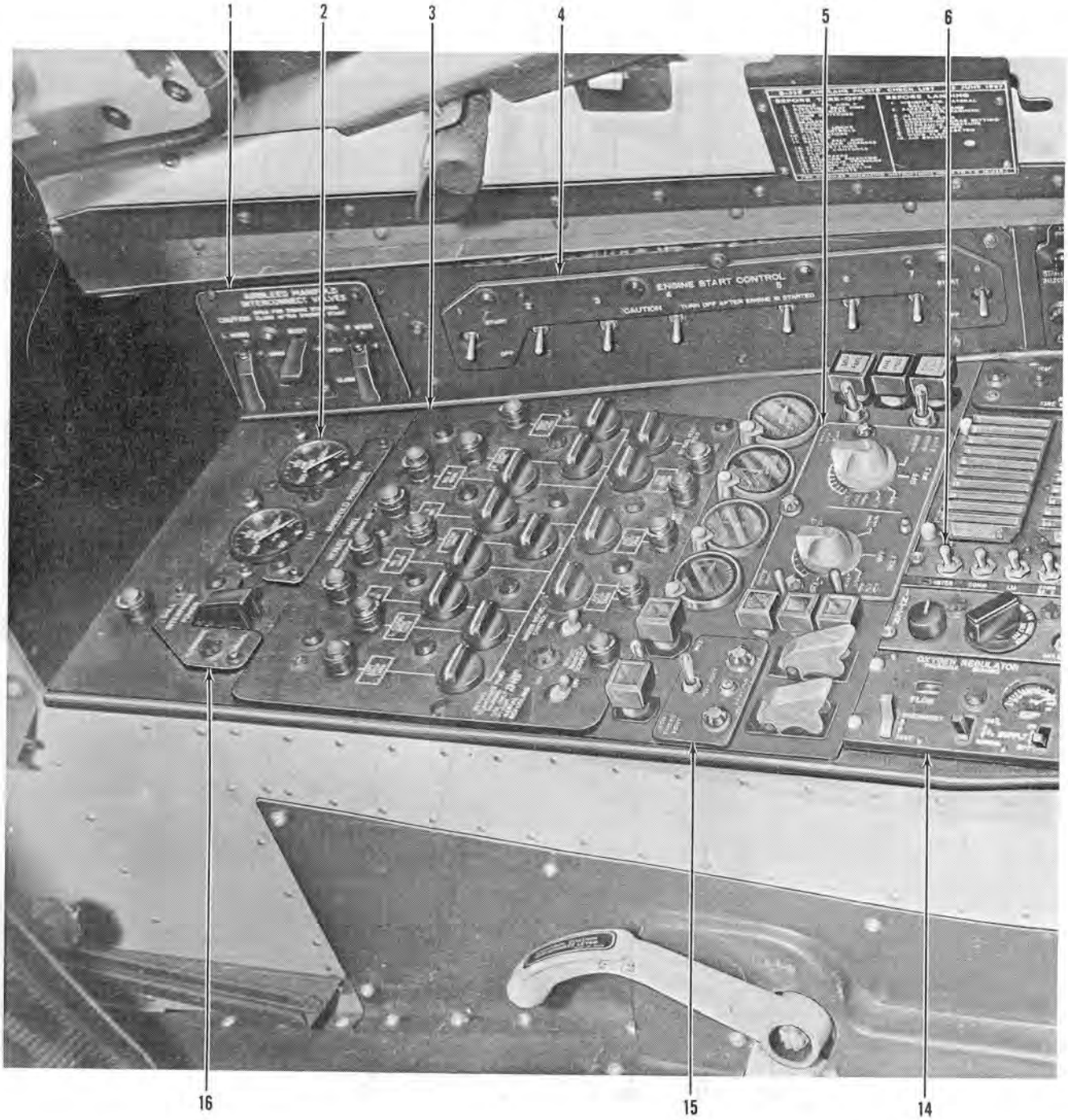
1. PILOT'S AUXILIARY CIRCUIT BREAKER PANEL
2. ASH TRAY
2A. FLARE EJECTOR SWITCH QL
3. INTERPHONE (SYSTEM) POWER SWITCH
4. WATER INJECTION PANEL
5. AUTOPILOT SERVOS CUTOUT SWITCH PANEL
6. PARKING BRAKE PRESSURE GAGE
7. INTERPHONE POWER SWITCH PANEL
8. PILOT'S INTERPHONE PANEL
9. LIASON RADIO CONTROL PANEL
9A. SWESS WARNING PANEL
9B. TACAN RADIO CONTROL PANEL
10. ATTITUDE AND DIRECTIONAL GYRO POWER SWITCH LH
11. NAVIGATION LIGHTS CONTROL PANEL
12. AN/APS-54 RADAR WARNING RECEIVER INDICATOR
13. OXYGEN CONVERTER QUANTITY GAGES
13A. ANTI-ICING CONTROL PANEL LH
14. WING FLAP EMERGENCY SWITCHES
15. PILOT'S OXYGEN REGULATOR
16. PILOT'S LIGHTING PANEL
17. DROP TANKS JETTISON SWITCH
18. HYDRAULIC CONTROL PANEL

Figure 1-9 (Sheet 1 of 2).



.....pilot's side panels (typical)

Figure 1-9 (Sheet 2 of 2).



1. AIR BLEED MANIFOLD INTERCONNECT SWITCHES
2. AIR BLEED MANIFOLD PRESSURE GAGES
3. REFUEL PANEL
4. ENGINE IGNITION AND STARTER CONTROLS
5. AGM-28 ENGINE CONTROL PANEL
6. COPILOT'S INTERPHONE PANEL
7. FUSELAGE OVERHEAT (FIRE) WARNING PANEL

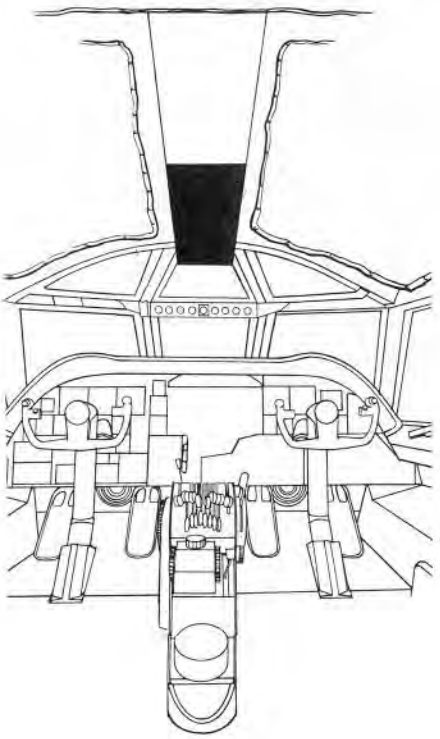
7A. ADM-20 FIRE WARNING PANEL
7B. EMERGENCY BATTERY SWITCH
7C. CARTRIDGE START PANEL

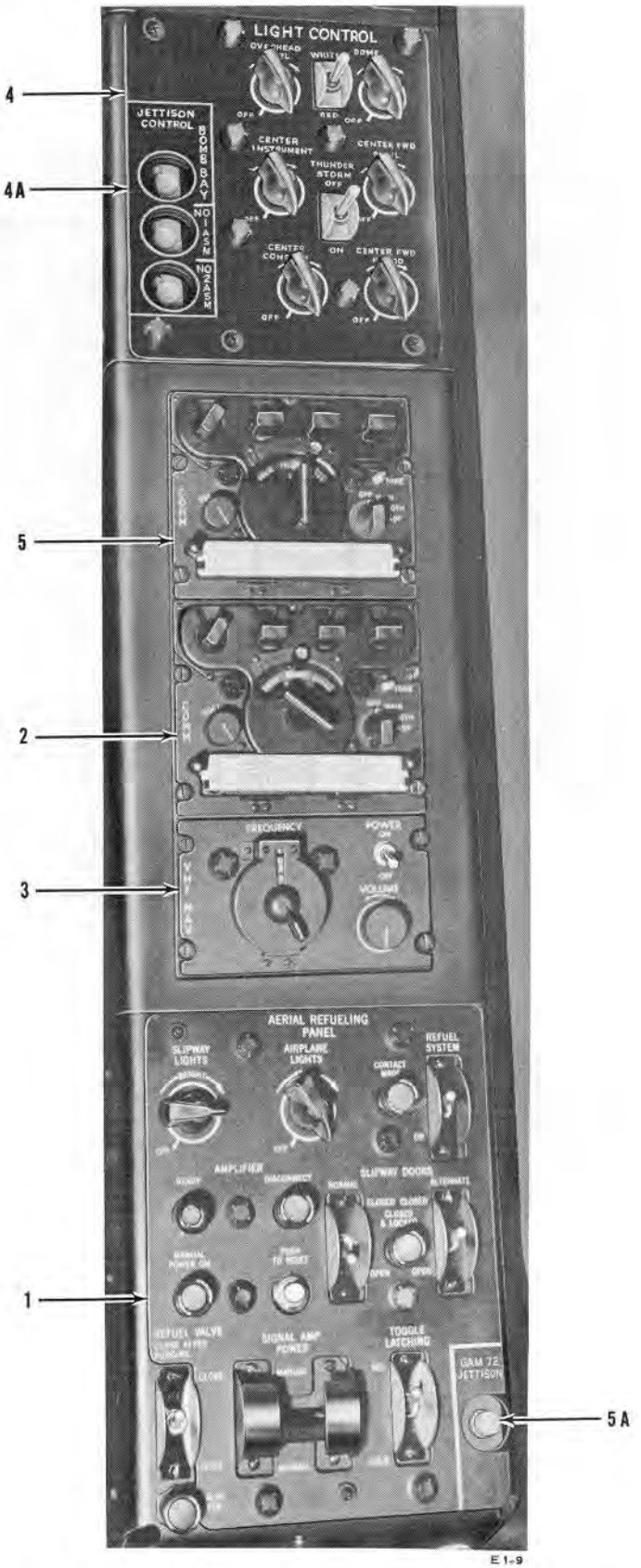
8. REFUEL GROUND CHECKOUT SWITCHES
9. AUTOPILOT RUDDER LIMIT BYPASS SWITCH
10. DELETED
11. D-C CONTROL PANEL
12. FORWARD AIR CONDITIONING PANEL
13. A-C CONTROL PANEL
14. COPILOT'S OXYGEN REGULATOR
15. AGM-28 EMERGENCY CONTROL PANEL
16. INTERPHONE POWER SWITCH PANEL

Figure 1-10 (Sheet 1 of 2).

..... copilot's side panels (typical)

Figure 1-10 (Sheet 2 of 2).





1. AIR REFUELING (IFR) PANEL
2. UHF COMMAND RADIO CONTROL PANEL
3. OMNI RANGE RADIO CONTROL PANEL
4. OVERHEAD LIGHTING PANEL

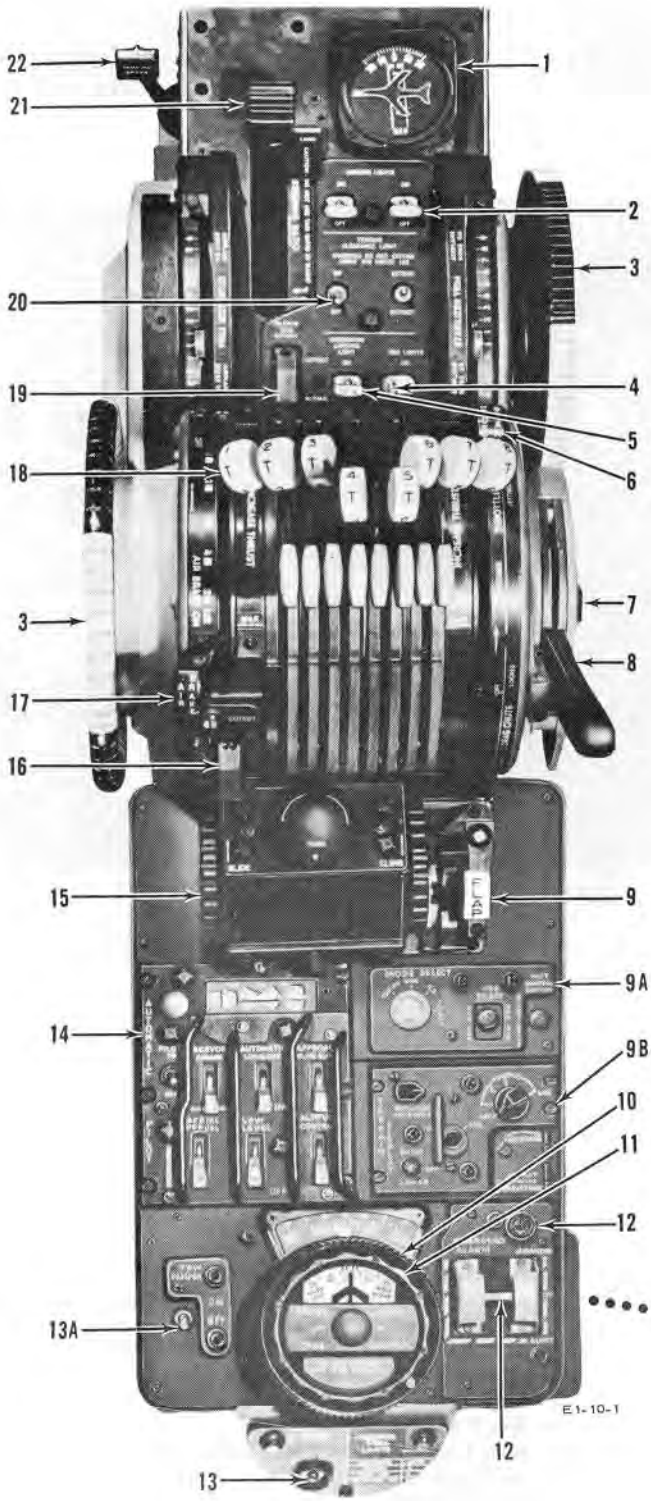
4A. JETTISON CONTROL PANEL

5. STANDBY UHF COMMAND RADIO CONTROL PANEL

5A. ADM-20 (LAUNCH GEAR) JETTISON SWITCH

overhead panel (typical)

Figure 1-11.



1. CROSSWIND CRAB POSITION INDICATOR
2. LANDING LIGHT SWITCHES
3. STABILIZER TRIM WHEELS AND INDICATORS
4. TAXI LIGHTS SWITCH
5. CROSSWIND LANDING LIGHT SWITCH
6. THROTTLE BRAKE LEVER
7. WARNING HORN SHUTOFF BUTTON
8. DRAG CHUTE LEVER
9. WING FLAP LEVER

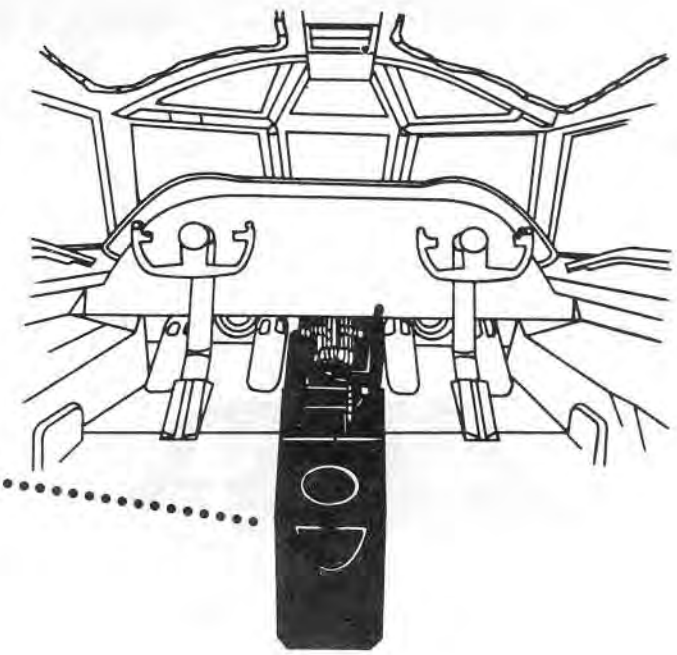
9A. NAV SYSTEM SELECT PANEL **LH**

9B. TERRAIN DISPLAY CONTROL PANEL **LH**

10. RUDDER TRIM KNOB AND INDICATOR
11. CROSSWIND CRAB CONTROL KNOB
12. EMERGENCY ALARM SWITCH AND MONITOR LIGHT
13. CROSSWIND CRAB CONTROL CENTERING BUTTON

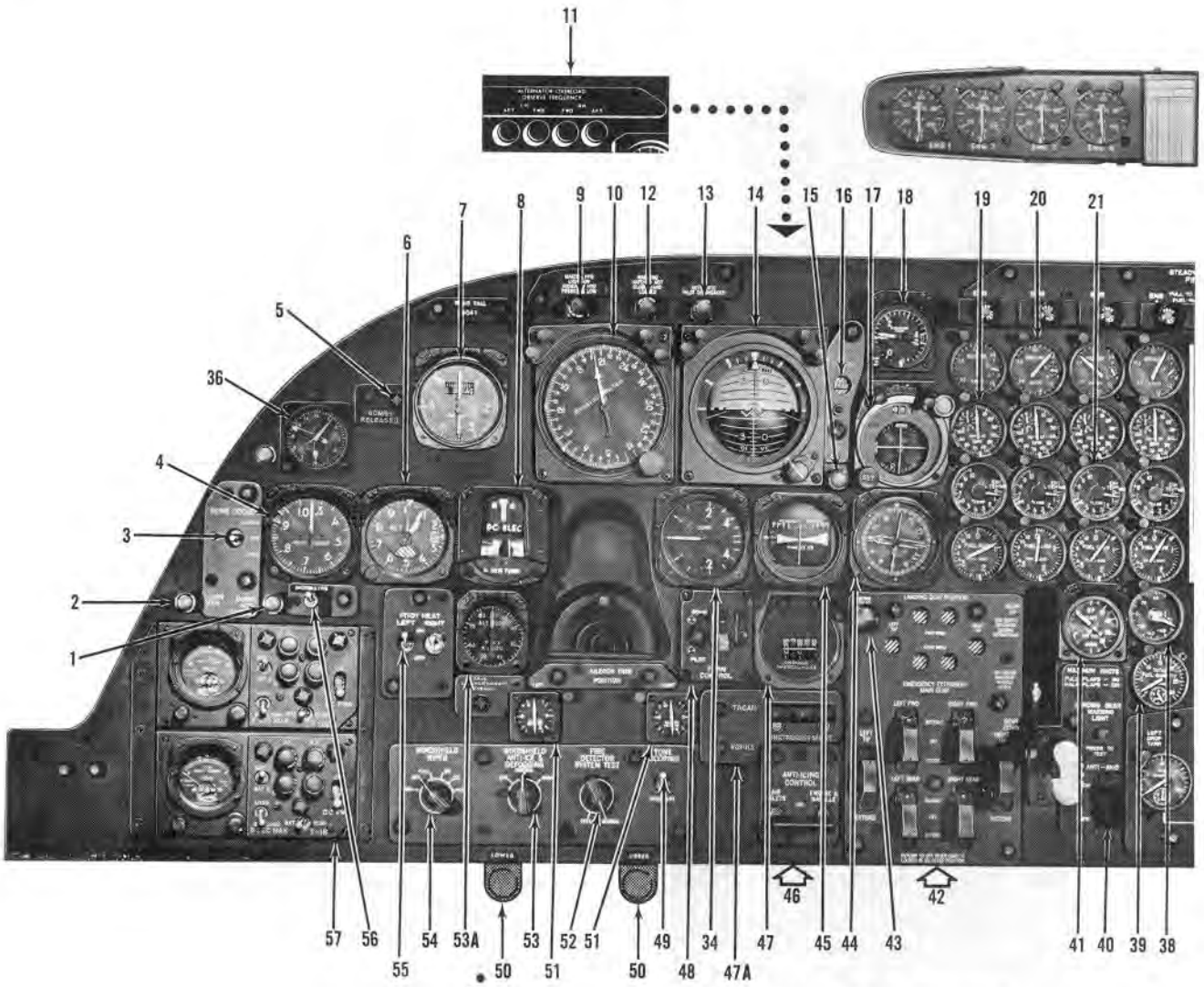
13A. YAW DAMPER SWITCH **SY**

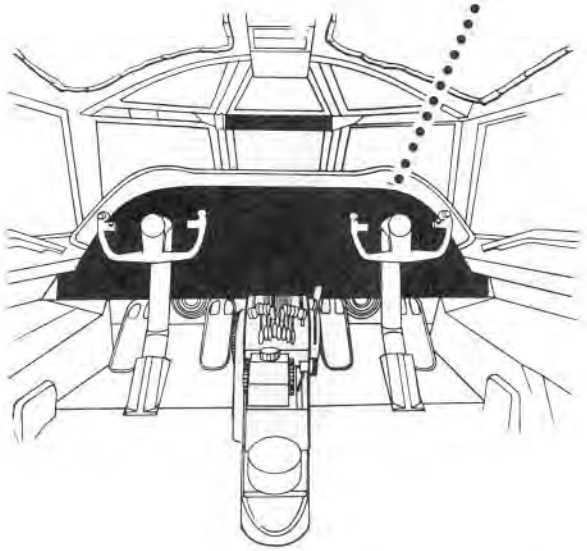
14. AUTOPILOT SWITCH PANEL
15. AUTOPILOT TURN AND PITCH CONTROLLER
16. STABILIZER TRIM CUTOUT SWITCH
17. AIRBRAKE LEVER
18. THROTTLES
19. AILERON TRIM CUTOUT SWITCH
20. TERRAIN CLEARANCE LIGHT SWITCHES
21. STEERING RATIO SELECTOR LEVER
22. PARKING BRAKE LEVER



•••••••••••••••••••••••••••••••••••• aisle stand (typical)

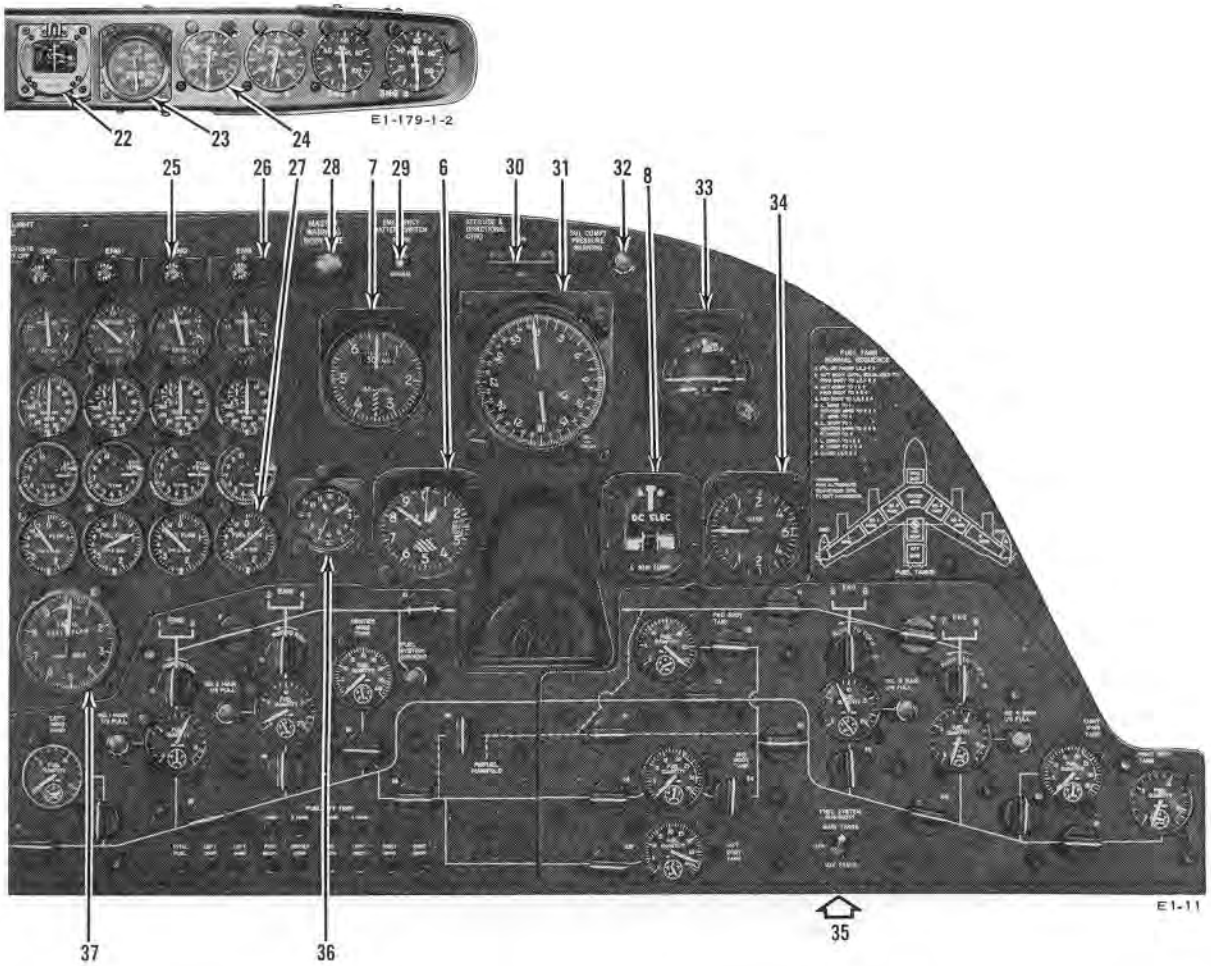
Figure 1-12.





1. BOMB DOORS NOT LATCHED LIGHT
2. BOMB DOORS OPEN LIGHT
3. BOMB DOOR SWITCH
4. MACH INDICATOR
5. BOMBS RELEASED LIGHT
6. ALTIMETER
7. AIRSPEED INDICATOR
8. TURN AND SLIP INDICATOR
9. HYDRAULIC PACK PRESSURE LOW MASTER LIGHT
10. DIRECTIONAL INDICATOR (N-1 REPEATER)
11. ALTERNATOR OVERLOAD LIGHTS B-52E
12. HATCHES NOT CLOSED AND LOCKED LIGHT
13. AUTOMATIC PILOT DISENGAGE LIGHT
14. PILOT'S ATTITUDE INDICATOR
15. TIME TO GO LIGHT
16. BNS STEERING INDICATOR
17. OMNI RANGE RADIO COURSE INDICATOR
18. ACCELEROMETER
19. TACHOMETERS
20. ENGINE PRESSURE RATIO GAGES
21. EXHAUST GAS TEMPERATURE GAGES
22. MAGNETIC STANDBY COMPASS
23. CABIN PRESSURE ALTIMETER 255 ▶ W144 ▶

Figure 1-13. (Sheet 1 of 2)



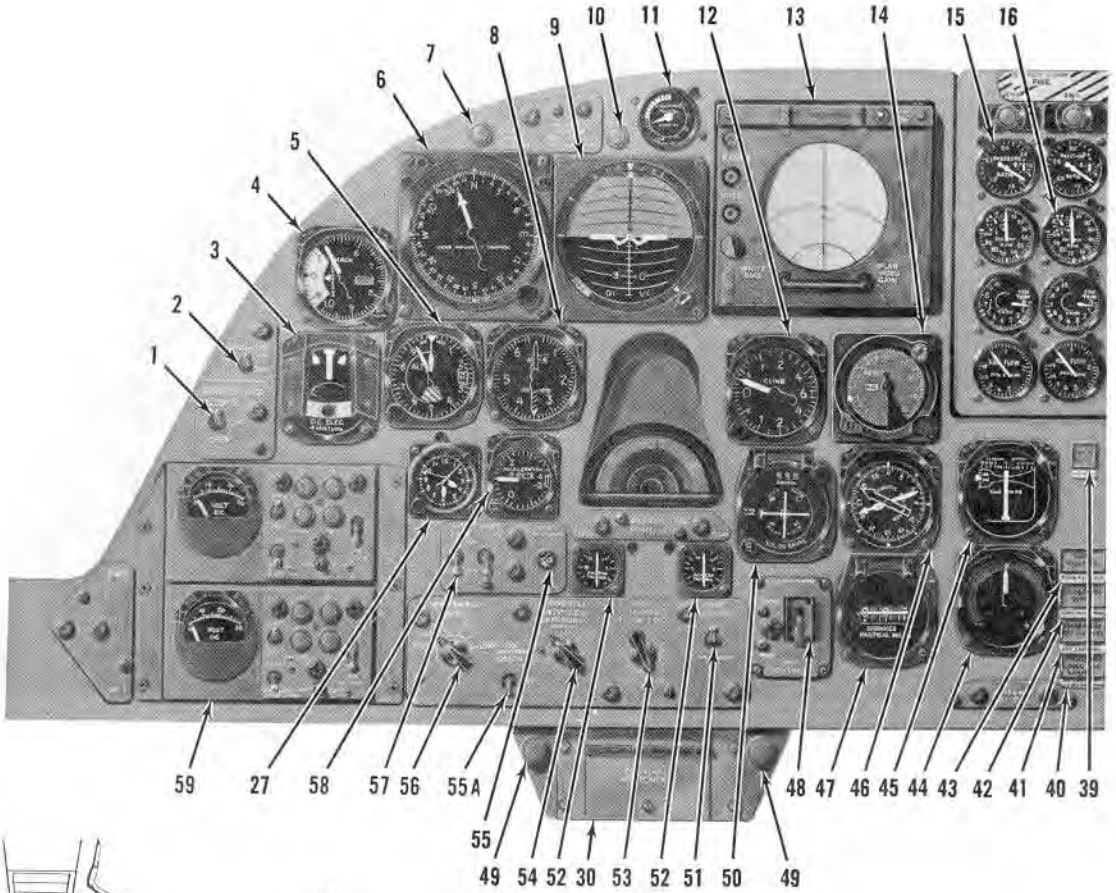
24. OIL PRESSURE GAGES
25. ENGINE FIRE WARNING LIGHTS
26. FIREWALL FUEL SHUTOFF SWITCHES
27. FUEL FLOWMETERS
28. MASTER FUSELAGE OVERHEAT (FIRE) WARNING LIGHT
29. EMERGENCY BATTERY SWITCH
30. ATTITUDE AND DIRECTIONAL GYRO POWER SWITCH
31. DIRECTIONAL INDICATOR (GYRO)
32. GUNNER'S CABIN PRESSURE WARNING LIGHT
33. COPILOT'S ATTITUDE INDICATOR
34. VERTICAL VELOCITY INDICATOR
35. FUEL SYSTEM CONTROLS
36. CLOCK
37. TOTAL FUEL FLOW INDICATOR
38. OUTSIDE AIR TEMPERATURE GAGE
39. TOTAL FUEL QUANTITY GAGE
40. ANTISKID SWITCH
41. WING FLAP POSITION INDICATOR
42. LANDING GEAR CONTROLS
43. BOMB SALVO LIGHT
44. RADIO MAGNETIC INDICATOR
45. FLIGHT COMMAND INDICATOR
46. ANTI-ICING CONTROL PANEL
47. DISTANCE INDICATOR
47A. NAVIGATION SYSTEM SELECT SWITCH PANEL
48. AUTOPILOT TURN CONTROL SELECTOR SWITCH
49. TONE SCORING INTERRUPT SWITCH
50. AIR OUTLET KNOBS
51. AILERON TRIM INDICATORS
52. ENGINE FIRE DETECTOR SYSTEM TEST SWITCH
53. WINDSHIELD ANTI-ICE AND DEFOGGING SWITCH
53A. TAIL COMPARTMENT PRESSURE INDICATOR
54. WINDSHIELD WIPER SWITCH
55. PITOT HEAT SWITCHES
56. MACH INDICATOR SWITCH
57. T-18 CONTROL PANELS

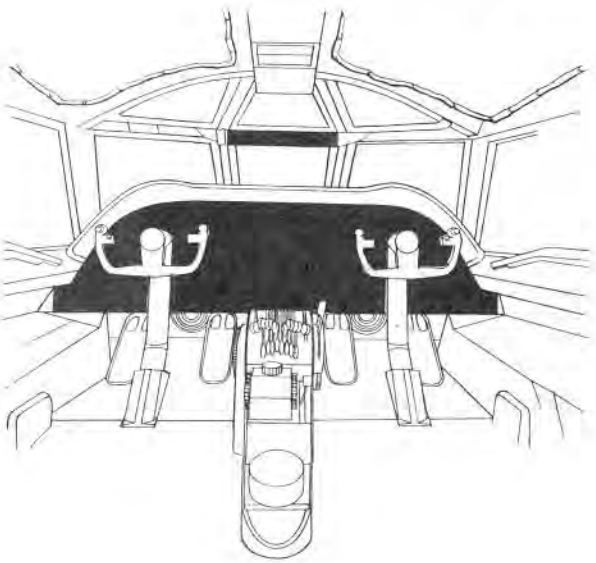
NOTE

Groups of controls indicated by ⇩ are identified on their applicable system control illustration

.....pilots' instrument panel (typical) Less LH

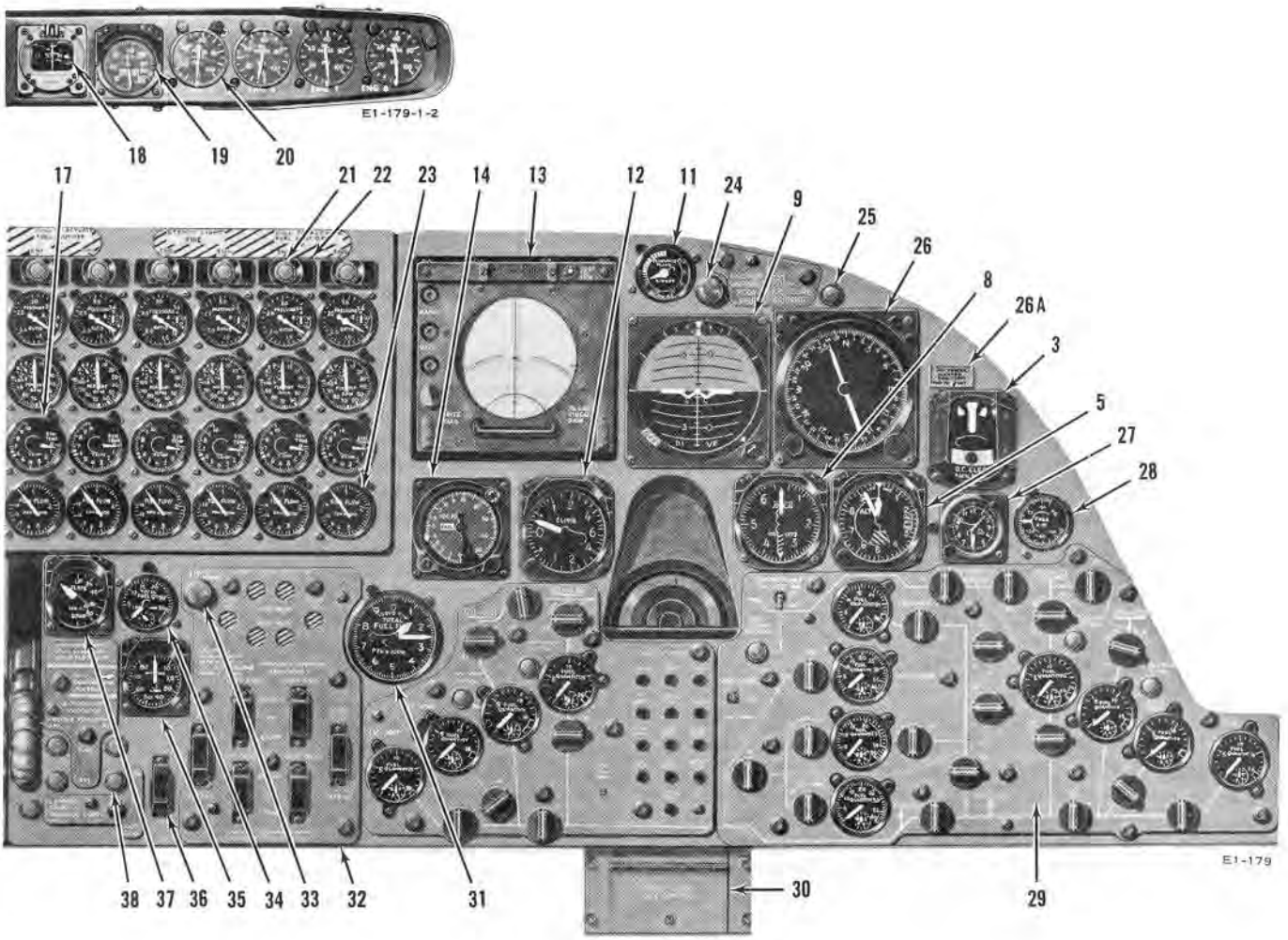
Figure 1-13 (Sheet 2 of 2).





1. BOMB DOOR SWITCH
2. MACH INDICATOR SWITCH
3. TURN AND SLIP INDICATOR
4. MACH INDICATOR
5. ALTIMETER
6. DIRECTIONAL INDICATOR (N-1 REPEATER)
7. AUTOMATIC PILOT DISENGAGE LIGHT
8. AIRSPEED INDICATOR
9. PILOT'S ATTITUDE INDICATOR
10. HYDRAULIC PACK PRESSURE LOW MASTER LIGHT
11. CLEARANCE PLANE INDICATOR
12. VERTICAL VELOCITY INDICATOR
13. TERRAIN DISPLAY INDICATOR
14. RADAR ALTIMETER SQ
15. ENGINE PRESSURE RATIO GAGES
16. TACHOMETERS
17. EXHAUST GAS TEMPERATURE GAGES
18. MAGNETIC STANDBY COMPASS
19. CABIN PRESSURE ALTIMETER 255 ▶ W144 ▶
20. OIL PRESSURE GAGES

Figure 1-13A (Sheet 1 of 2).



21. ENGINE FIRE WARNING LIGHTS
22. FIREWALL FUEL SHUTOFF SWITCHES
23. FUEL FLOWMETERS
24. MASTER FUSELAGE OVERHEAT (FIRE) WARNING LIGHT
25. GUNNER'S CABIN PRESSURE WARNING LIGHT
26. DIRECTIONAL INDICATOR (GYRO)
26A. A-C POWER MASTER CAUTION LIGHT ND
27. CLOCK
28. OUTSIDE AIR TEMPERATURE GAGE
29. FUEL SYSTEM CONTROLS (FIGURE 1-16)
30. TERRAIN PREFLIGHT ADJUST CONTROL
31. TOTAL FUEL FLOW INDICATOR
32. LANDING GEAR CONTROLS (FIGURE 1-41)
33. STORES JETTISONED LIGHT
34. TOTAL FUEL QUANTITY GAGE
35. TAIL COMPARTMENT PRESSURE INDICATOR
36. ANTISKID SWITCH
37. WING FLAP POSITION INDICATOR
38. ALTERNATOR OVERLOAD LIGHTS (B-52E)
39. TIME-TO-GO LIGHT
40. HATCHES NOT CLOSED AND LOCKED LIGHT
41. BOMB DOORS NOT LATCHED LIGHT
42. BOMB DOORS OPEN LIGHT
43. BOMB RELEASED LIGHT
44. LATERAL ERROR METER
45. FLIGHT COMMAND INDICATOR
46. RADIO MAGNETIC INDICATOR
47. DISTANCE INDICATOR
48. AUTOPILOT TURN CONTROL SELECTOR SWITCH
49. AIR OUTLET KNOB
50. OMNI-RANGE RADIO COURSE INDICATOR
51. TONE SCORING INTERRUPT SWITCH
52. AILERON TRIM INDICATOR
53. ENGINE FIRE DETECTOR SYSTEM TEST SWITCH
54. WINDSHIELD ANTI-ICE AND DEFOGGING SWITCH
55. BNS STEERING INDICATOR
55A. AUXILIARY WINDOW DEFOGGING SWITCH ND
56. WINDSHIELD WIPER SWITCH
57. PITOT HEAT SWITCHES
58. ACCELEROMETER
59. T-18 CONTROL PANELS

.....pilots' instrument panel LH

Figure 1-13A (Sheet 2 of 2).

ENGINE INSTRUMENTS

Engine instruments not described as part of an engine system are described below.

Tachometers

Speed of the high pressure compressor rotors in percent rpm is indicated by eight tachometers (19, figure 1-13 and 16, figure 1-13A) on the pilots' instrument panel. Engine-driven tachometer generators supply power to operate the indicators which are independent of the airplane electrical system. Each instrument has two pointers; the larger pointer indication is read on a dial calibrated from 0% to 100% rpm and the small pointer indication is read on a dial calibrated from 0% to 10% rpm.

Exhaust Gas Temperature Gages

Exhaust gas temperature of each engine is indicated by eight gages (21, figure 1-13 and 17, figure 1-13A) on the pilots' instrument panel. These gages are calibrated in degrees Centigrade and indicate the temperature of the exhaust gases of each engine. Engine thermocouples supply power to operate the gages which are independent of the airplane electrical power system.

Engine Pressure Ratio (EPR) Gages

An engine pressure ratio gage (20, figure 1-13 and 15, figure 1-13A) for each engine is located on the pilots' instrument panel. These gages indicate the ratio of engine inlet to exhaust pressures which is used as a measure of engine thrust. The engine inlet and exhaust indications are compared by a computer-transmitter which electrically transmits an indication to the engine pressure ratio gage. The computer-transmitter operates on 118-volt single-phase a-c power obtained from the aircraft electrical system. Pressure ratio gage circuit breakers are marked "Nacelle" - "1," "2," "3," and "4" on the "Eng Pressure Ratio Ind" portion of the pilot's auxiliary circuit breaker panel.

Oil Pressure Gages

Engine oil pressure is indicated by eight oil pressure gages (24, figure 1-13 and 20, figure 1-13A) above the pilots' instrument panel. These gages operate on 28-volt a-c power supplied through pressure transmitters in each engine oil system. A single circuit breaker marked "Oil Press Ind" for the eight oil pressure gages is on the pilot's auxiliary circuit breaker panel.

NOTE

If the oil pressure circuit breaker has popped, oil pressure indications are unreliable.

OIL SUPPLY SYSTEMS

Each engine is provided with an integral oil system supplied by an individual engine oil tank. The tanks supply oil to gear-type engine-driven oil pumps which provide pressure for lubrication of the engine bearings and accessory drives in various engine compartments. Scavenge pumps remove oil from the engine compartments, route it through an oil cooler, and return it to the tank for reuse. When the oil supply is exhausted, approximately 1 to 1 1/2 gallons of oil remain trapped in the lines and oil cooler. No manual controls are provided for the engine oil system. For oil servicing information, see figure 1-60.

B-52E

Total oil tank capacity is 16 gallons with 13.75-gallon capacity being usable. Oil temperature is maintained by oil cooler flaps which regulate the airflow through the oil cooler. There are two sets of oil cooler flaps, one for ground use and the other for flight use. The ground flaps are inside the engine inlet and facilitate cooling airflow by engine inlet airflow. The flight flaps are on the outside of the nacelle and facilitate cooling airflow by air flowing past the nacelle. Transfer of cooling flap control from air to ground flaps is accomplished by actuation of the landing gear safety switch. The oil cooler flaps are operated by 118-volt single-phase a-c power and are automatically controlled by a thermostat.

B-52F

Total oil tank capacity is 8.75 gallons with 6.8-gallon capacity being usable. Air for cooling is provided by ram air while in flight and by induced airflow while on the ground. Actuation of the landing gear safety switch on the ground causes compressor bleed air to flow through an air ejector in the aft portion of the oil cooler ducting, thus inducing a flow of air through the cooler. Oil temperature is controlled by a thermostatic control valve which is an integral part of the oil cooler.

FUEL SUPPLY SYSTEM

The airplane fuel supply system (figure 1-15) consists of a fuel feed system and a fuel transfer system. A refuel system, which is normally independent of the other two systems but may be connected to them through valves, is fully described under "Air Refueling System" and "Single Point Ground Refueling System," Section IV. Boost pumps in four main fuel tanks normally supply engine fuel. Each main tank normally supplies fuel to the engines in one nacelle. Auxiliary tanks, used to replenish the main tanks, include two outboard wing tanks, a center wing tank, three body tanks, and two external drop tanks. Routing of fuel from the auxiliary tanks to the main tanks is accomplished with the fuel

transfer system. Provisions are made to supply fuel to the AGM-28 missiles from the fuel transfer manifold through wing valves (fuel) and self-sealing quick-disconnect couplings. An AGM-28 wing valve (fuel) switch and an AGM-28 emergency shutoff switch on the copilot's side panel control the flow of fuel to each AGM-28 missile. For additional information regarding tie-in of the aircraft fuel supply system with the AGM-28 fuel system, refer to T.O. 1B-52C-30-1. A crossfeed manifold is provided which makes it possible to interconnect the fuel feed systems of each nacelle. Fuel system valves are numbered to simplify their identification. The valve numbers appearing on the fuel section of the pilots' instrument panel correspond to the valve identification numbers appearing in this manual. Circuit breakers for electrical power used to operate the fuel valves are also numbered and are on the copilot's circuit breaker panel. For correct fuel specification grade, see figures 1-60 and 5-1A.

FUEL TANK VENTING

Body fuel tanks and cavities are vented through a common manifold which opens to the atmosphere through

TANK CAPACITIES

TANKS	NO.	USABLE FUEL (EACH)		FULLY SERVICED (EACH)	
		POUNDS	GALLONS	POUNDS	GALLONS
NO. 1 AND 4 MAIN	2	15,275	2350	15,366	2364
NO. 2 AND 3 MAIN	2	17,947	2761	18,044	2776
MID BODY	1	33,111	5094	33,170	5103
FORWARD BODY FWD CELL	1	15,503	2385	15,568	2395
FORWARD BODY AFT CELL	1	12,916	1987	12,955	1993
AFT BODY	1	38,428	5912	38,532	5928
OUTBOARD WING	2	14,540	2237	14,580	2243
CENTER WING	1	35,613	5479	35,770	5503
DROP	2	19,500	3000	19,539	3006

USABLE FUEL TOTALS

TANKS	POUNDS	GALLONS
NO. 1, 2, 3 AND 4 MAIN	66,443	10,222
MAIN AND MID BODY	99,554	15,316
MAIN, MID BODY, FORWARD BODY AND AFT BODY	166,401	25,600
MAIN, ALL BODY, OUTBOARD AND CENTER WING	231,094	35,553
ALL TANKS INCLUDING DROP	270,094	41,553

NOTES

Fully serviced quantities include both trapped and drainable fuel.

The tanks will have the quantities shown when 6.5 lb/gal fuel is used.

NOTE: See data supplied in Section V, OPERATING LIMITATIONS, to determine fuel loading

fuel quantity data

Figure 1-14.

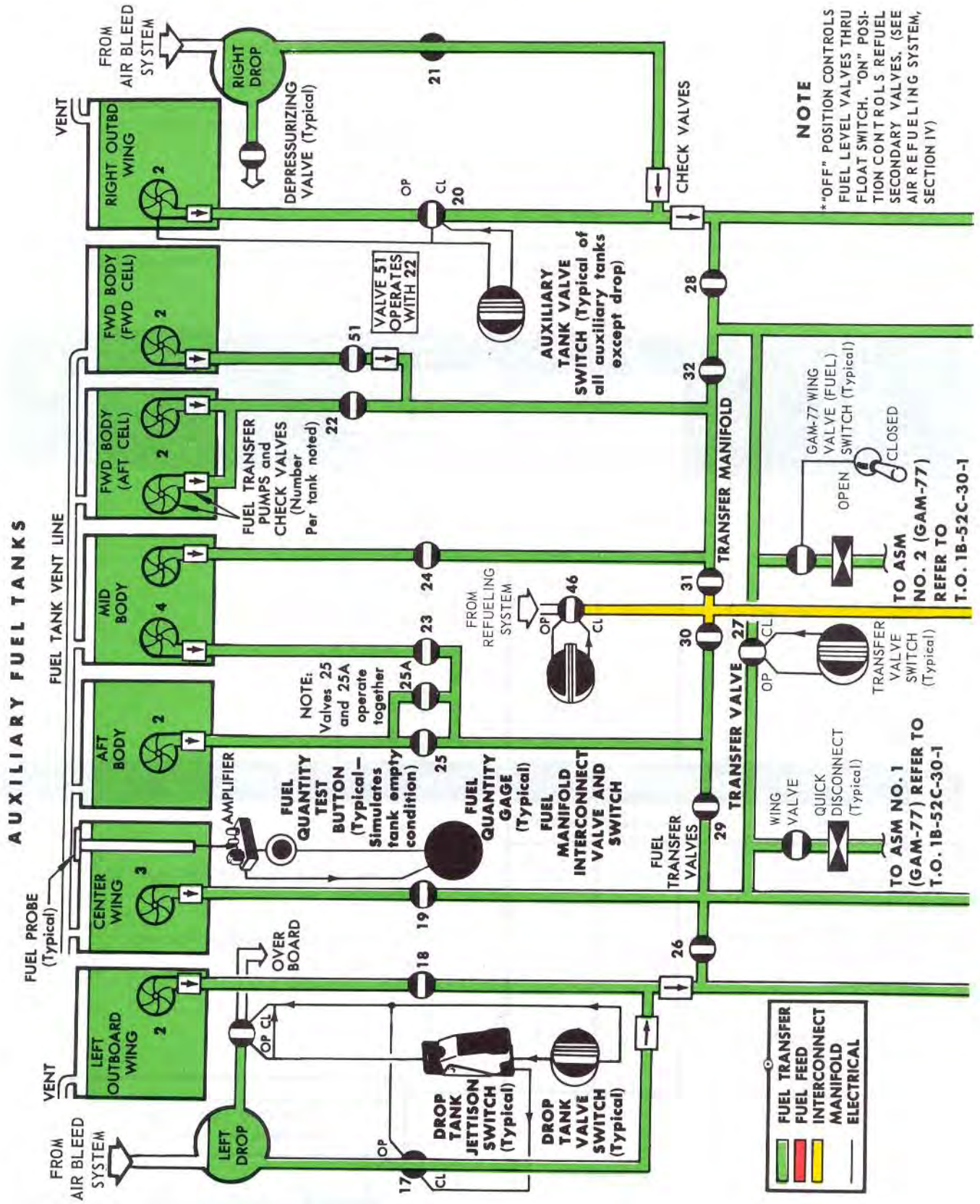
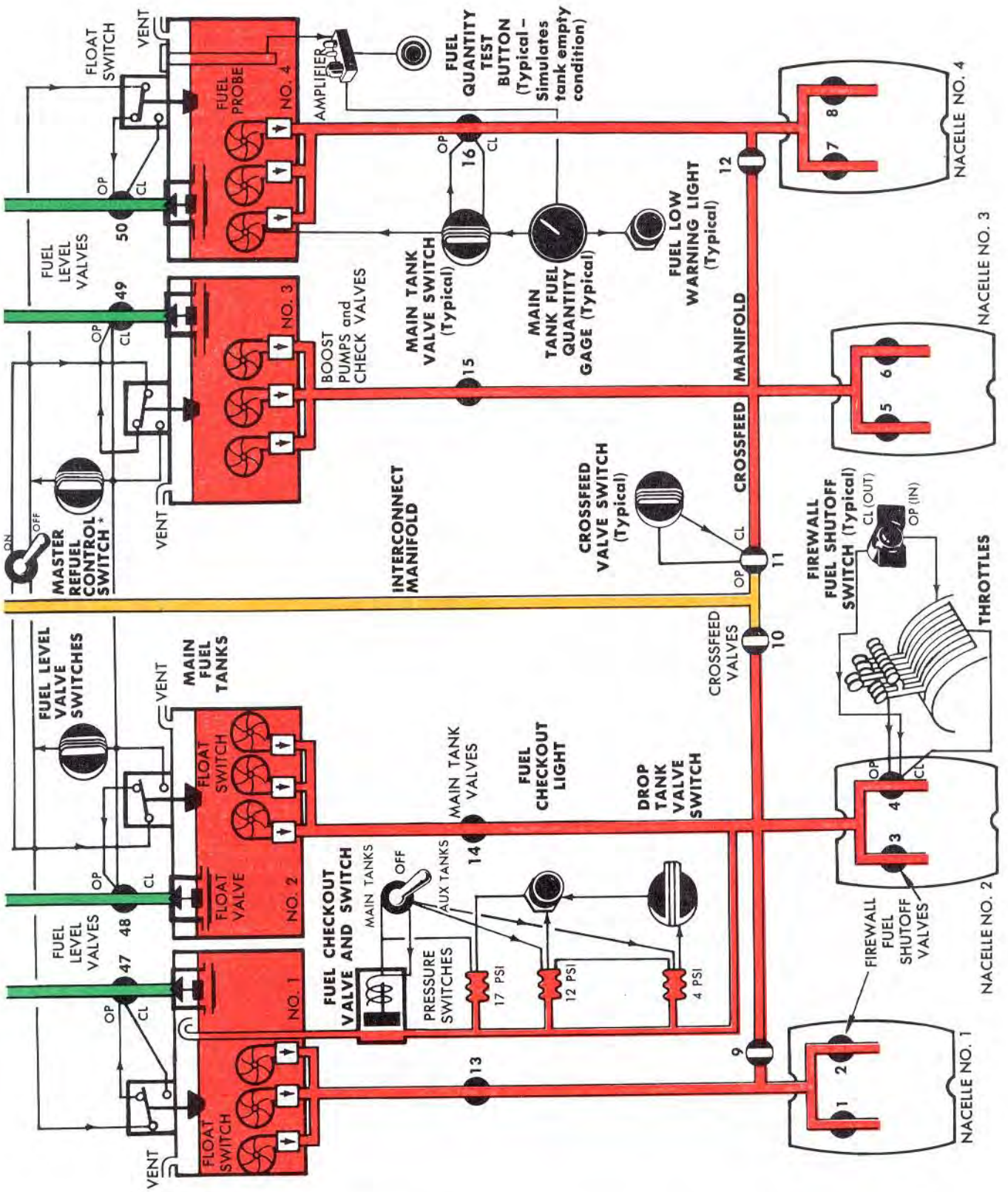


Figure 1-15. (Sheet 1 of 2)



.....fuel supply system (typical)

Figure 1-15. (Sheet 2 of 2)

a port located aft of the rear wheel well on the underside of the fuselage. A sump in the body tank vent system routes fuel discharged through the vents to the aft body tank. Wing tanks and cavities are vented overboard through vent outlets located on the lower surface of the wings. The vent system is designed for JP-4 fuel only. See "Rate of Climb Limitations With Emergency Fuel (Aviation Gasoline)" under "Fuel Grade Properties and Limits," Section V, for operating restrictions when using aviation gasoline.

FUEL FEED SYSTEM

The fuel feed system normally supplies fuel to the engines from the main fuel tanks. Three boost pumps in each main tank supply pressure to the fuel control system of the engines. Each main tank has a tank valve which controls fuel flow from the boost pumps. A crossfeed manifold is provided which makes it possible to interconnect the four main tanks to engine fuel feed system lines. This manifold also makes it possible to connect the fuel feed system directly with the refuel or fuel transfer systems.

Fuel Checkout System

Fuel pressure gages and warning lights are not provided for each tank. To save weight, a fuel checkout system is provided in the fuel feed system. This system allows ground pressure checking of each boost and transfer pump and each valve in both the fuel feed and transfer systems. To use the fuel checkout system, fuel under pressure is routed to three pressure switches by the positioning of various valves. These switches are located in the fuel feed line of the No. 2 main tank. The pressure switches will close and supply power to illuminate a pressure checkout light, indicating proper system operation.

Fuel Feed System Controls

MAIN TANK VALVE SWITCHES. Main tank valve switches (4, figure 1-16) on the fuel section of the pilots' instrument panel electrically control the tank valves (No. 13, 14, 15, and 16) and corresponding boost pumps in the main tanks. When the switch is rotated to align the white stripe on the switch with the flow line on the fuel panel, the switch is ON. The switch is of the push-to-turn type to avoid inadvertent operation. In ON position, switched battery power is supplied through circuit breakers marked "13," "14," "15," and "16" on the "Fuel Feed Valve Control" portion of the copilot's circuit breaker panel to open a motor-driven main tank valve, and 205-volt three-phase a-c power is supplied to the boost pumps in the corresponding main tank. Turning switch ON also energizes a main tank fuel low warning light circuit. With the main tank valve switch OFF, power is supplied to close the main tank valve, deenergize the boost pumps, and open the fuel low warning light circuit.

CROSSFEED VALVE SWITCHES. Four crossfeed valve switches (3, figure 1-16) are located on the fuel section of the pilots' instrument panel. These rotary switches control the crossfeed valves (No. 9, 10, 11, and 12). When the white stripe on the switch is aligned with the flow line on the fuel panel, the switch is ON and switched battery power for valves No. 9 and 12 or TR power for valves No. 10 or 11 is supplied to open the corresponding crossfeed valve. In OFF position, power is supplied to close the crossfeed valve. Control power for the crossfeed valve switches is supplied through circuit breakers marked "Left Wing" - "9" and "10" and "Right Wing" - "11" and "12" on the "Fuel Transfer Valve Control" portion of the copilot's circuit breaker panel.

FIREWALL FUEL SHUTOFF SWITCHES. Eight firewall fuel shutoff switches are provided on the pilots' instrument panel. For a complete description of these switches, see "Emergency Equipment," this section.

ND

BOOST PUMP SHUTOFF SWITCH. A boost pump shutoff switch (2A, figure 1-16) on the fuel section of the pilots' instrument panel electrically controls one boost pump in each main tank. This switch is normally used during combat cruise conditions to reduce electrical system power requirements in the event of permanent failure of one or more alternators. When the switch is ON, all three fuel boost pumps in each main tank are supplied normal power. When the switch is OFF, fuel boost pumps 3, 6, 11, and 14 in main tanks 1, 2, 3, and 4 respectively are deenergized. With one boost pump off in each main tank, the two remaining pumps in each main will provide adequate pressure for all engine fuel flow requirements under normal conditions (one main tank to two engines).

Fuel Feed System Indicators

FUEL QUANTITY GAGES AND TEST BUTTONS. The quantity of fuel in each main tank is indicated in pounds by four fuel quantity gages (5, figure 1-16) on the fuel section of the pilots' instrument panel. A fuel probe in each tank senses quantity indications. A fuel quantity test button (12, figure 1-16) is provided for each gage. Depressing the individual fuel quantity gage test button will cause counterclockwise rotation of the individual fuel quantity gage pointer. This rotation will continue as long as the test button is depressed.

NOTE

Normally the gage pointer will travel from empty to full through two complete rotations; however, in some instances due to low amplifier gain or friction in components, the pointer may stop rotating at a below empty indication. When the lack of inertia does not allow the pointer to indicate the "full" position, the test button should be released.

The fuel probe indications are amplified by 118-volt single-phase a-c operated amplifiers which operate the gages. Due to the type of fuel quantity probes used, changes in fuel density have little if any effect upon quantity indications. A full (by weight) indication of the fuel quantity gage completes circuits which supply power through relays to close the corresponding refuel secondary valve if the master refuel control

switch is ON and a refuel secondary valve switch is ON. A one-fourth full or less reading of a main tank fuel quantity gage completes circuits which supply power to a fuel low warning light provided the main tank fuel valve switch is in ON position. The fuel quantity gages are supplied 118-volt a-c power through circuit breakers marked "1," "2," "3," "4," "Left Drop," "Left Outbd," "Fwd Body," "Ctr Wing," "Mid Body," "Aft Body," "Right Outbd," and "Right Drop" on the "Fuel Indicators" portion of copilot's circuit breaker panel.

TOTAL FUEL QUANTITY GAGE. A total fuel quantity gage (1, figure 1-16) located on the fuel section of the pilots' instrument panel shows the total of individual fuel system indicator readings. The gage receives its indication by electronic addition of indications of the individual fuel gages. The fuel totalizer system operates on 118-volt single-phase a-c power supplied through a circuit breaker marked "Total Qty" on the "Fuel Indicators" portion of copilot's circuit breaker panel.

NOTE

- If a malfunction causes an individual fuel quantity gage pointer to rotate continuously, the total fuel quantity gage pointer will oscillate over a range equal to the full scale quantity of the malfunctioning individual gage. The pointer of the individual gage may be stopped at zero by pulling the circuit breaker just before the pointer reaches zero. If the malfunctioning individual fuel quantity gage is stopped as much as 1/4 inch below zero it is possible to render the total fuel quantity gage inoperative. If the fuel quantity gage for any tank is stopped at any point, this quantity will be the amount reflected for that tank in the reading of the total fuel quantity gage. The total fuel quantity gage will be in error by the amount that the individual quantity gage is in error.

- If an individual fuel quantity gage pointer falls below the zero mark, the total fuel quantity gage may rotate continuously clockwise. Depressing the individual fuel quantity gage test button will cause counterclockwise rotation of the individual gage pointer. The individual gage pointer may be set at zero by pulling the circuit breaker just before the pointer reaches zero and rotation of the total fuel quantity gage pointer will stop.

- Operation of the aileron trim tab motors will cause a slight upscale movement of the fuel quantity gage indicator pointers. The magnitude of movement will be less than 1% of full scale indication. The pointer will return to original indication as soon as operation of trim tab motors is discontinued. Similar upscale movements occur when the bomb bay floodlights are turned on.

- This fuel totalizing system is not the type which subtracts total fuel flow from a preset takeoff fuel quantity. The flow subtraction type system is not corrected for fuel density and thus accumulates errors which make it inaccurate at low fuel quantities.

FUEL SYSTEM CHECKOUT LIGHT AND SWITCH. A green fuel system checkout light (2, figure 1-16) and a fuel system checkout switch (9, figure 1-16) on the fuel section of the pilots' instrument panel are used for ground checking of fuel pressure. The switch has three positions, MAIN TANKS--OFF--AUX TANKS. MAIN TANKS position supplies 24-volt d-c TR power to a 17 psi pressure switch and a fuel system checkout valve. When fuel pressure reaches this setting, a fuel system checkout light on the fuel panel is illuminated by power from the pressure switch and will remain illuminated approximately 5 to 30 seconds following use of the pressure switches. In AUX TANKS position, 24-volt d-c TR power is supplied to a 12 psi pressure switch. When closed, this pressure switch supplies power to illuminate the same fuel system checkout light for all auxiliary tanks except the drop tanks. In AUX TANKS position with an auxiliary tank valve switch for a drop tank ON, power is directed to a similar 4 psi pressure switch. The fuel system checkout valve located between tank No. 1 and the fuel checkout pressure switches allows fuel pressure to bleed continuously at a restricted rate into tank No. 1 during use of the checkout system. This solenoid-operated spring-loaded closed valve is actuated when the fuel system checkout switch is in either MAIN TANKS or AUX TANKS position. TR power is supplied to the fuel system checkout light and switch through a circuit breaker marked "Fuel System" on the "Ground Checkout" portion of the pilot's auxiliary circuit breaker panel.

NOTE

The engine air bleed system must be pressurized to complete checkout of drop tanks.

FUEL LOW WARNING LIGHT. A red fuel low warning light (6, figure 1-16) is provided next to each main tank fuel quantity gage. This light is illuminated when a main tank fuel quantity drops to one-fourth full or less provided the corresponding main tank valve switch is in ON position. A microswitch in the fuel quantity gage is actuated when the fuel indication drops to one-fourth full or less. TR power for the light is provided through a circuit breaker marked "Warn Light Main Tanks" on the "Fuel Level Control" portion of the copilot's circuit breaker panel.

FUEL TRANSFER SYSTEM

The fuel transfer system allows replenishing of the main tanks from the auxiliary tanks during flight. Each auxiliary tank is connected to the fuel transfer manifold which in turn supplies the main tanks. Fuel transfer pumps are provided in all auxiliary tanks except the drop tanks. The drop tanks are pressurized by air from the air bleed system to provide transfer fuel pressure. Tank valves at each auxiliary tank control fuel flow to the transfer manifold. Transfer valves control routing of fuel from the auxiliary to the main tanks. Fuel level valves control fuel flow from the transfer manifold to the main fuel tanks.

Drop Tanks

Constant engine bleed air is supplied to the drop tank pressurization system to pressurize the drop tank for fuel transfer. A depressurizing valve is incorporated in the system to vent the drop tank and is energized by the respective drop tank transfer valve switch. When the transfer valve switch is in the closed position, the depressurizing valve is in the open position, venting the tank. When the transfer valve switch is in the open position, the depressurizing valve is closed allowing bleed air to pressurize the drop tank for fuel transfer through the transfer manifold. An electrically operated drop tank jettison system is provided. When operated, this system initiates a series of actions which close the tank valves and jettison the tanks.

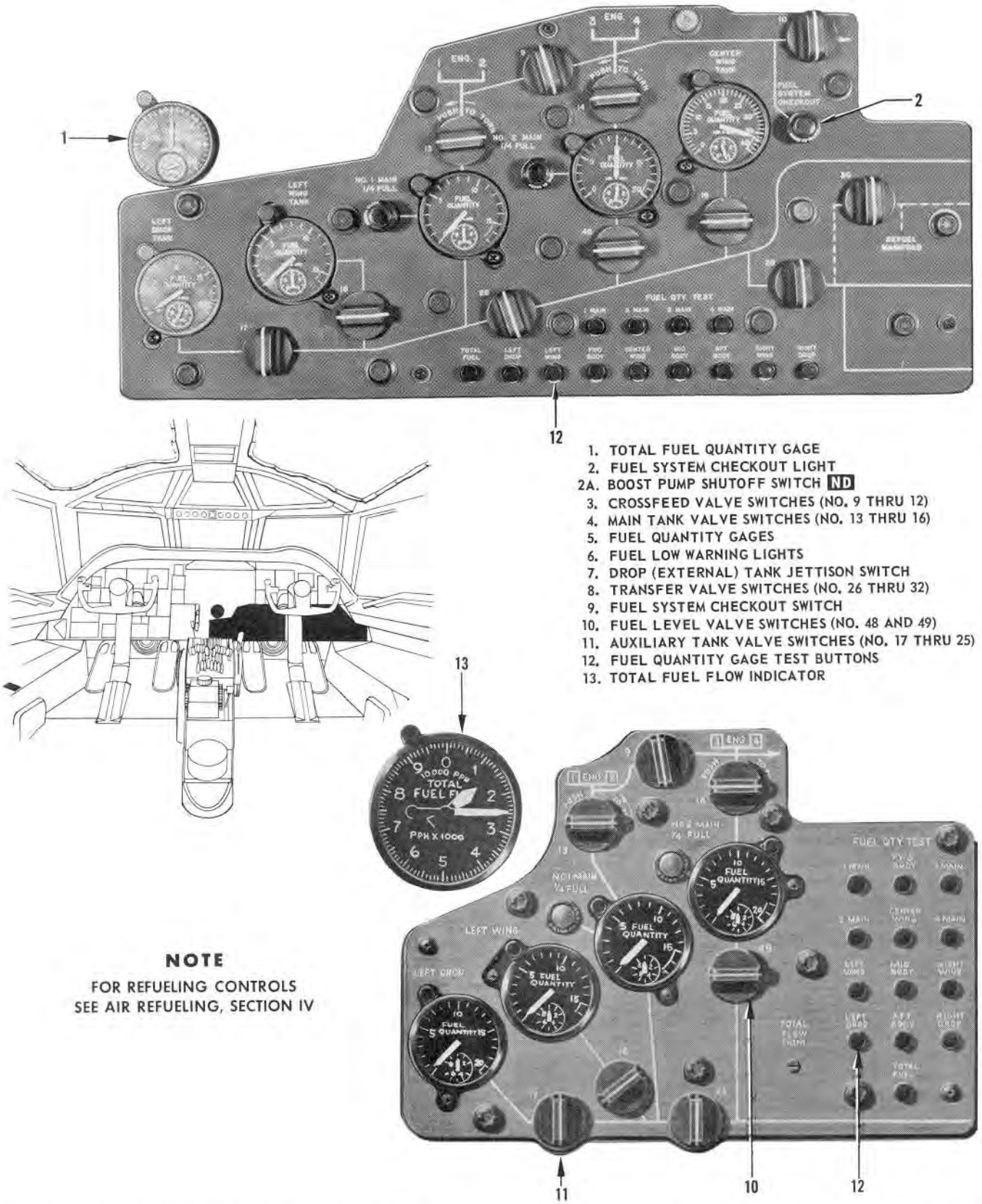
Fuel Transfer System Controls

AUXILIARY TANK VALVE SWITCHES. Auxiliary tank valve switches (11, figure 1-16) are provided for each auxiliary tank. These switches are located on the fuel section of the pilots' instrument panel and are used to control the auxiliary tank valves and to provide fuel pressure for transfer operations. These switches are similar to other fuel switches and are ON when the white line on each switch is aligned with the flow lines on the fuel panel. For all auxiliary tanks, moving the switch to ON position provides TR power to open the motor-driven auxiliary tank valve and to energize the corresponding transfer pump relays which supply 205-volt three-phase a-c power to the transfer pumps. Rotating the switch to OFF position provides power to close the tank valve and to deenergize the transfer pumps. The drop tanks do not have transfer pumps but instead are pressurized by air from the air bleed system to provide fuel pressure for transfer operations. For the drop tanks, placing the auxiliary tank valve switch (No. 17 or 21) in ON position supplies TR power through the drop (external) tank jettison switch to open the tank valve, close the depressurizing valve, and open the pressurizing valve. This provides fuel under pressure to the fuel transfer manifold. Moving the switch for the drop tanks to OFF position provides power to close the tank and pressurizing valves and to open the depressurizing valves. The auxiliary tank valve switches are supplied TR power through circuit breakers marked "Left Drop 17," "Left Outbd 18," "Ctr Wing 19," "Right Outbd 20," "Right Drop 21," "Fwd Body 22," "Mid Body 23," "Mid Body 24," and "Aft Body 25" on the "Fuel Feed Valve Control" portion of the copilot's circuit breaker panel.

TRANSFER VALVE SWITCHES. Rotary-type transfer valve switches (8, figure 1-16) on the fuel section of the pilots' instrument panel provide individual control of the fuel transfer valves (No. 26 through 32). Aligning the white stripe on the switch with the fuel panel flow line turns the switch ON. This completes a circuit supplying TR power to open corresponding transfer valve. In OFF position, power is supplied to close the valve. The transfer valve switches are supplied TR power through circuit breakers marked "Left Wing 26," "Body 27," "Right Wing 28," "Body" - "29," "30," "31," and "32" on the "Fuel Transfer Valve Control" portion of the copilot's circuit breaker panel.

MASTER REFUEL CONTROL SWITCH. An ON--OFF master refuel control switch (3, figure 4-61) on the refuel panel provides control of the valves used in replenishing the main tanks and in refueling both main and auxiliary tanks. In ON position, refueling of the main as well as auxiliary tanks is accomplished by the refuel secondary valves (No. 33 through 45) through the refuel system (figure 4-58). OFF position allows normal replenishing of the main tanks from the auxiliary tanks through the fuel level valves (No. 47, 48, 49, and 50). In OFF position, switched battery power is supplied through float switches to the main tank fuel level valves. ON position supplies switched battery power for control of all refuel secondary valves through the float switches and fuel gage full by weight switches. The switch is supplied switched battery power through circuit breakers marked "Master" - "Left" and "Right" on the "Fuel Level Control" portion of the copilot's circuit breaker panel. For further information on master refuel control switch, see "Air Refueling System," Section IV.

FUEL LEVEL VALVE SWITCHES. Two fuel level valve switches (10, figure 1-16) are located on the fuel section of the pilots' instrument panel. These rotary switches provide manual control of the fuel level valves (No. 48 and 49) for No. 2 and 3 main tanks. The fuel level valves are normally controlled by float switches in each main tank provided the master refuel control switch is in OFF position. When the white stripe on the switch is aligned with the flow lines on the fuel panel, the switch is ON and switched battery power is

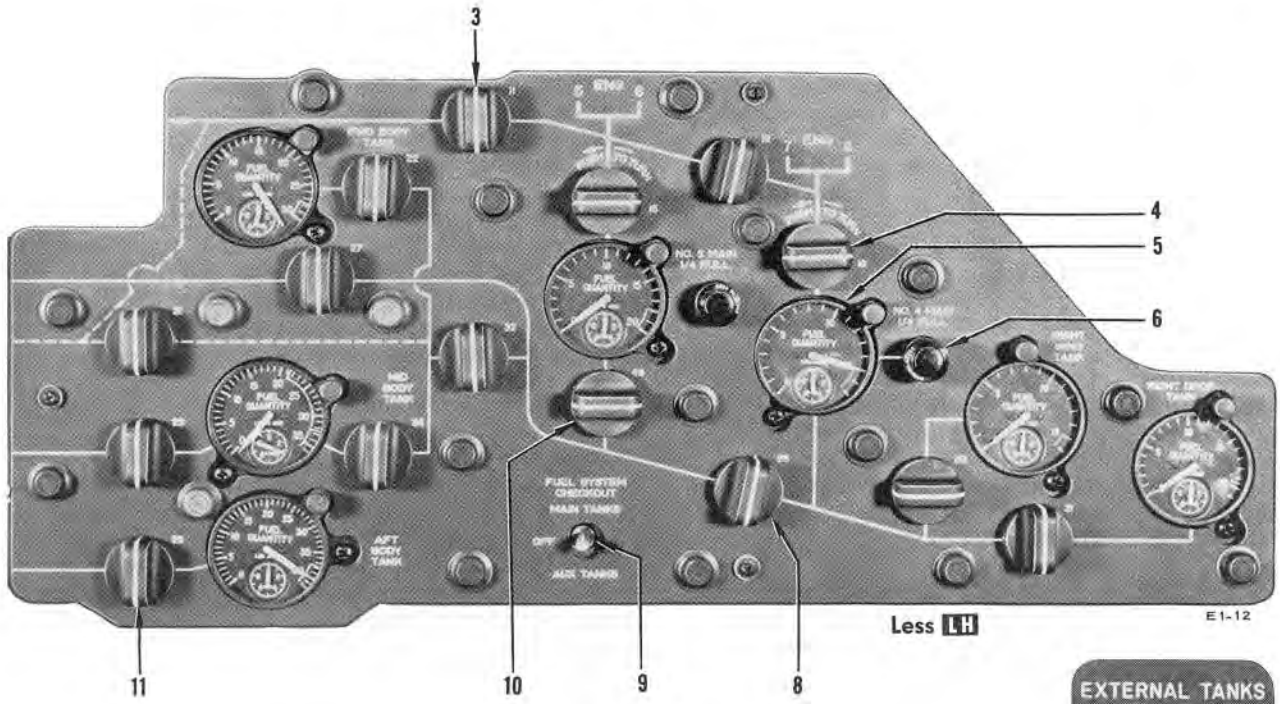


1. TOTAL FUEL QUANTITY GAGE
2. FUEL SYSTEM CHECKOUT LIGHT
2A. BOOST PUMP SHUTOFF SWITCH ND
3. CROSSFEED VALVE SWITCHES (NO. 9 THRU 12)
4. MAIN TANK VALVE SWITCHES (NO. 13 THRU 16)
5. FUEL QUANTITY GAGES
6. FUEL LOW WARNING LIGHTS
7. DROP (EXTERNAL) TANK JETTISON SWITCH
8. TRANSFER VALVE SWITCHES (NO. 26 THRU 32)
9. FUEL SYSTEM CHECKOUT SWITCH
10. FUEL LEVEL VALVE SWITCHES (NO. 48 AND 49)
11. AUXILIARY TANK VALVE SWITCHES (NO. 17 THRU 25)
12. FUEL QUANTITY GAGE TEST BUTTONS
13. TOTAL FUEL FLOW INDICATOR

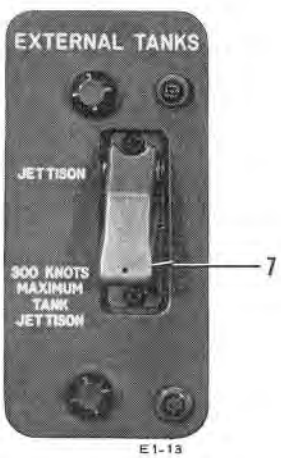
NOTE

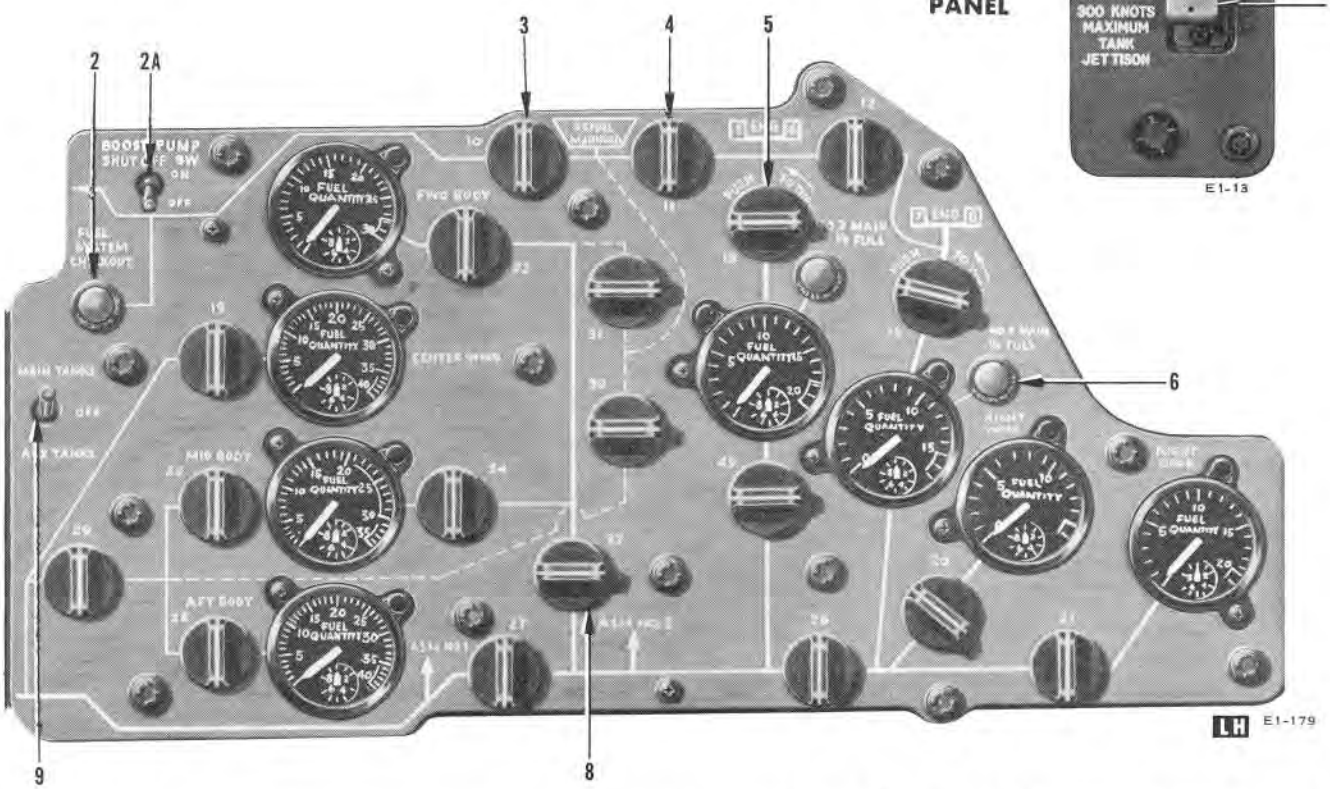
FOR REFUELING CONTROLS
SEE AIR REFUELING, SECTION IV

Figure 1-16. (Sheet 1 of 2).



PILOT'S SIDE PANEL





.....fuel system controls

Figure 1-16. (Sheet 2 of 2).

supplied through float switches to the fuel level valve to allow automatic replenishing of the main tanks. When the switch is OFF, power is supplied directly to close the fuel level valves. The fuel level valve switches are supplied switched battery power through a circuit breaker marked "Main Tanks Level" on the "Fuel Level Control" portion of the copilot's circuit breaker panel.

NOTE

Turning the master refuel control switch to ON position transfers float switch control of fuel level to the refueling secondary valves in the refuel system. This will cause the fuel level valves to remain in their last previous position. If they were closed at that time, no replenishing of the main tanks will occur from the fuel transfer system until the master refuel control switch is returned to OFF position.

DROP (EXTERNAL) TANK JETTISON SWITCH. A guarded drop (external) tank jettison switch (17, figure 1-9) located on the pilot's side panel has NORMAL--JETTISON positions and is guarded in the unmarked NORMAL position. Lifting the guard and moving the switch to JETTISON position supplies TR power through a circuit breaker marked "Drop Tank Jet" on the "Miscellaneous" portion of the pilot's circuit breaker panel to close drop relays. The drop relays supply 118-volt single-phase a-c power to start a series of actions which include the firing of a pair of explosive nuts. This pair of explosive nuts initiates action resulting in the release of the tank parachute. Deployment of the parachute activates a switch through a lanyard to fire another pair of explosive nuts which support the tank, thereby jettisoning the tank. Landing gear safety relays prevent accidental jettisoning of the drop tanks while on the ground. Positioning this switch to JETTISON position also supplies TR power through circuit breakers marked "Left Drop 17" and "Right Drop 21" on the "Fuel Feed Valve Control" portion of the copilot's circuit breaker panel to close the drop tank valves (No. 17 and 21) and to shut off the drop tank fuel quantity indicating system.

Fuel Transfer System Indicators

AUXILIARY TANK FUEL QUANTITY GAGES. Fuel quantity gages for the auxiliary tanks (5, figure 1-16) provided on the fuel section of the pilots' instrument panel indicate pounds of fuel available in the auxiliary tanks. Fuel quantity indications from a fuel probe in each auxiliary tank are amplified by a 118-volt single-phase a-c powered amplifier. The amplifier provides the fuel quantity gage with fuel quantity indications. Fuel tank quantity test buttons are provided for all auxiliary tank fuel gages. The auxiliary tank fuel quantity gages are supplied 118-volt a-c power through circuit breakers marked "Left Drop," "Left Outbd," "Fwd Body," "Ctr Wing," "Mid Body," "Aft Body," "Right Outbd," and "Right Drop" on the "Fuel Indicators" portion of the copilot's circuit breaker panel. Also see "Fuel Feed System Indicators," this section.

ELECTRICAL POWER SUPPLY SYSTEMS

A 205-volt three-phase 400-cycle a-c electrical system provides the primary airplane electrical power. Use of this high voltage a-c power permits a considerable weight saving in wire gages, actuators, and motor sizes over the conventional low voltage direct current airplane electrical system. Primary and secondary distribution buses supply power to the airplane. Primary power is generated by four alternating current generators, called alternators. This 205-volt three-phase a-c power is used for heavy loads such as boost pumps and wing flap motors. Single-phase 118-volt a-c power, obtained by tapping single phases of the three-phase power, is used for small motors, actuators, and electronic equipment. Transformers reduce single-phase power to 28 volts for most lighting and heating units. Secondary power is 24-volt dc supplied by transformer-rectifier (TR) units fed from the primary system. This TR power is used for control circuits, instruments, small motors, actuators, and electronic equipment. Batteries provide an auxiliary source of 24-volt d-c power to certain TR operated equipment in an emergency. The 24-volt d-c switched battery power supplied this equipment is normally obtained from the TR units but in the event of a-c system failure, these buses automatically switch to battery power. The batteries also supply power directly to some equipment. Both a-c and d-c power are distributed throughout the airplane by buses contained in units variously labeled as boxes, panels, or shields. Within these power distribution units, some of which are described in later paragraphs, indicator lights are provided which illuminate when power is being supplied to their corresponding buses. The position of the most important units in the power distribution network can be determined by studying electrical schematics (figures 1-17, 1-17A, 1-18, and 1-20) in this section. A nickel-cadmium battery (16A, figure 1-2) is installed to provide power for the special weapons emergency separation system (SWESS). A nickel-cadmium battery (AGM-28 armament provisions battery) (17A, figure 1-2) is installed to provide power for release and arming of the AGM-28 missiles during emergency missile release. These two batteries are completely independent of the aircraft power distribution system. Aircraft a-c and d-c power is also provided for the operation of certain AGM-28 missile systems. For additional information regarding missile circuit breakers, the AGM-28 armament provisions battery, and the tie-in of aircraft electrical systems and AGM-28 systems, refer to T.O. 1B-52C-30-1.

A-C POWER SYSTEM

The a-c power system (figure 1-18) consists of alternator packs, power distribution boxes, a central bus tie, power load boxes and shields, and circuit breaker panels. An a-c control panel (figure 1-19) at the co-pilot's station provides all of the controls and indicators for the a-c system, except on B-52E airplanes for a group of four alternator overload lights on the pilots' instrument panel.

Alternators

B-52E

The primary power supply (a-c) is obtained from four alternators designated left forward, right forward, left aft, and right aft. The forward alternators are in a compartment in front of the forward wheel well and the aft alternators are in the forward wheel well.

B-52F

The left engine of each nacelle drives an alternator; thus the four alternators are driven by engines 1, 3, 5, and 7. Each alternator is located on the left side of the engine which drives it.

Alternators provide two kinds of power, real and reactive. Real power, whose voltage and current are in phase, supplies loads such as motors and lights and is designated in watts or kilowatts. Reactive power serves no useful purpose except to furnish excitation energy for motors and is designated in vars or kilovars. See "Electrical System Operation," Section VII, for a discussion of these two types of power.

Pneumatic-Driven Alternator Packs

B-52E

Each alternator is bolted to an air turbine drive unit, the entire assembly being termed an alternator pack. The frequency of the primary power output depends upon the speed with which the alternator is driven. Therefore, the turbine drive with its speed control system will determine the frequency of the power furnished to the electrical systems by the alternators.

Engine-Driven Alternator Packs

B-52F

The assembly of an alternator and its drive unit is termed an alternator pack. Packs are located within a unique protrusion on the left side of each nacelle. The drive unit receives mechanical energy from the engine and transmits it to the alternator which converts this energy to electrical power. The drive unit governor regulates the speed and energy transmitted to the alternator, thus controlling the a-c frequency and power output.

Pneumatic-Driven Alternator

B-52E

The alternator drive turbine receives engine bleed air through two butterfly valves in series. The first valve

is a shutoff valve which controls starting and stopping. Its actuation is controlled manually by an alternator switch on the copilot's a-c control panel and automatically by protective shutdown relays. The second valve is a modulating valve whose function is to supply the correct amount of bleed air for maintaining a constant alternator output frequency regardless of electrical load. This is accomplished by the action of a frequency discriminator which senses deviations between desired speed and actual alternator speed and in turn sends a speed control signal to position the modulating valve. Speed trim of the drive is achieved directly through the frequency rheostats on the copilot's a-c control panel. In parallel operation, a real load division loop senses the differential signal between the average load signal and that resulting from the load actually being carried by its own alternator. This differential signal is of such phase and magnitude as to change the setting of the modulating valve which controls the amount of bleed air routed to the drive. If the drive is too lightly loaded, the valve will open and increase the pneumatic energy imparted to the drive. Since the drive speed will be held constant, the alternator will then assume more of the electrical load. Conversely, the signal will close the modulating valve of a too heavily loaded drive, thus reducing its output. As a result, each alternator can carry exactly its share of the load. The speed trim frequency rheostats can be used to adjust the speed and frequency of the alternator before paralleling. An automatic paralleling system with pushbutton control is provided. After paralleling, the frequency rheostats can be used to adjust the real load (kwatts) division. Constant fine adjustment is not necessary. The drive is cooled by ram air in flight and by blowers on the ground. Selection of cooling air is automatic since the circuits are wired through the landing gear safety switches.

Engine-Driven Alternator Drives

B-52F

Because of the requirements of certain electronic equipment for a stable a-c frequency, a drive is needed to drive the alternator at a constant speed throughout the range of various engine speeds. The drive used consists of a hydraulic transmission, controlled by an electro-mechanical governor. The transmission receives its input drive power directly from the engine. By use of a wobble plate pump, it adds to or subtracts from the variable input speed of the engine and provides a constant a-c output from the alternator of 400 (±1) cycles per second. Movement of governor flyweights controls the action by directing oil pressure to vary the pitch of the wobble plate. The position of the flyweights is affected both mechanically and electro-magnetically; mechanically by changes in centrifugal force due to variations in engine speed and electro-magnetically by signals from the copilot's frequency rheostat control and from a frequency and load controller. In parallel operation, the sensing transformer detects the difference between the average real load (kwatts) of all the alternators and the real load being carried by its own alternator. The signal resulting from a difference in real load will be of such phase and magnitude as to adjust the setting of the governor flyweights and thereby the pitch of the wobble plate. Although the drive speed will be held constant, the adjustment will allow the drive to impart more or less energy to the alternator, thus increasing or decreasing its output to match the average load. On airplanes Less ND, the frequency rheostats can be used to adjust the speed and frequency of the alternator before paralleling and the real load division after paralleling. Constant fine adjustment is not necessary. An automatic paralleling system with pushbutton control is provided.

Engine-Driven Alternator Drive Oil System

B-52F

Each alternator drive is provided a separate oil system which includes an oil tank having a usable capacity of 6 quarts and a total capacity of 10 quarts. Oil is routed through the alternator gearbox, through an oil cooler, and returned to the tank. Cooling air is provided by ram air pressure in flight and through actuation of the landing gear safety switch on the ground. Actuation of the safety switch permits high pressure compressor bleed air to enter an air ejector in the aft portion of the oil cooler ducting, thus inducing the flow of ambient cooling air. Oil temperature is controlled by a thermostatic valve which allows bypassing of the cooler. No manual controls are provided for this system. For oil servicing information, see figure 1-60.

Protective Features

B-52E

Automatic relays are installed for each alternator to protect the electrical system in the event of a malfunction. In some cases, a warning circuit is energized but the alternator pack will continue running until it is manually shut down. In other cases, a relay will shut the pack down automatically. Should this occur, the affected pack could probably be restarted but would shut down again unless the fault was cleared in restarting. See "Electrical System Emergency Operation," Section III, for information on restarting alternators.

B-52F

Several automatic features are incorporated in the alternators and their drives to protect the airplane and the electrical system in case of a malfunction. Since the alternator packs (alternator and drive assembly) cannot be stopped from turning while the engine is running, each protective feature may accomplish one or more of the following actions:

- Energize a warning light.
- Isolate the alternator by tripping open its bus tie circuit breaker.
- Take the alternator off the line by tripping open its alternator circuit breaker.
- Cut the power output by tripping open the exciter control relay and thus deexciting the field of the alternator.
- Throw the drive into full underspeed operation so that it will turn at the slowest rate possible for the speed at which the engine is operating.

NOTE

An alternator bus tie breaker will close automatically, if not already closed, when the alternator is turned OFF manually or automatically. When the alternator circuit breaker is opened manually, the bus tie circuit breaker must be closed manually.

B-52E

SPEED PROTECTION. An underspeed protection feature is provided which will shut down the pack at 320 cycles. This provides adequate underspeed protection for airplane electrical equipment. Primary overspeed protection is provided by a centrifugal switch and an overspeed generator which act to close the air bleed shutoff valve and, in some cases, the modulating valve when the frequency exceeds 450 to 460 cps. Additional overspeed protection is assured by several mechanical fuses in series in the circuit which holds the shutoff valve open. When any one or more of these mechanical fuses are broken, the unit will be shut down. The fuses can be cut by an overspeed trip bolt on the turbine shaft or by the turbine wheel itself if it becomes broken or misaligned. When a shutdown occurs because of a broken mechanical fuse, the unit cannot be restarted in flight. If the primary overspeed protection system (centrifugal switch and overspeed generator assembly) becomes inoperative during normal operation, it will automatically shut down the drive; however, should it be necessary to restart the drive, the speed (or system frequency) would then be sensitive to penumatic duct pressure. The frequency would reach a maximum of 430 cps with high duct pressure and decrease to below normal governed frequency with low duct pressure.

NOTE

An alternator bus tie breaker will close automatically, if not already closed, when the alternator is turned OFF manually or automatically. When the alternator circuit breaker is opened manually, the bus tie circuit breaker must be closed manually.

B-52F

SPEED PROTECTION. An underspeed-overspeed switch on a limit governor provides protection from excessively low or high alternator speeds. If the speed of the alternator drops to a point where the a-c output frequency is 330 cps (possibly due to a faulty governor or engine stopping), the switch will trip the alternator circuit breaker. This will take the alternator off the line and thus protect electronic equipment which might be damaged by operation at a low frequency. The alternator can be reparalleled if the cause of the underspeeding is eliminated. When the drive overspeeds (470 cps), the underspeed-overspeed switch not only trips the alternator circuit breaker but also causes the transmission to be hydraulically locked in the full underdrive (slowest output speed) position. When this happens, the alternator cannot be put back on the line for the duration of the flight.

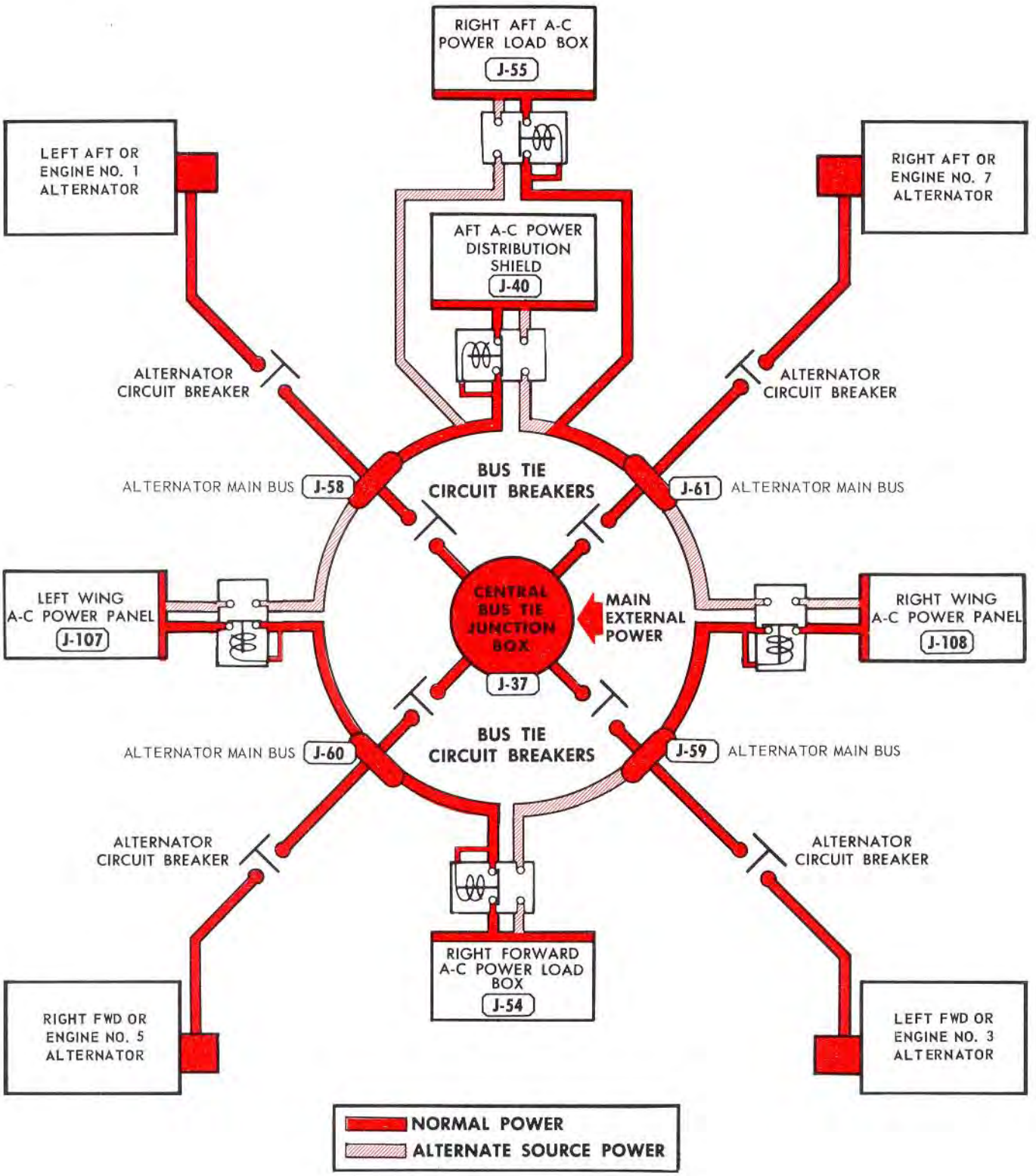
EXCITER PROTECTION RELAY. This relay continuously senses the exciter voltage in the alternator. When a fault occurs which causes sustained exciter ceiling voltage, this relay will disconnect the alternator from the line and shut it down. The complete relay consists of a voltage relay and a thermal delay relay. If exciter voltage increases to approximately 50 volts or more, the voltage relay will supply power to the thermal delay relay. After about 6 seconds at this voltage, the pack will be shut down. The time delay varies with voltage magnitude and is provided to override transient power surges and allow time for fuses to blow and clear faults in multiwire feeders. This relay therefore is a backup device to protect the alternator in case faults are not cleared or the alternator is shut down by other protective relays.

DIFFERENTIAL CURRENT PROTECTION RELAY. This relay (one for each phase of each alternator) functions to remove from service an alternator which is internally faulted or has grounded leads. It is actuated by loops which sense any difference between the current passing through the line of any phase and the current in the ground return line of that phase. This device includes the main buses so the relay will be energized in the event a phase-to-phase fault occurs. A differential current due to a fault will induce current in a transformer causing the relay to be energized when the fault current exceeds 20 amperes. This directs power to trip off the alternator pack without further delay.

DIFFERENTIAL REACTIVE CURRENT PROTECTION RELAY. This relay functions to remove an alternator from parallel operations when it senses an excessive reactive current differential between paralleled alternators. Should an alternator supply more than its share of reactive load, even though real load was equal on all alternators, the alternator would become overloaded and should be removed for isolated operation. When a reactive current differential exists because of this unbalance, a voltage is induced in an equalizer transformer secondary which will supply power to one bank of a selenium rectifier. This causes current to flow through a polarized relay coil to a control relay which trips off the bus tie breaker for the respective alternator. The alternator, now in isolated operation, can supply power only to those units on its own bus. If an alternator supplies less than its share of reactive load, the control relay will be actuated in the opposite direction and supply power to illuminate the alternator failure light.

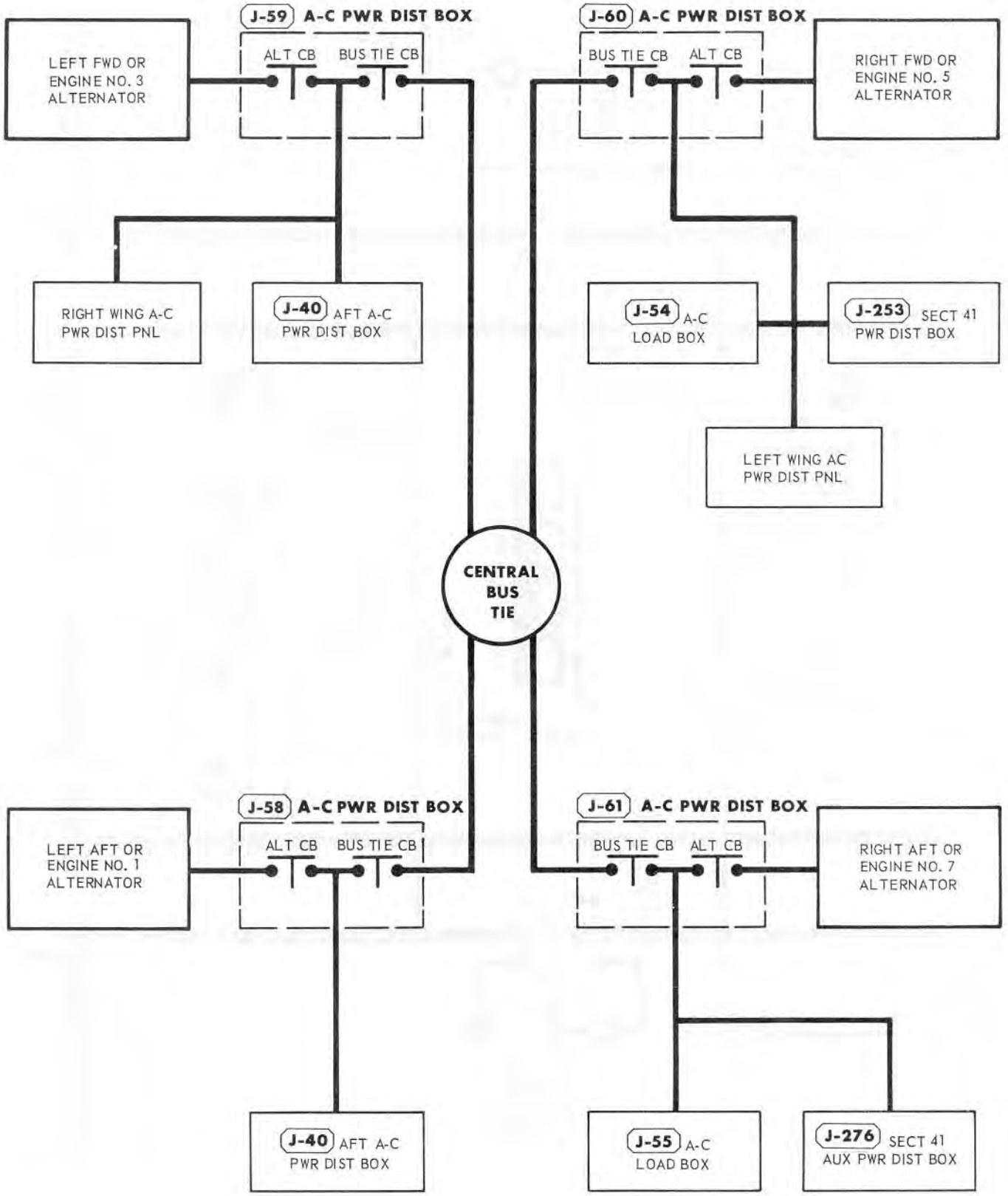
OVERVOLTAGE RELAY. This relay is part of the differential reactive current protection relay and functions only when the alternator is operating isolated. It provides overvoltage protection by closing and directing power to shut down the alternator when line to neutral (ground) voltage increases to 127 volts.

ALTERNATOR FAILURE RELAY. This relay senses the voltage on phase C of the respective alternator main bus. Loss of voltage on the main bus causes the relay to deenergize and close contacts to direct power through the alternator circuit breaker to the alternator failure light on the copilot's a-c control panel.



A-C power routing (typical) Less NF

Figure 1-17.



.....A-C power routing (typical) NF

Figure 1-17A.

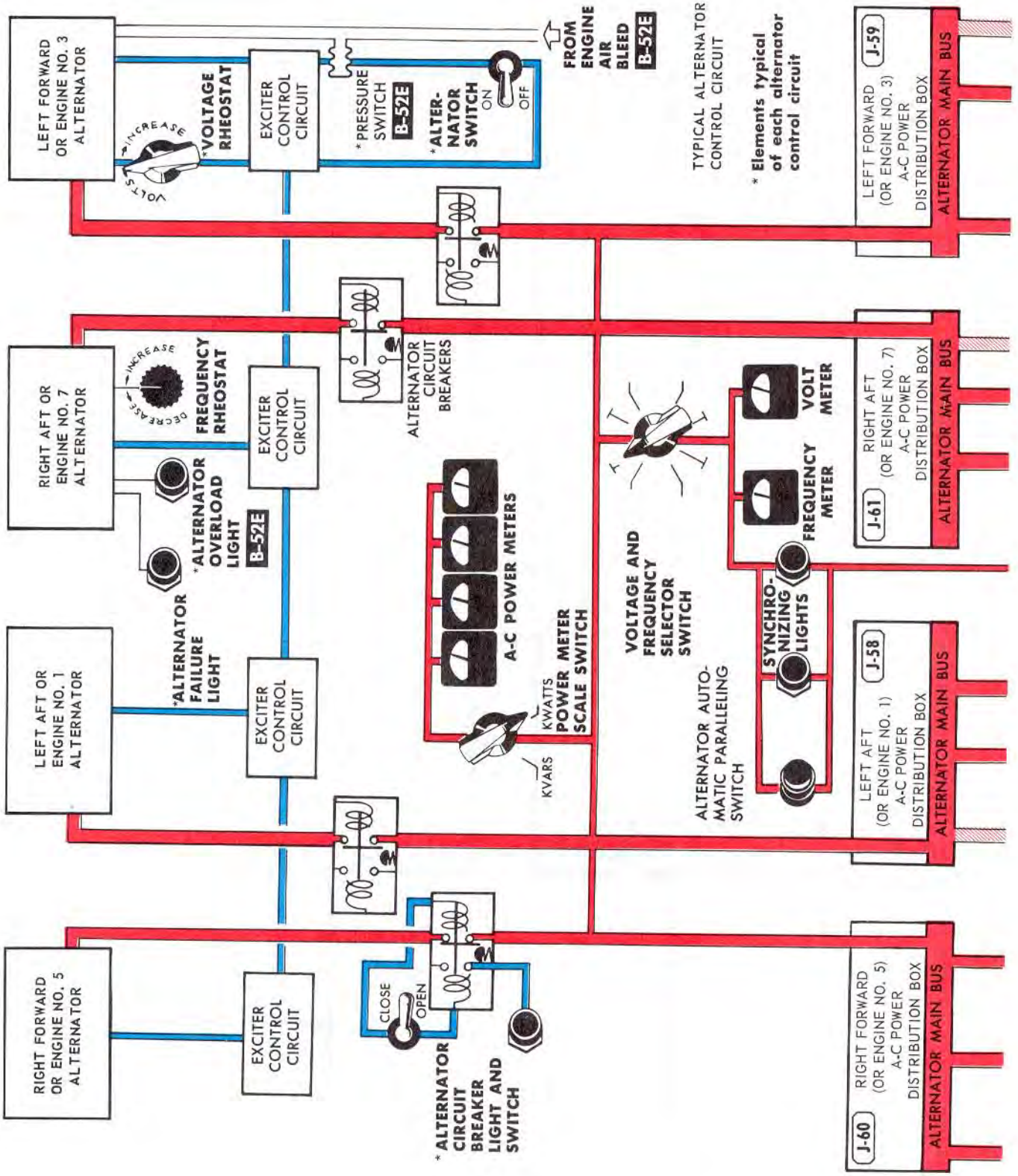
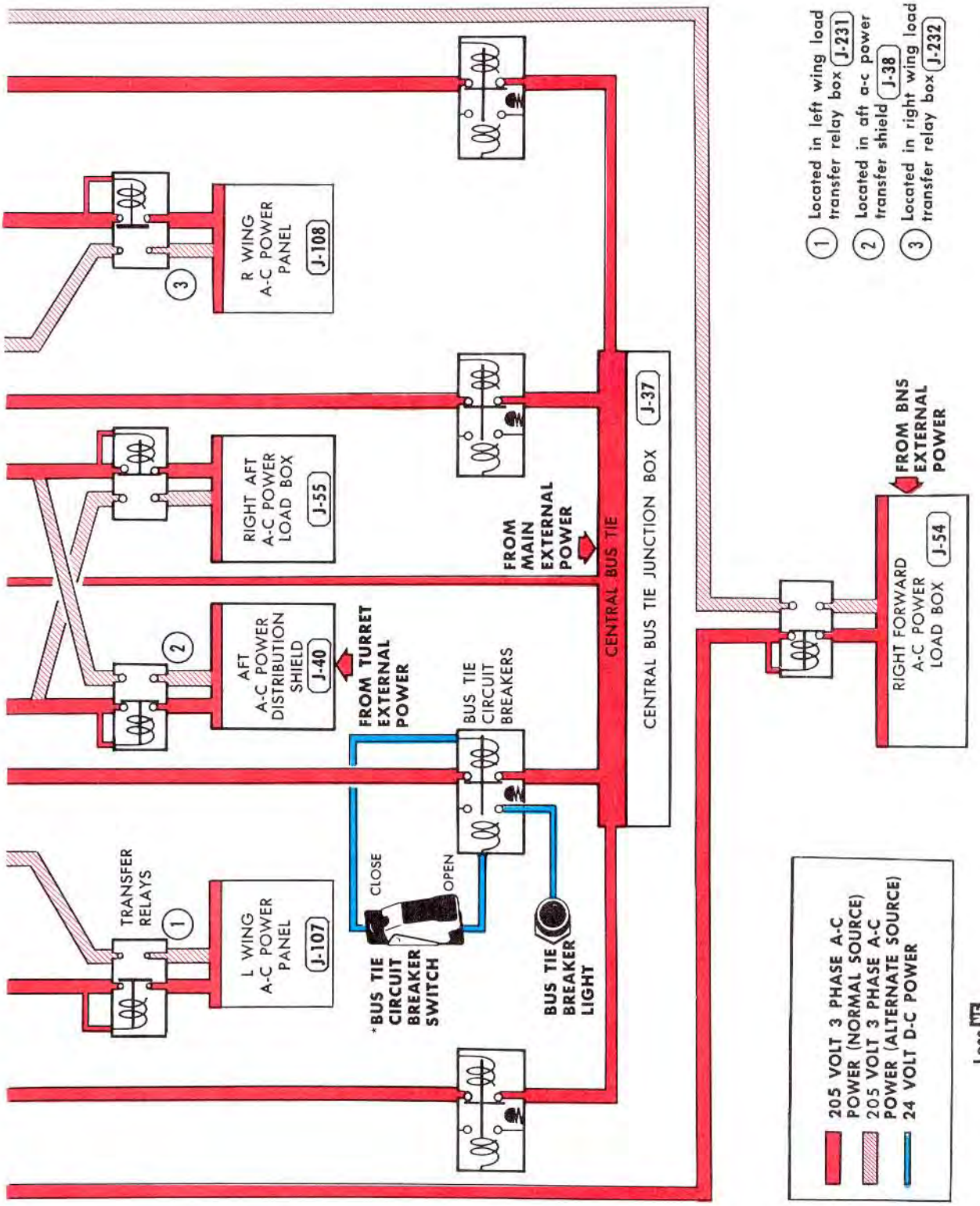


Figure 1-18 (Sheet 1 of 4).



A-C power system (typical)

Figure 1-18 (Sheet 2 of 4).

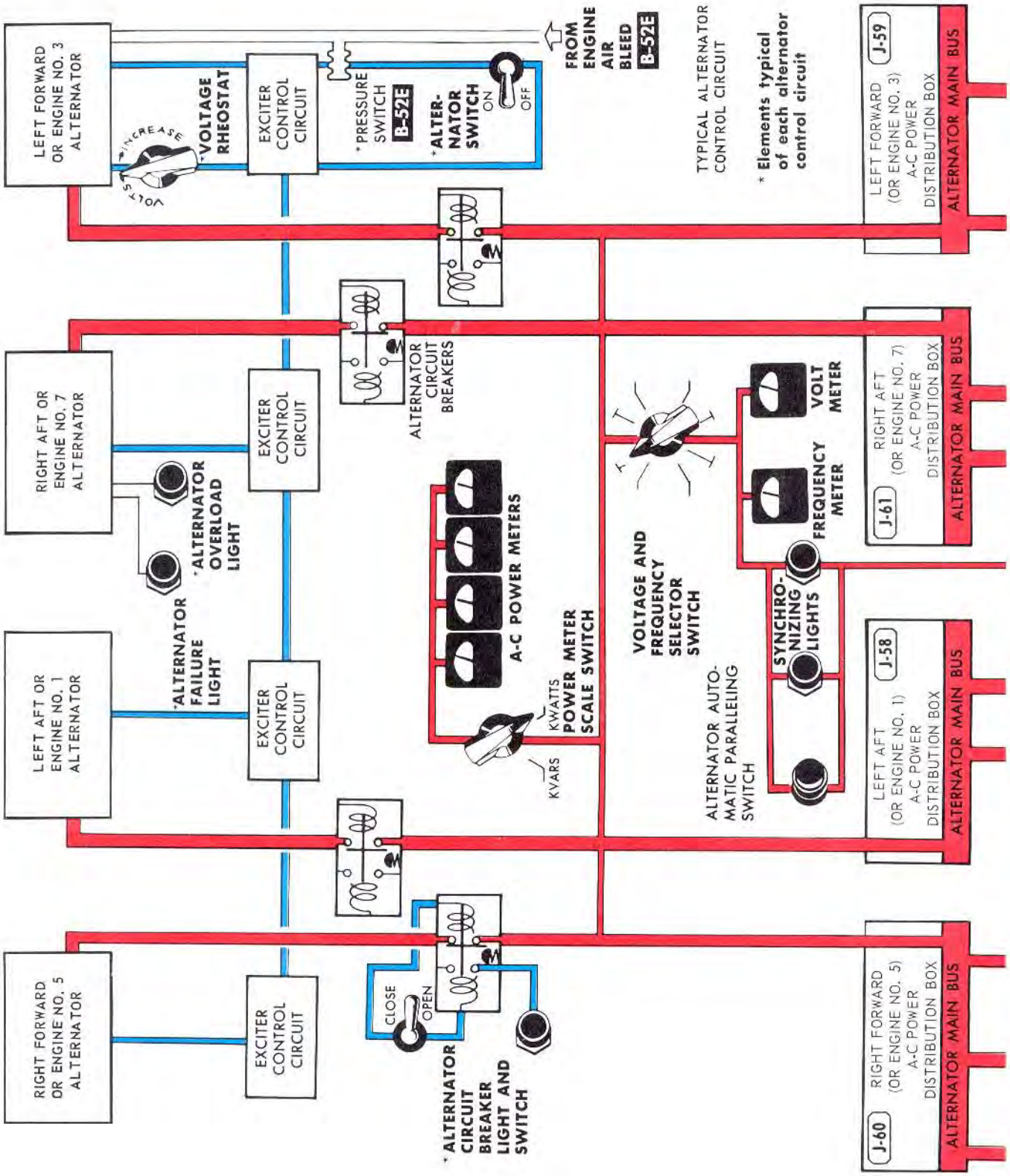
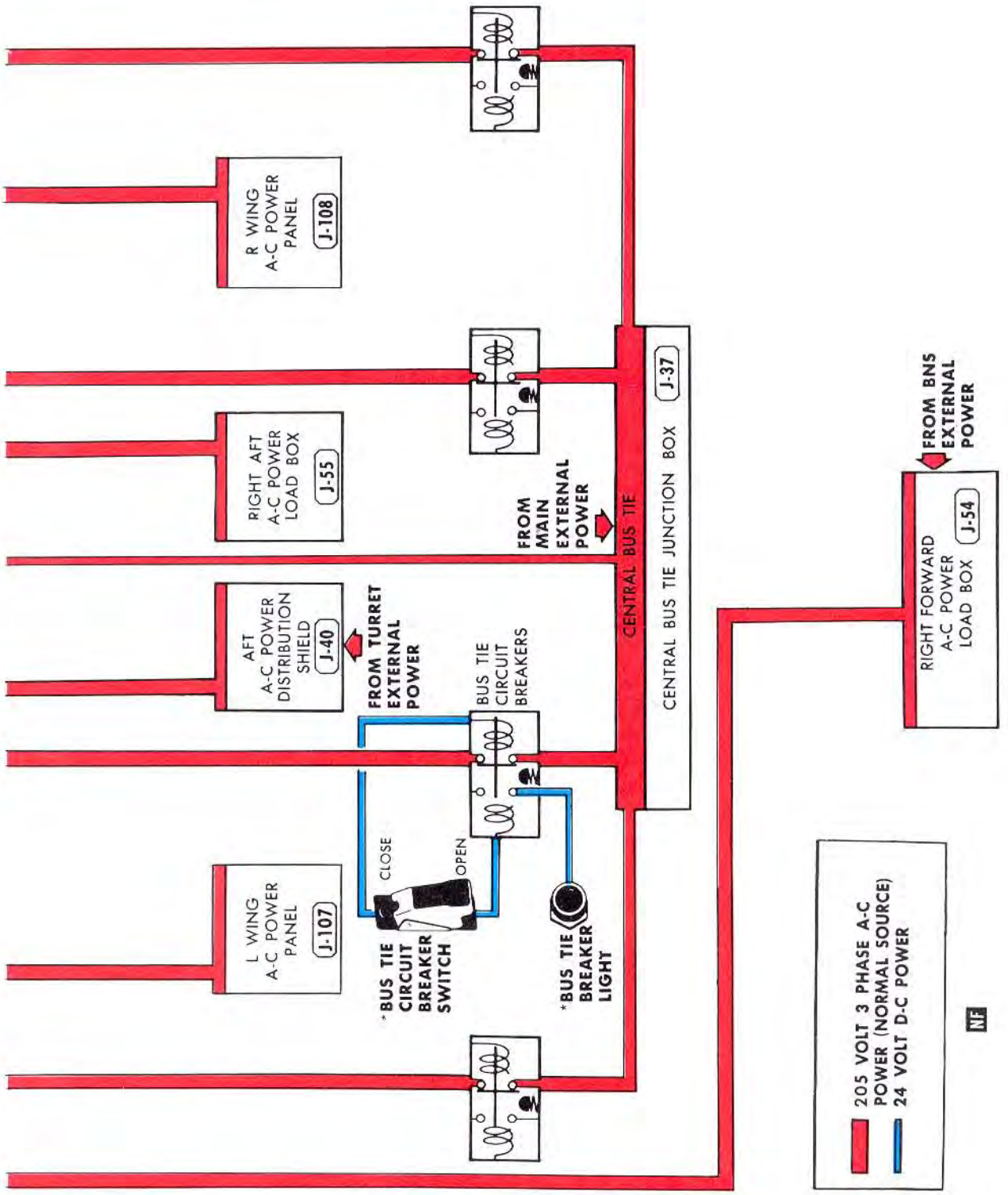
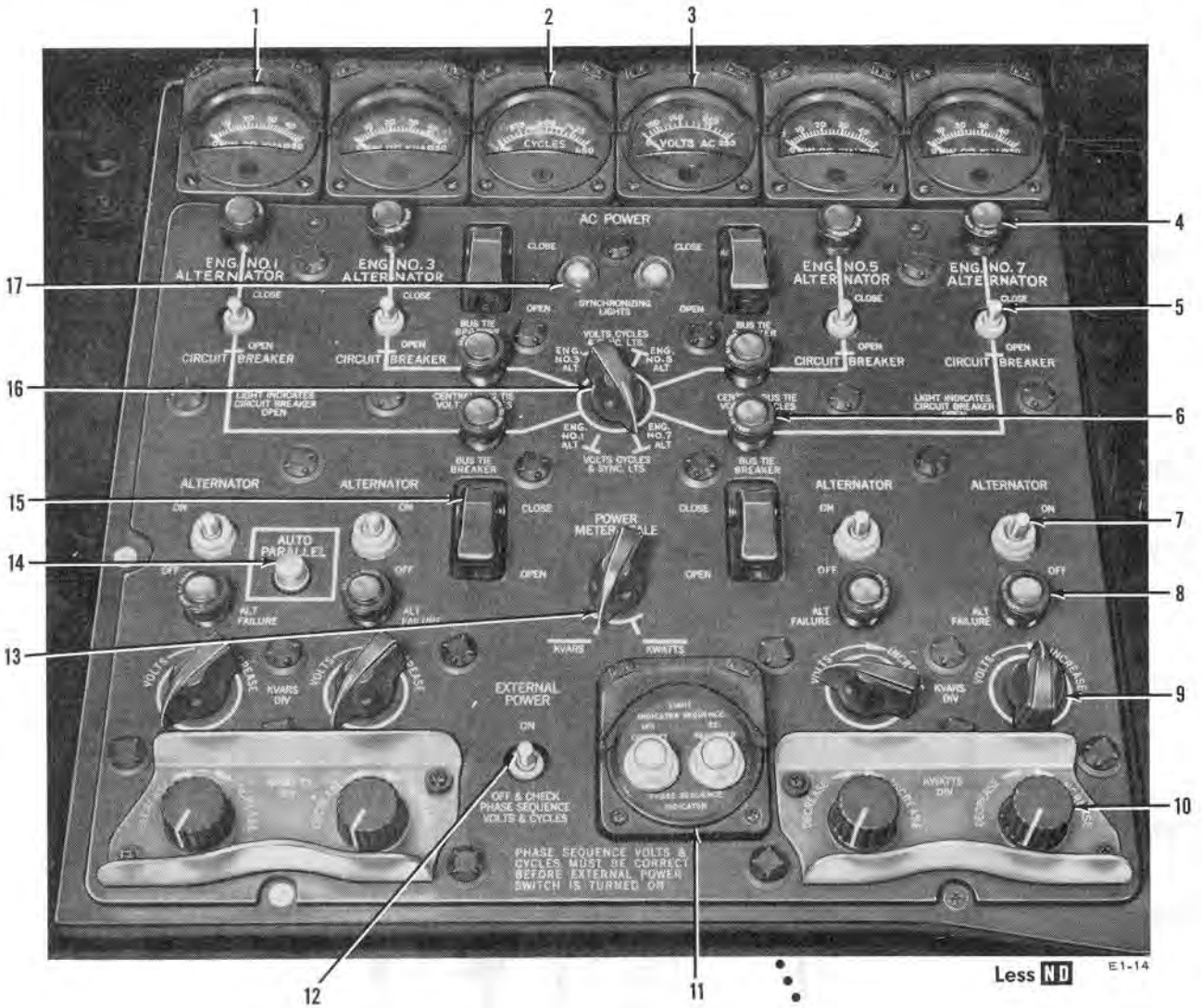


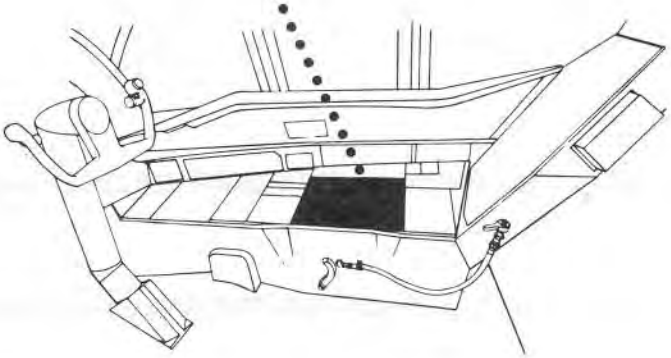
Figure 1-18 (Sheet 3 of 4).



.....A-C power system (typical) (cont)

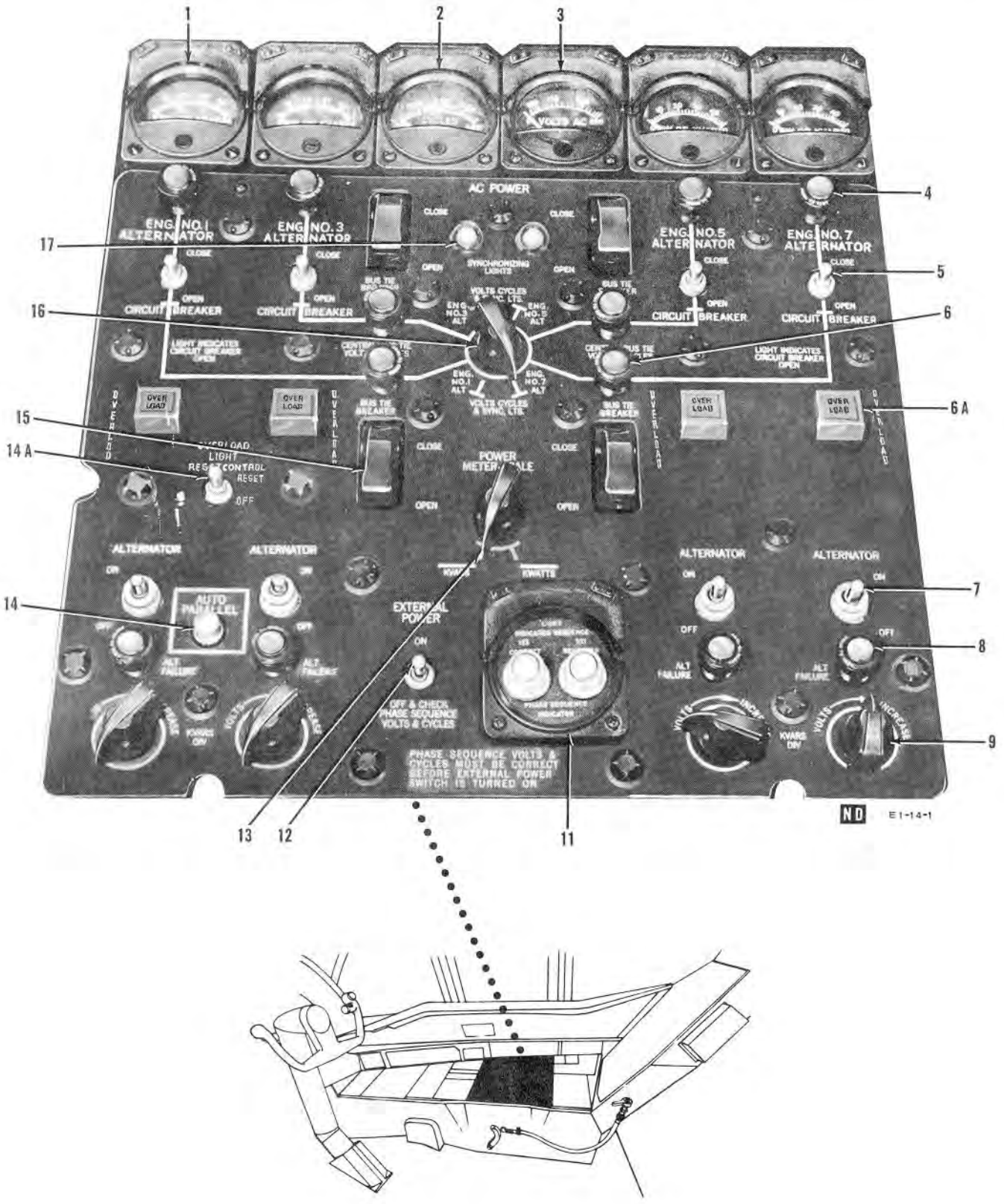
Figure 1-18 (Sheet 4 of 4).





1. POWER METERS
2. FREQUENCY METER
3. VOLTMETER
4. ALTERNATOR CIRCUIT BREAKER LIGHTS
5. ALTERNATOR CIRCUIT BREAKER SWITCHES
6. BUS TIE BREAKER LIGHTS
6A. ALTERNATOR OVERLOAD LIGHTS ND
7. ALTERNATOR SWITCHES
8. ALTERNATOR FAILURE LIGHTS
9. VOLTAGE RHEOSTATS
10. FREQUENCY RHEOSTATS Less ND
11. PHASE SEQUENCE INDICATOR
12. EXTERNAL POWER SWITCH
13. POWER METER SCALE SWITCH
14. ALTERNATOR AUTOMATIC PARALLELING SWITCH
14A. ALTERNATOR OVERLOAD LIGHTS RESET SWITCH ND
15. BUS TIE BREAKER SWITCHES
16. VOLTAGE AND FREQUENCY SELECTOR SWITCH
17. ALTERNATOR SYNCHRONIZING LIGHTS

Figure 1-19 (Sheet 1 of 2).



A-C control panel (typical)

Figure 1-19 (Sheet 2 of 2).

A-C Power Distribution Boxes

Primary power from each alternator is fed to separate main buses in the four power distribution boxes from which the power load boxes are supplied in an isolated manner during nonparallel operation.

Less NF

When operating isolated, each alternator acts as an alternate source for the power load boxes of another alternator. Load transfer relays automatically connect the alternate source to the power load boxes when the normal source fails. With normal power restored, the relays reconnect the normal source again. See figures 1-17 and 1-18.

NF

There is no alternate source of power since the automatic transfer relays have been removed. When operating isolated and an alternator malfunction occurs, its loads must be fed from the central bus tie. See figures 1-17A and 1-18.

Central Bus Tie Junction Box

For parallel operation, power is supplied to a central bus tie from the four distribution boxes. Greater reliability is obtained from the almost equal distribution of loads upon the alternators from this kind of operation for if an alternator fails, the total load will be automatically distributed equally to the remaining three. Fast clearing of faults will also occur because of the large currents available. During isolated operation, the central bus tie is used primarily for routing power from an operating alternator to the load boxes of any shutdown alternators. This provides a flexible method of distributing electrical power. The central bus tie also receives the external power through the external power receptacle and distributes it to the load boxes.

A-C Power Load Boxes, Panels, and Shields

The a-c power load boxes, wing power panels, and aft shields are supplied through multiwire feeders of three or four wires for each phase. The buses in these boxes supply all of the 205-volt three-phase loads and, in addition, furnish 118-volt single-phase power to the circuit breaker panels and to two 28-volt transformers.

A-C Power System Controls

B-52E

ALTERNATOR SWITCHES. Four ON--SWITCH OFF --OFF alternator switches (7, figure 1-19), spring-loaded to the neutral SWITCH OFF position, on the a-c control panel control the alternator packs. In ON position, switched battery power is directed through a safety pressure switch to open the air shutoff valve and close the exciter control relay. This permits bleed air to drive the turbine and energize the alternator field. The pressure switch will prohibit this start by remaining open if insufficient air is supplied by the air bleed system. In OFF position, switched battery power opens the alternator circuit breaker, opens the exciter control relay, and closes the air shutoff valve. This disconnects the alternator from its distribution box, turns it off, and shuts down the drive. The alternator switches receive switched battery power through circuit breakers marked "Left Fwd Alternator," "Right Fwd Alternator," "Left Aft Alternator," and "Right Aft Alternator" on the "Alternator Control" portion of the copilot's circuit breaker panel.

B-52F

ALTERNATOR SWITCHES. Four ON--SWITCH OFF --OFF alternator switches (7, figure 1-19), spring-loaded to the neutral SWITCH OFF position, are on the a-c control panel. In ON position, switched battery power closes the exciter control relay and enables the alternator field to be energized when the engine starts. In OFF position, the same power trips both the exciter control relay and the alternator circuit breaker. The alternator switches receive switched battery power through circuit breakers marked "Engine No. 1 Alternator," "Engine No. 3 Alternator," "Engine No. 5 Alternator," and "Engine No. 7 Alternator" on the "Alternator Control" portion of the copilot's circuit breaker panel.

B-52E

ALTERNATOR CIRCUIT BREAKER SWITCHES. Four CLOSE--SWITCH OFF--OPEN alternator circuit breaker switches (5, figure 1-19), spring-loaded to the neutral SWITCH OFF position, on the a-c control panel control the alternator circuit breakers. In CLOSE position, switched battery power closes the circuit breaker connecting the alternator to its distribution box and opens the external power circuit. In OPEN position, switched battery power opens the circuit breaker which disconnects the alternator from its distribution box and illuminates its alternator circuit breaker light. The alternator circuit breaker cannot be closed if the drive for that alternator is not running. The alternator circuit breaker switches receive switched battery power through circuit breakers marked "Left Fwd Cir Brkr," "Right Fwd Cir Brkr," "Left Aft Cir Brkr" and "Right Aft Cir Brkr" on the "Alternator Control" portion of the copilot's circuit breaker panel.

B-52F

ALTERNATOR CIRCUIT BREAKER SWITCHES. Four CLOSE--SWITCH OFF--OPEN alternator circuit breaker switches (5, figure 1-19), spring-loaded to the neutral SWITCH OFF position, on the a-c control panel control the alternator circuit breakers. In CLOSE position, switched battery power closes the circuit breaker connecting the alternator to its distribution box and opens the external power circuit. In OPEN position, switched battery power opens the circuit breaker which disconnects the alternator from its distribution box and illuminates its alternator circuit breaker light. The alternator circuit breaker cannot be closed if the alter-

nator is not on (exciter control relay closed) and the drive running within the speed range of the underspeed-overspeed switch setting. The alternator circuit breaker switches receive switched battery power through circuit breakers marked "Engine No. 1 Cir Brkr," "Engine No. 3 Cir Brkr," "Engine No. 5 Cir Brkr," and "Engine No. 7 Cir Brkr" on the alternator control portion of the copilot's circuit breaker panel.

BUS TIE BREAKER SWITCHES. Four CLOSE--SWITCH OFF--OPEN bus tie breaker switches (15, figure 1-19) on the a-c control panel control the central bus tie circuit breakers. The switches are guarded and spring-loaded to the neutral SWITCH OFF position. In CLOSE position, switched battery power closes the bus tie circuit breaker to connect the alternator main bus to the central bus tie. The four switches are placed in this position for operation on ground external power. In OPEN position, switched battery power opens the bus tie circuit breaker to disconnect the alternator main bus from the central bus tie and illuminate its bus tie breaker light (6, figure 1-19).

B-52E

The bus tie breaker switches receive switched battery power through circuit breakers marked "Left Fwd Bus Tie," "Right Fwd Bus Tie," "Left Aft Bus Tie," and "Right Aft Bus Tie" on the "Alternator Control" portion of the copilot's circuit breaker panel.

B-52F

The bus tie breaker switches receive switched battery power through circuit breakers marked "Engine No. 1 Bus Tie," "Engine No. 3 Bus Tie," "Engine No. 5 Bus Tie," and "Engine No. 7 Bus Tie" on the "Alternator Control" portion of the copilot's circuit breaker panel.

VOLTAGE RHEOSTATS. Four voltage rheostats (9, figure 1-19) are provided to adjust the voltage for each alternator. When a rheostat is rotated clockwise, the voltage output is increased and opposite rotation decreases it. Voltage from all four alternators is read from a single voltmeter (3, figure 1-19). The voltage rheostats also provide a means of adjusting the kvars division between alternators when operating in parallel. When a rheostat is rotated clockwise, the kvars (reactive load) will increase for the respective alternator and decrease for all others operating in parallel. When a rheostat is rotated counterclockwise, the kvars will decrease for the respective alternator and increase for all others operating in parallel. Kvars are read on the power meters with the power meter scale switch in KVARS position.

Less ND

FREQUENCY RHEOSTATS. Four frequency rheostats (10, figure 1-19) on the a-c control panel provide control for alternator speed and frequency. These controls are serrated knobs which are not spring-loaded and will stay in whatever position they are left in. When a rheostat is rotated clockwise, the speed and consequently the frequency of the respective alternator is increased. Counterclockwise rotation will decrease the frequency. Frequency for all four alternators is read from a single frequency meter. In addition to operating as a speed trim control, these rheostats also provide a means of adjusting the kwatts division between alternators operating in parallel. Rotating a rheostat clockwise increases the kwatt real load of the respective alternator and decreases the load of the other alternators. Rotating it counterclockwise decreases the kwatts on the respective alternator and increases the load on the others. Kwatts are read on the power meters with the power meter scale switch in KWATTS position. The frequency rheostat knobs are guarded to prevent accidental movement.

VOLTAGE AND FREQUENCY SELECTOR SWITCH. An eight-position voltage and frequency selector switch (16, figure 1-19) provides selection of voltage and frequency readings between each alternator and the central bus tie. In LH FWD ALT or ENG NO. 3 ALT position, the voltage and frequency of the left forward alternator or engine No. 3 alternator is read on the voltmeter and frequency meter. In addition, the synchronizing lights and the automatic paralleling system are placed in operation for this alternator. Three other positions will perform the above operations for their respective alternators as marked. Four other positions, each adjacent to an alternator position, connect the voltmeter and frequency meter to the central bus tie for respective voltage and frequency readings.

ALTERNATOR AUTOMATIC PARALLELING SWITCH. A PARALLEL--OFF pushbutton-type alternator automatic paralleling switch (14, figure 1-19) on the a-c control panel enables the copilot to parallel the alternators while using only one hand. When pushed to the PARALLEL (in) position, it will automatically parallel a selected alternator to the central bus tie at a moment when the two units are synchronized. During this action, electrical pulses are sent to close the alternator and bus tie circuit breakers. When released, the spring-loaded switch returns to OFF (out) position and the automatic paralleling system becomes inactive. The alternators also may be paralleled by manually closing either the alternator or bus tie circuit breakers. The alternator to be paralleled is selected by the voltage selector switch. The automatic paralleling switch receives switched battery power through a circuit breaker marked "Alt Auto Parallel" on the "Alternator Control" portion of the copilot's circuit breaker panel.

ND

ALTERNATOR OVERLOAD LIGHT RESET SWITCH. An alternator overload light switch (figure 1-19) on the a-c control panel has RESET and OFF positions. Holding the switch momentarily to the RESET position will reset the alternator overload lights on the a-c control panel. The switch is supplied TR power through circuit breakers marked "Alt 1 & 3 Ovld Power" and "Alt 5 & 7 Ovld Power" on the left and right forward d-c power boxes respectively.

A-C Power System Indicators

POWER METERS AND POWER METER SCALE SWITCH. Four power meters (1, figure 1-19) on the a-c control panel provide an indication in kilowatts of either the real or the reactive power supplied by each of the alternators. Selection between real and reactive power is obtained by a KVARS--KWATTS power meter scale switch (13, figure 1-19) for all four meters.

VOLTMETER, FREQUENCY METER, AND SYNCHRONIZING LIGHTS. One frequency meter (2, figure 1-19) and one voltmeter (3, figure 1-19) on the a-c control panel provide individual readings for each alternator and the central bus tie. Two synchronizing lights (17, figure 1-19) assist in the adjustment of the voltage and frequency of an alternator to those of the central bus tie.

ALTERNATOR CIRCUIT BREAKER LIGHTS. Four red alternator circuit breaker lights Less ND and four amber alternator circuit breaker lights ND (4, figure 1-19) on the a-c control panel illuminate to indicate open alternator circuit breakers. Each light circuit is closed to switched battery power through a contact of its alternator circuit breaker when the circuit breaker is open.

B-52E

The alternator circuit breaker lights receive switched battery power through circuit breakers marked "Cir Brkr Ind Lights" - "Fwd" and "Aft" on the "Alternator Control" portion of the copilot's circuit breaker panel.

B-52F

The alternator circuit breaker lights receive switched battery power through circuit breakers marked "Cir Bkr Ind Lights" - "Eng 3 & 5" and "Eng 1 & 7" on the "Alternator Control" portion of the copilot's circuit breaker panel.

BUS TIE BREAKER LIGHTS. Four red bus tie breaker lights Less ND and four amber bus tie breaker lights ND (6, figure 1-19) on the a-c control panel illuminate to indicate open central bus tie circuit breakers. Each light circuit is closed to switched battery power through a contact of its bus tie circuit breaker when the circuit breaker is open. The bus tie breaker lights receive switched battery power through a circuit breaker marked "Bus Tie Ind Lights" on the "Alternator Control" portion of the copilot's circuit breaker panel.

ALTERNATOR FAILURE LIGHTS. Four red alternator failure lights Less ND and four amber alternator failure lights ND (8, figure 1-19) on the a-c control panel provide alternator failure warning. During parallel operation, if an alternator is not supplying its share of reactive power, the respective differential reactive current protection relay will direct switched battery power to the light. During isolated operation, if the alternator voltage output is low, the alternator failure relay for the respective alternator will direct switched battery power to the light. In this case, the alternator circuit breaker must be closed before power can be directed to the light; therefore, the light will not be on when the alternator is shut down.

B-52E

The alternator failure lights receive switched battery power through circuit breakers marked "Left Fwd Bus Tie," "Right Forward Bus Tie," "Left Aft Bus Tie," and "Right Aft Bus Tie" on the "Alternator Control" portion of the copilot's circuit breaker panel.

B-52F

The alternator failure lights receive switched battery power through circuit breakers marked "Engine No. 1 Bus Tie," "Engine No. 3 Bus Tie," "Engine No. 5 Bus Tie," and "Engine No. 7 Bus Tie" on the "Alternator Control" portion of the copilot's circuit breaker panel.

NOTE

The alternator failure lights will only illuminate to show low alternator output. They will not illuminate for such conditions as overvoltage, excessive reactive power, or a fault in the alternator circuits.

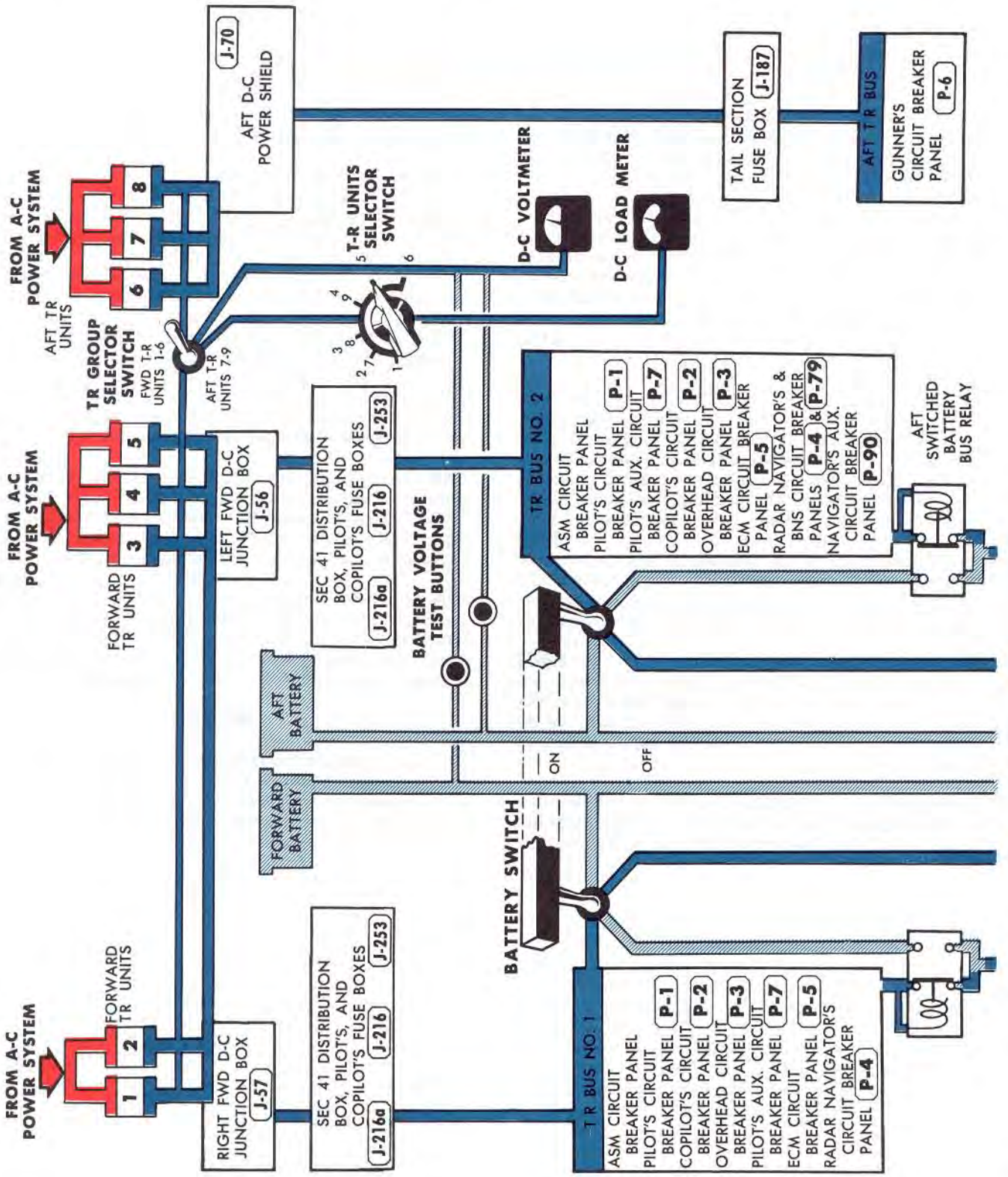
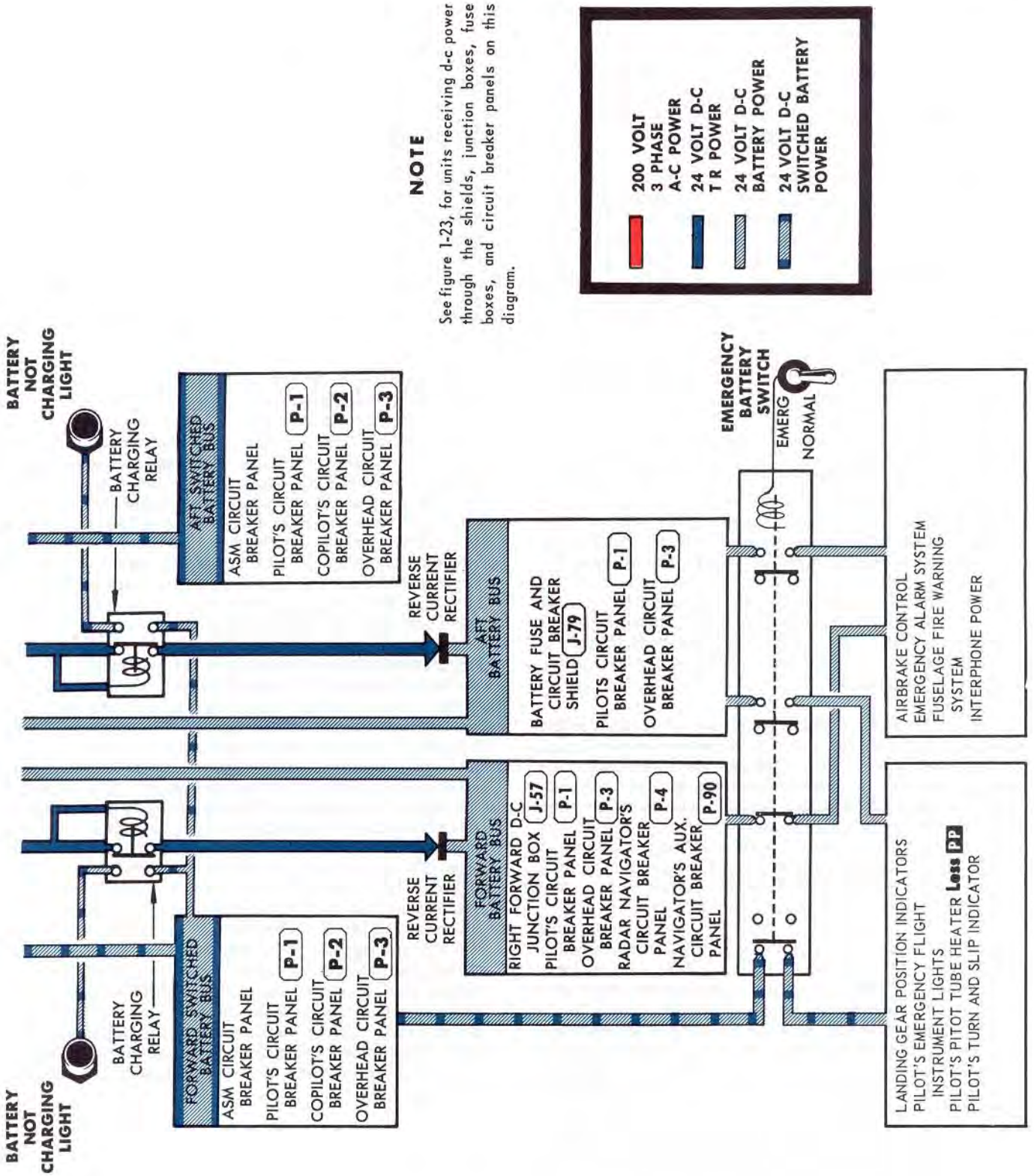


Figure 1-20.(Sheet 1 of 2)



.....D-C power system (typical)

Figure 1-20 (Sheet 2 of 2).

B-52E

ALTERNATOR OVERLOAD LIGHTS. Four red alternator overload lights (11, figure 1-13 and 38, figure 1-13A) on the pilots' instrument panel provide alternator pack electrical overload low air pressure warning. When air pressure to drive the alternator pack is low with respect to electrical loads, the governor of the pack will open the speed control valve as required to maintain constant frequency. If the air pressure continues to decrease or loads continue to increase, the speed control valve will open further until it causes a microswitch to close and direct d-c switched battery power to the respective light. This power is routed through the exciter control relay so that the light will not be on when the drive is shut down. The alternator overload lights receive switched battery power through circuit breakers marked "Left Fwd Alternator," "Right Fwd Alternator," "Left Aft Alternator," and "Right Aft Alternator" on the "Alternator Control" portion of the copilot's circuit breaker panel.

ND

ALTERNATOR OVERLOAD LIGHTS. Four amber alternator overload lights (6A, figure 1-19), one for each alternator, are on the a-c control panel. The lights will illuminate when their respective alternator becomes overloaded and will remain on as long as the alternator is overloaded. The lights may be reset by holding the reset switch momentarily to RESET position and will remain off if the alternator is not overloaded. This indication is also indicated on the master caution light system. The lights receive TR power through circuit breakers marked "Alt 1 & 3 Ovld Power" and "Alt 5 & 7 Ovld Power" on the left and right forward d-c power boxes respectively.

POWER-ON-BUS LIGHTS. Each a-c power bus in the main system is provided with three power-on-bus lights, one for each phase. The lights are visible through windows in the various boxes, panels, and shields and, when illuminated, indicate when power is on the bus. The following units contain power-on-bus lights: the central tie junction box, all four a-c power distribution boxes, both right forward and right aft a-c power load boxes, both right and left wing a-c power panels, and the aft a-c power distribution shield.

ND

A-C POWER MASTER CAUTION LIGHT. A rectangular amber indicator light (26A, figure 1-13A) with an integral push-to-reset switch is located on the right side of the pilots' instrument panel. The light has a "word warning" panel which, when illuminated, shows black letters "A-C Power Master Caution, Push to Reset" on an amber background. The master caution light serves to warn that the a-c power system which it monitors has a malfunction. The light will illuminate at the same time as the malfunction occurs and will remain on as long as the malfunction continues unless it is reset. The light may be reset by pressing the face of the light at which time it will go out and be ready to monitor remaining indication of malfunction within the a-c system. The a-c indicators monitored by the master caution light are as follows:

- Four alternator circuit breaker open indicator lights
- Four bus tie circuit breaker open indicator lights
- Four alternator overload lights
- Four alternator failure lights.

The master caution light and controller use TR power through a circuit breaker marked "Alt Master Caution Light" on the "Alternator Control" portion of the copilot's circuit breaker panel.

D-C POWER SYSTEM

The d-c power system (figure 1-20) consists of transformer-rectifier (TR) units, d-c power shields with TR buses, batteries with battery buses, switched battery buses, and circuit breakers, controls, and indicators. A d-c control panel (figure 1-21) at the copilot's station provides all the controls and indicators for the d-c system except for the emergency battery switch which is located on the pilots' instrument panel.

Transformer-Rectifier (TR) Units, Buses, and Circuit Breakers

Direct current power for normal operation is 24-volt output transformer-rectifier (TR) units which operate directly off the three-phase 205-volt a-c load boxes. The TR units are divided into two groups, forward and aft. The forward units located in the forward wheel well provide power through the forward d-c junction boxes to the crew members' circuit breaker panels. From there, the TR power is routed either through relays to the switched battery buses, through the battery switch to the battery charging relays, or directly to certain d-c operated equipment. The aft TR units are located in the aft equipment compartment. Power is routed from aft TR units through distribution buses in the aft d-c power shield to the gunner's circuit breaker panel. An autonavigator TR unit installed in the pilots' compartment supplies power to the AGM-28 autonavigator through a d-c power circuit breaker located on the ASM circuit breaker panel. The forward TR units are bussed together, as are the aft TR units, so that partial TR unit failure will not result in a loss of power to any d-c operated equipment. In the event of aft TR unit failure, the gunner will lose heat control and air conditioning pressurization will have to be dumped manually in the aft compartment. In addition, d-c power to the fire control system will be lost. The bus voltage depends on the inherent regulating qualities of the units; therefore, the voltage varies from approximately 24 volts at full load to 29.5 volts at light loads. Maximum continuous load for the TR units is 100% of rated power (1.0 on the loadmeter). Maximum load for 5 minutes is 150% (1.5 on the loadmeter) and maximum load for 1 minute is 250%. All units are rated at 100 amperes.

Batteries

An auxiliary source of d-c power is furnished by two 24-volt 24 ampere-hour batteries, designated forward and aft, in the forward wheel well. Each battery supplies power directly (through fuses and circuit breakers) to battery buses in the radar navigator's and pilots' circuit breaker panels and to several switched

battery buses. These switched battery buses are supplied battery power through switched battery bus relays when the battery switch is ON and TR power is not available. When forward TR power is available, the relays energize to the opposite position so that the loads are then supplied from forward TR power. Should a-c power fail, switched battery bus loads are assured of a source of power from the batteries for short periods. Loads such as landing gear emergency control, bomb salvo, emergency alarm, interphone, entry lights, fuselage overheat warning, and airbrake control are connected directly to battery buses to assure a source of power at all times. The batteries are charged from the TR buses through reverse current rectifiers. See Section III for emergency operation of battery power.

NOTE

Although control circuits for bomb salvo and landing gear emergency operation are on direct battery, completion of these operations requires the battery switch to be ON to provide power to start the four utility hydraulic packs and operate the bomb door control valves.

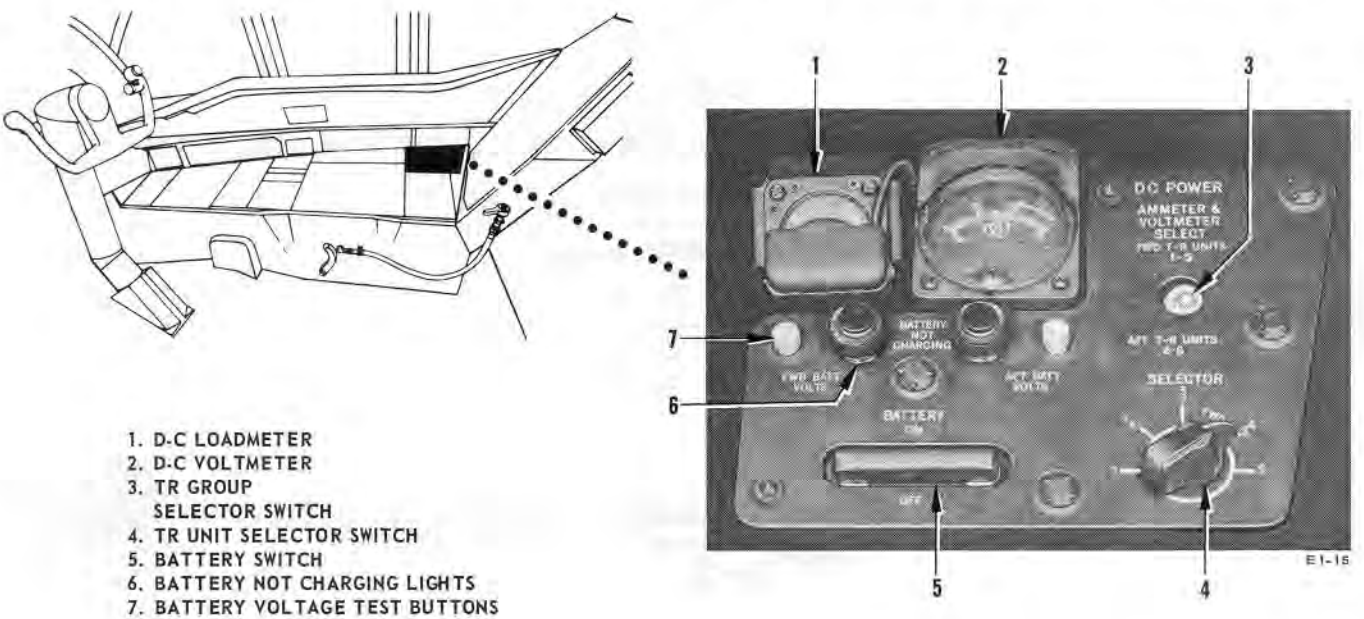
D-C Power System Controls

BATTERY SWITCH. A ganged ON--OFF battery switch (5, figure 1-21) on the d-c control panel routes battery power to the switched battery buses and controls battery charging. In ON position, battery power is directed to the switched battery buses through switched battery bus relays, and when TR power is available, relays are energized to direct charging power to the batteries. In OFF position, no battery power is available to the switched battery buses and no charging power is available to the batteries. Battery power is supplied directly from each battery to individual battery buses at all times, regardless of the position of the battery switch.

EMERGENCY BATTERY SWITCH. A NORMAL--EMERG emergency battery switch (29, figure 1-13 and 7B, figure 1-10) is located on the copilot's side panel. In EMERG position, this switch connects emergency battery power from the aft battery to the pilot's turn and slip indicator, pilot's pitot tube heater **Less PP**, landing gear position indicator, pilot's emergency flight instrument lights, interphone power, airbrake control, emergency alarm system, and fuselage overheat warning system. In NORMAL position, some loads receive power from the forward switched battery bus and some directly from the forward battery bus. Emergency battery power and its control is routed through circuit breakers on the pilots' overhead circuit breaker panel.

TR GROUP SELECTOR SWITCH. This switch (3, figure 1-21) on the d-c control panel provides selection of either the forward or aft TR unit groups for reading group bus voltage on the voltmeter. Positioning this switch is also necessary when reading the individual unit load on the loadmeter. The switch has positions FWD T-R UNITS--AFT T-R UNITS.

TR UNIT SELECTOR SWITCH. This switch (4, figure 1-21) on the d-c control panel provides individual selection of TR units for readings on the loadmeter.

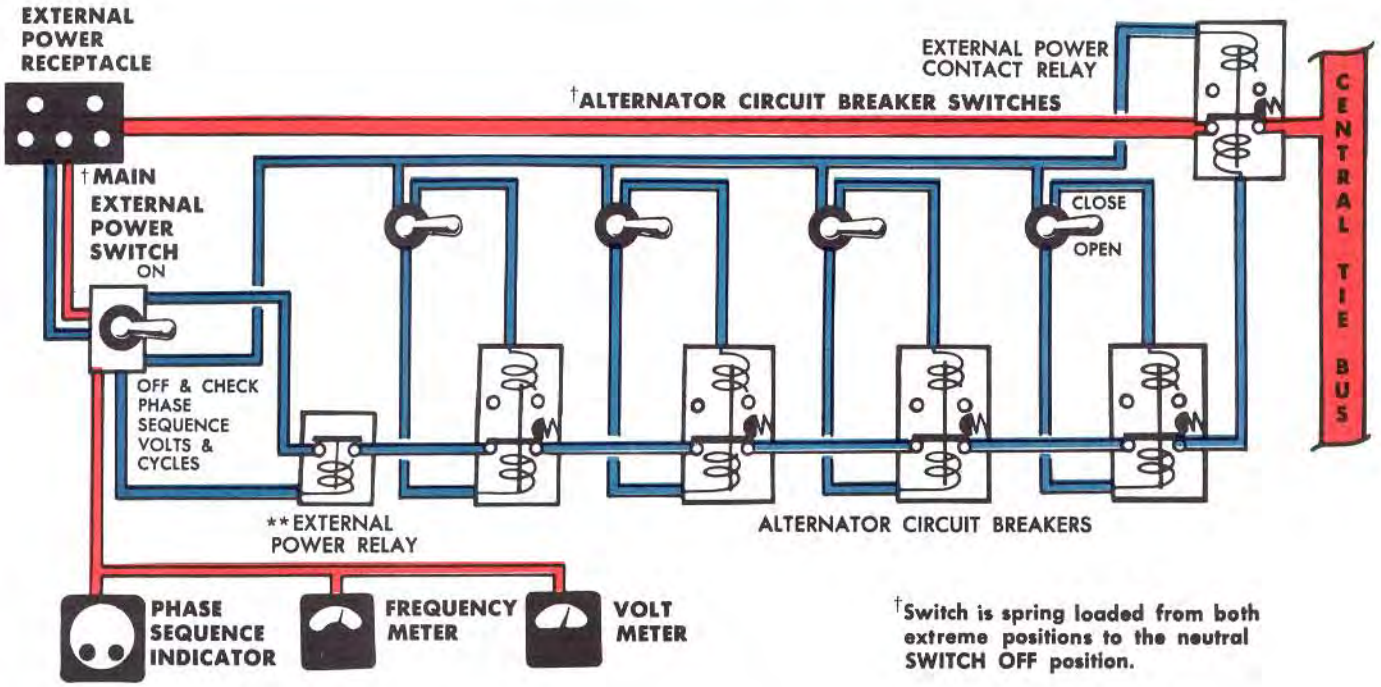


1. D-C LOADMETER
2. D-C VOLTMETER
3. TR GROUP SELECTOR SWITCH
4. TR UNIT SELECTOR SWITCH
5. BATTERY SWITCH
6. BATTERY NOT CHARGING LIGHTS
7. BATTERY VOLTAGE TEST BUTTONS

D-C control panel (typical)

Figure 1-21.

MAIN EXTERNAL POWER



†Switch is spring loaded from both extreme positions to the neutral SWITCH OFF position.

BOMBING-NAVIGATIONAL SYSTEM EXTERNAL POWER

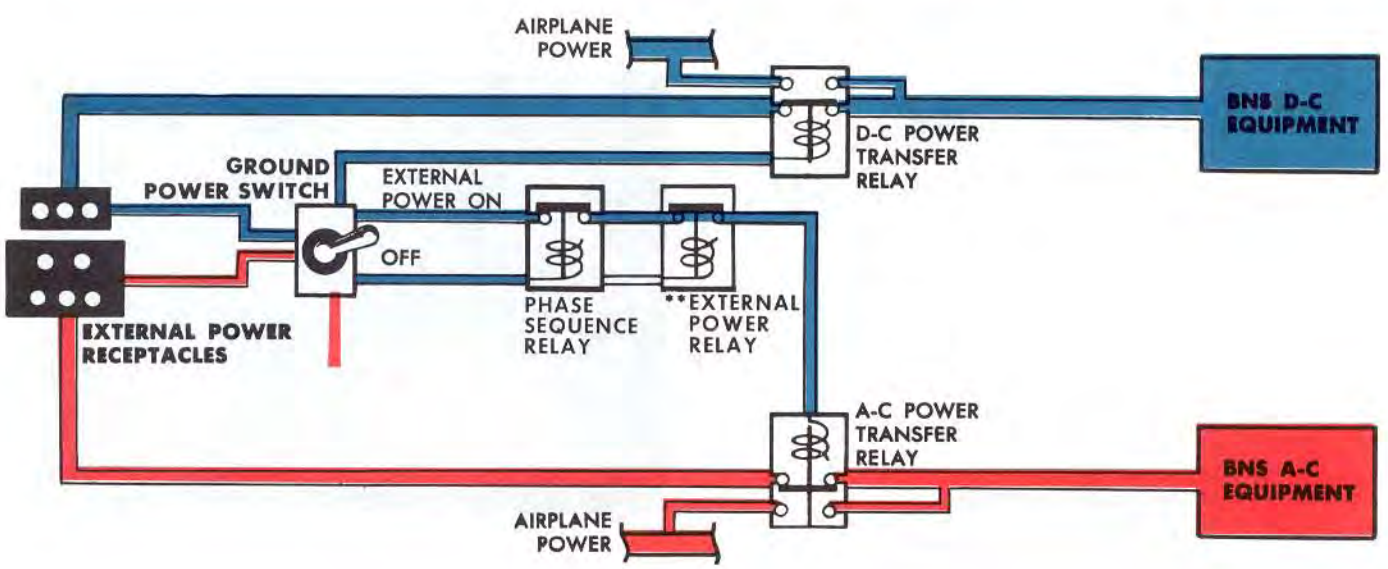


Figure 1-22. (Sheet 1 of 2).

A TR group selector switch in addition to the unit selector requires that the group selector switch be set to the proper group (forward or aft) before the unit selector switch is rotated to the desired units for loadmeter readings. The TR unit selector switch has FWD 1--2--3--4--5; AFT 6--7--8 positions.

BATTERY VOLTAGE TEST BUTTONS. Two buttons (7, figure 1-21) on the d-c control panel enable battery voltage to be read on the voltmeter. The buttons are marked "Fwd Batt Volts" and "Aft Batt Volts." When depressing a battery voltage test button, battery voltage will be read only when power is off the airplane or the battery switch is in OFF position. When power is on the airplane and the battery switch is in ON position, the voltage read when depressing a battery voltage test button will be TR voltage with a drop of approximately 1.5 volts because of the charging rectifiers.

D-C Power System Indicators

D-C VOLTMETER. A d-c voltmeter (2, figure 1-21) on the d-c control panel provides readings from 0 to 30 volts for either the forward or aft TR bus and for either the forward or aft battery.

D-C LOADMETER. A d-c loadmeter (1, figure 1-21) on the d-c control panel indicates individual TR unit load in tenths of TR unit capacity. Loadmeter readings can be obtained for the output of any TR unit.

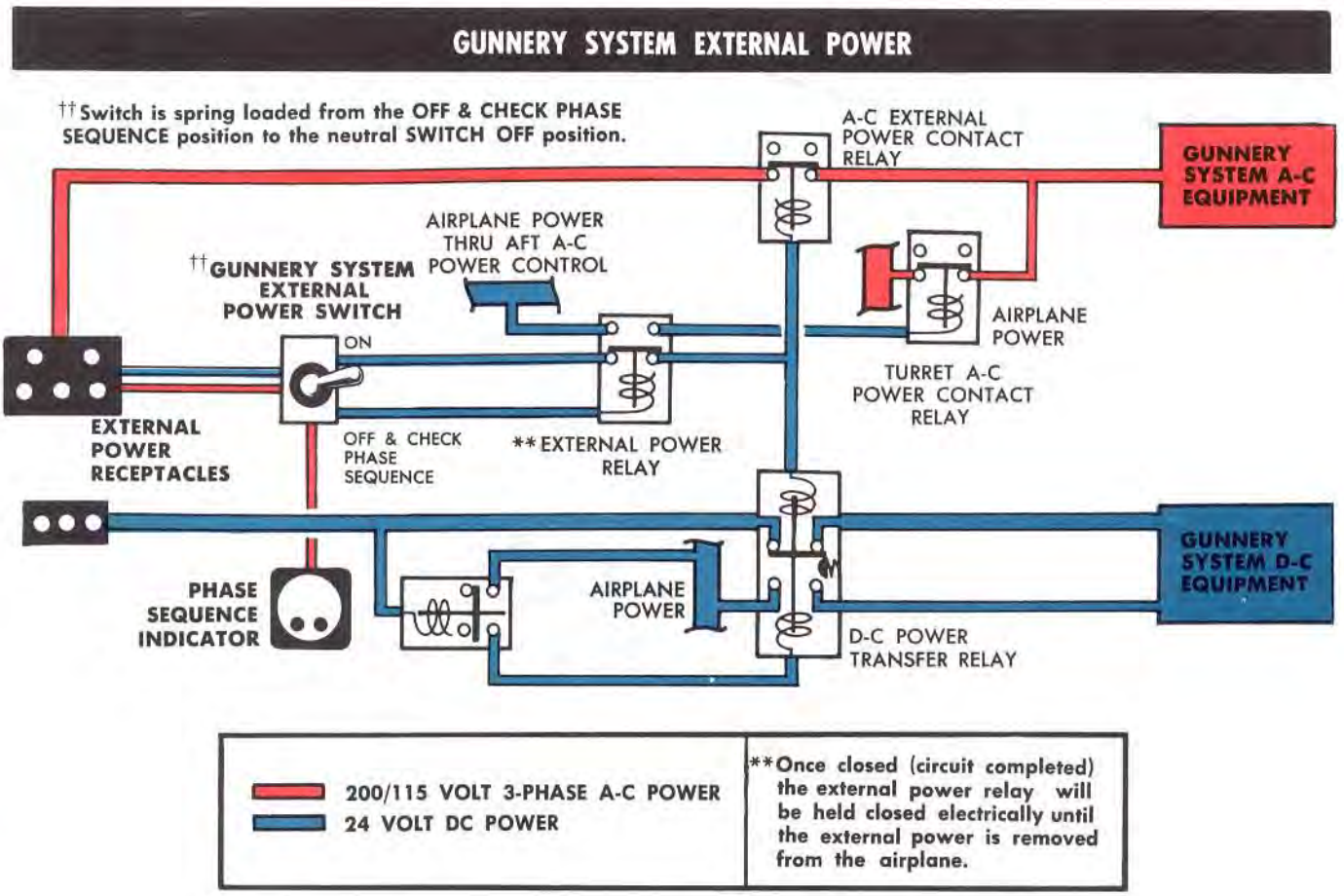


Figure 1-22. (Sheet 2 of 2).

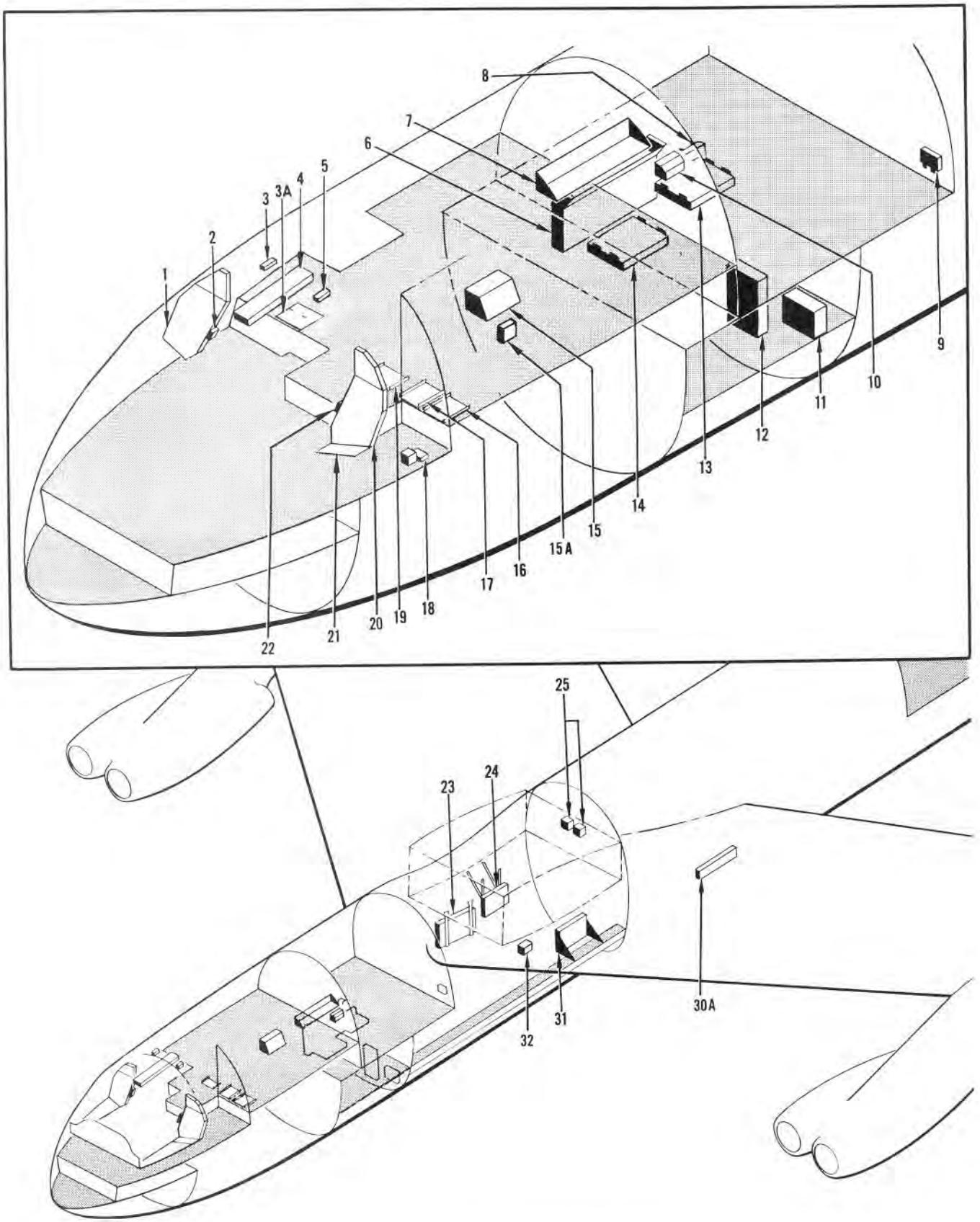
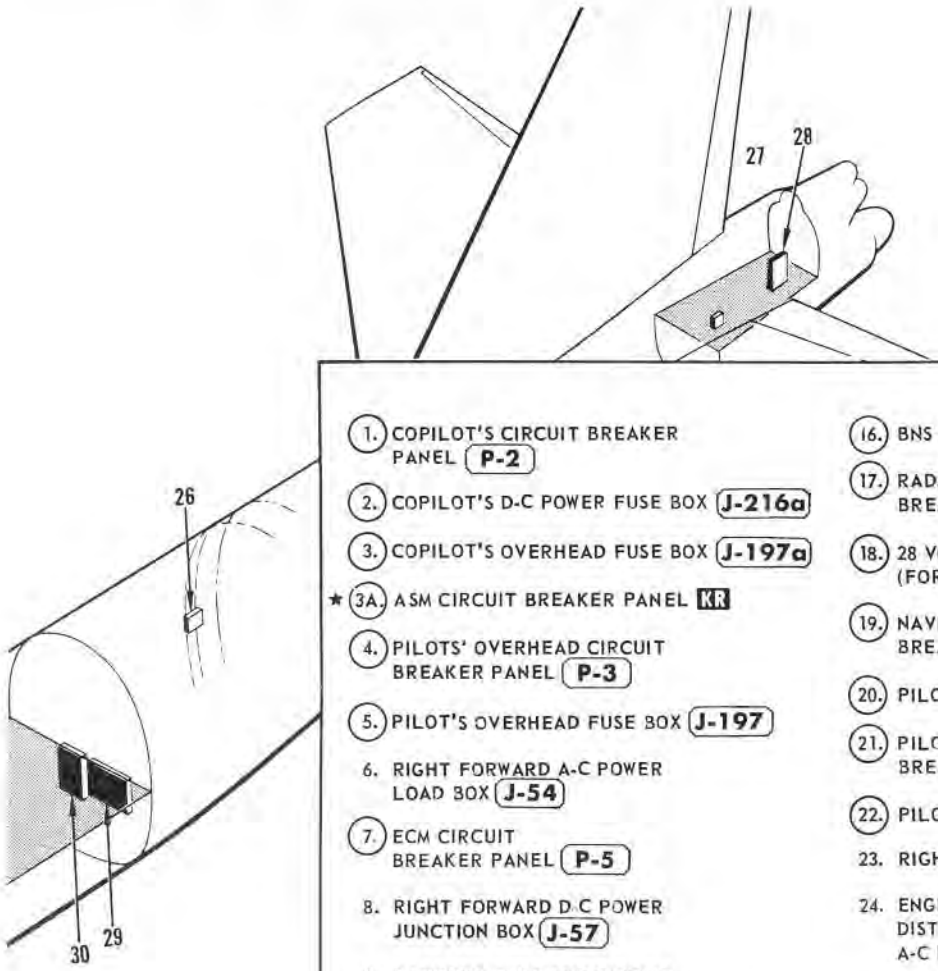


Figure 1-23 (Sheet 1 of 9).



1. COPILOT'S CIRCUIT BREAKER PANEL P-2
2. COPILOT'S D-C POWER FUSE BOX J-216a
3. COPILOT'S OVERHEAD FUSE BOX J-197a
★ 3A. ASM CIRCUIT BREAKER PANEL KR
4. PILOTS' OVERHEAD CIRCUIT BREAKER PANEL P-3
5. PILOT'S OVERHEAD FUSE BOX J-197
6. RIGHT FORWARD A-C POWER LOAD BOX J-54
7. ECM CIRCUIT BREAKER PANEL P-5
8. RIGHT FORWARD D-C POWER JUNCTION BOX J-57
9. BATTERY FUSE AND CIRCUIT BREAKER SHIELD J-79
10. ECM A-C POWER FUSE BOX J-254 Less NF
11. LEFT FORWARD D-C POWER JUNCTION BOX J-56
12. CENTRAL BUS TIE JUNCTION BOX J-37
13. ENGINE NO. 5 ALT A-C POWER DISTRIBUTION BOX B-52F OR RIGHT FWD A-C POWER DISTRIBUTION BOX B-52E J-60
14. ENGINE NO. 3 ALT A-C POWER DISTRIBUTION BOX B-52F OR LEFT FWD A-C POWER DISTRIBUTION BOX B-52E J-59
15. SECTION 41 POWER DISTRIBUTION PANEL J-253
15A. SECTION 41 AUXILIARY POWER DISTRIBUTION BOX J-276 NF

★ REFER TO T.O. 1B-52C-30-1 FOR CIRCUIT BREAKER INFORMATION

16. BNS CIRCUIT BREAKER PANEL P-79
17. RADAR NAVIGATOR'S CIRCUIT BREAKER PANEL P-4
18. 28 VOLT A-C POWER PANEL (FORWARD) J-217
19. NAVIGATOR'S AUXILIARY CIRCUIT BREAKER PANEL P-90
20. PILOT'S CIRCUIT BREAKER PANEL P-1
21. PILOT'S AUXILIARY CIRCUIT BREAKER PANEL P-7
22. PILOT'S D-C POWER FUSE BOX J-216
23. RIGHT AFT A-C POWER LOAD BOX J-55
24. ENGINE NO. 7 ALT A-C POWER DISTRIBUTION BOX B-52F OR RIGHT AFT A-C POWER DISTRIBUTION BOX B-52E J-61
25. WING FLAP MOTOR BOXES J-52 J-53
26. AFT D-C POWER SHIELD J-70
27. TAIL SECTION FUSE PANEL J-187
28. GUNNER'S CIRCUIT BREAKER PANEL P-6
29. AFT A-C POWER DISTRIBUTION SHIELD J-40
30. AFT A-C POWER TRANSFER SHIELD J-38 Less NF
30A. SWESS EQUIPMENT
31. ENGINE NO. 1 ALT A-C POWER DISTRIBUTION BOX B-52F OR LEFT AFT A-C POWER DISTRIBUTION BOX B-52E J-58
★ 32. GAM-77 ARMAMENT PROVISIONS BATTERY CIRCUIT BREAKER PANEL KR

○ ACCESSIBLE IN PRESSURIZED FLIGHT. ALL OTHER UNITS SHOWN ARE ACCESSIBLE ONLY IN UNPRESSURIZED FLIGHT.

circuit breaker and fuse locations

Figure 1-23 (Sheet 2 of 9).

CIRCUIT	PANEL
AIR BRAKE SYSTEM	
AIRBRAKE CONTROL	(4)
AIR REFUELING SYSTEM	
DISCONNECT	(4)
EXTERNAL LIGHTS	(4)
FUEL VALVES & HYDRAULIC PACK SHUTOFF	(4)
MANUAL CONTROL	(4)
SIGNAL AMPLIFIER 190▶239 W70▶W119	(4)
SIGNAL AMPLIFIER & DRAIN VALVE 240▶W120▶	(4)
SLIPWAY DOOR, NORMAL, ALTERNATE	(4)
AN/AJM-14( ) MONITORING SET QP	
AN/AJM-14( ) AC	(15)
AN/AJM-14( ) DC	(15)
ANTI-ICING SYSTEM	
AIRSCOOP ANTI-ICE CONTROL	(20)
ESCAPE HATCH CONTROL	(20)
FACE PLATE DEFOG	(7) (20) & (28)
NACELLE CONTROL	(20)
PITOT TUBE HEAT	(20) or (20) & 23
WINDSHIELD CONTROL	(20)
WINDSHIELD RELAYS	6, (15) & (20)
Q-SPRING SCOOP LK	(20) & 29
AUTOMATIC PILOT/FLIGHT CONTROL SYSTEM	
AUTOMATIC PILOT	(4)
YAW DAMPER SY	(20)

CIRCUIT	PANEL
BOMB DOOR SYSTEM	
AFT & FORWARD VALVES	(20)
EMERGENCY VALVE FORWARD	(20)
HOLD OPEN	(20)
POSITION INDICATORS	(17) & (20)
BOMB DOOR VALVE CHECK	(17)
BOMB DOOR RELAYS	(20)
HYDRAULIC PRESSURE INDICATOR	(17)
MA-2 (CLOSE) TIMER	(17)
BOMBING SYSTEM	
BOMB JETTISON LH UM	8
BOMB JETTISON RH UM	8
EMERGENCY RELEASE (Fwd & Aft)	30A
EXTERNAL ARM UM	(17)
EXTERNAL RELEASE UM	(17)
JETTISON POWER & CONTROL	(17)
INDICATOR LIGHTS	(17)
MONITOR CONTROL	(17)
NORMAL RELEASE	(17)
RELEASE HEATER POWER & CONTROL	(17)
RACK SELECT	(17)
PARACHUTE STATIC LINE CONTROL	(17)
PARACHUTE STATIC LINE CONTROL HEATERS	(17)
SWESS	(17) & 30A
SWESS BATTERY HEATER	(17)
BOMB NAV SYSTEM	
AZIMUTH DRIVE	(16)
BNS CONTROL	(16)

Figure 1-23 (Sheet 3 of 9).

CIRCUIT	PANEL
BOMB NAV SYSTEM (CONT)	
BNS OVERHEAT CONTROL	16
BNS RADAR PRESSURIZATION	16
BOMB-NAV EXCITATION	16
BOMB-NAV POWER SUPPLY	16
FILAMENTS	16
HEAT EXCHANGE PUMP	16
HSBR POWER	16
HSBR/RDPS EXCITATION	16
MODULE HEATERS	16
GROUND COOLING	16
MODULATION POWER	16
DESICCATOR	16
RDPS POWER SUPPLY	16
−500/150 LH	16
+600V	16
+300V/+150, −300V/−150V Less LH	16
NO. 1 +300V/+150V, NO. 2 +300V/+150V LH	16
DESICCATOR	16
PLATE POWER	16
SYNCHRO BUS	16
TOPOCOMP	16
TOPOCOMP COMPARATOR	16
TUNING DRIVE	16

CIRCUIT	PANEL
BRAKE SYSTEM	
ANTISKID CONTROL	20
ANTISKID VALVES	8 & 11
CABIN AIR CONDITIONING SYSTEM	
AIR CONDITIONING CABIN CONTROL	20 & 28
AIR CONDITIONING TEMPERATURE REGULATOR	20 & 28
AIR CONDITIONING AIR BLOWERS	20
AIR CONDITIONING RAM AIR VALVE, FWD COMPT	6
CABIN TEMPERATURE MOD VALVE, FWD	6
CABIN AIR CONDITIONING VALVE, AFT	29
AIR CONDITIONING WATER SEPARATOR BYPASS VALVE	20 & 29
BODY BLEED VALVE	28 & 15
RAM AIR BLEED	28 & 15
AIR CONDITIONING SAFETY VALVE	28
COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT	
INTERPHONE POWER (AN/AIC-10)	4, 5 & 20
UHF COMMAND (AN/ARC-34)	4 & 28 or 15 & 26
LIAISON RADIO (AN/ARC-65)	28
IFF TRANSPONDER SET (AN/APX-25)	17

.....circuit breaker and fuse locations (cont)

Figure 1-23. (Sheet 4 of 9).

CIRCUIT	PANEL
ECM SYSTEMS	
REFER TO T.O. 1B-52E-1A	
ELECTRICAL SYSTEM	
A-C INDICATORS	(2)
BATTERY CHARGING UNITS	8 & 11
ALTERNATOR CONTROL	(2)
ALTERNATOR DISTRIBUTION	13, 14, 24 & 31
TR UNITS (AFT)	26
TR UNITS (FWD)	8 & 11
EXTERNAL POWER	(2)
ALTERNATOR OVERLOAD POWER	8 & 11
OVERHEAD POWER TR SWITCHED BATTERY	(20)
NAV LIGHTS TRANSFORMER (FUSES)	(21)
PILOT TR POWER, SWITCHED BATTERY	(20)
FLIGHT GYRO POWER & CONTROL	(4) or (21)
COPILOT SWITCHED BATTERY, FWD & AFT BUSES	(1)
AFT SWITCHED BATTERY POWER	(4)
IGNITION, FWD & AFT BUSES	(1)
BATTERY POWER, PILOT & RADAR NAV	(4)
FORWARD SWITCHED BATTERY POWER	(4)
BNS OVERHEAD A-C POWER	(15)
PILOT'S A-C POWER	(15)

CIRCUIT	PANEL
ELECTRICAL SYSTEM (CONT)	
COPILOT'S A-C POWER	(15)
BNS D-C POWER	(15)
PILOT'S D-C POWER	8 & 11
COPILOT'S D-C POWER	8 & 11
GUNNER'S D-C POWER	26
ECM A-C POWER	(15)
28-VOLT A-C POWER	(15)
AFT CABIN POWER CONTROL	(28)
AFT 28-VOLT TRANSFORMER POWER	(28)
ENGINES	
AIR BLEED VALVES	(20)
CONTROL	(1)
FIRE DETECTION	(21)
IGNITION	(1)
PRESSURE RATIO INDICATORS	(15) & (21)
OIL COOLER VALVES	(21)
OIL PRESSURE INDICATOR	(21)
STARTERS	(21)
WATER INJECTION SYSTEM	8, 11, 13, 14 (21), 24 & 31
WING DRAIN VALVES	(21)

Figure 1-23 (Sheet 5 of 9).

CIRCUIT	PANEL
FIRE CONTROL SYSTEM	
AIR COMPRESSOR	(28)
AIR CONDITIONING CONTROL	(28)
AMMO BOOSTERS	(28)
CONTROL COLUMN	(28)
CONTROL PANEL	(28)
FCS EVALUATOR MQ	(28)
HEATERS	(28)
POWER CENTRAL	(28)
SEARCH RADAR	(28)
TRACK RADAR	(28)
TURRET	(28)
FLAP SYSTEM	
FLAP BRAKES	8 & 11
FLAP CONTROL	(20)
FLAP INDICATORS	(20)
FLAP MOTOR POWER	6, 23 & 25
FLIGHT CONTROL SYSTEM	
LATERAL TRIM	(20)
LATERAL TRIM INDICATOR	(20)
STABILIZER CONTROL	(4)
STABILIZER RELAY	(4) & 29
STABILIZER TRIM HEATER	(28)
FUEL SYSTEM	
FIRE SHUTOFF VALVES	(1)
BOOST PUMP CONTROL	(1)
BOOST PUMP POWER	6, 23 & 29
FLOW INDICATORS	(1)
TOTAL QUANTITY INDICATOR	(1)
LEVEL CONTROL VALVES	(1)
TRANSFER VALVE CONTROL	(1)
SCAVENGE	(1) & 6
TANK DROP POWER, L & R	6
L & R DROP AIR PRESSURE	(1) & (17)
DROP TANK JETTISON	(20)
MANIFOLD PRESSURE L & R	(4)
WARNING LIGHT, MAIN TANK	(1)
HYDRAULIC SYSTEM	
HYDRAULIC PACKAGE CONTROL	(20)
PRESSURE WARNING LIGHT	(20)
PRESSURE INDICATOR	(20)

..... circuit breaker and fuse locations (cont)

Figure 1-23 (Sheet 6 of 9).

CIRCUIT	PANEL
HYDRAULIC SYSTEM (CONT)	
STANDBY PUMPS	6, 23 & 29
STANDBY PUMP CONTROL	(20)
HEATER, HYD PACKS	6, 23 & 29
INSTRUMENTS	
COPILOT'S ATTITUDE INDICATOR	(4)
DIRECTIONAL INDICATOR (GYRO)	(20)
PILOT'S ATTITUDE INDICATOR	(4) or (20)
OUTSIDE AIR TEMPERATURE	(20)
TURN & SLIP INDICATORS	(20)
EMERGENCY FLIGHT INSTRUMENT LIGHTS	(10) or (20)
FLIGHT GYROS	(4) or (21)
RADAR ALTIMETER SQ	26 & 29
LANDING GEAR AND STEERING SYSTEM	
ANTISKID CONTROL	(20)
ANTISKID VALVES	8 & 11
CROSSWIND CRAB INDICATOR	(20)
EMERGENCY LANDING GEAR CONTROL	(20)
EMERGENCY TIP GEAR CONTROL	(20)
LANDING GEAR CENTERING	(20)
LANDING GEAR POSITION & WARNING	(20)
SAFETY SWITCH RELAY B-52E	(20)
WARNING HORN (LANDING GEAR & FLAP)	(20)

CIRCUIT	PANEL
LIGHTING EXTERIOR	
AIR REFUELING EXTERNAL LIGHTS	(4)
ANTICOLLISION	(4)
CROSSWIND LANDING	(4)
LANDING LIGHTS	(4)
NAVIGATION	(4)
TAXI	(4)
TERRAIN CLEARANCE	(4)
LIGHTING INTERIOR	
AISLE & SPOT	(7), (19), (20) & (28)
DOME	(7), (19), (20) & (28)
ENTRY	(19) & (28)
INSTRUMENT (EMERGENCY)	(4) or (7) & (20)
DIMMING CONTROL	(20)
PANEL	(7), (19), (20) & (28)
PRESS TO TEST	(20)
SIGNAL LIGHT RECEPTACLE	(15) or (28)
STANDBY COMPASS	(20)
INSTRUMENT	(4) & (19) (20) & 28

Figure 1-23 (Sheet 7 of 9).

CIRCUIT	PANEL
LIGHTING — INTERIOR (CONT)	
THUNDERSTORM	(20)
FLOOD	(7), (19) & (20)
SERVICE	(19)
WALKWAY & CRAWLWAY	(19)
MISCELLANEOUS SYSTEMS	
BODY OVERHEAT DETECTOR	(4)
EMERGENCY WARNING ALARM	(4) & 11
CAMERA CONTROL	(17)
SEAT POSITION	(4) or (20), (7) & (17)
INTERPHONE DYN, CALL	(17)
BNS OUTLETS	(15)
ECM TEST RECEPTACLES	6, (10), 11, 26 & 29
ANTENNA COUPLING	(28)
HOT CUP	(17) & (28)
IFF TEST RECEPTACLES	(15) & (17)
PRESSURE INDICATOR (SECTION 49)	(1) & (28)
RAM BLOWER VALVES	6 & 23
PRESSURE WARNING (SECTION 49)	(1) & (28)

CIRCUIT	PANEL
MISCELLANEOUS SYSTEMS (CONT)	
TEST POWER BOMB BAY	11
WINDSHIELD WIPER	(20)
VGH RECORDER	(20)
DEPRESSURE WARNING (REQUEST)	(21)
EJECTION HATCH WARNING	(21)
FREE AIR TEMPERATURE	(20)
GROUND CHECKOUT, FUEL & REFUEL SYSTEMS	(21)
MISSILE SYSTEM (GAM-72)	
GAM-72 CONTROL	11
FIRE WARNING	(4)
JETTISON CONTROL	(4) & (17)
LAUNCH CONTROL	(17)
MISSILE RELEASE ACTUATOR	(17)
MISSILE RELEASE CARTRIDGES NO. 1 & 2	(17)
NTI	(17)
PROGRAM CONTROL	(17)
POWER FUSES	(6)
MISSILE SYSTEM (GAM-77)	
REFER TO T.O. 1B-52C-30-1 FOR CIRCUIT BREAKER INFORMATION	

.....circuit breaker and fuse locations (cont)

Figure 1-23 (Sheet 8 of 9).

CIRCUIT	PANEL
NAVIGATION EQUIPMENT	
AN/APN-69 RADAR BEACON	(28) & (29)
AN/ARN-31 GLIDE SLOPE	(15) & (20)
AN/APN-89	(16)
AN/ARN-14 ODR	(20) & (28)
ASTROCOMPASS MD-1	(17)
DIRECTION FINDER, AN/ARA-25	(28)
N-1 COMPASS	(17)
N-1 COMPASS AMPLIFIER	(17)
ME-1 COMPASS AMPLIFIER	(17)
PERISCOPIC SEXTANT	(17)
AIRSPEED COMPUTER	(15) & (20)
AN/ARN-21 TACAN	(20)

CIRCUIT	PANEL
NAVIGATION EQUIPMENT (CONT)	
TRUE HEADING COMPUTER	(17)
AN/ARN-32 MARKER BEACON	(17)
PHOTOGRAPHIC EQUIPMENT	
CAMERA CONTROL POWER	(17)
CAMERA DOOR CONTROL	(17)
CAMERA EXCITATION KG	(16)
TERRAIN RADAR	
PILOT IND HV POWER SUPPLY, 25 AMP PQ	(16)
TERRAIN COMPUTER BLOWERS	(17)
TERRAIN DISPLAY	(16)

.....circuit breaker and fuse locations (cont)

Figure 1-23 (Sheet 9 of 9).

Pages 1-59 thru 1-64, deleted.

BATTERY NOT CHARGING LIGHTS. Two red battery not charging lights (6, figure 1-21) on the d-c control panel illuminate to indicate a battery not charging condition. The lights will illuminate when forward TR power is available with the battery switch in OFF position or when no TR power is available and the battery switch is in ON position. The lights will go out when the battery switch is in ON position with TR power available or with the battery switch in OFF position and no TR power available. The battery not charging lights receive switched battery power through a circuit breaker marked "Copilot Sw Battery Fwd Bus" on "TR Power" portion of the copilot's circuit breaker panel.

EXTERNAL ELECTRICAL POWER SYSTEMS

Three external power receptacles are provided for energizing airplane equipment from an external source; a main receptacle, a bombing navigational system receptacle, and a gunnery system receptacle.

Main External Power

The main external power is routed into the central tie junction box by means of a main external power receptacle (21, figure 1-60) located on the right side of the fuselage adjacent to the forward wheel well. This receptacle has a total of five pins; three pins take 205-volt three-phase a-c power, one pin is for ground, and one pin is for 24-volt d-c power to operate the connection relay. This relay which connects a-c power to the airplane is closed through actuation of a switch on the copilot's a-c control panel. In addition, the relay is closed through the open side of the alternator circuit breakers so that when any alternator circuit breaker is closed, external power is isolated from the airplane. D-C power is provided by airplane TR units utilizing external a-c power.

Bombing Navigational System External Power

External power for the bombing navigational system is routed to the radar navigator's circuit breaker panel by means of a double receptacle (24, figure 1-60) located on the right side of the fuselage adjacent to the forward wheel well above and forward of the main external power receptacle. This unit consists of two receptacles; one for a-c power which is identical with the main external power receptacle, and one for d-c power. The d-c receptacle has three pins; two to take 24-volt dc for control and power, and one for ground.

Gunnery System External Power

The external power for the gunnery system is routed to the aft a-c power transfer shield by means of a double receptacle (10, figure 1-60) aft of and adjacent to the right rear wheel well. The gunnery system external power receptacle supplies both 205-volt three-phase a-c power and 24-volt d-c power to the gunnery system and is essentially the same as the bombing navigational system external power receptacle.

External Electrical Power System Controls

EXTERNAL POWER SWITCHES. A three-position switch for controlling external power is provided for each external power system. The main external power switch (12, figure 1-19) on the a-c control panel is marked ON--OFF & CHECK PHASE SEQUENCE VOLTS & CYCLES. The switch is spring-loaded to the neutral unmarked OFF position. In OFF & CHECK PHASE SEQUENCE VOLTS & CYCLES position with ground cart power on the main receptacle, the phase sequence is read on the phase sequence indicator, the voltage and frequency are read on the voltmeter and frequency meter, and the external power control circuit is armed. In ON position, d-c power closes an external power circuit breaker which will connect external power to the aircraft distribution system. This circuit breaker will remain closed only as long as the four alternator circuit breakers remain open. The main external power circuit breaker is tripped by any one of the following actions:

1. Failure of external power or removal of external power plug.
2. Placing an alternator circuit breaker switch in the CLOSE position.
3. Placing the main external power switch in OFF & CHECK PHASE SEQUENCE VOLTS & CYCLES position.

CAUTION

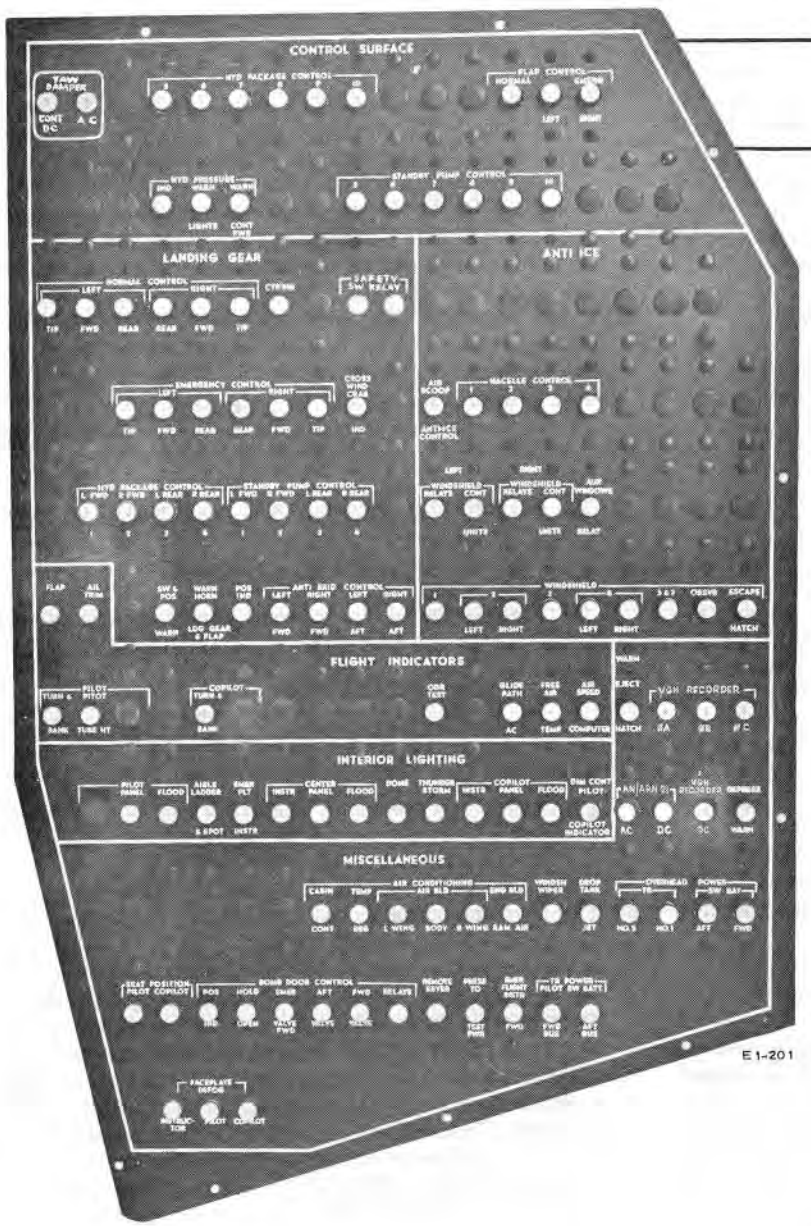
In order to disconnect external power, the "Ext Pwr CB Trip" circuit breaker on the copilot's circuit breaker panel must be in.

The bombing navigational system external power switch (3, figure 4-38 and 42, figure 4-38A) is on the radar navigator's side panel and the gunnery system external power switch (7, figure 4-55) is on the gunner's panel. They operate in a manner similar to the main receptacle external power switch except that the external power relay circuits are not connected through the alternator circuit breakers. The navigational system switch is marked "Ground Power" with ON--OFF positions. The gunner's external power switch is marked ON--OFF --CHECK PHASE SEQUENCE and is spring-loaded from CHECK PHASE SEQUENCE position to OFF position. Voltage and frequency of these two external power systems are not read on the aircraft indicators.

External Electrical Power System Indicators

PHASE SEQUENCE INDICATORS. Indicators are provided to indicate external power phase sequences (except BNS) since three-phase motors will run backwards if phase sequence is incorrect. An indicator (11, figure 1-19; figure 1-22; 4, figure 4-38; and 8, figure 4-55) is adjacent to each external power switch and operates through the switch. Each indicator has two lights marked "1 2 3 Correct" and "3 2 1 Reversed."

PILOT'S CIRCUIT BREAKER PANEL (P-1)



SEE FIGURE 1-23 FOR LOCATION OF CIRCUIT BREAKER PANELS

PILOT'S AUXILIARY CIRCUIT BREAKER PANEL (P-7)

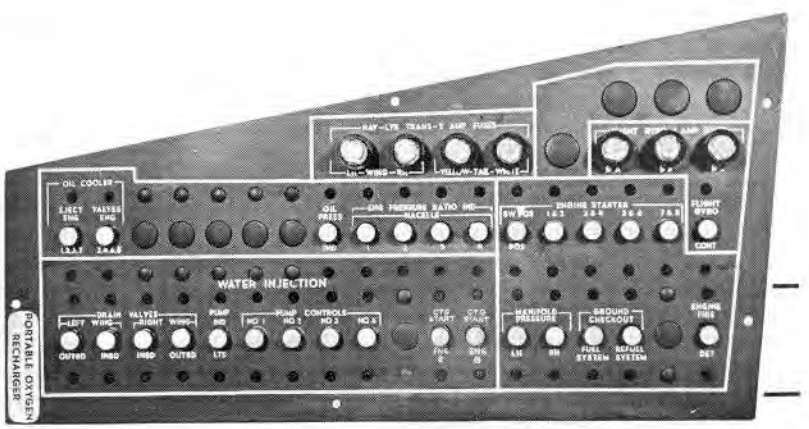
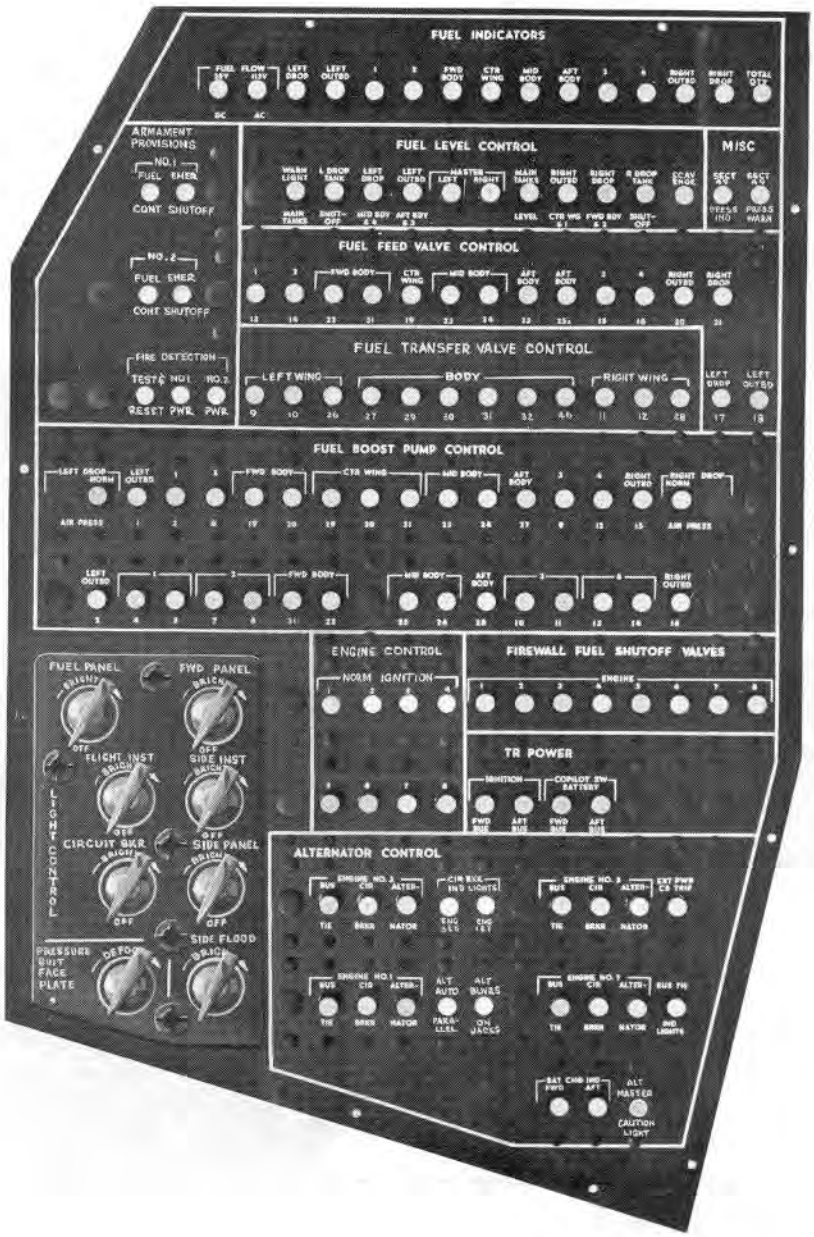


Figure 1-24 (Sheet 1 of 6).

COPILOT'S CIRCUIT BREAKER PANEL (P-2)

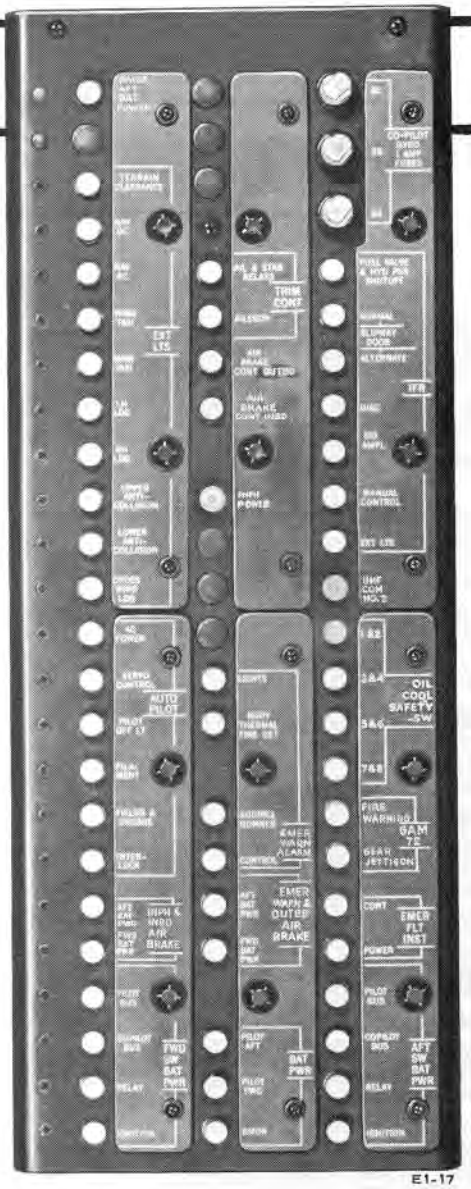


E1-202

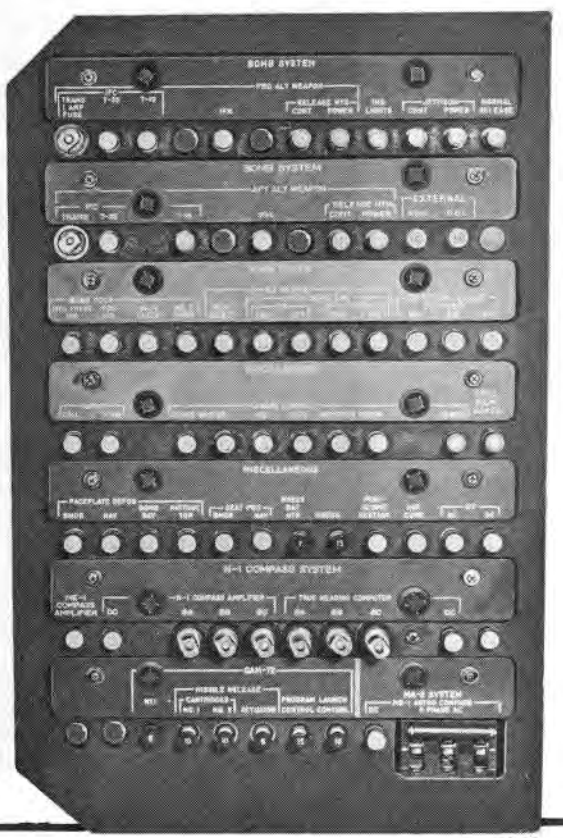
.....circuit breaker panels (typical)

Figure 1-24. (Sheet 2 of 6).

PILOTS' OVERHEAD CIRCUIT BREAKER PANEL (P-3)



E1-17

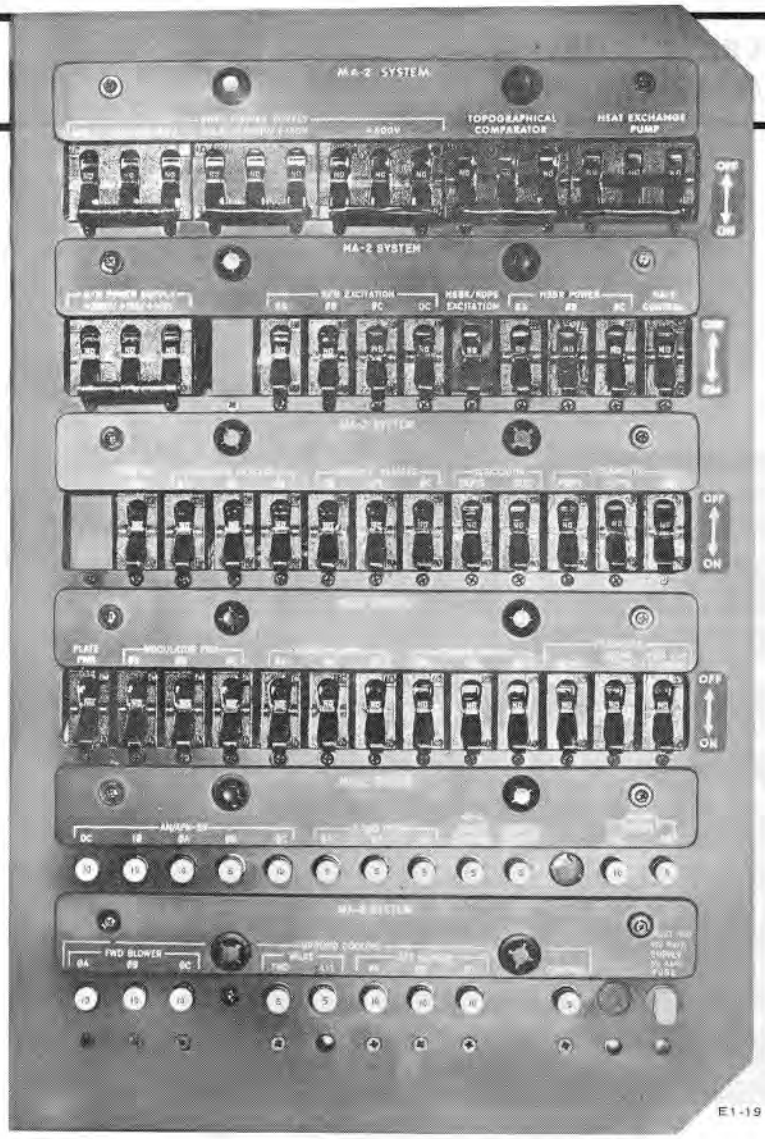


E1-18

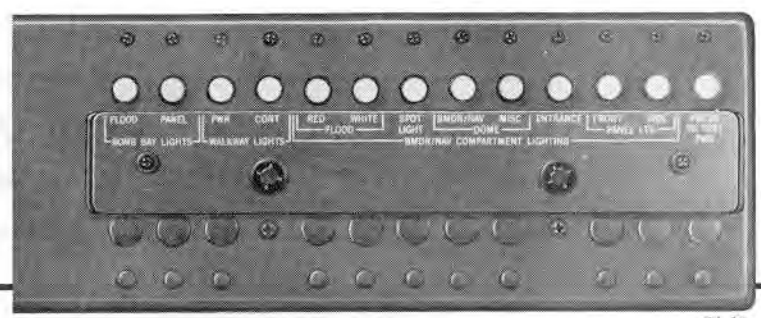
RADAR NAVIGATOR'S CIRCUIT BREAKER PANEL (P-4)

Figure 1-24 (Sheet 3 of 6).

BNS CIRCUIT BREAKER PANEL (P-79)



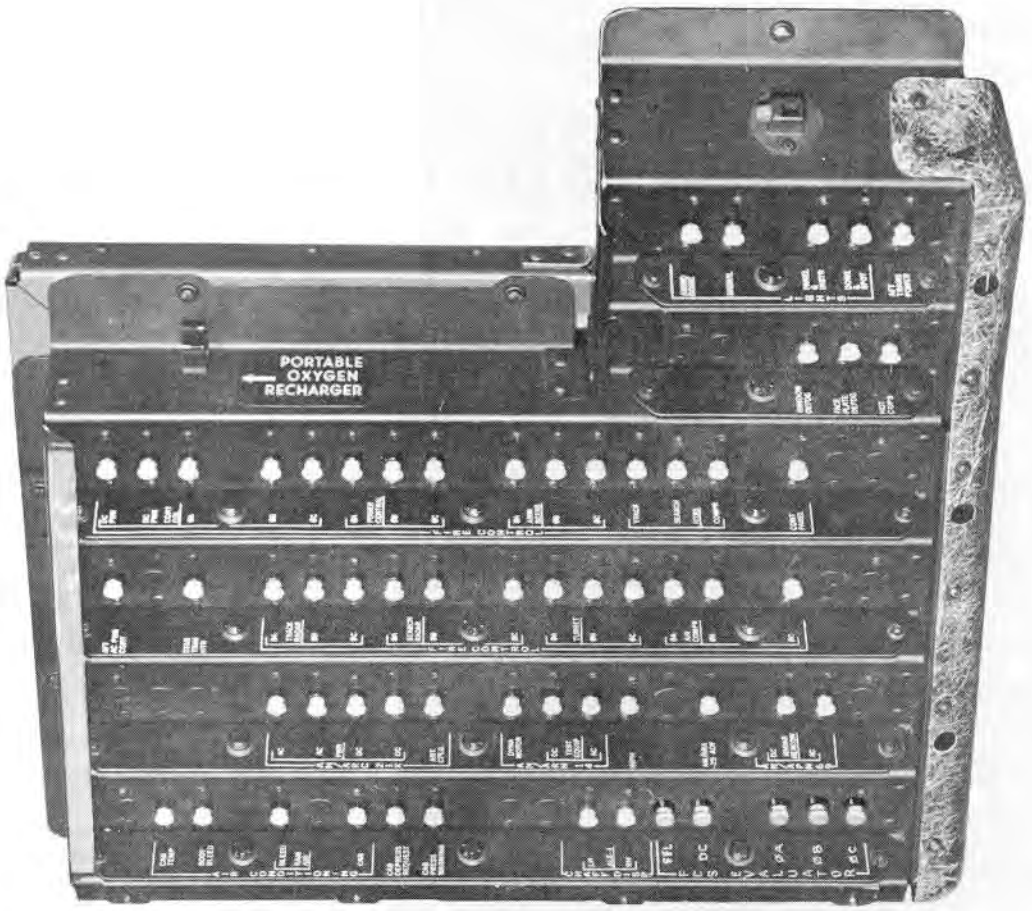
NAVIGATOR'S AUXILIARY CIRCUIT BREAKER PANEL (P-90)



.....circuit breaker panels (typical) (cont)

rigure 1-24 (Sheet 4 of 6).

GUNNER'S CIRCUIT BREAKER PANEL (P-6)



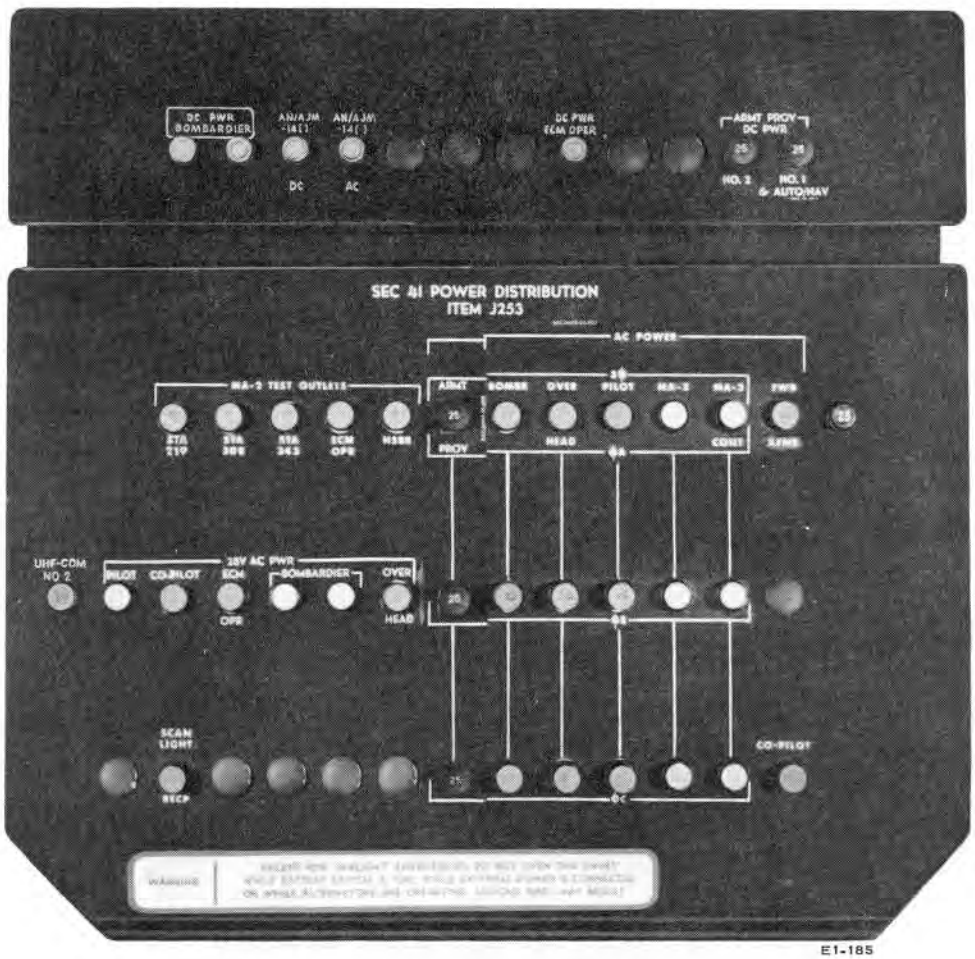
E1-21

ECM CIRCUIT BREAKER PANEL (P-5)

REFER TO T.O. 1B-52E-1A

Figure 1-24 (Sheet 5 of 6).

SECTION 41
POWER DISTRIBUTION PANEL



E1-185

ASM CIRCUIT BREAKER PANEL
REFER TO T.O. 1B-52C-30-1

.....circuit breaker panels (typical)

Figure 1-24 (Sheet 6 of 6).

HYDRAULIC POWER SUPPLY SYSTEMS

The hydraulic power supply system of this airplane differs from a conventional system in its decentralization. Instead of the usual single main hydraulic system serving an entire airplane, there are 10 individual hydraulic systems (figure 1-25) supplying power to the various hydraulic mechanisms of the airplane. Hydraulic systems 1, 2, 3, and 4 supply the main landing gear, wheel brake, steering and crosswind crab, bomb door, and slipway door systems. Hydraulic systems 5, 6, 7, and 8 supply the spoiler and airbrake and the tip gear systems. Hydraulic systems 9 and 10 supply the stabilizer trim system. As a safety feature, all essential hydraulically operated equipment is provided with two unrelated sources of pressure; thus, if one system should fail, the alternate system will permit continued operation on either an emergency or a normal basis. A turbine-driven hydraulic pack (operated by air from the air bleed system) in each of the 10 hydraulic systems is the source of supply for hydraulic pressure. Supplementary pressure is available upon demand from an electrically driven hydraulic standby pump. Decentralization of the hydraulic system saves weight (shorter tubing runs and less fluid). It also reduces battle vulnerability from the standpoint that shorter tubing runs present smaller targets. In addition, the alternate sources of hydraulic pressure give increased life to vital equipment during either combat or routine missions.

NOTE

Slight damage to an air bleed duct will not seriously impair operation of the hydraulic system.

TYPICAL HYDRAULIC POWER SUPPLY SYSTEM

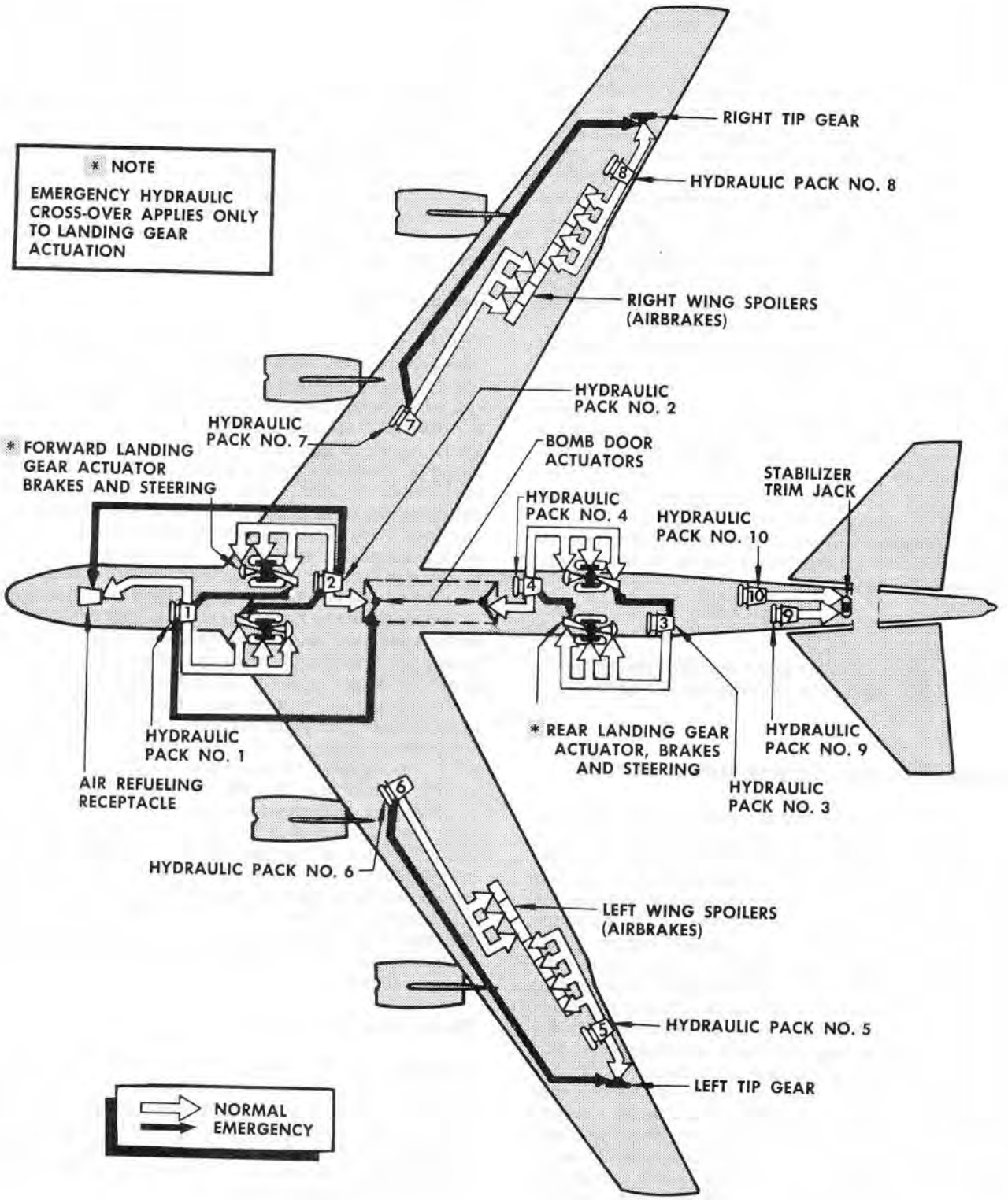
Each of the individual hydraulic power supply systems (figure 1-26) has the function of supplying hydraulic fluid under pressure for the distribution systems (brakes, steering, landing gear, etc). Each hydraulic system includes a hydraulic pack which normally provides the hydraulic pressure for the system and a pressure switch-operated standby pump to supply system pressure for emergencies. A pressure bypass valve permits the standby pump to start under a no-load condition by bleeding pressure between the standby pump and the check valve. A restrictor is provided between the pressure and return lines to allow a quick pressure drop to indicate pack failure through a pressure switch and warning light. Check valves separate the two sources of pressure and allow the pack and/or standby pump to furnish system pressure. A pressure relief valve limits maximum pressure in the system to 3750 (±100) psi at full flow and a pressure transmitter gives the system pressure through a hydraulic pressure gage. Oil-air type accumulators with attached air gages are provided. Systems 1, 2, 3, 4, 9, and 10 each have an accumulator and a restrictor valve to prevent momentary drops in pressure caused by small service demands and also to prevent short cycling of the standby pump. There are two accumulators each on systems 5, 6, 7, and 8. There are no restrictor valves in systems 5, 6, 7, and 8. Systems 1, 2, 3, and 4 operate continuously during gear down operation. With the landing gear up and locked, these systems operate exclusively on a pressure demand basis for bomb bay and slipway door actuation. If there are no pressure demands, these packs remain inoperative. Systems 5, 6, 7, 8, 9, and 10, however, are continuous duty systems with packs operating at all times.

Hydraulic Pack

There are three parts to each hydraulic pack: the turbine driven by air from the air bleed system; the gearbox driven by the turbine and including the governor and overspeed control; and the reservoir containing the hydraulic oil and housing a main hydraulic pump, a control oil pump, and a scavenge pump. Turbine speed is controlled by two valves which are located in the turbine air duct. The shutoff valve which starts and stops the pack is controlled by a shutoff valve control unit. Located between the shutoff valve and the pack is a speed control valve. This valve is controlled by the governor unit which automatically regulates turbine speed. A visual sight gage to indicate the quantity of hydraulic oil in the reservoir is located on the end of the hydraulic pack opposite the turbine. The reservoir has a maximum capacity of 4 gallons. The main hydraulic pump, a variable displacement piston type, is submerged in the reservoir. Operating at one-tenth turbine speed, the pump supplies 8 gpm at 2650 psi with a maximum pressure of 3000 (±250) psi. The control oil pump supplies oil for actuating the speed control valve. It also provides the oil supply to lubricate the gearbox and overspeed control unit. A low oil pressure shutoff circuit is incorporated which will automatically shut off the pack in the event of low control oil pressure. The reservoir is pressurized by an air line from the turbine at sea level from 14 to 16 psi to minimize the boiling effects of fluid at high altitudes. A negative "g" tank in the reservoir provides the pumps with hydraulic fluid during periods of negative gravitational force.

Shutoff Valve Control Unit

The shutoff valve control unit mechanically opens or closes the shutoff valve in the turbine air duct. This mechanical action is performed by a motor-driven actuator in the control unit which is electrically operated by the hydraulic pack switch. A cam on the drive shaft of the control unit acts as a limit switch for the extreme positions of the shutoff valve.



.....hydraulic system locations

Figure 1-25.

Governor Unit

The function of the governor unit is to actuate the speed control valve in the turbine air duct. A hydraulic shuttle valve in the governor unit controlled by a fly-ball governor directs hydraulic pressure from a control oil pump in the pack reservoir to a hydraulic actuator in the governor unit. The actuator mechanically positions the speed control valve which regulates the quantity of engine bleed air admitted to the hydraulic pack turbine. Speed of the turbine is thus regulated by controlling the incoming airflow.

Control Oil Low Pressure Cutoff Switch

A control oil low pressure cutoff switch is incorporated on all hydraulic packs to automatically shut off the pack in the event of low control oil pressure, thereby preventing damage to the pack due to inadequate lubrication. For starting purposes, provisions are made in hydraulic packs 5, 6, 7, 8, 9, and 10 to override the cutoff switch when the hydraulic pack switch is in ST position. Hydraulic packs 1, 2, 3, and 4 employ a time delay relay which automatically overrides the cutoff switch during starting operations.

Overspeed Control

The overspeed control is a device to prevent an overspeed condition of the hydraulic pack turbine. Whenever overspeeding occurs, a mechanical latch trips to actuate a linkage which closes the shutoff valve. Closing the shutoff valve in the turbine air duct eliminates the supply of engine bleed air and the turbine can no longer operate. The overspeed control will automatically override the shutoff valve control unit. The overspeed control can be reset with the hydraulic pack switch.

NOTE

An exhaust air orifice is installed immediately downstream of the turbine wheel. Back pressure created by this restriction acts as a safety feature by preventing turbine wheel destructive overspeed.

Standby Pump

The standby pump in each hydraulic system supplies sufficient hydraulic pressure to operate the system should a hydraulic pack fail. The standby pump is an electric motor driven gear-type pump which delivers 0.45 gpm at 3000 psi. In emergencies, this pump is capable of maintaining system pressures up to 2850 (±250) psi. However, the operating speed of hydraulic equipment is reduced 15 times when the system is solely dependent upon the standby pump. Three quarts of hydraulic fluid are trapped in the pack reservoir for exclusive use by the standby pump during emergencies.

NOTE

- There is no time limit on continuous operation of the hydraulic standby pumps except when the landing gear is extended with the emergency switches and the switches are left in EXTEND position.
- The standby pumps for systems 1, 2, 3, and 4 are each provided with an emergency hydraulic standby pump relay. The relays permit operation of the standby pumps regardless of standby pump switch, pressure switch, turbine control, or bomb door relay position. The relays are energized when the landing gear emergency extension switches are placed in the EXTEND position.

HYDRAULIC POWER SUPPLY SYSTEM CONTROLS

The hydraulic power supply system controls are arranged on the hydraulic control panel (figure 1-27). The hydraulic pack switches and the pressure gage selector switch for hydraulic systems 1, 2, 3, and 4 are grouped under the "Main Gear Power" section of the panel. Pack switches and the pressure gage selector switch for systems 5, 6, 7, 8, 9, and 10 are grouped under the "Control Surface Power" section. Adjacent to the hydraulic control panel on the pilot's side panel are the switches for the standby pumps grouped under "Standby Pumps."

Hydraulic Pack Switches

Ten hydraulic pack switches (6, figure 1-27) are located on the hydraulic control panel at the pilot's station which control the starting and stopping of individual hydraulic packs. Switches for hydraulic packs 1, 2, 3, and 4 have ON--OFF & RESET positions and are guarded to the ON position. The toggle switch must be placed in ON position before the switch guard can be manually closed. With a switch in ON position, 24-volt d-c switched battery power actuates the shutoff valve control unit. Positioning the switch to OFF & RESET either closes the shutoff valve or resets the overspeed control unit, whichever is required. Switches for hydraulic packs 5, 6, 7, 8, 9, and 10 have ST--ON--OFF & RESET positions and are guarded to the ON position. Normally in starting, placing the toggle switch in ST position will extinguish the low pressure light in approximately 3 seconds. The switch is then placed to ON position.

CAUTION

No hydraulic pack switch should remain in ST position longer than 6 seconds, as this could result in running the pack in a dry condition if the pack hydraulic oil is depleted.

Hydraulic packs 1 (left forward), 2 (right forward), 3 (left aft), and 4 (right aft) have electrical power from the hydraulic pack switches under various conditions.

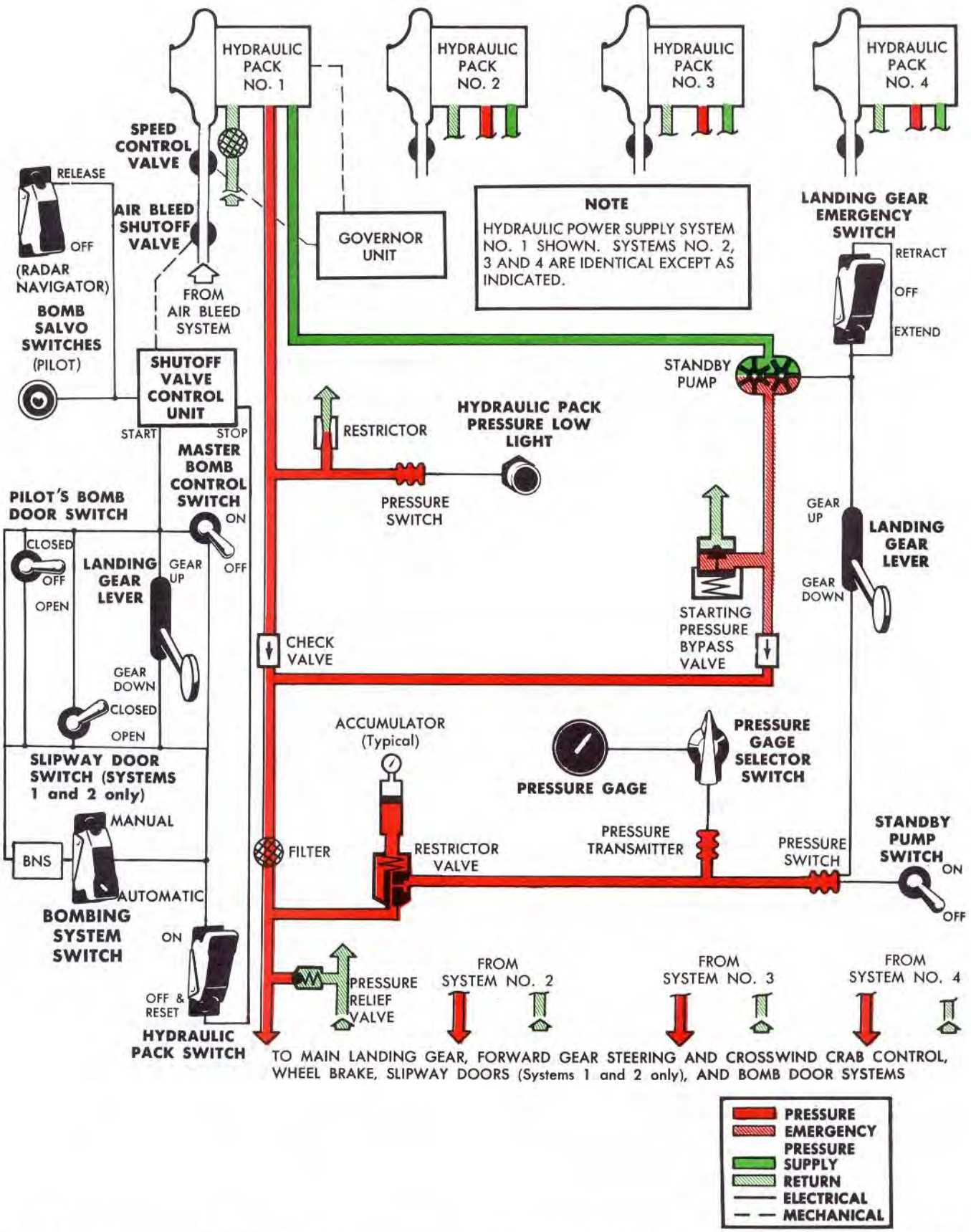
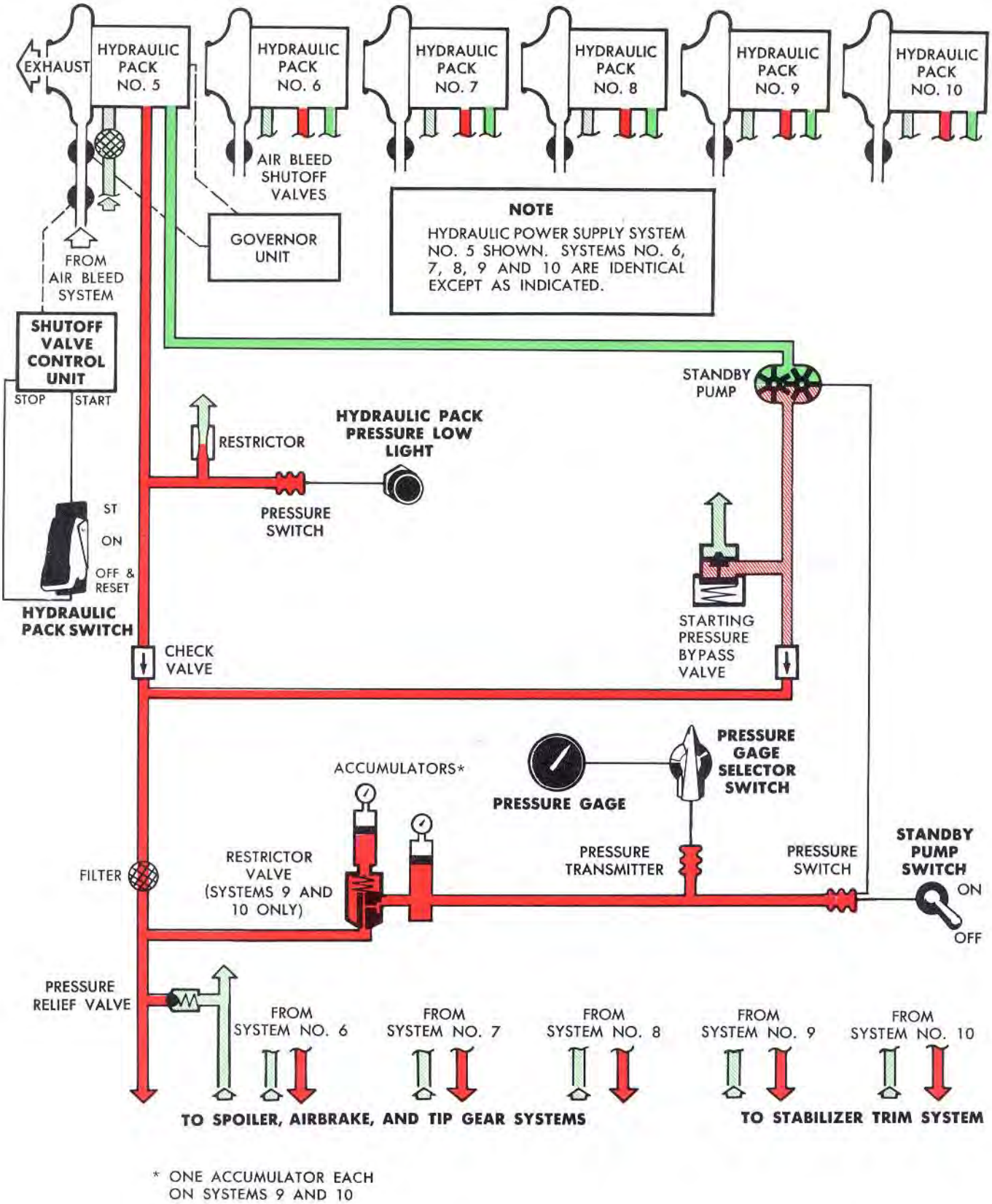


Figure 1-26. (Sheet 1 of 2).



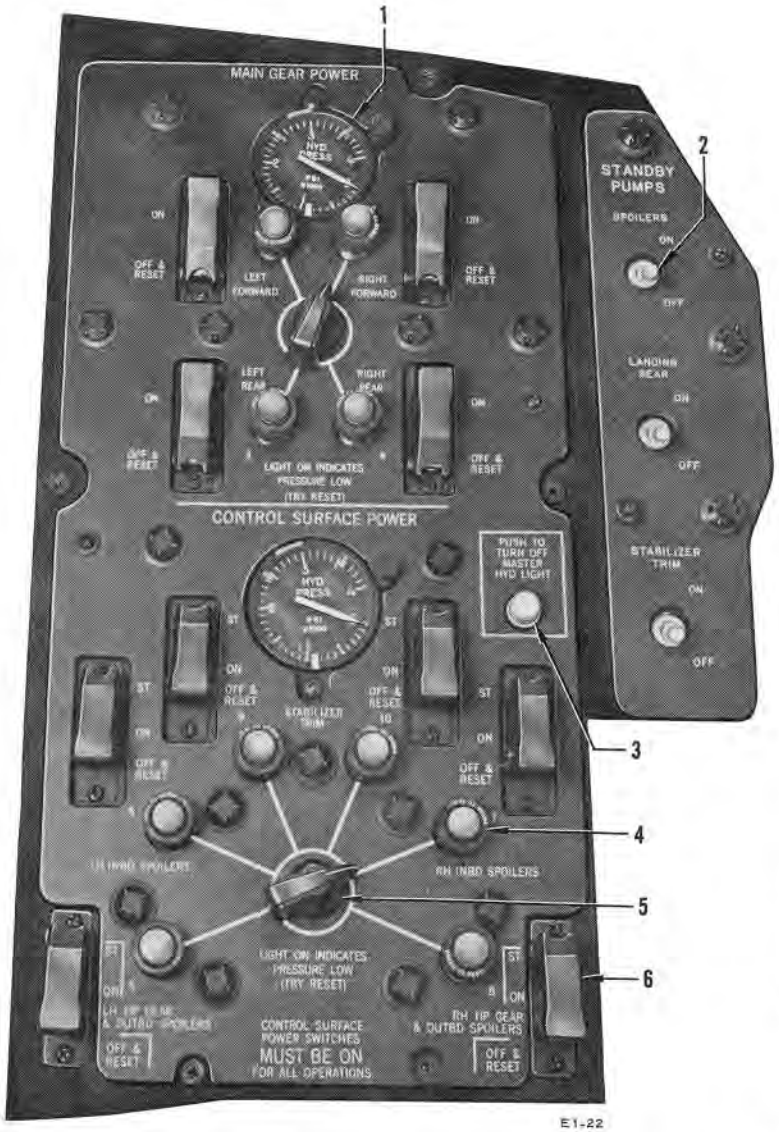
.....hydraulic power supply systems (typical)

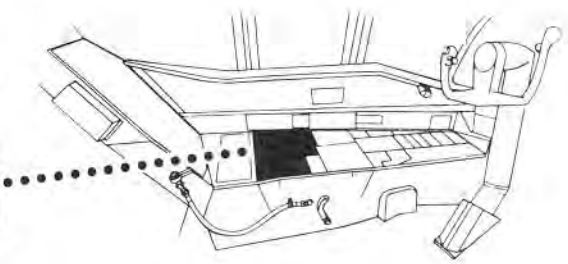
Figure 1-26. (Sheet 2 of 2).

These four packs operate any time the landing gear is not up and locked. When the gear is up and locked, the packs will shut down except under the following conditions: Packs 1, 2, and 4 will operate when the master bomb control switch is in ON position, when the bomb salvo switch is actuated, or when the pilot's bomb door switch is in OPEN position. Pack No. 1 will operate when the normal slipway door switch is in OPEN position. Pack No. 2 will operate when the alternate slipway door switch is in OPEN position. The hydraulic pack switches 1 through 4 receive switched battery power through circuit breakers marked "Hyd Package Control" - "L Fwd 1," "R Fwd 2," "L Rear 3," and "R Rear 4" on the "Landing Gear" portion of the pilot's circuit breaker panel. Hydraulic pack switches 5 through 10 receive switched battery power through circuit breakers marked "Hyd Package Control" - "5," "6," "7," "8," "9," and "10" on the "Control Surface" portion of the pilot's circuit breaker panel.

Standby Pump Switches

Three standby pump switches (2, figure 1-27) are conveniently grouped on the pilot's side panel adjacent to the hydraulic control panel. One switch marked "Landing Gear" controls each standby pump for hydraulic systems 1, 2, 3, and 4. Another switch marked "Spoilers" controls each standby pump for hydraulic systems 5, 6, 7, and 8. A third switch marked "Stabilizer Trim" controls each standby pump for hydraulic systems 9 and 10. Each switch has ON--OFF positions. When a switch is in OFF position, its respective pumps are inoperative. ON position insures automatic operation of the standby pumps. On systems 5, 6, 7, 8, 9, and 10 with the standby pump switch in ON position, TR power is fed to a pressure switch. The switch is closed when the gage reads 2550 (+250/-200) psi and is opened when the gage reads 2850 (±250) psi. When the switch is closed, power is fed through a pressure switch to a





1. HYDRAULIC SYSTEM PRESSURE GAGES
2. STANDBY PUMP SWITCHES
3. MASTER HYDRAULIC LIGHT SWITCH
4. HYDRAULIC PACK PRESSURE LOW LIGHTS
5. PRESSURE GAGE SELECTOR SWITCH
6. HYDRAULIC PACK SWITCHES

.....hydraulic control panel

Figure 1-27.

power relay which connects 200-volt three-phase a-c power to the standby pump for starting operation. The standby pumps for systems 1, 2, 3, and 4 have a turbine control relay connected between the pressure switch and the three-phase power relay. With standby pump switch in ON position, the standby pumps will operate whenever the landing gear emergency switch is actuated or when the normal pack is inoperative and the landing gear is not fully up and locked. Standby pump switches 1 through 4 are provided power through circuit breakers marked "Standby Pump Control" - "L Fwd 1," "R Fwd 2," "L Rear 3," and "R Rear 4" on the "Landing Gear" portion of the pilot's circuit breaker panel. Standby pump switches 5 through 10 receive power from circuit breakers marked "Standby Pump Control" - "5," "6," "7," "8," "9," and "10" on the "Control Surface" portion of the pilot's circuit breaker panel.

HYDRAULIC POWER SUPPLY SYSTEM INDICATORS

Pressure Gages and Selector Switches

Two gages (1, figure 1-27) on the hydraulic control panel indicate hydraulic pressure of the hydraulic systems. These gages are calibrated from 0 to 4000 psi. The gage on the section of the hydraulic control panel labeled "Main Gear Power" indicates the pressure of hydraulic system 1, 2, 3, or 4. The gage on the section of the panel labeled "Control Surface Power" indicates the pressure of hydraulic system 5, 6, 7, 8, 9, or 10. A pressure gage selector switch (5, figure 1-27) near each gage controls the 28-volt a-c power which connects the pressure transmitter and the pressure gage. The switch on the main gear power section of the panel has LEFT FORWARD--RIGHT FORWARD --LEFT REAR--RIGHT REAR positions. These positions correspond to hydraulic systems 1, 2, 3, and 4 respectively. The other switch on the control surface power section of the panel has LEFT TIP GEAR & OUTBD SPOILER--LEFT SPOILER INBD--RIGHT SPOILER INBD--RIGHT TIP GEAR & OUTBD SPOILER--STABILIZER TRIM 9--STABILIZER TRIM 10 positions. These positions correspond to hydraulic systems 5, 6, 7, 8, 9, and 10 respectively. The pressure gages are provided power through a circuit breaker marked "Hyd Pressure Ind" on the "Control Surface" portion of the pilot's circuit breaker panel.

Hydraulic Pack Pressure Low Light

Each of the 10 individual hydraulic systems has a red hydraulic pack pressure low light (4, figure 1-27) on the hydraulic control panel at the pilot's station. Whenever pressure from the main hydraulic pump falls below approximately 1300 (±200) psi, a warning light illuminates and remains illuminated until the pressure from the main hydraulic pump rises above approximately 1500 (±150) psi. Since the light indicates hydraulic pack failure, it will remain on even though system pressure is restored to normal by the standby pump. Only a return of the affected pack to proper operation will extinguish the light. The light operates on TR power through a pressure switch in the hydraulic line. On packs 1, 2, 3, and 4, the electrical power will be fed to the pressure switch only when the landing gear is not up and locked, or the bomb door switch, slipway door switch, or landing gear emergency switch is actuated. The hydraulic pack pressure low lights are provided TR power through a circuit breaker marked "Hyd Pressure Warn Lights" on the "Control Surface" portion of the pilot's circuit breaker panel.

Hydraulic Pack Pressure Low Master Light

A red hydraulic pack pressure low master light (9, figure 1-13 and 10, figure 1-13A) located on the pilot's instrument panel provides the pilot with a convenient means of monitoring the hydraulic packs. On some airplanes, this light will illuminate simultaneously with an individual hydraulic pack low pressure light and on other airplanes, this light has a time delay controller which provides a 10- to 15-second delay before the master warning light illuminates in the event of low hydraulic pressure to prevent flashing on actuation of the various hydraulic systems. A "Push to Turn Off Master Hyd Light" spring-loaded switch (3, figure 1-27) on the hydraulic control panel controls TR power. Pushing the switch in extinguishes the red master low pressure light so that subsequent pack failures may be detected. The individual low pressure light will remain on until the affected pack is returned to normal operation. The hydraulic pressure low master light is provided TR power through a circuit breaker marked "Hyd Pressure Warn Lights" on the "Control Surface" portion of the pilot's circuit breaker panel.

AIR BLEED (PNEUMATIC POWER SUPPLY) SYSTEM

The air bleed system (figure 1-28) is a major power source on the airplane. The air bleed system is supplied high pressure high temperature air bled from all eight engines. This bleed air is ducted into two manifolds. The manifold on the left side of the airplane receives bleed air from engines 1 through 4 and distributes it to all air bleed ducts on the left side of the airplane. The manifold on the right side of the airplane receives bleed air from engines 5 through 8 and distributes it to all the air bleed ducts on the right side of the airplane. The left and right manifold are normally separated from each other, but through the use of manifold interconnect valves, engine bleed air from any engine can be directed to any part of the air bleed system. When failure of part of the air bleed system occurs, cross-feeding of bleed air can be accomplished by the use of the manifold interconnect valves. By the use of these same valves, cross-feeding between the left and right manifolds can be prevented. Systems that receive power directly from the air bleed system are the hydraulic systems; air conditioning systems; nacelle and scoop anti-icing systems; engine starting system; drop tank pressurizing system; and, on B-52E airplanes, the a-c electrical system and water injection system. The air bleed system ground source connection (22, figure 1-60) which is used to supply air to the system when the airplane engines are not in operation is located in the lower left surface of the fuselage just forward of the forward wheel well.

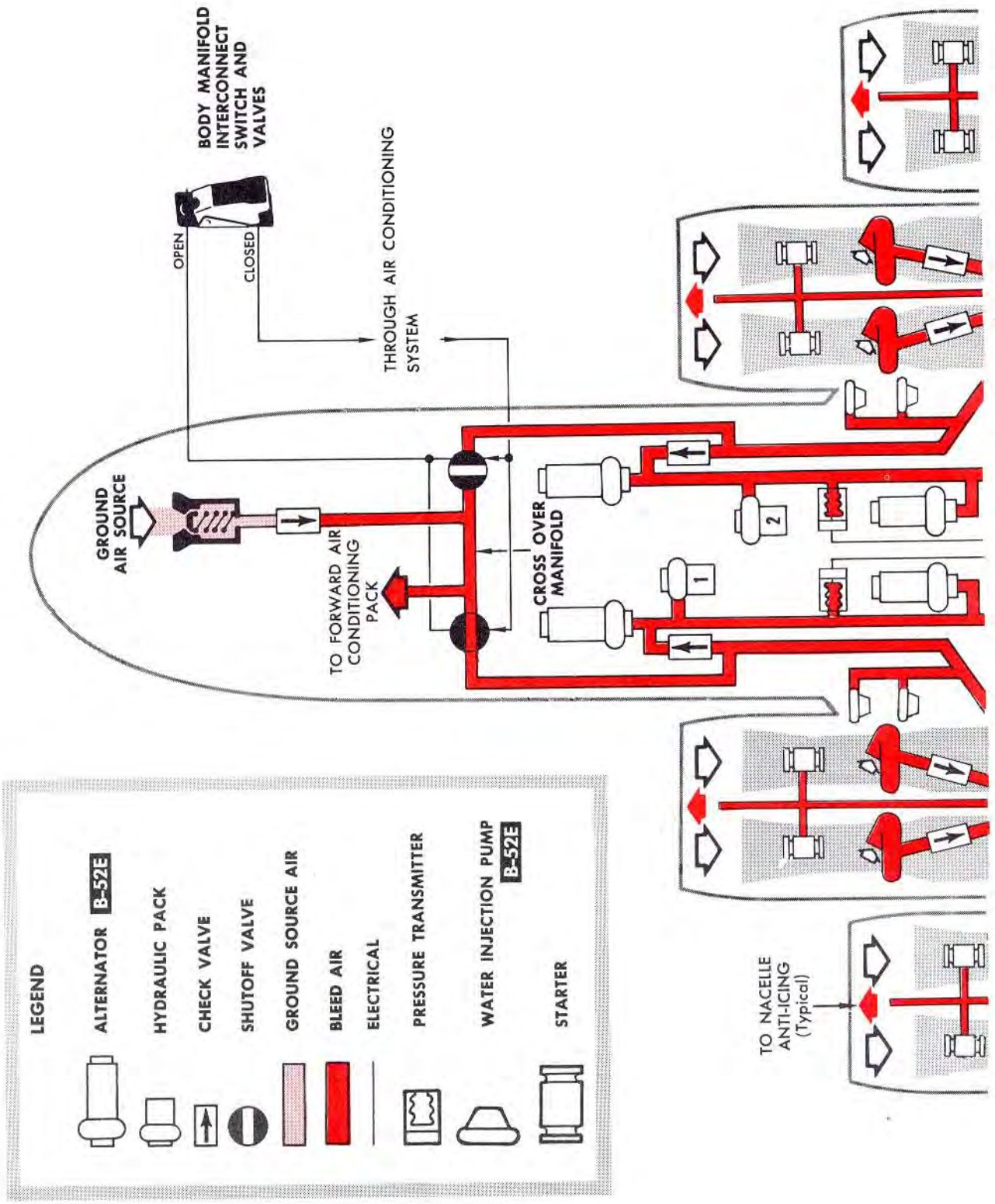
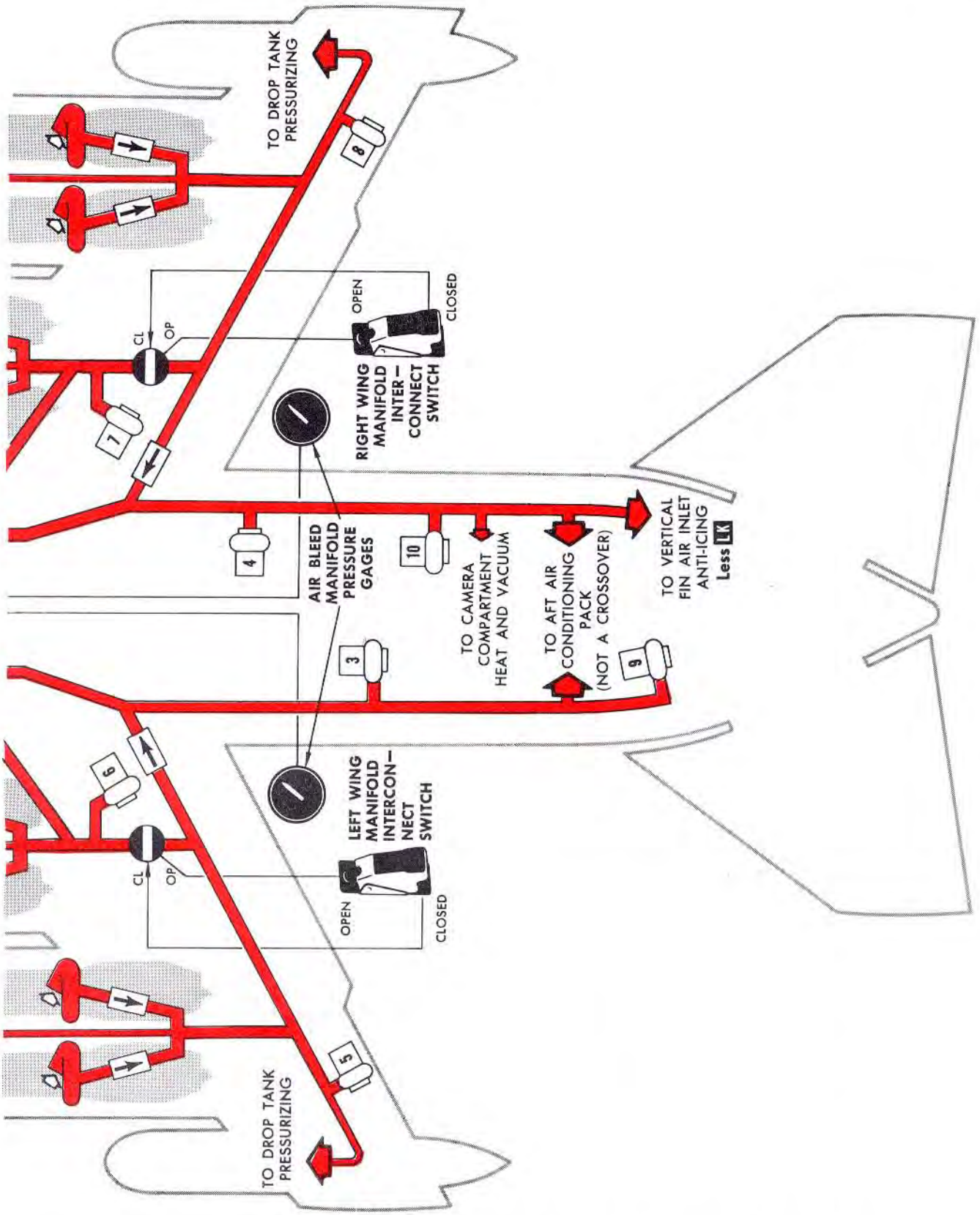


Figure 1-28. (Sheet 1 of 2).



air bleed system (typical)

Figure 1-28. (Sheet 2 of 2).

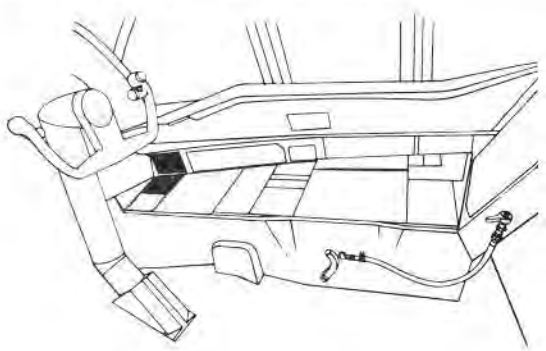
AIRBLEED SYSTEM CONTROLS

Wing Manifold Interconnect Switches

Two OPEN--CLOSED wing manifold interconnect switches (1 and 3, figure 1-29), guarded to CLOSED position, located on the copilot's auxiliary side panel electrically control the opening and closing of the wing interconnect valves. When a switch is in OPEN position, the wing valve is open so that the inboard and outboard engines on that side of the airplane mix their bleed air freely and flow is allowed either way through the valves. When a switch is in CLOSED position, the wing valve is closed so that the outboard engines on that side of the airplane will be isolated from a portion of the system which is then supplied directly by the inboard engines as shown in figure 1-28. The wing interconnect valves are motor driven and operate on 118-volt single-phase a-c power supplied through circuit breakers marked "Air Conditioning Air Bld" - "L Wing" and "R Wing" on the "Miscellaneous" portion of the pilot's circuit breaker panel. Normally, these valves are closed and the switches are in CLOSED position.

E1-23

1. LEFT WING MANIFOLD INTERCONNECT SWITCH
2. BODY MANIFOLD INTERCONNECT SWITCH
3. RIGHT WING MANIFOLD INTERCONNECT SWITCH
4. AIR BLEED MANIFOLD PRESSURE GAGES



... air bleed system controls

Figure 1-29.

Body Manifold Interconnect Switch

An OPEN--CLOSED body manifold interconnect switch (2, figure 1-29), guarded to CLOSED position, is located on the copilot's auxiliary panel. This switch, in conjunction with the air conditioning master switch and the air bleed selector switch, electrically controls the opening and closing of the two body interconnect valves. When the body manifold interconnect switch is in OPEN position, both valves are open. When the body manifold interconnect switch is in CLOSED and the air conditioning master switch is in either OFF or RAM position, both valves are closed. When the body manifold interconnect switch is in CLOSED and the air conditioning master switch is in either 7.45 PSI or COMBAT 4.50 PSI position, the left body interconnect valve is open and the right body interconnect valve is closed (provided the air bleed selector switch is in NORMAL position). When the air bleed selector switch is moved from NORMAL to ALTERNATE position, the body interconnect valves reverse their positions. The valves are motor driven and operate on 118-volt single-phase a-c power supplied through a circuit breaker marked "Air Conditioning Air Bld" - "Body" on the "Miscellaneous" portion of the pilot's circuit breaker panel.

Air Conditioning Master Switch

An air conditioning master switch (4, figure 4-3) located on the forward air conditioning panel has OFF--RAM--7.45 PSI--COMBAT 4.50 PSI positions. This switch affects the operation of the body interconnect valves only when the body air bleed interconnect switch is in CLOSED position. OFF or RAM position of the air conditioning master switch closes both of the body interconnect valves. The 7.45 PSI or COMBAT 4.50 PSI position of the air conditioning master switch closes one body interconnect valve and opens the other. Which body interconnect valve is opened and which is closed depends upon the position of the air bleed selector switch. For additional information on the air conditioning master switch, see "Air Conditioning System," Section IV.

Air Bleed Selector Switch

The air bleed selector switch (5, figure 4-3) located on the forward air conditioning panel affects the operation of the body interconnect valves only when the body air bleed manifold interconnect switch is in CLOSE po-

sition and the air conditioning master switch is in either the 7.45 PSI or COMBAT 4.50 PSI position. The air bleed selector switch has two positions, NORMAL --ALTERNATE. When in NORMAL position, the left body manifold interconnect valve is open and the right body manifold interconnect valve is closed. When in ALTERNATE position, the left body manifold interconnect valve is closed and the right body manifold interconnect valve is open. For additional information on the air bleed selector switch, see "Air Conditioning System," Section IV.

AIR BLEED SYSTEM INDICATORS

Air Bleed Manifold Pressure Gages

Two air bleed manifold pressure gages (4, figure 1-29) on the copilot's side panel measure the pressure in each of the air bleed manifolds. The gages are calibrated from 0 to 200 psi and are electrically operated from 28-volt a-c power by a pressure transmitter in each manifold which receives power through circuit breakers marked "Manifold Pressure" - "LH" and "RH" on the pilot's auxiliary circuit breaker panel.

FLIGHT CONTROL SYSTEMS

Primary flight control of the airplane is accomplished by three basic systems: the aileron, elevator, and rudder systems. The control surfaces of each system are moved to desired control positions by air forces acting upon control tabs. These tabs in turn are moved by cables which are connected to dual control wheels, control columns, and rudder pedals located at the pilots' stations. Lateral control is augmented by spoilers which are part of a spoiler and airbrake system. Lateral trim is obtained from a trim tab on each aileron. The entire stabilizer however moves to provide pitch trim. Directional trim is achieved by resetting a centering mechanism in the rudder control tab cable system.

VORTEX GENERATORS

The airplane is equipped with vortex generators which are installed on the upper surface of each wing forward of the ailerons. For further information on vortex generators, see "Aileron Buffeting," Section VI.

GUST DAMPERS

No internal or external surface locks are provided for the flight controls. To prevent damage due to gusts, hydraulic dampers are provided for each primary surface. These dampers are completely self-contained and are automatic in operation. They will prevent damage to the flight controls from gusts up to 65 knots. The damping action will not be felt during normal flight control movement.

CAUTION

When gusts above 65 knots (75 mph) are experienced, it is advisable to park the airplane headed into the wind. Landing gear down locks should be installed and wheels chocked. If the airplane is subjected to ground gusts of 65 knots or more, the elevator and rudder structures will be overloaded. All of the gust damping mechanism and its supporting structure, together with the rudder and elevator hinge No. 1 supporting structure, and all of the aileron gust damping mechanism should be thoroughly inspected for damage.

RUDDER SYSTEM

Directional control and trim are achieved with the rudder system. The rudder is a floating surface, operated by control and stability tabs.

Rudder Pedals

The rudder pedals are conventional and are adjustable fore and aft by levers on the outboard side of each pedal. Movement of the rudder pedals is transmitted by cables to control tabs which then serve to move the control surface to the desired position.

Stability Tab

The rudder is moved by a stability tab as well as a control tab. This stability tab is the upper of two tabs on the rudder and acts to damp lateral oscillations (Dutch roll). It is moved by a bob weight for small deflections and by the pilot for large deflections. When the rudder is in the neutral position, full deflection of the bob weight results in a 5° deflection of the stability tab; introducing control tab motion by the pilot can increase the stability tab travel to 12°. The directional damping action cannot overcome pilot control of the rudder. For further information on the stability tab, see "Rudder Stability Tab," Section VI. On aircraft SY, the rudder stability tab is further controlled by an electromechanical yaw damper which operates in parallel with the magnetic yaw damper and senses the yaw rate of the aircraft through a rate gyro. The electromechanical yaw damper acts on the existing bob-weight which in turn controls the stability tab. For additional information, see "Electromechanical Yaw Damper" under "Automatic Flight Control System," Section IV.

Rudder Q-Spring

Rudder feel and centering is provided by a rudder Q-spring in the cable system. This device consists of two bellows chambers attached to fuselage structure. Ram air from the leading edge of the fin enters the two chambers and exerts a pressure directly proportional to indicated airspeed; this pressure exerts a force on a cable which is attached to a Q-spring arm on the rudder torque tube. Tension in the cable tends to keep the Q-spring arm centered, thereby also centering the rudder control system. It also adds a resistance to pilot control force, thus simulating airloads on a conventional rudder system.

Rudder Trim

Rudder trim is accomplished by resetting the centering action of the rudder Q-spring on the rudder control tab cable system. The trim linkage is set by a screw acting on Q-spring linkage. This screw is cable-operated by the rudder trim knob on the aisle stand.

RUDDER TRIM KNOB AND INDICATOR. The rudder trim knob and indicator (10, figure 1-12) on the aisle stand are the only controls provided for rudder trim. Rotation of the knob will reposition the Q-spring linkage, holding the rudder pedals and the rudder control tab in a new center position. The mechanically operated indicator is calibrated up to 12 units maximum trim nose left and right.

ELEVATOR SYSTEM

Pitch control is provided by the elevator system. The elevators are floating surfaces, operated by control tabs located on the trailing edge of each elevator at the inboard end. The left and right elevator halves are independently hinged and may move independently of each other on the ground. (Since the control tabs are interconnected, the elevator halves will always act together in flight.) The control tabs are cable-operated from the pilots' control columns. The control columns transmit control movements through separate control column disconnect mechanisms to the respective right and left forward control cable quadrant, where a pair of cables joins them into a single system. On aircraft NM, a force switch assembly is contained in each of the control rods located between the control column transverse shaft bellcranks and the forward elevator control quadrants. These switches, although having no effect on the elevator system, provide the pilots with a means of quickly terminating any unscheduled stabilizer trim movements that may result from stabilizer or autopilot system malfunction. For further information on force switch operation, see "Force Switches" under "Stabilizer Trim System," this section. Either or both control columns may be manually disconnected from the cable system and stowed forward against the instrument panel. A connection is provided between the disconnect linkage and the seat ejection system so that the column will be automatically disconnected and stowed during the seat ejection cycle.

Elevator Q-Spring

Elevator feel and centering is provided by an elevator Q-spring in the cable system. The Q-spring consists of a single bellows chamber attached to the empennage structure operating in conjunction with a steel coil spring preloaded in tension to provide control centering force in the low speed range. Operation of the elevator control system in either direction from neutral immediately places a cable in tension against the resistance of the Q-spring and the coil spring. On aircraft RG, an additional tension spring is added to the elevator system to provide better artificial feel and a more positive control column neutral position. For further information, see "Elevator Feel Characteristics" in Section VI. The Q-spring obtains ram air pressure from the leading edge of the fin and operates as described under "Rudder System," this section. Conventional elevator trim is not provided but pitch trim is accomplished by hydraulically moving the entire stabilizer.

Control Columns and Disconnect Levers

Conventional pilot's and copilot's control columns (4, figure 1-32) are provided which can be manually disconnected from the elevator system by pushing forward and downward on control column disconnect levers (7, figure 1-32). These levers are located near each pilot's outboard armrest and below their respective side panels. When disconnecting a control column, grasp the control wheel, push down on the disconnect lever, and assist the control column into its stowed position. On aircraft Less QE, the control columns, when manually disconnected, will move forward to stowed detent automatically. On aircraft QE, the columns will remain in position when manually disconnected. In either case, reconnection of control columns after depressing disconnect lever is dependent on column being cycled through stowed detent or disconnect lever being pulled up before being reconnected.

NOTE

After ejection sequence has been initiated, the control column can be reengaged by pulling the disengage lever up as far as possible and holding while the control column is pulled aft until engagement occurs.

WARNING

When the column has been reengaged after ejection sequence has been initiated, the column must be manually stowed for subsequent ejection.

STABILIZER TRIM SYSTEM

Pitch trim of the airplane is provided by the stabilizer trim system (figure 1-33). The leading edge of the stabilizer is raised and lowered by a jackscrew driven by two hydraulic motors; one of the motors drives the screw and the other drives the nut. The motor driving the screw is supplied pressure from hydraulic system No. 10 while hydraulic system No. 9 supplies the motor driving the nut. The hydraulic pressure to the motors is metered by valves which are controlled by the cable system or a parallel electric trim control system through a followup system. Trim position creeping, due to airloads on the stabilizer, is prevented by a hydraulically released brake on each hydraulic motor. Pitch trim is not automatically adjusted when the wing

Figures 1-30 and 1-31 Deleted.

flaps are raised and lowered. An automatically operated heating element is installed in each followup screw to prevent icing of the screw threads. For operating limitations of the stabilizer trim system, see "System Limitations," Section V.

NOTE

If heater elements are not installed or are inoperative, the stabilizer trim system may become inoperative under certain conditions of temperature and humidity. This inoperative condition could be caused by frost or ice buildup on the followup screws which may jam the screws and prevent stabilizer operation either manually or electrically until the frost or ice is melted. Operation without heaters after cold soak at altitude may result in a reduced operation rate electrically and sponginess in the operation of the manual trim wheel.

Stabilizer Trim Wheels and Indicators

Manual control of the stabilizer trim metering valve is provided by rotation of the stabilizer trim wheels (3, figure 1-12) on the aisle stand. The pilot's trim wheel is attached to the throttle shaft and operates through a chain sprocket linkage to move a trim indicator located forward and inboard of the wheel. The copilot's trim wheel and trim indicator are located opposite to the pilot's trim indicator. The indicators are calibrated in units of stabilizer leading edge movement from nine units "Airplane Nose Dn" to four units "Airplane Nose Up" with one unit equaling 1° of stabilizer travel. Any trim accomplished using the electric trim control system will feed back through the cable system rotating the manual trim wheels and indicators. The manual trim wheels can be used to override the electric trim control system or autopilot trim system. One degree of stabilizer movement is equal to one revolution of the manual trim wheel. During ground checks of the stabilizer trim system when hydraulic packs 9 and 10 are operating and their respective accumulators are fully charged, the hydraulic system is capable of driving the stabilizer at a rate of approximately six units every 10 seconds. If the stabilizer trim is actuated continuously for periods longer than 8 seconds, the trim rate will slow to about four units every 10 seconds, caused by the depletion of the system accumulators. For this reason, trim operation should be interrupted for approximately 4 seconds after the stabilizer has been driven about four units to allow time for the accumulators to recharge. When the system is functioning normally, the manual trim wheel should rotate at the rate of two-thirds revolution per second. In flight, trim rates will be slightly less than six units every 10 seconds because of aerodynamic loads on the stabilizer. Trim rates are also reduced to about one-half the normal rate when only one hydraulic pack is operating. The trim wheel face and periphery is painted in alternate black and white segments as a visual aid and reminder when the electric trim control system is being used.

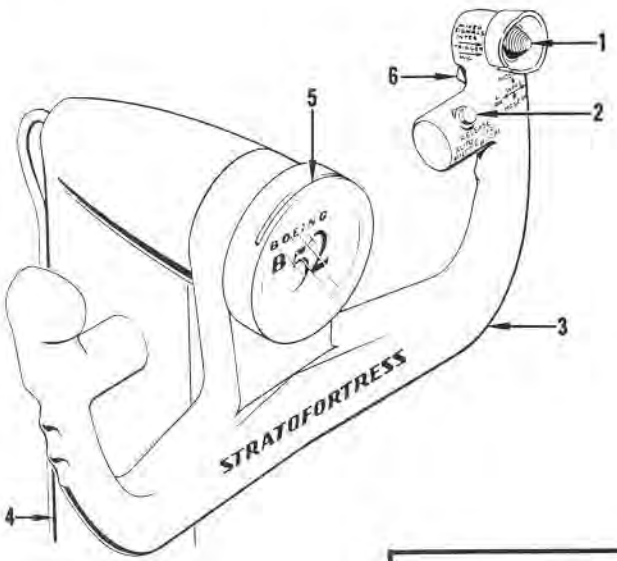
Aileron and Stabilizer Trim Buttons

An aileron and stabilizer trim button (1, figure 1-33) is located on the outboard grip of each pilot's control wheel. Guards are provided on the control wheels at the stabilizer trim switch housing to prevent inadvertent actuation of the trim switch. To initiate electrical control of the stabilizer trim, either the NOSE UP or NOSE DN position is used. The buttons are spring-loaded to an unmarked center OFF position.

CAUTION

The spring-loaded feature of the stabilizer trim switch should not be relied on to return the switch to neutral. The pilot should manually return the switch to neutral with a positive thumb movement each time it is used. To aid in recognizing a malfunctioning electrical trim system before reaching an extreme out-of-trim condition, the trim switch will be actuated in short intermittent bursts when used during flight. Due to the possibility of the switch sticking, care should also be taken to avoid inadvertent actuation of the switch when flying on autopilot. A runaway trim condition would result if a trim switch was stuck and autopilot was disengaged.

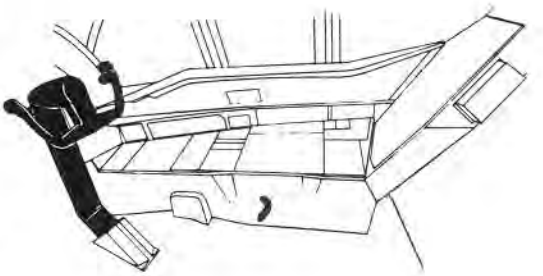
Actuation of the stabilizer trim button produces the following visible results: 1) nose up trim moves the trim indicator aft toward "Airplane Nose Up," the manual trim wheel rotates aft, and the stabilizer leading edge moves down; and conversely 2) nose down trim moves the trim indicator forward toward "Airplane Nose Dn," the manual trim wheel rotates forward, and the stabilizer leading edge moves up. Moving a button to either trim position closes a circuit to supply TR power to one of two power relays. These relays will switch 205-volt three-phase a-c power to operate the trim control motor. The trim control circuit breakers are located in the "Trim Cont" portion of the pilot's overhead circuit breaker panel. Positioning a button to a trim position will also supply TR power to the respective nose up or nose down clutch solenoid in the control motor. The stabilizer trim function of the aileron and stabilizer trim buttons is inoperative when the autopilot elevator servo cutout switch is positioned to IN and the autopilot servos engage switch is positioned to ENGAGE position. This is accomplished by electrically disconnecting the control circuits between the trim buttons and the actuator clutches. For operating limitations of the stabilizer trim system, see "Systems Limitations," Section V. For further information on the aileron trim function of these buttons, see "Aileron System," this section.



1. AILERON AND STABILIZER TRIM BUTTON
2. AUTOPILOT AND AIR REFUELING (IFR) BOOM RELEASE BUTTON
3. CONTROL WHEEL
4. CONTROL COLUMN
5. FLIGHT DATA CARD HOLDER
6. INTERPHONE TRIGGER SWITCH
7. DISCONNECT LEVER

NOTE

COPILOT'S CONTROL COLUMN AND DISCONNECT LEVER SHOWN - PILOT'S OPPOSITE



..... control column and disconnect lever

Figure 1-32.

CAUTION

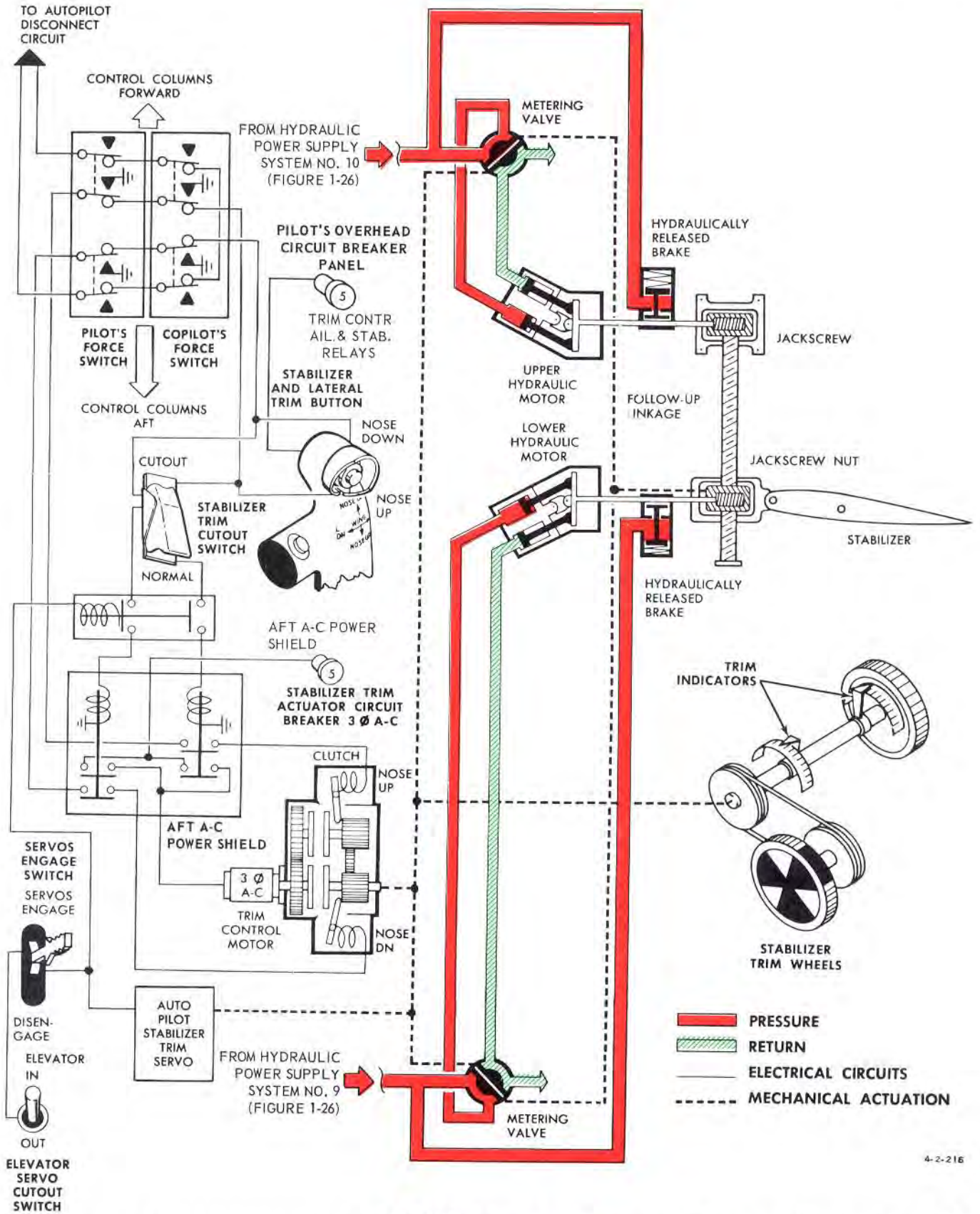
If both pilots actuate their stabilizer trim buttons simultaneously but in opposite directions, opposing and essentially equal forces will be set up in the magnetic clutches and the anticipated trim action will not take place. Holding the trim buttons in opposite directions will stall the electric actuators. This may result in overheating and eventual failure of the actuator clutches if they remain in the stalled condition for periods in excess of 2 minutes. Continuous overheating would render electric actuation of the stabilizer trim inoperative.

Stabilizer Trim Cutout Switch

A guarded CUTOUT--NORMAL stabilizer trim cutout switch (16, figure 1-12) on the aisle stand is provided to deactivate the electrical operation of the stabilizer trim buttons for stabilizer trim. In CUTOUT (guard up) position, the stabilizer trim cannot be operated electrically. For normal electrical control of stabilizer trim, this switch must be in NORMAL (guard down) position. Manual control of stabilizer trim is not affected by the cutout switch in either CUTOUT or NORMAL position. The switch is provided TR power through a circuit breaker marked "Ail & Stab Relays" on the "Trim Cont" portion of the pilots' overhead circuit breaker panel.

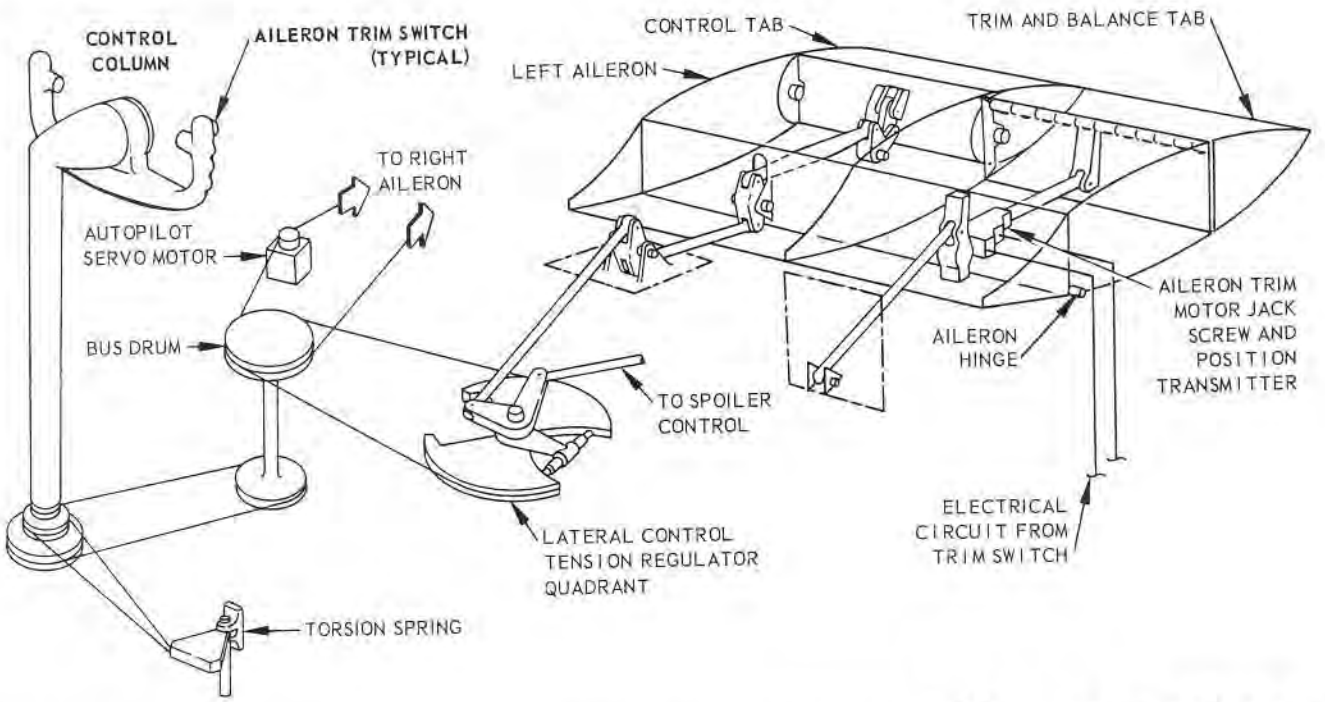
Force Switches

Force switches are installed within the control column linkage to provide the pilots with an effective means of immediate interruption of any unscheduled stabilizer trim movement. A pilot's natural reaction in responding to an aircraft pitch movement with an opposing control column force is utilized. When such an opposing force on either control column reaches 24 to 36 pounds, two microswitches are actuated to open. One switch disengages the autopilot and the other deactivates the stabilizer trim in the unscheduled direction only. Electrically controlled trim opposing the unscheduled trim movement continues to be available by means of trim buttons unless deactivated by the trim cutout switch or circuit breakers. Note that as control column force is reduced below the 24 to 36 pounds required to actuate the microswitches, the switches close and restore any unscheduled stabilizer trim not originally caused by the autopilot which will not reengage. For further information, see "Force Switch Operation" under "Flight Control System Emergency Operation," Section III.



stabilizer trim system (typical)

Figure 1-33.



aileron system

Figure 1-34.

AILERON SYSTEM

Lateral control of the airplane at normal flight speeds is provided by the aileron system (figure 1-34). The ailerons are control tab operated floating surfaces of comparatively small size. They are supplemented by spoilers to assure effective lateral control at the slower speeds. Rotation of the control wheels will mechanically operate the aileron control tabs which control aileron movement. In addition, rotation of the control wheels positions hydraulic valves to operate the spoilers simultaneously with the ailerons. See "Spoiler and Airbrake System," this section, for further information on spoilers. Centering springs in the aileron cable system will center the control wheels and provide aileron feel.

Control Wheels

The pilots are provided dual control wheels (3, figure 1-32). Each wheel has, on its outboard grip, an aileron and stabilizer trim button, an autopilot and air refueling (IFR) boom release button, and an interphone trigger switch. A flight data card can be placed in a slot (5, figure 1-32) in front of the medallion on the pilot's and copilot's control wheels.

NOTE

The control wheels are not disconnected from the lateral controls when the control columns are disconnected.

Aileron and Stabilizer Trim Buttons

For electrical control of the aileron trim, each pilot is provided with an aileron and stabilizer trim button (1, figure 1-32) on the outboard handgrip of his control wheel. These buttons have L WING DN--R WING DN --NOSE DN--NOSE UP--OFF positions. Only the first two positions and the unmarked center OFF position affect the aileron trim. The other two trim positions control stabilizer trim. When slid sideways to L WING

DN or R WING DN position, this button will close contacts to supply TR power through a circuit breaker marked "Ail & Stab Relays" on the "Trim Cont" portion of the pilots' overhead circuit breaker panel to one of two aileron trim relays. This relay, when energized, will close contacts to supply 118-volt single-phase a-c power through a circuit breaker marked "Aileron" on the "Trim Cont" portion of the pilots' overhead circuit breaker panel to an aileron trim motor in each aileron. These motors drive the aileron trim tabs. The limit switches prevent damage to the system when the aileron control tabs have reached their limit of travel. The d-c control circuit to each aileron trim relay is closed only when the other relay is deenergized. Thus, when one pilot is trimming the ailerons, the other pilot's trim circuit is disconnected. The trim buttons energize either the aileron or stabilizer trim circuits but not both at the same time. The function of the buttons for stabilizer trim is described under "Stabilizer Trim," this section.

CAUTION

Continuous actuation of the aileron trim mechanism is limited to two complete duty cycles followed by a 10-minute cooling period. See "Aileron Trim Mechanism Limitations" under "System Limitations," Section V.

Aileron Trim Cutout Switch

A guarded CUTOUT--NORMAL aileron trim cutout switch (19, figure 1-12) is provided. In CUTOUT position, aileron trim is inoperative. NORMAL position will allow operation of aileron trim by the aileron and stabilizer trim buttons. The switch is provided power through a circuit breaker marked "Aileron" on the "Trim Cont" portion of the pilots' overhead circuit breaker panel.

Aileron Trim Indicators

Two aileron trim indicators (51, figure 1-13 and 52, figure 1-13A) on the pilots' instrument panel indicate the position of the aileron trim tabs in units of aileron trim. An individual unit corresponds to a degree of aileron trim tab travel. The aileron trim tab has a travel of 14° (±2°) up and 14° (±2°) down from neutral position. The neutral position is 2° up on tab with no followup ratio. The aileron trim position indicating system operates on TR power supplied through a circuit breaker marked "Ail Trim" on the "Flight Indicators" portion of the pilot's circuit breaker panel.

Synchronizing Aileron Trim Tab Actuators

Aileron trim tabs can be synchronized in flight or on the ground by actuating the aileron trim button until either the extreme left wing down or right wing down position is reached and both actuators are shut off by their respective limit switches. The tabs will then be synchronized and normal operation can be resumed.

CAUTION

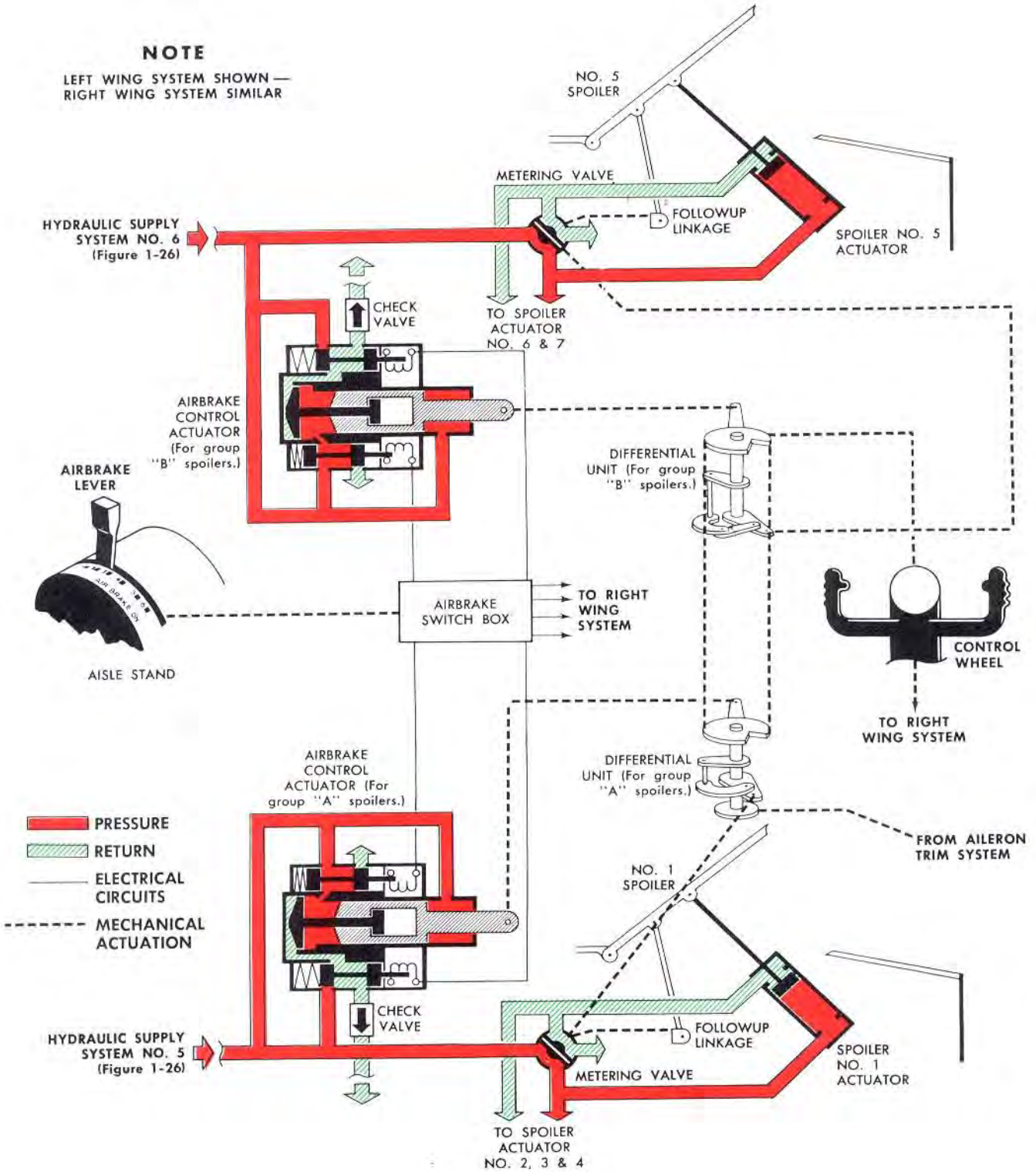
Synchronizing aileron trim tab actuators in flight is not recommended unless a serious control problem exists. Should the actuator clutch stick or the actuator motor fail, it will be impossible to move the tab.

NOTE

Different vendors supply the trim tab actuators, any combination of which may be used on the same B-52E airplane. Since these actuators do not all have the same operating speed, some combinations will show different trim tab displacements, even after resynchronizing. This condition does not affect ability to trim the airplane. The resynchronizing procedure outlined above restores maximum synchronization when necessary.

SPOILER AND AIRBRAKE SYSTEM

Supplementary lateral control and airbrake action are provided by a spoiler and airbrake system (figure 1-35). Each wing is provided with seven spoilers which perform a dual function. When initiated by control wheel rotation, the spoilers provide additional surface to aid in lateral control at low airspeeds. When an airbrake lever is actuated, the spoiler metering valves open simultaneously, raising the spoilers of each wing symmetrically to act as airbrakes. The spoilers are numbered from left to right, left outboard being No. 1 and right outboard being No. 14. The spoilers have been divided into two groups: group A and group B. Group A includes the No. 1, 2, 3, 4, 11, 12, 13, and 14 outboard spoilers while group B comprises the No. 5, 6, 7, 8, 9, and 10 inboard spoilers. Full spoiler actuation for lateral control is still available when the spoilers are raised as airbrakes.



.....spoiler and airbrake system (typical)

Figure 1-35.

NOTE

Above 250 knots IAS, the spoiler actuators do not have sufficient force to raise the spoilers full up. Adequate roll control is still available under these conditions. Because of this force limitation, the roll response with wheel position is not the same with airbrakes up as with zero airbrakes. In the area of spoiler blowdown, a dead area exists, but when the control wheel is rotated beyond this area, spoiler control will be regained and roll control will still be obtained.

SPOILER ACTUATION

The spoiler action is initiated by control wheel rotation which mechanically opens hydraulic metering valves to supply pressure to the spoiler actuators. A mechanical followup system automatically returns the metering valves to the closed position when the spoilers reach the position called for by the control wheels. In case of hydraulic failure, the spoilers will be returned to the down position by airloads.

AIRBRAKE ACTUATION

Use of the spoilers as airbrakes is controlled by an airbrake lever which electrically controls solenoid valves and hydraulic control units at each spoiler differential unit. The hydraulic control units reset the spoiler differential units to open the spoiler metering valves simultaneously. Opening both metering valves at once raises the spoilers symmetrically to produce airbrake action. All power and control circuit breakers for the airbrakes are on the pilot's overhead circuit breaker panel. For normal airbrake operation, forward battery power is supplied through two circuit breakers marked "Fwd Bat Pwr," one on the "Inph and Inbd Air Brake" portion and one on the "Emer Warn and Outbd Air Brake" portion of the panel. Emergency aft battery power is supplied through two circuit breakers marked "Aft Bat Pwr" on the same portions of the panel providing the emergency battery switch is in the EMERG position. Control power for the airbrakes is provided through circuit breakers marked "Air Brake Control Outbd" and "Air Brake Control Inbd."

SPOILER AND AIRBRAKE HYDRAULIC PRESSURE

The hydraulic pressure for spoiler and airbrake actuation is provided by hydraulic systems 5, 6, 7, and 8. The left wing group A spoilers are supplied pressure by hydraulic system No. 5, left wing group B by hydraulic system No. 6, right wing group B by hydraulic system No. 7, and right wing group A by hydraulic system No. 8. No cross-feeding of hydraulic pressure between systems is provided. The same actuators raise the spoilers for airbrake action as for lateral control. A hydraulic control unit resets the spoiler control linkage for airbrake actuation. Actuation of the hydraulic control units is controlled by solenoid valves which are energized in accordance with the position selected by the airbrake lever.

AIRBRAKE LEVER

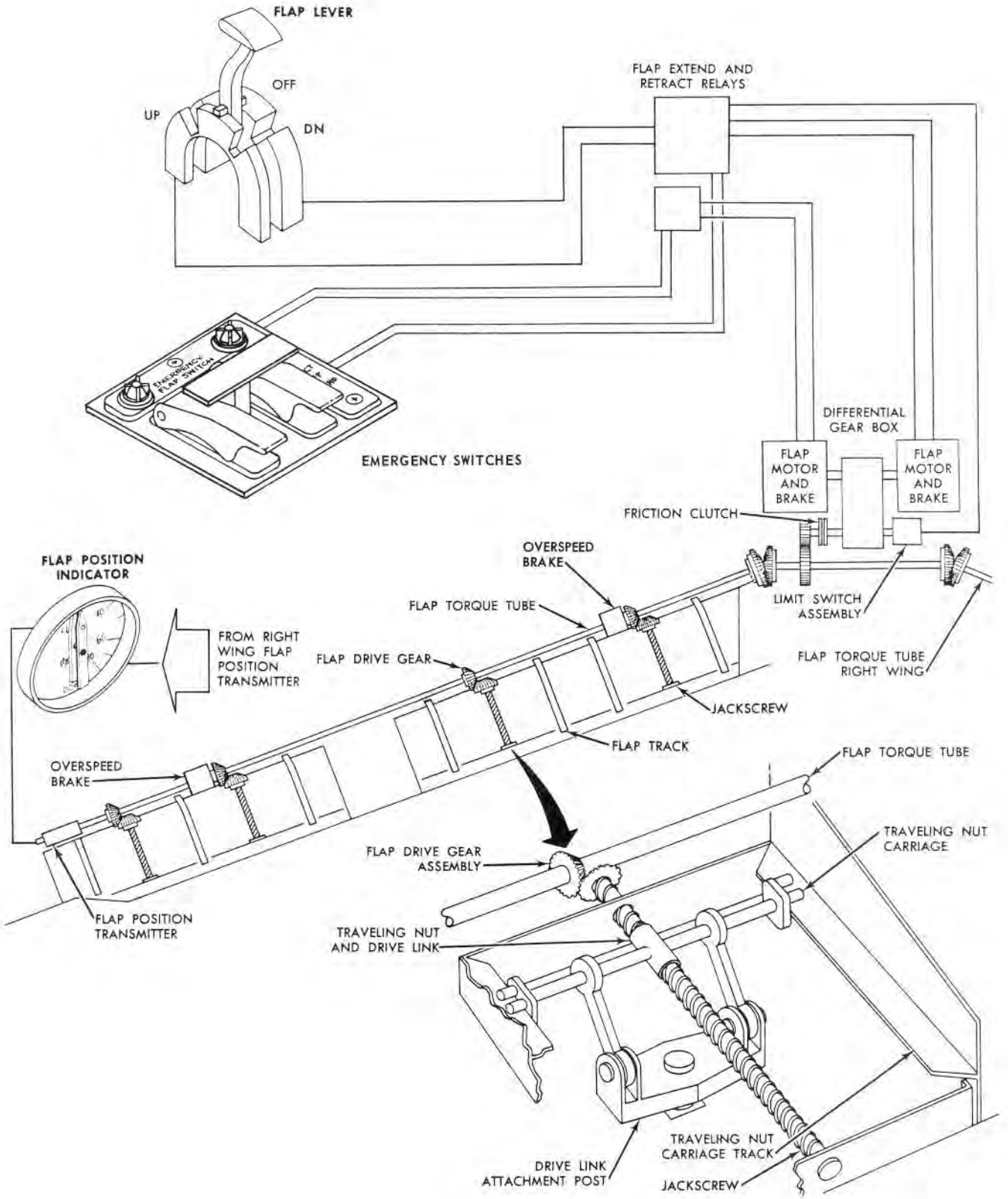
An airbrake lever (17, figure 1-12) on the pilot's side of the aisle stand operates six contacts in the airbrake switch box supplying 24-volt d-c power to the solenoid valves at the hydraulic control units. These units mechanically open the metering valves which direct hydraulic pressure to actuate the spoilers. The lever has an OFF position and six operating positions marked 1--2--3--4--5--6. Detents are provided at OFF and at positions 2, 4, and 6. Position 1, marked "AR," is used primarily for air refueling and gives increased roll rate authority. OFF position of the airbrake lever deenergizes the airbrake control circuits and permits the spoilers to provide lateral control only. When the airbrake lever is progressively moved through its full range (with control wheel in neutral), the outboard spoilers and the inboard spoilers will be operated alternately as follows:

LEVER POSITION	OUTBOARD SPOILERS	INBOARD SPOILERS
OFF	0°	0°
1	10°	0°
2	10°	20°
3	40°	20°
4	40°	40°
5	50°	40°
6	50°	60°

Two controlling circuit breakers marked "Air Brake Contr" "Inbd" and "Outbd" are located on the pilot's overhead circuit breaker panel.

WING FLAP SYSTEM

The wing flaps are modified Fowler flaps. Two flap sections are provided on each wing. Flap movement consists of both rotation and rearward travel. During the first 37 1/2% of extension, the flaps rotate downward 35° with little rearward movement. For the remainder of the extension, the flaps move rearward only. During flap extension, most of the drag increase occurs during the first 20% of the flap motion. This initial 20% rotates the flaps down 29° in approximately 10 seconds, leaving only 6° of rotation in the remaining 80% of flap extension. See figure 6-14 for additional information on flap characteristics. Each flap section is driven by two screws. All wing flap screws are driven by a common drive shaft which is operated by a power unit in the center wing equipment bay (figure 1-36). This power unit contains two 200-volt three-phase a-c motors and a differential gearbox. Each motor is provided with an electrically released brake which will be released only when the motor is energized and putting out torque. Wing flap motors are controlled by either a normal or an emergency control system. These systems differ in power source, circuit, and in that the emergency system has no limit switches. All wing flap control and indicating circuits are supplied 24-volt d-c TR power. When the normal control system is used, the right motor will run for both extension and retraction of the wing flaps. The emergency system has a separate switch to control each motor. A



wing flap system

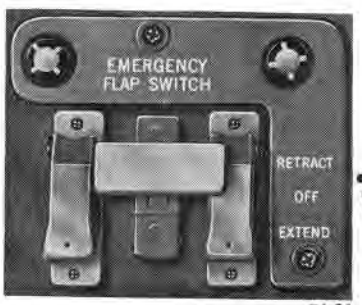
Figure 1-36.

guard is provided to prevent simultaneous operation of both emergency switches so that either motor, but not both, can be used for either extension or retraction of the wing flaps. Extension or retraction time is approximately 40 seconds. For information on the aerodynamic characteristics of the wing flaps, see Section VI.

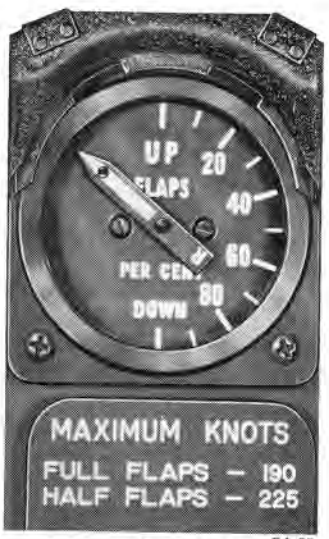
WING FLAP SYSTEM CONTROLS

Wing Flap Lever

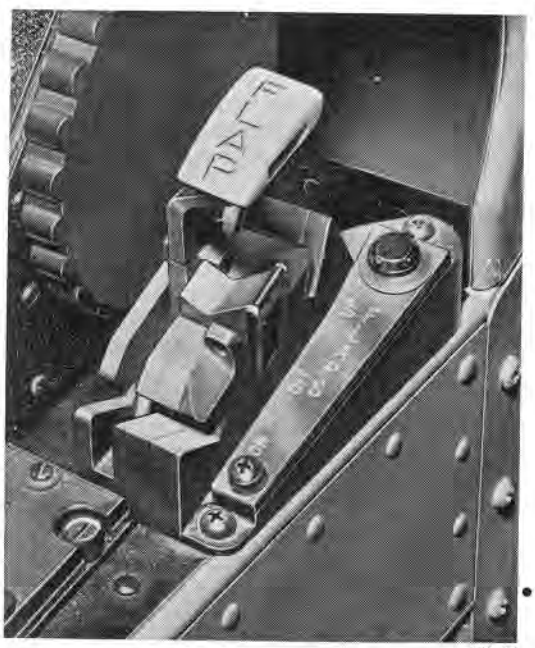
Control of the wing flaps is accomplished by moving a lever (figure 1-37) with an airfoil-type knob on a detent quadrant located on the right side of the aisle stand. This lever provides UP--OFF--DN positions with detents at the UP and DN positions. The lever must be pulled up out of the detent before it can be moved from either the UP or DN position. An OFF position is located on either side of a spring-loaded latch-type stop which is in the middle of the detent quadrant. Depressing the latch toward the flap lever allows the flap lever to be moved from OFF position on either side of the latch to the opposite detent. Each of the two motors in the wing flap drive power unit is controlled by a pair of 24-volt d-c flap motor power relays, one for extend and one for retract. The right flap motor is used to extend or retract the flaps during normal operation. Each pair of flap motor power relays introduce 205-



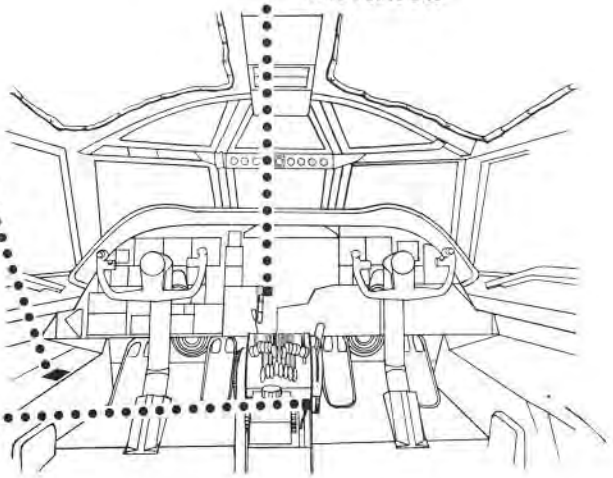
E1-24
WING FLAP EMERGENCY SWITCHES



E1-25
WING FLAP POSITION INDICATOR



E1-26
WING FLAP LEVER



wing flap system controls

Figure 1-37.

volt three-phase a-c power to the motors when energized by either the normal or the emergency wing flap control system, causing the flaps to extend or retract in approximately 40 seconds. The wing flap lever is provided TR power through a circuit breaker marked "Flap Control Normal" on the "Control Surface" portion of the pilot's circuit breaker panel.

Wing Flap Emergency Switches

Emergency control of the wing flap motors is accomplished by actuation of one of two RETRACT--OFF--EXTEND switches (2, figure 1-37) on the pilot's side panel. These switches are spring-loaded and guarded to the OFF position. A switch interlock guard is provided in addition to the individual switch guards to prevent the pilot from lifting more than one individual guard at a time to eliminate inadvertent use of both motors at once. The emergency control system is not equipped with limit switches. If a switch is held in either RETRACT or EXTEND position, the motor will drive the wing flaps into mechanical stops and a clutch in the power unit will start slipping. The emergency flap switches are provided TR power through circuit breakers marked "Flap Control Emerg" - "Left" and "Right" on the "Control Surface" portion of the pilot's circuit breaker panel.

WING FLAP SYSTEM INDICATORS

Wing Flap Position Indicator

A dual wing flap position indicator (1, figure 1-37) on the pilots' instrument panel reads from 0% to 100% of wing flap travel. The indicator transmitters are located on the outboard ends of the wing flap drive shaft. The dual indicating system is provided to show any difference in position of the left and right wing flap sections such as would result from a broken drive shaft. The top needle in the indicator, having a hole in it and marked R, indicates the right wing flaps and the bottom needle marked L indicates the left flaps. The wing flap position indicators are provided TR power through a circuit breaker marked "Flap" on the "Flight Indicators" portion of the pilot's circuit breaker panel.

Wing Flaps Up Warning Signal

The wing flaps up warning signal is sounded by the landing gear warning horn. The signal will sound only when the aircraft is on the ground, throttles for engines 3 and 5 or 4 and 6 are at or beyond approximately 80% of NRT, and flaps are not fully extended. A series circuit energized by TR power through the horn, throttles for engines 3 and 5 or 4 and 6, landing gear squat switches, and through the flap limit switches actuates the horn. Engines 1, 2, 7, and 8 are not included in this circuit. The wing flap warning horn is provided aft switched battery power through a circuit breaker marked "Warn Horn Ldg Gear & Flap" on the "Landing Gear" portion of the pilot's circuit breaker panel.

LANDING GEAR SYSTEM

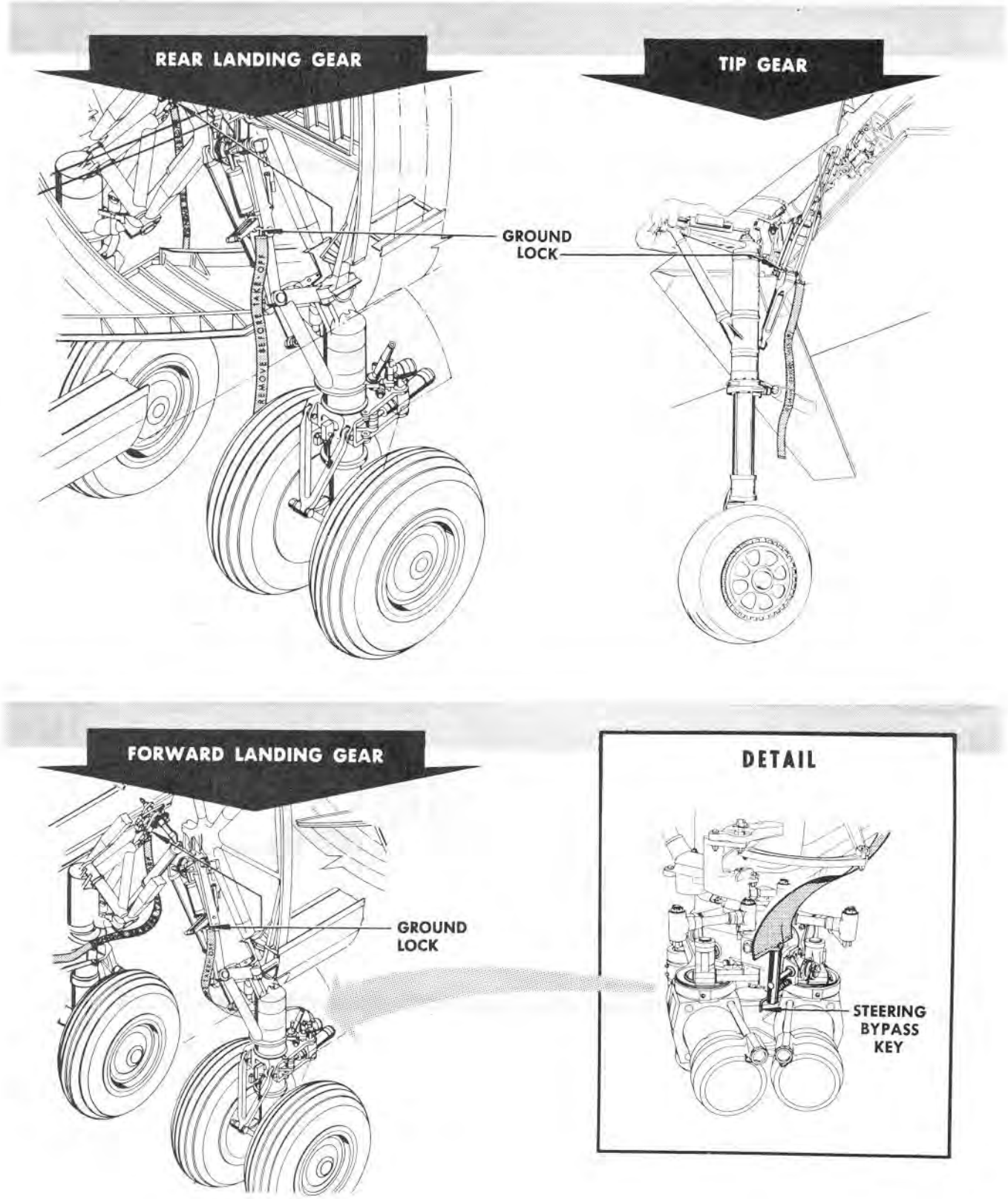
The landing gear system is a composite of the main landing gear system and the tip gear system. The dual wheel main landing gear are in a quadricycle arrangement with two side by side forward and two side by side rear. The left forward and left rear gear retract forward into fuselage wheel wells while the right forward and right rear gear retract aft into fuselage wheel wells. The tip gears are located between the outboard engine strut and the drop tank strut and retract inboard and slightly forward into each wing. The function of the tip gear is to prevent damage to the wing tips during abnormal ground maneuvers and/or high gross weight conditions. Normally the tip gear tires contact the ground only under maximum weight conditions. All landing gear are hydraulically actuated through electrically operated valves. Retraction and extension of each landing gear is accomplished by its hydraulic actuator with pressure supplied from individual hydraulic systems. A single mechanical lock on the main landing gear drag strut locks the main landing gear in either the extended or retracted position. Oleo safety switches prevent inadvertent gear retraction on the ground. There are no provisions for overriding these switches in an emergency. The landing gear is fully retracted in 8 to 10 seconds or extended in 10 to 12 seconds. The main landing gear doors are connected to the main landing gear and follow the cycle of operation selected by the normal landing gear lever or the landing gear emergency switches. The tip gear doors, however, are in two sections; the strut section is connected to the tip gear and follows the cycle of operation for the gear and the wheel well section is hydraulically actuated and is controlled for proper sequence operation by mechanical linkage in the tip gear system. For information on landing gear brakes, see "Wheel Brake System," this section. For information on landing gear steering and crosswind crab operation, see "Steering and Crosswind Crab System," this section.

LANDING GEAR GROUND LOCKS

Three pairs of landing gear ground locks (figure 1-38) prevent retraction of the landing gear on the ground. Each ground lock is a pin-type lock with a red warning streamer attached. Each pair of locks differs from the other two pairs for identification purposes. The tip gear locks are the smallest of the three types. The rear main gear locks are of a larger type and have the pin on only one end of the streamer. The front main gear locks have the ground lock pin on one end of the streamer and a two-pin arrangement on the other. The two-pin arrangement is the steering valve bypass key. The ground lock pins are inserted in each main landing gear drag strut and each tip gear side brace.

MAIN LANDING GEAR SYSTEM

Each landing gear of the main landing gear system (figure 1-39) is supplied with hydraulic pressure by an individual hydraulic system. An emergency source for extension and retraction is provided by an alternate system. The left forward main landing gear receives its normal pressure from hydraulic system No. 1 with hydraulic system No. 2 supplying emergency pressure.



landing gear ground locks

Figure 1-38.

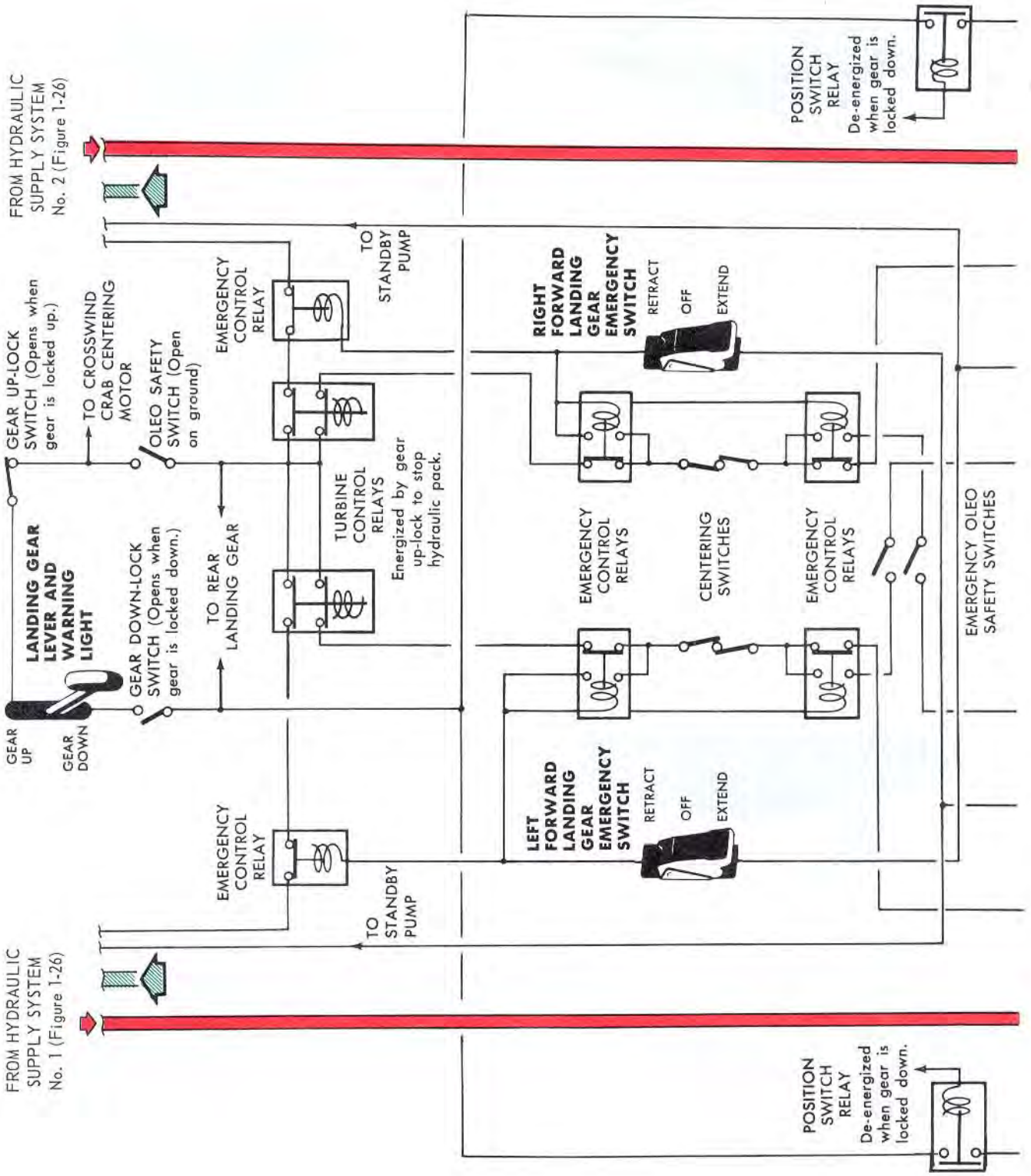
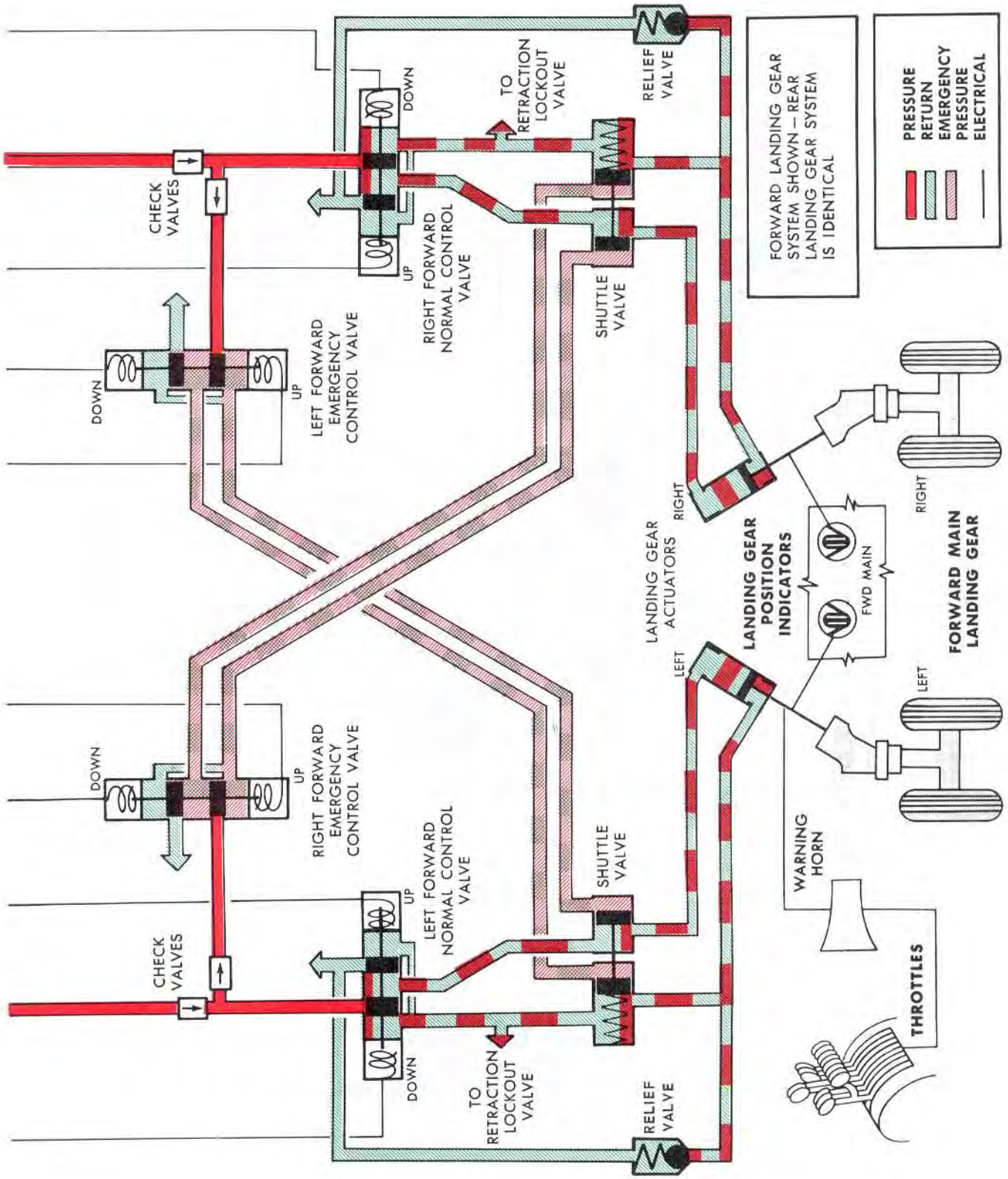
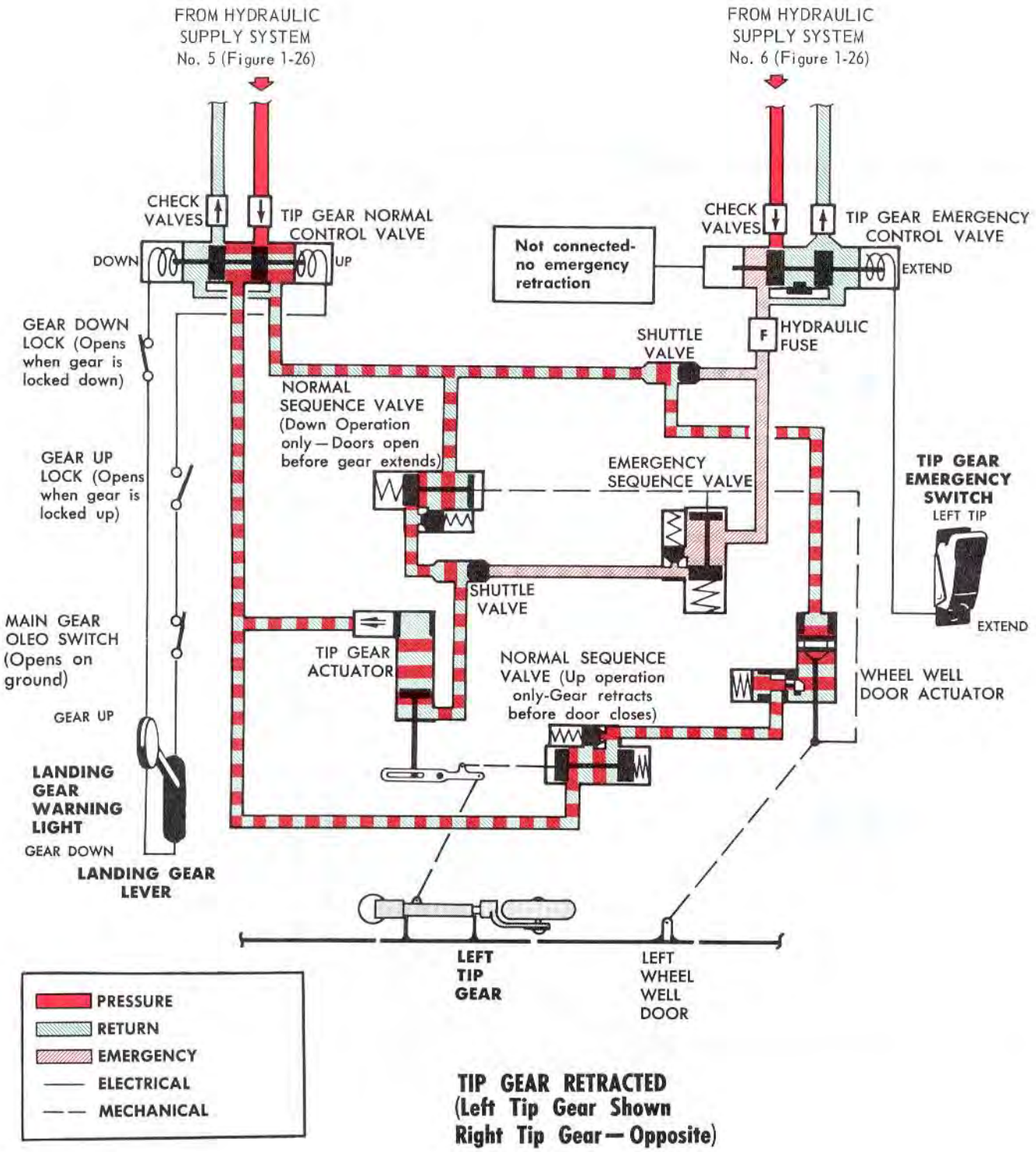


Figure 1-39. (Sheet 1 of 2).



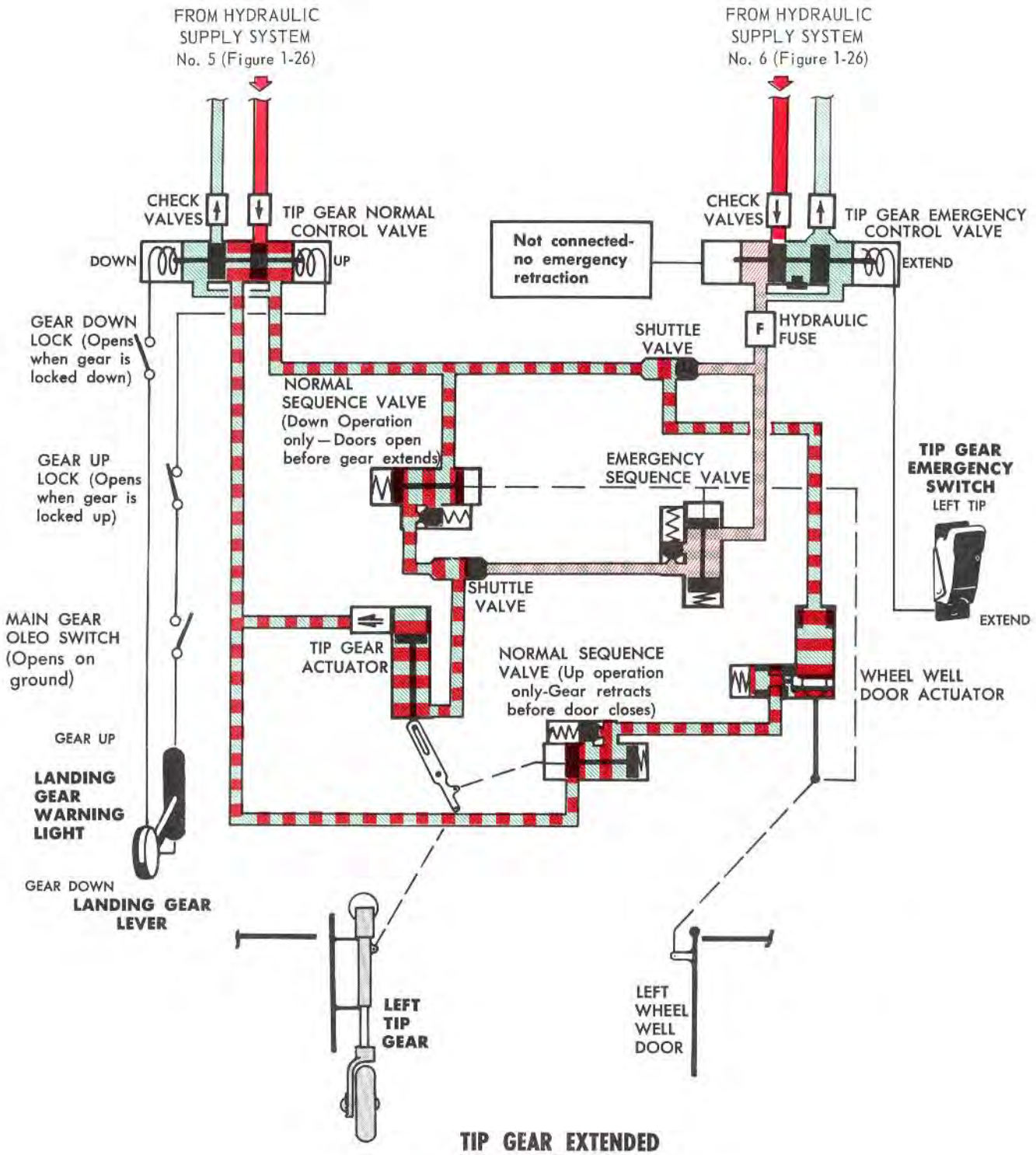
..... main landing gear system (typical)

Figure 1-39. (Sheet 2 of 2).



TIP GEAR RETRACTED
(Left Tip Gear Shown Right Tip Gear—Opposite)

Figure 1-40. (Sheet 1 of 2).



TIP GEAR EXTENDED
(Left Tip Gear Shown Right Tip Gear — Opposite)

tip gear system

Figure 1-40. (Sheet 2 of 2).

The pressure sources are reversed for the right forward main gear, with No. 2 serving as normal and No. 1 as emergency. The left rear main gear normal pressure is provided by hydraulic system No. 3 with hydraulic system No. 4 as emergency. Normal pressure for the right rear main gear is supplied by hydraulic system No. 4 and emergency pressure is from hydraulic system No. 3. Normal hydraulic pressure is directed to the main landing gear through solenoid-actuated normal control valves and through shuttle valves. The solenoids are energized by a series of switches which are controlled by the landing gear lever. The shuttle valves, spring-loaded for normal pressure and hydraulically actuated for emergency pressure, route either normal or emergency pressure to the landing gear actuators. To prevent hydraulic system failure due to a malfunctioning shuttle valve, a relief valve is installed on airplanes QU to bypass excessive hydraulic pressure that may result from shuttle valve blockage. When the pressure on the retract side of the actuator reaches 3500 (±50) psi, the relief valve opens and routes the retract pressure around the shuttle valve and the normal control valve into the main system return line. The normal gear up circuit supplies power to the crosswind crab centering motor through centering switches to insure centering of the main landing gear prior to retraction. This circuit also includes oleo safety switches which prevent inadvertent retraction when either the left front or right rear main landing gear is on the ground and the oleo strut is compressed more than 0.75 inch. A gear uplock switch deenergizes the hydraulic pack circuits when the gear is up and locked. Since the landing gear will free fall almost to the locked position, a position switch is included in the circuit which keeps the circuit energized until the landing gear reaches the full down and locked position. If a failure of the normal system occurs, actuation of the desired main landing gear emergency switch will route hydraulic pressure from the proper alternate hydraulic pack to the system which failed. Actuation of emergency landing gear switches does not automatically center the landing gear.

LANDING GEAR SAFETY SWITCHES

Microswitches are installed on each landing gear main strut so that compression of the landing gear oleos actuate the switches which, through relays, operate various systems. Compression of the oleos sufficient to actuate the safety switches may take place in either of two ways: 1) when the weight of the aircraft is supported on the ground by the landing gear or 2) when in flight with the gear extended, the crosswind crab is actuated to an angle of 14° or more. The following described actions take place upon actuation of the landing gear safety switches:

- Cabin pressure dump valve is opened.
- The electromechanical yaw damper becomes inoperative SY.
- Air for oil cooling, on aircraft with ground and flight flaps, will be transferred to the ground flap system. On all other aircraft, compressor bleed air will be routed through an air ejector into the aft portion of the cooling ducting.
- Air for the air conditioning system is drawn from the forward wheel well.
- Airscoop and Q-spring anti-icing, if on, will be turned off.
- The antiskid valves will be deenergized and application of brakes prior to landing will result in locked brakes. Normal braking may be applied during the landing roll.
- Drop tanks cannot be released.
- The BNS ground cooling system blowers will operate.
- The BNS overheat system automatic shutdown thermal switch will become armed.
- The flap warning horn will sound if the throttles are at or beyond approximately 80% of NRT and the flaps are not fully extended.
- The GAM-77 anti-ingestion systems become operative.
- The GAM-77 anti-ice systems become inoperative.
- The ground interphone panels become operative.
- The landing gear cannot be retracted by either the normal or emergency controls.
- On aircraft with pneumatic driven alternators, the alternator blowers will be turned on. On aircraft with engine-driven alternators, bleed air will be routed through an air ejector into the aft portion of the alternator cooling ducting.

TIP GEAR SYSTEM

The tip gear system (figure 1-40) for each gear receives normal hydraulic pressure from an individual hydraulic system. Hydraulic system No. 5 supplies the left tip gear and hydraulic system No. 8 supplies

the right tip gear. Hydraulic systems No. 6 and 7 are used to provide hydraulic pressure for emergency extension of the left and right tip gear, respectively. There are no provisions for emergency retraction. The tip gear system operates in an indirect manner. In gear down operation, the normal landing gear lever actuates switches which energize the down circuit. When the solenoid in the normal control valve is energized, hydraulic pressure is directed to the wheel well door actuator and to the normal sequence valve. When the wheel well door opens, mechanical linkage opens the normal sequence valve permitting hydraulic pressure to enter the tip gear actuator thus extending the tip gear. A reverse sequence insures proper door and gear timing during the retraction cycle. The tip gear circuits pass through the main landing gear oleo safety switches to prevent inadvertent retraction on the ground.

LANDING GEAR SYSTEM CONTROLS

CAUTION

- During retraction or extension of the landing gear by either the normal or emergency system, do not change the position of the control handle or the emergency switch while the gear is in motion since this procedure may rupture a hydraulic line.

- During retraction or extension of the landing gear by one system, do not actuate the other system while the gear is in motion since this procedure may rupture a hydraulic line.

Landing Gear Levers

A landing gear lever (2, figure 1-41) is located on the pilots' instrument panel ahead of the aisle stand. The lever handle is in the shape of a miniature landing gear wheel to facilitate recognition. Positions of the lever are GEAR UP--GEAR DOWN. The landing gear lever is held by a spring-loaded pawl and a detent on the inside end of the lever making it necessary to pull out on the handle approximately 1/4 inch to move the lever from one position to the other. In changing positions of the landing gear lever, the pawl travels over the lever quadrant surface which has detents at each end for engaging the pawl in the GEAR UP or GEAR DOWN position. The quadrant has a safety stop at a midpoint position between the detents which provides a GEAR DOWN latched position if the pawl on the landing gear control lever fails to remain in the GEAR DOWN detent. Movement of lever actuates a group of switches which control the solenoids of the control valves and the first motion of the landing gear hydraulic actuator will unlock the locks for gear actuation in either the up or down position. The landing gear lever is mechanically linked to a steering ratio selector unit which prevents movement to GEAR UP until the steering ratio selector lever is in TAKEOFF LAND position. This mechanical linkage also adjusts the steering ratio selector unit to zero ratio when the landing gear lever is moved to GEAR UP position. GEAR DOWN position energizes the landing light and crosswind landing light circuits. The landing gear lever controls forward switched battery power for the right aft and left forward main landing gear and aft switched battery power for the right forward and left aft main landing gear.

NOTE

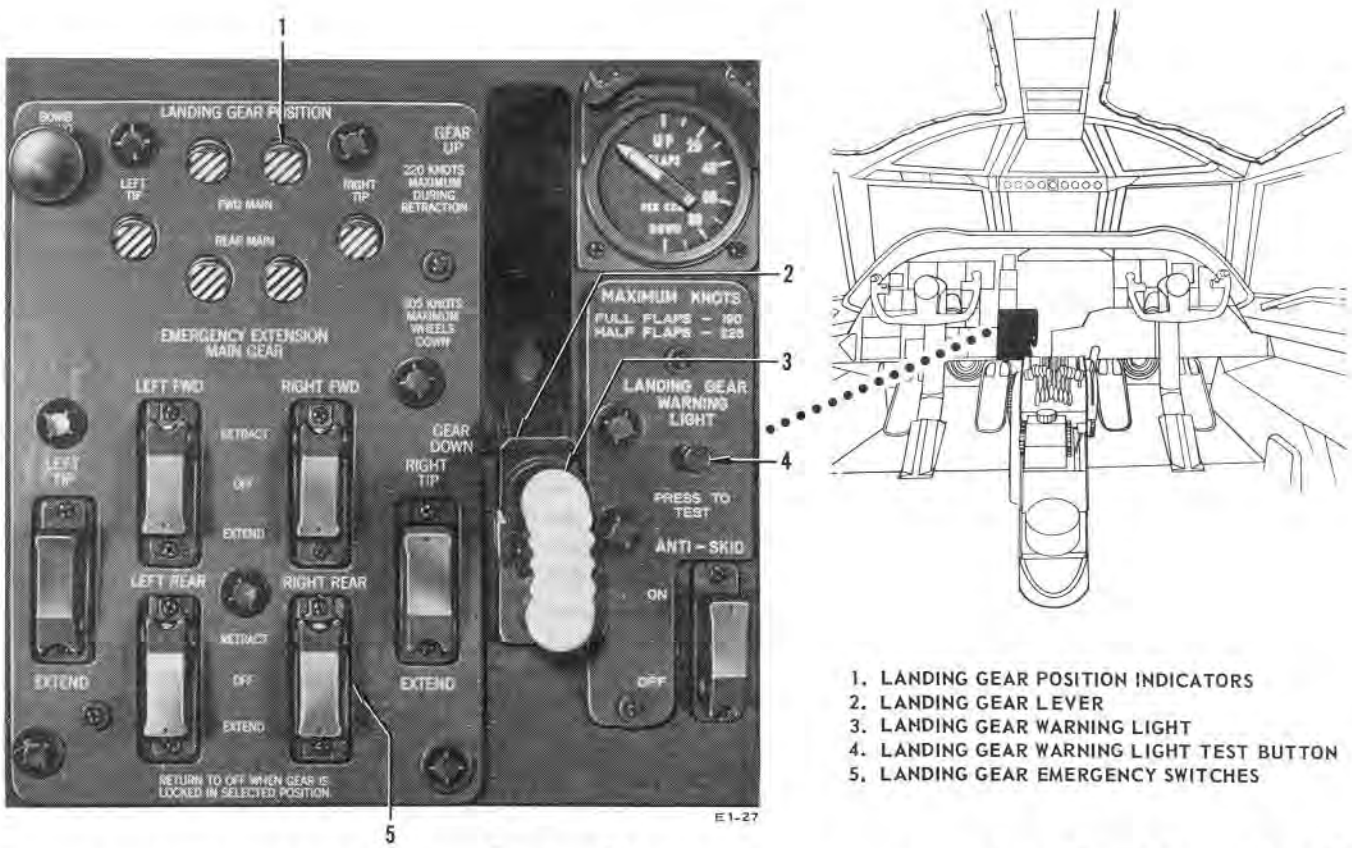
- An automatic double-lock arrangement is provided at the down position of the landing gear lever to insure a positive lock.

- A spring-loaded second locking pawl is permanently attached to the underside of the landing gear lever. This engages to a mating latch attached to the surface of the instrument panel. When the landing gear is placed in GEAR DOWN position, the locking pawl slides over the top of the mating latch and is engaged on the lower surface in a positive locked position. The locking pawl is disengaged from the mating latch by normal operation of the landing gear lever.

- The effort required to operate the landing gear lever is increased if the rudder pedals are not in neutral. This increase in operating effort is caused by the requirement to displace the steering system.

Landing Gear Emergency Switches

Six guarded switches (5, figure 1-41) on the left of the landing gear lever are used for emergency actuation of the landing gear. Four switches, one for each main landing gear, have EXTEND--OFF--RETRACT positions. The other two switches, one for each tip gear, have only EXTEND--OFF positions since there are no emergency retraction provisions for the tip gear. The switch guards are spring-loaded and are designed to return the switches from other positions to OFF position when the guards are closed. The emergency switches control forward direct battery power for the left aft and right forward main landing gear and aft direct battery power for the left forward and right aft main landing gear. Each switch operates an emergency control valve to direct pressure from an alternate hydraulic system for gear actuation and, at the same time, energizes the standby pump of the alternate hydraulic system. Each separate landing gear may be actuated independently of the others by use of the individual emergency switches. Operation of the main landing gear control lever does not affect the position of the landing gear when the emergency switches are placed in either RETRACT or EXTEND position. The electrical emergency extend circuits are independent of the normal landing gear extend circuits. Extend circuits of either system will not deenergize those of the other; however, the main landing gear shuttle valves will allow emergency hydraulic pressure to override normal hydraulic system pressure. The emergency retract circuits will deenergize the normal retract circuits when the main landing gear control lever and the separate emergency switches are placed in RETRACT position at the same time. Actuation of emergency landing gear switches does not automatically center the landing gear. The normal landing gear retract and extend circuits are deenergized by a lock switch when the landing gears are actuated to either extreme position. Emergency retract and extend circuits are energized until the emergency switches are returned to OFF position. Due to actuation of the main landing gear safety switches by the



1. LANDING GEAR POSITION INDICATORS
2. LANDING GEAR LEVER
3. LANDING GEAR WARNING LIGHT
4. LANDING GEAR WARNING LIGHT TEST BUTTON
5. LANDING GEAR EMERGENCY SWITCHES

landing gear controls (typical)

Figure 1-41.

weight of the airplane, either the normal or the emergency retract circuits cannot be energized for retraction when the airplane is on the ground. Landing gear actuation is provided by individual emergency switches when certain gear have failed to actuate after positioning of the main landing gear control lever to the position desired. Emergency control circuit breakers marked "Left - Tip, Fwd, and Rear" and "Right - Rear, Fwd, and Tip" are located on the "Landing Gear" portion of the pilot's circuit breaker panel.

NOTE

- Limit emergency landing gear switch actuation to 10 seconds maximum if gear has failed to extend or retract after unlocking by use of the normal system.
- Should a single battery be the only electrical power source available, the main landing gear can still be extended or retracted through the combined use of the landing gear lever and emergency switches. See "Electrical System Emergency Operation," Section III.

LANDING GEAR SYSTEM INDICATORS

Landing Gear Position Indicators

Six tab-window type landing gear position indicators (1, figure 1-41) in the lower center of the pilots' instrument panel and a red landing gear warning light (3, figure 1-41) in the end of the landing gear lever indicate landing gear position. Each tab indicator has three visual indicators to register landing gear position. When the landing gear is up and locked, the word UP appears in the tab window. A gear in an intermediate position is indicated by slanting alternate (barber pole) stripes. The appearance of a wheel symbol indicates a gear down and locked. Whenever gear actuation is taking place and the landing gear position does not agree with the landing gear lever position or the landing gear warning horn is blowing, the red light in the landing gear lever illuminates. As soon as the landing gear is locked in the selected position, the red light goes out provided the warning horn is not blowing. The indicators operate normally on switched battery power and are provided power from the aft battery when the emergency battery switch is in EMERG position. A landing gear warning light test button (4, figure 1-41) is located near the landing gear lever on the instrument panel. The landing gear warning light will be illuminated when this button is depressed. The landing gear position indicators are provided power through a circuit breaker marked "Pos Ind." The warning light is provided power through a circuit breaker marked "Sw & Pos Warn." Both circuit breakers are on the "Landing Gear" portion of the pilot's circuit breaker panel.

Landing Gear Warning Horn and Shutoff Buttons

The landing gear warning horn is flush mounted on the pilot's side panel. The horn sounds when any throttle is retarded near IDLE while any one landing gear is not down and locked. A single shutoff button (7, figure 1-12) on the copilot's side of the aisle stand may be used for silencing the horn; however, the horn will sound again when another throttle is retarded. The warning horn operates on TR power supplied through a circuit breaker marked "Warn Horn Ldg Gear & Flap" on the "Landing Gear" portion of the pilot's circuit breaker panel.

STEERING AND CROSSWIND CRAB SYSTEMS

A means of steering the airplane on the ground and of presetting the crab angle of the landing gear during crosswind landings and takeoffs is furnished by two separate yet integrated systems known as the steering and the crosswind crab system (figure 1-42). The need for a system to steer the airplane on the ground becomes obvious when one considers that no differential wheel braking is available and that differential engine thrust is ineffective at low speeds. The steering system and crosswind crab system are integrated through mechanical and cable linkage to a differential coordinating unit. Cable and mechanical linkage from this unit operate steering metering valves on both forward and rear main gear. The steering metering valves meter hydraulic pressure to the actuating cylinders which position each forward gear for steering or all four gear for crosswind crab.

NOTE

Actuation of the crosswind crab system sets up a new neutral position for steering which does not affect the turning angle available with the takeoff and landing steering ratio but limits the turning angle available with the taxi steering ratio. With crosswind crab set and the steering ratio selector in the taxi range, the available turning angle is 55° in the direction opposite the crab setting and 55° minus the crab setting in the direction of crab.

STEERING SYSTEM

The forward main landing gear are steered by hydraulic pressure controlled by movement of the rudder pedals. The left forward gear uses pressure from hydraulic system No. 1 and the right forward gear from hydraulic system No. 2. Standby pump pressure is available for emergency steering if there is a failure of either No. 1 or 2 pack or both when the standby pump switch marked "Landing Gear" is in ON position. In event of steering failure on one front gear with the standby pump switch OFF, that gear will trail the other front gear which has steering. Steering is accomplished when the rudder pedals move mechanical and cable linkage through a ratio selector unit and a differential coordinating unit to the metering valves which hydraulically position the forward main gear. The steering ratio selector unit mechanically limits steering angles for two conditions. A taxi ratio allows the forward gear to be turned to a maximum angle of 55° right or left of a center position with full rudder pedal travel.

The second ratio is used for takeoff and landing and restricts the turning angle to 12° right or left of center. The differential coordinating unit has three main components; a forward drum, a jackscrew, and a rear drum, all three interconnected. Rudder pedal movement for steering mechanically moves the forward drum in an amount determined by the ratio selector. Movement of the forward drum moves the rear drum through linkage to mechanically operate the steering metering valves on each of the forward main gear. These valves meter hydraulic pressure to the actuating cylinders to position the gear as desired. During towing operations, a valve between the steering actuating cylinders on each forward gear must be opened by a steering bypass key to bleed pressure. This is to prevent damage caused by hydraulic locking of the pistons in the actuating cylinders. The bypass keys are on one end of each of the forward gear ground lock streamers. Each bypass key has a two-pin arrangement; when the key is inserted into the steering metering valve receptacle, one pin secures the key in place and the other moves the bypass valve to bleed pressure. Centering springs are provided near each steering valve which only assist in returning the gear and rudder pedals to neutral whenever pressure on the rudder pedals is removed.

NOTE

For maximum steering and rudder control, no rudder trim should be used. The maximum steering angle is reduced when rudder trim in the opposite direction is used. For example, steering to the left is reduced when nose right trim is introduced. The steering angle is reduced proportionally to the amount of trim used to displace the rudder pedals.

Steering Ratio Selector Lever

A steering ratio selector lever (1, figure 1-43) on the left forward end of the aisle stand is used to select one of two steering ratios. The two ratios are TAXI--TAKEOFF LAND which allow steering of up to 55° and 12° respectively. To move the lever from either one of these positions, a knob on the lever must be pulled up to free the lever from a detent position. When the lever is moved from one position to the other, it mechanically adjusts the steering ratio selector unit to limit the angles of turn available. The ratio selector lever is mechanically linked to the landing gear lever. This is done to prevent moving the landing gear lever up unless the ratio selector lever is in TAKEOFF LAND position and to prevent moving the ratio selector lever while the landing gear are retracted. When the landing gear lever is moved to GEAR UP position, the linkage will adjust the steering ratio selector unit to a zero steering ratio. This prevents any actuation of the steering metering valves by rudder pedal movement and returns the steering control system to center. Since normally the landing gear lever will be positioned before using the emergency landing gear switches, the ratio selector will usually be adjusted accordingly. Centering cams in each gear maintain the gear at centered position as soon as oleos are fully extended. A trunnion swivel shutoff valve is on each main gear and shuts off hydraulic pressure to the steering valves when the landing gear have retracted 60°. This prevents steering action before the gear has cleared the wheel well during landing extension.

NOTE

With the steering ratio selector lever in either TAXI or TAKEOFF LAND position, the landing gear will follow the rudder pedal displacement by a predetermined amount. Moving the selector lever from one to the other position will be met by increasing resistance as the rudder displacement is increased from the neutral position. This is the result of attempting to steer the landing gear to the new position as required by the steering ratio selector unit through use of the selector lever. This condition can be avoided by placing the rudder pedals in the neutral position before moving the steering ratio selector lever.

CROSSWIND CRAB SYSTEM

A crosswind crab system is provided to facilitate making crosswind landings and takeoffs and to reduce the hazards of crosswind conditions. The crosswind crab system provides a means of turning all four main gear to align with the runway while the airplane is flown in a wings level attitude compensating for drift. This system utilizes the steering actuators on the front main gear and a similar set on the rear main gear. The landing gear can be preset and turned up to 20° left or right of center during the approach. The maximum of 20° crab will accommodate landings in crosswinds up to and including 43 knots blowing 90° to the runway at a landing weight of 270,000 pounds. The direction of the landing gear is preset by a crosswind crab control knob which mechanically operates the steering metering valves on each main gear. These valves meter hydraulic pressure to the actuating cylinders to position the gear as desired. The crosswind crab system is automatically centered when the landing gear lever is moved to GEAR UP position. On the ground after landing, the gear is quickly centered by a pilot-operated centering button or by turning the crosswind crab control knob to center.

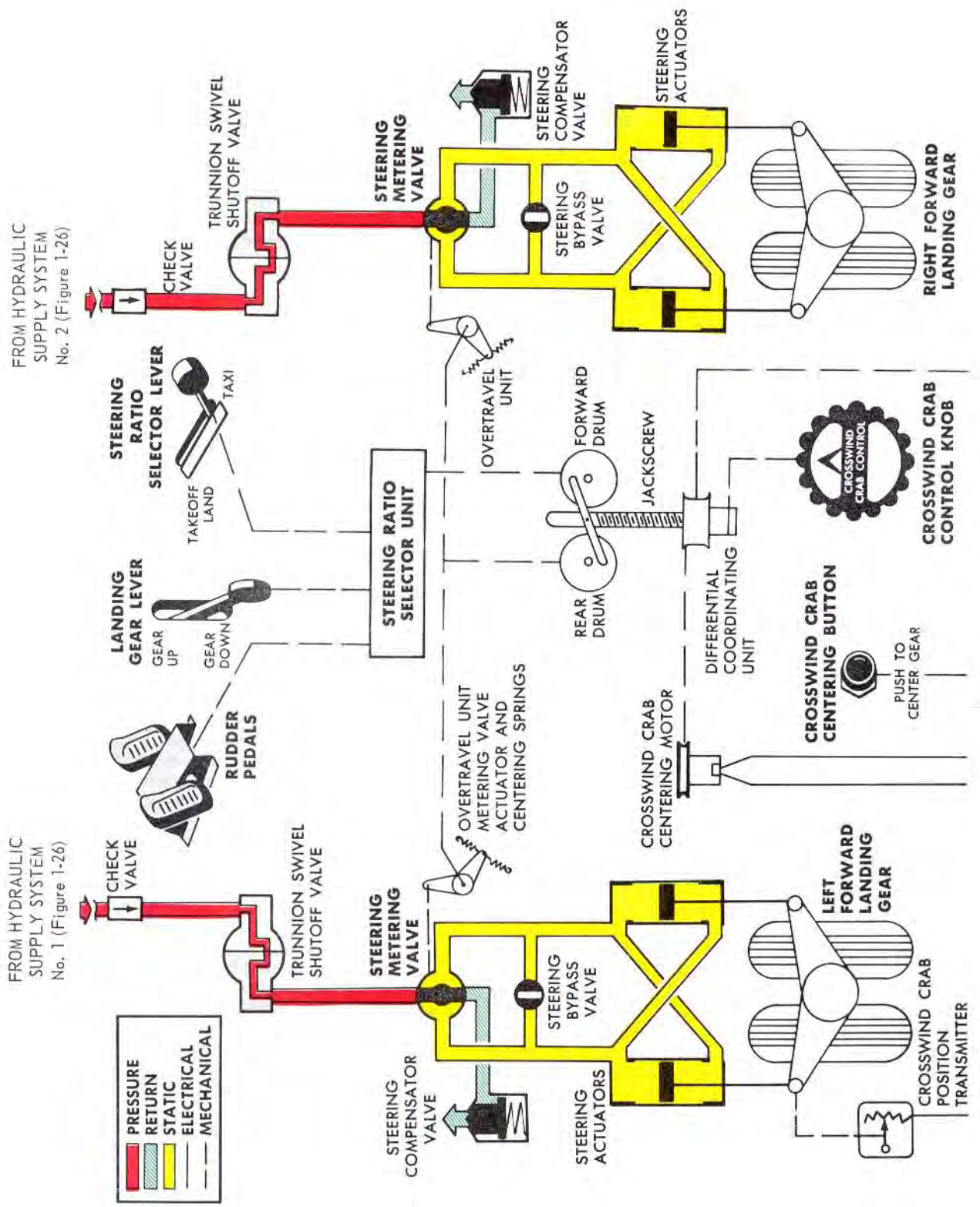
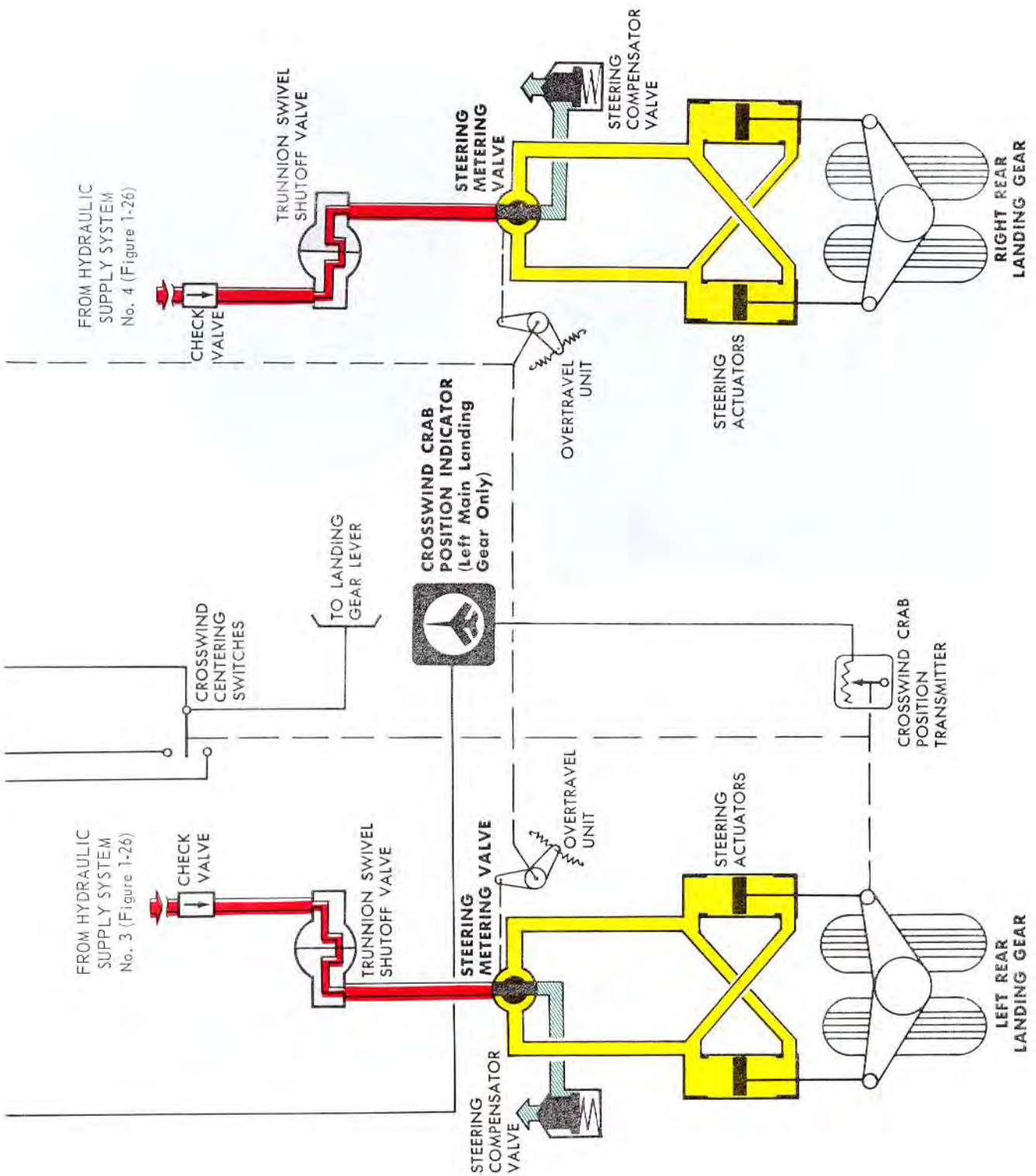
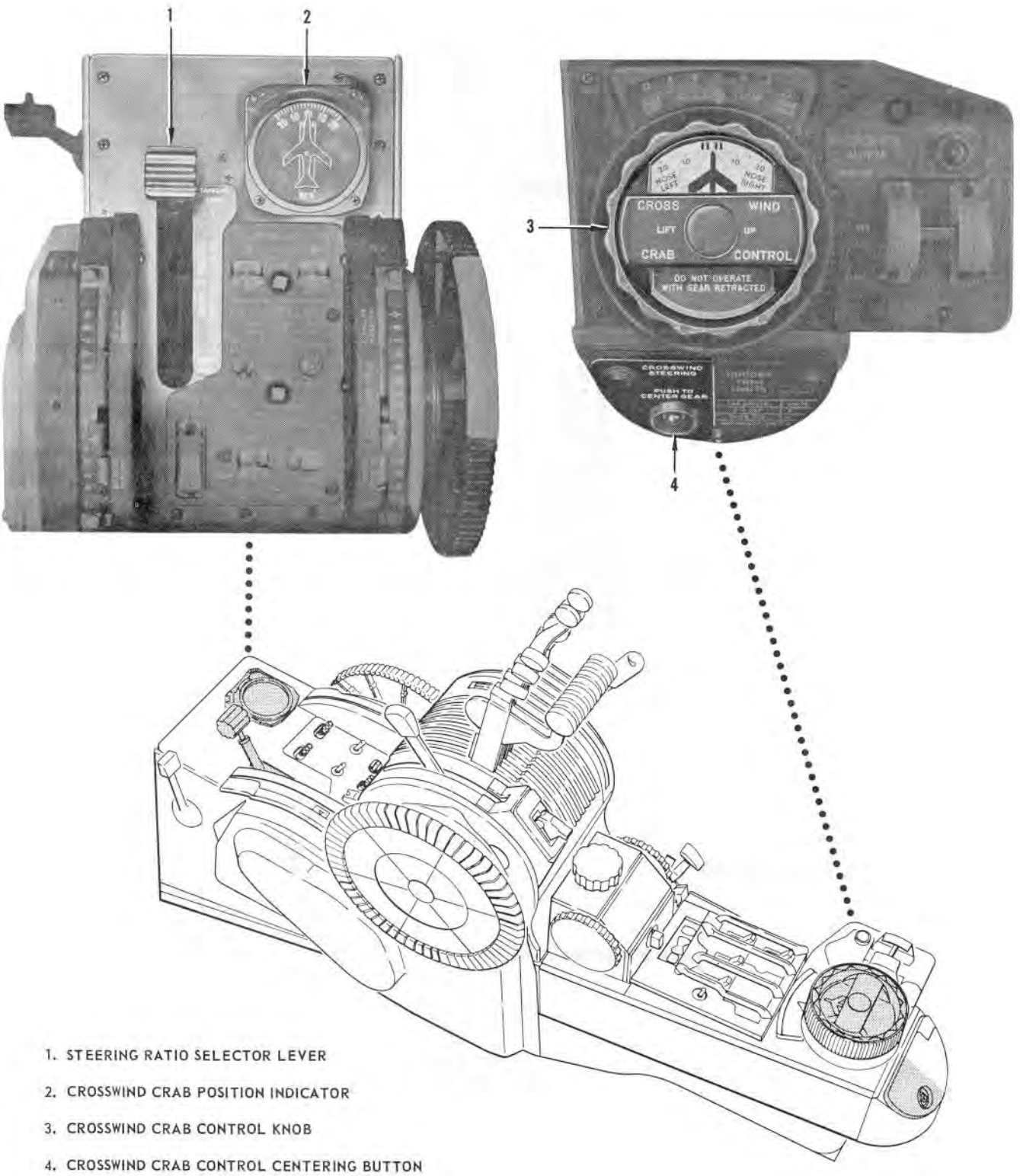


Figure 1-42. (Sheet 1 of 2).



.....steering and crosswind crab system

Figure 1-42. (Sheet 2 of 2).



1. STEERING RATIO SELECTOR LEVER
2. CROSSWIND CRAB POSITION INDICATOR
3. CROSSWIND CRAB CONTROL KNOB
4. CROSSWIND CRAB CONTROL CENTERING BUTTON

.....steering and crosswind crab controls

Figure 1-43.

Crosswind Crab System Controls

CROSSWIND CRAB CONTROL KNOB. The crosswind crab control knob (3, figure 1-43) is recessed in the rudder trim control knob on the aft end of the aisle stand. The control has an indicator in the form of a miniature airplane which points to a degree scale to indicate the amount of nose left or right crosswind crab trim selected. To move the control, it is necessary to lift up before turning. When the crosswind crab control knob is turned for crosswind crab trim, cable linkage moves the jackscrew at the differential coordinating unit. The jackscrew positions the rear drum of the coordinating unit to move cable and mechanical linkage to operate the forward gear steering metering valves. The jackscrew also moves cable and mechanical linkage to operate the rear gear steering metering valves. It is to be noted that the rear main gear can be steered only through movement of the jackscrew of the coordinating unit while the forward main gear are steered by movement of the rear drum of the coordinating unit. The rear drum can be moved both by the jackscrew for crosswind crab and by the forward drum of the coordinating unit for steering by the rudder pedals. This action allows steering of the forward gear even when the forward gear are preset for crosswind crab.

NOTE

When the main landing gears are extended and crabbed in flight to an angle equal to or exceeding 14° through any combination of crosswind crab setting and rudder pedal movement, the landing gear safety switches will be actuated. See "Landing Gear Safety Switches," this section.

CROSSWIND CRAB CENTERING BUTTON. A crosswind crab centering button (4, figure 1-43) aft of the crosswind crab control knob on the aisle stand is used to center all four main landing gear from a turned position to neutral. The crosswind crab centering button controls an electric motor which turns the jackscrew in the coordinating unit in the desired direction to center all four gear. When the left rear gear is centered, power to the motor is interrupted causing all centering action to stop. The centering button is a push-type switch spring-loaded to OFF position. Electrical TR power is supplied through a circuit breaker marked "Ctring" on the "Landing Gear" portion of the pilot's circuit breaker panel. The direction of the motor is governed by two cam-actuated centering switches on the left rear main landing gear. When either of these switches is actuated by the cam and the centering button is pushed, the circuit is energized to operate the centering motor.

Crosswind Crab System Indicators

CROSSWIND CRAB POSITION INDICATOR. The indicator (2, figure 1-44) on the forward right side of the aisle stand shows, in a relative plan view presentation, the amount in degrees that the landing gear is turned to compensate for aircraft crab during crosswind conditions. The indicator is an electrically operated instrument and receives TR power through a circuit breaker marked "Cross Wind Crab Ind" on the "Landing Gear" portion of the pilot's circuit breaker panel, which is carried through two position transmitters, one on the left forward gear and one on the left rear gear. The indicator has a diagram marked with a miniature runway and a scale calibrated from 0° to 20° both right and left. Two movable pointers, one mounted above the other, indicate the degree of turn. The lower pointer, a simple needle, indicates the forward left gear and the upper pointer, in the form of a miniature airplane, indicates the left rear gear. Since the gear position is in the opposite direction from that indicated by the pointers, it is always considered that the airplane is being turned into the wind at an angle to the runway. When the airplane is steered, the lower pointer will move in a direction opposite that of the turn and the upper pointer will remain in the position of the crab angle.

NOTE

After crosswind crab has been set, both pointers of the crosswind crab indicator should match crab angle within ±2°.

WHEEL BRAKE SYSTEM

Each wheel of the main landing gear has hydraulic brakes. The brakes are of the multiple disc type. Braking is accomplished by toe pressure on any or all of the rudder pedals. No differential braking is provided. A hand-operated pump is available in the left forward wheel well. An antiskid system to automatically detect and correct a skid condition is on each wheel of the main landing gear. Parking brakes are also provided.

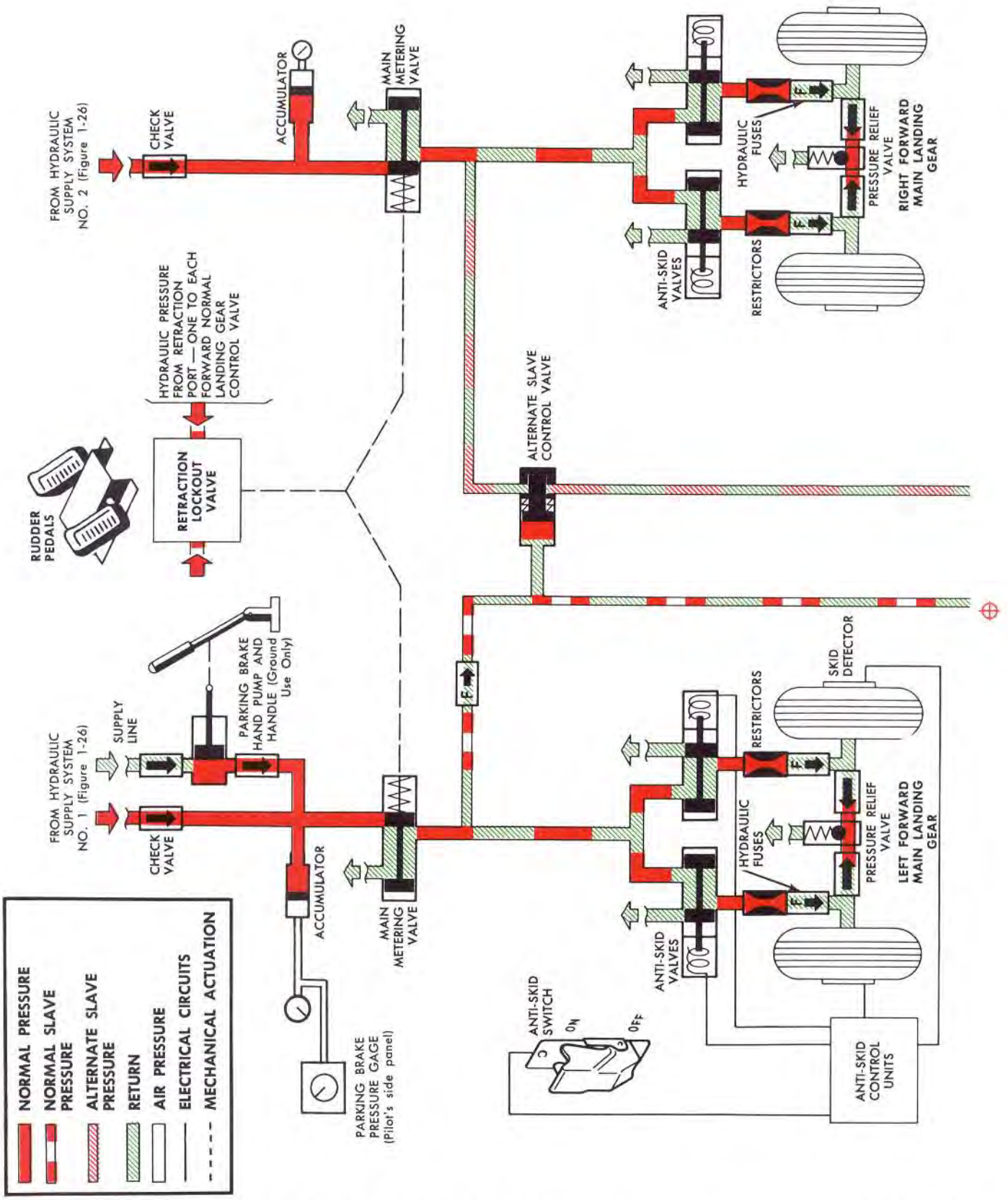


Figure 1-44. (Sheet 1 of 2).

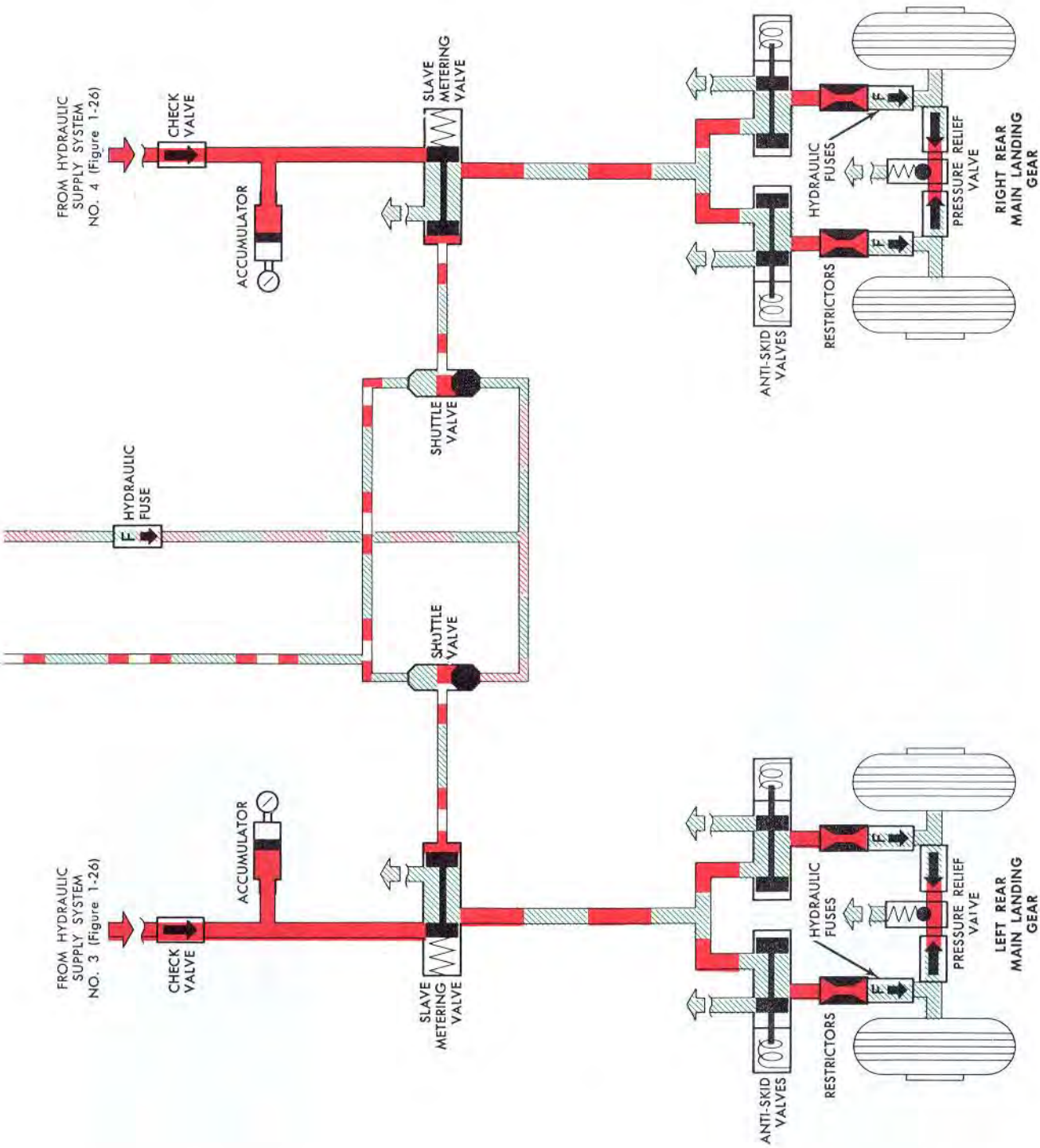
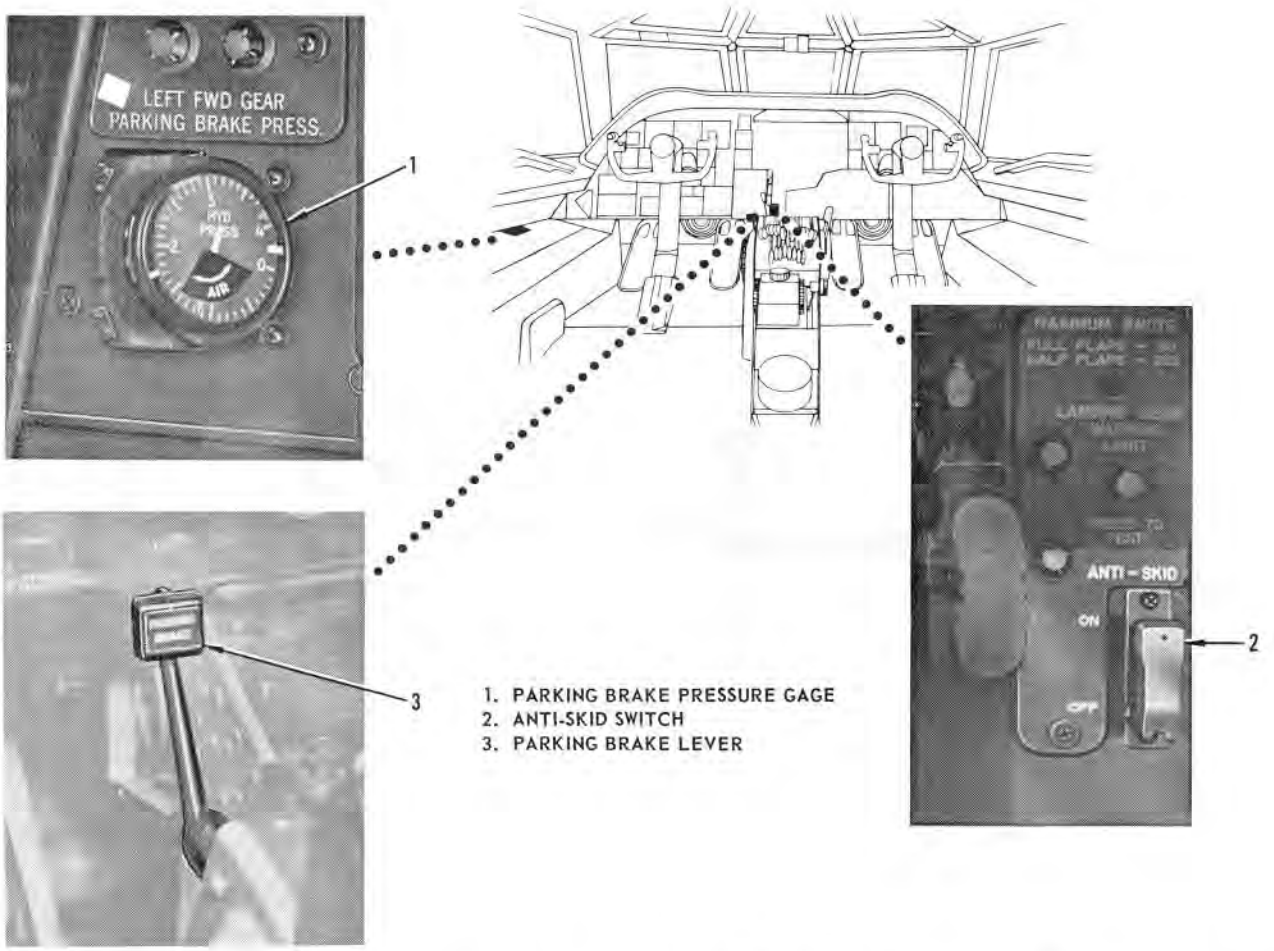


Figure 1-44. (Sheet 2 of 2).

WHEEL BRAKE HYDRAULIC PRESSURE

Each main landing gear has an individual brake system as shown in figure 1-44. Hydraulic pressure to each main gear is supplied by an individual hydraulic system. There is an accumulator in each main gear brake system. The two forward main gear brakes are actuated simultaneously and the two rear main gear brakes are slaved to the forward brake systems. This provides equal braking on all four main gear. Hydraulic system No. 1 supplies pressure to the left forward main gear brakes and normal slave pressure to the rear main gear brakes. Hydraulic system No. 2 supplies pressure to the right forward main gear brakes and alternate slave pressure to the rear main gear brakes. The left rear main gear brakes are supplied pressure by hydraulic system No. 3. The right rear main gear brakes receive pressure from hydraulic system No. 4. Toe pressure on the rudder pedals is transmitted to two main metering valves through mechanical linkages and a spring system of feel and return springs. The feel springs absorb linkage travel and hold spring tension on the metering valves. The return springs return and hold the metering valves in the off position. Lockout retraction valves, operated by hydraulic pressure from the normal landing gear retraction lines, act on the spring system so that braking action during gear retraction will be reduced to one-fourth of normal braking pressure. Hydraulic pressure from the main metering valves is used for two purposes, one is brake actuation on each wheel of the forward main gear and the other is hydraulic actuation of the two slave metering valves, one for each rear main gear. Pressure is supplied to the two slave metering valves through the normal slave line or the alternate slave line. Differential pressure in the normal slave line holds a control valve in the alternate slave line closed. The alternate slave line control valve will open if the pressure in the normal slave line becomes appreciably less than the pressure in the alternate slave line. Either slave line pressure can enter the two slave metering valves through a shuttle valve on each metering valve. The shuttle valve positions according to pressure differential. Positioning of the slave metering valves controls the hydraulic pressure from hydraulic systems No. 3 and 4 to the rear wheel brakes. Hydraulic pressure to the brakes is further controlled by an anti-skid system.



1. PARKING BRAKE PRESSURE GAGE
2. ANTI-SKID SWITCH
3. PARKING BRAKE LEVER

wheel brake system controls

Figure 1-45.

ANTISKID SYSTEM

The antiskid system consists of a skid detector on each main gear wheel, an antiskid valve for each wheel, a relay unit for each main gear, and an antiskid switch. Switched battery power for the antiskid system is supplied through circuit breakers marked "Anti Skid Control" - "Left Fwd," "Right Fwd," "Left Aft," and "Right Aft" on the "Landing Gear" portion of the pilot's circuit breaker panel. The antiskid valve for each wheel is electrically actuated through relays from a skid detector unit on each wheel. This valve is spring-loaded to open position to allow pressure to reach the brakes. When any wheel is in a skid condition, a signal is transmitted by the skid detector unit through the relay unit to actuate the valve. The antiskid valve is then positioned to shut off pressure to the brake and opens a port to the return line releasing the brake pressure on that wheel. At the end of the side signal, following a very short time delay, brake pressure is again restored to the wheel. If the skid continues until wheel rotation stops, a locked wheel signal is transmitted through an additional relay to release brake pressure from that wheel. Upon brake pressure release, the wheel is free to rotate and again starts to accelerate. After a short time delay to permit the wheel to reach nonskid speed, the brake pressure is again restored to the wheel. For further information, see "Landing Gear Safety Switches," this Section.

NOTE

A skid or locked wheel condition on any one wheel does not affect braking on any other wheel.

WHEEL BRAKE SYSTEM CONTROLS

Rudder Pedals

Toe pressure on any one of the four rudder pedals will actuate the wheel brakes.

Parking Brake Lever

The parking brake lever (3, figure 1-45) is on the left forward side of the aisle stand. Moving the lever aft while depressing the rudder pedals sets the parking brakes. A mechanical linkage from the parking brake lever locks the rudder pedals in a brakes-applied position. As long as hydraulic pressure is available, the brakes will remain on. The parking brake may be released by merely depressing the brake pedals until the parking brake lever releases, then releasing the brake pedals.

Antiskid Switch

The antiskid switch (2, figure 1-45) on the pilots' instrument panel to the right of the landing gear lever has ON--OFF positions and is guarded to ON position. When the switch is ON, the antiskid system is in operation.

Parking Brake Hydraulic Hand Pump

The hand pump and handle are located on the right side in the left forward wheel well. This is a ground handling facility, used to charge the left front gear accumulator pressure during towing operations. Approximately 70 double strokes are required on the hand pump to charge the accumulator for one or two brake applications with the antiskid switch in OFF position.

WHEEL BRAKE SYSTEM INDICATORS

Parking Brake Pressure Gages

There are five gages to indicate the hydraulic pressure of the four main gear brake accumulators. There is one brake accumulator in each wheel well. A gage is on the end of each of the brake accumulators for the left and right rear and left and right forward main landing gear. A second gage (1, figure 1-45) for the left forward main landing gear brake accumulator is located on the pilot's side panel and is marked "Parking Brake Pressure." See figure 1-60 for air pressure preload values.

DRAG CHUTE SYSTEM

A 44-foot ribbon-type drag chute is provided for deceleration during the landing roll. This parachute is contained in a compartment (4, figure 1-2) in the bottom of the tail compartment. Deploying the drag chute is accomplished by lowering the aft end of the chute compartment into the slipstream. This pulls a ripcord and a pilot chute drags the main chute out of the compartment. The risers of the main chute are attached to the airplane through a terminal held by a jettison mechanism. The terminal incorporates a shear pin which will shear if the drag chute is deployed at airspeeds above approximately 160 to 180 knots IAS on the ground and approximately 170 to 190 knots IAS in the air. Drag chute deployment and jettisoning are accomplished manually by a cable system. This cable system operates a deploy mechanism to open the compartment when operated in one direction. After the release mechanism has been actuated, the cable system can be operated in the opposite direction to actuate the jettison mechanism. For operating limits of the drag chute, see "Airspeed Limitations," Section V.

NOTE

A locking device in the control system operated by the drag chute compartment door prevents actuation of the jettison mechanism when the door is closed.

DRAG CHUTE LEVER

Operation of the drag chute is controlled by a DEPLOY --LOCKED--JETTISON lever (8, figure 1-12) on the aisle stand. This lever manually controls the drag chute release and jettison mechanisms through the cable system. It must be moved to DEPLOY position before it can be moved to JETTISON position. LOCKED position holds the spring-loaded drag chute compartment door securely closed.

NOTE

If the door opens accidentally, thus deploying the drag chute, the chute can be jettisoned by moving the drag chute lever directly to JETTISON from LOCKED position.

TURRET-DRAG CHUTE INTERCONNECT CONTROL KNOB

A turret-drag chute interconnect system is provided to facilitate the gunner's exit following turret jettison. A push-pull type control knob (10, figure 4-54) at the gunner's station controls drag chute deactivation when jettisoning the turret. When in the normal knob down position, the drag chute is deactivated (i.e., not available for pilot use) if the turret is jettisoned. With the control knob in the down position and the drag chute deployed, jettisoning the turret will automatically jettison the drag chute. With the control knob pulled up, the drag chute remains activated (i.e., available for pilot use) whether the turret is jettisoned or not. If, subsequently, the pilot decides prior to turret jettison that the drag chute will not be required, the control knob may be readily reset (full down). However, following turret jettison, it may be possible to reset the control knob only by exerting a downward force of approximately 30 pounds.

INSTRUMENTS

Only those instruments which are not properly a part of a complete system are listed in figure 1-46. The instruments listed include pitot-static operated instruments, direct-current operated instruments, and alternating-current operated instruments.

NOTE

The machmeter ideally would give a true Mach reading; however, there are two sources of error in the system. One is the position error inherent in the pitot-static system and the other is the instrument error which is inherent in the mechanism of the instrument itself. The magnitude of the position error is shown on the "Position Error" chart in Part 1 of the Appendix. Since no calibration is available, the magnitude of the instrument error is not known to the pilot but will be within the maximum allowable tolerance of ±.03, ME-5 machmeter (±.01, A-1 machmeter). See Part 1 of the Appendix for a further discussion of these errors and a method of inflight determination of the Mach number. All Mach numbers given in this flight manual are indicated Mach unless otherwise noted.

PITOT-STATIC INSTRUMENTS

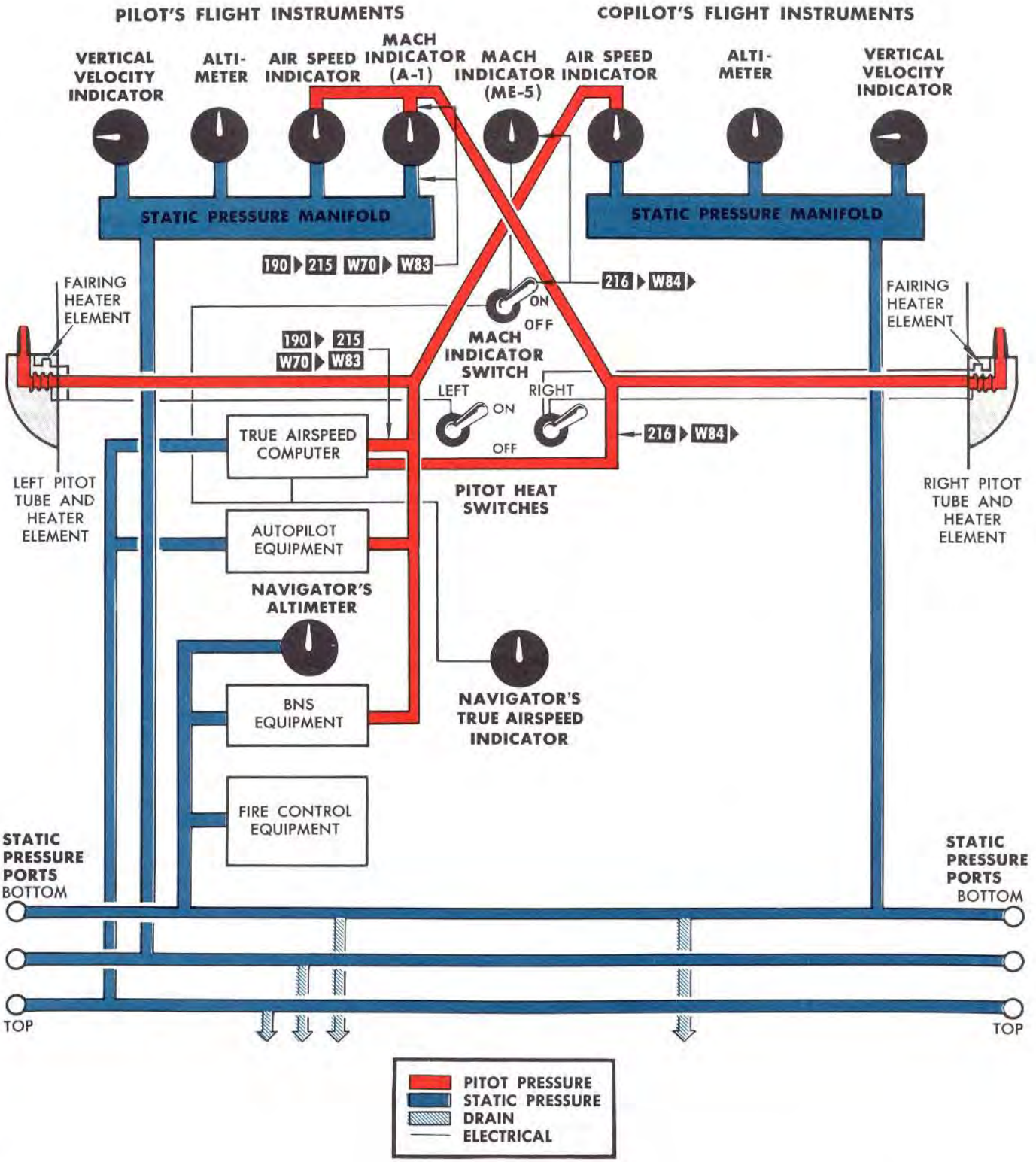
The pitot-static system (figure 1-47) contains two pitot tubes and six static ports. The pitot tubes are located aft of the forward radome on the lower left and lower right of the control cabin. The right pitot tube supplies impact pressure to the pilot's airspeed indicator, Mach indicator 190▶ 215 W70▶W83, and true airspeed computer 216▶ W84▶. The left pitot tube supplies impact pressure to copilot's airspeed indicator, autopilot equipment, true airspeed computer 190▶ 215 W70▶ W83, and BNS equipment. Three static pressure ports

INSTRUMENTS	OPERATING POWER	CIRCUIT PROTECTION
AIRSPEED INDICATOR	Pitot-static	None
ALTIMETER	Pitot-static	None
VERTICAL VELOCITY INDICATOR	Pitot-static	None
MACH INDICATOR (A-1)	Pitot-static	None
*MACH INDICATOR (ME-5)	A-C Electric	None
**TURN AND SLIP INDICATOR	D-C Electric	Pilot's circuit breaker panel
PILOT'S ATTITUDE INDICATOR	A-C Electric	Pilot's or pilot's auxiliary circuit breaker panel
COPILOT'S ATTITUDE INDICATOR	A-C Electric	Pilot's overhead circuit breaker panel
DIRECTIONAL INDICATOR (GYRO)	A-C Electric	Pilot's circuit breaker panel
OUTSIDE AIR TEMPERATURE GAGE	D-C Electric	Pilot's circuit breaker panel
ACCELEROMETER	None	None
MAGNETIC STANDBY COMPASS	None	None
CLOCK	None	None

*Remotely operated from the true airspeed computer.
**Receives emergency power through the emergency battery switch.

instruments

Figure 1-46.



pitot-static system (typical)

Figure 1-47.

are located on each side of the control cabin. Each port is interconnected with the corresponding port on the opposite side of the aircraft. The top ports provide static pressure for the autopilot equipment and the true airspeed computer. The center ports provide static pressure to the pilot's flight instruments which include Mach indicator 190▶215 W70▶W83, altimeter airspeed indicator, and vertical velocity indicator. The copilot's airspeed indicator, altimeter, and vertical velocity indicator along with the radar navigator's altimeter, the fire control equipment, and the BNS equipment are supplied static pressure by the bottom ports. For information on pitot head anti-icing, see Section IV.

NOTE

Due to the location of static ports relative to airflow under different conditions of flight, instruments depending upon a static source may vary in accuracy. See the "Position Correction" charts in Part 1 of the applicable Appendix for the correction desired under a particular condition.

Airspeed Indicators

A Type L-7A airspeed indicator (7, figure 1-13 and 8, figure 1-13A) is located at both the left and right sides of the pilots' instrument panel. By the use of two pointers, the pilots can observe the airspeed indication and the maximum allowable airspeed reading at the same time. The airspeed dial is graduated from 50 to 650 in 10-knot increments. A rotating drum, visible through a window in the dial, is graduated from 0 to 100 in 2-knot increments for sensitive indications. Stops limit the maximum speed pointer travel in the range from 200 to 600 knots. Mach number indications from 0.6 to 1.0 are also provided in this range as a reference for the Mach number index adjustment. A triangular index at the edge of the dial is set to the aircraft maximum allowable Mach number by an adjustment made at the rear of the instrument case. This adjustment governs the rate of change of the maximum airspeed pointer to indicate Mach airspeed of the aircraft for any flight altitude or airspeed. In operation, the maximum airspeed pointer moves down the scale from the upper limits with lowering pressure altitude, and the indicated airspeed pointer moves up the scale with increasing airspeed. When the pointers coincide, the Mach airspeed for the existing flight condition has been reached.

Altimeters

190▶ W70▶W83 W86 W90▶W94 W96▶

A Type MA-1 altimeter (6, figure 1-13 and 5, figure 1-13A) is located on the pilot's, copilot's, and radar navigator's instrument panels. Three pointers indicate hundreds, thousands, and tens of thousands of feet with reference to a single dial scale uniformly graduated from 1 to 10. The long pointer indicates 1000 feet in one revolution, the intermediate pointer 10,000 feet in one revolution, and the short pointer 10,000 feet for each major graduation on the dial. The maximum altitude reading is 80,000 feet. A zero setting system, controlled by a knob on the front of the instrument, permits the pilots to set the pointers to a zero reading at any ground pressure altitude from 28.1 to 31.0 inches of mercury.

W84▶W87 W89 W95

A Type MD-1 altimeter (6, figure 1-13 and 5, figure 1-13A) is located on the pilot's, copilot's, and radar navigator's instrument panels. A single pointer indicates hundreds of feet on a dial face graduated from 1 to 10 while a drum indicates thousands of feet graduated from -1 to 80. The maximum altitude reading is 80,000 feet. A zero setting system, controlled by a knob on the front of the instrument, permits the pilots to set the pointer to a zero reading at any ground pressure altitude from 28.1 to 31.0 inches of mercury.

ALTIMETER CORRECTION CARD. An altimeter correction card and holder (15A, figure 1-8) is located on the pilot's side glare shield. The use of this card is necessary to fly corrected altitude for traffic separation as required by regulations. This card takes into account both the position error of the airplane and the mechanical error of the altimeter, therefore, each time the altimeter is changed on a specific airplane, the correction card must be replaced using the instrument corrections for the new altimeter. For further information concerning the use of the altimeter correction card, refer to Part 1 of the Appendix.

Vertical Velocity Indicators

An AN5825-7 vertical velocity indicator (34, figure 1-13 and 12, figure 1-13A) is located at both the right and left sides of the pilots' instrument panel. These instruments measure the rate of climb or rate of descent. The dial is graduated from 0 to 6000 feet per minute on two adjoining scales. A single pointer indicates rate of climb or rate of descent from the common zero.

Mach Indicator (A-1)

190▶215 W70▶W83

A Type A-1 Mach indicator (4, figure 1-13 and 4, figure 1-13A) located on the left side of the pilots' instrument panel indicates the ratio of airplane speed to the speed of sound at the particular pressure altitude at any time during flight. A single pointer indicates the Mach number on a dial face graduated in tenths and having a range of 0.3 to 1.0. The instrument is connected directly to the pitot-static system.

Pages 1-113 and 1-114, figures 1-48 and 1-49 deleted

ELECTRICALLY OPERATED INSTRUMENTS

Radar Altimeter AN/APN-150 SQ

See "Communication and Associated Electronic Equipment," Section IV.

Mach Indicator (ME-5)

216▶ 223 250▶ W84▶ W100 W166▶Plus HW

A Type ME-5 Mach indicator (4, figure 1-13 and 4, figure 1-13A) located on the left side of the pilots' instrument panel indicates the ratio of airplane speed to the speed of sound at the particular pressure altitude at any time during flight. The instrument has a range of 0.5 to 1.0 which is indicated on a stationary dial by a rotating pointer. A rotating subdial is also provided which reads in hundredths and is graduated from 1 to 10. Movable indices are located on the face of the instrument, one on the main dial and one on the subdial which rotates with the subdial scale. These indices can be moved to any value of Mach number desired as a reference without affecting the reading or adjustment of the instrument. Rotating the knob in the lower right corner of the instrument while in its normal (out) position will move the index on the main dial. Depressing and rotating the knob will allow adjustment of the index on the subdial. If power is on the instrument, movement of the subdial index will not cause movement of the subdial. However, if there is no power on the instrument, movement of the subdial index may cause movement of the subdial and the main dial pointer. This rotation of pointer and subdial scale will not affect indicator reading. When power is turned on and the true airspeed computer is warmed up sufficiently, needle and subdial will indicate appropriate Mach reading. The ME-5 is a servo-type indicator, receiving power from the true airspeed computer through a Mach indicator switch (56, figure 1-13 and 2, figure 1-13A) on the pilots' instrument panel below the indicator. The purpose of the Mach indicator switch, which has ON--OFF positions, is to turn the instrument off during takeoff. If the switch is turned ON before takeoff, the needle will jump to Mach 1.0 because the instrument is transistorized and warms up faster than the computer. Even though the computer may have warmed up, the indicator will remain at Mach 1.0 and oscillate during takeoff until sufficient pitot pressure reaches the computer at which time the needle will suddenly flip to the appropriate Mach reading. Because an oscillating needle can become disconcerting on takeoff, the Mach indicator should not be turned ON until takeoff has been completed and computer operation is assured.

Turn and Slip Indicators

A Type C-6 turn and slip indicator (8, figure 1-13 and 3, figure 1-13A) is located on both the right and left sides of the pilots' instrument panel. A small gyro, switched battery power driven on the pilot's side and TR power driven on the copilot's side, acts on the turn pointer to indicate rate of turn of the aircraft. A liquid damped black ball in a curved glass tube provides a slip or skid indication. In a coordinates turn, the ball will remain centered while the needle indicates the rate of turn. In straight flight, both the needle and the ball will remain centered. A 360° needle-width turn takes 4 minutes. Power for the gyros is supplied through circuit breakers marked "Pilot Turn & Bank" and "Copilot Turn & Bank" on the "Flight Indicators" portion of the pilot's circuit breaker panel. Emergency power is provided through the emergency battery switch for the pilot's turn and slip indicator.

Pilot's Attitude Indicator (Type MM-1)

Less HX

A Type MM-1 attitude indicator (14, figure 1-13 and 9, figure 1-13A) on the left side of the pilots' instrument panel is remotely operated by a vertical gyro control unit. The vertical gyro is fully aerobatic in that it is not limited by pitch or roll. The 118-volt three-phase a-c power utilized by this instrument is stepped down from 205 volts by a transformer which receives power from the aircraft primary system. The remote control circuit operates on TR power. A-C power is supplied through fuses marked "Flight Gyro 1 Amp Fuses" - "ØA," "ØB," and "ØC" and TR power is supplied through a circuit breaker marked "Flight Gyro Cont" on the pilot's auxiliary circuit breaker panel. Both circuits are routed through the attitude and directional gyro power switch (30, figure 1-13) on the pilots' instrument panel Less LH and (10, figure 1-9) on the pilot's side panel LH. The vertical gyro indicator has 360° of freedom in roll and a minimum of ±82° in pitch. The sphere indicates the degree of climb or dive in a reference to a miniature aircraft. The sphere has a white background with black circular arcs above zero pitch line and a black background with white circular arcs below zero pitch line. These circular arcs are spaced at 5° intervals with the long arcs indicating each 10° of pitch. Pitch angles of 30° and 60° above and below the horizon are also indicated by numerals. CLIMB or DIVE markings are centered on the respective 45° pitch circle. A knob on the front of the indicator is used to adjust the horizon line up or down with respect to the miniature aircraft to accommodate the viewer's line of vision and to trim the instrument to zero pitch for ease of reference in extended shallow climbs or dives. The degree of roll is indicated by the position of the bank pointer relative to the 10°, 20°, 30°, 60°, and 90° bank scale markings on the

ELECTRICALLY OPERATED INSTRUMENTS

Radar Altimeter AN/APN-150 SQ

See "Communication and Associated Electronic Equipment," Section IV.

Mach Indicator (ME-5)

216 ▸ WB4 ▸

A Type ME-5 Mach indicator (4, figure 1-13 and 4, figure 1-13A) located on the left side of the pilots' instrument panel indicates the ratio of airplane speed to the speed of sound at the particular pressure altitude at any time during flight. The instrument has a range of 0.5 to 1.0 which is indicated on a stationary dial by a rotating pointer. A rotating subdial is also provided which reads in hundredths and is graduated from 1 to 10. Movable indices are located on the face of the instrument, one on the main dial and one on the subdial which rotates with the subdial scale. These indices can be moved to any value of Mach number desired as a reference without affecting the reading or adjustment of the instrument. Rotating the knob in the lower right corner of the instrument while in its normal (out) position will move the index on the main dial. Depressing and rotating the knob will allow adjustment of the index on the subdial. If power is on the instrument, movement of the subdial index will not cause movement of the subdial. However, if there is no power on the instrument, movement of the subdial index may cause movement of the subdial and the main dial pointer. This rotation of pointer and subdial scale will not affect indicator reading. When power is turned on and the true airspeed computer is warmed up sufficiently, needle and subdial will indicate appropriate Mach reading. The ME-5 is a servo-type indicator, receiving power from the true airspeed computer through a Mach indicator switch (56, figure 1-13 and 2, figure 1-13A) on the pilots' instrument panel below the indicator. The purpose of the Mach indicator switch, which has ON--OFF positions, is to turn the instrument off during takeoff. If the switch is turned ON before takeoff, the needle will jump to Mach 1.0 because the instrument is transistorized and warms up faster than the computer. Even though the computer may have warmed up, the indicator will remain at Mach 1.0 and oscillate during takeoff until sufficient pitot pressure reaches the computer at which time the needle will suddenly flip to the appropriate Mach reading. Because an oscillating needle can become disconcerting on takeoff, the Mach indicator should not be turned ON until takeoff has been completed and computer operation is assured.

Turn and Slip Indicators

A Type C-6 turn and slip indicator (8, figure 1-13 and 3, figure 1-13A) is located on both the right and left sides of the pilots' instrument panel. A small gyro, switched battery power driven on the pilot's side and TR power driven on the copilot's side, acts on the turn pointer to indicate rate of turn of the aircraft. A liquid damped black ball in a curved glass tube provides a slip or skid indication. In a coordinates turn, the ball will remain centered while the needle indicates the rate of turn. In straight flight, both the needle and the ball will remain centered. A 360° needle-width turn takes 4 minutes. Power for the gyros is supplied through circuit breakers marked "Pilot Turn & Bank" and "Copilot Turn & Bank" on the "Flight Indicators" portion of the pilot's circuit breaker panel. Emergency power is provided through the emergency battery switch for the pilot's turn and slip indicator.

Attitude Indicators (Type MM-4)

A Type MM-4 attitude indicator (14, figure 1-13 and 9, figure 1-13A) on both the pilot's and copilot's instrument panels provides an indication of airplane pitch and roll attitudes. A moving internally illuminated spheroid with a horizon bar dividing the light colored upper half from the dark colored lower half at the zero pitch position is displayed with reference to a miniature airplane fixed within the instrument cover glass. Pitch reference lines are marked each 5° by portions of great circles which intersect at the pitch axis. The words

CLIMB or DIVE are centered on the respective 45° lines and numerals 30 and 60 on the lines indicating those degrees of pitch angle. A knob at the lower right front of the indicator case permits zeroing the horizon line with reference to the miniature aircraft. A bank pointer, rotating with the roll gimbal, indicates bank angle with respect to a bank index at 10°, 20°, 30°, 60°, and 90° points on the bank angle dial fixed under the cover glass. A red attitude warning flag marked OFF, low on the left side of the indicator face, is the power failure indicator. The servo mechanisms which actuate the pitch and roll gimbals are remotely operated by a vertical gyro control unit for each indicator. The vertical gyro has 360° of freedom in roll and ±82° freedom in pitch. Gravity sensing during turns is cut off by a switching rate gyro. The vertical gyros are energized by three-phase ac, and the necessary single-phase ac to operate the indicators is supplied when the attitude and directional gyro power switch on the pilots' instrument panel is turned ON. See "Attitude and Directional Gyro Power Switch" below for additional power source information. When the attitude and directional gyro power switch is turned ON, the attitude warning flag should disappear within approximately 60 seconds. The warning flag should appear immediately upon interruption of a-c power to the flight gyro transformer in at least two of the three phases.

NOTE

An error in the pitch indication of the attitude indicators is generated during accelerations or decelerations. The error is indicated in a nose high direction during and after a forward acceleration and in a nose down direction during and after deceleration. The longer the duration of acceleration (or deceleration), the greater will be the indicated error and the longer it will persist when acceleration (or deceleration) ceases. The erection system will reduce the error at about the same rate it was generated. With the Type MM-4 attitude indicator, pitch error may reach one bar width during a high gross weight takeoff while, with earlier installed indicators, the error under the same conditions may be more than three times greater.

WARNING

It is possible that a malfunction of the attitude indicator might be determined only by cross-checking it with the remaining flight instruments.

Directional Indicator (Gyro)

A Type C-5C directional indicator (31, figure 1-13 and 26, figure 1-13A) located on the right side of the pilots' instrument panel receives 118-volt three-phase a-c power from the same transformer that supplied power to the copilot's attitude indicator. Power is controlled by the attitude and directional gyro power switch (30, figure 1-13) on the pilots' instrument panel Less [L] and (10, figure 1-9) on the pilot's side panel [L]. The pointer may be set to a vertical or horizontal position for ease of reading by depressing the right knob and rotating the pointer and dial. The left knob rotates the pointer only. Depressing either knob unclutches the pointer from the gyro and causes a flag marked CAGED to appear. The instrument contains a warning flag marked OFF which will appear if any two of the three phase circuits should fail. Neither flag is visible during normal flight.

Directional Indicator (N-1 Repeater)

A Type V-7A directional indicator (10, figure 1-13 and 6, figure 1-13A) located on the pilots' instrument panel is a repeater-type instrument with the pointer synchronized to the N-1 compass. Power for rotor excitation is 118-volt 400-cycle single-phase ac. The dial face is graduated in 2° increments from 0° to 360° with numerals at 10° intervals. Four of the cardinal points are indicated by letters. The last digit of the numerals is left off for simplification. A setting knob is provided so that the dial can be set to any desired heading with reference to an index at the top of the dial. The knob and dial rotate in the same direction and the pointer, which is attached to the rotor of the indicating mechanism, also rotates in synchronization with the dial when the indicator is properly energized.

Attitude and Directional Gyro Power Switch

An attitude and directional gyro power switch (30, figure 1-13) is located on the upper right side of the pilots' instrument panel Less [redacted] and (10, figure 1-9) on the pilot's side panel [redacted]. It is a two-way toggle switch consisting of two toggles ganged together with ON--OFF positions. In ON position, power is supplied to the pilot's and copilot's attitude indicators and the directional indicator. The 205-volt primary aircraft power is routed through the switch from two separate sources of power; one source supplying power to the transformer which operates the pilot's attitude indicator, and the other source supplying power to the additional transformer which operates the copilot's attitude indicator and the directional indicator. These power sources are supplied to the equipment through instrument-type fuses in individual indicating-type fuse holders marked "ØA," "ØB," and "ØC" under "Flight Gyro" on the pilot's circuit breaker panel for the pilot's attitude indicator and on the overhead circuit breaker panel for the copilot's attitude indicator and the directional indicator. In OFF position, power is cut off to these instruments.

NOTE

A burned out fuse light will illuminate provided the gyro power switch is in OFF position.

Outside Air Temperature Gage

A Type G-10 outside air temperature gage (38, figure 1-13 and 28, figure 1-13A) is located on the lower center area of the pilots' instrument panel. The air temperature gage is operated by an electrical resistance thermometer bulb located flush with the body skin on the lower left side of the forward pressurized section aft of the radar navigator's escape hatch. The temperature range of the gage is -70° to +50° C. The pointer should rest off the scale with power off, and should register outside air temperature with power on. Electrical TR power is supplied through a circuit breaker marked "Free Air Temp" on the "Flight Indicators" portion of the pilot's circuit breaker panel.

SELF-POWERED INSTRUMENTS

Accelerometer

An accelerometer (18, figure 1-13 and 58, figure 1-13A) is located on the left side of the pilots' instrument panel. The accelerometer is a self-contained unit requiring no external connections. The dial is calibrated in "g" units from -2 to +4 "g's." With the aircraft in straight and level unaccelerated flight, the main pointer indicates +1 "g," the normal force of gravity. The instrument contains three pointers with the main pointer giving continuous indications. Two auxiliary pointers indicate and maintain maximum plus and minus accelerations until they are reset, using the reset knob on the front of the instrument.

Magnetic Standby Compass

A Type AN5766T4 magnetic standby compass (22, figure 1-13 and 18, figure 1-13A) is located on top of the forward center window between the oil pressure gages.

Clocks

A Type A-13A clock (36, figure 1-13 and 27, figure 1-13A) is provided on the left and right sides of the pilots' instrument panel and on the radar navigator's panel. They are spring-wound 8-day clocks and have a winding knob on the lower left corner. A sweep second-hand and minute totalizer, both controlled by successive depressions of a START--STOP--RESET knob on the upper right corner, are provided.

EMERGENCY EQUIPMENT

For location of emergency equipment, see figure 3-1.

ENGINE FIRE WARNING SYSTEM

The airplane is not equipped with an engine fire extinguishing system but is equipped with eight engine fire warning lights and an engine fire detector system test switch.

Engine Fire Warning Lights

There are eight engine fire warning lights (25, figure 1-13 and 21, figure 1-13A) on the firewall fuel shutoff switches. These red lights, when on, indicate an engine fire and warn the pilot to shut down the affected engine. The circuits, when energized, receive forward switched battery power through a circuit breaker marked "Engine Fire Det" on the pilot's auxiliary circuit breaker panel.

Engine Fire Detector System Test Switch

The engine fire detector system test switch (52, figure 1-13 and 53, figure 1-13A) located on the pilots' instrument panel is used to test continuity of the engine fire warning system. The switch has two positions, TEST --NORMAL. In TEST position, illumination of the engine fire warning lights indicates a satisfactory circuit. In NORMAL position, the engine fire warning lights will illuminate only when an engine fire is detected.

FIREWALL FUEL SHUTOFF SWITCHES

The eight firewall fuel shutoff switches (26, figure 1-13 and 22, figure 1-13A) are located on the pilots' instrument panel. These switches, together with the throttle, control the firewall fuel shutoff valves. With the firewall fuel shutoff switches in NORMAL (in) position and a throttle advanced out of CLOSED, a throttle microswitch closes a circuit to supply 24-volt d-c switched battery power to open the firewall fuel shutoff valve. With a throttle retarded to CLOSED, the throttle microswitch routes the same power to close the firewall fuel valve. When the firewall fuel shutoff switch is pulled, the close circuit of the firewall fuel shutoff valve is energized regardless of the throttle position.

B-52F

If the engine being shut down is one which drives an alternator, the exciter control relay for that alternator will be tripped open by the shutoff switch. In turn, the tripped exciter control relay causes the alternator circuit breaker to be opened. Thus the alternator is both turned off and taken off the line.

NOTE

The firewall fuel shutoff switches are provided for use in case the throttle linkage jams. Emergency shutdown of an engine can be accomplished approximately 20 seconds faster by retarding the throttle to CLOSED position.

FUSELAGE OVERHEAT WARNING (FIRE WARNING) SYSTEM

The fuselage overheat warning system is provided to indicate an overheat condition occurring within the uninhabited areas of the fuselage. The system includes 20 thermal detectors strategically placed throughout the fuselage, warning indicators at the copilot's station, and a means of testing the indicators. See figure 1-50 for thermal detector locations. All power circuit breakers are on the pilot's overhead circuit breaker panel. Normal power is supplied through a circuit breaker marked "Fwd Bat Pwr" on the "Emer Warn & Outbd Air Brake" portion of the panel. Emergency power is supplied through a circuit breaker marked "Aft Bat Pwr" on the same portion of the panel. The emergency battery switch must be placed in the EMERG position before emergency power is available.

Fuselage Overheat Warning Lights

Indication of an overheat condition is provided by 20 fuselage overheat warning lights (figure 1-51) on the copilot's side panel and a master warning light (28, figure 1-13 and 24, figure 1-13A) on the right side of the pilots' instrument panel. Each of the warning lights on the copilot's side panel corresponds to one of the thermal detectors in the fuselage. These lights are "word warning" panels which, when energized, illuminate to show black letters on a red background thus locating the area of the overheat condition. The master fuselage overheat warning light will illuminate whenever any one of the word warning panels is energized. Both lights will remain on as long as the overheat conditions exist. The master light however can be reset to off so that it will again illuminate to alert the pilots in the event of additional indication on the word warning panels. Since the detectors are set for 300° F, a lighted warning panel is primarily a warning of an overheat condition; however, the possibility of fire must always be considered. See "Fuselage Overheat Indications" under "Fire," Section III, for a discussion of warning light indications and actions which should follow.

Master Fuselage Overheat Warning Light Reset Switch

The master warning light reset switch (figure 1-51) is a pushbutton switch adjacent to the fuselage overheat warning lights on the copilot's side panel. It is used to reset the master warning light to off after it has been illuminated due to an overheat condition in the fuselage. Resetting the master light will not affect the other fuselage overheat warning lights but serves only to ready it for further indication.

Fuselage Overheat Warning Light Test Switch

A push-to-test switch (figure 1-51) located adjacent to the fuselage overheat warning lights is used to test operation of the fuselage overheat warning panels. When the switch is pushed in, the 20 fuselage fire warning lights and the master warning light should illuminate. Operation of this switch does not test the thermal detectors.

MISSILE (GAM-72) FIRE WARNING SYSTEM

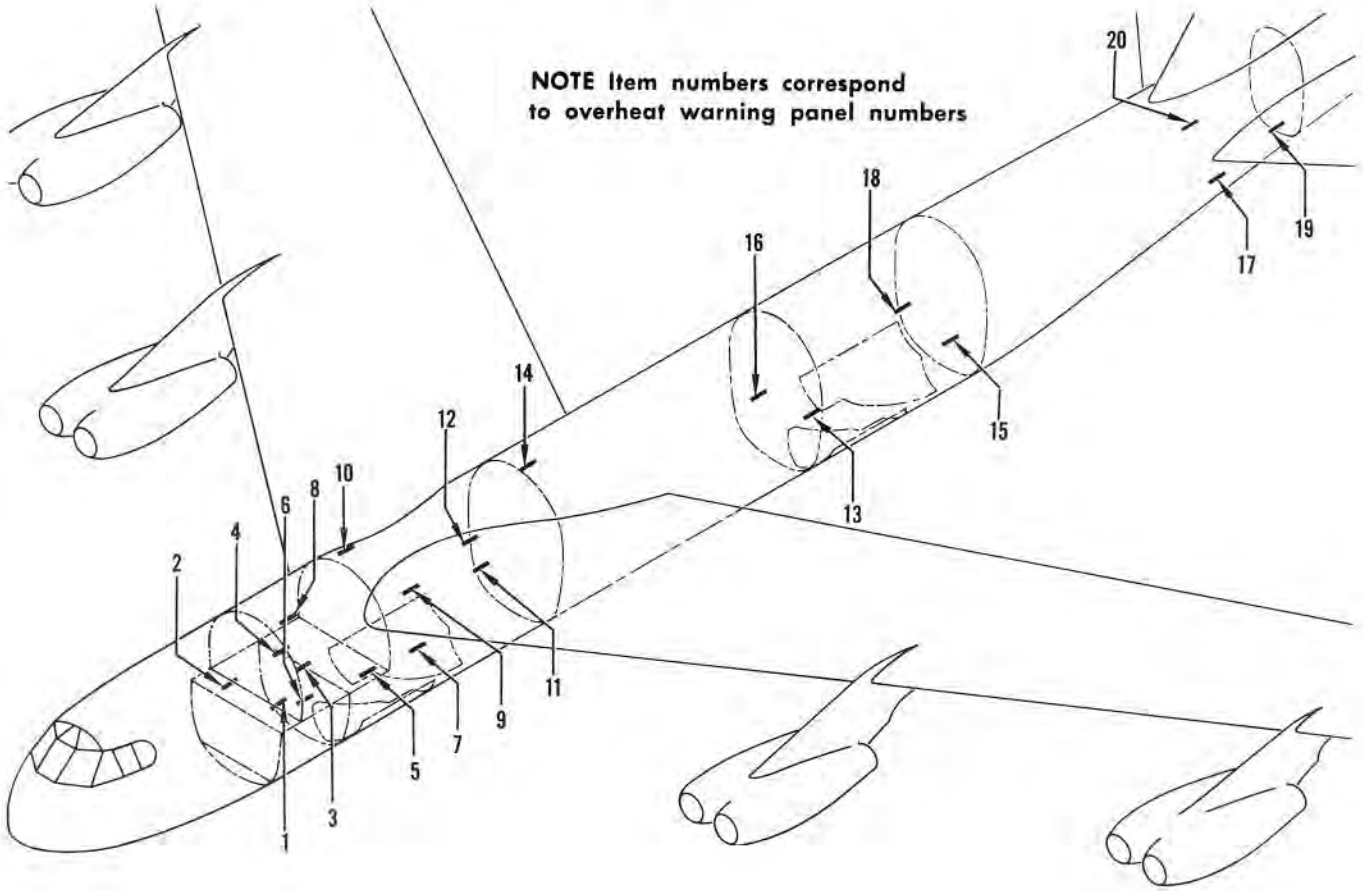
K-S

The (GAM-72) fire warning system provides a means of testing and monitoring the missile fire detection circuit. The system consists of fire detectors No. 1, 2, 3, and 4 (one in each missile), a fire warning panel incorporating a red GAM-72 fire warning light (7A, figure 1-10) at the copilot's station, and two red GAM-72 fire warning lights at the radar navigator's station (figure 4-38A).

Circuit Selector Switch

K-S

A circuit selector switch having 1--2--3--4 positions on the fire warning panel provides a means of testing individual detector circuits. Placing the selector switch in position "1" will test the detector in missile No. 1. If the circuit is operative, the GAM-72 fire warning light on the fire warning panel will illuminate provided



LEFT SIDE FUSELAGE

1. ALTERNATOR DECK FORWARD L.H. B-52E
   FORWARD EQUIPMENT BAY L.H. B-52F
3. FORWARD L.H. ALTERNATOR B-52E
5. FORWARD AIRCONDITIONING PACK
7. HYDRAULIC PACK NO. 1
9. FORWARD WHEEL WELL UPPER L.H.
11. AFT L.H. ALTERNATOR B-52E
    FORWARD WHEEL WELL AFT L.H. B-52F
13. AFT WHEEL WELL FORWARD L.H.
15. HYDRAULIC PACK NO. 3
17. AFT AIR CONDITIONING PACK
19. HYDRAULIC PACK NO. 9

RIGHT SIDE FUSELAGE

2. ALTERNATOR DECK FORWARD R.H. B-52E
   FORWARD EQUIPMENT BAY R.H. B-52F
4. FORWARD R.H. ALTERNATOR B-52E
6. ECM RADOME
8. FORWARD WHEEL WELL FORWARD R.H.
10. FORWARD WHEEL WELL UPPER R.H.
12. AFT R.H. ALTERNATOR AND HYDRAULIC PACK NO. 2 B-52E
    HYDRAULIC PACK NO. 2 B-52F
14. WING REAR SPAR – CENTER BODY
16. HYDRAULIC PACK NO. 4
18. AFT WHEEL WELL AFT R.H.
20. HYDRAULIC PACK NO. 10

fuselage overheat warning system thermal detector locations (typical)

Figure 1-50.

the circuit test switch is ON. Placing the selector switch in positions "2," "3," and "4" will test detector circuits in missiles No. 2, 3, and 4 respectively.

Circuit Test Switch

KS

A two-position momentary ON--OFF circuit test switch on the fire warning panel controls power to the circuit select switch.

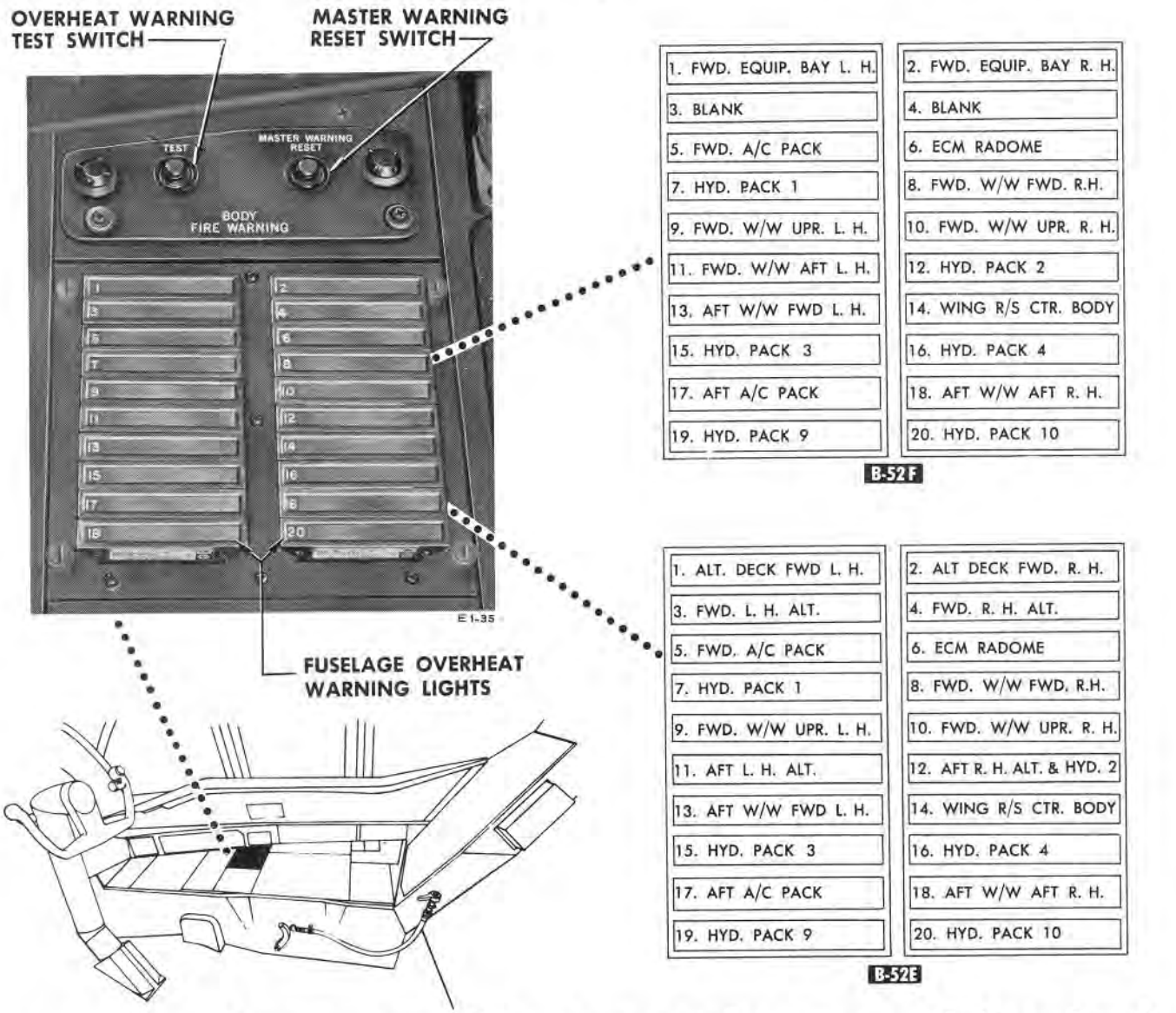
Fire Warning Lights

KS

One red warning light marked "GAM-72 Fire" is on the fire warning indicator panel. Two red word-warning lights marked "1-2 Fire" for the left side and "3-4 Fire" for the right side are on the launch control panel under "L and R Fire Warning" located at the radar navigator's station. The light at the copilot's station will illuminate when any missile fire detector is actuated provided the circuit test switch is OFF; however, the copilot is unable to determine how many missile fire detectors are actuated or what their numbers are. The lights at the radar navigator's station will illuminate when the fire detector in either of the respective missiles is actuated provided the circuit test switch is OFF. The radar navigator can determine if the actuated detector is on the left or right side of the bomb bay but he cannot establish how many detectors are actuated. Switched battery RL or forward battery KS power is supplied to the lights through a circuit breaker marked "Fire Warning" under the "GAM-72" portion of the pilots' overhead circuit breaker panel.

HAND FIRE EXTINGUISHERS

Stored pressure bromochloromethane (CB) type extinguishers (5, figure 3-1) are installed in the aircraft.



..... fuselage overheat warning panel (typical)

Figure 1-51.

One extinguisher is located at the EW officer's station; one to the right and aft of the navigator's seat; and one to the right of the gunner's seat. A trigger-type handle on top of the extinguisher permits operation with one hand. A pressure gage on each extinguisher indicates the CB pressure in the extinguisher. When fully serviced, the extinguishers are effective within a range of 25 feet in combating all types of fires. The fully serviced pressure is 165 (±10) psig at 70° F.

WARNING

Repeated or prolonged exposure to high concentractions of bromochloromethane (CB) or decomposition products should be avoided. CB is a narcotic agent of moderate intensity but prolonged effect. It is considered tc be less toxic than carbon tetrachloride, methyl bromide, or the usual products of combustion. In other words, it is safer to use than previous fire extinguishing agents. However, normal precautions should be taken including the use of oxygen when available. Crew members should go on 100% OXYGEN immediately, with emergency toggle lever in EMERGENCY position, if exposed to fumes.

NOTE

When using a portable oxygen bottle, the regulator setting will be 30M or higher, commensurate with cabin altitude.

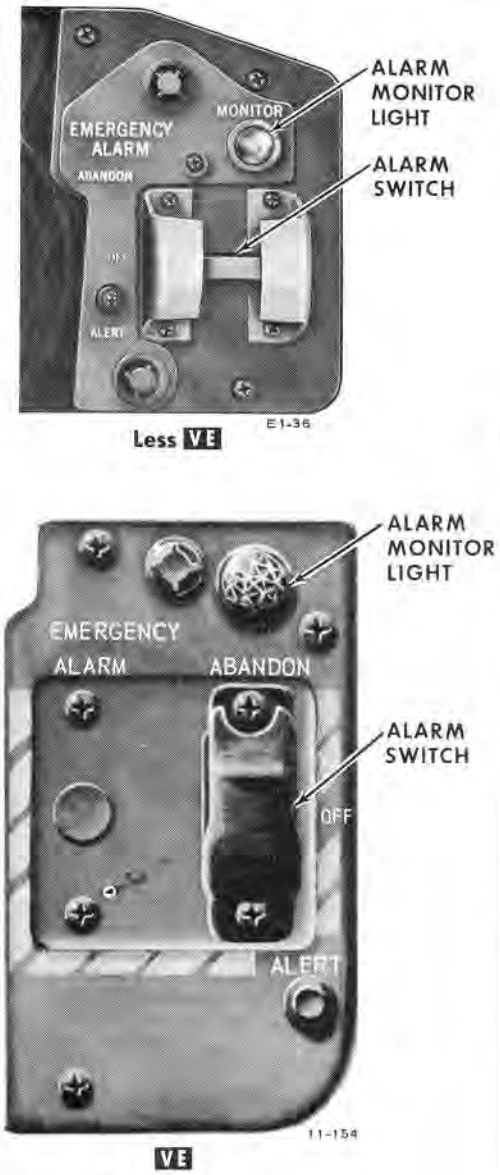
EMERGENCY ALARM SYSTEM

NOTE

- This system is independent of the battery switch position. The system operates on emergency battery power when emergency battery switch is in EMERG position.
- The interphone is considered the primary means for crew warning. The emergency alarm system is designed to warn personnel while off interphone.

Emergency Alarm Lights

Red emergency alarm lights are installed at the radar navigator's station, at the celestial navigation station on aircraft NF, at the EW officer's station, at the bomb bay forward and aft work stations, and at the gunner's normal and auxiliary stations. A monitor light (figure 1-52) is provided on the pilots' aisle stand. The lights are controlled by a guarded ALERT--OFF--ABANDON emergency alarm switch on the pilots' aisle stand. In ALERT position, switched battery power is supplied to the circuit and a flasher mechanism flashes all alarm lights at a frequency of approximately 30 to 60 times a minute. In ABANDON position, the same power supply bypasses the flasher causing the lights to glow continuously. In addition, the lights glow continuously when either the pilot's or copilot's control column is stowed during the ejection sequence. The lights normally are supplied forward battery power through a circuit breaker marked "Fwd Bat Pwr." The lights are also supplied aft battery power through a circuit breaker marked "Aft Bat Pwr" when the emergency d-c power switch is in EMERG position. Both circuit breakers are on the "Emer Warn & Outbd Air Brake" portion of the pilots' overhead circuit breaker panel. Control and lighting power is supplied from the same circuit through circuit breakers marked "Control and Lights" on the "Emer Warn Alarm" portion of the pilots' overhead circuit breaker panel.



emergency alarm panel

Figure 1-52.

Gunner's Emergency Alarm Audio Signal

An alarm circuit consisting of a signal generator, energized by battery power, is installed in the gunner's

interphone circuit. The generator is energized by the same guarded ALERT--OFF--ABANDON emergency alarm switch on the pilots' aisle stand that controls the emergency alarm system. When the emergency alarm switch is in ALERT position, the signal generator sends a pulsating signal to the gunner's headset. In ABANDON position, a steady signal replaces the pulsating signal. The alarm system is automatically energized to signal "abandon" when either the pilot's or copilot's control column is stowed in the ejection sequence. The gunner's signal generator is normally supplied forward battery power through a circuit breaker marked "Fwd Bat Pwr." The signal generator is also supplied aft battery power through a circuit breaker marked "Aft Bat Pwr" when the emergency d-c power switch is in the EMERG position. Both circuit breakers are on the "Emer Warn & Outbd Air Brake" portion of the pilots' overhead circuit breaker panel. Control power is supplied through a circuit breaker marked "Audible Gunner" on the "Emer Warn Alarm" portion of the pilots' overhead circuit breaker panel.

TERRAIN CLEARANCE LIGHT

A retractable terrain clearance light located on the fuselage bottom just forward of the forward main landing gear provides illumination during night ditching or crash landing. The light is controlled by two toggle switches (20, figure 1-12) on the aisle stand. One switch has EXTEND--SWITCH OFF--RETRACT positions. In EXTEND position, 118-volt a-c power is supplied to a motor which extends the light out of the fuselage. In RETRACT position, the light retracts into the fuselage. The neutral SWITCH OFF position allows the light to be stopped at any degree of travel during extension or retraction. However, the light will not illuminate within 10° of the retracted position. The motor will automatically shut off when the light reaches the end of its travel at either position. The other switch has ON--OFF positions. ON position supplies 28-volt a-c power to illuminate the light unless it is within 10° of the retracted position. A circuit breaker marked "Terrain Clearance" on the "Ext Lts" portion of the pilots' overhead circuit breaker panel supplies 118-volt a-c power through the switches for the motor and the stepdown transformer which supplies 28-volt a-c for the light.

FIRST AID KITS

First aid kits (24, figure 3-1) are provided at convenient locations throughout the airplane; two in the control cabin lower deck and one in the tail compartment.

NOTE

This equipment may not be installed in the aircraft at all times. If not installed, it is available in base supply and shall be installed for combat missions.

AXES

Axes (27, figure 3-1) are installed in the control cabin lower deck and in the tail compartment.

CRASH LANDING AND DITCHING STATIONS

Stations to be used for both crash landing and ditching are provided on the upper deck of the control cabin for the navigator, radar navigator, instructor pilot, and instructor navigator. All stations are equipped with safety belts. The navigator's and radar navigator's stations are located behind the pilot's and copilot's seats respectively. The instructor navigator's station is located at the head of the ladder aft of the copilot's side panel. A ditching hammock, stowed behind a zipper panel on the right side of the compartment and installed in fittings on the floor when in use, is provided for the instructor navigator during ditching or crash landing. The instructor pilot's station is located at the back of the instructor pilot's seat. In use, the seat is swung aft after pulling the release cable under the seat, the front seat is folded and secured by a small tab, and the aft seat is lowered into position. The bunk is not stressed for crash landing or ditching.

DITCHING HAMMOCK

A ditching hammock is provided at the instructor navigator's ditching station. The hammock consists of webbing sewn together to form a support for the occupant of the ditching station. The hammock is anchored to the body structure near the top of the control cabin wall immediately forward of the ladder. Attachment fittings, to which a safety belt is fastened, are sewn into the lower end of the hammock. The hammock is stowed behind a zipper panel in the cabin lining. The hammock is installed by plugging the attachment fittings into holes in plates on the floor of the cabin.

GLOBAL SURVIVAL KITS

A global survival kit (figure 1-59) is provided for each ejection seat and the gunner's seat. The kit is located in the bottom of the seat and includes a seat cushion. Provisions for an inflatable raft, sleeping bag, rations, battery radio, M-4 rifle and ammunition, and assorted items of survival equipment are contained in the kit. The survival kit is made up of two compartments, a small compartment to the rear of the kit and the main compartment containing the liferaft and survival equipment. A waterproof container, equipped with straps for carrying as a back pack, serves as an inner compartment containing various items of survival equipment. The inner compartment is secured with straps in the bottom of the main compartment. A coating of international orange reflective material is applied to the inner surface of the main compartment lid and may be used in signaling or as a marker. A nylon drop line is connected by a yoke to the aft end of the main compartment. The line is passed through a slot in the center of the main compartment lid. The other end of the line is attached to a detachable fitting which is part of the right parachute attachment fitting. The liferaft is fastened to a loop on the drop line about 10 feet from the survival kit. A kit release handle is provided to release the kit from the parachute harness, open the container lid, and inflate the liferaft. The drop line connected to the right attachment fitting permits the liferaft and kit to hang below the crew member during the parachute descent. The survival kit is designed to be used with the modified B-5 parachute

and the modified safety belt. Special hardware is provided with some kits to permit the use of the kits with other types of parachutes. The kit is attached to the parachute by means of a linkage assembly strap connected by quick-disconnect fittings to the parachute harness accessory ring. When attached to the modified B-5 parachute, the parachute webbing is passed through loops (19, figure 1-59) in the safety belt. This interconnects the parachute, safety belt, and survival kit. The kit is installed in the aircraft merely by placing it in the seat bucket. The straps are then passed through the safety belt loops and connected to the parachute accessory rings with the quick-disconnects. The safety belt and parachute are then installed in the integrated harness fittings on the seat. Normally, the survival kit is not detached from the parachute except for emergency reasons such as a crash landing or when accomplishing an alternate bailout. After ejection from the aircraft and opening of the parachute, the survival kit release handle is pulled. Operation of the handle releases the parachute attachment fittings, allowing the kit to drop, the lid to open, and the liferaft to inflate. The drop line remains attached to the parachute harness and is attached to the compartment lid, the liferaft, and the survival kit. The liferaft will hang about 15 feet below the descending airman, and the kit about 25 feet below.

NOTE

The contents and some components of the kit are designed to serve a useful purpose for survival. No item that can be carried should be discarded, but each item should be utilized in the most economical and advantageous manner.

Global Survival Kit Controls

The survival kit release handle (23, figure 1-59) is operated by pulling up against the handle latch until the handle pulls free of the kit. A liferaft arming device is incorporated in the survival kit. This mechanism includes a plunger (24, figure 1-59) located on the bottom of the survival kit. When the survival kit is placed in the seat, the plunger will be depressed. If the kit release handle is pulled with the plunger depressed, the parachute attachment fittings will be disconnected from the kit. With the plunger depressed, the lid (31, figure 1-59) will not open and the drop line (26, figure 1-59) will remain attached to the kit. The kit release handle may then be reset by replacing the handle in the socket and pushing down, locking the handle latch. When the release handle has been reset, the parachute strap adjuster may be reinstalled in the kit by inserting in the sockets on the kit and pushing down.

NOTE

- Do not allow the arming device (plunger) to drop down before the release handle and attachment fittings have been reset.
- Do not use the survival kit release handle to carry the kit. To do so may cause the kit to open and the liferaft to inflate.
- It is possible to install the survival kit in the ejection seat with the liferaft arming plunger extended. Insure that the plunger is fully depressed into the kit before occupying an ejection seat.

When the survival kit is removed from the seat, the liferaft arming plunger will be extended, arming the inflation mechanism. If the kit release handle is pulled with the plunger extended, the lid will open, the drop line will be attached to the parachute harness, the raft will inflate, and the parachute attachment fittings will be disconnected.

WARNING

Do not pull the kit release handle while in the airplane with the kit not installed in the seat. Pulling the handle with the kit suspended will cause the liferaft to inflate, leaving the crew member attached to the inflated raft and survival kit. In an emergency, this could cause a fatal delay in escaping from the airplane.

A compartment lid manual release knob is located on the left side of the kit aft of the parachute attachment fitting. Pulling the knob will open the main compartment lid, giving access to the uninflated liferaft and equipment. A separate latch is provided on the aft compartment to open the lid and gain access to the additional survival equipment. A compressible parachute spacer (20, figure 1-59) is installed on the lid of the aft compartment. A foam rubber seat cushion is fastened with zippers to the lid of the main compartment.

WARNING

Do not substitute or add cushions to the seat cushion provided with the kit. The cushion provided is designed to properly absorb the acceleration forces encountered during ejection, and substitution or addition of a cushion could result in serious injury during an ejection.

PARACHUTE STATIC LINE

An emergency parachute static line is installed in the control cabin lower deck to the right of the aft end of the entrance hatch under the raised deck. The line is used to facilitate bailout of an injured crew mem-

Figure 1-53 Deleted.

ber through the navigator's hatch. At high altitudes (above 14,000 feet), the line should be connected to the automatic parachute arming lanyard. At lower altitudes, the line should be connected directly to the ripcord T-handle of the parachute. On aircraft [V], a parachute static line and parachute static line reel assembly are provided for the gunner. This assembly is located on the left side of the reclining portion of the gunner's seat and will allow the gunner to move freely about in the seat without arming the parachute, yet will automatically arm the parachute following bailout.

ESCAPE ROPES

An escape rope (8, figure 3-1) is located at each of the pilot's, copilot's, EW officer's, and gunner's positions. The rope at the gunner's position is located under the lining to the gunner's left (airplane right) and is of sufficient length to reach the ground through the aft entry door. The ropes at the pilot's and copilot's positions are located in panels above the pilot's and copilot's circuit breaker panels, aft of the side windows. The rope at the EW officer's position is located in back of the upper compartment lining to the right of the escape hatch. The ropes are of sufficient length to reach the ground through the escape hatches. The ropes are provided to help personnel escape from the airplane in any conceivable normal or crash attitude.

ESCAPE HATCHES

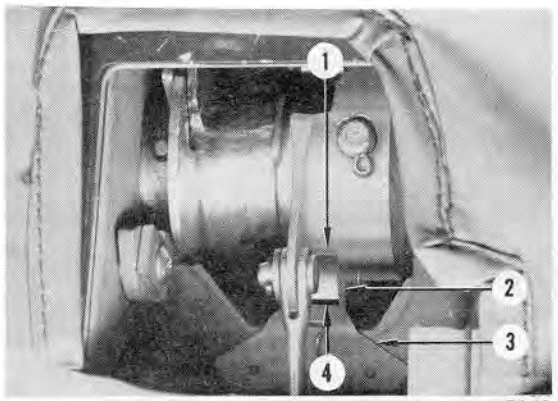
The escape hatches (3, 9, 12, 14, and 18, figure 3-1) in the airplane are of metal construction. The pilot's, copilot's, and EW officer's hatches are located in the upper surface of fuselage over their respective stations. The radar navigator's and navigator's hatches are located in the lower surface of the fuselage below their respective stations. Windows are provided in the pilot's and copilot's escape hatches to provide side vision when the airplane is in a banked attitude on landing approach and to provide better vision during air refueling. The navigator's hatch also serves as the forward entry door. The escape hatches for the EW officer's, the radar navigator's, and the navigator's positions are equipped with aerodynamic hatch lifters. The purpose of the lifter is to insure positive jettisoning of the hatch during the automatic ejection sequence, regardless of crew member order of ejection. The lifter consists of a flap mounted flush on the outside of the hatch. The flap is hinged at the aft edge of the hatch and is actuated by the automatic hatch jettison mechanism. Two pushrods connect the flap to the jettison mechanism. When the jettison mechanism is actuated, the flap is pushed into the airstream where the flap acts to pull the hatch from the airplane. The flaps on the EW officer's hatch and on the main entry door are provided with access doors to permit the use of the outside handle to open the hatch. The hatch lifter is actuated by the ballistics thruster during the automatic ejection sequence only. Operation of the manual hatch release handle merely unlocks the hatch.

NOTE

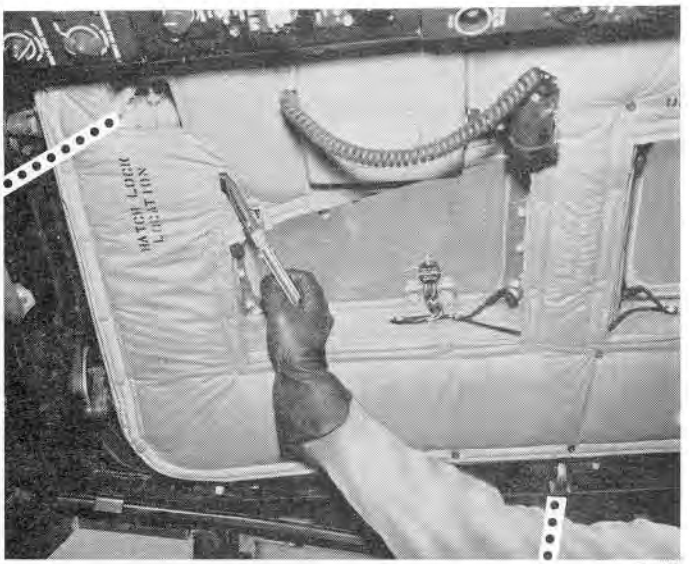
At airspeeds in excess of 300 knots IAS, the aft upper escape hatch lifter(s) may extend approximately 2 inches. This condition is considered normal and does not constitute a hazard to crew members. It does not affect the functional reliability of the escape system.

WARNING

Removing a hatch without first disconnecting the arming link will fire the catapult safety pin-pull initiator and leave the seat catapult in an armed condition.

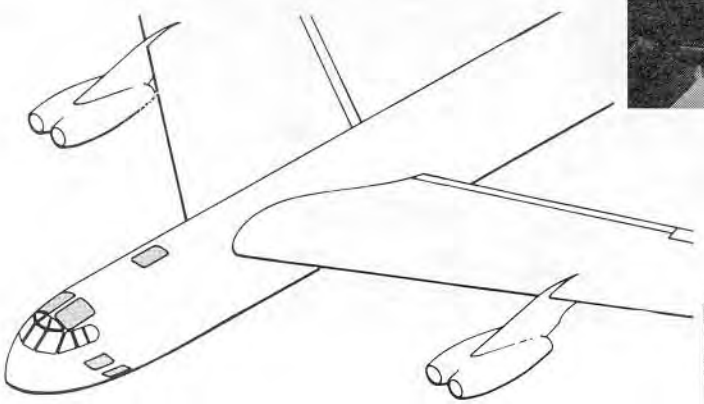


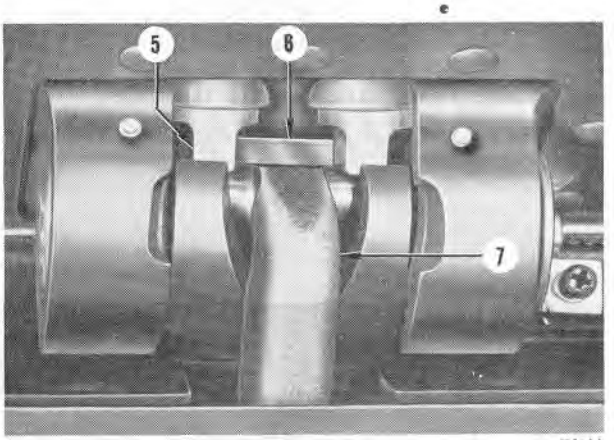
E1-42



E1-43

CLOSING ESCAPE HATCH
(Typical)



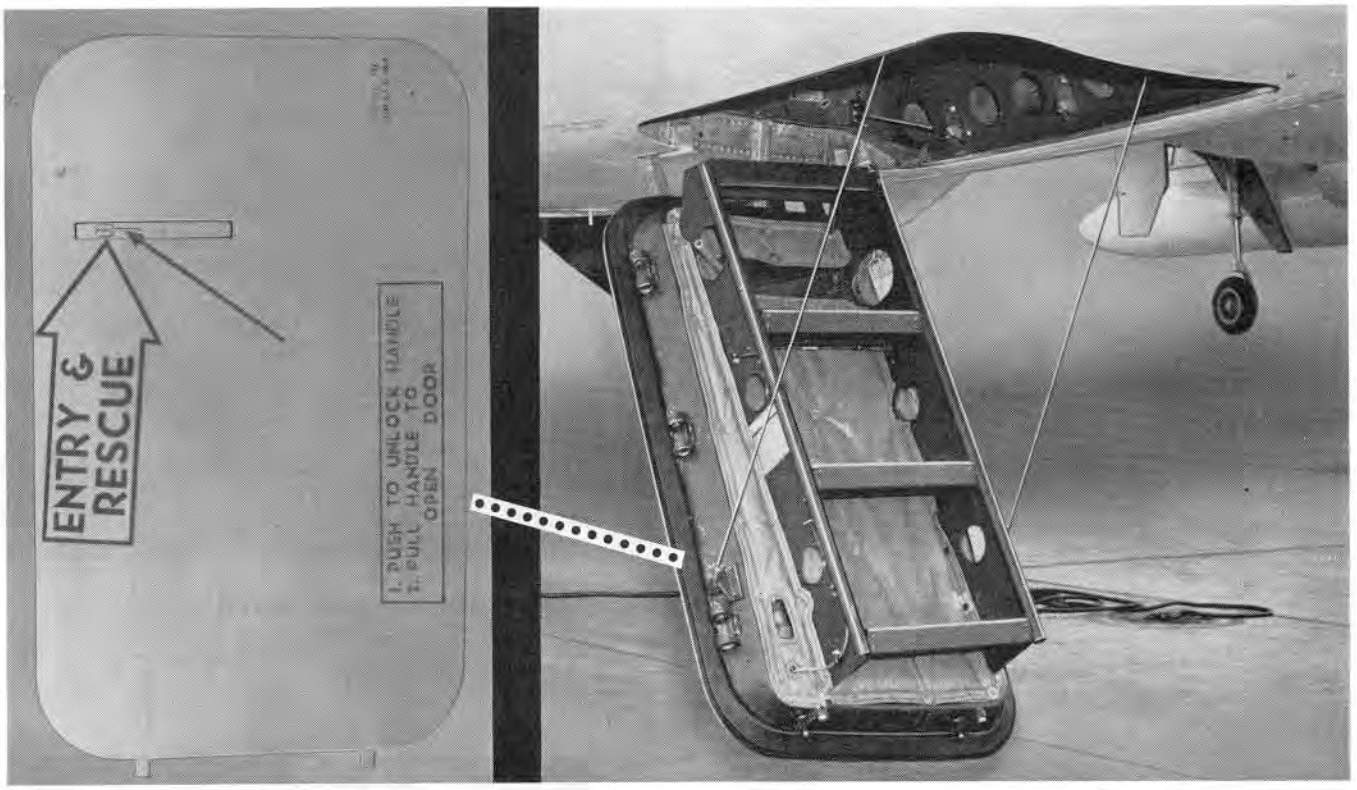


E1-44

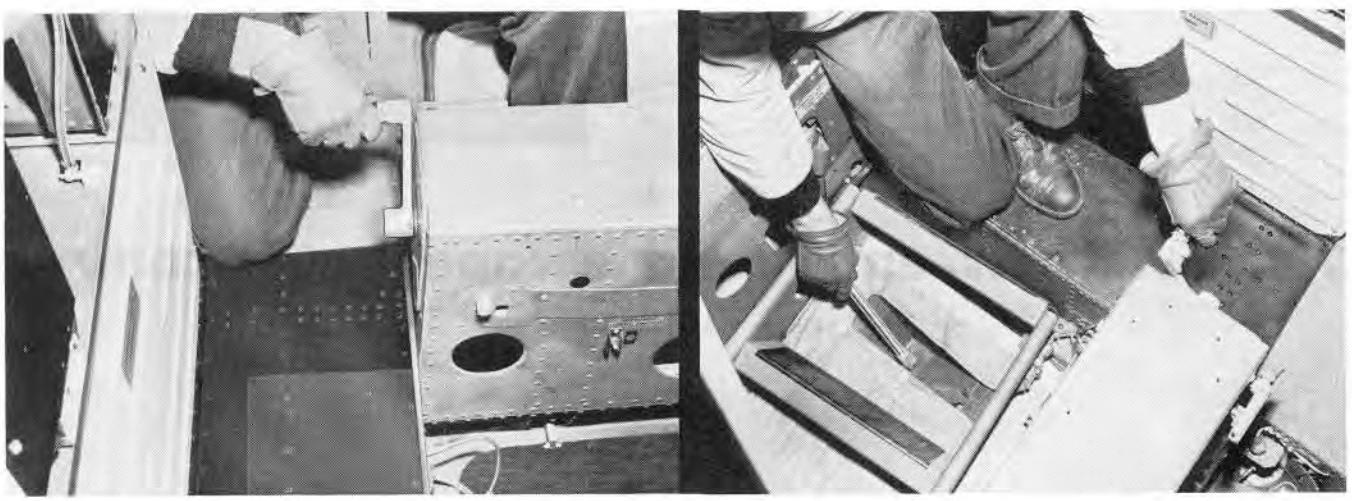
1. LOCK ARM SHOULDER
2. LOCKPIN
3. LOCKPIN SIGHTING SHIELD
4. PAINT STRIPE
5. LATCH PIN
6. LATCH HOOK (LONG LIP)
7. LATCH ARM

.....entry and escape hatch controls

Figure 1-54. (Sheet 1 of 3).

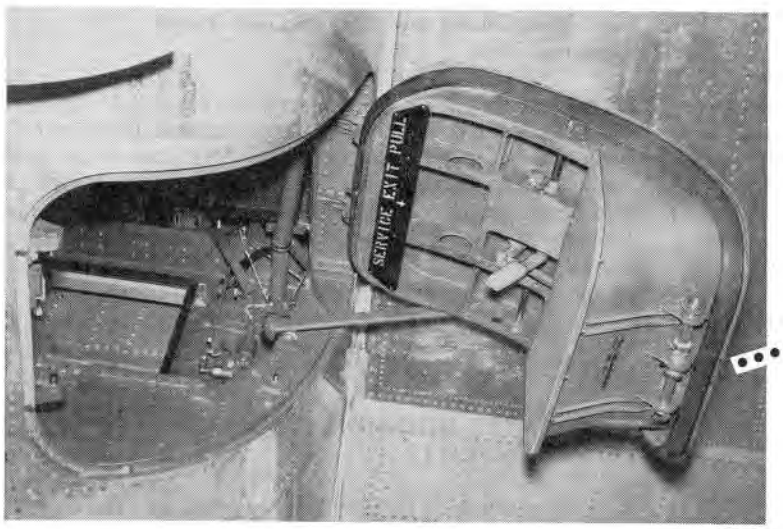


OUTSIDE VIEW, CLOSED AND LOCKED MAIN ENTRY DOOR



RAISING (LOWERING) MAIN ENTRY DOOR LOCKING MAIN ENTRY DOOR

Figure 1-54. (Sheet 2 of 3).

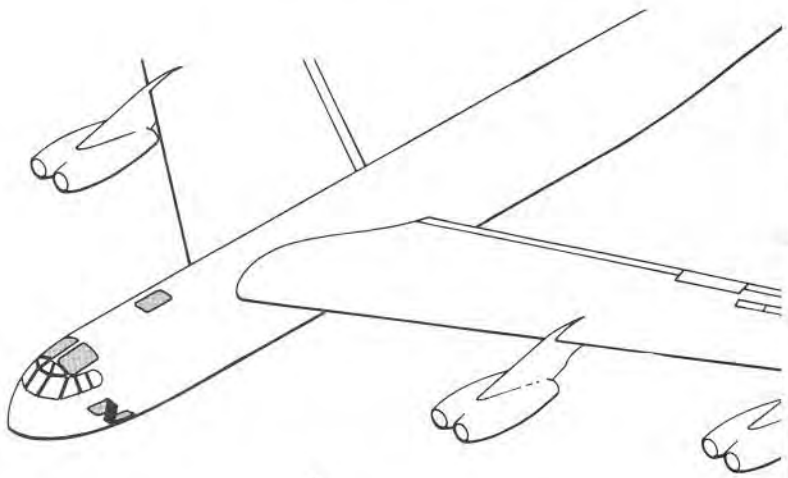


E1-49

AFT ENTRY DOOR

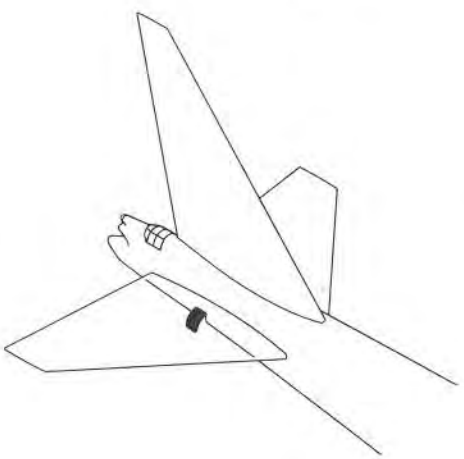
E1-50

OUTSIDE VIEW, CLOSED AND LOCKED



E1-51

INSIDE VIEW, INSIDE HANDLE IN LOCKED POSITION



.....entry and escape hatch controls (cont)

Figure 1-54. (Sheet 3 of 3).

Ejection Hatch Manual Release

All the hatches (figure 1-54) can be opened from the inside and all except the radar navigator's can be opened from the outside by pulling the handle away from the hatch. In addition, there is a manual hatch jettison handle to the right of the radar navigator's seat (and the navigator's seat Less UX Less UZ) (6, figure 4-72A) near the bottom of the seat. These hatches are all part of the various seat ejection systems and will open independently of the handles when the appropriate ejection seat mechanism is actuated. The hatches are for emergency use only and should not be opened indiscriminately.

WARNING

- At the radar navigator's station (and the navigator's station Less UX Less UZ), the ejection seat must be electrically positioned to the full down and full aft position in order to reach the manual hatch jettison handle with parachute harness fastened. Crew members of small stature may not be able to reach the manual hatch jettison handle with the seat correctly positioned. If the crew member is unable to jettison the hatch with the manual hatch jettison handle, he must proceed to alternate exit for bailout.

Less TF Less UZ

- Extreme care must be used by personnel to preclude inadvertent actuation of manual hatch jettison handle by interphone cord or clothing.

On aircraft TF Less UZ, a safety guard (5A, figure 3-11A) is provided to prevent inadvertent actuation of the manual hatch jettison handle. The guard is held in place by spring clips. In order to actuate the manual hatch jettison handle, it is necessary to remove the guard. The guard is chained to the emergency release base plate.

On aircraft UZ, a safety guard is installed on the radar navigator's manual hatch jettison handle to prevent inadvertent actuation of the handle. The manual hatch jettison handle can be raised only when the safety latch is simultaneously pushed down.

Hatch Not Closed and Locked Light (Hatch Warning Light)

A red warning light (12, figure 1-13 and 40, figure 1-13A) on the left side of the pilots' instrument panel illuminates to warn when any of the five escape hatches, the aft entry door into the tail compartment, or the aft equipment compartment access door is not closed and locked. The light utilizes TR power through a circuit breaker marked "Eject Hatch" on the "Warn" portion of the pilot's circuit breaker panel.

ENTRANCE DOORS

MAIN ENTRY DOOR (NAVIGATOR'S ESCAPE HATCH)

A main entry door (figure 2-1) opening into the control cabin lower deck is provided for access into the aircraft. An entrance ladder (figure 2-1) to aid in entering the aircraft is installed inside the main entry door. The door can be opened from both inside and outside the aircraft by pulling either handle away from the hatch.

AFT ENTRY DOOR

An aft entry door (figure 2-1) opening into the tail compartment is provided for access into the airplane. The aft entry door can be operated from both inside and outside the airplane by pulling either handle away from the hatch. The door has a ratchet mechanism which enables it to be held open in various positions for easier use as a ground emergency exit.

UPWARD EJECTION SEATS

NOTE

For complete description of downward ejection seats, see "Downward Ejection Seats," Section IV.

The pilots' positions in the forward crew compartment are equipped with bucket-type ejection seats designed to provide a safe and effective means of bailout from the aircraft. Provisions are made to accommodate a

survival kit and back-type automatic opening parachute and integrated harness.

WARNING

Do not use any form of shock absorbing device other than the survival kit and/or the seat cushion designated as standard equipment for the ejection seat. Utilizing the wrong seat cushions and/or survival kit or too much cushioning material does not provide comfort, but actually creates a definite injury hazard and may position the seat occupant where it is difficult to reach the controls. Chance of vertebral injury is increased considerably by the seat occupant sitting on too thick a compressible mass. When utilizing the ejection seat in this circumstance, it will not exert a direct force on the occupant until the seat has traveled 2 or 3 inches upward. After this amount of travel, the seat has gathered such momentum that excessive impact is produced when the seat initially lifts the seat occupant. During crash landing or ditching, the same compression factor will permit the seat occupant to sink far enough down to loosen the shoulder straps, thus allowing the seat occupant to slump forward, possibly incurring severe back injury. Additional cushioning may also raise the seat occupant to such a height that his arms will not be held by the arm retainers on either armrest, thus exposing them to possible injury from flailing in the wind blast following ejection.

Each seat is equipped with folding armrests which may be folded by releasing the armrest catch (11, figure 1-55). Arming levers, one in each armrest, are used to prepare the seat for ejection. A series of ballistic devices and mechanical linkages incorporated in the seat, when initiated by either arming lever, will lock the inertia reel, stow the control column, jettison the hatch, and arm the seat for ejection. The alarm system is energized to signal "abandon" simultaneously as either the pilot's or copilot's control column stows. A catapult is incorporated to eject the seat from the aircraft and is fired by squeezing either of the firing triggers inside each arming lever. Each seat can be positioned electrically up and down, fore and aft, and tilted by seat positioning switches. Electrical, oxygen, and ballistic lines are provided with disconnects to permit separation of the lines when the seat is ejected. Each seat is equipped with a headrest and an inertia reel which assist the occupant in maintaining position during ejection. An integrated harness release mechanism provides a means for separating the safety belt and parachute harness from the seat automatically after ejection. Manual operation of the integrated harness release will disengage the safety belt and parachute and, in addition, will disengage the parachute arming lanyard. A specially designed manual safety belt is installed in the integrated harness release fittings, and the integrated harness release handle is pulled to release the parachute and safety belt from the seat. See "Integrated Harness System," this section, for additional information. For a detailed discussion of seat ejection sequences, see "Escape Systems Operation," Section VII.

UPWARD EJECTION SEAT CONTROLS

Arming Levers

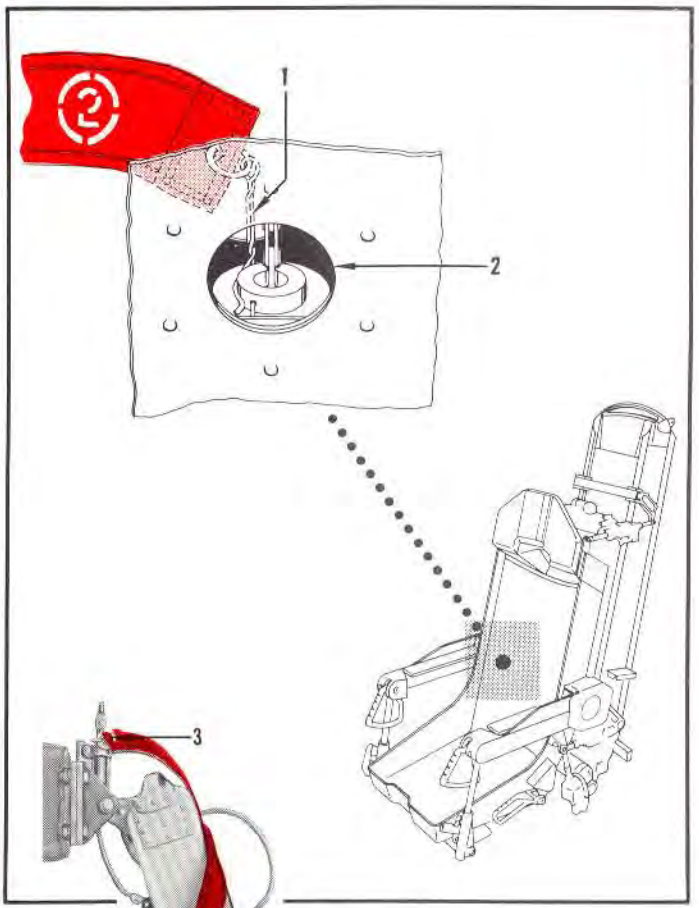
Loop-type arming levers (9, figure 1-55) installed in the armrest of each seat are used to prepare the seat for ejection. The arming levers also provide a grip to help keep the occupant's hands and arms in place during ejection. The arming levers are stowed and latched beneath the armrests and the arming levers can be operated only when the armrests are in the raised position. Each lever operates independently and either lever can be used to arm the seat. The use of both levers is recommended whenever possible since the levers provide a suitable handgrip. A release lever is provided to unlock and permit rotation of the arming levers. On airplanes 216 ▶ W104 ◀, a locking mechanism has been installed to prevent inadvertent unlocking of the arming lever. The release lever must be squeezed in order to unlock the arming lever, and held depressed to rotate the arming lever forward and upward to the locked arming position. When in the locked arming position, the arming initiator is fired and the inertia reel is locked.

WARNING

190 ▶ 215 W70 ▶ W103

Make certain the arming levers are locked in the stowed position. An unlocked arming lever is indicated by a depressed arming lever release and exposed leaf springs on the arming lever. The leaf spring is installed between the inside of the curved portion of the arming lever and the arming lever release (figure 1-56). Do not attempt to lock the arming lever unless it is in the stowed position and the No. 1 safety pins have been installed and locked. To lock the arming lever, depress the exposed leaf springs and allow the arming lever release to spring back to the locked position. In the event the arming lever release is inadvertently unlocked in flight and cannot be reset, exercise extreme care to prevent accidental rotation of the arming lever. Rotation of the arming lever to the locked position will jettison the hatch, stow the control column, lock the inertia reel, and arm the seat.

Firing the arming initiator actuates the hatch jettison thruster and the control column stowage thruster, stowing the control column and jettisoning the hatch. The link connected to the hatch fires the catapult pin-pull

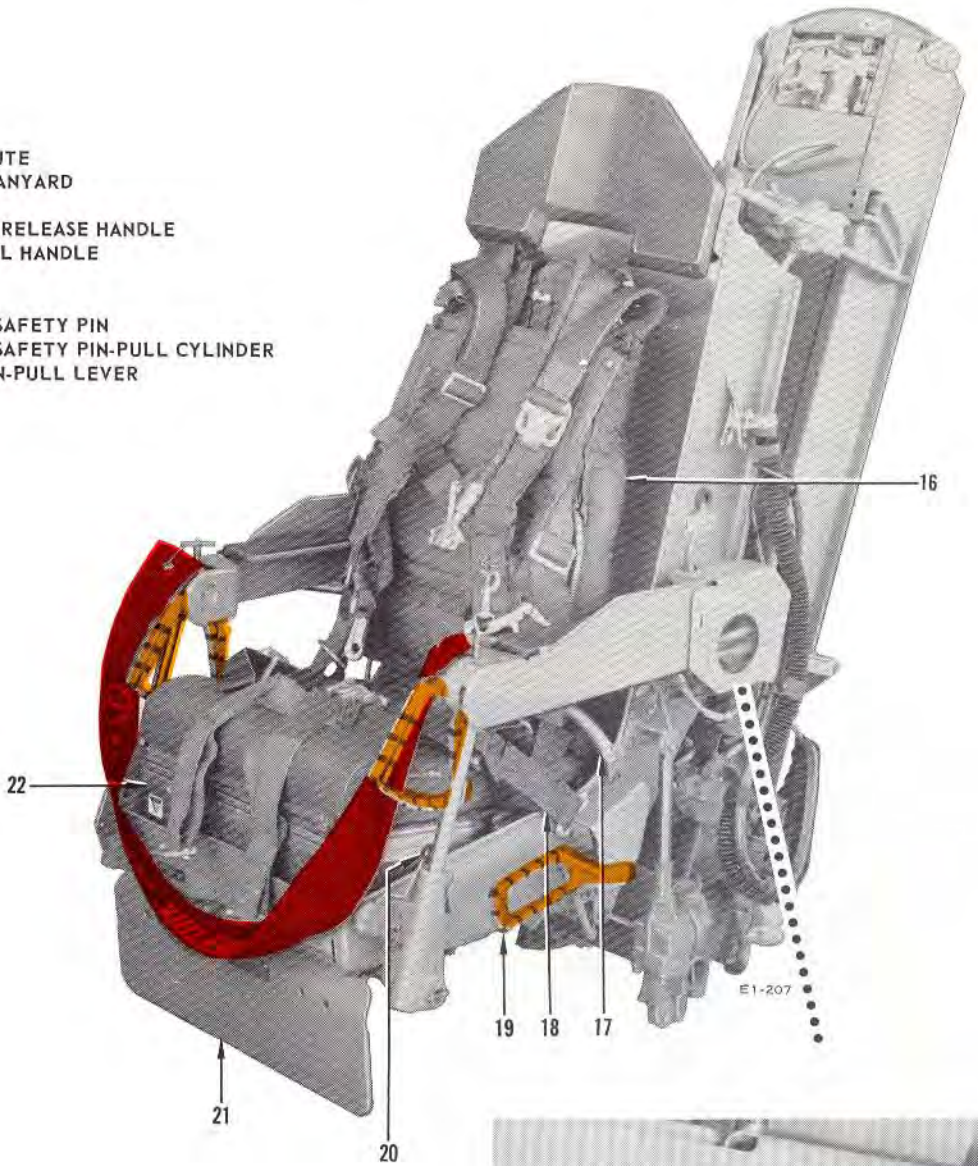


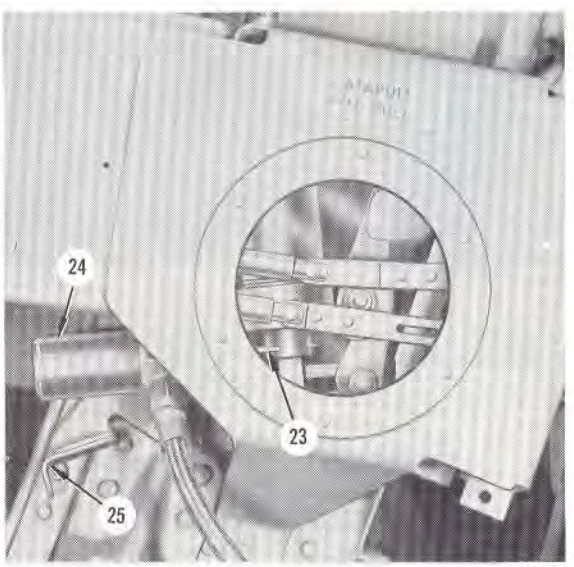
1. MAINTENANCE SAFETY PIN, NO. 2 (ARMING INITIATOR)
2. OBSERVATION WINDOW
3. MAINTENANCE SAFETY PIN, NO. 3 (CATAPULT SAFETY PIN-PULL INITIATOR)
4. HEADREST
5. POUCH FOR NO. 1 FLIGHT SAFETY PINS
6. ARMRESTS
7. FLIGHT SAFETY PINS, NO. 1 (ARMING LEVERS)
8. ARMING LEVER RELEASE
9. ARMING LEVER
10. SEAT POSITIONING SWITCHES
11. ARMREST CATCH
12. SURVIVAL KIT RELEASE HANDLE (TYPICAL)
13. FIRING TRIGGER
14. MAINTENANCE SAFETY PIN, NO. 4 (INTEGRATED HARNESS RELEASE INITIATOR)
15. INTEGRATED HARNESS RELEASE INITIATOR

SEAT POSITIONING SWITCHES E1-206

Figure 1-55. (Sheet 1 of 2)

16. MODIFIED B-5 PARACHUTE
17. PARACHUTE ARMING LANYARD
18. SAFETY BELT
19. INTEGRATED HARNESS RELEASE HANDLE
20. INERTIA REEL CONTROL HANDLE
21. LEG SUPPORT
22. SURVIVAL KIT
23. CATAPULT INITIATOR SAFETY PIN
24. CATAPULT INITIATOR SAFETY PIN-PULL CYLINDER
25. MANUAL CATAPULT PIN-PULL LEVER





upward ejection seat

Figure 1-55. (Sheet 2 of 2)

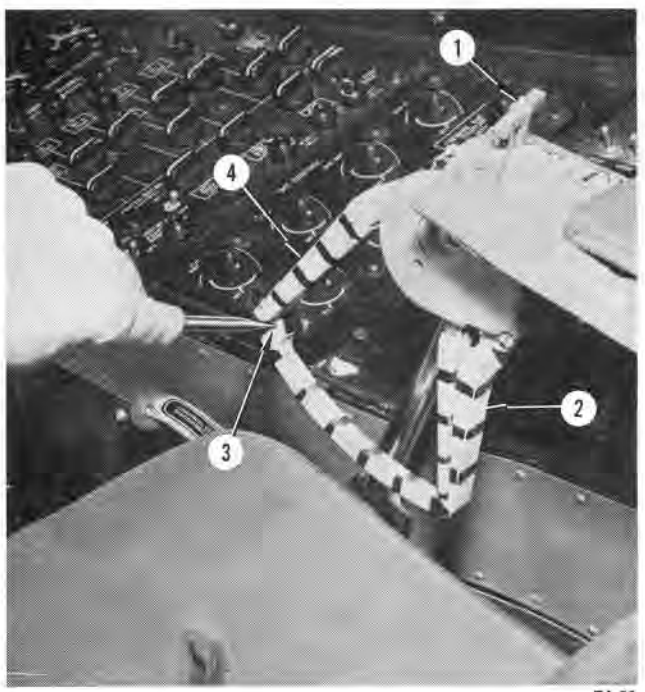
initiator which actuates the pin-pull and removes the pin from the catapult initiator, thus arming the seat. See figure 1-57 for arming lever sequence of operation.

WARNING

The arming levers cannot be raised when the armrests are folded. To accomplish ejection, at least one armrest must be raised from the stowed position.

NOTE

A pointed instrument (such as a pencil) is needed to stow the arming levers. To stow either arming lever, depress the forward detent lockpin (5, figure 1-57) visible through the inner armrest skin just below the arming lever pivot. With this lockpin depressed, rotate the arming lever downward until the motion is arrested. Then, depress the aft detent lockpin (6, figure 1-57) visible through the inner armrest skin just below the arming lever pivot. Rotate the arming lever to the fully stowed position.



E1-53

1. ARMING LEVER SAFETY PIN
2. ARMING LEVER
3. LEAF SPRING RETAINER
4. ARMING LEVER RELEASE

resetting arming lever release 190▶215 W70▶W103

Figure 1-56.

Catapult Firing Triggers

A catapult firing trigger (13, figure 1-55) is installed in each arming lever and maintains a 25° lag as the arming lever is moved to the armed position. The firing triggers are locked and cannot be actuated until the hatch is jettisoned. When a trigger is pulled, the catapult is fired and the seat is ejected.

Seat Safety Pins and Streamers

Each upward ejection seat is provided with two safety pins (7, figure 1-55) (numbered 1) to be used by the flight crew member to prevent inadvertent initiation of the seat ejection sequence. The two pins (lockpins) are attached to each end of a single red streamer and are inserted in the arming levers through holes in the armrest structure. These two pins should be in place in the arming levers during preflight and postflight on the ground and whenever the crew member leaves his seat in flight.

NOTE

The seat may be armed any time one of the two No. 1 safety pins are removed. Rotation of the arming lever from which No. 1 pin has been removed arms the seat.

WARNING

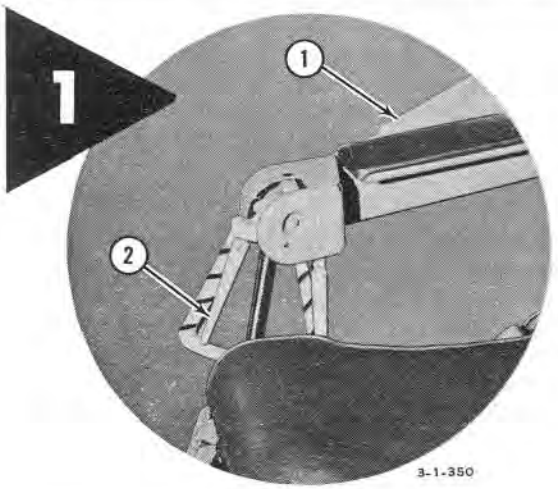
In the event the arming levers have been rotated, the seat cannot be safetied until the arming levers have been stowed. Installation of the safety pins with the arming levers rotated to the up position will not prevent the seat from firing if either firing trigger is squeezed.

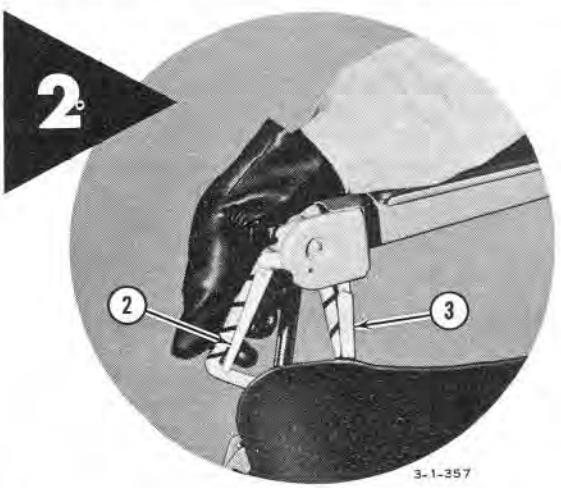
In addition, each upward seat is provided with three safety pins (numbered 2, 3, and 4) to be used for maintenance operations only. The three pins are attached to a single red streamer and are stowed in the box provided when the seat is on flight status.

Seat Positioning Switches

Three seat positioning switches (10, figure 1-55) are located on the right front corner of the seat. The up and down switch is mounted vertically, the fore and aft switch is mounted horizontally, and the tilt switch is mounted on a 45° slant. To obtain seat movement, the switch is pushed in the direction movement is desired to electrically position the seat. The switches are supplied 118-volt a-c power through circuit breakers marked "Seat Position" - "Pilot" and "Copilot" on the "Miscellaneous" portion of pilot's circuit breaker panel.

EITHER OR BOTH ARMING LEVERS

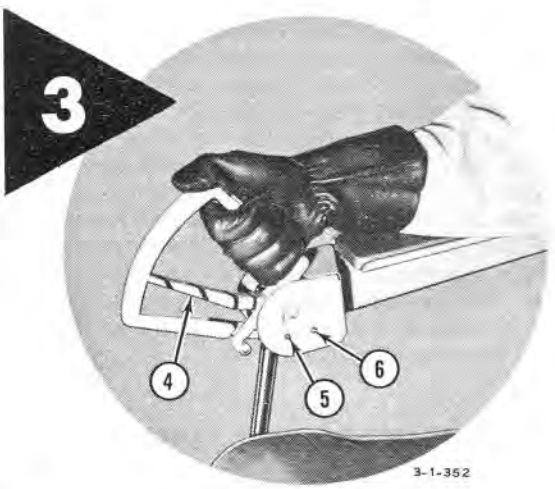




1 Raise armrest (1) to locked position.

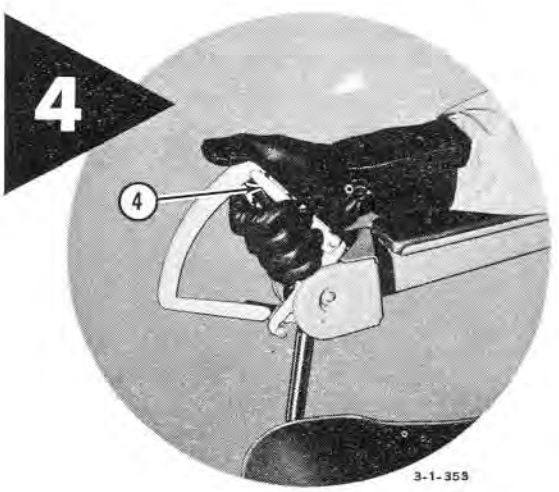
2 Squeeze arming lever release (2).

3 Rotate arming lever (3) forward and upward to locked position. Firing trigger (4) rotates to firing position.



NOTE

- Rotating the arming lever stows control column and jettisons escape hatch. The alarm system is energized to signal ABANDON when either the pilot's or copilot's control column stows. Hatch jettisoning fires initiator, arming seat.
- It is necessary to partially release grip on arming lever to grasp firing trigger.
- Stow arming lever by depressing detent lockpins (5) and (6) in order while rotating arming lever forward and downward.



4 Squeeze firing trigger (4) to fire seat catapult.

upward ejection seat arming lever and trigger sequence

Figure 1-57.

Manual Catapult Initiator Safety Pin-Pull Lever

A lever (25, figure 1-55) is provided to manually disengage the catapult pin-pull cylinder in the event the catapult pin-pull initiator does not fire when the hatch is jettisoned from the airplane. The pin is removed from the catapult initiator by lifting the lever and manually withdrawing the catapult pin-pull cylinder. The lever is held in the locked position when the arming lever is stowed and can be pulled only after the arming lever is raised to the up position.

INTEGRATED HARNESS SYSTEM

The integrated harness system provided in the aircraft consists of the integrated harness release mechanism located on the seat, the safety belt, and the modified B-5 automatic parachute (figure 1-59). The integrated harness release mechanism includes a trigger, an integrated harness release initiator with necessary ballistic tubing, an integrated release handle, and an inertia control handle. Firing the ejection seat catapult triggers the integrated harness release initiator which fires after a 1-second delay to open the integrated harness release fittings on the seat and allow seat occupant, parachute, and safety belt (along with survival kit) to separate from the seat as an integral unit. (Separation from the seat arms the automatic parachute since the parachute arming lanyard is anchored to the seat.) Pulling the integrated harness release handle on the seat provides for separation of man, parachute (and arming lanyard), and safety belt from the seat following crash landings or ditching.

INTEGRATED HARNESS SYSTEM CONTROLS

Integrated Harness Release Handle

An integrated harness release handle (19, figure 1-55) painted yellow with black stripes is located on the left side of each seat to enable the parachute harness and safety belt to be detached from the seat. Pulling the release handle upward disengages the two safety belt fittings, the parachute harness shoulder straps, and the parachute arming lanyard, thus completely freeing the occupant from the seat. The gunner's release handle disengages the two safety belt fittings and the parachute shoulder harness. The release mechanism is reset by pushing the handle down.

NOTE

- The integrated harness release handle should not be used to free the occupant from the seat for normal inflight or postflight movement. If the release is pulled and the parachute and survival kit are worn during such movement, the parachute will have to be removed to reinstall the shoulder straps in the inertia reel fitting without assistance.
- The integrated harness release handle should be pulled directly upward since any fore, aft, or side loads can cause the handle to bind resulting in excessive force required to pull the handle.

Inertia Reel Control Handle

A handle (20, figure 1-55) with LOCKED--RELEASED positions is located on the left side of each seat. A detent is provided for retaining the handle at either position of the quadrant. In RELEASED position, the shoulder harness will extend to allow the crew member to lean forward; however, the inertia reel will automatically lock when an impact force of 2 to 3 "g's" is encountered. When the reel is locked in this manner, it will remain locked until the handle is moved to LOCKED and then returned to RELEASED position. When the handle is in LOCKED position, the inertia reel is manually locked so the crew member is prevented from bending forward. LOCKED position may be used as an additional safety feature over the automatic operation of the reel.

MODIFIED B-5 AUTOMATIC PARACHUTES

A B-5 automatic parachute, developed specifically for use in B-52 aircraft upward and downward ejection seats, modified to utilize the integrated harness release mechanism in the seat is provided in the ejection seats. The B-5 automatic parachute is equipped with a faster opening Type C-9 canopy for improved low level escape capability. Modifications include shoulder straps (1, figure 1-59) which are sewn into the parachute harness for attachment to the inertia reel fitting. Additional straps (8, figure 1-59) are sewn into the lower harness to provide for attachment of the global survival kit. These straps are not used when the quick-disconnect fittings and straps (21, figure 1-59) are installed on the survival kit. A bailout oxygen bottle and gage is contained in the parachute and may be inspected by opening the flap located under the right side of the parachute lining. Normal bailout bottle pressure is 1800 psi based on 80° F. A reduction in temperature causes reduction in cylinder pressure of 3.5 psi for each degree of F. The bailout bottle (figure 1-59) is operated by pulling the green knob (9, figure 1-59) on the right front of the harness. A Type F-1B automatic release device which can be preset by opening the zipper located under the left side of the parachute lining contains an aneroid opening device and timer. The F-1B timer is set for the number of seconds delay recorded in the parachute log book. The automatic release device is activated when the arming lanyard (6, figure 1-59) is pulled, either manually or automatically by separation from the seat. When activated, the automatic release device opens the parachute after a preset delay of 1 second when the preset altitude is reached, or if activated below the preset altitude, the automatic release opens the parachute 1 second after separation from the seat. A ripcord T-handle (4, figure 1-59) manually releases the parachute when pulled. The ripcord T-handle bypasses the automatic release device. A canopy quick-release fitting (2, figure 1-59) is located on the upper left of the harness to permit release of the left set of risers for spilling the canopy after landing. Two canopy quick-release fittings located on the upper left and right of the harness may be fixed to allow complete release of the canopy after landing. The parachute is installed in the seat as follows:

1. The shoulder strap attaching hardware is inserted into the inertia reel fitting of the seat.
2. The survival kit attachment straps (21, figure 1-59) are connected to the survival kit strap adjusters. Thread these straps through the loops (19, figure 1-59) in between the webbing of the safety belt and attach to the parachute accessory rings with the quick-disconnect at the opposite end.
3. Safety belt attachment fittings (17, figure 1-59) are inserted into integrated harness release fittings on the seat.
4. The parachute arming lanyard anchor is inserted into the integrated harness release fitting at the left rear corner of the seat.

NOTE

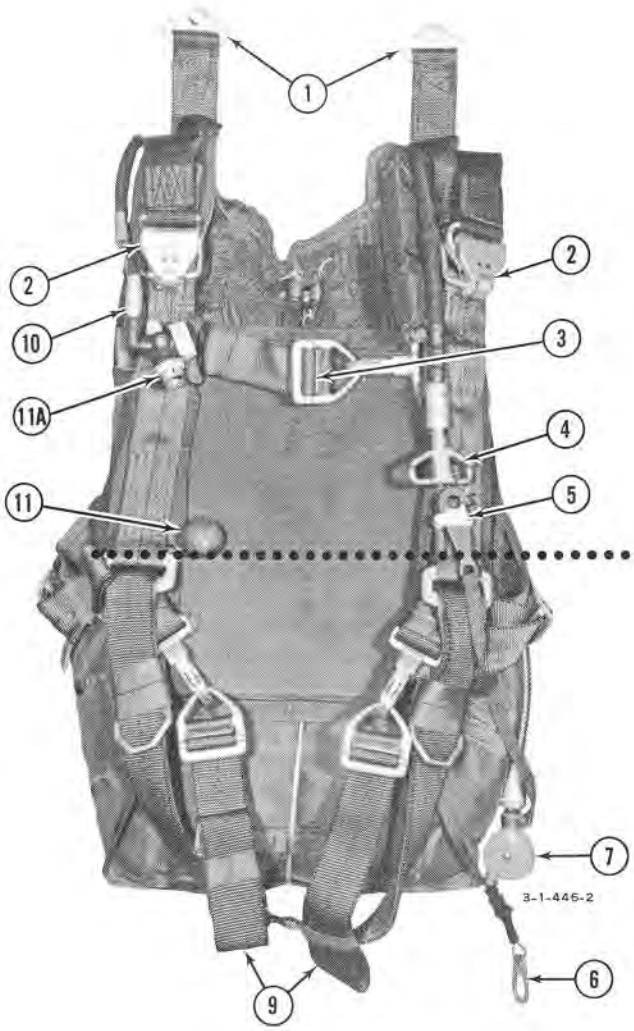
The modified B-5 automatic parachute, safety belt, and survival kit should first be installed in the seat, then buckled to the crew member.

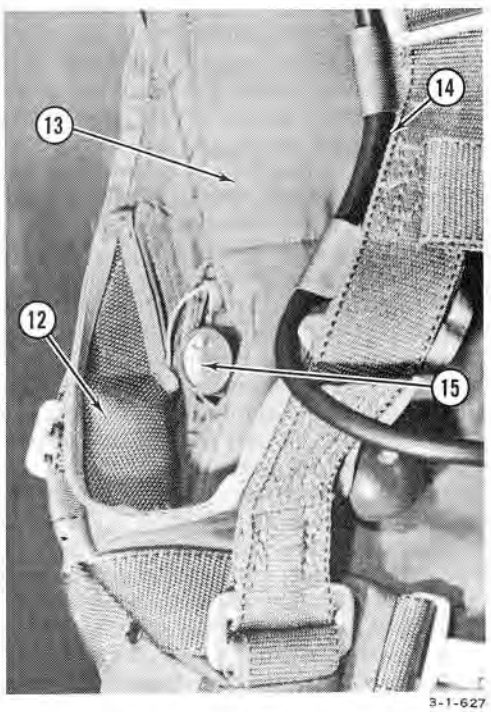
Since the parachute must be removed by the wearer in order to attach the shoulder straps to the inertia reel fittings unassisted, it is recommended that the parachute and survival kit be left in the seat when the crew member desires to make routine movements about in the aircraft. It is then only necessary to buckle chest strap, leg straps, and safety belt and to connect oxygen mask to prepare for ejection in an emergency.

NOTE

Do not open the safety belt to permit unrestrained hip movement. Since the parachute arming lanyard is anchored to the seat, this could spill the parachute in the seat.

Figure 1-58 deleted





BAILOUT OXYGEN BOTTLE

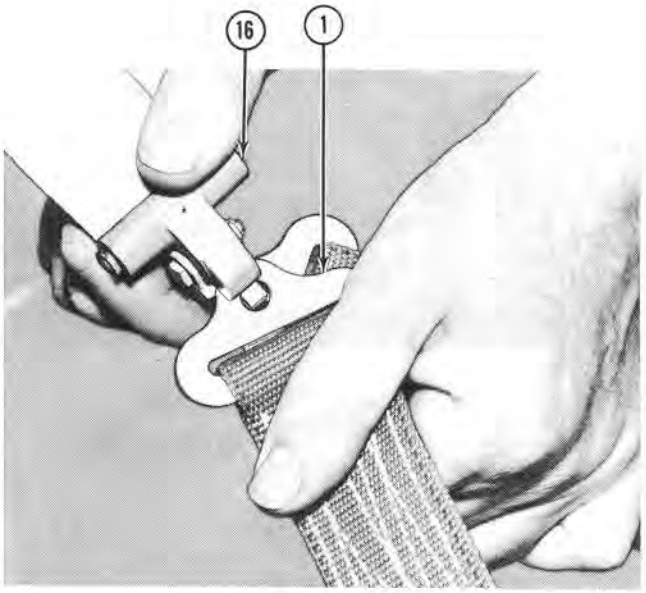
MODIFIED B-5 AUTOMATIC PARACHUTE

1. SHOULDER STRAPS
2. QUICK-RELEASES
3. CHEST STRAPS
4. RIPCORD T-HANDLE
5. ZERO DELAY LANYARD (STOWED)
6. ARMING LANYARD
7. ARMING KNOB
8. DELETED
9. LEG STRAPS
10. BAILOUT OXYGEN HOSE CONNECTOR
11. BAILOUT BOTTLE RELEASE KNOB
11A. CRU-8/P OXYGEN HOSE CONNECTION
12. BAILOUT BOTTLE INSPECTION FLAP
13. PARACHUTE BACKPAD
14. BAILOUT OXYGEN HOSE
15. BAILOUT BOTTLE PRESSURE GAGE
16. INTEGRATED HARNESS RELEASE FITTING
17. SAFETY BELT ATTACHMENT FITTING
18. SAFETY BELT
19. UPWARD EJECTION SEAT ATTACHMENT LOOPS

Figure 1-59 (Sheet 1 of 5).

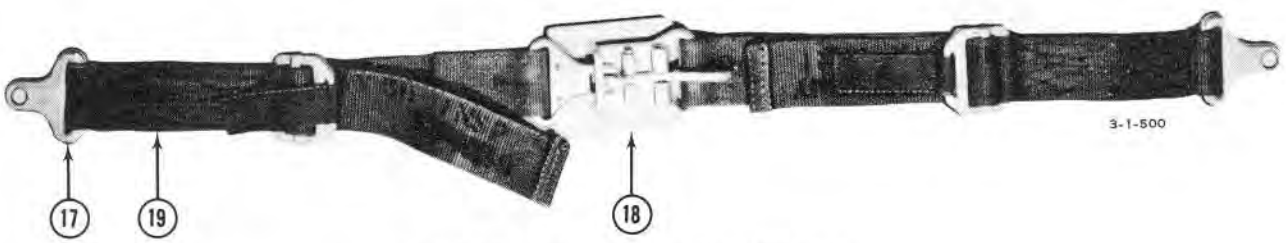
NOTE

EQUIPMENT SHOWN MAY NOT BE TYPICAL.



ATTACHING PARACHUTE SHOULDER HARNESS TO INTEGRATED HARNESS RELEASE FITTING

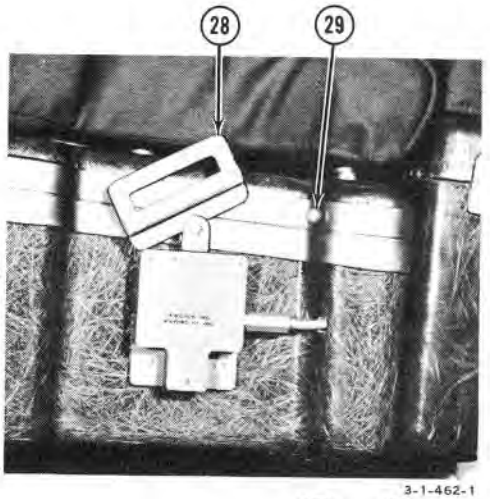
ZERO DELAY LANYARD ATTACHED TO RIPCORD T-HANDLE



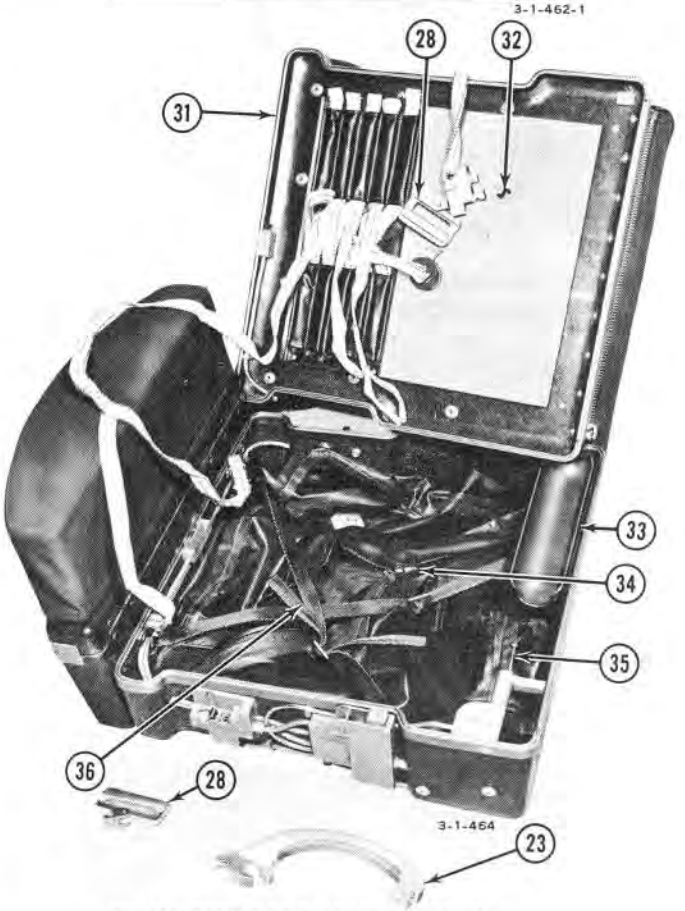
BELT FOR UPWARD EJECTION SEAT

bailout equipment - upward ejection seats

Figure 1-59 (Sheet 2 of 5).



SEAT CUSHION REMOVED

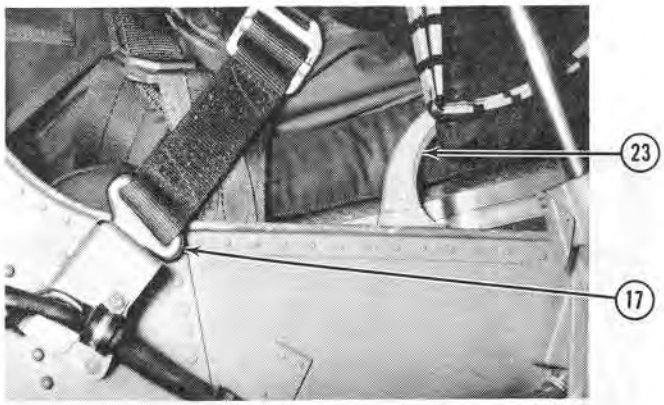


MAIN COMPARTMENT LID OPEN

GLOBAL SURVIVAL KIT

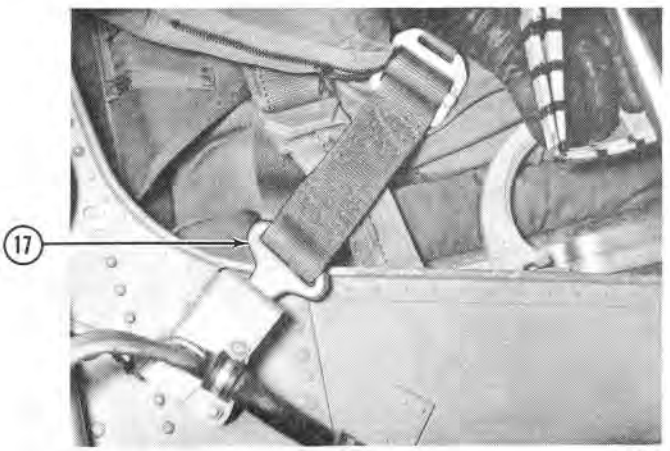
20. COMPRESSIBLE SPACER
21. SURVIVAL KIT QUICK-DISCONNECT FITTING AND STRAP
22. SEAT CUSHION
23. KIT RELEASE HANDLE
24. ARMING PLUNGER
25. MAIN COMPARTMENT
26. DROP LINE
27. AFT COMPARTMENT
28. SURVIVAL KIT STRAP ADJUSTER
29. COMPARTMENT LID MANUAL RELEASE KNOB
30. ZIPPER
31. COMPARTMENT LID
32. REFLECTIVE SURFACE
33. HOLDER FOR CO_2 BOTTLE
34. WATERPROOF CONTAINER
35. CO_2 RELEASE CABLE
36. WATERPROOF CONTAINER TIE-DOWN STRAPS
37. AFT COMPARTMENT LID MANUAL RELEASE LATCH

Figure 1-59 (Sheet 3 of 5).



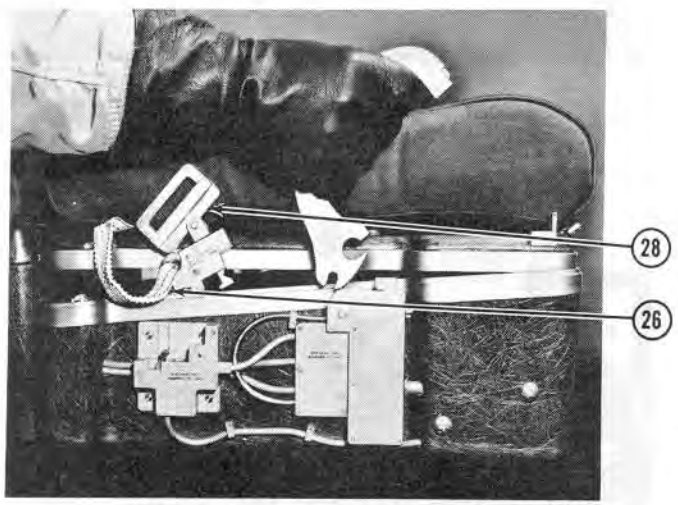
3-1-734

KIT IN SEAT

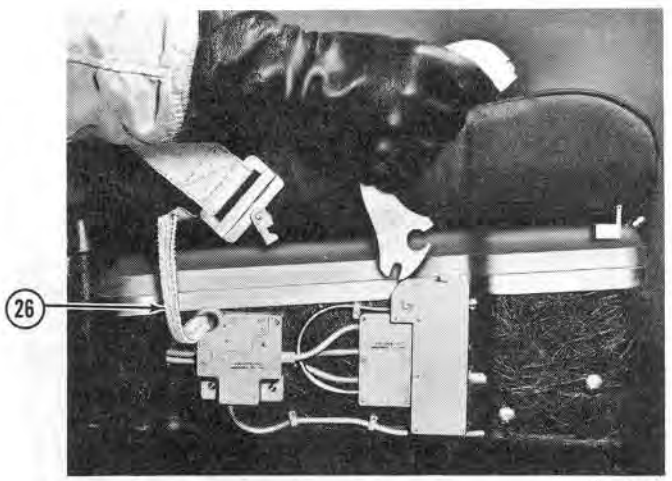


3-1-735

SURVIVAL KIT STRAP ADJUSTER RELEASE

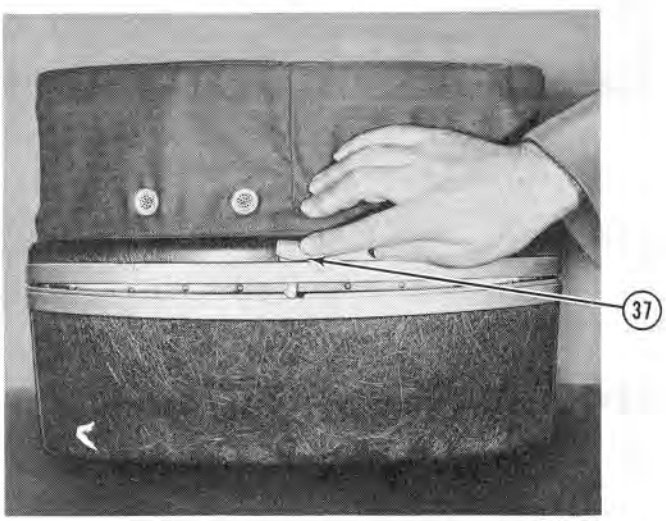


KIT SUSPENDED — PLUNGER EXTENDED 3-1-512



3-1-463-1

KIT IN SEAT — PLUNGER DEPRESSED



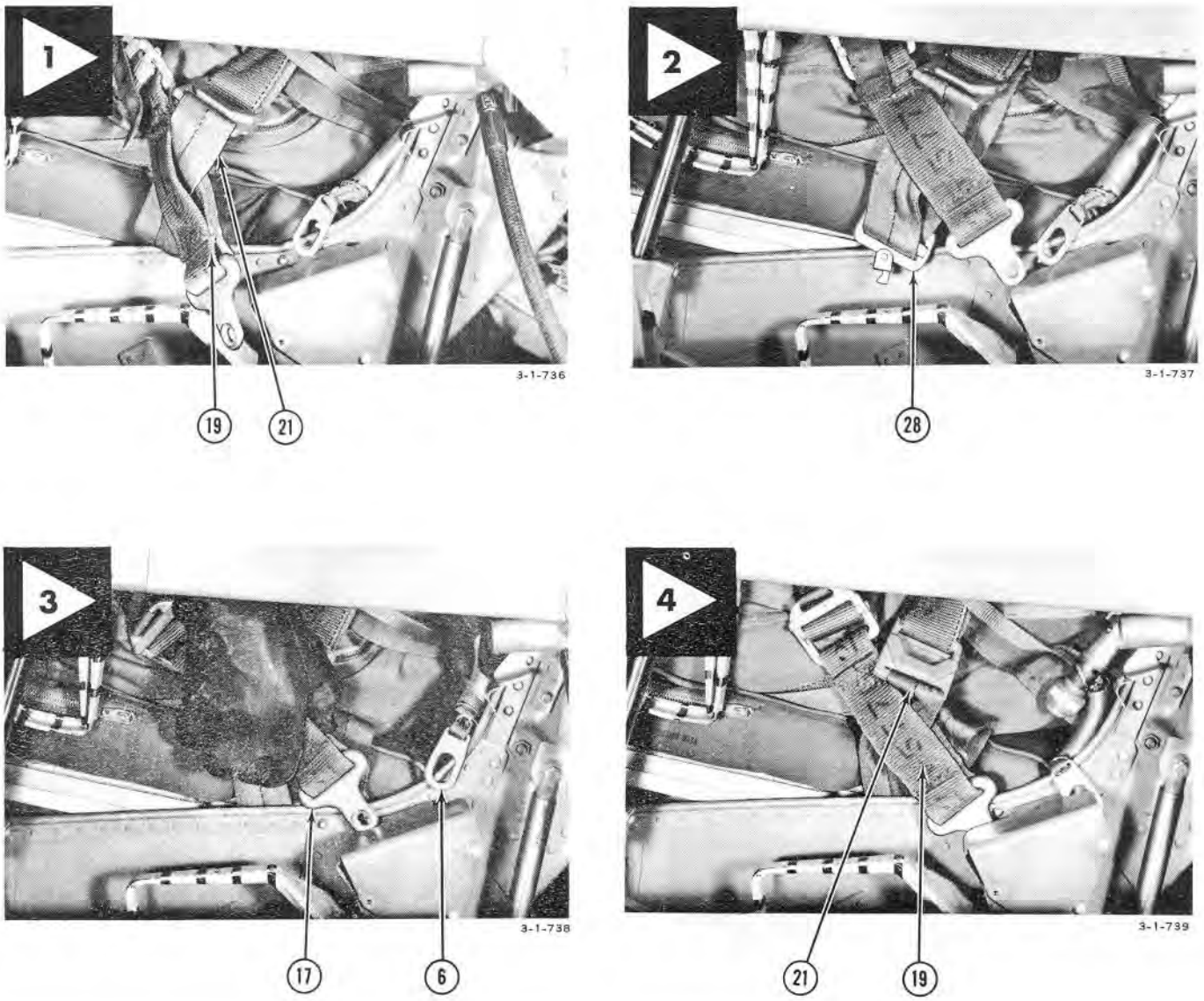
3-1-513

OPENING AFT COMPARTMENT

GLOBAL SURVIVAL KIT OPERATION

bailout equipment - upward ejection seats

Figure 1-59 (Sheet 4 of 5).



UPWARD SEAT EJECTION

INSTALLATION OF PARACHUTE SAFETY BELT AND SURVIVAL KIT (TYPICAL)

bailout equipment - upward ejection seats

Figure 1-59 (Sheet 5 of 5).

Zero Delay Lanyard

A zero delay lanyard provides for improved low altitude escape capability when using an upward ejection seat. The lanyard is attached to the automatic release device arming knob. When the hook on the other end of the lanyard is hooked to the ripcord T-handle, the automatic release device is bypassed and the manual ripcord release is pulled simultaneously as separation from the seat occurs. (In effect, this is zero second delay in deployment of the automatic parachute following separation from the seat.) The zero delay lanyard should be hooked to the T-handle before takeoff, after takeoff, and before landing. During all flight above minimum altitudes, the hook must be detached from the ripcord T-handle and stowed on the stowage ring provided on the parachute harness. "Hooking" and "stowing" are manually accomplished by each crew member.

WARNING

Zero second delay parachute configuration should never be used at speeds in excess of approximately 400 knots IAS since opening shock will be excessive.

SAFETY BELT

A safety belt (18, figure 1-59) with standard manual release and lock lever fittings is provided with each seat. The belt is installed by inserting the attachment fittings in the integrated harness release fittings on each side of the seat. The survival kit is then secured to the parachute by threading the parachute attachment fittings through the straps on the safety belt and fastening them to the kit. Thus, the seat occupant, parachute, safety belt, and survival kit are released from the seat as an integral unit whenever the integrated harness release fittings are opened. For routine movements in the aircraft, it is recommended that the crew member unlock and open the safety belt, then disconnect the parachute chest and leg straps, leaving the parachute with survival kit attached to the seat.

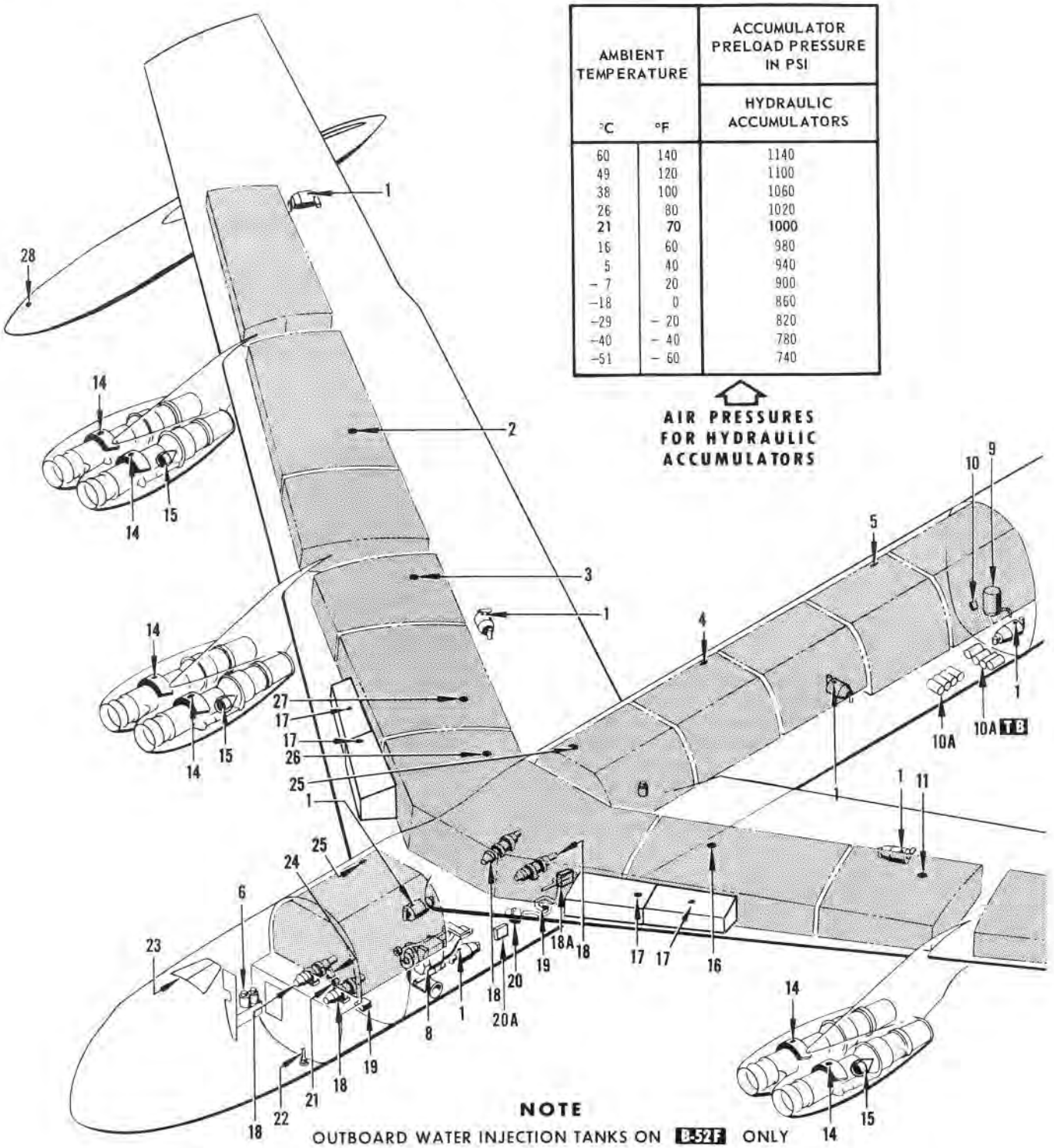
AUXILIARY EQUIPMENT

The following equipment and its operation is described in "Auxiliary Equipment," Section IV.

Air Conditioning Systems
Anti-Icing Systems
Communication and Associated Electronic Equipment
ECM Equipment
Lighting Equipment
Oxygen System
Autopilot
Automatic Flight Control System (A/A42G-11)
Instrument Landing System (ILS) Equipment
Automatic Approach Equipment
Navigation Equipment
Aircraft Weapons Control System Monitoring Set (AN/AJM-14(V))
Weapons Control System - Offensive (AN/ASQ-38(V))
Bombing System
Bomb Door System
Missile System (GAM-72)
Missile System (GAM-77)
Gunnery System
Air Refueling System
Single Point Ground Refueling System
EW Officer's Upward Ejection Seat
Navigators' Downward Ejection Seats
Integrated Harness System
Turret Jettison System
Miscellaneous Equipment

AMBIENT TEMPERATURE °C	AMBIENT TEMPERATURE °F	ACCUMULATOR PRELOAD PRESSURE IN PSI — HYDRAULIC ACCUMULATORS
60	140	1140
49	120	1100
38	100	1060
26	80	1020
21	**70**	**1000**
16	60	980
5	40	940
− 7	20	900
−18	0	860
−29	− 20	820
−40	− 40	780
−51	− 60	740

AIR PRESSURES FOR HYDRAULIC ACCUMULATORS

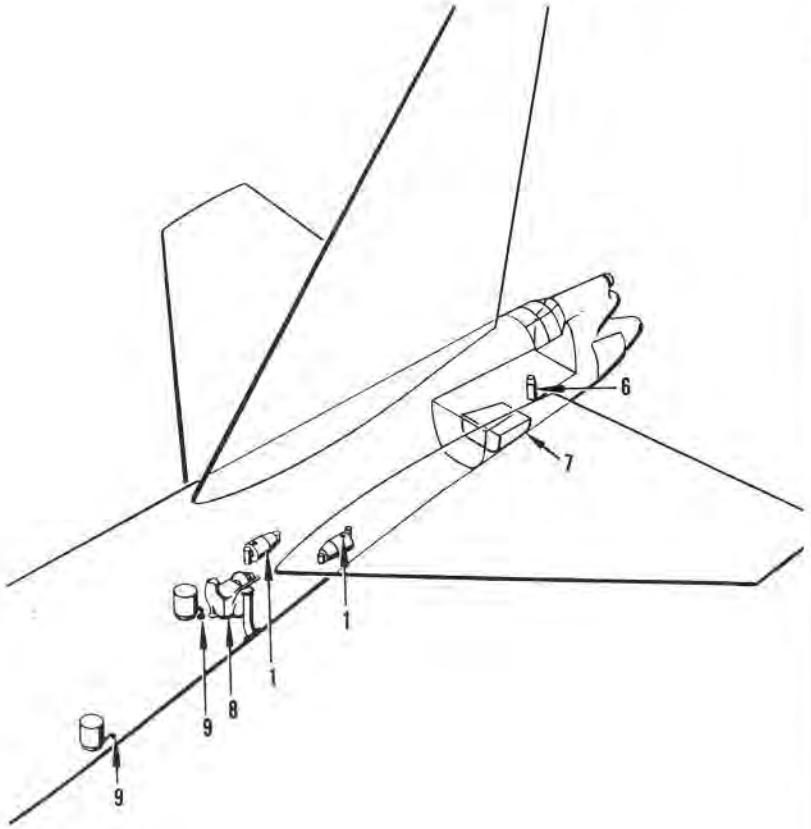


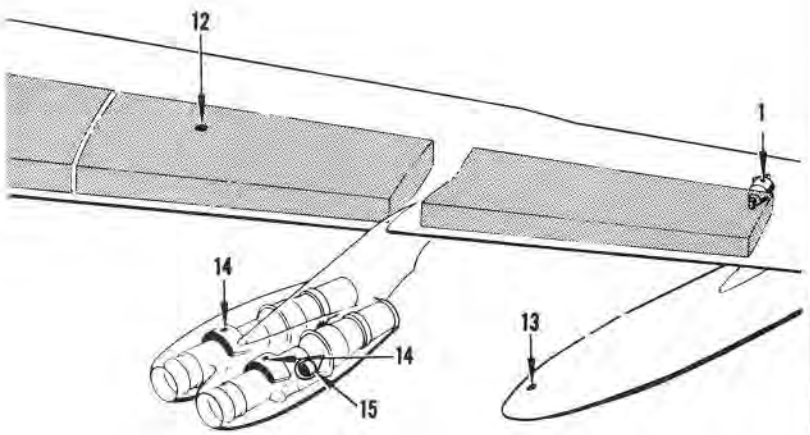
NOTE

OUTBOARD WATER INJECTION TANKS ON B-52F ONLY

1. HYDRAULIC PACK RESERVOIRS
2. RIGHT OUTBOARD WING TANK
3. NO. 4 MAIN TANK
4. MID BODY TANK
5. AFT BODY TANK
6. DRINKING WATER CONTAINERS
7. DRAG CHUTE COMPARTMENT
8. AIR CONDITIONING PACK RESERVOIRS
9. LIQUID OXYGEN SYSTEM CONVERTER FILLER VALVES
10. GUNNERY SYSTEM EXTERNAL POWER RECEPTACLE
10A. STARTER CARTRIDGES QN AND TB
11. NO. 1 MAIN TANK
12. LEFT OUTBOARD WING TANK
13. LEFT DROP TANK
14. ENGINE OIL TANKS
15. ALTERNATOR PACK RESERVOIRS B-52F
16. NO. 2 MAIN TANK
17. WATER INJECTION TANKS
18. ALTERNATOR PACK RESERVOIRS B-52E
18A. SWESS BATTERY

Figure 1-60 (Sheet 1 of 2).





19. BATTERIES
20. SINGLE POINT REFUELING RECEPTACLE
20A. GAM-77 ARMAMENT PROVISIONS BATTERY
21. MAIN EXTERNAL POWER RECEPTACLE
22. AIR BLEED SYSTEM GROUND SOURCE CONNECTION
23. AIR REFUELING RECEPTACLE
24. BOMBING-NAVIGATIONAL SYSTEM EXTERNAL POWER RECEPTACLE
25. FORWARD BODY TANK
26. CENTER WING TANK
27. NO. 3 MAIN TANK
28. RIGHT DROP TANK

SPECIFICATIONS

FUEL
MIL-J-5624 JP-4 (NATO F-40)
12 TANKS

FUEL (Alternate)
MIL-J-5624 JP-5 (NATO F-44)

FUEL (AV Gas)
MIL-G-5572 (NATO F-12)

OIL (Turbine)
MIL-L-7808C (NATO O-148)
8 TANKS

HYDRAULIC FLUID
MIL-H-5606 (NATO H-515)
10 PACKS

ALTERNATOR DRIVE UNIT OIL B-52F
MIL-L-7808C (NATO O-148)
4 RESERVOIRS

ALTERNATOR PACK OIL B-52E
MIL-O-6081 GRADE 1005
4 PACKS

AIR CONDITIONING PACK OIL
AS SPECIFIED ON PACK NAMEPLATE
2 PACKS

WATER INJECTION
CLEAN UNDISTILLED WATER – WATER WITH LESS THAN 10 PARTS SOLIDS PER MILLION PARTS. WATER WITH MORE IMPURITIES MUST BE RESTRICTED TO EMERGENCY USE ONLY
2 TANKS B-52E
4 TANKS B-52F

NOTE
WATER INJECTION IS NOT USED BELOW 40°F.

BATTERY WATER
DISTILLED WATER
4 BATTERIES

LIQUID OXYGEN
MIL-O-27210, Type II
3 CONVERTERS

STARTER CARTRIDGES MXU/4A
4 (OR 8) CARTRIDGES

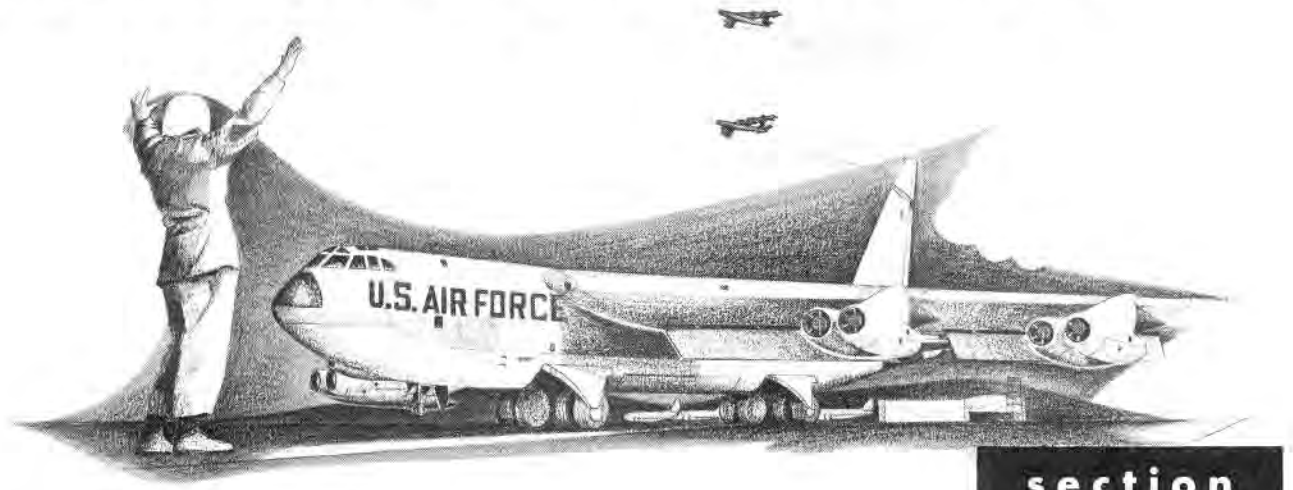
POWER CARTS
COMPRESSOR, TYPE MA-1A (OR EQUIVALENT)
EXTERNAL HYDRAULIC TEST STAND, TYPE D-5A (OR EQUIVALENT)
GENERATOR SET, TYPE MD-3 (OR EQUIVALENT)
EXTERNAL GROUND BLOWER, TYPE A-2 (OR EQUIVALENT)
EXTERNAL GROUND SUPPORT BLOWER, TYPE MC-1 (OR EQUIVALENT)

NOTE
FOR GAM-77 FLUID SPECIFICATIONS AND SERVICING REFER TO T.O. 1B-52C-30-1.

servicing (typical)

Figure 1-60 (Sheet 2 of 2)

NORMAL PROCEDURES



section II

NOTE

This section contains text and an amplified checklist. An abbreviated checklist is contained in T.O. 1B-52E-CL-1-1. The text is divided into primary paragraphs which form the phases of a normal flight. Most of these paragraphs are followed by an amplified checklist for the particular phase of the flight. The amplified checklist is presented in a chronological form that will enable the flight crew to complete their inspection, checks, and operation of the airplane in an expedient yet thorough manner. The amplified checklist describes in detail the steps to be completed. Crew members may strike out checklist items not applicable to their particular aircraft model. Each major part has been assigned to one of the pilots or a crew member to be read by him, and to be accomplished by others in the crew. However, there are exceptions as some of the checklists will be read and completed silently. To show which crew member will accomplish certain steps, the normal crew coding will be used and the code letters will appear after the response to each step. The amplified checklist has also been designed to accommodate the production of the abbreviated checklist to be used during airplane operation.

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PREPARATION FOR FLIGHT

FLIGHT RESTRICTIONS

All limitations imposed on the airplane are described in "Operating Limitations," Section V.

FLIGHT PLANNING

The necessary fuel, airspeed, and thrust settings required to complete a proposed mission should be determined by using the operating data from the Appendix. A mission problem in Part 12 contains complete information on fuel distribution, cg control, and other problems which occur during a long mission. See "Fuel Servicing." With ADM-20 installed, flight planning must include ADM-20 missile programming. Accomplish AGM-28 mission planning for simulated launch only.

FUEL SERVICING

Fuel tank and fuel gage calibration to date has not become sufficiently accurate to be relied upon. For this reason, dipsticks have been provided for use by the servicing crew. In order that the pilot may check the fuel loading, a refueling and distribution log will be with the aircraft Form 781 and will be checked and signed by the pilot during the "Interior Inspection." For information on the "Refueling and Distribution Log," refer to Part 12 of the applicable Appendix.

TAKEOFF AND LANDING DATA CARDS

Compute all takeoff and landing data and complete the takeoff and landing data cards as illustrated in Parts 2 and 9 of the applicable Appendix. This data should be rechecked just prior to flight to determine the effect of any changes in runway conditions or airplane configuration.

WEIGHT AND BALANCE

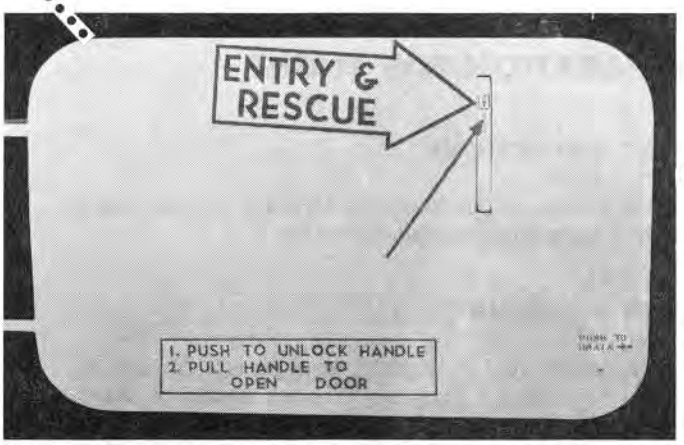
Obtain and check the takeoff and anticipated landing gross weight and balance before flight. Check that the required fuel, ammunition, and bomb load have been loaded. See "Operating Limitations," Section V, for weight and cg limitations. Do not attempt takeoff or landing with cg outside the specified limits. Refer to T. O. 1-1B-40, Handbook of Weight and Balance Data, for weight and loading information. This information is supplemented by a load adjuster. Also check Form 365F (Form F) for specific weights and cg information for each flight. See Part 12 of the applicable Appendix for a sample copy.

ENTRANCE

Two main entrance doors (figure 2-1) provide access into the airplane. The forward pressurized compartment has a door on the lower right side of the fuselage ahead of the forward landing gear wheel well. A door on the right rear side of the fuselage underneath the horizontal stabilizer is used for entrance into the tail pressurized compartment. A flush-type handle is pulled out to unlatch each door. An entrance light switch is located to the right of each door upon entering. The entrance light operates on direct battery power.

E1-70

MAIN ENTRY DOOR



E1-45

MAIN ENTRY DOOR LATCH

AFT ENTRY DOOR E1-72

E1-50

AFT ENTRY DOOR LATCH

entrance to airplane

Figure 2-1.

CHECKLISTS

The flight manual checklists have been designed so that they may be used for training missions with or without bombs/missiles, for alert posture, and for EWO missions which are launched from other than a ground alert posture. Ground alert checklist implementation and instructions are contained in "Alert Procedures," this section.

NOTE

When no bombs or missiles are loaded, safety wires and seals are not required on the associated monitor control and release system controls.

Nuclear Bombs

Nuclear bomb procedures from the -25 Tech Orders (Pre-Takeoff and Inflight sections only) have been integrated within the flight manual checklists for all nuclear bombs monitored by the DCU-9A panels. Since the DCU-9A panels are located in the navigators' compartment, bomb procedures have been integrated primarily in Section VIII; however, a few bomb procedures will also be found in Section II. The bomb items appear as line items without amplification in both the amplified and abbreviated checklists. Amplification of the line items pertinent to nuclear bomb procedures may be found in Section I of T.O. 1B-52B-25-3-2. To complete a single checklist for a mission involving a nuclear bomb, the air crew must remove the applicable "Bomb Preflight" and "Descent and Landing Procedures" checklist pages from T.O. 1B-52B-CL-25-3-2-1 and insert them as indicated in the flight manual checklist.

Conventional Munitions

Conventional munitions procedures have been integrated with the affected flight crew checklists.

Missiles

The procedures that lend themselves to integration in existing checklists have been so integrated for applicable crew members. Otherwise, the procedures have been integrated as complete checklists. The integrated procedures appear as line items without amplification in both the amplified and abbreviated checklists. Amplification of the line items pertinent to missile normal procedures may be found in Section II of the appropriate publication as listed below. Numbering of checklist items in the abbreviated checklists will not coincide with the numbering in the amplified checklists as listed below unless the procedure has been integrated as a complete checklist.

ADM-20 CHECKLISTS. ADM-20 "Before Exterior Inspection," "Exterior Inspection," "Interior Inspection," and "Postflight Inspection" checklists will appear integrated in the "Normal" part of the navigator's and radar navigator's abbreviated flight crew checklists. All other ADM-20 checklists will appear as a nonintegrated package in the "Missile" part of the navigator's and radar navigator's abbreviated flight crew checklists. Amplification of all ADM-20 line items will appear in T.O. 1B-52G-1-2 and T.O. 1B-52E-1-4.

AGM-28 CHECKLISTS. The AGM-28 normal procedures amplified checklists will appear in the B-52/AGM-28 Aircrew Weapon Delivery Technical Manual, T.O. 1B-52C-30-1. The abbreviated checklists for certain AGM-28 normal procedures are integrated in the "Normal" part of the pilots', navigator's, and radar navigator's abbreviated flight crew checklists. However, "AGM-28 Inflight Procedures," "Ferry Mission Procedures," and "Unscheduled Landing with AGM-28 Missiles" will appear nonintegrated in the "Missile" part of the pilots', navigator's, and radar navigator's abbreviated flight crew checklists. The emergency procedures for AGM-28 will appear in the "Emergency" portion of the aircrew abbreviated checklists as nonintegrated items. In the pilots' checklists, these are the "Emergency Shutdown," "Engine Fire During Ground Start," "Ballistic Drop," and "Jettison." In the navigator's and radar navigator's checklists, these are the "Armament System Malfunction Indications," "Ballistic Drop," and "Jettison."

Bomb Runs

The bomb run checklists in Section VIII have been designed so that they may be used for both training and EWO missions. They have been consolidated for use by both the navigator and radar navigator. Large charge tactics have been incorporated in each bomb run checklist. The low altitude bomb run checklists cover both the long look and short look type tactics.

PREPARATION FOR FLIGHT CHECKLIST

NOTE

The following items will be checked by the pilot prior to flight.

1. Form 175 - Checked (P)

   The pilot will complete Form 175 with related attachments in accordance with prescribed procedures.

2. Form 365F - Completed (CP)

   The copilot will compute the Form 365F in accordance with the applicable Appendix, Part 12, "Mission Planning."

PREPARATION FOR FLIGHT CHECKLIST (Cont)

3. Takeoff & Landing Data & Fuel Prediction Curve Form 201 - Completed (CP)

   a. Copilot computes this data in accordance with appropriate flight manual appendix.

   b. Minimum items to be accomplished will include all entries on the takeoff data checklist card.

4. Pilots' Route Map - As required (P-CP)

5. Review Takeoff Abort Procedures (P-CP)

6. Crew Briefing - Completed (P)

   a. Announce assembly time.

   b. Brief crew and extra crew members on required clothing, equipment, etc.

   c. The pilot will determine qualification of all personnel for the flight. At the discretion of the pilot, fully qualified personnel may be dismissed from the briefing at this time.

   d. Crew members emergency briefing (as required). Each crew member not fully qualified will report his position and exit for crash landing during takeoff, and his primary and secondary bailout exit. In the event of planned crash landing, all crew members not essential to flight will bail out if time and conditions permit. Review gunner's emergency call light signals if gunner is not fully qualified.

   e. Extra crew members emergency briefing (as required)

      (1) Instructor Pilot Position - Take off and land strapped in position, remain in position for crash landing on takeoff, exit out pilot's or copilot's escape hatch.

      Bailout - Primary, navigator's escape hatch; secondary, radar navigator's escape hatch.

      (2) Instructor Navigator Position - Take off and land strapped in position, remain in position for crash landing on takeoff, exit out EW officer's escape hatch.

      Bailout - Primary, navigator's escape hatch; secondary, radar navigator's escape hatch.

      (3) Bunk Position - Take off and land in position, remain in position for crash landing on takeoff, exit out EW officer's hatch.

      Bailout - Primary, navigator's escape hatch; secondary, radar navigator's escape hatch.

      (4) 10th Position (if applicable) - Take off and land strapped in position, remain in position for crash landing on takeoff, exit out pilot's or copilot's escape hatch.

      Bailout - Primary, navigator's escape hatch; secondary, radar navigator's escape hatch.

      (5) Any Crew Member Occupying the EW Position NF - Assure that the ALR-20 rack is stowed and locked before ejection.

   f. Emergency signals - Interphone is the primary means of crew warning. For bailout, pilot will give the command "Bail out." Interphone will be supplemented by the alarm system.

      (1) Alert or intermittent signal - Prepare for crash landing or ditching, alert signal repeated prior to impact.

      (2) Abandon or steady signal - Abandon airplane. If above minimum altitude, bail out. On land or water, exit out escape hatches on abandon signal after airplane has stopped.

PREPARATION FOR FLIGHT CHECKLIST (Cont)

(3) Minimum bailout altitudes.

Gunner and Extra Crew Members -_____ ft
Downward Ejection -_____ ft
Upward Ejection -_____ ft

Bailout Order - G, N, IN, #10, Bunk, IP, EW, RN, CP, P.

g. Parachutes will normally be worn at all times except when leaving a position for short periods. Spare chutes will be located in each compartment.

h. Lifevests will be worn as required.

i. Oxygen Masks - The pilot will tell the crew when to use oxygen based on applicable regulations and mission requirements. Crew areas are defined as upper deck, lower deck, and tail compartment.

j. Fire Extinguishers - One in tail, one at galley, one at EW officer's position.

k. First Aid Kits - One in tail, two at galley.

l. Crash Axes - One in tail, one at galley.

m. Escape Ropes - One in tail, one at each upward ejection seat. Use for emergency ground exit.

n. Oxygen Report Briefing

During the climb, copilot requests an oxygen and zero delay lanyard check at 12,000 feet. Copilot, notify aircrew and receive gunner's acknowledgment when passing through 26,000 and 35,000 feet. The sequence for oxygen report is the same as for crew report. During cruise, the copilot will monitor the gunner's remote cabin altimeter and the tail compartment low pressure warning light at intervals not to exceed 15 minutes and initiate the oxygen checks at 30-minute intervals when both cabin altitudes are below 12,000 feet, at 15-minute intervals when either cabin altitude is 12,000 to 25,000 feet, and at no longer than 10-minute intervals when either cabin altitude is above 25,000 feet. If cabin altitude is below 12,000 feet, only the gunner and copilot/pilot will report. The remaining crew members will check their equipment and report if abnormal. At level-off, only the gunner and copilot/pilot need report if cabin pressure is 12,000 feet or below. Oxygen checks are not required below 10,000 feet MSL.

NOTE

On extended flights (flights in excess of 17 hours duration), the gunner may be relieved of crew duties for periods of crew rest by the copilot. Before the gunner is relieved from crew duties, the copilot will request a cabin pressure and oxygen check and ascertain that the gunner is on interphone and oxygen. During the period of the gunner's crew rest, the copilot will monitor the gunner's remote cabin altimeter and the tail compartment low pressure warning light at intervals not to exceed 15 minutes. Close crew coordination between the pilot and copilot is mandatory to insure frequent monitoring.

PREFLIGHT CHECK

BEFORE EXTERIOR INSPECTION CHECKLIST

NOTE

The crew chief will have the Form 781 available to the pilot, and the wing flaps extended when the flight crew arrives at the airplane (station time). Station time will normally be no longer than 1 1/2 hours prior to takeoff.

1. Fire & Security Guards - Posted (if applicable) (P)

2. Check Form 781 - Completed (P)

   Pilot checks Form 781 to ascertain the status of equipment necessary for anticipated flight. Each discrepancy noted will be discussed with crew member concerned. If bombs/missiles are aboard, check for loading completion entry. If GAM-72's are carried, check the missile Form 781 for applicable entries. If GAM-77's or -77A's are carried, check the missile Forms 781 to ascertain engineering status and to make certain that each missile has been serviced with fuel, oil, and ammonia. On GAM-77A missiles, if the missile is to be ground started, check for starter cartridge installation.

NOTE

When carrying GAM-77 missiles only, check that safe plugs are aboard the airplane when warheads are installed.

3. Brief Ground Crew on Stabilizer Trim Check, Alarm System Check, Engine Start & Taxi Out Procedures - Completed (P)

   Brief the ground crew member that he will report when the stabilizer reaches the 0° position and will report the movement of the leading edge of the stabilizer during the stabilizer trim check. During the "Crew Report," a ground crew member will check the alarm system in the bomb bay and report condition to pilot. Brief crew chief to check for alternator (and B-52F oil) cooling air and report only if no cooling air detected.

NOTE

If nuclear bombs are aboard, insert and use the applicable bomb preflight checklist of T.O. 1B-52B-CL-25-3-2-1. The normal two-man policy will be observed. The navigator must complete the "Before Exterior Inspection" checklist prior to the bomb preflight.

4. Brief Ground Crew to Connect External Power to Aircraft After Navigator's "Before Exterior Inspection" (if applicable) (P)

   Exterior and interior lights may be utilized at the discretion of the pilot to assist in interior preflight. Pilot may direct ground crew or other crew member to enter aircraft and place ground power on central tie bus as required prior to loading equipment. (Two-man policy will apply as directed.)

EXTERIOR INSPECTION

NOTE

The exterior inspection is designed to be accomplished normally by an experienced pilot and copilot, each inspecting one side of the airplane simultaneously, one pilot starting with nose section (right) through empennage and the other pilot starting with the left aft wheel well through the nose section (left). However, in the event only one pilot is available, he can perform the complete inspection.

Because of the size and complexity of the airplane, the detailed inspection will have been completed by qualified ground crew personnel. The flight crew exterior inspection is an inspection of general airplane condition. This inspection is based on the assumption that the flight crew is merely accepting the airplane for flight with emphasis on the items that affect the safety of flight. During the inspection, emphasis will be directed toward checking for hydraulic leaks, fuel leaks, and general condition. Additional flight crew preflight will not be accomplished. If normal ground support is not available, see "Strange Field Procedures," this

section, for amplified checklist. If AGM-28's are being carried, an exterior inspection will be accomplished as outlined in the abbreviated checklist. Amplification for this checklist can be found in T.O. 1B-52C-30-1. If the gunner is not flying, see "Strange Field Procedures," this section.

INTERIOR INSPECTION CHECKLIST (PILOT)

1. Control Cabin Lower Deck - Checked (radar navigator and navigator not flying)

   a. Crawlway - Checked

      Inspect crawlway area of forward wheel well for loose equipment and general condition.

   b. Bulkhead Door - Locked

   c. Emergency Pressure Dump Handle - CLOSED

      Bulkhead door and emergency cabin pressure dump handle must be closed in order to pressurize the control cabin. Check that baggage and equipment is secure and clear of the door and area behind the downward ejection seats to prevent jamming in event of ejection.

   d. N-1 Compass Latitude Correction Knob - OFF

   e. BNS Radar Power Switch - OFF

   f. Air Outlet & Auxiliary Heat Knobs:

      (1) Upper - 1/2 to full out

      (2) Lower - Full out

      (3) Warmer - Full in

      NOTE

      These knob settings are approximate settings only. After the cabin temperature has stabilized, knob adjustment may then be varied slightly for crew comfort.

   g. BNS Power & Heater Switches - OFF

   h. Compass & True Heading Computer Cutoff Switch - ON

      Check that compass and true heading computer system cutoff switch on the radar navigator's overhead panel is in the guarded ON position.

   i. Automatic Astrocompass:

      (1) Set Selector Switch - GHA

      (2) Power Filter Switch - SUN

      (3) Star Selector Switch - OFF

      (4) Lat-Long Switch - MANUAL

   j. IFF Master Switch - OFF

   k. Doppler Radar System Power Switch - OFF

   l. Circuit Breakers - Set

   m. Oxygen Regulators (three) - OFF and 100% OXYGEN

   n. Ejection Seats, Escape Hatches & Parachutes - Checked

      For checks to be accomplished, refer to the "Interior Inspection" portions of the "Navigator's Checklist" and "Radar Navigator's Checklist" in Section VIII.

Figures 2-2 and 2-3 deleted

INTERIOR INSPECTION CHECKLIST (PILOT) (Cont)

2. Pilot's Ejection Seat:

   a. Arming Levers - Stowed, safety pins No. 1 installed and locked

   190▶215 W70▶W103

   Inspect both arming lever releases to make certain the arming levers are locked in the stowed position. Do not rotate the arming levers during the inspection. An unlocked arming lever is indicated by a depressed arming lever release and exposed leaf springs on the arming lever. The leaf spring is installed between the inside of the curved portion of the arming lever and the arming lever release (figure 1-56). To lock the arming lever, depress the exposed leaf springs and allow the arming lever release to spring back to the locked position. Do not attempt to lock the arming lever unless it is in the stowed position and the No. 1 safety pins have been installed and locked.

   WARNING

   If the arming lever has been rotated, call maintenance immediately and stay clear of the seat.

   b. Hatch Link - Checked

   Check link connecting escape hatch to catapult safety pin-pull initiator.

   c. Maintenance Safety Pins - Checked removed

   Check No. 2, 3, and 4 pins removed. Take care that no streamer was torn free of a safety pin during removal, thus inadvertently leaving the pin installed. Also make certain that no safety pin is overlooked because the streamer has been detached previously. See figure 1-55 for location of safety pins.

   d. Catapult Initiator Safety Pin-Pull Cylinder - Pin in place

   Catapult initiator safety pin should extend through the catapult initiator. If pin is pulled out, initiator may have been fired; call maintenance immediately.

   WARNING

   Shipping pin or safety pin with streamer must not be installed in catapult initiator.

   e. Manual Catapult Pin-Pull Lever - Checked

   Lever latched, pin-pull cylinder secured.

   f. Catapult to Initiator Tube Run - Checked connected

   Check tube for proper and secure connection.

   g. Harness Release Initiator to Pin-Pull Cylinder Tube - Connected

   Make certain the tube run from the integrated harness release initiator is connected to the integrated harness release pin-pull cylinder.

3. Parachute:

   a. Preflight Check - Performed

   Perform preflight check on parachute if not previously performed by checking parachute inspection record for current inspection. Determine from this record the setting of automatic ripcord release mechanism. Check bailout bottle for minimum pressure and bailout oxygen hose connector for security.

INTERIOR INSPECTION CHECKLIST (PILOT) (Cont)

b. Survival Kit, Inertia Reel, Parachute & Safety Belt - Installed and interconnected

Parachute, survival kit, inertia reel, and safety belt are interconnected with the parachute-survival kit attachment straps passing through the loops in the safety belt. Check that the survival kit is properly bottomed in the seat to insure that the arming plunger is fully depressed.

WARNING

Care must be taken to assure the survival kit attachment straps are properly laced through the safety belt.

c. Zero Delay Lanyard - Hooked

d. Parachute Arming Lanyard Anchor - Installed

WARNING

Be certain that the parachute arming lanyard anchor is securely fastened in the attachment fitting on the seat. Failure to attach the lanyard anchor to the seat will necessitate manual operation of the parachute after ejection.

4. Readiness Switch Assembly:

a. Readiness Switches (4) - SAFE

Check that both ASM switches and both bomb switches are in the SAFE position.

b. Readiness Switch Cover - Closed and sealed

Check that access cover is closed, safety pinned, and sealed.

5. Circuit Breakers - Set

5A. Flare Ejector Power Switch - OFF

6. Water Injection Switches - OFF and CLOSED (OPEN if not serviced with water)

Water injection pump switches OFF; water injection drain valves switch CLOSED.

6A. Autopilot Servos Cutout Switches - IN

7. SWESS Control - SAFE and sealed

7A. Anti-Icing Control Switch - OFF

8. Mach Indicator Switch (if installed) - OFF

9. Windshield Anti-Ice & Defogging Switch - OFF

10. Deleted

11. Air Outlet Knobs:

a. Upper - 1/2 to full out

INTERIOR INSPECTION CHECKLIST (PILOT) (Cont)

b. Lower - Full out

NOTE

These knob settings are approximate settings only. After the cabin temperature has stabilized, knob adjustment may then be varied slightly for crew comfort.

12. Emergency Landing Gear Switches - Guards closed
13. Landing Gear Lever - GEAR DOWN, in detent
14. Antiskid Switch - ON, guard closed
15. Steering Ratio Selector Lever - TAKEOFF LAND
16. Aileron Trim Cutout Switch - Guard closed
17. Airbrake Lever - OFF
18. Stabilizer Trim Cutout Switch - Guard closed
19. Throttles - CLOSED
20. Wing Flap Lever - OFF
21. Thermal Curtains - Installed and stowed

INTERIOR INSPECTION CHECKLIST (COPILOT)

1. EW Station - Checked (EW officer not flying)

a. Ejection Seat:

(1) Arming Levers - Stowed, safety pins No. 1 installed and locked

190▶215 W70▶W103

Inspect both arming lever releases to make certain the arming levers are locked in the stowed position. Do not rotate the arming levers during the inspection. An unlocked arming lever is indicated by a depressed arming lever release and exposed leaf springs on the arming lever. The leaf spring is installed between the inside of the curved portion of the arming lever and the arming lever release (figure 1-56). To lock the arming lever, depress the exposed leaf springs and allow the arming lever release to spring back to the locked position. Do not attempt to lock the arming lever unless it is in the stowed position and the No. 1 safety pins have been installed and locked.

WARNING

If the arming lever has been rotated, call maintenance immediately and stay clear of the seat.

(2) Maintenance Safety Pins - Checked removed

Check No. 2, 3, and 4 pins removed. Take care that no streamer was torn free of a safety pin during removal, thus inadvertently leaving the pin installed. Also make certain that no safety pin is overlooked because the streamer has been detached previously. See figure 1-55 for location of safety pins.

INTERIOR INSPECTION CHECKLIST (COPILOT) (Cont)

(3) Catapult Initiator Safety Pin-Pull Cylinder - Pin in place

Catapult Initiator safety pin should extend through the catapult initiator. If pin is pulled out, initiator may have been fired; call maintenance immediately.

WARNING

Shipping pin or safety pin with streamer must not be installed in catapult initiator.

(4) Manual Catapult Pin-Pull Lever - Checked

Lever latched, pin-pull cylinder secured.

(5) Catapult to Initiator Tube Run - Checked connected

Check tube for proper and secure connection.

(6) Harness Release Initiator to Pin-Pull Cylinder Tube - Connected

Make certain the tube run from the integrated harness release initiator is connected to the integrated harness release pin-pull cylinder.

b. Parachute Preflight - Performed

c. Oxygen Regulators (two) - OFF and 100% OXYGEN

d. ECM Equipment - Off

Check all power switches off; circuit breakers set.

e. Air Outlet Knobs:

(1) Upper - 1/2 to full out

(2) Lower - Full out

NOTE

These knob settings are approximate settings only. After the cabin temperature has stabilized, knob adjustment may then be varied slightly for crew comfort.

f. Section 41 Power Distribution Panel Circuit Breakers - Set

2. Overhead Circuit Breakers - Set

Check overhead circuit breaker panel and leave GAM-72 gear jettison circuit breaker pulled.

INTERIOR INSPECTION CHECKLIST (COPILOT) (Cont)

3. Copilot's Ejection Seat:

a. Arming Levers - Stowed, safety pins No. 1 installed and locked

190▶215 W70▶W103

Inspect both arming lever releases to make certain the arming levers are locked in the stowed position. Do not rotate the arming levers during the inspection. An unlocked arming lever is indicated by a depressed arming lever release and exposed leaf springs on the arming lever. The leaf spring is installed between the inside of the curved portion of the arming lever and the arming lever release (figure 1-56). To lock the arming lever, depress the exposed leaf springs and allow the arming lever release to spring back to the locked position. Do not attempt to lock the arming lever unless it is in the stowed position and the No. 1 safety pins have been installed and locked.

WARNING

If the arming lever has been rotated, call maintenance immediately and stay clear of the seat.

b. Hatch Link - Checked

Check link connecting escape hatch to catapult safety pin-pull initiator.

c. Maintenance Safety Pins - Checked removed

Check No. 2, 3, and 4 pins removed. Take care that no streamer was torn free of a safety pin during removal, thus inadvertently leaving the pin installed. Also make certain that no safety pin is overlooked because the streamer has been detached previously. See figure 1-55 for location of safety pins.

d. Catapult Initiator Safety Pin-Pull Cylinder - Pin in place

Catapult initiator safety pin should extend through the catapult initiator. If pin is pulled out, initiator may have been fired; call maintenance immediately.

WARNING

Shipping pin or safety pin with streamer must not be installed in catapult initiator.

e. Manual Catapult Pin-Pull Lever - Checked

Lever latched, pin-pull cylinder secured.

f. Catapult to Initiator Tube Run - Checked connected

Check tube for proper and secure connection.

g. Harness Release Initiator to Pin-Pull Cylinder Tube - Connected

Make certain the tube run from the integrated harness release initiator is connected to the integrated harness release pin-pull cylinder.

INTERIOR INSPECTION CHECKLIST (COPILOT) (Cont)

4. Parachute:

   a. Preflight Check - Performed

      Perform preflight check on parachute by checking parachute inspection record for current inspection. Determine from this record the setting of automatic ripcord release mechanism. Check bailout bottle for minimum pressure and bailout oxygen hose connector for security.

   b. Survival Kit, Inertia Reel, Parachute & Safety Belt - Installed and interconnected

      Parachute, survival kit, inertia reel, and safety belt are interconnected with the parachute-survival kit attachment straps passing through the loops in the safety belt. Check that the survival kit is properly bottomed in the seat to insure that the arming plunger is fully depressed.

WARNING

Care must be taken to assure the survival kit attachment straps are properly laced through the safety belt.

   c. Zero Delay Lanyard - Hooked

   d. Parachute Arming Lanyard Anchor - Installed

WARNING

Be certain that the parachute arming lanyard anchor is securely fastened in the attachment fitting on the seat. Failure to attach the lanyard anchor to the seat will necessitate manual operation of the parachute after ejection.

5. Circuit Breakers - Set

6. Cabin Pressure Release Switch - Guard closed

7. Air Conditioning Master Switch - RAM

8. Air Bleed Selector Switch - NORMAL

9. Temperature Selector - AUTOMATIC (temperature as desired)

   Optimum air conditioning is obtained using an initial setting between 60° and 70°.

10. Engine Starter Switches - OFF and GROUND START (for pneumatic start); No. 2 and 8 START and FLIGHT START (for cartridge start)

REVERSE SIDE INTENTIONALLY LEFT BLANK

INTERIOR INSPECTION CHECKLIST (COPILOT) (Cont)

11. Refuel Panel Switches - CLOSED and OFF
12. AGM-28 Emergency Control Panel:
    a. Fire Test Switch - OFF
    b. Fire Reset Switch - OFF
    c. Emergency Shutoff Switches - NORMAL (guard closed)
13. AGM-28 ASM Engine Control Panel:
    a. AGM-28 Engine Control Knob Safety Guard & Streamer - Installed (if cartridge installed)
    b. Ready for Launch Switches - OFF
    c. Wing Valve Switches - CLOSE
    d. Engine Control Knobs - OFF
14. Air Bleed Switches - OPEN
15. All Fuel Panel Switches - OFF
16. Terrain Display Mode Selector Switch LH - OFF
17. Thermal Curtains - Installed and stowed
18. Firewall Switches B-52F - IN

BEFORE STARTING ENGINES

BEFORE STARTING ENGINES CHECKLIST (Pilot/Copilot reads)

1. Oxygen System - Checked (P-CP)

   The following items may be accomplished silently:

   a. Shutoff Lever - ON

      Pressure gage reads approximately 300 psi.

   b. Regulator Diluter Lever - 100% OXYGEN

   c. Emergency Toggle Lever - EMERGENCY

      Flow indicator should indicate continuous flow. Block regulator hose with hand; indicator should indicate no flow.

   d. Emergency Toggle Lever - NORMAL

   e. Mask & Hose - Connect and test

      Check for 10- to 20-pound pull for disconnect.

BEFORE STARTING ENGINES CHECKLIST (Pilot/Copilot reads) (Cont)

f. Mask - Test

(1) Emergency Toggle Lever - TEST MASK

Hold breath; indicator should indicate no flow.

NOTE

Flow condition may be indicated by a slight leak around the face form. If light hand pressure against the mask does not stop the flow, the mask is unacceptable.

(2) Emergency Toggle Lever - NORMAL

g. Regulator Diluter Lever - NORMAL OXYGEN

2. Interphone - Checked (P-CP)

3. Battery Switch - OFF, voltage checked (CP)

Battery switch OFF, check the no-load condition of the batteries by separate actuation of the battery voltage buttons (24-volt minimum, 26-volt maximum).

4. Emergency Battery Switch - EMERG, checked, NORMAL (P-CP)

Copilot positions the emergency battery switch to EMERG. Pilot should check the operation of the turn-and-slip indicator and illumination of essential flight instrument lights on emergency battery power. Pilot actuates the emergency alarm switch to ALERT to check the alarm system on emergency battery power. While in ALERT, returns emergency battery switch to NORMAL, checking continuous operation of the alarm system. Pilot then turns emergency alarm system to OFF.

5. Battery Switch - ON, not charging light on (CP)

6. Alternator Panel:

a. Alternator Circuit Breakers - Lights on (CP)

Momentarily hold alternator circuit breaker switches to OPEN if necessary.

CAUTION

Alternator circuit breakers should be open to avoid possibility of damage to electronic equipment due to low frequencies during engine start.

b. Bus Tie Breakers - Checked CLOSE, lights out (CP)

c. Alternator Switches B-52F - ON (CP)

7. External Power - Checked and on, battery not charging lights out (CP)

CAUTION

If "321 Reversed" indicator light comes on, external power phase sequence is reversed. Disconnect external power, turn off the batteries, and obtain another power cart.

8. Radios - On (P-CP)

BEFORE STARTING ENGINES CHECKLIST (Pilot/Copilot reads) (Cont)

9. Warning & Indicator Lights - Press to test (P-CP)

   Pilot and copilot will press to test all warning and indicator lights that are not illuminated. The copilot will press to test the fuselage overheat warning test switch and check illumination of the pilot's master warning light and the fuselage overheat warning lights on the copilot's side panel.

10. Firewall Switches - IN and checked (P-CP)

    Push the firewall fuel shutoff switches to NORMAL (in) and check the fire detector system and lights by moving the fire detector switch to TEST.

11. Gyro Switch - ON (P/CP)

12. Navigation Lights - BRIGHT and FLASH (P)

13. Ground, Connect and Clear Bomb Door - Connected and clear (GC)

14. Crew Report - Completed (P)

    a. Pilot actuates emergency alarm switch to ABANDON, switches interphone to CALL, and announces "Crew report."

    b. The sequence for crew reporting is as follows: gunner, navigator, EW officer, radar navigator, copilot, pilot, instructor navigator, 10th man, bunk, and instructor pilot.

    c. All crew members will switch to CALL and report, "Station check complete." Station check consists of seat, oxygen, interphone, abandon signal, call light, and zero delay lanyard check.

    d. Pilot checks his call light when each crew member switches to CALL.

    e. Ground crew checks the alarm system in the bomb bay and reports condition to pilot.

15. ADM-20 Fire Warning Circuits [KS] - Tested (CP-RN)

    Rotate selector switch to positions 1 through 4. Actuate fire warning system circuit test switch to ON at each position. In each position, the ADM-20 fire warning indicator light will illuminate. The appropriate fire warning lights at the radar navigator's station will also illuminate.

16. Fuel Quantity - Checked (P-CP)

    The copilot depresses the fuel quantity test buttons to assure proper operation of fuel gages and calls off the fuel gage readings to the pilot who records them in the No. 2 block of the fuel log. The copilot will have recorded in the No. 1 block of the fuel log the planned fuel load. The pilot cross-checks the fuel load dipstick readings, totals the individual readings, and compares the total with the totalizer reading.

17. Gyro Instruments - Checked (P-CP)

WARNING

Any time during critical phases of flight and especially during night and/or instrument conditions, the pilot not flying the aircraft will closely monitor his flight instruments and cross-check them against the instruments of the other pilot. If an apparent error in aircraft attitude is detected, the pilot flying the aircraft will be advised immediately.

BEFORE STARTING ENGINES CHECKLIST (Pilot/Copilot reads) (Cont)

18. Wing Flaps - UP, lever OFF (CP-GC)

Flaps should be full down at the time the crew enters the airplane. Ground personnel will be on interphone and advise the pilots of flap position and movement. Place flap lever to UP position and note movement to full up. Move lever to OFF position.

CAUTION

- Wing flap operation shall be discontinued within 10 seconds if flaps fail to start moving. Any additional attempt to start the flaps shall be limited to 10-second intervals of actuation. Do not use either flap motor for more than eight attempted starts in any 30-minute period.
- To prevent inadvertent movement of the wing flaps after the desired flap position is obtained, the wing flap lever will be left in DN position at all times when full flap extension is desired. To prevent flap motor damage which may be caused by limit switch actuation after flap retraction, the lever will be moved to OFF when the flaps up indication is received.

NOTE

Flaps are limited to three complete duty cycles (extension and retraction) in any 30-minute period (eight starts allowed in any 30-minute period).

19. Radios - Checked (P-CP)

a. Copilot checks primary and secondary radios and obtains taxi and takeoff instructions.

b. Pilot sets in appropriate omni frequency, turns on the TACAN-ODR marker mixer switch, and listens for correct audio signals. A visual check is made of the radio magnetic indicator and omnirange radio course indicator to determine if correct magnetic and course signals are being received by the set.

c. Pilot places navigation system select switch to TACAN and the TACAN function switch to T/R position. If aircraft is so located (within line of sight with an AN/URN-3 beacon), the pilot may tune the set to the channel of the beacon and determine if the radio course indicator is receiving bearing information, the distance indicator is receiving range information, and that the beacon signal can be heard in the headset.

20. Altimeters - Set (P-CP-RN/N)

Set in accordance with AFM 51-37.

NOTE

When resetting altimeters, special attention should be given to the altimeter to insure that the 10,000-foot pointer is reading correctly.

21. Standby Pump Switches - ON (P)

22. AGM-28 Emergency Control Panel:

a. Fire Test Switch - Actuate (CP)

23. AGM-28 ASM Engine Control Panel:

a. Low Fuel Light(s) - ON (CP)

BEFORE STARTING ENGINES CHECKLIST (Pilot/Copilot reads) (Cont)

b. Oil Pressure Light(s) - ON (CP)

c. Wing Valve Switches - CLOSE, lights on (CP)

24. Airbrake, Control & Trim Check, AAER - Completed (P-CP)

AAER = airbrake, aileron, elevator, and rudder

NOTE

- This check made in coordination with ground crew observer.
- All responses made by the ground observer during this check should be in terms of the actual observed movement of the particular flight control being checked. The responses listed in this checklist should serve as a guide only.
- Spoiler and airbrake rigging tolerances are such that the spoiler groups on each wing may not exactly line up during partial or full extension of either the spoilers or airbrakes. Also, when airbrakes are in position 6, a slight additional raising of the spoilers on a wing when the control wheel is moved out of neutral is normal. The outboard segments will rise from 50° to 60° as more control wheel rotation is applied.

a. Airbrake & Control Check:

(1) Airbrake Lever - Position 6

Ground reports: Inboard 60°; outboard 50°.

NOTE

Wing droop associated with high gross weight fuel loads may make it impossible to see the outboard airbrake segments from the cockpit. These segments will be at 50° instead of 60°.

(2) Control Wheel - Full left

Ground reports: Left spoilers up, left aileron control tab down, right aileron control tab up, right spoilers down.

(3) Control Wheel - Full right

Ground reports: Left spoilers down, left aileron control tab up, right aileron control tab down, right spoilers up.

(4) Control Wheel - Neutral

Ground reports: Inboard 60°; outboard 50°.

BEFORE STARTING ENGINES CHECKLIST (Pilot/Copilot reads) (Cont)

(5) Airbrake Lever - OFF

Ground reports: All airbrakes down.

NOTE

Full control wheel travel will still result in both inboard and outboard spoiler segments assuming the full 60° extension (i.e., with airbrakes in position 6, control wheel displacement to full left will cause the left spoilers to move from inboards 60°, outboards 50° to both segments 60°, and right spoilers from inboards 60°, outboards 50° to both segments zero. Returning control wheel to neutral with airbrakes in position 6 will cause spoilers to assume the position of inboards 60°, outboards 50°).

b. Aileron Trim Check:

(1) Aileron Trim Button - L WING DN

Copilot actuates trim button to L WING DN and pilot actuates aileron trim cutout when both trim indicators reach approximately 5°. Copilot releases trim button and pilot places trim cutout switch in OFF or NORMAL guard down. Ground observer reports, "Left aileron trim tab down, right aileron trim tab up" and pilot notes movement of left and right trim indicators.

(2) Aileron Trim Button - R WING DN

Pilot returns aileron trim to neutral, ground observer reports movement of aileron trim tabs, and pilot observes trim indicators for correct indications.

CAUTION

Continuous actuation of the aileron trim mechanism is limited to two complete duty cycles followed by a 10-minute cooling period. (See "Aileron Trim Mechanism Limitations," Section V.)

NOTE

If the left and right aileron trim tabs are not displaced an equal amount during this check, they can be synchronized by actuating the aileron trim button until either the extreme L WING DN or R WING DN position is reached and both actuators are shut off by their respective limit switches. The tabs will then be synchronized and normal operation can be resumed.

c. Elevator Check:

(1) Control Column - Full forward

Ground reports position of elevator and elevator control tabs.

(2) Control Column - Full back

Ground reports position of elevator and elevator control tabs.

BEFORE STARTING ENGINES CHECKLIST (Pilot/Copilot reads) (Cont)

d. Rudder & Rudder Trim Check:

(1) Rudder Pedal - Full left

Ground reports position of rudder control tab.

(2) Rudder Pedal - Full right

Ground reports position of rudder control tab.

(3) Rudder Trim Knob - Centered

25. Ground, Start External Air - 30 psi desired (CP)

26. Pack 9 & 10 Switches - ON and checked (P)

Hydraulic pack switches 9 and 10 to start until hydraulic pack pressure low warning light is out (or 6 seconds, whichever is shorter), then ON, pressure checked.

27. Autopilot Safety Check - Completed (P)

a. Check turn knob and roll trim knob in detent position.

b. Place autopilot master switch in ON.

c. Note trim indicators centered and place servos engage switch to ENGAGE.

NOTE

If autopilot cannot be initially engaged or if disengagement of autopilot occurs during checkout due to rudder contacting the rudder limit switch, the copilot should hold the autopilot rudder limit bypass switch in BYPASS position throughout remainder of check.

d. Depress pilot's autopilot release button; autopilot should disengage and the disengage warning light should flash.

e. Turn autopilot master switch OFF.

28. Stabilizer Trim - Checked, takeoff trim set (P-CP)

NOTE

After initiating a trim change, the stabilizer trim switch will always be returned to neutral using a positive movement of the pilot's thumb.

CAUTION

During ground operation of the stabilizer trim mechanism, observe system limitations as given in Section V.

a. Ground observer reports direction in which leading edge is moving for both directions operated.

BEFORE STARTING ENGINES CHECKLIST (Pilot/Copilot reads) (Cont)

b. Nose Down Operation - Checked

(1) Copilot applies nose down trim electrically, checking that stabilizer trim wheel and indicator move in correct direction.

(2) Pilot momentarily actuates the trim cutout switch, at approximately 1 unit nose down position, to check interruption of electrical trim power and abrupt stoppage of manual trim wheel.

(3) On airplanes NM, check pitch attitude control force switch operation as follows:

(a) Copilot pulls back on his control column while still trimming until trim actuation stops to check force switch operation.

(b) Copilot reduces force on control column and continues nose down trim until trim actuation starts, then releases trim switch noting that wheel stops abruptly.

(c) Copilot trims electrically toward zero and pushes forward on the control column while still trimming until trim actuation stops to check force switch operation in opposite direction.

(4) Copilot trims to zero with the pilot again checking operation of trim cutout switch after approximately 1 unit of travel.

c. Nose Up Operation - Checked

(1) Pilot operates trim electrically from zero to 1 unit of nose up trim, checking that stabilizer trim wheel and indicator move in the correct direction and noting that manual trim wheel stops abruptly when trim switch is released.

(2) On airplanes NM, check pitch attitude control force switch operation as follows:

(a) Pilot applies nose up trim electrically and pushes forward on the control column until trim actuation stops to check force switch operation.

(b) Pilot reduces force on control column and continues nose up trim until trim actuation starts, then releases trim switch.

(c) Pilot trims electrically toward zero and pulls back on control column while still trimming until trim actuation stops to check force switch operation in opposite direction.

(3) Pilot returns stabilizer trim to zero electrically.

d. Ground observer reports leading edge position after pilot returns stabilizer to zero.

e. Pilot sets stabilizer trim for takeoff.

29. Pack 9 & 10 Switches - OFF (P)

30. External Air - Off (if delay expected before starting engines) (GC)

When a delay is expected prior to engine starting, the power cart should be shut down to conserve its limited fuel supply.

BEFORE STARTING ENGINES CHECKLIST (Pilot/Copilot reads) (Cont)

31. Fuel Switches:

    a. Normal: 13, 14, 15 & 16 - ON (CP)

    b. Boost Pump Shutoff Switch ND - ON (CP)

    The boost pump shutoff switch should be ON for all normal operation. Switch in OFF position de-energizes one boost pump in each main tank.

32. Ground, Remove Ground Locks & Bypass Keys - Roger (GC)

33. Standby Pumps Pressures - Checked (P)

34. Steering Ratio - TAXI (P)

35. Ground Locks & Bypass Keys - Counted and stowed (N)

36. SWESS Control Switch - SAFE and sealed (P)

37. SWESS Armed Light - OFF (P)

38. SWESS Warning Light - OFF and tested (P)

39. Circuit Breakers - Set (P-CP)

40. Windshield Anti-Icing - NORMAL (P)

41. Pitot Heat - ON (P)

NOTE

- For normal training missions, disregard the remaining items in the checklist and proceed to "Starting Engines and Before Taxiing Checklist."
- The aircrew may leave their stations provided they can assure that the configuration of the various controls and switches will not be changed. If not, they must accomplish the "Before Leaving Airplane" checklist. Upon returning to the airplane for flight, the "Interior Inspection" and "Before Starting Engines" checklists must be reaccomplished for switch positioning prior to starting engines. This requirement does not apply when preparing the airplane for alert posture.

42. Ground, Close All Hatches - Roger (GC)

43. Hatch Warning Light - Out (P)

44. Ground, Reopen Navigator's & Gunner's Hatches - Roger (GC)

45. Hydraulic Packs 5, 6, 7, 8, 9 & 10 - ST (Climatic) (P)

    Hydraulic pack switches will be placed in ST only when OAT is 0° C (32° F) or below if external air is going to be applied for heating purposes.

46. Stabilizer & Spoiler Standby Pumps - OFF (P)

47. Oxygen - OFF and 100% OXYGEN (ALL)

BEFORE STARTING ENGINES CHECKLIST (Pilot/Copilot reads)(Cont)

48. Interior Lights - ON (P-CP)
49. External Power - OFF (CP)
50. Battery - OFF (CP)
51. Interphone Switch - OFF (P)
52. Hydraulic Packs 5, 6, 7, 8, 9 & 10 - OFF & RESET (Climatic) (P)

    To be accomplished only when OAT is 0° C (32° F) or below.

53. Entrance Light - OFF (P)

STARTING ENGINES AND BEFORE TAXIING

STARTING ENGINES AND BEFORE TAXIING CHECKLIST (Pilot reads)

NOTE

- Only the **boldface** items need be accomplished for Scramble. All items will be reviewed during climb or as soon as practicable.
- During EWO alert operations, takeoff will not be delayed for items pertaining to crew equipment, radio checks, anticollision lights, and SIF/IFF settings.

1. Crew Equipment - On and adjusted (P-CP)

   Crew equipment should be donned at this time for normal training missions.

1A. PARKING BRAKES — SET (P)

2. BATTERY — ON (CP)

3. INTERPHONE SWITCH — ON (P)

4. EXTERNAL POWER — OFF, CHECKED, ON (OFF, IF NOT USED) (CP)

5. Ground, Close Hatches - Roger (GC); light out (P)
6. Ground, Start External Air - Roger (GC); 30 psi desired (CP)

NOTE

Satisfactory starts may be made at less than 30 psi although starting time will be increased. See "Strange Field Procedures," this section.

7. Stand by to Start Engines - Fire guard posted and clear (GC)

   Ascertain that personnel and equipment are clear of intake and exhaust ducts.

WARNING

If airplane is directly behind another operating jet airplane or will be run up with its tail into the wind, the following procedure will be used:
1. All crew members will go on oxygen and place diluter lever at 100% OXYGEN.
2. Whenever contamination is suspected, 100% oxygen will be used during ground operation and takeoff.
3. After contamination is no longer suspected, place the diluter lever of the oxygen regulator in NORMAL OXYGEN.

STARTING ENGINES AND BEFORE TAXIING CHECKLIST (Pilot reads) (Cont)

CAUTION

When practicable, start and run up engines with airplane on a clean paved surface to reduce possibility of dirt or other objects being drawn into engine compressors and damaging engines.

8. START ENGINES — STARTED (CP)

NOTE

- MD-3 power units will be used on all aircraft starts. While on alert, battery starting procedures will be a backup in event of MD-3 power failure.
- For other than alert starts, if AGM-28's need to be pneumatically started on the ground, the AGM-28's may be started before the aircraft engines. Refer to missile engine ground start checklist.

The following procedures are designed to be used for starting engines with or without external electrical power. The battery system may not be dependable at low temperatures. When battery start procedures are used, all normal engine and alternator starting precautions will be used; engine oil pressure and fuel flow indication will be inoperative until an alternator is on the line.

NOTE

- Pilot monitors starting sequence to prevent engines exceeding limitations.
- Combustion must occur within 20 seconds after throttle is advanced. Exhaust gas temperature is the best indication of combustion. Fuel flow for a normal start should be between 570 and 1250 pph B-52E (560 and 1250 pph B-52F) prior to combustion; it may increase to 2000 pph during acceleration, then should drop to between 570 and 1250 pph B-52E (560 and 1250 pph B-52F) at stabilized idle rpm. A hot start is best indicated by rapidly increasing exhaust gas temperature but excessive fuel flow can also warn of this condition.
- If the ambient temperature is -22° F (-30° C) or below, idle the engine for a 2-minute warmup period. See "Cold Weather," Section IX, for engine starting in cold weather.
- B-52F
- "Hung" starts (when the starter does not drop out) are usually characterized by failure of the engine to accelerate beyond 40% rpm and are more likely to occur at temperatures of 45° F (7° C) and below. EGT may rise slowly but should not be allowed to exceed the starting limit. If engine does not accelerate to idle rpm within 90 seconds or if a tendency to exceed other limits is observed, proceed with engine shutdown and applicable maintenance instructions for obtaining a satisfactory start.

STARTING ENGINES AND BEFORE TAXIING CHECKLIST (Pilot reads) (Cont)

CAUTION

- Advancing the throttle before 12% rpm is reached increases the possibility of a hot start.
- In order to prevent starter internal failure in case starters fail to drop out, the starter switches are moved to OFF as the engines attain 45% rpm.
- Oil pressure must be 35 psi minimum within 30 seconds.
- If external electrical power is lost during an engine start and the engine being started is below approximately 35% rpm, immediately retard the throttle to CLOSED and discontinue the start until electrical power is restored. The loss of a-c power (and TR power) will close the starter air valves on engines 3, 4, 5, and 6, depriving these engines of starter assistance which may result in hot starts if throttles are not closed.
- All cases of overspeed and overtemperature operation will be recorded in Form 781. See figure 5-2 for engine operating limitations.
- Avoid reengaging the engine starter while the engine is still rotating unless it becomes necessary to do so. Such practice may reduce starter service life.
- If fuel flow or EGT exceeds limits, retard throttle to CLOSED, place starter switch to OFF, allow at least 30 seconds for fuel drainage, and check for malfunction before attempting a restart.
- To prevent damage to wing flap structure, operation at engine rpm greater than 92% with wing flaps extended should be kept to a minimum.
- B-52F Ground crew checks for alternator and engine oil cooling air. Any engine which does not have cooling airflow will be shut down.

Pneumatic Start — With External Electrical Power

NOTE

Check all engine starter switches OFF and GROUND START.

Pilot announces "Starting No. 4." Copilot positions No. 4 starter switch to START. At a minimum of 12% rpm, pilot advances No. 4 throttle to 90% rpm. As No. 4 engine reaches 45% rpm, copilot places No. 4 starter switch to OFF. As No. 4 engine accelerates through IDLE rpm, copilot places all remaining starter switches to START. As the engines reach a minimum of 12% rpm, pilot advances throttles 1, 2, and 3 and copilot advances throttles 5, 6, 7, and 8 to IDLE. As the engines reach 45% rpm, copilot places the respective starter switches OFF.

Pneumatic Start — Without External Electrical Power

Pilot announces "Starting No. 1." Copilot positions No. 1 starter switch to START. At a minimum of 12% rpm, pilot advances No. 1 throttle to 90% rpm. As No. 1 engine reaches 45% rpm, copilot places No. 1 starter switch OFF and, as No. 1 engine accelerates through IDLE rpm, the left aft alternator B-52F started, alternator circuit breaker closed, No. 1 alternator B-52F circuit breaker closed, then positions remaining starter switches to START. As the remaining engines reach 12% rpm, pilot advances throttles 2, 3, and 4 and copilot advances throttles 5, 6, 7, and 8 to IDLE. As the engines reach 45% rpm, copilot positions the respective starter switches OFF.

STARTING ENGINES AND BEFORE TAXIING CHECKLIST (Pilot reads) (Cont)

Cartridge Start

NOTE

- Check No. 2 and 8 engine starter switches START and FLIGHT START.
- In order to start engines 1, 3, 4, 5, 6, and 7, the starter selector switch must be positioned to GROUND START before the respective engine starter switches are placed to START for the engine starter relays to become energized.
- Engine oil pressure and fuel flow indication and standby pumps pressure for braking will be inoperative until an alternator is on the line.

B-52E

- If external electrical power is not available, place the left aft alternator switch ON after engines 2 and 8 are started and accelerate through IDLE rpm. Do not advance No. 2 and 8 throttles past IDLE rpm until the alternator is started and on the line. TR power will then be provided for opening the remaining starter air valves.

B-52F

- If external electrical power is not available, No. 1 hydraulic pack will be started as engine No. 2 and/or 8 accelerates through 45% rpm. Starting of engines 3, 4, 5, and 6 will be delayed until engines 1 and 7 are started and their respective alternators are on the line. Place No. 1 and 7 alternator circuit breaker switches to ON at IDLE rpm. TR power will then be provided for opening the inboard starter air valves.

Pilot announces "Starting No. 2 and 8." Copilot positions "Eng 2" and "Eng 8" cartridge start switches to ON momentarily, then releases. At a minimum of 12% rpm, pilot advances No. 2 and 8 throttles to 90% rpm. As No. 2 and 8 engines reach 45%, copilot positions No. 2 and 8 starter switches to OFF, positions the starter selector switch to GROUND START, then positions No. 1, 3, 4, 5, 6, and 7 starter switches to START. At a minimum of 12% rpm, pilot advances throttles 1, 3, and 4 and copilot advances throttles 5, 6, and 7 to IDLE. As the engines reach 45% rpm, copilot positions the respective starter switches OFF.

WARNING

In the event starter cartridge does not fire, pilot will notify ground crew by interphone, designate engine on which cartridge did not fire, and ensure that starter switches are OFF. Cartridge will not be removed until there is no evidence of exhaust smoke at the starter exhaust duct and at least 5 minutes will have elapsed since the start of initiation. Pilot will make entry on Form 781.

CAUTION

During operation of the cartridge-pneumatic system, observe limitations given in Section V.

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STARTING ENGINES AND BEFORE TAXIING CHECKLIST (Pilot reads) (Cont)

AGM-28 Missile Engine Ground Starts

If AGM-28's are to be used for takeoff, as soon as copilot has placed remaining starter switches to START, he will request ground crew to make air available for ASM 2. ASM 2 will be started as outlined below. After ASM 2 has been started, copilot requests ground crew to provide air for ASM 1, which will be started in the same manner.

NOTE

After the missile engines have been started, the copilot will request the navigator to check that the electric out lights are off.

PNEUMATIC START (COPILOT)

NOTE

This procedure is applicable for AGM-28B missiles if starting with external air is to be accomplished.

1. External Air - Connected
2. Engine Control Knob(s) - GRD START
3. Engine Control Knob(s) - IGN (at 12%)
4. EGT & Rpm - Check
5. Engine Control Knob(s) - IDLE (at 58% to 62%)
6. Oil Pressure & Low Fuel Lights - Off

CARTRIDGE START - AGM-28B (COPILOT)

1. Engine Control Knob Safety Guard & Streamer - Removed, stowed
2. Engine Control Knob(s) - IGN
3. EGT & Rpm - Check
4. Engine Control Knob(s) - IDLE (at 58% to 62%)
5. Oil Pressure & Low Fuel Lights - Off

Disconnecting External Air

Ground will disconnect external air after engines are started and throttles are retarded to IDLE.

9. ENGINE & NACELLE ANTI-ICING SWITCH — CLIMATIC (P)

If icing conditions exist or are anticipated during taxiing, takeoff, or before initial climbout is completed, turn engine, nacelle, and scoops anti-icing switch ON.

NOTE

- Engine icing can occur during ground operation and at speeds below 250 knots IAS if the OAT is 5° C (41° F) or below and the dew point is within 4° C (7° F) of the OAT. Engine icing can also occur within this speed and temperature range at any time visible moisture is present.
- Due to engine performance loss, the use of engine and nacelle anti-icing during takeoff will reduce EPR settings, increase both takeoff ground roll and minimum runway required by 2.5% B-52E, 5% B-52F, and reduce the initial climb rate. See Parts 2 and 3 of applicable Appendix for specific effects on performance.

STARTING ENGINES AND BEFORE TAXIING CHECKLIST (Pilot reads) (Cont)

10. Starter Switches & Light - OFF and out (CP)

11. AIR BLEED SWITCHES — CLOSED (CP)

12. ALTERNATORS — STARTED (IF APPLICABLE), CHECKED (CP)

Pneumatic Driven

a. Notify ground crew observer to stand by to check for cooling air on all alternators. Ground crew observer will report if no cooling air is available when all alternators are started.

CAUTION

- An alternator which does not have cooling air within 5 minutes must be shut down. An alternator may be restarted within 5 minutes of takeoff without ground cooling air.
- If an alternator shows no voltage or frequency indication, it must be presumed that the drive has tripped off during starting. If this occurs or if drive is known to have tripped, do not attempt to restart drive until the overspeed latch arm on the drive has been inspected.

b. Start all four alternators by momentarily holding each alternator switch in ON. Starting sequence: right aft, right forward, left forward, left aft.

c. Using the voltage and frequency selector switch, check operation of each alternator; voltage should read 205 (±5) volts. Adjust by means of voltage rheostats if necessary. Frequency should be 395 to 405.

Engine Driven

a. Using the voltage and frequency selector, check voltages at 205 (±5) volts and frequencies at 400 (±5) cps. Adjust voltages with voltage rheostat if necessary and, on airplanes **Less ND**, the frequency with the frequency rheostat. On airplanes **ND**, there are no means of adjusting frequency. A voltage oscillation of ±2 volts and a frequency oscillation of ±2 cps is allowable after a 5-minute warmup.

13. A-C POWER — CHECKED, ALTERNATORS ON THE LINE (CP)

NOTE

On aircraft equipped with ARC-34A command radio, when switching from ground power to aircraft power, the command radio off-main-both-ADF switch may have to be turned OFF than back to MAIN or BOTH to obtain proper system operation. This procedure is necessary since the master voltage oscillator circuit in the power supply may be unable to recover itself and start oscillation after momentary interruption of power.

Pneumatic Driven

a. Position voltage and frequency selector switch to RH AFT ALT.

b. Position right aft alternator circuit breaker switch to CLOSE.

STARTING ENGINES AND BEFORE TAXIING CHECKLIST (Pilot reads) (Cont)

c. Position voltage and frequency selector switch to RH FWD ALT.

d. Push automatic paralleling switch; hold until alternator circuit breaker open light goes out. If alternator circuit breaker open light does not go out, adjust the frequency of the right forward alternator until the synchronizing light blinks very slowly, then push automatic paralleling switch again.

e. Adjust and parallel the remaining two alternators (left forward and left aft) in the same manner. Check all alternator and bus tie circuit breaker lights out.

f. Check the load division. Maximum allowable difference in real load between any two alternators is 9 kwatts after the units are stabilized. Stabilization period is approximately 15 minutes. Adjust, using frequency rheostat controls.

g. The reactive load should be so adjusted that the difference between any two alternators is no greater than 4 kvars. The reactive load division is adjusted by use of the voltage rheostats.

NOTE

Constant fine adjustment of kwatt and kvar load division is not required.

Engine Driven

a. Position voltage and frequency selector switch to ENG NO. 7 ALT.

b. Position engine No. 7 alternator circuit breaker switch to CLOSE.

CAUTION

Parallel the remaining alternators without delay after the first one is on the line. Although the first alternator will be providing power for all operating equipment, its ground cooling air is sufficient only if it is generating no more than 50% (about 18 kwatts) of its rated power.

c. Position voltage and frequency selector switch to ENG NO. 5 ALT.

Less ND

d. Push automatic paralleling switch; hold until the engine No. 5 alternator circuit breaker open light goes out. If light does not go out, adjust the frequency of the alternator until the synchronizing lights blink very slowly, then push automatic paralleling switch again.

ND

d. Push automatic paralleling switch; hold until engine No. 5 alternator circuit breaker open light goes out. If light does not go out, advance the respective engine throttle until the synchronizing lights blink very slowly. Push automatic paralleling switch again. Retard throttle to the desired position.

e. Adjust and parallel the remaining two alternators in the same manner. Check all alternator and bus tie breaker lights out.

f. Check the load division. Maximum allowable difference in real load between any two alternators is 6 kwatts. Adjust, using frequency rheostat controls on airplanes **Less ND**. On airplanes **ND**, there are no means to adjust frequency.

STARTING ENGINES AND BEFORE TAXIING CHECKLIST (Pilot reads) (Cont)

g. The reactive load should be so adjusted that the difference between any two alternators is not greater than 4 kvars. The reactive load division is adjusted by use of the voltage rheostats.

NOTE

- Constant fine adjustment of kwatt and kvar load division is not required.
- A variable amount of kwatt and kvar load oscillation may be present immediately after paralleling. These oscillations should however be within ±3 units after a 5-minute warmup period.

14. HYDRAULIC PACKS — ON, PRESSURES CHECKED (P)

Hydraulic Packs 1, 2, 3 & 4 - ON

Hydraulic Packs 5, 6, 7, 8, 9 & 10 - ST until hydraulic pressure low warning light is out (or 6 seconds, whichever is shorter), then ON, pressures checked (P)

This should be accomplished while copilot is paralleling alternators. Pilot checks each pack for pressure buildup (3000 (±250) psi), pressure low warning lights out, and sets selector to No. 2 pack.

CAUTION

Any pack which does not produce a system pressure increase that can be positively identified as a pressure increase above system pressure existing prior to pack startup shall be rechecked in the following manner to verify operation. With the pilot's hydraulic pressure indicator selector switch positioned on the system to be checked, open the respective standby pump circuit breaker. Partially depressurize system being checked by actuating, as required, the applicable controls which are supplied hydraulic power by the system being checked. Pressure shall drop temporarily but should rapidly build back up and stabilize at 3000 (±250) psi. Close standby pump circuit breaker. Repeat the above procedures for other systems as required.

WARNING

If it is necessary to actuate spoilers and airbrakes, clear personnel from spoiler area prior to actuation.

15. GROUND, REMOVE WHEEL CHOCKS & CLEAR AIRCRAFT FOR TAXI — ROGER (GC)

Ground crew will disconnect and remove all ground support equipment and stand by on interphone.

16. AIR CONDITIONING MASTER SWITCH — 7.45 PSI; NOTIFY RN (CP)

Notify radar navigator that alternators are on the line and cooling air is available. If subsequent reentry to the forward cabin is required, cabin pressure must be relieved by opening one of the pilot's sliding windows prior to opening the entrance hatch.

STARTING ENGINES AND BEFORE TAXIING CHECKLIST (Pilot reads)(Cont)

17. CREW EQUIPMENT — ON AND ADJUSTED (P-CP)

WARNING

Tighten the parachute-survival kit attachment straps as tightly as possible to prevent the safety belt from inflicting facial injuries during a manual bailout or delaying escape during crash landing or ditching.

NOTE

When equipped with a modified B-5 parachute, if it becomes necessary to leave the seat during flight, the crew member should open the safety belt and unbuckle the parachute harness leaving the parachute and survival kit in the seat. If the parachute is worn when leaving the seat, upon returning to the seat, it will be necessary to take it off in order to reinstall the parachute and safety belt in the seat.

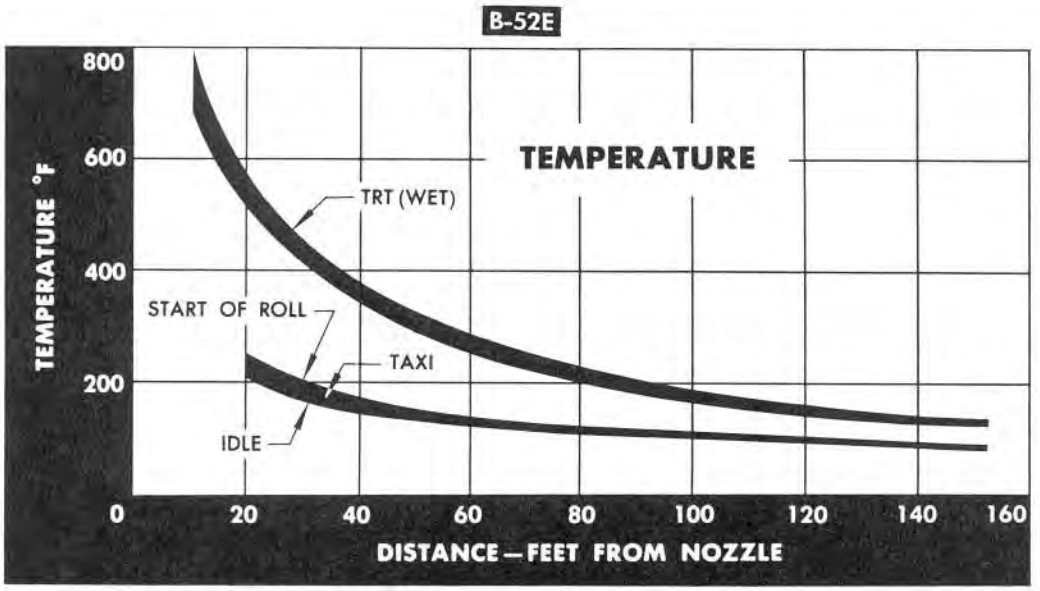
18. Ground, Disconnect Interphone - Roger (GC)

19. TAXI ON CREW CHIEF'S SIGNAL (P-G)

Pilot announces, "Crew, stand by to taxi." Gunner reports "Gunner ready to taxi."

CAUTION

The airplane may be taxied over the ground power units. It is imperative that carts be properly positioned to avoid contact with airplane when taxiing out. Wing flaps must be up. Pilot taxies airplane straight ahead until ground crew signals that he is clear of the power units. As soon as the airplane starts rolling, throttles will be retarded to minimum power required for taxiing to avoid upsetting the power carts by jet blast. Airplane must be positioned so that no airplane will have to taxi over the power carts of another airplane.



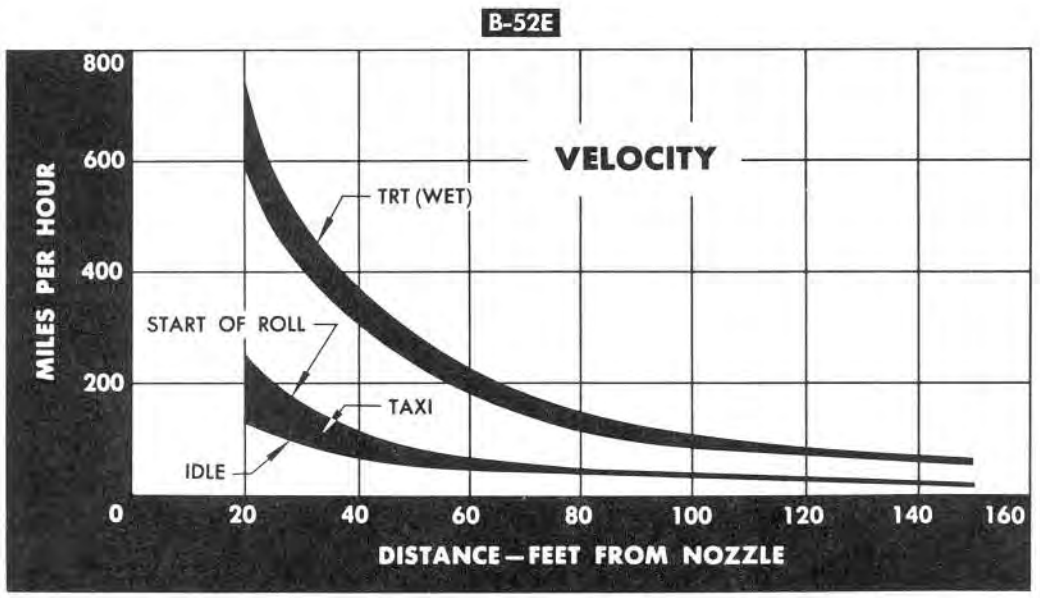
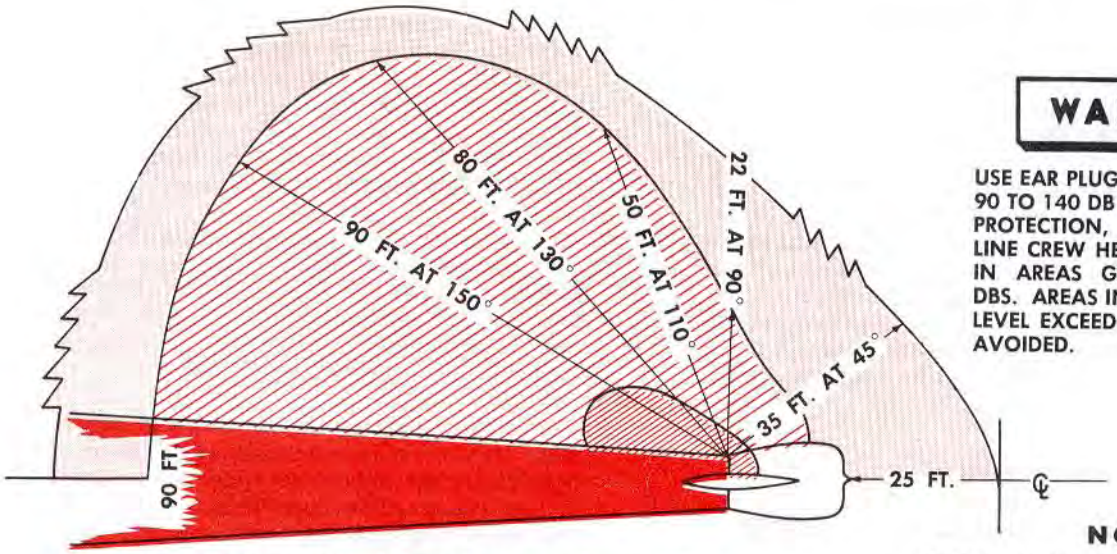


Figure 2-4. (Sheet 1 of 2).



ESTIMATED SOUND PRESSURE LEVELS AT TAKEOFF POWER (WET) FOR TWO ENGINE OPERATION WITH SONIC SUPPRESSORS INSTALLED.

ONE ENGINE OPERATION WILL REDUCE THE NOISE LEVEL APPROX 3 DB

WITH EXCEPTION OF THE 25 FOOT LIMIT FORWARD OF THE ENGINES, THE DISTANCE FIGURES SHOWN WILL INCREASE APPROXIMATELY 10% WITHOUT SONIC SUPPRESSORS INSTALLED.

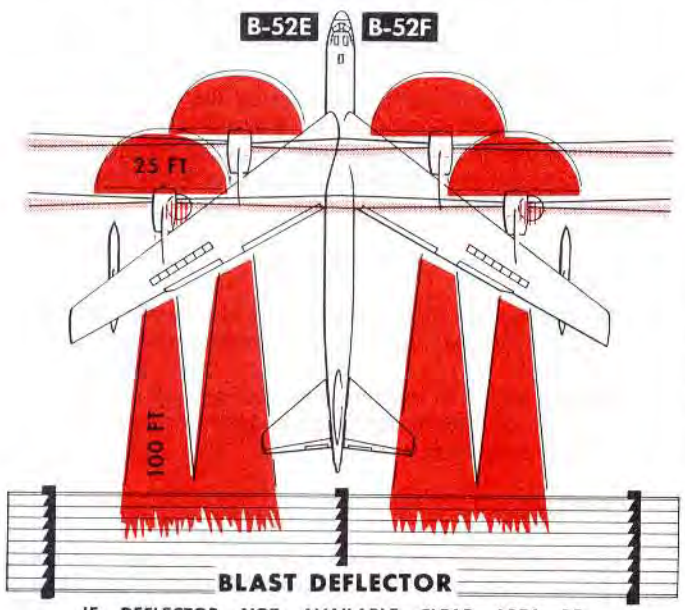
WARNING

USE EAR PLUGS OR MUFFS WITHIN 90 TO 140 DB AREA. ADDITIONAL PROTECTION, SUCH AS FLIGHT LINE CREW HELMETS, IS REQUIRED IN AREAS GREATER THAN 140 DBS. AREAS IN WHICH THE NOISE LEVEL EXCEEDS 170 DBS MUST BE AVOIDED.

NOTE

- FOR AGM-28 ENGINE DANGER AREAS, REFER TO T.O. 1B-52C-30-1.
- B-52F TO PREVENT DAMAGE TO ASPHALT TAXIWAYS OR PARKING AREAS, PERFORM ENGINE RUN-UP ON CONCRETE RAMP WHEN SONIC SUPPRESSORS ARE INSTALLED.

B-52E B-52F



IF DEFLECTOR NOT AVAILABLE CLEAR AREA BEHIND AIRPLANE FOR A DISTANCE OF 200 FEET.

NOISE DECIBEL LEVEL B-52F

- 165 TO 170 DB POSSIBLE
- 140 DB DANGER AREA
- 130 DB AREA

BLAST EFFECT B-52F

SINGLE ENGINE WITH SONIC SUPPRESSORS

FIGURES REPRESENTING EGT °F AND VELOCITY IN KNOTS WILL INCREASE APPROXIMATELY ⅓ WITHOUT SONIC SUPPRESSORS INSTALLED.

℄ JET DISTANCE IN FEET	TAXI POWER (IDLE)		MILITARY PWR (DRY)		MAXIMUM PWR (WET)	
	EGT °F	VEL KNOTS	EGT °F	VEL KNOTS	EGT °F	VEL KNOTS
25	150	75	250	350	270	390
50	100	30	150	155	170	165
75	–	–	120	90	130	100
100	–	–	100	40	110	65
125	–	–	–	–	–	–

WARNING

- DURING CARTRIDGE STARTS, THE ENGINE CARTRIDGE STARTER EXHAUST IS 850° F. THEREFORE, REMAIN CLEAR OF A 4-FOOT RADIUS AREA AROUND THE CARTRIDGE STARTER EXHAUST DIRECTLY BELOW NACELLES OF ENGINES 2 AND 8.
- A STARTER TURBINE DISINTEGRATION AREA EXISTS TO THE SIDE OF THE STARTER TURBINE AREA.

- CARTRIDGE STARTER EXHAUST DANGER AREA
- EXHAUST BLAST (AND INLET DANGER) AREA
- STARTER TURBINE DISINTEGRATION AREA

engine danger areas

Figure 2-4 (Sheet 2 of 2).

ENGINE GROUND OPERATION

Except for ambient temperatures of -30° C (-22° F) and below, no warmup period is required for the engines. Normally, as soon as the engines stabilize at idle rpm, the throttles can be advanced to maximum allowable. After starting however, the engines (with the exception of engines which are advanced for starting the remaining engines) should be allowed to run at idling speed until readings have stabilized and ground check has been completed. Rapid movement of the throttles should be avoided at all times to prevent exceeding allowable exhaust gas temperatures. A minimum of 2 seconds should be used for transition from IDLE to maximum allowable.

CAUTION

B-52F

When engine cowlings are installed and latched, ground operation of engines at 90% rpm or higher is limited to a maximum of 5 minutes. If operation at 90% rpm or higher reaches the time limit of 5 minutes, a cooling period of 20 minutes at idle power is required before again advancing rpm to 90% or higher.

TAXIING

PILOT

The pilot will release his brakes upon receiving "Clear to taxi" signal from the crew chief. When the airplane starts to roll, a check of brakes should be made. To steer the airplane, use rudder pedals. Differential braking is not possible and thrust from the outboard engines is ineffective for turning unless used in conjunction with normal steering. Use the largest radius of turn possible and never attempt to steer when the airplane is not rolling. For minimum turning radius, see figure 2-5. To avoid severe landing gear oscillations during low speed braking and to obtain acceptable brake and tire life and adequate brake performance, especially with regard to potential refused takeoffs, observe the limitations outlined under "Ground Operation Limitations," Section V.

CAUTION

- To prevent structural damage when making a turn with full rudder travel, maximum ground turning speeds should be 5 knots with ratio selector lever in TAXI or 27 knots with ratio selector lever in TAKEOFF LAND position.
- To prevent structural damage during high speed taxi runs, place the steering ratio selector lever in TAKEOFF LAND. Steering in TAXI during high speed taxi runs produces excessive steering when small amounts of rudder pedal displacement are induced which can produce critical side loads on airplane structure.
- During taxiing, both tip gears should be on or over maintained surfaces. Structural damage to the tip gear can be sustained while taxiing if the tip gear is permitted to run on rough terrain, particularly if the tip gear is heavily loaded.
- One or both tip protection gear wheels may remain in the trail-forward position (strut inboard) after having been reversed during a sharp turn or rearward towing. This is particularly true when wing and drop tanks are full. For a reversed right tip gear, introduce 20° nose left crosswind crab at a rate of approximately 2.5° per foot while moving forward at 2 or 3 knots until the gear casters. A minimum distance of 20 feet forward and 5 feet to the side is required for this procedure. If the gear does not caster, apply right steering, with the steering ratio selector in TAXI position, until the gear casters. Realign the airplane with the runway by reverse steering. If necessary, use reverse crosswind crab to recenter the airplane on the runway. For a reversed left tip gear, the above procedure should be followed using the opposite directions to those stated. If space does not permit use of this procedure, stop the airplane and have the gear turned manually with the use of a turning bar.

NOTE

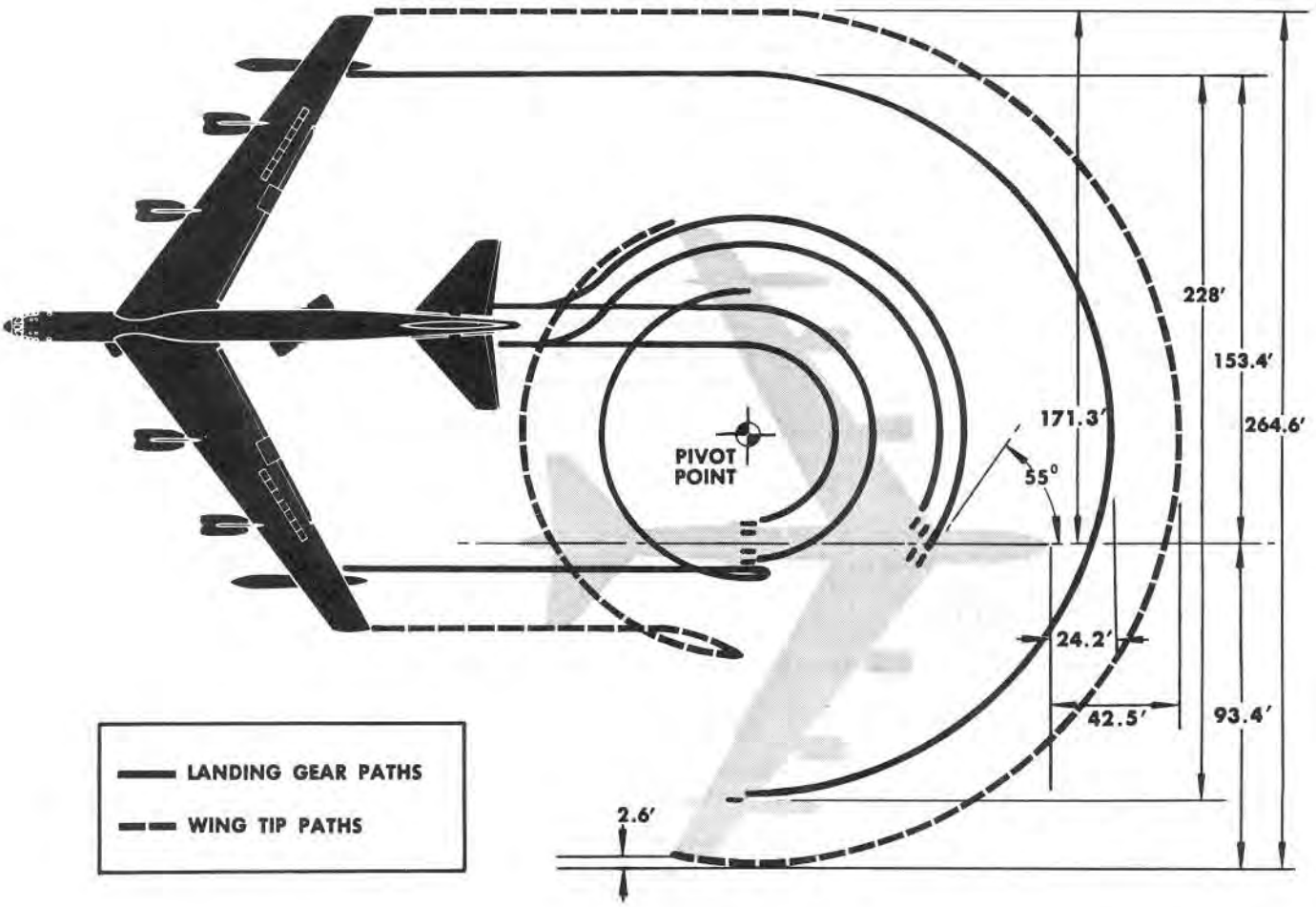
- The taxiing checklist should not be performed while taxiing through a congested area.
- The high fuel consumption during taxiing makes it necessary to hold engine speed and taxi time to a minimum.

COPILOT

The copilot will monitor the tower and assist in maintaining a clearance of all obstacles during taxiing.

B-52E

The copilot will monitor air pressure and overload lights to assure sufficient pneumatic air to maintain normal alternator operation. If adequate manifold air pressure is not maintained, the alternator will decrease in frequency and, upon advancing throttles, the turbine controls may not react fast enough to prevent the alternator from shutting down from an overspeed condition.



MINIMUM GROUND CLEARANCE	
WING TIP (FULL DROP TANKS)	3.8'
WING TIP (NO DROP TANKS)	5.5'
DROP TANK (FULL)	1.8'
OUTBOARD NACELLE	3.7'
INBOARD NACELLE	5.8'
FUSELAGE BOTTOM	4.3'
GAM-77 MISSILE	2.2'

.....turning radius and ground clearance

Figure 2-5.

TAXIING CHECKLIST (Copilot/EW reads)

NOTE

Only the **boldface** items need be accomplished for Scramble. All items will be reviewed during climb or as soon as practicable.

1. RADIO CHECKS — COMPLETED BEFORE TAKEOFF (P-CP)

2. BRAKES — CHECKED (P)

Check wheel brakes for proper operation as soon as possible after airplane starts to move. Pilot monitors hydraulic pack pressure low master light while taxiing. Hydraulic pressure fluctuations due to loss of fluid or other malfunctions may be observed on the pressure gages.

CAUTION

- Maintain manifold pressure above 15 psi while making sharp turns. Power should then be adjusted for normal taxi operations to prevent excessive use of brakes.
- Do not attempt to use either steering or crosswind crab when aircraft is not rolling as severe loads would be applied to tires and landing gear.

3. FLAP LEVER — DN (CP)

Copilot lowers flaps after taxiing to insure clearance from ground equipment.

4. BOMB DOORS — CLOSED (P)

Pilot will place the bomb door switch to OPEN to insure that both latches are unlatched, check that the not latched light is on, and then place the switch to CLOSED.

CAUTION

Copilot monitors manifold air pressure and verifies that manifold pressure is 30 psi minimum just prior to bomb door closing operation in order to maintain sufficient hydraulic pack output to prevent damage to bomb doors.

5. Radar Altimeter SQ - ON (P)

6. FLIGHT INSTRUMENTS — CHECKED (P-CP)

Check needle for turn indication and ball for freedom of movement; attitude indicator erected and flag out of sight; N-1 compass for movement in turns; and all pitot-static pressure instruments for correct indications.

7. A-C & D-C Power - Checked (CP)

Copilot monitors alternator loads (kvars and kwatts), system frequency, and voltage while taxiing.

NOTE

- Constant fine adjustment of kwatt and kvar load division is not required. B-52E
- In the event the alternator overload lights illuminate, throttles No. 4 or 5 will be advanced to supply more air bleed pressure for alternator operation.

8. Crosswind Crab - Checked and down (P/CP)

If time permits, check operation of the crosswind crab to insure positive response in both directions. Manually turn the crosswind crab knob in each direction, recentering the crosswind crab control with the centering button in each instance. Check both indicator needles for correct indication.

BEFORE TAKEOFF

BEFORE LINEUP CHECKLIST (Copilot/EW reads)

NOTE

Only the **boldface** items need be accomplished for Scramble. All items will be reviewed during climb or as soon as practicable.

1. Parking Brakes - Set (P)

2. **TAKEOFF DATA — REVIEWED (P-CP-N)**

   Review time, S_1 and S_2 speeds, and EPR.

3. **STANDBY PUMPS — ON (P)**

4. **ANTICOLLISION & NAVIGATION LIGHTS — ON AND STEADY (P)**

5. Control Surface Trim - Set (P-CP)

   Pilot and copilot check aileron and rudder trim for takeoff setting.

6. **STABILIZER TRIM — CHECKED FOR TAKEOFF SETTING (P-CP)**

WARNING

To preclude the possibility of inadvertent actuation of the stabilizer trim switch, the pilot should rest his thumb between the horizontal spur and the upright position of the control wheel grip during all normal operations. Special care should be taken during takeoff, landing, and air refueling operations. In addition, the copilot monitors the stabilizer trim indicator during the takeoff roll.

NOTE

During flight, the stabilizer trim switch should be operated in short intermittent bursts to aid in recognizing a malfunctioning electrical trim system before reaching an extreme out-of-trim condition.

7. **CONTROL COLUMNS — CONNECTED (P-CP)**

   Copilot holds column rigid near neutral while pilot applies push force and pull force on his column to confirm columns connected.

8. Airbrake Lever - OFF (P)

9. **WING FLAPS — 100%, LEVER DN (P-CP)**

   Pilot and copilot check wing flap indicators full down, wing flap lever in DN.

10. **FUEL SWITCHES 9, 12, 13, 14, 15 & 16 — ON, INITIAL TRANSFER STARTED (CP)**

    This sets the fuel system controls for takeoff.

WARNING

Crossfeed valve switches No. 9 and 12 must be ON to provide an alternate source of fuel to nacelle during takeoff.

BEFORE LINEUP CHECKLIST (Copilot/EW reads) (Cont)

NOTE

- During takeoff-climb, with crossfeed valves 9 and 12 OPEN, a temporary lateral unbalanced fuel condition can occur in the main tanks because of differential pressure output of the fuel boost pumps in the individual mains. This condition will be corrected when crossfeed valves 9 and 12 are CLOSED and normal transfer from the auxiliary tanks to main tanks is begun.

- Monitor main tank fuel gages frequently during fuel transfer so that overfilling due to transfer valves failing in the open position may be prevented.

11. WINDOWS & HATCHES — CLOSED AND LOCKED (P-CP)

12. ARMREST SAFETY PINS — REMOVED (P-CP)

13. Gyros & Compass - Checked and set (P-CP-N)

Pilot and copilot set directional indicators with runway heading at top of dial. Pilot checks with navigator for N-1 compass reading. Pilot and copilot set attitude indicators to indicate level flight. Cross-check N-1 compass against magnetic compass.

14. Terrain Avoidance System Check - Completed (P-CP)

a. Terrain Display Mode Selector Switch - PLAN (P)

b. Full Sweep - Checked (P-CP)

c. Failure Warning Cursor - Present (P-CP)

d. 10-Mile Range Gate Indicator Lights - Illuminated (P-CP)

e. Stabilization Reference Selector Switch - HOR (P)

f. Terrain Display Indicator Intensity - Adjusted as desired (P)

g. Terrain Display Indicator Persistence - Adjusted for proper fade (P-CP)

Adjust persistence so that the picture is just beginning to fade as the sweep starts back.

h. Video Display - Centered (P-CP)

Pilot and copilot observe that video can be obtained on the terrain display indicators and the display is within 1/16 inch of being centered.

i. Failure Warning Cursor Movement - Checked (raise and lower clearance plane) (P-CP)

Pilot and copilot observe movement of failure warning cursor while pilot changes selection of clearance plane elevation. As the clearance plane is raised, the failure warning cursor moves progressively toward shorter ranges. When the clearance plane is lowered, the failure warning cursor will move out in range.

j. Set Clearance Plane At -2320 (±130) Feet - Check failure warning cursor at 3-mile range (P-CP)

k. Set Clearance Plane At -3000 Feet - Check failure warning cursor at approximately 4- to 5-mile range (P-CP)

l. Stabilization Reference Selector Switch - FRL (P)

m. Selected Target - Faded (indicators agree within 50 feet) (P-CP)

Fade a selected ground target by raising the clearance plane. Verify that the fadeout point (clearance plane setting where the terrain video disappears) of a specific target on the pilot's and copilot's terrain display indicators agree within 50 feet.

BEFORE LINEUP CHECKLIST (Copilot/EW reads) (Cont)

n. Stabilization Reference Selector Switch - HOR (P)

o. Selected Target - Reappearance checked (P-CP)

Note that the target previously faded on FRL mode reappears after switching to horizontal mode.

NOTE

TP TX

The TA warning light should not illuminate for clearance plane settings between -300 to -3000 feet during these checks.

p. Clearance Plane - Set (P-CP)

Pilot sets the clearance plane as desired for the flight.

q. Terrain Display Mode Selector Switch TP TX - PROFILE CAL (P-CP)

r. Horizontal Reference Line TP TX: (P-CP)

(1) Sharp Definition - Checked

(2) Centered (±1/32 inch) - Checked

(3) Full Coverage - Checked

(4) Horizontal (±2°) - Checked

Check for the presence of a sharply defined and centered (±1/32 inch) horizontal reference line providing full coverage of the terrain display indicator viewing area. The horizontal reference line shall be horizontal (±2°).

s. Profile Calibration Cursor TP TX - Coincides (±1/4 inch) with profile calibration etch mark (P-CP)

t. Terrain Display Mode Selector Switch TP TX - PROFILE 3 (P)

(1) 3-Mile Range Gate Indicator Lights - Illuminated (P-CP)

(2) Horizontal Reference Line - Present (P-CP)

(3) Profile Calibration Cursor - Disappears (P-CP)

Observe that the 3-mile range gate indicator light illuminates, the horizontal reference line remains, and the profile calibration cursor disappears.

(4) Automatic Clearance Plane Setting - Checked (P-CP)

A preset clearance plane setting (set according to mission requirement) is automatically selected and indicated on the pilots' clearance plane position indicators.

(5) Terrain Trace - Present (P-CP)

A terrain trace shall be present on the terrain display indicators.

(6) TA Warning Push-To-Test Button - Pressed (P-CP)

(a) Horizontal Reference Line - Disappears

(b) TA Warning Light - Illuminates

NOTE

TP TX

During the profile mode checks, the TA warning light should not illuminate except when the TA warning push-to-test button is pressed.

BEFORE LINEUP CHECKLIST (Copilot/EW reads) (Cont)

u. Terrain Display Mode Selector Switch TP TX - PROFILE 6 (P)

(Repeat check as shown for PROFILE 3 except the 6-mile range gate indicator lights will illuminate.)

v. Terrain Display Mode Selector Switch TP TX - PROFILE 10 (P)

(Repeat check as shown for PROFILE 3 except the 10-mile range gate indicator lights will illuminate.)

w. Terrain Display Mode Selector Switch - OFF (notify RN) (P)

15. Navigation System Select Switch - As desired (P)

16. Crew, Stand by for Takeoff (CP-G)

Gunner will make appropriate checks and respond over the interphone. Any crew member noting discrepancies which may compromise the successful completion of the mission will so advise the pilot at this time.

17. **SIF/IFF (IF APPLICABLE) — NORM (MODE AND CODE AS BRIEFED) (P-N)**

Pilot notifies navigator to set IFF as briefed.

18. **STARTER SELECTOR — FLIGHT START (CP)**

19. **WATER INJECTION PUMP SWITCHES B-52E — ON (IF APPLICABLE), LIGHTS CHECKED (P)**

TAKEOFF

Close attention must be given to the recommended procedures in order to obtain the best takeoff performance. The normal takeoff technique is that which will be required to produce the results stated in the takeoff charts in the applicable Appendix. These procedures have been selected as being the most desirable from the consideration of safety and the attainment of minimum practical takeoff distance. For brake energy limits, see figure 5-7A.

CAUTION

- If it is absolutely necessary to fly the airplane immediately following a heavily braked landing or refused takeoff, a check of the brake energy limit chart (figure 5-7A) should be made prior to takeoff.
- If a tire failure is suspected on takeoff before decision speed is reached, the takeoff should be discontinued. This is to preclude the possibility of landing gear failure caused by takeoff with a partially disintegrated tire.

TAKEOFF PERFORMANCE

Performance Data

All takeoff performance data should be determined prior to takeoff. This assures accurate planning and close monitoring of all takeoffs. The data includes such items as takeoff gross weight, runway OAT, field length and altitude, wind direction and velocity, airplane cg, and the runway gradient. From such items, it may be determined whether water injection is needed, what the stabilizer setting is, what the crosswind crab setting is, and what the takeoff distance will be. A change in any one of these items will have a large effect on takeoff performance as shown by figure 2-6. Relative humidity, which appreciably affects reciprocating engines, has a negligible effect on turbojet engines. Sufficient charts to accurately determine takeoff performance are included in Parts 2 and 3 of the applicable Appendix.

S_1 S_2 Acceleration Monitor System

The S_1S_2 acceleration monitor system is based on a timed acceleration check between two indicated airspeeds which can be compared against a precomputed acceleration rate taken from charted values prior to takeoff. Use of this system virtually eliminates wind error, airspeed indicator calibration error is minimized, and no reference point outside of the airplane is necessary. The S_1S_2 system checks acceleration only after takeoff power is set which increases accuracy during rolling takeoffs. Excellent crew coordination is essential when using the S_1S_2 acceleration check. When the computed takeoff distance is 4000 feet or less, the S_1S_2 takeoff procedure will not be used. In lieu of timing acceleration, a check of all engine instruments will be made when 70 knots is reached during takeoff roll. At this point, the decision will be made to continue or abort the takeoff.

INITIAL TIMING SPEED. Initial timing speed is the speed (70 knots IAS) at which timing is started to determine acceleration characteristics of the airplane.

S_1. S_1' is the computed decision speed (S_1 speed) which must be reached at the termination of the acceleration check time (S_1 time).

S_2. S_2 is the takeoff indicated airspeed (unstick speed).

Takeoff Planning

Adequate takeoff planning must always include the possibility of poor acceleration during the takeoff run. Although many factors may cause poor acceleration, the most probable cause is engine failure. If such a failure occurs, it must be possible either to stop in the runway distance remaining or to continue the takeoff safely on seven engines. The decision whether or not a stop can be made in the remaining runway must be made immediately and with the aid of predetermined criteria. This information is shown graphically in Part 2 of the applicable Appendix. The minimum runway required is the runway length required to accelerate to S_1, experience an engine failure, and take off with seven engines. Minimum runway required charts in Parts 2 and 3 of the applicable Appendix are used to determine the maximum gross weight for a specific runway length. It should be pointed out, however, that climbout performance must be considered when determining the maximum gross weight for operation off a given runway. This is necessary because it is possible under certain runway pressure altitude and temperature conditions to load the airplane so that, although the takeoff could be accomplished, very poor and sometimes unsafe climbout performance exists. This is discussed more fully under "After Takeoff," this section. To determine the maximum takeoff weight, enter the appropriate minimum runway required chart with the runway length available and arrive at a weight as determined by the existing field pressure altitude and temperature. Check the climbout performance for this weight, temperature, and field pressure altitude by referring to the charts in Part 4 of the applicable Appendix, keeping in mind terrain clearance and flap retraction problems. Once this weight has been determined, the only other information required is that which will enable the pilot to properly monitor the takeoff; namely, the minimum EPR settings, the decision speed and time, and the takeoff speed (S_2).

FOR SEA LEVEL AND GROSS WT. OF 380,000 POUNDS

AN INCREASE OF	Changes Takeoff Distance Approx.			
	WITH WATER-FT		NO WATER-FT	
	B-52E	B-52F	B-52E	B-52F
1000 FEET IN ALTITUDE AT 100°F	+600	+450	+1050	+900
1000 POUNDS IN WEIGHT AT 100° F, J57-P-43WA ENGINES	+60	+50	+70	+100
1000 POUNDS IN WEIGHT AT 100° F, J57-P-43WB ENGINES		+30		+60
10°F ON 100°F OAT	+400	+270	+900	+750
10 KNOTS WIND	−950	−700	−1250	−930

factors affecting takeoff distance

Figure 2-6.

Engine Thrust

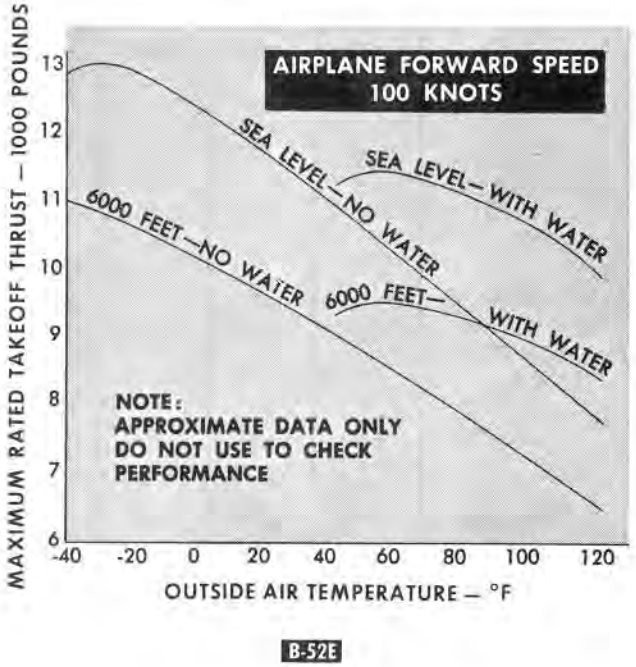
The characteristics of a turbojet engine are such that the engine thrust for takeoff decreases considerably with increases in outside air temperature and field elevation. To alleviate this condition, a water injection system has been added to each engine so that reasonable takeoff performance is retained at high OAT's and high field elevation. J57-P-43WB **B-52F** engines are trimmed per flat rated engine trim procedures which allow the "wet" takeoff thrust rating to be developed through a range of OAT conditions from 40° to 100° F by manipulation of the throttles according to the required EPR indication. Typical **B-52E** and **B-52F** engine thrust values with changes in temperature and altitude for a takeoff with forward speed of 100 knots are shown in figure 2-7 (approximate values only).

CAUTION

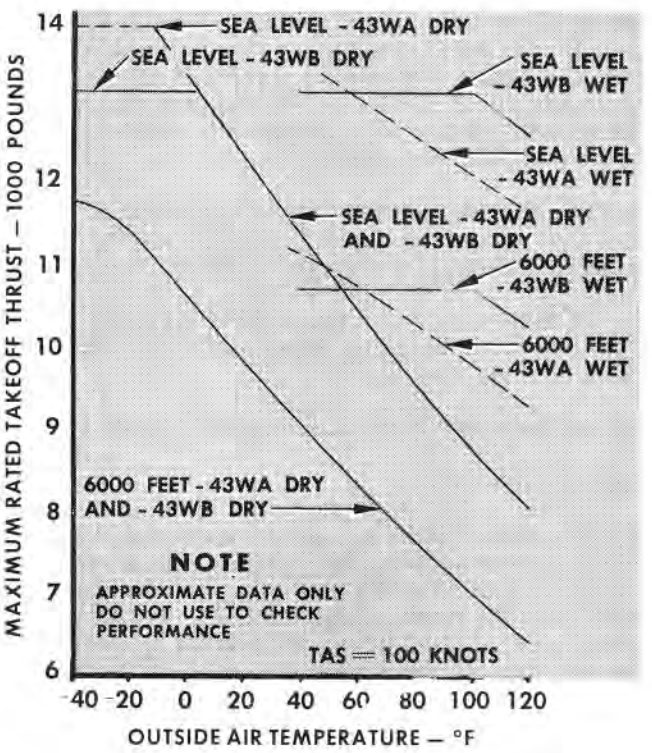
- The scaling effect of water with various impurities tends to decrease engine efficiency; therefore, use of water injection should not be indiscriminate but rather should be reserved for heavy weight, high temperature takeoffs when it is actually needed as a safety factor, and for periodic functional checks of the system.
- Water injection should not be used at pressure altitudes greater than 8000 feet. Use of water injection above this altitude will result in harmful overspeed of the low speed compressor.
- Due to venturi effect at the engine inlets, engine icing may be expected during a water injection takeoff when the runway temperature is approximately 40° F and the temperature of the water in the water injection tanks is 40° F or less. The engine and nacelle anti-icing system will not prevent icing which will occur under this combination of air and water temperatures. Prior to any planned water injection takeoff with runway temperatures forecast to be approximately 40° F, the airplane should be serviced with water warm enough to remain above 40° F at takeoff time.
- Water injection must not be used if the runway OAT is less than those shown under the minimum temperature limit column in figure 2-9.

TAKEOFF PROCEDURES

Correct takeoff procedures may vary under different takeoff conditions. There are, however, some procedures which are standard for every takeoff. These procedures, which are discussed in "All Takeoffs,"



B-52E



B-52F

engine takeoff thrust

Figure 2-7.

should always be adhered to. For the takeoff calculations and a summary of the takeoff procedures, see Parts 2 and 3 of the applicable Appendix. See figure 2-8 for a diagram of the typical takeoff and initial climb operations. This diagram serves to illustrate where various actions outlined in the checklist are taken.

All Takeoffs

Takeoff rated thrust (TRT) or military rated thrust (MRT) will be used for all takeoffs except touch-and-go. The correct stabilizer trim setting will be used for all takeoffs. The wing flaps will be set for 100% down and intermediate settings will never be used.

ROLLING TAKEOFF. In order to minimize the fatigue damage effects to the wing structure, all takeoffs will normally be made from a rolling start. In those situations when safety may be compromised by performing a rolling takeoff or when runway conditions dictate, takeoff may be made from a braked condition; however, maximum thrust operation with brakes locked will be kept to a minimum. When making a rolling takeoff, the airplane will be aligned with the runway at normal taxi speeds using the radius guide lines.

CAUTION

The maximum turn-on speed for a 140- to 150-foot turn radius is 15 knots. This limit is based on airplane strength and must not be exceeded.

Steering ratio selector may be placed in TAKEOFF LAND after completion of the "Before Lineup Checklist" if the runway turn radius permits. Not permitting, it will be placed in TAKEOFF LAND when aligned with the runway. Power will never be advanced to TAKEOFF setting until within 15° of runway heading.

THROTTLES. The throttles will be advanced slowly and evenly to OPEN or the allowable takeoff EPR position. Minimum time for movement from IDLE to OPEN position is 2 seconds. No attempt will be made to steer by throttles as differential thrust is ineffective and reduction of thrust on one side will increase the takeoff ground run.

STABILIZER TRIM. The stabilizer trim setting required for takeoff depends upon the center of gravity location and the airplane weight. The correct stabilizer trim setting may be determined from charts in Parts 2 and 3 of the applicable Appendix.

CAUTION

Failure to set the stabilizer correctly could result in:

1. An accelerated stall if the stabilizer trim is set too high (airplane nose up).
2. Longer than predicted takeoff ground runs if the stabilizer trim is set too low (airplane nose down).

WING FLAPS. The wing flaps are so designed that the highest lift-drag ratio is achieved at the 100% down position. For this reason they are always used in this position. Because wing flap extension time is 40 seconds and intermediate settings are ineffective, the lowering of flaps during the takeoff roll is not recommended.

CONTROL TECHNIQUE. Steering should be accomplished with the rudder pedals throughout the ground run. The steering system will be effective until sufficient speed is established for rudder control. The takeoff will require a pull force on the control column approximately 5 to 10 knots prior to unstick speed. The control column will be pulled back as required to achieve the computed unstick speed. At the appropriate speed, the forward wheels will come off the runway first and the airplane will tend to rotate about the rear wheels. Relaxing back pressure at the time the airplane leaves the ground will stop this pitching action. If, however, the stabilizer trim is set too high (airplane nose up), the control column must be pushed well forward to stop the pitching action. Should rearward control column movement be delayed until just before the takeoff point, the takeoff ground run may be increased as much as 5%. See Parts 2 and 3 of the applicable Appendix for determination of takeoff distances.

Water Injection Takeoff

CAUTION

The water injection pumps switch and the water injection drain valve switch are in close proximity. The conditions of a rolling takeoff make intense demands on the pilot's attention at this time and it is of the utmost importance that the pilot be certain he is not preparing to actuate the water injection drain valve switch rather than the water injection pumps switch.

B-52E

Following alignment with the runway, advance all throttles slowly to OPEN position, noting that the water pressure lights are out. The water injection throttle microswitches will have been actuated just before the throttles reach the full OPEN position, allowing the water shutoff valves to open and permit water to be injected into the engines. The most positive indication that the water injection system is operating correctly will be an increase in the fuel flow and EPR of each engine above that normally attained without water. For duration of the water supply, see figure 2-9. It is desirable to have sufficient water to last during takeoff, landing gear retraction, and acceleration to flaps down initial climb speed. The time required for this will generally be less than 110 seconds if prescribed procedures are employed. To aid in planning a water injection takeoff, ground run time is given on the takeoff ground run charts in Part 2 of the Appendix. At sea level on a standard day with no forward speed, the use of water

NOTE

- THE TAKEOFF SHOWN IS FOR NORMAL CONDITIONS. MODIFICATIONS MAY BE USED TO MEET VARIOUS REQUIREMENTS.
- REFER TO PARTS 2 AND 3 OF THE APPLICABLE APPENDIX FOR COMPLETE DATA ON DETERMINATION OF DECISION TIME AND TAKEOFF SPEEDS.

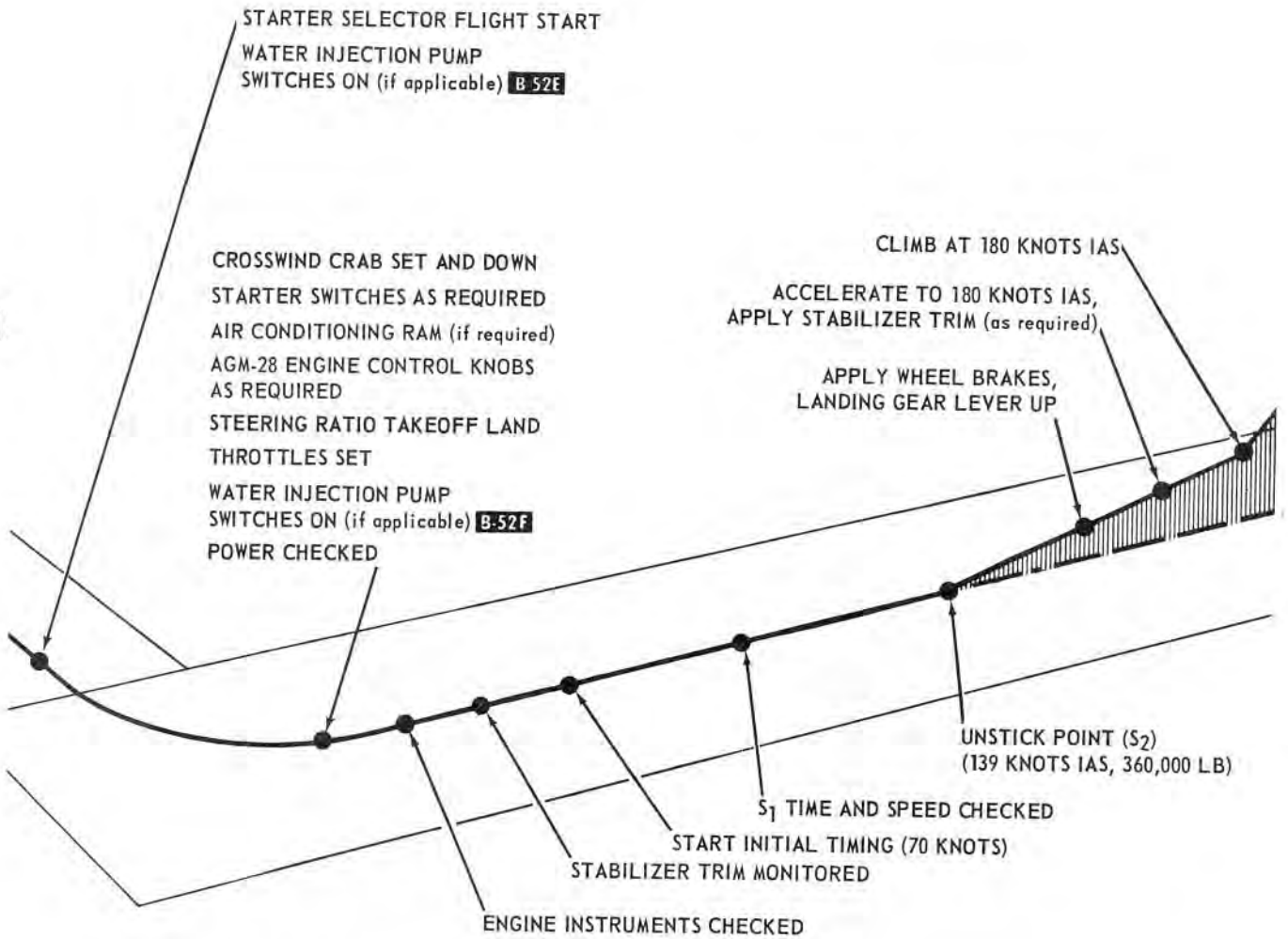
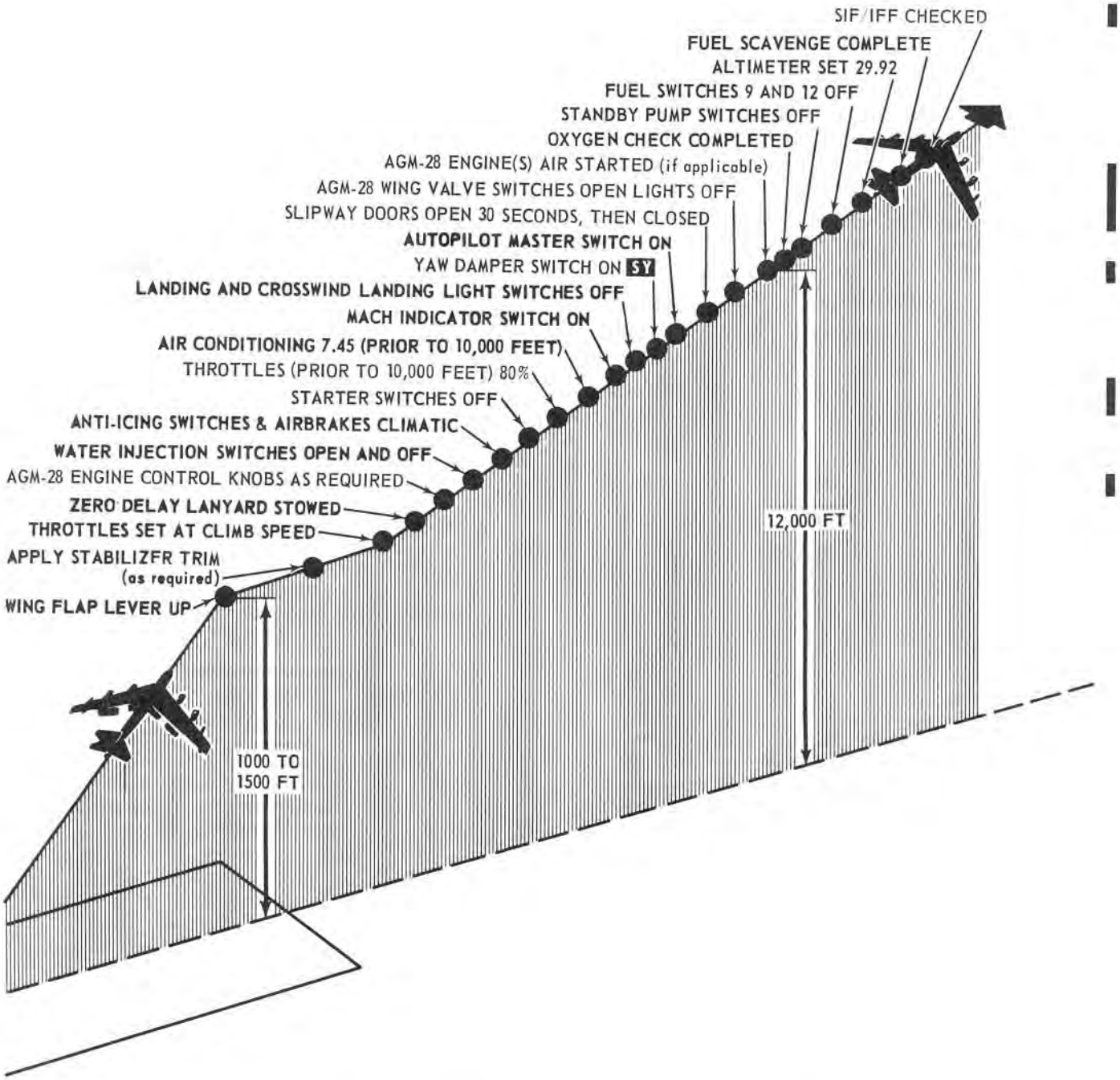


Figure 2-8 (Sheet 1 of 2).



NOTE

AIRSPEEDS BASED ON AN AVERAGE GROSS WEIGHT OF 360,000 LBS

.....takeoff and initial climb diagram (typical)

Figure 2-8 (Sheet 2 of 2).

injection increases fuel flow approximately 1800 pounds per hour per engine. A corresponding increase will also result in the engine pressure ratio but no significant change will occur in rpm. Assuming that a normal takeoff and climbout has been completed, the throttles may be left OPEN for military rated thrust (30-minute limit) or retarded to normal rated thrust (continuous operation), depending on conditions encountered and the climb schedule to be followed. Move the drain valves switch to OPEN position. When water supply is depleted, turn the water injection pump switches OFF. Leave the drain valve switch in OPEN position. For drain rates, see figure 2-9.

B-52F

Following alignment with runway, power will be advanced to the dry EPR setting for wet takeoff, cross-checking the rpm. If a minimum of 91% rpm is not reached on all engines with the dry EPR setting for wet takeoff, appropriate throttles will be advanced to obtain the 91% rpm minimum. As soon as the dry EPR has been set and adjusted, the pilot will position the water injection system switch to ON. Note that the water pressure lights go out and the water pressure indicators read ON. The water injection throttle microswitches will have been actuated as the throttles reach an indicated 86% rpm position, allowing the water shutoff valves to open. The most positive indication that the water injection system is operating correctly will be an increase in the fuel flow and EPR of each engine above that normally attained without water. When water reaches the engines, copilot will adjust the throttles to obtain the desired wet EPR. The desired wet EPR will be approximately 0.02 higher than the EPR values listed in Part 2 of the Appendix and assures takeoff rated thrust in the 50- to 80-knot IAS range where water augmentation will take effect. The duration of the water supply for full tanks is 110 seconds. It is desirable to have sufficient water to last during takeoff, landing gear retraction, and acceleration to flaps down initial climb speed. The time required for this will generally be less than 110 seconds if prescribed procedures are employed. To aid in planning a water injection takeoff, ground run time is given on the takeoff ground run charts in Part 2 of the Appendix. At sea level on a standard day with no forward speed, the use of water injection increases fuel flow approximately 4000 pounds per hour per engine. A corresponding increase will also result in the engine pressure ratio but no significant change will occur in rpm. After takeoff has been accomplished and water depleted, the throttles should be advanced to full open until climb speed and attitude has been established.

Assuming that a normal takeoff and climbout has been completed, the throttles may be left in military rated thrust (30-minute limit) or retarded to normal rated thrust (continuous operation) depending upon conditions encountered and the climb schedule to be followed. Move the drain valve switch to OPEN position and leave it OPEN. For drain rates, see figure 2-9.

NOTE

B-52E and B-52F

In the short time lapse between water runout and system shutdown, engine surges may occur momentarily and will be evidenced by fluctuations of EPR. This condition is due to lack of positive pump supply when water nears depletion and will not adversely affect engine life.

CAUTION

After moving the drain valves switch to OPEN position, do not actuate the switch in flight at or above the freezing level. Operation of a frozen valve may cause valve failure.

AIRPLANE	MIN OAT FOR WATER INJECTION	WATER CAPACITY	DURATION WITH FULL TANKS	DRAINAGE RATE	
				PUMPS ON	PUMPS OFF
B-52E	40° F	300 GAL	110 SEC	4 MIN	25 MIN
B-52F	40° F	1200 GAL	110 SEC	17 MIN	20 MIN

water injection data

Figure 2-9.

PARTIAL WATER TAKEOFF. Water takeoffs may be safely made without water augmentation on all engines; however, the following criteria is established for partial water takeoffs for normal training missions:

1. Water takeoffs will not be planned for an airplane with any known system malfunction, such as an inoperative water pump.
2. Takeoff will not be continued with more than two engines without water augmentation.
3. Minimum runway required with all eight engines dry will not exceed runway available.
4. Subtract 2 knots per engine without augmentation from the decision speed.
5. Engine(s) not receiving water will be advanced to dry takeoff EPR but must be monitored closely for high EGT and/or high rpm and adjusted to wet takeoff EPR immediately should water suddenly be received by the engine(s).

CAUTION

B-52F

It is not recommended that these airplanes take off for operation above freezing level with both engines of one nacelle not receiving water. In such a case, gravity draining would be the only way in which the water tank could be emptied. Since gravity draining requires approximately 20 minutes, operation time above freezing level may be sufficient to result in water system damage.

Light Weight Takeoff

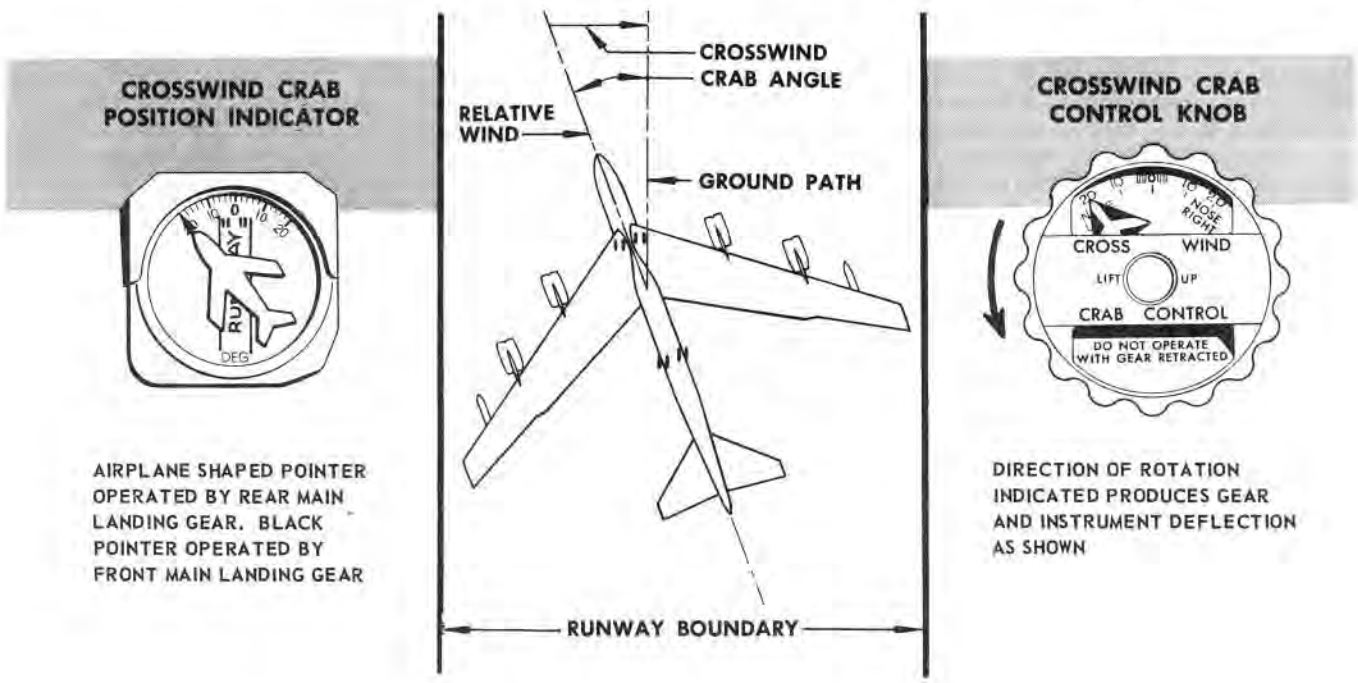
When the computed takeoff distance is 4000 feet or less, the takeoff will be considered a light weight takeoff. When takeoff is made at light weight, the airspeed and rate of climb increase rapidly after unstick. This condition reduces the time during which trim changes can be made. The pilot should control any nose up rotation with forward control column and nose down trim and check for proper movement of the manual trim wheel. After the landing gear is retracted, the thrust should be adjusted during climb to flap retraction altitude to produce a rate of climb of approximately 1500 to 2000 feet per minute.

NOTE

A wet takeoff will not be made at a gross weight of less than 300,000 pounds for the B-52E nor less than 330,000 pounds for the B-52F.

Obstacle Clearance Takeoff

If obstacle clearance is marginal, retract the landing gear as soon as possible after becoming airborne, leave wing flaps fully extended, and climb at 10 knots above



crosswind crab operation

Figure 2-10.

takeoff speed until the obstacle is cleared. The charts in Parts 2 and 3 of the applicable Appendix show the distance required from point of brake release to clear a 50-foot obstacle with seven and eight engines. Since an engine failure may be encountered after S_1, it is recommended that the charts be entered using the seven-engine ground run distance. After the climb from C to F (figure 2-12), allow the airplane to accelerate to 180 knots IAS and continue climb to at least 1000 feet above the terrain before starting flap retraction. See "Obstacle Clearance Climbout," this section, for maximum climb angle discussion.

Crosswind Takeoff

NOTE

- Sustained runway wind velocity plus one-third of the gust factor will be used to compute crosswind crab settings for a takeoff with gusty wind conditions.
- If a crosswind cannot be compensated for by use of the crosswind crab system, a takeoff is not recommended.

Prior to the time of takeoff, the takeoff speed and local field wind velocity and direction should be ascertained and the crosswind crab setting determined for these conditions. If uncorrected tower wind is obtained, it is recommended that 50% of the velocity be used. See Parts 2 and 3 of the applicable Appendix for applicable crosswind takeoff information. Taxi into takeoff position so that the nose of the airplane is pointing into the direction of the wind component. At the same time, turn the crosswind crab control knob in the direction the nose of the airplane is to be crabbed into the wind (figure 2-10). The miniature airplane and pointer located on the crosswind crab indicator should be in alignment at the degree setting corresponding to the degrees of crab angle previously determined for the wind and gross weight. The miniature airplane and pointer should be crabbed across the imaginary runway on the indicator in the same direction that the airplane is crabbed across the runway on the takeoff run.

CONTROL TECHNIQUE. The takeoff procedure used is the same as that for a normal takeoff except that the airplane will be crabbed into the wind, a condition which may seem strange the first few times a pilot uses this crosswind crab technique. Engine thrust may pull the airplane toward the side of the runway from which the wind is blowing before the airplane becomes airborne. This effect is easily overcome by use of the proper amount of rudder pedal steering. If the crosswind is of a large enough magnitude, it may cause the airplane to heel over on the downwind tip gear at low speeds. Such a differential tip gear loading can cause high stresses in the tip gear tire as airspeed increases. An attempt to level the wings with lateral control can be initiated when passing through 60 knots IAS on the takeoff roll, but full control wheel travel may be necessary at this airspeed. A slight increase in the ground roll of not more than 1% can be anticipated because of the drag imposed by the raised spoilers. The lateral control required to maintain a wing-level attitude will diminish as the airspeed increases to the takeoff speed if the crab angle setting being used was determined for correct wind and gross weight. Forward gear steering becomes less effective as the wheels become lightly loaded; however, the rudder control becomes more effective and compensates for decrease in effectiveness of forward gear steering.

LANDING GEAR RETRACTION. After the airplane is airborne and brakes have been applied, retract the landing gear. The crosswind crab control knob and indicator will be automatically centered prior to the time the gear retracts.

Night Takeoff

When making a night takeoff, use the same procedure as for a day takeoff. If the pilot wishes to energize the fluorescent dials on his instruments so that they glow with maximum intensity, the white spotlight may be used on the applicable instruments for a few seconds while the pilot's eyes are covered. The landing lights, terrain clearance light, and crosswind landing light may also be used at the pilot's discretion.

NOTE

The landing lights are in the leading edge of the front landing gear doors and will remain on until the landing gear is up and locked.

TAKEOFF CHECKLIST

NOTE

This checklist need not be read during takeoff.

WARNING

Do not attempt to take off unless stabilizer trim has been properly set for takeoff and airbrakes are down.

1. Crosswind Crab - Set and down (P-CP)

   Copilot sets crosswind crab control while taxiing to takeoff position and pilot checks setting.

2. GAM-77 Engine Control Knob(s) - As required (CP)

3. Throttles - Set (P-CP)

   B-52E

   Throttles advanced to full open. Check four red lights out for wet takeoff.

NOTE

B-52E JA Less PJ

Pull the thermistor circuit breakers if water is not initiated automatically, and reset as soon as possible after becoming airborne. This circuit breaker should be in at all times unless difficulty is experienced in establishing water.

B-52F

With J57-P-43WB engines, pilot advances throttles to applicable EPR setting. When making a wet takeoff, throttles will be advanced to the dry EPR setting for wet takeoff, then the application of water should approximate the wet takeoff EPR. With J57-P-43W and -43WA engines, throttles are advanced to full open.

NOTE

When making a takeoff from a standing start, pilots should be alert for possible airplane movement when throttles are advanced since the parking brakes were not designed to hold the airplane with all engines at MRT. If movement is detected, depressing the brakes beyond parking brake position will bring the airplane to a stop.

WARNING

If the warning horn sounds as throttles are advanced beyond approximately 80% NRT, the flaps should be rechecked at 100% down.

4. Steering Ratio - TAKEOFF LAND (P/CP)

WARNING

If the steering ratio selector lever is placed in TAXI in flight, it is possible to steer the front gear to the full 55° position. Under some conditions, it would be impossible to return the gear from the 55° position which would cause a hazardous landing condition. If the steering ratio lever is not in TAKEOFF LAND, the landing gear cannot be retracted.

TAKEOFF CHECKLIST (Cont)

CAUTION

Center the rudder pedals before repositioning the steering ratio selector lever. Actuation of the lever when the rudder pedals are deflected is very difficult and will result in a sudden change in steering angle.

5. Water Injection Pump Switch B-52F - ON (if applicable), lights checked (P)

   Check increased fuel flow, EPR, and eight amber lights out.

WARNING

B-52F

If for any reason the water injection switch is turned OFF such as to reduce climbout rate, do not turn back ON because flameout can occur when water is reinitiated.

6. Power - Checked (P-CP)

   In the event no more than three engines are not more than 0.05 (or two at 0.08 and one other at 0.05 on airplanes LF) below the minimum EPR and the rest of the engines equal or exceed the recommended value and all other instruments indicate normal operation, the takeoff may be continued, if the decision speed is attained within the acceleration check time.

7. Engine Instruments - Checked (CP)

   During initial portion of the takeoff roll, copilot checks oil pressure, EPR, rpm, and EGT indicators within limits and monitors engine instruments during remainder of takeoff roll.

8. Stabilizer Trim Indicator - Monitor (CP)

   Copilot monitors the stabilizer trim indicator during the takeoff roll in order to detect any inadvertent change in takeoff trim setting.

9. 70 Knots - Now (P)

   Pilot announces over interphone "Coming up on 70 knots" at approximately 60 knots. At 70 knots, pilot announces "Now." As pilot announces "Now," the navigator/copilot will start his stopwatch.

10. S_1 - Now (N/CP)

    The navigator/copilot announces over interphone "Coming up on_____seconds" approximately 3 seconds prior to S_1 time. At S_1 time, navigator/copilot will announce "Now." The pilot will check his airspeed and announce to the crew his decision to continue the takeoff or abort, based on the time/speed relationship.

11. Unstick Speed (S_2) - Now (CP)

    Copilot calls over interphone "Coming up on unstick speed" approximately 5 knots before reaching unstick speed. At unstick speed, copilot announces over interphone "Now."

TAKEOFF CHECKLIST

NOTE

This checklist need not be read during takeoff.

WARNING

Do not attempt to take off unless stabilizer trim has been properly set for takeoff and airbrakes are down.

1. Crosswind Crab - Set and down (P-CP)

   Copilot sets crosswind crab control while taxiing to takeoff position and pilot checks setting.

1A. Starter Switches - As required (CP)

   Place engine starter switches to START for all wet takeoffs. If icing conditions exist or are anticipated during or after a dry takeoff, place the engine starter switches to START before advancing throttles to takeoff thrust.

2. Air Conditioning Master Switch - RAM (if required) (CP)

   Wet takeoffs will be made with air conditioning in RAM to prevent moisture condensation fogging the windshield and instruments. Cold soaking by use of ground air conditioning increases such fogging tendency. If excessive noise tends to blank out interphone or radio communication, takeoff may be made with air conditioning in RAM even though water is not used.

CAUTION

For takeoff with air conditioning master switch in RAM position, AN/ASB -4 system may be operated for 3 minutes with the cabin low airflow warning light on. Air conditioning master switch must be returned to 7.45 PSI by then to prevent overheat damage to the equipment.

3. AGM-28 Engine Control Knob(s) - As required (CP)

4. Steering Ratio - TAKEOFF LAND (P/CP)

WARNING

If the steering ratio selector lever is placed in TAXI in flight, it is possible to steer the front gear to the full 55° position. Under some conditions, it would be impossible to return the gear from the 55° position which would cause a hazardous landing condition. If the steering ratio lever is not in TAKEOFF LAND, the landing gear cannot be retracted.

CAUTION

Center the rudder pedals before repositioning the steering ratio selector lever. Actuation of the lever when the rudder pedals are deflected is very difficult and will result in a sudden change in steering angle.

TAKEOFF CHECKLIST (Cont)

5. Throttles - Set (P-CP)

B-52E

Throttles advanced to full open. Check four red lights out for wet takeoff.

NOTE

B-52E

If the water injection system has not been previously primed by maintenance, a momentary delay should be expected after turning the water injection switches to ON before the water injection low pressure lights go out.

B-52F

With J57-P-43WB engines, pilot advances throttles to applicable EPR setting. When making a wet takeoff, throttles will be advanced to the dry EPR setting for wet takeoff, then the application of water should approximate the wet takeoff EPR. With J57-P-43W and -43WA engines, throttles are advanced to full open.

NOTE

When making a takeoff from a standing start, pilots should be alert for possible airplane movement when throttles are advanced since the parking brakes were not designed to hold the airplane with all engines at MRT. If movement is detected, depressing the brakes beyond parking brake position will bring the airplane to a stop.

WARNING

- If the warning horn sounds as throttles are advanced beyond approximately 80% NRT, the flaps should be rechecked at 100% down.
- To eliminate or reduce the possibility of flameout, it is recommended that if engine, nacelle, and scoops anti-icing is not ON before power is set for takeoff, its use be delayed until water (if used) is expended and power is reduced to NRT. Delay actuation of anti-ice system approximately 1 minute after reducing power to NRT as engine stall or flameout is possible due to water collecting in the engine anti-ice system.

6. Water Injection Pump Switch B-52F - ON (if applicable), lights checked (P)

Check increased fuel flow, EPR, and eight amber lights out.

WARNING

B-52F

If for any reason the water injection switch is turned OFF, do not turn back ON with the drain valves closed because flameout can occur when water is reinitiated. The remaining water may be drained rapidly by moving the drain valves switch to OPEN prior to turning the water injection switch ON.

7. Power - Checked (P-CP)

In the event no more than two engines are not more than 0.08 and one other not more than 0.05 below the minimum EPR and the rest of the engines equal or exceed the recommended value and all other instruments indicate normal operation, the takeoff may be continued if the decision speed is attained within the acceleration check time.

8. Engine Instruments - Checked (CP)

During initial portion of the takeoff roll, copilot checks oil pressure, EPR, rpm, and EGT indicators within limits and monitors engine instruments during remainder of takeoff roll.

9. Stabilizer Trim Indicator - Monitor (CP)

Copilot monitors the stabilizer trim indicator during the takeoff roll in order to detect any inadvertent change in takeoff trim setting.

TAKEOFF CHECKLIST (Cont)

10. 70 Knots - Now (P)

    Pilot announces over interphone "70 knots" at approximately 60 knots. At 70 knots, pilot announces "Now." As pilot announces "Now," the navigator will start his stopwatch. (Pilot not flying the aircraft will accomplish time check if navigator is not flying and will back up navigator's timing on all takeoffs.)

11. S_1 - Now (N)

    The navigator announces over interphone "Coming up on_____seconds" approximately 3 seconds prior to S_1 time. At S_1 time, navigator will announce "Now." The pilot will check his airspeed and announce to the crew his decision to continue the takeoff or abort, based on the time/speed relationship. (Pilot not flying the aircraft will accomplish time check if navigator is not flying and will back up navigator's timing on all takeoffs.)

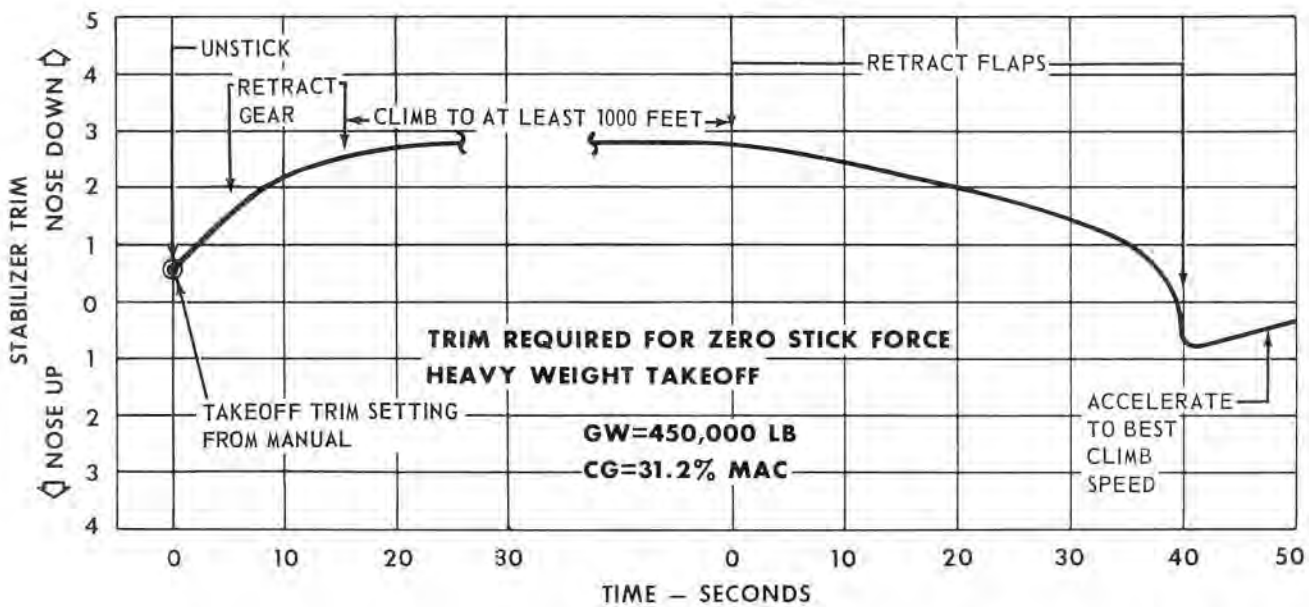
12. Unstick Speed (S_2) - Now (CP)

    Copilot calls over interphone "Coming up on unstick speed" approximately 5 knots before reaching unstick speed. At unstick speed, copilot announces over interphone "Now."

AFTER TAKEOFF

CLIMBOUT PLANNING

Under some operation conditions, climbout can be the most critical phase of airplane operation. For this reason, it is essential that the climbout technique be planned during mission planning prior to the flight. The climbout procedures essentially fall into two categories which are explained in the following paragraphs. These are a normal climbout and an obstacle clearance climbout. The "Takeoff Ground Run" and "Minimum Runway Required" charts in Parts 2 and 3 of the applicable Appendix show a line for the flaps down rate of climb equal to 300 feet per minute on seven engines using no water injection. If, during mission planning, it is found that the combination of gross weight, runway pressure altitude, and OAT are such that the required ground run falls above this line (giving less than 300 feet per minute rate of climb), the gross weight must be reduced or a marginal climbout will result. If an obstacle must be cleared, the obstacle clearance climbout procedure will be used.



takeoff—climb stabilizer trim schedule

Figure 2-11.

AFTER TAKEOFF PROCEDURES

After leaving the ground, the wheel brakes will be applied before starting gear retraction to avoid wheel well damage from spinning wheels. The landing gear retraction should be started as soon after unstick as possible.

Stabilizer Trim Use After Takeoff

The period from takeoff to flaps up requires active stabilizer trim use by the pilot to meet the rapidly changing trim requirements. Stabilizer trim should be utilized as required to maintain stick forces near zero to preclude the rapid development of an out-of-trim condition. Stick forces associated with flaps down are very light even at full travel of the control column and can lead to the false impression that stabilizer trim is not required.

NOTE

Control column force is a function only of control column position and airspeed; this force is not dependent on stabilizer position. If the control column is at full travel and stabilizer trim is being used, no change in control column force will occur until the control column is repositioned by the pilot. A positive method of determining whether or not the trim is working is to note the action of the trim wheel.

Excessive force is not required to position the control column at full travel in the flaps down configuration. Therefore, if a condition develops in which the pilot is holding the control column hard against the stops and not effecting positive control of the airplane, he must make a conscious effort to utilize stabilizer trim. If this condition has developed and trimming action has been started, the response of the airplane may not be immediately apparent. Continue trimming until control is regained.

A typical profile of trim requirements is given in figure 2-11. When the airplane is out of ground effect, landing gear is retracted, and the airplane is accelerated to 180 knots IAS, a nose down stabilizer trim requirement of approximately 3 units exists. During the first 80% of flap retraction, approximately 1.5 units of stabilizer nose up trim is needed. An additional 1.5 units of nose up trim is required during the last 20% of flap retraction. For these trim requirements, the manual trim wheel is too slow to maintain zero stick force; therefore, the stabilizer trim button should be used. During flap retraction, stick forces are light and a few seconds of holding a rearward control column rather than retrimming can result in an airplane out-of-trim condition of 3 or 4 units nose down trim and an approaching loss of elevator authority. Application of nose up trim and full up elevator will result in immediate recovery. See "Flight Control System Characteristics," Section VI, for information on elevator and stabilizer characteristics. After the flaps are fully retracted, nose down trim change will be required during acceleration to best climb speed.

WARNING

- When holding full up elevator, the pilot must be certain that he is engaging the trim button in NOSE UP position. Due to the position of the control column, he may be pushing in on the button or down on the trim button guard.
- During initial climb phase, since a severe attitude change occurs requiring considerable manipulation of the stabilizer trim, pilots should be especially alert for a stabilizer trim malfunction during this critical phase of flight and initiate immediate action as outlined in "Flight Control System Emergency Operation," Section III.

Normal Climbout Procedures

After unstick, the airplane is accelerated to 180 knots IAS and a flaps down climbout made to at least 1000 feet above the terrain (path CD in figure 2-12). At this point, flap retraction will be initiated. The airplane will be accelerated on takeoff heading during flap retraction whenever possible. The airspeed must be maintained above the minimum recommended with flaps up.

Obstacle Clearance Climbout Procedure

When obstacles near the field must be cleared on takeoff, the climbout performance becomes very important. A high angle of climb for clearing close obstacles is maintained by leaving flaps down and climbing at 10 knots above unstick speed until the obstacle is cleared. The speeds for the maximum climb angle with flaps down are 20 to 30 knots higher than unstick speeds. Since the airplane might cover considerable ground distance before attaining the maximum climb angle speed, do not attempt to attain these speeds unless the obstacle to be cleared is at a relatively long distance from the takeoff point.

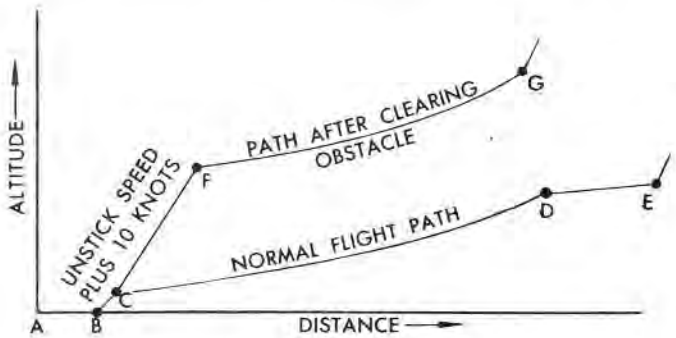
Flap Retraction Precautions

During flap retraction, the speed schedule shown in figure 2-13 should be maintained within ±10 knots. This schedule gives a safe margin between flap placard and minimum speeds. If flap retraction is started at 180 knots and a climbing attitude is maintained, it will be practically impossible to exceed the flap placard speed limit. If the airspeed is low, the rate of climb should be reduced or power added. During the flap retraction

cycle it is required that the pilot monitor the airplane attitude as closely as possible, keeping the airplane trimmed to a zero stick force, especially during the last 20% of flap retraction. If the climbout has been properly planned and no emergency develops, a satisfactory vertical velocity can be maintained while accelerating during flap retraction. However, under conditions of high gross weight, high OAT, and high field elevation, or any combination of these factors, it may be impossible to maintain a positive vertical velocity during the latter part of the flap retraction period. Flaps should not be retracted in a turn, and the speed schedule of 180 knots IAS at 100% flaps down, 190 knots IAS-flaps 50%, 200 knots IAS-flaps 30%, and 220 knots IAS-flaps full up should be followed. In any event, maintain a sufficient positive vertical velocity to keep from exceeding the flap placard speed of 225 knots IAS at the 50% position and 253 knots at the 10% position.

CAUTION

An altitude loss can be expected during flap retraction if the maximum allowable dry thrust flaps down positive vertical velocity at 180 knots IAS is less than 1500 feet per minute. At a vertical velocity of 500 feet per minute, the loss at the completion of flap retraction will be about 500 feet.



POINT A. Start takeoff roll using takeoff rated thrust (TRT) with wing flaps down.

POINT B. Takeoff point; start gear retraction.

PATH CD. Leave flaps down and climb out at 180 knots IAS to 1000 to 1500 feet above the terrain.

POINT D. Start flap retraction at 1000 to 1500 feet altitude above the terrain.

PATH CF. Leave flaps extended and climb at unstick speed plus 10 knots until the obstacle is cleared.

POINT F. Maximum desired altitude for clearing obstacle (at least 1000 feet above terrain).

PATH FG. Start flap retraction at 180 knots; maintain a rate of climb sufficient to keep from exceeding flap placard limits.

POINTS E AND G. Points at which flaps are up. Accelerate to the best climb speed as given in Part 4 of the applicable Appendix.

.... after takeoff flight paths

Figure 2-12.

NOTE

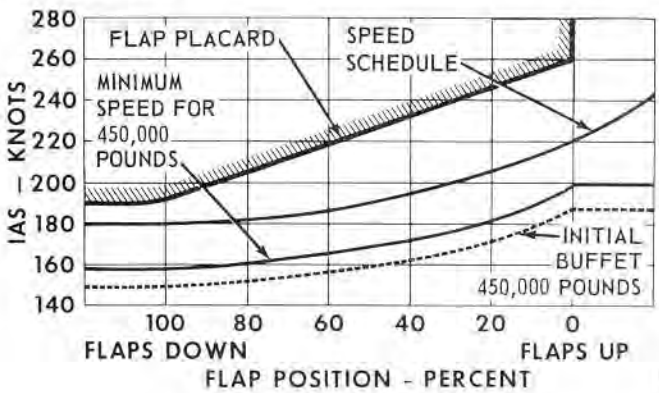
An error in the pitch indication of the attitude indicators is generated during accelerations or decelerations. The error is indicated in a nose high direction during and after a forward acceleration and in a nose down direction during and after deceleration. The longer the duration of acceleration (or deceleration), the greater will be the indicated error and the longer it will persist when acceleration (or deceleration) ceases. The erection system will reduce the error at about the same rate it was generated. With the Type MM-4 attitude indicator, pitch error may reach one bar width during a high gross weight takeoff while, with earlier installed indicators, the error under the same conditions may be more than three times greater.

WARNING

It is possible that a malfunction of the attitude indicator might be determined only by cross-checking it with the remaining flight instruments.

SUMMARY OF AFTER TAKEOFF PROCEDURES

Climb out with flaps full down at 180 knots IAS to an altitude of at least 1000 feet above the terrain and retract the flaps. If a positive vertical velocity of 1000 feet per minute is not attained when reaching 1000 feet above the terrain, flap retraction will be delayed until an altitude of 1500 feet above the terrain is reached. If an obstacle must be cleared, climb out with flaps down at unstick speed plus 10 knots until a safe altitude has been reached.



..... flap retraction speeds

Figure 2-13.

AFTER TAKEOFF — CLIMB CHECKLIST

NOTE

- Only the circled items will be accomplished after Low Altitude Tactic.
- During and right after takeoff, pilots should be alert to reset any hydraulic pack which may have been tripped off due to air bleed surges. B-52F

1. Wheel Brakes - Apply (P)

   Apply wheel brakes firmly for approximately 3 seconds before landing gear retraction.

2. Landing Gear Lever - GEAR UP (P); Six up (CP)

WARNING

To prevent flying the airplane into the ground, the pilot will exercise caution not to exert inadvertent forward pressure on the control column when reaching forward to raise the landing gear lever.

CAUTION

If any gear fails to indicate up and locked, to prevent system damage, do not recycle the landing gear system prior to initiating emergency procedure.

3. Flap Lever - UP and OFF (CP)

At 180 knots IAS and a minimum altitude of 1000 feet above the terrain, the pilot directs the copilot to raise the flaps. If a positive vertical velocity of 1000 feet per minute is not attained when reaching 1000 feet above the terrain, flap retraction will be delayed until an altitude of 1500 feet above the terrain is reached. At the appropriate time, the copilot advises, "Flaps coming up, flaps 50%, flaps 30%, and flaps full up." In addition, the copilot monitors the flight instruments, including the airspeed, during flap retraction. As a guide, the normal speed schedule during flap retraction should be approximately 180 knots IAS at 100%, 190 knots IAS at 50%, 200 knots IAS at 30%, and 220 knots IAS when flaps reach the full up position. If the actual indicated airspeed varies from these values by 10 knots or more, the copilot should so advise the pilot so he can make necessary pitch changes. When the flaps up indication is received, move the flap lever to OFF to prevent flap motor damage which may be caused by limit switch actuation after flap retraction.

WARNING

- During the last 20% of flap retraction, maintain zero stick force using the stabilizer trim button. In event of adverse nose down pitching tendency, airbrakes may be used to correct to a normal nose up condition.
- Any unusual rolling moment encountered during flap operation could indicate an asymmetrical flap condition for which corrective action must be taken immediately. (A discussion of flight characteristics with asymmetrical flaps is included in Section III.)
- If power is reduced during initial climb, it may be necessary to add power during flap retraction to maintain the desired speed schedule and to preclude loss of altitude.

4. Throttles - Set (CP)

A NRT climb at a specific airspeed or mach number is accomplished by adjusting to the EPR tabulated in the appropriate abbreviated checklist chart in T.O. 1B-52E-1CL-1 for the correct altitude and cockpit OAT gage reading. Computation will be accomplished by the navigator when aboard. EPR settings can also be obtained from the "Thrust Settings" charts contained in Part 4 of the Appendix.

AFTER TAKEOFF — CLIMB CHECKLIST (Cont)

NOTE

- EPR setting to be used in climb should not be made until water supply is exhausted.
- All asterisk (*) items will be read by copilot and response given over interphone. All other items will be completed silently by the appropriate crew member.

(*5.) Crew, Stow Zero Delay Lanyard (crew members occupying upward ejection seats and gunner if static line installed) - Stowed (P-CP)

See figure 3-5 for zero delay lanyard chart and note that zero delay lanyard should be disconnected as near 2000 feet above the terrain as possible.

6. AGM-28 Engine Control Knob(s) - As required (CP)

*7. Water Injection Switches - OPEN and OFF (when applicable) (P)

Move the drain valves switch to OPEN. After the water supply is completely exhausted, turn the water injection pump switch(es) OFF (if system was used during takeoff). If system was serviced but not used during takeoff, move the drain valves switch to OPEN and turn the water injection pump switch(es) ON until water supply is depleted. Leave drain valve switch in OPEN at all times, except when the system is serviced, to drain water from the lines and to prevent damage to valves.

CAUTION

- When substantial amounts of water are to be drained, the water injection pump switch(es) must be in ON to force all water out of the system before the airplane reaches high altitude.
- After moving the drain valves switch to OPEN, do not actuate the switch in flight at or above the freezing level. Operation of a frozen valve may cause valve failure.

(*8.) Anti-Icing Switches & Airbrakes - Climatic (P)

Engine and nacelle anti-icing switch ON if required. Windshield anti-ice and defogging switch remains on NORMAL (HIGH if required). If airbrake position 4 was used with the inboard airbrake control circuit breaker pulled, and airbrakes are no longer required, reset the circuit breaker.

WARNING

Actuating the engine and nacelle anti-icing above NRT may cause engine surge and flameout. To prevent flameout, check that starter switches are in START before turning on anti-icing. Leave starter switches in START until rpm and EPR have stabilized.

9. Starter Switches - OFF (CP)

When rpm and EPR have stabilized, turn starter switches OFF.

WARNING

To prevent flameout, do not turn starter switches OFF until rpm and EPR have stabilized.

AFTER TAKEOFF — CLIMB CHECKLIST (Cont)

10. Throttles (prior to 10, 000 feet) (only on engines supplying air conditioning) B-52E - 80% (CP)

NOTE

B-52E

To prevent nuisance tripoff of the air conditioning pack, retard throttles to 80% rpm on engines supplying air before switching from RAM to 7. 45 PSI. When turning the air conditioning system on or off at higher power settings, the automatic pressure limiter valve at the air conditioning pack may be tripped off which mechanically shuts off the air conditioning system. To restore air conditioning after such tripoff, it is necessary to enter the forward wheel well and reset the pressure limiter valve.

*11. Air Conditioning Master Switch - Checked 7. 45 PSI (prior to 10, 000 feet) (CP) B-52E

Copilot positions this switch to 7. 45 PSI, after reducing rpm to 80% on engines supplying air conditioning, and waits at least 15 seconds before restoring throttles to desired power setting.

*12. Mach Indicator Switch (if installed) - ON (P)

13. Landing & Crosswind Landing Light Switches - OFF (CP)

*14. Yaw Damper Switch SY - ON (P/CP)

15. Autopilot Master Switch - ON (CP)

16. Slipway Doors - Open 30 seconds, then closed (CP)

17. AGM-28 Wing Valve Switch(es) - OPEN, light(s) off (CP)

18. AGM-28 Engine(s) - Air started (if applicable) (CP)

*19. Oxygen Check - Completed (CP-G)

NOTE

On extended flights (flights in excess of 17 hours duration), the gunner may be relieved of crew duties for periods of crew rest by the copilot. Before the gunner is relieved from crew duties, the copilot will request a cabin pressure and oxygen check and ascertain that the gunner is on interphone and oxygen. During the period of the gunner's crew rest, the copilot will monitor the gunner's remote cabin altimeter and the tail compartment low pressure warning light at intervals not to exceed 15 minutes. Close crew coordination between the pilot and copilot is mandatory to insure frequent monitoring.

a. During the climb, copilot requests an oxygen and zero delay lanyard check at 12, 000 feet. The sequence for oxygen report is the same as for crew report. Oxygen panels will be checked for:

(1) Oxygen Supply Shutoff Lever - ON

(2) Regulator Diluter Lever - NORMAL OXYGEN

(3) Pressure - 300 psi

(4) Flow Indicator - Functions normally

(5) Emergency Toggle Lever - NORMAL

b. Gunner and copilot report, "Cabin altitude_____ feet. Oxygen panel checked."

AFTER TAKEOFF—CLIMB CHECKLIST (Cont)

c. Navigator, EW officer, radar navigator, and pilot report, "Oxygen panel checked." Pilot reports oxygen quantities.

d. Under steps "b" and "c," gunner, copilot, EW officer, and pilot will report "Zero delay lanyard stowed."

e. Copilot, notify aircrew and receive gunner's acknowledgment when passing through 26,000 and 35,000 feet.

f. The copilot will request an oxygen check at level-off. During cruise, the copilot will monitor the gunner's remote cabin altimeter and tail compartment low pressure warning light at intervals not to exceed 15 minutes and initiate the oxygen checks at 30-minute intervals when both cabin altitudes are below 12,000 feet, at 15-minute intervals when either cabin altitude is 12,000 to 25,000 feet, and at no longer than 10-minute intervals when either cabin altitude is above 25,000 feet. If cabin altitude is below 12,000 feet, only the gunner and copilot/pilot will report. The remaining crew members will check their equipment and report if abnormal. At level-off, only the gunner and copilot/pilot need report if cabin pressure is 12,000 feet or below.

(*20.) Standby Pump Switches - OFF (P)

Pilot depresses brake pedals several times and checks pressures on packs 1 through 4 to insure that all utility packs have been shut down.

*21. Fuel Switches 9 & 12 - OFF (CP)

Copilot closes crossfeed valve switch 9 and monitors engines 1 through 4 for approximately 30 seconds. If no flameout occurs, copilot then closes crossfeed valve switch 12 and monitors engines 5 through 8 for approximately 30 seconds.

(*22.) Altimeter - Set 29.92 (P-CP-RN)

23. Fuel Scavenge - Complete (CP)

a. Refuel Scavenger Pump Switch - ON

b. Refuel Manifold Scavenged Light - On; Refuel Scavenger Pump Switch - OFF

24. IFF - Checked (CP-N)

If positive operation of the normal mode of IFF has not been established during departure with an air traffic control facility, a check should be made with such a facility as soon after takeoff as flight conditions will permit.

NOTE

For aircraft operating on Radar Controlled Airways or through Positive Controlled Airspace, this check must be performed prior to entering these regions. If IFF is inoperative, consult the appropriate navigation publication before entering controlled areas.

CLIMB

The normal climb technique described herein will be required to produce the results stated in Part 4 of the applicable Appendix. Either military rated thrust or normal rated thrust may be used for a climb depending upon the conditions encountered, results desired, and engine life expected. Referring to figure 2-14, it should be noted that Point A will be reached at approximately the same time regardless of whether military rated thrust or normal rated thrust is used for the climb. Approximately 300 pounds less fuel will be required when military rated thrust is used but engine life probably will be shortened slightly since higher engine speeds and higher temperatures will be encountered. When climb speed is approached, note the full throttle total fuel flow and retard throttles to reduce fuel flow by 15% (this setting will be very close to normal rated thrust). After climb power has been set, power will be balanced by use of the individual EPR gages, maintaining the same total fuel flow. EXAMPLE: When climb speed has been reached after takeoff, the total fuel flow is noted to be 60,000 pounds per hour, the throttles are retarded until the total fuel flow is

51, 000 pounds per hour (60, 000 x 0. 15 = 9, 000; 60, 000 - 9, 000 = 51, 000).

CAUTION

If the airplane was serviced with aviation gasoline in any tanks, see "Rate of Climb Limitations," Section V.

NOTE

Climbs should not be made at less than normal rated thrust since this procedure will result in a loss of range because of the excessive time spent in climbing.

CLIMB DATA

A study of the climb charts, Part 4 in the applicable Appendix, will show that a constant airspeed, determined by the gross weight at the start of climb, is maintained during climb until the proper constant climb Mach number is reached. The loss of one engine during a climb will decrease the airplane rate of climb. See Part 4 of the applicable Appendix for data on eight- and seven-engine climb performance.

ICING DURING CLIMB

If icing conditions are known to exist within the climb flight path, the engine and nacelle anti-icing system should be turned on prior to the time icing conditions are encountered.

FUEL MANAGEMENT FOR LATERAL TRIM

Normally, a correctly rigged airplane will need no more than 1 unit of rudder and 2 units of aileron trim to fly "hands off" in level flight when all engines are developing equal thrust and there is no lateral unbalance due to fuel loading. When maximum range or maximum endurance is desired, zero lateral trim, zero rudder trim, and zero sideslip should be established and maintained. This may be accomplished through fuel management by performing the "Emergency Emptying of an Auxiliary Tank" procedure in Section III. Fuel weight differential between left and right outboard wing tanks shall be limited as follows:

1. Not more than 1, 500 pounds for gross weights of 390, 000 pounds or above. If additional trim is required, turbulence must be avoided and maneuver load factors limited to 1. 5 "g's." A maximum of 1 unit of rudder and 2 units of aileron trim may be used under these conditions.
2. Not more than 3, 000 pounds for gross weights less than 390, 000 pounds. If additional trim is required, turbulence must be avoided and maneuver load factors limited to 1. 5 "g's." A maximum of 1 unit of rudder and 2 units of aileron trim may be used under these conditions.

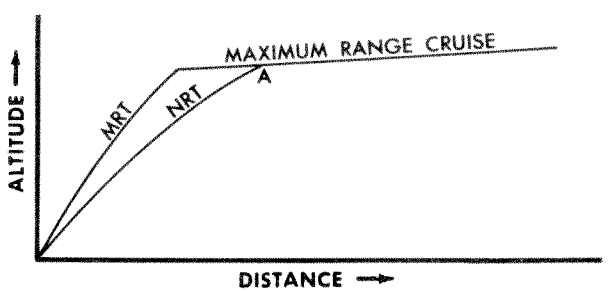
If wings level with zero sideslip cannot be attained within the limits noted in the preceding steps "1" and "2," the fuel differential should be returned to zero and rudder and aileron trim utilized within the limits noted in Section V. As this is an abnormal condition, the following items should be investigated at the earliest opportunity:

1. Fuel gage error
2. Lateral and rudder rigging
3. Trim indicator not agreeing with trim tab deflection
4. Asymmetrical thrust due to:
   a. EPR gage error
   b. Engine(s) out of trim
   c. Fuel flow gage error
5. Possible structural damage.

CRUISE

RANGE

Normally a combat mission will be flown using procedures which will produce maximum range. The performance of a jet airplane is such that maximum range is attained by flying at one particular Mach number and gradually increasing altitude as airplane weight is decreased through fuel consumption. Such a climbing flight path is accomplished by setting the throttles so as to provide a given engine pressure ratio (EPR) for a corresponding cruise Mach number and checking the altitude frequently to make certain it agrees with that specified by the altitude curve. The rate of climb required is very small (averaging from 16 to 20 feet per minute or about 1000 to 1200 feet per hour). Therefore, rather than attempt to fly at some specified rate of climb, check the flight altitude with that given in the altitude curve at frequent intervals to assure that the proper climbing flight path is being maintained. Operating the engines at the proper pressure ratio setting should provide the proper amount of thrust to produce the correct climbing flight path. The cruise Mach number should be checked frequently by means of the airspeed indicator. The Mach indicator may be inaccurate, causing a range loss of several percent. There is only one weight-altitude schedule which will result in maximum range. Such information is provided in Part 5 of the applicable Appendix and is the maximum range curve on the charts. The remaining curves on these charts are called best range for the particular flight condition and result in slightly less range than that attained by flying maximum range. Best range (constant altitude) cruise is usually used for a noncombat mission because the difference in range between this type of cruise and maximum cruise is not great if the altitude flown is above 35, 000 feet. Also see "Fuel Management for Lateral Trim," under "Climb," this section.



climb flight paths

Figure 2-14.

CENTER OF GRAVITY

Control of the center of gravity of this airplane during any cruise operation is quite simple if fuel is transferred to the main tanks using the recommended procedure in Section VII. See Section V for center of gravity information. As fuel is consumed, the cg location will shift slightly, and a running check should be maintained so that the approximate cg location is known at all times. The stabilizer trim wheel may be used to make such a check by referring to the chart in Part 5 of the applicable Appendix. For maximum range cruise operation at the chart Mach number, the stabilizer trim indicator should be in the vicinity of zero units. If the stabilizer setting is within the limits of 1 unit nose up and 1 unit nose down, the cg could be expected to be within normal limits. If the stabilizer trim is set outside of these limits, the cg location should be checked against the stabilizer trim chart in Part 5 of the applicable Appendix and compared to calculations based on fuel distribution.

ENDURANCE

Maximum endurance is frequently desired during operational missions when it becomes necessary to hold over a check point, rendezvous with a tanker, accomplish a navigational check, or to provide time to correct airplane functional difficulties. Maximum endurance can be attained only if the recommended airspeeds are observed within ±10 knots and by operating the number of engines specified in Part 6 of the applicable Appendix, and by maintaining zero trim using "Fuel Management for Lateral Trim," under "Climb," this section.

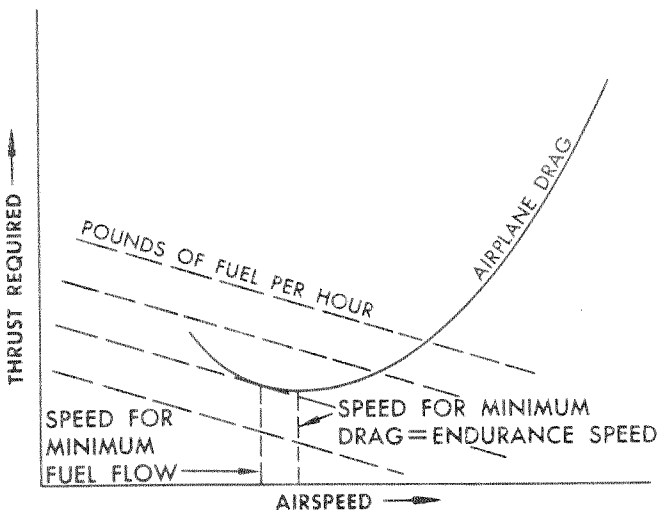


Figure 2-15.

Endurance Procedures

Maximum endurance is accomplished by flying at a gradually decreasing airspeed and gradually increasing altitude as the gross weight is decreased through fuel consumption. If endurance operation lasts less than 4 hours, the gain in endurance by flying a climbing flight path is negligible and constant altitude operation is recommended. The optimuin endurance airspeed for any weight and altitude is the airspeed at which the pounds of fuel per hour is at a minimum. This is slightly less than the airspeed at which the airplane drag is at a minimum (figure 2-15). The recommended endurance speed schedule is at the minimum drag point. This results in a negligible penalty in fuel flow while the increased speed is desirable from a piloting standpoint. Shutting down some engines at certain altitudes and airspeeds will result in the remaining engines operating in a more favorable range of rpm with higher efficiencies. See Part 6 of the applicable Appendix.

FLIGHT CHARACTERISTICS

See Section VI for information regarding flight characteristics.

AIR REFUELING

See Section IV for all air refueling descriptive and operational information.

ADM-20 INFLIGHT OPERATION

Amplified checklists for B-52E/ADM-20 operation are published in T.O. 1B-52E-1-4. The corresponding abbreviated checklists are published in T.O. 1B-52E-1CL-2, navigator's, and T.O. 1B-52E-1CL-3, radar navigator's.

AGM-28 INFLIGHT OPERATION

Amplified checklists for B-52E/AGM-28 operation are published in T.O. 1B-52C-30-1. The corresponding abbreviated checklists are published in T.O. 1B-52E-1CL-1, pilots'; T.O. 1B-52E-1CL-2, navigator's; and T.O. 1B-52E-1CL-3, radar navigator's.

LOW ALTITUDE TACTIC

If a portion of the mission is to be conducted at low altitude, a forecasted altimeter setting will be obtained for the low altitude entry point. A comparison of this forecasted altimeter setting with the altimeter setting obtained from the air traffic control agency will be made prior to descent for the low altitude portion of the mission. If a difference in altimeter reading is in excess of 0.2 inch Hg, altimeter setting should be verified.

Upon entry to the low altitude tactic, accomplish the circled items of the "Descent Checklist." Descent to low altitude will normally be made at 4000 fpm; however, the rate of descent may be reduced provided the aircraft crosses published fixes at the specified altitude. The airspeed will not exceed Mach .80 or 280 knots IAS, whichever is less. If icing conditions are encountered, airbrakes may be used, not to exceed position 4, as necessary to maintain sufficient power for engine anti-icing; however, this will impose range penalties. With airbrakes in position 2, the range loss is approximately 32% and in position 4, approximately 50%; fuel flow increase is approximately 54% and 100% respectively. These approximate figures should be used when flying at low altitude only. If conditions require the use of airbrake position 2 during low level flight, the following procedure is recommended:

1. Pull the "Inboard Airbrake Control" circuit breaker located on the pilot's overhead circuit breaker panel.
2. Move airbrake lever to position 4. Drag and range degradation will be approximately the same as when operating normally in position 2. Buffet level will be substantially reduced. Roll response will be the same since spoiler operation is not affected by pulling the airbrake control circuit breaker.

NOTE

The engine and nacelle anti-icing control switch will be turned on below 20,000 feet when the OAT gage reading is below 10° C during night flights or in areas of forecasted or suspected icing conditions. This serves to preheat the anti-icing surfaces even though the EPR may be below that required to anti-ice. During icing conditions, the EPR must be above a minimum prescribed value to anti-ice. Two methods are available to insure proper anti-icing. One is to fly at a speed of 340 knots IAS or greater. The other is to maintain the following EPR by extending drag items as necessary.

	B-52E		B-52F	
Altitude	Minimum EPR Below 280 Knots IAS	Minimum EPR 280 Knots IAS and Above	Minimum EPR Below 280 Knots IAS	Minimum EPR 280 Knots IAS and Above
Sea Level	1.60	1.50	1.61	1.50
5,000 ft	1.60	1.50	1.75	1.57
10,000 ft	1.70	1.60	1.83	1.63
15,000 ft	1.82	1.72	1.90	1.69
20,000 ft & above	1.95	1.85	1.95	1.75

When climbing back to altitude, accomplish the circled items of the "After Takeoff-Climb Checklist."

OPERATION

Present low altitude operational information is based on the results of low altitude flight tests. During these tests, the aircraft and its systems were operated at near maximum design capability. With the requirement of all-weather flying at airspeeds up to the design limit of the aircraft, adequate preflight planning is especially essential to successful completion of a low altitude mission. Icing conditions at low altitudes and high speeds can be more severe than those normally encountered. Also, it is extremely difficult to anticipate icing conditions during low altitude operation, particularly at night. Crew coordination is considered critical when flying at low altitude. There have been some unusual psychological effects on crew members and fatigue is found to increase much more rapidly at low altitude than at high. There is considerable difficulty for pilots in interpreting readings of certain instruments while bouncing due to turbulence; however, it is fairly easy to determine the range of scale which the instrument needle is in and generally this is sufficient. Adverse effects which are frequently encountered at low altitude and which must be considered when planning a mission are increased turbulence, reduced vision, reduced radar range, the inconsistency of winds due to terrain effect, and extreme difficulty in the use of celestial navigation because of turbulence and the frequency of overcasts. Also noise interference with interphone and radio communication is experienced when the air conditioning pack is in operation during high power settings. To avoid such interference, the air conditioning master switch must be positioned to RAM. On climbout, place the air conditioning master switch in 7.45 before reaching 10,000 feet as shown in the "After Takeoff-Climb Checklist." Another obvious consideration while flying at low altitude is that of planning the mission to insure an awareness of any hazardous terrain conditions and an avoidance of dangerous aircraft-terrain relationships. See "Low Altitude Flight Characteristics," Section VI. There is no necessity to deviate from normal fuel management sequences during operation at low altitudes.

NOTE

For operation of terrain avoidance system, see Section IV.

BOMBING

All bombing procedures and operational information are contained in Section VIII. Those procedures involving the pilots are prepared in such a manner as to be performed upon notification from the navigators. Therefore, no abbreviated checklists pertaining to

bombing will be prepared for the pilots. A description of bombing equipment, especially the pilot's last resort bombsight, is given in Section IV.

DESCENT

This is the recommended procedure for all letdowns where there is no range emergency and should be accomplished as follows:

1. Maintain cruising altitude until approximately 40 miles from the landing base. This distance will depend upon the airplane altitude at the end of mission. Normally voice radio communication can be established between the pilot and the tower at this distance.
2. Lower the landing gear and retard all throttles to the IDLE stops. Observe the gear extension placard limits in Section V.
3. Extend airbrakes to position 4 or as required.

WARNING

Care should be taken to retrim between each two-unit increment of airbrake operation.

4. Make descent at 4000 feet per minute not to exceed Mach .75 or 250 knots IAS, whichever is slower, but not less than 220 knots IAS.

DESCENT CHECKLIST (Pilot/Copilot/EW reads)

NOTE

Only the circled items will be accomplished for Low Altitude Tactic.

1. AGM-28 Wing Valve Switches - CLOSE (CP)

NOTE

Close the wing valves at least 5 minutes prior to engine shutdown. This is to lower the fuel level in the missile fuel tank to prevent fuel spillage due to thermal expansion after landing.

(2.) Navigation System Select Switch - As desired (P)

(3.) Altimeter Setting - Obtained (CP)

When the altimeter setting is received from appropriate air traffic control facility, a comparison should be made with the appropriate forecasted altimeter setting.

a. Altimeter Settings:

	FORECAST	CURRENT
Low Altitude Entry	_____	_____
Destination	_____	_____
Alternate	_____	_____

4. Fuel Panel - Checked (CP)

Crossfeed valve switches 9 and 12 will be positioned to OPEN when any main tank indicates 5000 pounds or less.

5. Landing Data - Computed and checked (CP-N)

Compute gross weight and best flare speed with airbrakes in position 2 and check landing data card.

(6.) Standby Pump Switches - All ON (P)

DESCENT CHECKLIST (Pilot/Copilot/EW reads) (Cont)

7. Engine & Nacelle Anti-Icing - Climatic (P)

If suspected icing conditions exist in the descent area, turn ON the engine and nacelle anti-icing (anti-icing control) switch 5 minutes prior to descent and check for noticeable EPR drop on all engines at time of switch actuation to indicate proper operation of the system.

8. Landing Gear Lever - GEAR DOWN (P); Six down (CP)

Pilot moves landing gear lever to GEAR DOWN and checks for positive engagement of the pawl in the gear down detent by forcibly and positively pushing in on the landing gear lever after the lever is in GEAR DOWN. Check operation of landing gear warning light.

a. Gunner reports position of the tip gear if not down.

b. Radar navigator visually checks the two forward trucks and reports the position and alignment of the forward landing gear if not down.

c. Copilot observes the position of the landing gear position indicators and reports "Six down" when so indicated.

CAUTION

If any gear fails to indicate down and locked, to prevent system damage, do not recycle the landing gear system prior to initiating emergency procedure.

9. Throttles - Set (P)

10. Airbrake Lever - Set (P)

The airbrake lever normally will be set at position 4; however, the airbrakes may be used as required.

11. Autopilot - Disengaged (P-CP)

Autopilot will be disengaged for penetration and for descent to low level.

12. Starter Switches - Climatic (CP)

When descending under possible inlet icing conditions, starter switches should be placed in START and remain in START until sufficient power for anti-ice heat has been reestablished and stable engine operation obtained. When landing is anticipated under inlet icing conditions, starter switches should be in START prior to final power reduction.

13. Reset Altimeters - Reset (P-CP-RN)

Reset altimeters to station pressure when descending through altimeter changeover altitude as applicable. For low altitude entry, the radar navigator may reset his altimeter after altitude measurement. Pilot will confirm with crew the type of penetration and approach to be accomplished with particular emphasis on any intermediate altitude restrictions and minimum indicated altitude for the type of approach.

14. Crew, Hook Zero Delay Lanyard (crew members occupying upward ejection seats, and gunner [V] - Hooked (P-CP-EW-G)

See figure 3-5 for zero delay lanyard chart. Only crew members occupying upward ejection seats and gunner [V] accomplish this action.

DESCENT CHECKLIST (Pilot/Copilot/EW reads) (Cont)

15. Terrain Avoidance System Letdown (Plan & Profile Modes) - Accomplished (P-CP)

WARNING

To determine the capability of the TA system, the following checks should be performed during entry into low level. These checks will be valid only if accomplished over flat or rolling terrain.

NOTE

- Letdown procedures should be initiated at approximately 10, 000 feet above the terrain.
- Steps "a" through "h" will normally be accomplished as a functional check during all descents for low level tactics. Remaining items will be accomplished in level flight during entry into TA routes or segments. TA displays will be in an operational mode at least 2 minutes prior to TA checks.
- If any of the following TA system checks are not satisfactory, refer to TA system error compensation procedures in Section IV.

a. Terrain Display Mode Selector Switch - PLAN (P/CP)

b. Stabilization Reference Selector Switch - FRL (P/CP)

c. Clearance Plane - Set to 3000 feet (P/CP)

(1) Returns (5000 to 3000 feet absolute altitude) - Checked (P-CP)

Observe ground returns starting to move in from 10-mile range between 5000 and 3000 feet absolute altitude.

d. Airbrakes (3000 feet absolute altitude) - OFF (P)

NOTE

Copilot takes control of aircraft and continues slow descent while pilot performs checks.

e. Terrain Display Mode Selector Switch - PROFILE 3 (P)

NOTE

Check that clearance plane indicator changes to briefed profile mode setting.

f. Stabilization Reference Selector Switch - HOR (P)

g. Terrain Trace (1900 (±250) feet absolute altitude) - Appears (P-CP)

To check short range accuracy, note that terrain trace appears at bottom of scope at 1900 (±250) feet absolute altitude.

DESCENT CHECKLIST (Pilot/Copilot/EW reads) (Cont)

h. Level Off at IFR Altitude (if applicable) - Accomplished (CP)

(1) Autopilot Low Level Switch [SYI] - LOW LEVEL (if desired) (CP)

NOTE

On low level routes where TA segments are down track from the low level entry point, the terrain display mode selector switch may be turned to OFF. An operational TA display mode must be selected at least 2 minutes (for equipment warmup) prior to continuing the checklist.

i. Terrain Display Mode Selector Switch - PLAN (P)

j. Clearance Plane - Set to 1000 feet (P)

k. Level Off at 1000 Feet Above Terrain - Accomplished (CP)

(1) Autopilot Low Level Switch [SYI] - LOW LEVEL (if desired) (CP)

NOTE

Copilot is responsible for flying the aircraft at the proper airspeed maintaining 1000 feet above the terrain until the TA system checks have been completed by the pilot.

(2) Radar Altimeter Indicators & Pressure Altimeters - Cross-checked (P-CP-RN-N)

(3) Returns - Checked (P-CP)

Check for presence of terrain returns at all ranges beyond minimum range; no returns indicate negative error (error in the unsafe direction).

l. Stabilization Reference Selector Switch - FRL (P)

(1) Plan Display - Compared (P-CP)

Switch from horizontal to FRL stabilization and note plan display does not change significantly. Aircraft must be at proper FRL speed during FRL stabilization mode for this check to be valid.

m. Stabilization Reference Selector Switch - HOR (P)

n. Clearance Plane - Set to 400 feet (P)

(1) Returns Should Disappear - Checked (P-CP)

Retention of returns indicates a positive error (error in safe direction).

o. Clearance Plane - Set to briefed TA altitude (P); Cross-checked (CP)

WARNING

Check that clearance plane is not set to a value less than briefed setting.

p. Terrain Display Mode Selector Switch - PROFILE 3 (P)

Note that terrain trace is approximately halfway between the horizontal reference line and profile calibration etch mark.

DESCENT CHECKLIST (Pilot/Copilot/EW reads) (Cont)

q. Stabilization Reference Selector Switch - FRL (P)

(1) Terrain Trace Positions - Compared (P-CP)

Switch from horizontal to FRL stabilization and note trace does not move more than 1/4 inch up or down when compared to horizontal mode. Aircraft must be at proper FRL speed during FRL stabilization mode for this check to be valid.

r. Instrument Hood - As required (P/CP)

s. Final Descent to TA Altitude - Accomplished (P/CP)

NOTE

- Final descent will be accomplished in profile 3 mode with FRL stabilization (at proper FRL speed). Maintain the terrain trace at or below the horizontal reference line for 1/2 inch each side of the ground track line. If desired, select plan mode with FRL stabilization (at proper FRL speed). Check that clearance plane is set as desired. Maintain plan display free of returns 1/8 inch each side of ground track line from the 3-mile range mark to vertex of scope; maintain video outside the 3-mile range mark along the centerline.

- Pilot flying aircraft monitors TA display, radar altimeter, and flight instruments. Pilot not flying aircraft monitors aircraft position and aircraft systems operation.

WARNING

The primary duty of pilot not flying the aircraft is to visually monitor the terrain clearance of the aircraft.

15. Terrain Avoidance System Letdown (Plan Mode Only) - Accomplished (P-CP)

WARNING

To determine the capability of the TA system, the following checks should be performed during entry into low level. These checks will be valid only if accomplished over flat or rolling terrain.

NOTE

- Letdown procedures should be initiated at approximately 10,000 feet above the terrain.

- Steps "a" through "e" will normally be accomplished as a functional check during all descents for low level tactics. Remaining items will be accomplished in level flight during entry into TA routes or segments. TA displays will be in an operational mode at least 2 minutes prior to TA checks.

- If any of the following TA system checks are not satisfactory, refer to TA system error compensation procedures in Section IV.

a. Terrain Display Mode Selector Switch - PLAN (P/CP)

DESCENT CHECKLIST (Pilot/Copilot/EW reads) (Cont)

b. Stabilization Reference Selector Switch - FRL (P/CP)

c. Clearance Plane - Set to 2000 feet (P/CP)

(1) Returns (5000 to 2500 feet absolute altitude) - Checked (P-CP)

Observe ground returns starting to move in from 10-mile range between 5000 and 2500 feet absolute altitude.

d. Airbrakes (3000 feet absolute altitude) - OFF (P)

NOTE

Copilot takes control of aircraft and continues slow descent while pilot performs checks.

e. Level Off at IFR Altitude (if applicable) - Accomplished (CP)

(1) Autopilot Low Level Switch SYI - LOW LEVEL (if desired) (CP)

NOTE

On low level routes where TA segments are down track from the low level entry point, the terrain display mode selector switch may be turned to OFF. An operational TA display mode must be selected at least 2 minutes (for equipment warmup) prior to continuing the checklist.

f. Stabilization Reference Selector Switch - HOR (P)

g. Clearance Plane - Set to 1000 feet (P)

h. Level Off at 1000 Feet Above Terrain - Accomplished (CP)

(1) Autopilot Low Level Switch SYI - LOW LEVEL (if desired) (CP)

NOTE

Copilot is responsible for flying the aircraft at the proper airspeed maintaining 1000 feet above the terrain until the TA system checks have been completed by the pilot.

(2) Radar Altimeter Indicators & Pressure Altimeters - Cross-checked (P-CP-RN-N)

(3) Returns - Checked (P-CP)

Check for presence of terrain returns at all ranges beyond minimum range; no returns indicate negative error (error in the unsafe direction).

i. Stabilization Reference Selector Switch - FRL (P)

(1) Plan Display - Compared (P-CP)

Switch from horizontal to FRL stabilization and note plan display does not change significantly. Aircraft must be at proper FRL speed during FRL stabilization mode for this check to be valid.

DESCENT CHECKLIST (Pilot/Copilot/EW reads) (Cont)

j. Stabilization Reference Selector Switch - HOR (P)

k. Clearance Plane - Set to 400 feet (P)

(1) Returns Should Disappear - Checked (P-CP)

Retention of returns indicates a positive error (error in safe direction).

l. Clearance Plane - Set to briefed TA altitude (P); Cross-checked (CP)

WARNING

Check that the clearance plane is not set to a value less than briefed setting.

m. Stabilization Reference Selector Switch - FRL (P)

n. Instrument Hood - As required (P/CP)

o. Final Descent to TA Altitude - Accomplished (P/CP)

NOTE

- Final descent will be accomplished in plan mode with FRL stabilization (at proper FRL speed). Check that clearance plane is set as desired. Maintain plan display free of returns 1/8 inch each side of ground track line from the 3-mile range mark to vertex of scope; maintain video outside the 3-mile range mark along the centerline.
- Pilot flying aircraft monitors TA display, radar altimeter, and flight instruments. Pilot not flying aircraft monitors aircraft position and aircraft systems operation.

WARNING

The primary duty of pilot not flying the aircraft is to visually monitor the terrain clearance of the aircraft.

16. Autopilot Low Level Switch (Low Altitude Tactic Only; if TA Letdown is not used) [52] - LOW LEVEL (P/CP)

17. Starter Switches - OFF (if applicable) (CP)

REVERSE SIDE INTENTIONALLY LEFT BLANK

BEFORE LANDING

BEFORE LANDING CHECKLIST (Copilot/EW reads)

1. Navigation System Select Switch - As desired (P/CP)
2. Fuel Panel - Checked (CP)
3. Landing Gear - Checked down (CP)
4. Airbrake Lever - Position 2 (P)
5. Wing Flaps - 100%, lever down (CP)

Allow aircraft to decelerate to 220 knots IAS. Copilot extends flaps at the request of the pilot and monitors flap indicator to ascertain both flaps are extending simultaneously. Copilot will report when the flaps are 50% and full down. Flap lever will be left in DN. Flap extension time is 40 seconds. Flaps may be extended during the last 500 feet of the penetration.

CAUTION

Wing flap operation shall be discontinued within 10 seconds if flaps fail to start moving. Any additional attempt to start the flaps shall be limited to 10-second intervals of actuation. Do not use either flap motor for more than eight attempted starts in any 30-minute period.

6. AGM-28 Engine Control Knob(s) - As required (CP)
7. Crosswind Crab - Set and down (CP)

Obtain wind direction and velocity from the control tower. Compute and set crosswind crab as required. If crosswind crab is not to be used, knob and position indicator must be checked for zero setting and gear position.

CAUTION

If wheel brakes are applied immediately before and held during touchdown when the main gear is turned more than 14° (by any combination of crosswind crab setting and steering), the airplane will land with wheels locked because the antiskid system is inoperative in this condition. When the landing gear is turned, the landing gear centering cams compress the landing gear. At more than 14° from center, the landing gear is compressed enough to actuate landing gear safety switches as if the airplane were actually on the ground. The antiskid system (which is tied into the landing gear safety switches) allows the wheels to be locked when the airplane is on the ground and not moving. Releasing the brakes will activate the antiskid system.

8. Best Flare Speed _____ Knots - Rechecked (CP-N)

Copilot computes best flare speed for airbrakes in position 2 and cross-checks airspeed indicator with pilot's indicator.

APPROACH

Since conditions at airports are continually changing, the landing approach techniques must be varied to meet existing conditions. In general a normal landing pattern can be used. With full airbrakes, the gliding angle is approximately the same as that for a propeller-driven airplane. The chart in figure 2-16 shows the slope of the approach path for a landing made with various thrust and airbrake settings. The procedure that follows is typical of the techniques that may be used.

APPROACH PROCEDURE

Referring to figure 2-19, the downwind leg is entered at the altitude specified in applicable regulations. The "Before Landing Checklist" will be completed at this point and the airspeed reduced to 30 knots above computed best flare speed. The turn from downwind leg will be a descending 90° turn to a base leg with a reduction in airspeed and altitude. Roll out to a wings-level attitude while descending on base leg for sufficient duration (approximately 10 seconds) to allow for visual clearance of other aircraft in all directions. A 90° descending turn to final approach will then be initiated and, at completion of rollout on final approach, the airspeed will be 10 knots above computed best flare speed, minimum altitude 800 feet above the runway.

A 30° bank will be the maximum allowable in the traffic pattern. During the final approach, the airspeed will be held constant and the glide path maintained by throttle adjustment and further extension or retraction of the airbrakes as needed. The 10 knots above best flare speed will be maintained until the flare point is reached. As the flare point is reached and the airplane is rotated for landing, the throttles will be retarded so as to cross the end of the landing runway at best flare speed. After touchdown, the airbrakes should be fully extended and the drag chute deployed.

NOTE

- When unusual fuel loadings, heavy weights, or other than normal conditions exist, the stabilizer trim setting should be noted when on the downwind leg in straight and level flight at best flare plus 30 knots with gear and flaps down and airbrakes in position 2. The stabilizer trim noted should be used as a target trim setting in case of a go-around or a touch-and-go landing.

- During the approach and landing, the copilot should monitor the altitude and airspeed and warn the pilot when above or below safe altitude or airspeed or whenever the angle of bank exceeds recommended values.

- On aircraft RG, anticipate higher control column forces during all low speed operation. Be especially alert to this condition during the landing flare. See "Elevator Feel Characteristics" under "Flight Control System Characteristics," Section VI.

- If a crosswind leg is flown, the aircraft will be rolled out to a wings level attitude on the crosswind leg for sufficient duration to permit visual clearance of other aircraft in all directions.

- The pilot's and/or copilot's sliding window may be opened at normal traffic pattern speeds while in the traffic pattern provided all escape hatches are in place. If an escape hatch has been released, the opening of a sliding window should be avoided as inward acting airloads may cause the sliding windows to blow into the cabin area.

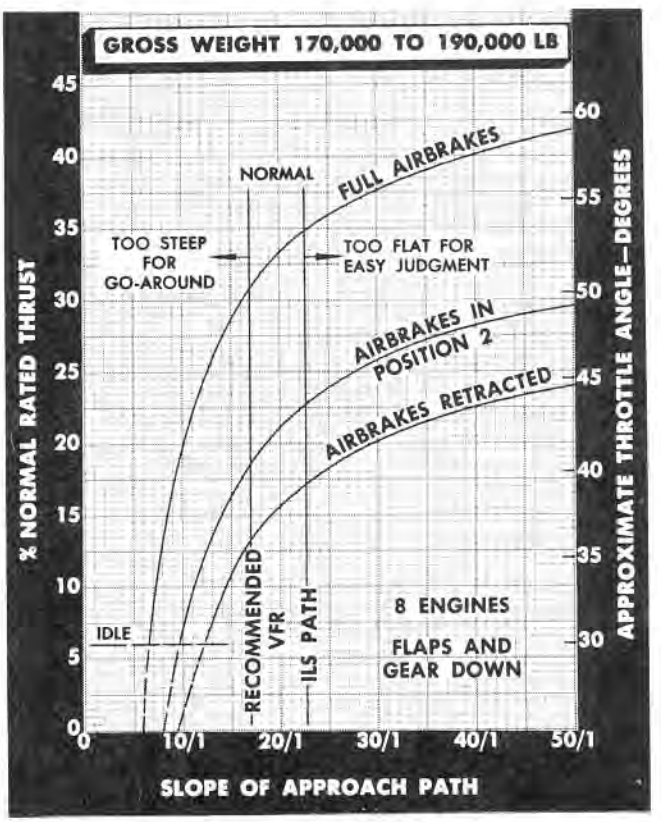
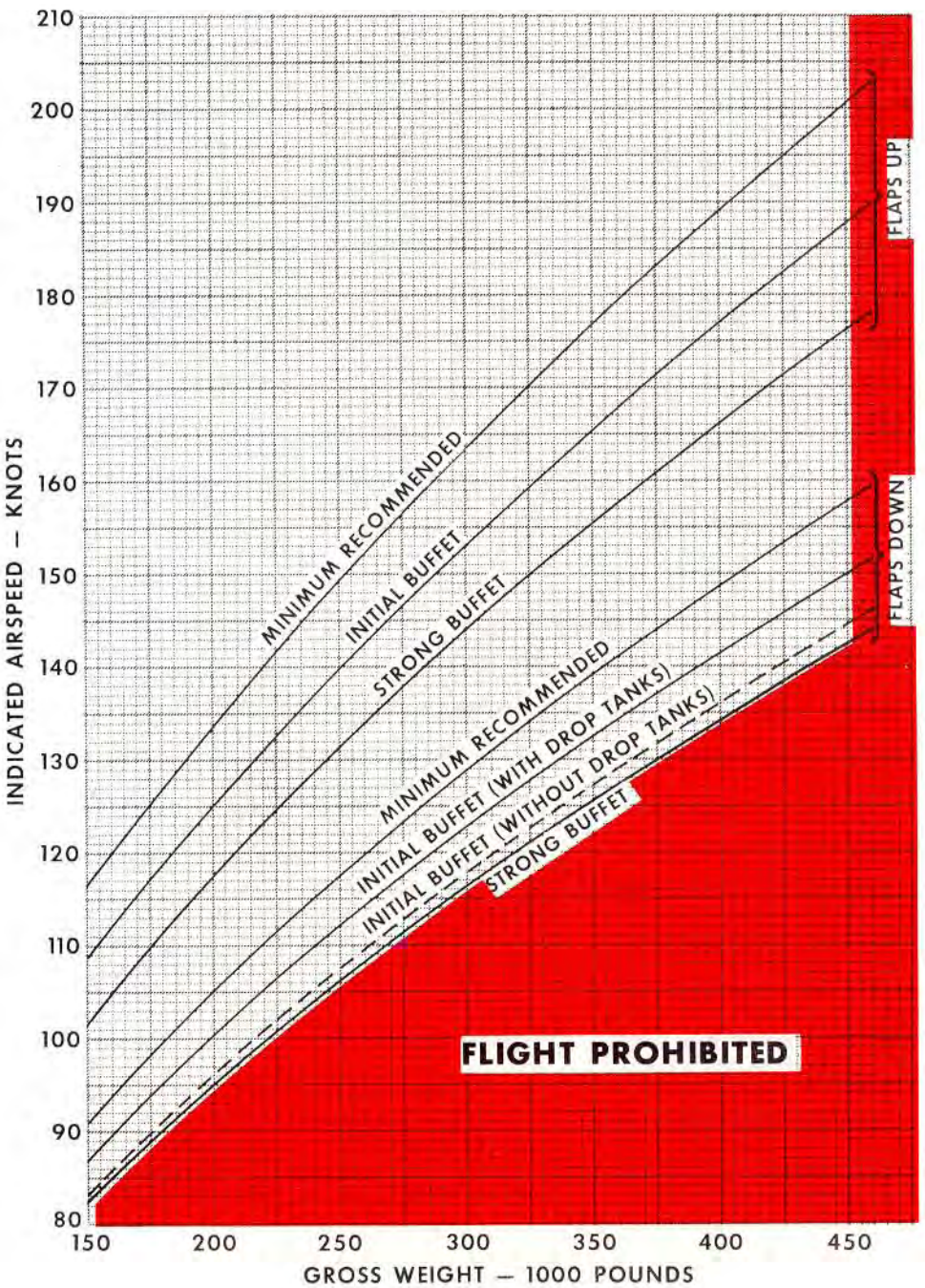


Figure 2-16.



CONDITIONS:

- NO GROUND EFFECT
- WITH OR WITHOUT DROP TANKS EXCEPT AS NOTED
- LANDING GEAR UP OR DOWN
- SEA LEVEL TO 10,000 FEET

REMARKS:

- Landing gear extension or retraction has no effect on speeds shown.
- Increase chart airspeed by 1% for each 5,000 feet above 10,000 feet pressure altitude.

.....minimum speeds - low altitude

Figure 2-17.

Heavy Weight Landing

It is possible to make landings at any weight up to the maximum gross weight as long as rates of descent at touchdown are limited (see "Weight Limitations," Section V). Since most landing experience will have been obtained at gross weights less than 270,000 pounds, landings below this weight will be considered a routine operation. If necessary to land the airplane above 270,000 pounds, normal landing techniques may be used up to approximately 325,000 pounds. If it should become necessary to land the airplane above 325,000 pounds gross weight, the following techniques are recommended:

1. Do not use airbrakes. Approach speed will be 10 knots above the no airbrake best flare speed. The slower approach and flare speed with zero airbrakes will give less flare distance. The danger of a hard landing will also be less because of the slower deceleration when not using airbrakes.
2. Intercept the approach path farther out than usual. Maintain a fairly normal approach slope with rates of descent on the order of 500 fpm. Plan to arrive over the end of the runway at the best flare speed at a lower altitude than for a normal landing.
3. Reduce thrust cautiously during the landing flare to insure that the rate of descent is controlled. The key to a good heavy weight landing is not the attitude but speed control using thrust after crossing the end of the runway. The aircraft may settle very rapidly if thrust is suddenly reduced.
4. The landing attitude will be approximately the same as for a normal landing.

To determine approach speeds and to estimate flare and runway stopping distances, see Part 9 of the Appendix.

Airbrakes

The airbrakes are operated by a throttle-type control located next to the throttle quadrant and offer a very effective means of controlling the approach path and speed. Speed can be bled off quite rapidly by their use. The airplane noses up when airbrakes are extended, but the trim change is easily handled by elevator use or by retrimming. It is recommended that position 2 be used because it produces a reasonable glide angle and a comfortable approach attitude. Best flare speed for airbrake position 2 is approximately 10 knots faster than the no airbrake best flare speed. If it is desired to make a steeper approach, greater amounts of airbrake up to full application can be used. However, when using more airbrakes, higher speeds should be held such that at full airbrake deflection, best flare speeds of approximately 20 knots greater than the recommended no airbrakes best flare speed are maintained. This is recommended because of the very rapid bleed off of speed during the landing flare when full airbrakes are used. The minimum touchdown speed is not changed regardless of the amount of airbrake extension although there is some change in landing attitude. Using full airbrake extension changes the touchdown attitude to such an extent that at minimum touchdown speed the airplane will touch down rear gear first with the front gear about one-third of a wheel diameter in the air. Touching down all wheels simultaneously with airbrakes fully extended will add 11% to the minimum touchdown speeds. Stalling speeds are not affected by airbrake position. With practice, airbrakes can be used to a great extent to vary the approach and landing pattern, to steepen the final approach, or to reduce airspeed rapidly.

Minimum Speeds

The minimum recommended airspeeds at which the airplane should be flown in straight flight with flaps either up or down are given on figure 2-17. It must be remembered that in turns the minimum speeds must be increased from those shown.

LANDING

LANDING WITH GUSTY WIND CONDITIONS

Gusts seldom exceed ±50% of the average wind velocity. It is not necessary to increase the final approach speed for gust velocities up to and including 15 knots. For gust velocities in excess of 15 knots, the final approach speed should be increased two-thirds of the gust velocity in excess of 15 knots. For example, with a wind velocity of 20 knots with gusts to 50 knots, 10 knots would be added to the final approach speed (total gust velocity 30 knots; 30 - 15 = 15 knots; 15 x 2/3 = 10 knots).

TOUCHDOWN

The recommended touchdown is with the rear gear first at minimum touchdown speed. (See Part 9 of the applicable Appendix for landing speeds.) This allows an adequate flare and prevents a bounce; however, if the forward gear is too high when the rear gear touches, a

hard landing may result. Full airbrakes should be applied immediately after touchdown provided there is no bounce. With the antiskid system operative, the wheel brakes may also be applied immediately after touchdown although this decreases brake service life. The runway available will determine when the wheel brakes should be applied. The normal landing charts in Part 9 of the applicable Appendix show the landing ground roll distances with wheel brakes applied at 90 knots IAS. See "Minimum Run Landing," this section, for more details on use of brakes and drag chute.

NOTE

The front gear is well forward of the cg and if allowed to touch down first, a bounce is almost certain to occur. This usually is the result of too much speed.

CROSSWIND LANDING

Prior to or during the time the airplane is in the traffic pattern, a decision must be made as to whether or not the crosswind crab system is to be used. After obtaining the wind direction and velocity from the tower located at the field at which the landing is to be made, compute the crab angle for the wind and landing gross weight.

NOTE

- Sustained runway wind velocity plus one-third of the gust factor will be used to compute crosswind crab settings when landing with gusty wind conditions.
- If a crosswind cannot be compensated for by use of the crosswind crab system, a landing is not recommended.

CAUTION

If wheel brakes are applied immediately before and held during touchdown when the main gear is turned more than 14° (by any combination of crosswind crab setting and steering), the airplane will land with wheels locked because the antiskid system is inoperative in this condition. When the landing gear is turned, the landing gear centering cams compress the landing gear. At more than 14° from center, the landing gear is compressed enough to actuate landing gear safety switches as if the airplane were actually on the ground. The antiskid system (which is tied into the landing gear safety switches) allows the wheels to be locked when the airplane is on the ground and not moving. Releasing the brakes will activate the antiskid system.

With Use of Crosswind Crab System

Smooth landings can be made through use of the crosswind crab system even though crosswinds of high velocity are encountered. Such landings also require very little additional effort from the pilot. Touching down with the airplane in a crabbed attitude may seem strange the first few times such landings are tried, but this technique is easily learned by the pilot.

CROSSWIND CRAB SETTING. After voice radio contact has been established with the tower, obtain the runway surface wind and direction. The most accurate wind measurements are obtained close to the ground. Limited experience indicates that 50% of tower values closely approximate runway winds. If only uncorrected tower wind values are used, it is recommended that the crab setting be established using 50% of tower values. From this data and with the aid of the chart located in a holder on the aisle stand and reproduced as figure 2-18, determine the crosswind crab setting to be used in the landing. A more precise setting can be obtained if desired by reference to the chart in Part 9 of the applicable Appendix. After the landing gear has been extended, turn the crosswind crab control knob until the miniature airplane and pointer on the indicator are in alignment at the crab angle setting determined for the wind and gross weight. Extend the flaps, raise airbrakes to position 2, and control the airspeed in the same manner as for a normal approach. After rolling out onto final approach and after the airplane is crabbed into the wind to give a flight path straight down the runway, recheck the position of the miniature airplane and pointer on the crosswind crab control indicator. The nose of the airplane, as well as the nose of the miniature airplane and pointer on the indicator, should always be pointed off the runway into the direction of the wind component. Lower the crosswind crab control knob after crab setting has been established.

CROSSWIND CRAB PRE-ALIGNMENT

RELATIVE WIND DIRECTION	CROSSWIND - KNOTS 10	20	30	40
20°	2°	3°	5°	7°
40°	3°	6°	10°	13°
60°	4°	9°	13°	17°
90°	5°	10°	15°	20°

Above data computed for gross weights between 225,000 and 270,000 pounds, flaps down. (Refer to Part 8 of the applicable appendix for flaps up.)

..... crosswind crab settings

Figure 2-18.

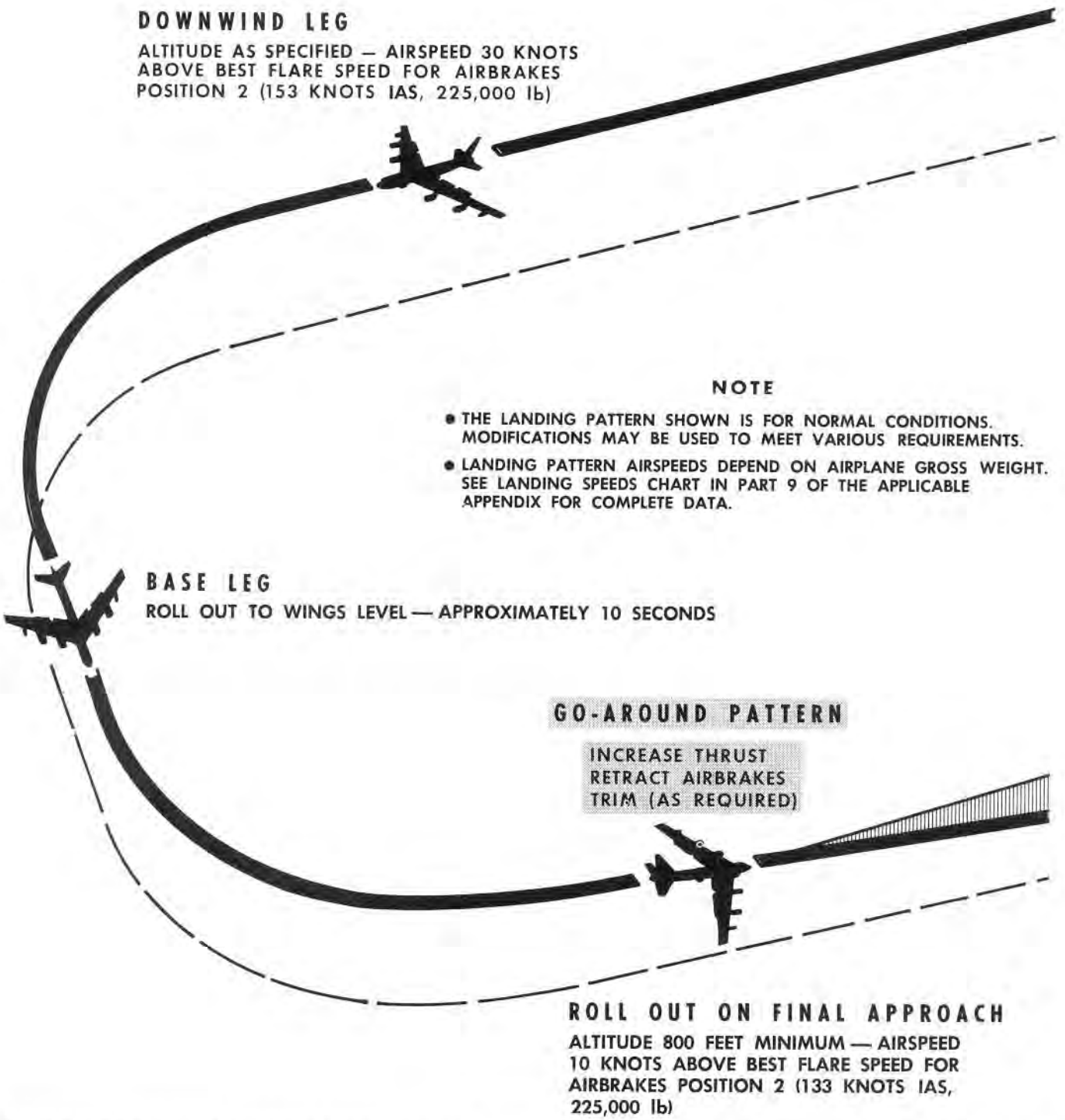
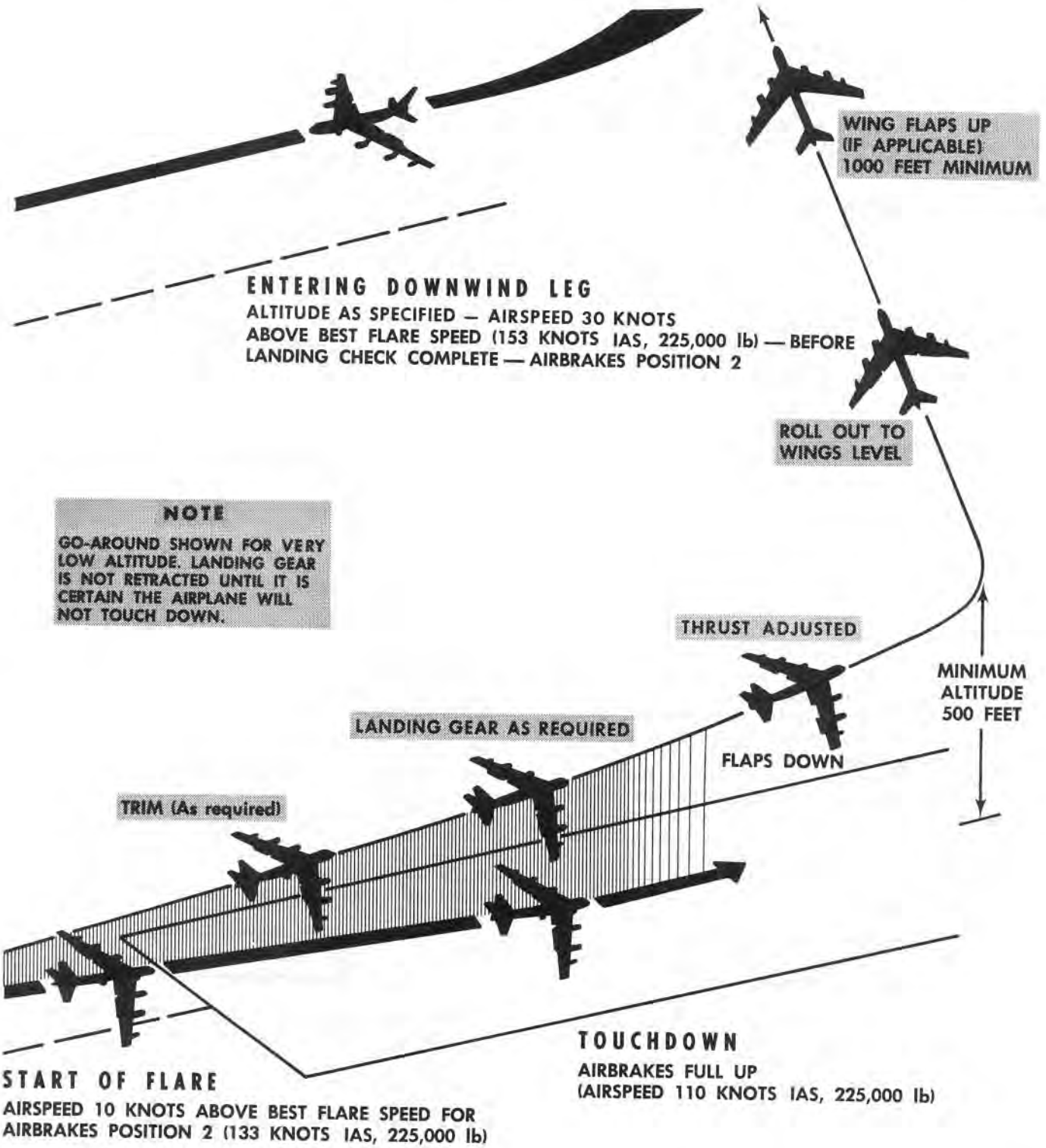


Figure 2-19 (Sheet 1 of 2).



.....landing and go-around patterns (typical)

Figure 2-19 (Sheet 2 of 2).

WARNING

Make certain that the miniature airplane on the crosswind crab position indicator is pointed the same direction as the actual airplane is crabbed relative to the runway.

CAUTION

If rudder trim is used on landing, be certain that the crosswind crab control knob is not turned instead of the rudder trim knob since they are located near each other.

NOTE

The upper and lower pointers on the crosswind crab position indicator may show a difference in heading once crosswind trim is established. This condition is normal and is caused by the fact that only the forward gear are steerable and operate even when set for crosswind conditions. As a result, any rudder pedal deflections will show up as a difference in indication between the two pointers.

LANDING ROLL. After the airplane is on the runway, more and more lateral control will be required to hold the wings in a level position as the speed decreases. When the wings can no longer be maintained in a level position, begin to decrease the crosswind gear setting by using the crosswind centering button as needed, or by turning the crosswind crab control knob. Continue to gradually reduce the crab angle setting on the gear until the gear is in the normal straight ahead position at the end of the landing run. Do not remove crosswind crab too soon or too rapidly as some of the usefulness of the crosswind crab system will be lost. The crosswind crab system is not normally used to steer the airplane on the ground.

CAUTION

Heavy braking should not be applied with large amounts of crosswind crab still existing, as this could result in the airplane ground looping on wet or icy runways.

NOTE

Be alert for indication of a missetting of crosswind crab at touchdown. Corrections should be accomplished by normal rudder pedal steering. Do not use the crosswind crab control knob for steering except in an emergency. On very smooth landings, a missetting of crosswind crab will not immediately manifest itself by the airplane diverging off either side of the runway; the first indication of incorrect setting will be a deceleration force due to tires scuffing.

Without Use of Crosswind Crab System

If the crosswind crab system is not to be used because of low crosswind, the landing may be made by approaching fully crabbed with rudder and ailerons centered. If desired, a combination of crabbing into the wind and a slight lowering of the upwind wing may be accomplished, but the wing should not be lowered to such an extent that the tip gear touches the ground first upon landing. Touchdown in the crabbed attitude with normal landing rates of descent will not induce detrimentally high side loads on the landing gear since the gear is lightly loaded at this time. By landing rear gear first, the airplane will tend to pivot about the rear gear and thereby reduce the crab angle by the time the forward gear touches. Full airbrakes should be applied and the drag chute may be deployed at touchdown since forward gear steering will be adequate by the time the drag chute becomes effective.

MINIMUM RUN LANDING

The approach for a minimum run landing should be planned so as to arrive over the end of the runway with the throttles at IDLE and at a speed as close to best flare speed as possible. A minimum run landing is accomplished by having the brake antiskid system operative, deploying the drag chute, using full airbrakes after touchdown, applying maximum effort to the wheel brakes immediately after touchdown, and continuing throughout the landing roll. The drag chute provides considerable deceleration force over the first portion of the landing roll while the wheel brakes have a small decelerating effect because the wheels are lightly loaded. As the airplane decelerates, the drag chute becomes less effective while the brakes become more effective.

CAUTION

All landings should be planned from a landing distance standpoint as though the drag chute is not installed. The use of the chute should be considered only as an aid to braking and a means of reducing tire and brake wear.

NOTE

Deployment of the drag chute or application of brakes prior to touchdown is not recommended.

WHEEL BRAKE APPLICATION

Each wheel is equipped with a complete brake antiskid assembly, eight units per airplane. Therefore, when one wheel approaches a skid and the brake pressure is released by the skid detector, no other wheel brake assembly is affected. Regardless of this desired feature however, the wings should be held as near level as possible during the landing roll so that all wheels are on the ground. If the wings are not level, the high tire on each landing gear becomes lightly loaded causing a loss in braking effectiveness, because of the limited braking torque on the heavily loaded wheels. Optimum braking effectiveness with antiskid operative is obtained by depressing the rudder pedals fairly hard and letting the individual brakes cycle as required to prevent skids. Application of a fairly hard force on the brake pedals will result in the heavily loaded wheels being cycled at a slower and more desirable rate while the lightly loaded wheels are cycled quite rapidly. This cycling can be felt by the pilot and becomes quite noticeable, especially if several of the gears cycle on and off at approximately the same time. If several of the gears do start to cycle in unison and cause a violent vibration, the pedals should be released momentarily and then reapplied. The difference between conventional braking and use of antiskid is that, with antiskid operative, the brakes can be applied earlier in the landing roll and maximum braking can be maintained throughout the entire roll without excessive tire wear due to skids. On slippery surfaces at low taxi speeds, wheel deceleration is very fast when brakes are applied, and skid signals are generated more frequently releasing brake pressure before a locked wheel occurs. Airplane deceleration is not felt by the pilots because of the fast cycling of the antiskid system. However, the use of antiskid under these conditions is the recommended procedure since attempting to brake without it results in greater stopping distances. See "Touchdown," this section, and Part 9 of the applicable Appendix for maximum rolling speeds for brake application. For brake energy limits, see figure 5-7A.

DRAG CHUTE DEPLOYMENT

Normally the drag chute will be deployed on all landings. The drag chute should be deployed only after touchdown. The time required for the drag chute to open is about 4 seconds after the drag chute lever is pulled to DEPLOY position. It is not recommended that the drag chute be deployed during the flare while the aircraft is floating since there is a tendency for the aircraft to pitch up or down, depending upon the speed, and to drop in due to rapid deceleration. It is also recommended that, if the drag chute is to be used, it be deployed at a speed above 90 knots. At speeds below 90 knots, the pilot chute cannot be relied on to deploy the drag chute consistently. See Section V for drag chute limitations.

CAUTION

When landing under conditions of gusty crosswinds, light gross weight, and a slippery runway, airplane weathercocking and loss of steering effectiveness may result. See "Landing" under "Cold Weather Procedures," Section IX, for further information.

NOTE

Dragging the chute along the runway causes considerable wear on the chute suspension lines and canopy. If possible, keep engine thrust high enough at the lower ground run speeds to hold the chute off the ground until the airplane can be turned off the runway. Request the ground crew to stand by to retrieve the chute as soon as the airplane is clear of runway and chute is jettisoned.

ALTERNATOR OPERATION

B-52E

During the landing roll, sufficient engine bleed air will be available normally to operate all pneumatic-driven accessories. The copilot will monitor air pressure and overload lights to assure sufficient pneumatic air to maintain normal alternator operation. If adequate manifold air pressure is not maintained, the alternator will decrease in frequency and, upon advancing throttles, the turbine controls may not react fast enough to prevent the alternator from shutting down from an overspeed condition. Advance throttles 4 and 5 if any lights come on.

CAUTION

B-52E

When making a landing where high runway elevation and high outside air temperatures prevail, the possibility exists that insufficient pneumatic air may be available to the utility hydraulic packs. This condition may exist even though it is not indicated by the illumination of alternator overload lights. Under such conditions two alternators should be turned off during the ground roll.

NIGHT LANDING

The procedures and techniques used for a night landing are the same as those used for a normal day landing except that the landing lights should be turned on at

pilot's discretion. In addition, the terrain clearance light and the crosswind landing lights may be used at the pilot's discretion. On B-52E, more electrical power is required during night operations and sufficient thrust should be maintained during the ground roll so as to provide the required air bleed for alternator and hydraulic pack operation.

OBSTACLE CLEARANCE LANDING

The distance to touchdown after clearing a 50-foot obstacle with full flaps is shown on charts in Part 9 of the applicable Appendix. If a relatively high altitude must be maintained to clear some obstacle located within the traffic pattern, a steeper approach must be made after clearing the obstacle. A normal approach with full flaps and airbrake lever in position 2 is made with sufficient altitude to clear the obstacle. Immediately after clearing the obstacle, the airbrake lever is moved to position 6 and the approach is steepened. Should the obstacle be located close to the end of the runway, it may be necessary to place the airbrake lever in position 6 and steepen the approach before passing over the obstacle. In this case, the pilot should approach at a sufficiently high altitude to assure clearance with the steeper approach. If full airbrakes are used, the rate of descent will be higher than normal and the flare will have to be started earlier.

LANDING CHECKLIST

Accomplish after touchdown (need not be read).

1. Airbrake Lever - Position 6 (P)
2. Drag Chute Lever - DEPLOY (CP)

   In the event a go-around is not anticipated and the drag chute does not deploy, do not jettison the chute. This will permit the cause of the malfunction to be determined during the postflight inspection. See Section V for drag chute limitations.

3. Hydraulic System - Checked (P)

   Check No. 2 and emergency brake pressure (3000 (±250) psi) and all low pressure warning lights out.

4. Crosswind Crab Control Knob - Centered (P)
5. Starter Switches - OFF (CP)

   Turn starter switches OFF as soon as possible after landing to keep operating time to a minimum. (See "Ignition System Limitations," Section V.)

6. Steering Ratio Selector Lever - TAXI (P)

CAUTION

Center the rudder pedals before repositioning the steering ratio selector lever. Actuation of the lever is very difficult when the rudder pedals are deflected and could result in a dangerously abrupt change in steering angle.

GO-AROUND

The decision to make a go-around should be made as early as possible since jet engine acceleration time is relatively high and approach speeds are relatively close to touchdown speeds. Normally this decision can be made prior to touchdown. As soon as it has been decided to go around, increase thrust, retract airbrakes, trim as required, and, after it is certain that the airplane will not touch the ground, retract the landing gear.

The increase in thrust alone, depending upon the airspeed and attitude of the airplane, may require a considerable amount of nose down trim. For pilot comfort and ease of flying, the power should be adjusted during climb to flap retraction altitude to a setting which will produce a rate of climb of approximately 1500 to 2000 feet per minute. If power is reduced during this initial climb, it may be necessary to add power during flap retraction to maintain the desired speed schedule and to preclude loss of altitude. When the airplane reaches 1000 feet and 180 knots IAS, the flaps may be retracted. However, if a positive vertical velocity of 1000 feet per minute is not attained when reaching 1000 feet above the terrain, flap retraction will be delayed until an altitude of 1500 feet above the terrain is reached. Flaps should not be retracted in a turn. During the flap retraction cycle, it is required that the pilot monitor his airplane attitude as closely as possible keeping the airplane trimmed to a zero stick force especially during the last 20% of flap retraction. The normal flap retraction speed schedule should be maintained. (See figure 2-19 for a go-around pattern.) In case the decision to go around is not reached until after the airplane is on the ground and the drag chute has not been deployed, additional nose down stabilizer trim will normally be required during the takeoff roll in order to keep the nose from pitching upward as soon as the wheels are off the ground. Allow approximately 7 minutes and 5000 pounds of fuel for a go-around.

WARNING

At gross weights above 220,000 pounds, a go-around should not be attempted if the drag chute has been deployed since it is possible that the drag chute may not jettison. The go-around then would be impossible. At gross weights up to 220,000 pounds, sufficient power is available to make a go-around successfully while pulling the drag chute. The climbout should be made at 10 knots above best flare speed for a go-around while pulling the drag chute.

NOTE

When go-around is accomplished during closed traffic pattern work, the pilot may at his discretion leave the landing gear and flaps down.

GO-AROUND CHECKLIST (Copilot reads)

1. Throttles - Set (as required) (P)
2. AGM-28 Engine Control Knobs - Set (as required) (CP)
3. Airbrake Lever - OFF (P)

   Pilot will retract airbrakes, level off, and check for a positive increase of airspeed.
4. Trim - As required (P)

   At all times during go-around, pilot will make a conscious effort to keep the airplane trimmed to zero stick force.
5. Landing Gear Lever - As required (P-CP)

   Pilot will retract the gear when it is established that airplane will not contact the runway.

WARNING

To prevent flying the airplane into the ground, the pilot will exercise caution not to exert inadvertent forward pressure on the control column when reaching forward to raise the landing gear lever.

6. Thrust - Adjusted (P)

   Pilot will accelerate to desired IAS and adjust power to establish a 1500 to 2000 foot per minute rate of climb.

GO-AROUND CHECKLIST (Copilot reads) (Cont)

7. Wing Flaps - As required (CP)

Flaps will be retracted in a wings-level attitude, using the normal speed schedule and in accordance with the flap retraction procedures outlined in the "After Takeoff-Climb Checklist," this section.

NOTE

- If climbing back to altitude, perform "After Takeoff-Climb Checklist."
- If remaining at traffic pattern altitude for closed traffic, GCA, ILS approaches, etc, perform "Before Landing Checklist."

TOUCH-AND-GO LANDING

Failure to lower airbrakes and retrim the airplane for takeoff may result in excessive pitchup immediately following unstick. At any time that abnormal pitching tendencies are noted, stabilizer trim should be utilized immediately. Touch-and-go landings can normally be performed within the limits shown on the "Touch-and-Go Landing Checklist" unless additionally restricted by the major command concerned.

TOUCH-AND-GO LANDING CHECKLIST (Copilot reads)

- While touch-and-go landings may be accomplished successfully under conditions more extreme than those listed below, in the interest of flying safety, they will not be performed when:
  (1) Gross weight exceeds 270,000 pounds.
  (2) Crosswind crab control setting requirement is more than 8°.
  (3) Any spoiler is inoperative.
  (4) Any hydraulic pack and associated standby pump is inoperative.
  (5) Any time hydraulic pack No. 1, 2, 9, or 10 is inoperative.
  (6) Any time more than one hydraulic pack or standby pump is inoperative.
- Touch-and-go landings are exempted from the requirement of continuous ignition during the takeoff or landing phase.
- Steps preceded by an asterisk (*) will be accomplished on the runway. All subsequent steps are accomplished while on downwind leg.

*1. Airbrake Lever - Position 6 (P)

*2. Stabilizer Trim - **RESET FOR TAKEOFF**

Pilot not flying the aircraft will position the stabilizer trim setting to 1 unit nose down and notify other pilot that trim has been reset.

WARNING

If the stabilizer trim is not reset prior to takeoff, the excessive amount of nose up trim will cause a pitchup after takeoff. Any pitch attitude changes following a takeoff must be countered immediately by continuous use of the stabilizer trim in addition to control column movement.

*2A. Airbrake Lever - OFF (P)

It is essential that the airbrake lever be returned to the OFF position before executing the takeoff following a touch-and-go to preclude an unexpected pitchup following takeoff.

TOUCH-AND-GO LANDING CHECKLIST (Copilot reads) (Cont)

*3. Throttles - Advanced

The pilot performing the takeoff after a touch-and-go landing will advance the throttles to near vertical position of the quadrant allowing engines to accelerate and stabilize before any additional power is applied. Do not advance throttles beyond the vertical position until the pilot resetting stabilizer trim has verbally verified that the trim has been reset for takeoff. The pilot occupying the other seat will monitor the engine instruments and notify the pilot making the takeoff of any abnormal engine acceleration characteristics.

4. Landing Gear - Checked six down (P)

Pilot checks lever detent and landing gear position indicators.

5. Fuel Panel - Checked (CP)

Crossfeed valve switches 9 and 12 will be positioned to OPEN when any main tank indicates 5000 pounds or less.

6. Wing Flap Lever - DN (CP)

7. Crosswind Crab - Set and down (CP)

7A. Yaw Damper Switch SY - ON (P/CP)

8. Best Flare Speed - _____ Knots (CP-N)

Copilot computes best flare speed for airbrakes in position 2 and cross-checks airspeed indicator with pilot's indicator.

9. Airbrake Lever - Position 2 (P)

TAXI-BACK LANDING

Full stop taxi-back landings may be accomplished under the following limitations:

1. Airplane gross weight will not exceed 250,000 pounds.
2. Dry runways must prevail during the period in which this activity is being conducted.
3. Touchdown will be accomplished in the first third of the existing runway to include the sterile portion at the end.
4. Normal no-brake-chute stopping distance will not exceed 50% of the available runway exclusive of the sterile portion of the approach end.
5. After establishing a stable ground roll, brakes will be checked for operation followed by intermittent full application.
6. Landing gear will remain down in the traffic pattern for all subsequent landings. A minimum interval of 15 minutes air time will be established between landings or prior to retracting the gear to provide wheel and brake cooling.
7. A maximum of four full stop taxi-back landings may be accomplished on one sortie. The fourth landing may be followed by a final full stop landing utilizing the brake chute.

TAXI-BACK LANDING CHECKLIST (Copilot reads)

NOTE

Taxi-back landings may be accomplished using the following checklist and the "Before Landing Checklist."

1. Airbrake Lever - Position 6 (P)

TAXI-BACK LANDING CHECKLIST (Copilot reads) (Cont)

2. Wheel Brakes - Check (P)

   After establishing a stable ground roll, brakes will be checked for operation, followed by intermittent application of brakes as required.

3. Crosswind Crab Control Knob - Centered (P)
4. Steering Ratio Selector Lever - TAXI (P)
5. IFF - STDBY (N)
6. Airbrake Lever - OFF (P)
7. Stabilizer Trim - Reset to 1 unit nose down (P-CP)
8. Control Surface Trim - Set (P)
9. Wing Flaps - 100%, lever DN (P/CP)
10. Fuel Panel - Set as required, valves 9 and 12 open (CP)
11. Crew - Stand by for takeoff (CP-G)

11A. IFF - NORM (N)

12. Crosswind Crab - Set and down (P-CP)
13. Steering Ratio Selector - TAKEOFF LAND (P)
14. Throttles - Set
15. 70 Knots - Now (P)
16. S_1 - Now (N/CP)
17. Unstick (S_2) - Now (CP)
18. Stabilizer Trim - Monitor (CP)
19. Yaw Damper Switch SY - ON (P/CP)

AFTER LANDING

The after landing check shall be performed after the airplane has been turned off the runway. Hard taxi braking or riding the brakes shall be avoided at all times, particularly after a landing or refused takeoff. See "Wheel Brake System Operation," Section VII.

AFTER LANDING CHECKLIST (Copilot reads)

Accomplish after turning off the runway.

CAUTION

Maintain manifold pressure above 15 psi while making sharp turns. Power should then be adjusted for normal taxi operations to prevent excessive use of brakes.

1. Drag Chute Lever - JETTISON (CP)

   The drag chute will be jettisoned by the copilot after the aircraft has turned off the runway and prior to being stopped for completion of the "After Landing Checklist."

AFTER LANDING CHECKLIST (Copilot reads) (Cont)

2. Parking Brake - Set (P)
3. Arming Lever Safety Pins (two) - Installed (P-CP)

   Install pins before leaving seat.
4. Airbrake Lever - OFF (P)
5. Stabilizer Trim - Reset to zero (and CUTOUT TK) (P)
6. AGM-28 Engine Control Knobs - OFF (CP-N)
7. Deleted
8. Hydraulic Packs No. 5, 6, 7 & 8 (and, TK , 9 & 10) - OFF, master warning light reset (P)
9. Spoiler & Stabilizer Standby Pump Switches - OFF (P)
10. Bomb Door Switch - OPEN (P)

CAUTION

Copilot monitors manifold air pressure and verifies that manifold pressure is 30 psi minimum just prior to bomb door opening operation in order to maintain sufficient hydraulic pack output to prevent damage to bomb doors.

11. Aft Alternators B-52E - OFF (CP); Alternator Circuit Breakers for Engines 1 and 7 B-52F - OPEN (CP)

NOTE

B-52E

Copilot will monitor air pressure and overload lights to assure sufficient pneumatic air to maintain normal alternator operation. If adequate manifold air pressure is not maintained, the alternator will decrease in frequency and, upon advancing throttles, the turbine controls may not react fast enough to prevent the alternator from shutting down from an overspeed condition.

12. Starter Selector Switch - GROUND START (CP)
13. Air Bleed Switches - OPEN (CP)
14. Unnecessary Electrical Equipment: (P-CP)
    a. Liaison Radio, TACAN & Omni Power Switches - OFF
    b. Anticollision Lights - OFF
    c. Navigation Lights - FLASH
    d. Machmeter Switch (if installed) - OFF
    e. Pitot Heat Switches - OFF
    f. Windshield & Nacelle Anti-Ice - OFF
    g. Radar Altimeter SQ - OFF
    h. Autopilot Master Switch - OFF
15. Readiness Switch Cover - Closed, pin inserted (P)

AFTER LANDING CHECKLIST (Copilot reads) (Cont)

16. Throttles 1, 2, 7 & 8 - 75% rpm, then CLOSED (P-CP)

While taxiing back to the ramp, advance throttles 1, 2, 7, and 8 to approximately 75% rpm for 30 seconds before moving to the CLOSED position. This will insure complete scavenging of engine oil and prevent overservicing. This procedure will also prevent fuel from accumulating underneath the engines after shutdown.

NOTE

If the engine is allowed to idle for more than 27 seconds, the oil sump area will fill and require scavenging again.

17. Fuel Panel - Checked (CP)

Close all fuel valves not required.

18. Sliding Window - Open (CP)

Copilot opens sliding window approximately 2 inches to relieve cabin pressure.

ENGINE SHUTDOWN

CAUTION

Normally an engine will be sufficiently cool after landing to permit an immediate shutdown. If an engine has been operating at above 85% rpm for a period exceeding 1 minute after landing, allow the engine to idle at least 5 minutes before shutting down. This will prevent damage resulting from rapid temperature change.

BEFORE LEAVING AIRPLANE

BEFORE LEAVING AIRPLANE CHECKLIST (Copilot reads)

1. Parking Brake Lever - ON (P)

1A. AGM-28 B-52 Power Switches - OFF (CP-N)

2. Air Conditioning Master Switch - RAM (CP)

3. Attitude & Directional Gyro Power Switch - OFF (P/CP)

3A. Stabilizer Trim Less TK - Checked, reset to zero and CUTOUT (P)

a. Pilot assures that the stabilizer is positioned at zero units and firmly grips the manual trim wheel while actuating the electric trim switch to the NOSE DN position. The ground observer reports, "Stabilizer leading edge moving up." Pilot continues to actuate the trim switch and holds the trim wheel until the ground observer reports, "Leading edge has stopped." (The stabilizer will move until the cable slack is taken up between the trim wheel and actuator.)

b. Pilot releases electric trim switch and retains grip on manual trim wheel until all imposed trim forces have disappeared. The stabilizer should return to its original position.

NOTE

Approximately 55 pounds of force at the trim wheel will be required before the electric motor clutches will slip. A maximum of 10 seconds trim motor slippage is permissible. Ten minutes cooling must be allowed before additional slippage checks in the same direction can be made. This does not limit normal operation of the electrical trim motor.

BEFORE LEAVING AIRPLANE CHECKLIST (Copilot reads) (Cont)

c. Repeat the above check with trim switch actuated to NOSE UP.

4. Seat Positioning Switch - DOWN and AFT (P-CP)
5. Standby Pump Switches - OFF (P)
6. Alternator Switches B-52E - OFF (CP); Alternator Circuit Breakers for Engines 3 and 5 B-52F - OPEN (CP)
7. External Power (if available) - OFF, checked and ON (CP)
8. Throttles - 75% rpm, then CLOSED (P)

NOTE

Before shutting down any engines, advance throttle to 75% RPM to accomplish scavenging. Sufficient engine scavenging will be accomplished by 30 seconds of engine operation at 75% RPM. Move throttle to CUTOFF within a few seconds after retarding throttle from the 75% setting. If the engine is allowed to idle for more than 27 seconds, the oil sump area will fill and require scavenging again.

9. UHF Radios - OFF (CP)
10. Fuel Switches - OFF (CP)
11. Hydraulic Pack Switches - OFF & RESET (guards open) (P)
12. Battery Switch - OFF (CP)
13. Oxygen System - OFF and 100% OXYGEN (P-CP)
    a. Oxygen Supply Shutoff Lever - OFF
    b. Regulator Diluter Lever - 100% OXYGEN
    c. Supply Hose - Disconnected and stowed
14. Wheel Chocks - In place (GC)
15. Parking Brake Lever - OFF (P)
16. Light Switches - OFF or as required (P-CP)
17. Control Columns - Disconnected (P-CP)

    Do not allow control column to slam forward.

18. Interphone Switch - OFF (P)

POSTFLIGHT

The copilot will check for possible cold brakes. He will consider the conditions contained in "Brake Design" under "Wheel Brake System Operation" in Section VII before writing up a cold brake discrepancy. The pilot will assemble the crew to collect completed logs and forms and discuss items pertinent to the mission. If applicable, AGM-28 Form 781's and Form 650 will be completed. The pilot will interrogate each crew member to determine proper entries in Form 781 to facilitate maintenance inspections.

1. Record any limits in the Flight Manual that have been exceeded during the mission.
2. Record the occurrence of any of the following:
   a. Stick forces in excess of 100 pounds.
   b. Low altitude flight time (record airspeed attained, accelerometer readings and frequency of turbulence encountered, and airspeed at which turbulence encountered).
   c. On aircraft Less UR, encountering turbulence at any altitude such that the accelerometer readings exceed 1.7 or 0.3 "g" (1.0 (±0.7) "g").
   d. If, in the pilot's opinion, the aircraft has encountered heavy loads due to turbulence (record highest and lowest accelerometer readings).
   e. Flutter or buffet.
3. Record any unusual or excessive operations, such as:
   a. Exceeding EPR by more than 0.20 during wet or dry power check prior to takeoff.
   b. Wing flap clutch slippage of more than 20 seconds.
   c. Jettisoning of drag chute or deployment of drag chute over 135 KIAS.
   d. Long taxi runs at high speed.
   e. Excessive braking during aborted takeoffs.
   f. A live starter cartridge being carried in the starter breech during flight.
   g. The reduction in yaw damper torque that results in a tail shake or twisting of the aft body and empennage.
   h. Landing or takeoff with wheel shimmy or hard vibrations.
   i. Emergency descent or spoiler buffet being encountered.
   j. Engine failure resulting in seizure or unbalance.
   k. An alternator automatically shutting down in flight.
   l. An alternator or CSD tripoff during flight or ground operation.
   m. A leaking hot air duct.
   n. Flight through lightning.
   o. Emergency jettisoning of ADM-20 launch gear.
   p. Hard landings (any landing with sink rate in excess of allowable limits).
   q. Wet takeoff with water impurities of 10 or more parts solids per million parts.

STRANGE FIELD PROCEDURES

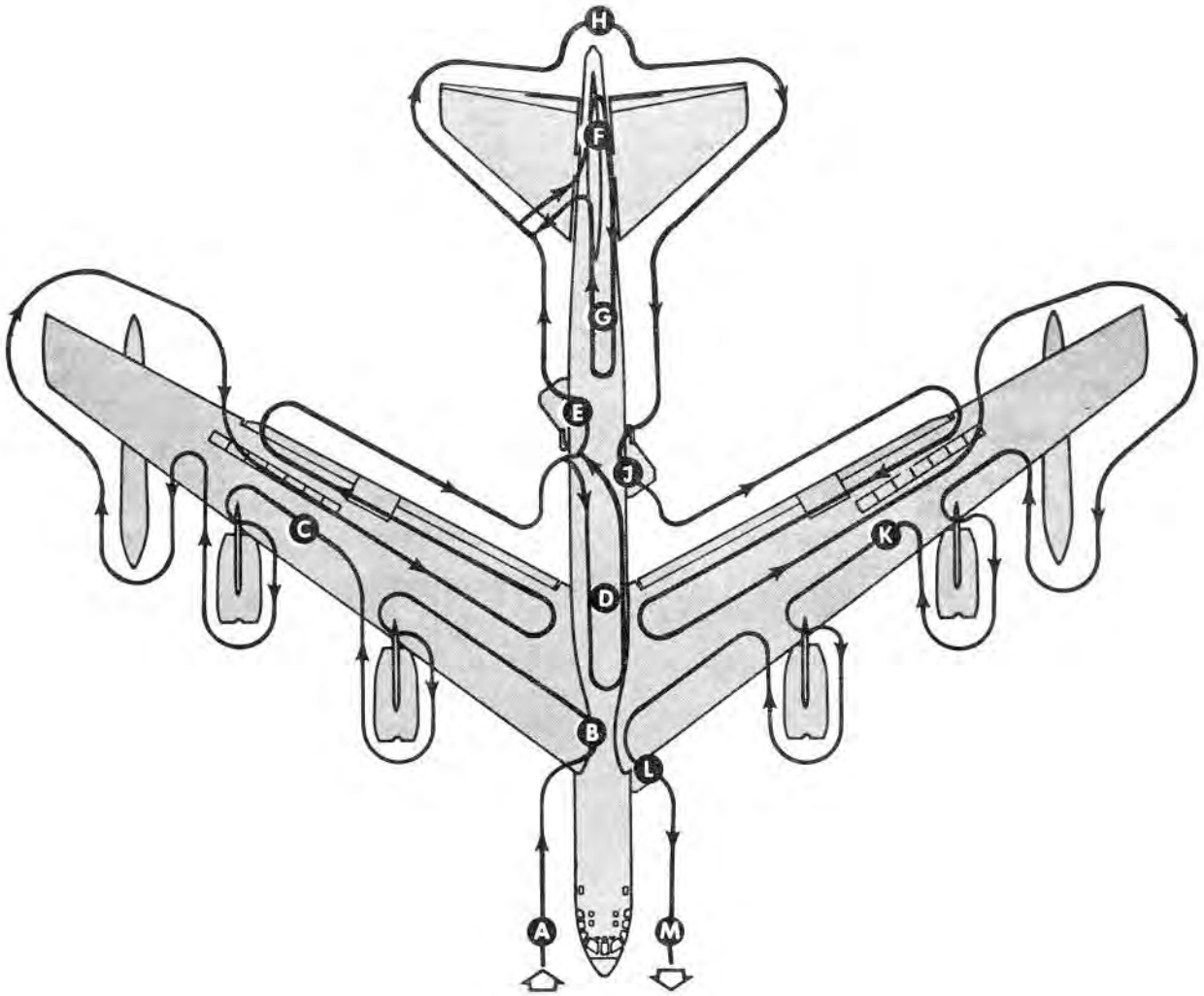
If it is necessary to land the airplane at an airfield where normal ground support is not available, there are several items which must be performed by the flight crew after parking the airplane and prior to takeoff. To assist the flight crew in accomplishing these steps properly, the following checklists are provided:

NOTE

Refer to T.O. 1B-52C-30-1 for strange field procedures when AGM-28 missiles are aboard.

AFTER PARKING

1. Parking Ramp - Checked
The pilot should ascertain that the parking ramp is constructed to withstand the airplane gross weight after refueling.
2. Wheel Chocks - In place
3. Landing Gear Ground Locks - Installed
4. Bypass Keys - Installed
5. Bomb Doors - Closed (if nuclear bomb(s) aboard)
6. Bomb Door Actuators - Disconnected (when nuclear bomb(s) not aboard)
7. Bomb Pins (if bombs are aboard) - Installed
8. Duct Plugs - In place
9. Pitot Tube Covers - In place
10. Oxygen Buildup and Vent Valve Handles - Leave in SERVICE
11. Gunnery System - Guns unarmed (if applicable)
12. Outside Turret Jettison Handle Maintenance Safety Pin - Installed
13. Windows and Hatches - Closed
14. Security Guard - Posted
15. Drag Chute (if used) - Dried and repacked



- A RIGHT NOSE SECTION
- B RIGHT FORWARD WHEEL WELL
- C RIGHT WING
- D BOMB BAY
- E RIGHT AFT WHEEL WELL
- F TAIL COMPARTMENT
- G AFT COMPARTMENT
- H EMPENNAGE
- J LEFT AFT WHEEL WELL
- K LEFT WING
- L LEFT FORWARD WHEEL WELL
- M LEFT NOSE SECTION

..... exterior inspection diagram (typical)

Figure 2-20.

PRIOR TO NORMAL PREFLIGHT

Due to unfamiliarity with this aircraft by maintenance personnel at strange fields, the following items must be closely checked by the flight crew:

1. Electrical and Air Power Carts - Available

NOTE

- Electrical power can be obtained from an MD-3 power cart or any source of 400-cycle three-phase 200 (±5)-volt a-c power having an AN3430 plug. About 10 amperes of 24-volt d-c power is needed on pin E to close the relays to energize the airplane circuits with external a-c power.

- External electrical power is not required for starting. See "Starting Engines and Before Taxiing Checklist," this section. To provide starting for QN aircraft which do not require use of external pneumatic power, starter cartridges must be installed as given under "Installation of Starter Cartridges," this section.

- Pneumatic power to start an engine can be obtained from an MA-1, MA-1A, or 502 cart. If one of the above-mentioned carts is not available, a source could be used that can supply approximately 1.8 pounds of air per second at a pressure of not more than 200 or less than 30 psi gage and at a temperature of 300° F for the length of time it will take to start an engine. If the air temperature is below 300° F, a flow of air greater than 1.8 pounds per second will be needed. The use of an air source not specifically designed for aircraft should be limited to starting one engine.

- If the available source of pneumatic power cannot supply air at a pressure of 30 psi, a start may be attempted at a lower pressure. With no other pneumatically operated equipment operating, allow available pressure to build up and stabilize, then follow normal starting procedures.

CAUTION

When attempting a start at less than 30 psi, monitor the exhaust gas temperature and starting time very closely. Close throttles immediately if EGT exceeds 550° C at a rapid rate of rise or 580° C at a normal rate of rise. Starting at reduced pressure may require starter operation longer than 1 minute, in which case the minimum rest period between starting attempts should be extended beyond the minimums set forth in "Starter Limitations," Section V.

NOTE

- See figure 1-60 for fuel, oil, and hydraulic oil grades and specifications and for power cart types.

- For partial fuel loading charts, refer to T.O. 1-1B-40, "Handbook of Weight and Balance Data."

2. Drag Chute - Installed
3. Fuel System - Serviced
4. Oil Tanks - Serviced
5. Oxygen System - Serviced as necessary
6. Water Injection System - Serviced as necessary
7. Hydraulic Packs - Checked, serviced as necessary
8. Hydraulic Pack Accumulator Preload - Checked
9. Perform normal flight crew checklist.

Installation of Starter Cartridges QN

The following procedure is applicable to installation of starter cartridges on engines No. 2 and 8.

1. First release the three outboard and then the six inboard latches which secure the lower side cowl to the upper cowl panel and lower engine strut structure. Since the lower side cowl is suspended by outboard hinges, this allows the cowling to be lowered from inboard for access and permits securing the attached support rods to the engine housing with stud bolts provided at locations opposite the cowling support rod attach fittings.

CAUTION

- To prevent bending the cowling, the three outboard (one forward and two aft) latches must be released before the inboard latches are released.

- Only one man is required for opening the lower side cowl and installing the support rods.

2. Remove breech cap from starter by pulling disconnect handle and rotating breech cap clockwise until cap becomes free.
3. Check and, if necessary, clean inside of breech cap dome to assure good electrical contact with ground clip of cartridge.
4. Remove Air Force MXU-4/A cartridge from its container.
5. Remove short-out clip from Olin Mathieson cartridge and bend ground clip up to assure good contact with breech cap. On Amoco cartridges, bend grounding clip away from electrical contact to release contact and to serve as a ground between cartridge and breech.

6. Insert cartridge in breech with ground clip end against cap dome.

WARNING

Before installing cap and cartridge on engines, insure that cartridge starter switches remain in OFF position.

7. Place breech cap in position on breech chamber and engage locking lugs. Pull disconnect handle and rotate breech cap counterclockwise until breech connector mates properly.
8. Remove support rods and position the lower side cowl to the engine strut structure. Align the latch pins with pin receptacles and secure the pins.

NOTE

With exception of steps "4," "5," and "6," the above procedure may also be used for cartridge removal.

EXTERIOR INSPECTION CHECKLIST

NOTE

The exterior inspection is designed to be accomplished normally by an experienced pilot and copilot, each inspecting one side of the airplane simultaneously, one pilot starting with nose section (right) through empennage and the other pilot starting with the left aft wheel well through the nose section (left). However, in the event only one pilot is available, he can perform the complete inspection. The following inspection is based on the assumption that appropriate maintenance personnel are not available to perform this preflight and that the flight crew is accomplishing the preflight with emphasis on the items that affect the safety of flight. See figure 2-20 for a diagram of the route to be followed during the exterior inspection. The fluid level on all hydraulic packs should be checked for the minimum readings listed in the appropriate sections of the "Exterior Inspection Checklist" regardless of pressure.

(A) Right Nose Section

1. Pitot Tube - Cover removed and clear
2. Static Ports & Drain Plugs - Checked

Check static ports clear and drain plugs installed. Static ports are located high on the right side of the fuselage and underneath the fuselage aft of the entrance door.

3. Air Ducts & Vents - Clear

Check all vent openings clear, access doors secure, duct plugs removed, and fuel cap in place.

(B) Right Forward Wheel Well

1. Landing Lights - Checked

Check right landing light and crosswind and taxi light for cleanliness, security, and glass and filament intact.

2. Wheel Chocks - In place
3. Tires & Hydraulic Lines - Checked

Ascertain tires have been inflated to proper pressure for present gross weight. Check tires for cuts, blisters, worn spots, and slippage; hydraulic lines for security and leaks.

4. Safety Switch Linkage, Torsion Link & Oleo Extension - Checked

Check oleo safety switch linkage connected and secure; torsion link connected, pin in place, and safetied; and oleo strut for cleanliness, hydraulic leaks, and proper inflation (15.8 (±0.25) inches between centers of torsion links).

5. Landing Gear Ground Lock - Installed
6. Battery Cover - Secure
7. No. 1 Hydraulic Pack Fluid Level - Checked, 3.1 gallons minimum

Visually inspect pack for general condition and check fluid level sight gage for proper servicing (3.1 gallons minimum).

8. Leaks & General Condition - Checked

Check the entire wheel well area for foreign objects, hydraulic or fuel leaks, and security of all equipment.

9. Single Point Refuel Cap - Secure
10. No. 2 Hydraulic Pack Fluid Level - Checked, 3.1 gallons minimum

Visually inspect pack for general condition and check fluid level sight gage for proper servicing (3.1 gallons minimum).

(C) Right Wing

1. Access Panels, Airscoops, Vents & Drains - Checked

Check access panels fastened and secure, plugs removed from all airscoops and vents, drains clear and unobstructed, and no leaks.

2. No. 3 Strut for Condition - Checked

Check strut for cracks, buckling, and loose rivets.

3. Engines 5 & 6 Aft Section - Checked

Check engine tail plugs removed, tailpipes free of foreign matter, and turbine buckets not nicked or missing.

4. Nacelle Cowlings & Surge Bleed Valves - Checked

Check nacelle cowlings for cracks and security and check four B-52E valves open, two B-52F, valves closed.

5. Fuel Heater Exhaust - Checked

Check fuel heater exhaust for evidence of fuel leaks.

6. Engine Oil and Alternator Cooling Exhausts on B-52F - Checked

Check alternator cooling air and water injection pump exhausts on the left-hand engine and the engine oil cooler exhausts on both engines unobstructed and no leaks.

7. Nose Section 5 and 6 (and engine oil and alternator cooling inlets on B-52F) - Checked

Check engine intake plugs removed, intakes free of foreign matter, and check for nicked compressor blades. On B-52E airplanes, check oil coolers free of dents and cracks. On B-52F airplanes, check nose dome secure and undamaged. Alternator cooling air and engine oil cooler inlets free of foreign matter.

8. Access Panels, Vents & Drains - Checked

Check access panels fastened and secure, plugs removed from all vents, drains and weep holes clear, and no leaks.

9. No. 4 Strut for Condition - Checked

Check strut for cracks, buckling, and loose rivets.

10. Engines 7 & 8 Aft Section - Checked
Check engine tail plugs removed, tailpipes free of foreign matter, and turbine buckets not nicked or missing.
11. Nacelle Cowlings & Surge Bleed Valves - Checked
Check nacelle cowlings for cracks and security and check four B-52E valves open, two B-52F, valves closed.
12. Fuel Heater Exhaust - Checked
Check fuel heater exhaust for evidence of fuel leaks.
13. Engine Oil and Alternator Cooling Exhausts on B-52F - Checked
Check alternator cooling air and water injection pump exhausts on the left-hand engine and the engine oil cooler exhausts on both engines unobstructed and no leaks.
14. Nose Section 7 and 8 (and engine oil and alternator cooling inlets on B-52F) - Checked
Check engine intake plugs removed, intakes free of foreign matter, and check for nicked compressor blades. On B-52E airplanes, check oil cooler free of dents and cracks. On B-52F airplanes, check nose dome secure and undamaged. Alternator cooling air and engine oil cooler inlets free of foreign matter.
15. Access Panels, Airscoops, Vents & Drains - Checked
Check access panels fastened and secure, plugs removed from all airscoops and vents, drains and weep holes clear, and no leaks.
16. No. 8 Hydraulic Pack Fluid Level - Checked, 3.0 gallons minimum
Visually inspect pack for general condition and check fluid level sight gage for proper servicing (3.0 gallons minimum).
17. Taxi Light - Checked
Check for cleanliness and glass intact. Check security of light mounted in tip gear door on airplanes Less JG.
18. Tip Gear Well - Checked
Check hydraulic lines and actuators secure, no leaks; wiring and other equipment secure. Check tip gear door hinges in place and secure.
19. Tip Gear Ground Lock - Installed
20. Oleo Strut, Wheel & Tire - Checked
Check oleo strut for cleanliness, hydraulic leaks, and proper inflation; shimmy damper installed. Inspect wheel for cracks and tire for cuts, blisters, worn spots, and slippage.
21. Drop Tank - Checked
Check tailcone for security.
22. Access Panels & Fuel Vents - Checked
Check access panels secure and fuel vents clear and unobstructed; no fuel leaks.
23. Wing Tip & Upper Surface - Checked
Check wing tip antennas for cracks and dents; upper wing surface for frost, snow, ice, or dust; and access openings and fuel caps in wing and fuselage for security. Check for missing or bent vortex generators.
24. Outboard Wing Trailing Edge - Checked
Check skin for cracks, buckling, and loose rivets.
25. Outboard Wing Flap Well - Checked
Check hydraulic lines for leaks and pneumatic ducts and wiring for security.
26. Inboard Wing Flap Well - Checked
Check hydraulic lines for leaks, pneumatic ducts and wiring control cables for security, and circuit breakers set.
27. No. 7 Hydraulic Pack Fluid Level - Checked, 2.8 gallons minimum
Visually inspect pack for general condition and check fluid level sight gage for proper servicing (2.8 gallons minimum).
28. Lower Surface of Wing Flaps, Aileron & Tabs - Checked
Check lower surfaces for loose rivets, cracks or buckling in skin, and security and condition of actuators and screws.
29. Upper Surface of Wing Flaps, Aileron & Tabs - Checked
Check upper surfaces for loose rivets, cracks or buckling in skin, and security and condition of rollers and connecting links.
30. Fuselage & Bomb Doors - Checked
Check fuselage and bomb doors for loose rivets, buckling, snow, and ice.

(D) Bomb Bay

1. Oxygen Regulator(s) - OFF and 100% OXYGEN
Number of oxygen regulators in bomb bay varies from zero to two, depending on kit installation.
2. Bomb Bay for Leaks, Security of Wires, Cables & Ducts - Checked
Check bomb bay for fuel and hydraulic leaks; security of wires, cables, and pneumatic ducts.

(E) Right Aft Wheel Well

1. Tires & Hydraulic Lines - Checked
Ascertain tires have been inflated to proper pressure for present gross weight. Check tires for cuts, blisters, worn spots, and slippage. Check hydraulic lines for security and leaks.
2. Safety Switch Linkage, Torsion Link & Oleo Extension - Checked
Check oleo safety switch linkage connected and secure; torsion link connected, pin in place, and safetied; and oleo strut for cleanliness, hydraulic leaks, and proper inflation (15.8 (±0.25) inches between centers of torsion links).
3. Landing Gear Ground Lock - Installed
4. Leaks & General Condition - Checked
Check the entire wheel well area for foreign objects, hydraulic or fuel leaks, and security of all equipment.
5. No. 3 Hydraulic Pack Fluid Level - Checked, 3.1 gallons minimum
Visually inspect pack for general condition and check fluid level sight gage for proper servicing (3.1 gallons minimum).

(F) Tail Compartment (Gunner Not Flying)

1. Elevation Stow Pin - Installed
2. Air Conditioning Master Switch - 7.45 PSI
3. Cabin Temperature Selector Switch - 40° F

4. Radar and Fire Control System Switches - OFF/SAFE/wired or pinned
5. Circuit Breaker Panel - Set
   a. Compressor three-phase and heater circuit breakers - Pulled
   b. All circuit breakers in unless otherwise directed

(G) Aft Compartment (Gunner Not Flying)

1. The pilot performs a walk through inspection of the aft compartment; checks for general condition, loose or foreign objects and/or leakage of any unit. Specific emphasis will be directed to:
   a. Control cables, ducting, and wiring
   b. Stabilizer nut and jackscrew
   c. FCS pneumatic pressure gage (1200 psi minimum)
   d. Oxygen converters
   e. Chaff pins
   f. Hydraulic packs
   g. Air conditioning pack
   h. ECM transmitters for hydraulic leaks
2. Emergency Cabin Pressure Dump Handle - Checked
3. Pressure Bulkhead Door - Closed

(H) Empennage

1. Access Panels, Air Ducts & Vents - Checked
Check all plugs removed from air ducts and vents, ducts and vents clear and unobstructed, and access panels secure.
2. Right Oxygen Buildup & Vent Valve Handle(s) - Checked
Check that liquid oxygen buildup and vent valve handle(s) has been placed in SERVICE; close and secure access panel.
3. Right Horizontal Stabilizer, Elevator & Tab - Checked and set at 0°
Check all surfaces for loose rivets, cracks and buckling in skin, snow, ice, and general condition. Specifically check for ice on the seal between the stabilizer and fuselage.
4. Drag Chute Compartment - Checked
Check door locked indicator pin flush and door secure. Check that drag chute riser terminal is properly engaged in the jettison release jaws. If the drag chute has been in place during damp weather, check with crew chief to ascertain that chute is dry.
5. Ammunition Door - Closed
6. Sight Cover - Removed
Check that optical door protective cover is removed.
7. Turret - Stowed
8. Vertical Fin, Rudder & Tabs - Checked
Check all surfaces for loose rivets, cracks and buckling in skin, snow, ice, and general condition.
9. Left Horizontal Stabilizer, Elevator & Tab - Checked
Check all surfaces for loose rivets, cracks and buckling in skin, snow, ice, and general condition. Specifically check for ice on the seal between the stabilizer and fuselage.
10. Air Ducts & Vents - Clear
Check all plugs removed from air ducts and vents, ducts and vents clear and unobstructed, and Q-spring opening in leading edge of fin clear.
11. Left Oxygen Buildup & Vent Valve Handle - Checked
Check that liquid oxygen buildup and vent valve handle has been placed in SERVICE; close and secure access panel.

(J) Left Aft Wheel Well

1. Static Ground Wire - Checked
Check ground wire secure and touching ground.
2. Tires & Hydraulic Lines - Checked
Ascertain tires have been inflated to proper pressure for present gross weight. Check tires for cuts, blisters, worn spots, and slippage. Check hydraulic lines for security and leaks.
3. Safety Switch Linkage, Torsion Link & Oleo Extension - Checked
Check oleo safety switch linkage connected and secure; torsion link connected, pin in place, and safetied; and oleo strut for cleanliness, hydraulic leaks, and proper inflation (15.8 (±0.25) inches between centers of torsion links).
4. Landing Gear Ground Lock - Installed
5. Leaks & General Condition - Checked
Check the entire wheel well area for foreign objects, hydraulic or fuel leaks, and security of all equipment.
6. No. 4 Hydraulic Pack Fluid Level - Checked, 3.1 gallons minimum
Visually inspect pack for general condition and check fluid level sight gage for proper servicing (3.1 gallons minimum).

(K) Left Wing

Repeat procedures for right wing in the following order:
1. Fuselage & Bomb Doors - Checked
2. Upper Surface of Wing Flaps, Aileron & Tabs - Checked
3. Lower Surface of Wing Flaps, Aileron & Tabs - Checked
4. Inboard Wing Flap Well - Checked
5. No. 6 Hydraulic Pack Fluid Level - Checked, 2.8 gallons minimum
6. Outboard Wing Flap Well - Checked
7. No. 5 Hydraulic Pack Fluid Level - Checked, 3.0 gallons minimum
8. Outboard Wing Trailing Edge - Checked
9. Wing Tip & Upper Surface - Checked
10. Access Panels & Fuel Vents - Checked
11. Drop Tank - Checked
12. Oleo Strut, Wheel & Tire - Checked
13. Tip Gear Ground Lock - Installed
14. Tip Gear Well - Checked
15. Taxi Light - Checked
16. Access Panels, Airscoops, Vents & Drains - Checked
17. No. 1 Strut for Condition - Checked

18. Engines 1 & 2 Aft Section - Checked
19. Nacelle Cowlings & Surge Bleed Valves - Checked
20. Fuel Heater Exhaust - Checked
21. Engine Oil and Alternator Cooling Exhausts on B-52F - Checked
22. Nose Section 1 and 2 (and engine oil and alternator cooling inlets on B-52F) - Checked
23. Access Panels, Vents & Drains - Checked
24. No. 2 Strut for Condition - Checked
25. Engines 3 and 4 Aft Section - Checked
26. Nacelle Cowlings & Surge Bleed Valves - Checked
27. Fuel Heater Exhaust - Checked
28. Engine Oil and Alternator Cooling Exhausts on B-52F - Checked
29. Nose Section 3 and 4 (and engine oil and alternator cooling inlets on B-52F) - Checked
30. Access Panels, Airscoops, Vents & Drains - Checked

CAUTION

Operation of an air conditioning unit with the wing duct plugs in place can result in overspeeding of the turbine driven blower and destruction of the unit.

(L) Left Forward Wheel Well

1. Wheel Chocks - In place
2. Tires & Hydraulic Lines - Checked

Ascertain tires have been inflated to proper pressure for present gross weight. Check tires for cuts, blisters, worn spots, and slippage. Check hydraulic lines for security and leaks.

3. Safety Switch Linkage, Torsion Link & Oleo Extension - Checked

Check oleo safety switch linkage connected and secure; torsion link connected, pin in place, and safetied; and oleo strut for cleanliness, hydraulic leaks, and proper inflation (15.8 (±0.25) inches between centers of torsion links).

4. Landing Gear Ground Lock - In place
5. Battery Cover & Drain Lines - Secure

Check drain lines securely attached to drain ports and covers fastened.

6. Leaks & General Condition - Checked

Check the entire wheel well area for foreign objects, hydraulic or fuel leaks, and security of all equipment.

7. Water Injection Circuit Breakers - Set (if serviced with water)

Circuit breakers for nacelles 1 and 4 are located on the left forward d-c power junction box. Circuit breakers for nacelles 2 and 3 are located on the right forward d-c power junction box.

8. Air Conditioning Pack Oil Level - Checked

Visually inspect pack for general condition. Check oil level approximately 1/4 inch minimum above "L" mark on sight gage.

9. Landing Light - Checked

Check the left landing light for cleanliness, security, and glass and filament intact.

(M) Left Nose Section

1. Air Ducts & Vents - Clear

Check all vent openings clear, access doors secure, and duct plugs removed.

2. Static Ports & Drain Plugs - Checked

Check static ports clear and drain plugs installed. Three ports are located high on side of fuselage.

3. Escape Hatch - Secure

Check left escape hatch secure and flush with airplane skin.

4. Pitot Tube - Cover removed, clear

ALERT PROCEDURES

The normal checklists in Sections II and VIII are designed to permit use during alert. The additional checklists in this section are used in situations peculiar only to the alert cycle. Any time bombs/missiles are aboard, the normal two-man policy will be observed. After maintenance has declared an airplane ready for alert and the bombs/missiles have been loaded, the aircrew will conduct an initial acceptance check. When the aircrew declares the airplane ready for alert and the airplane is on the alert line, it will be placed in a "cocked" configuration. At a predesignated time each 24 hours, the aircrew will accomplish the "Daily Alert Preflight Checklist." If the daily alert preflight is not accomplished by the new crew during changeover, the new crew must accomplish the navigator's "Before Exterior Inspection" checklist and the "Bomb Preflight." (It is intended that the "Daily Alert Preflight" be accomplished only once each 24 hours.)

INSTRUCTIONS

Security

Entrance to or into the fuselage or bomb bay area of a "cocked" configured aircraft will be in accordance with command directives.

Maintenance While On Alert

At any time while the aircraft is cocked, if a requirement exists to refuel (except external wing tanks), the aircrew will uncock the aircraft using the "Uncocking Checklist." Normal servicing requirements for water, oxygen, hydraulics or pneumatics, which do not require access to the cockpit, may be accomplished on a cocked aircraft. Maintenance may be performed without uncocking provided force timing is not degraded, power is not placed on the aircraft, access to the cockpit or bomb bay area is not required, and no electrical component is involved. When the aircraft is uncocked for maintenance/refueling and the maintenance/refueling is completed, the aircraft will be recocked by the alert aircrew using the "Interior Inspection Checklist" and "Before Starting Engines Checklist." If other than the alert flight crew personnel have had access to the

bomb bay and/or AGM-28's during the required maintenance, the navigator's "Before Exterior Inspection," "Bomb Preflight," and/or "AGM-28 Preflight" inspections must also be completed.

Pilot Procedures

1. AIRPLANE AND BOMBS ACCEPTANCE
   a. Before Exterior Inspection
   b. Bomb Preflight. If this checklist is accomplished by a substitute crew, it must be reaccomplished by the crew assigned for alert prior to aircraft cocking.
   c. Exterior Inspection
   d. Interior Inspection
   e. Before Starting Engines
   f. Starting Engines and Before Taxiing. This checklist will not be accomplished unless the airplane is to be taxied to the alert area.
   g. After Landing
   h. Before Leaving Airplane
2. AIRCRAFT COCKING
   a. Interior Inspection
   b. Before Starting Engines. Bomb bay doors may be left open or closed depending on local conditions.
3. SCRAMBLE. Pilots will use the normal checklist when the execution order is given. Boldfaced items contained in the checklist for "Starting Engines and Before Taxiing," "Taxiing," and "Before Lineup" checklists are the minimum items required for a fast reaction takeoff. During EWO alert operations, takeoff will not be delayed for items pertaining to crew equipment, radio checks, anticollision lights, and SIF/IFF settings. If time permits, these checklists should be used in their entirety. After the aircraft is safely airborne, the "Starting Engines and Before Taxiing," "Taxiing," and "Before Lineup" checklists should be reviewed and applicable items not previously completed should be performed when time permits. Engine start will be in accordance with "Normal Procedures." "Before Lineup Checklist" will be completed as a continuation of the "Taxiing Checklist" without stopping the airplane prior to taking the runway. Transfer of control of airplane between pilots will be accomplished to insure proper monitoring of airplane movement and clearance. Upon completion of alert scramble procedures, pilots may recock the airplane using the "Recocking Checklist."
4. UNCOCKING. Use "Uncocking Checklist."

Radar Navigator and Navigator Procedures

1. AIRPLANE AND BOMBS ACCEPTANCE
   a. Before Exterior Inspection
   b. Exterior Inspection. This includes the bomb preflight.
   c. Interior Inspection

NOTE

This completes the cocking procedures for the radar navigator and the navigator. If the aircraft is uncocked for maintenance or refueling, it will be recocked using the appropriate portions of the "Exterior Inspection" and the entire "Interior Inspection" checklists.

2. SCRAMBLE. Accomplish the "Before Takeoff Checklist." Upon completion of alert scramble procedures, the navigators may recock the aircraft using their "Recocking Checklist."
3. DAILY ALERT PREFLIGHT. There are no specific items that are to be accomplished by the radar navigator or navigator other than those called for by the copilot on his "Daily Alert Preflight Checklist."
4. UNCOCKING. Items to be accomplished by the radar navigator and navigator are on the pilot's "Uncocking Checklist" and will be accomplished at his direction.

EW Officer Procedures

1. AIRPLANE ACCEPTANCE
   a. Before Exterior Inspection
   b. Exterior Inspection
   c. Interior Inspection
   d. ECM Equipment Operational Check - As required
   e. After Landing
2. SCRAMBLE
   a. Starting Engines
   b. Read over interphone the "Taxiing Checklist" and "Before Lineup Checklist."
3. DAILY ALERT PREFLIGHT. There are no specific items that are to be accomplished by the EW officer other than those called for by the copilot on his "Daily Alert Preflight Checklist."

Gunner Procedures

1. AIRPLANE AND FIRE CONTROL SYSTEM ACCEPTANCE
   a. Before Exterior and Exterior Inspection
   b. Interior Inspection
   c. Before Engine Start
   d. After Landing and After Parking
2. DAILY ALERT PREFLIGHT. All [D] flagged items will be accomplished by the gunner on daily alert preflight.
3. SCRAMBLE
   a. On scramble, the gunner will enter the airplane through the aft entrance door.
   b. The gunner will close the aft entrance door after entering the airplane.
   c. Continue normal checklist beginning with "Before Starting Engines Checklist."

RECOCKING CHECKLIST (Copilot reads)

NOTE

The following checklist will be used to recock the airplane only after an alert exercise.

1. Radar Altimeter SO - OFF (P)
2. Fuel Transfer - As required (CP)

   Fuel may be transferred as necessary for local refueling procedures.
3. Brakes - Set (P)
4. Armrest Safety Pin - Installed (P-CP)
5. Water Injection Switches B-52E - OFF (P)
6. Anticollision & Nav Lights - OFF and FLASH (P)
7. Stabilizer & Spoiler Standby Pumps - OFF (P)
8. Engine & Nacelle Anti-Icing Switch - OFF (P)
9. Bomb Doors - As required (P)
10. Cartridge Start Switches - Checked OFF (CP)

    Check that the spring-loaded switches are in OFF position.
11. Engine Starter Switches - OFF and GROUND START (CP)
12. Air Bleed Switches - OPEN (CP)
13. Sliding Window - Open (CP)
14. Air Conditioning - RAM (CP)
15. Flaps - UP and OFF (CP)
16. Fuel Switches 13, 14, 15 & 16 ON, all others OFF (CP)
17. Alternators - B-52E OFF (CP); Alternator Circuit Breakers B-52F - OPEN (CP)
18. Throttles - 75% rpm, then CLOSED (P)

    An engine may be left running at idle rpm while ground crew prepares cartridge breech for new cartridge (this will provide immediate restart capability). When cartridge is ready to install, shut down remaining engine.
19. Cartridge Start Circuit Breakers - Pulled (P)
20. Hydraulic Packs - OFF & RESET (P)
21. Hydraulic Packs 5, 6, 7, 8, 9 & 10 - ST (climatic) (P)
22. Battery - OFF (CP)
23. Engine Starter Switches - No. 2 and 8 START and FLIGHT START (for cartridge start) (CP)
24. Hydraulic Packs 5, 6, 7, 8, 9 & 10 - OFF & RESET (climatic) (P)
25. Oxygen - OFF and 100% (ALL)
26. Wheel Chocks - In place (GC)

RECOCKING CHECKLIST (Copilot reads) (Cont)

27. Parking Brakes - Off (P)
28. Interphone - OFF (P)
29. Circuit Breakers - Set (P-CP)

    Check that circuit breakers are reset after starter cartridges are installed.

30. Entrance Light - OFF (P)
31. Downlocks & Bypass Keys - Stowed (P/CP)

    If the aircraft has been towed, ascertain that the downlocks and bypass keys have been removed and stowed.

RECOCKING CHECKLIST (RN-N)

NOTE

The following checklist will be used to recock the aircraft only at the termination of an alert exercise.

1. SIF/IFF - STDBY (N)
2. BNS:
   a. Standby Button - Depressed (RN)
   b. Intensity Knob - CCW (RN-N)
   c. Receiver Gain Knob - CCW (RN-N)
   d. Video Knob - CCW (RN-N)
   e. Range Selector Switch - 20 (RN)
   f. Radar Power Switch - OFF (RN)
   g. BNS Power Switch - OFF (RN)
   h. Ground Blowers Switch - OFF (RN)
   i. Desiccator Switch - OFF (RN)
   j. Stab Bypass Switch - ON (RN)
   k. Gyro Erect Switch - HI (RN)
3. Automatic Astrocompass (N):
   a. Star Selector Switch - OFF
   b. Power Filter Switch - POWER OFF
4. Doppler Radar (N)
   a. Radar Silence Switch - SILENT
   b. System Power Switch - OFF
5. Oxygen Regulator - OFF and 100% OXYGEN (RN-N)
6. Pin No. 1 - Installed (RN-N)
7. Pin No. 6 - Installed (N)

UNCOCKING CHECKLIST (Airplane on Alert Line — Copilot reads)

1. Interpnone Switch - ON (P)

   Pilot and copilot connect interphone and check for operation.

2. ADM-20 Gear Jettison Circuit Breaker - Checked out (P)

3. IFF:

   a. Master Switch - OFF (N)

   b. Code - Classified setting removed (N)

4. Standby Pump Switches - OFF (P)

   Pilot places all standby pump switches to OFF.

5. Fuel Switches - OFF (CP)

6. Engine Starter Switches - OFF and GROUND START (CP)

7. Gyro Switch - OFF (P/CP)

8. Radios - OFF (P-CP)

9. Pitot Heat - OFF (P)

10. Anti-Icing Systems - OFF (P)

11. Battery - ON (CP)

    Copilot places battery switch in ON and checks not charging lights on.

12. External Power - Checked and ON (CP)

13. Flaps - As required (CP)

    Copilot contacts ground observer and ascertains that flap area is clear prior to placing flap lever in DN.

CAUTION

Discontinue wing flap operation within 10 seconds if flaps fail to move in order to prevent excessive slipping of the wing flap power unit slip clutch.

14. Bomb Door Actuators - Disconnected (GC)

    Ground crew observer disconnects bomb door actuators and installs bomb door strut locks (if applicable).

15. Downlocks & Bypass Keys - Installed (GC)

UNCOCKING CHECKLIST (Airplane on Alert Line — Copilot reads) (Cont)

16. Lights - Off, or as required (P-CP)
17. External Power - Off (CP)

    Copilot checks with ground crew and other crew positions for power requirements prior to turning off electrical power.

18. Battery - OFF (CP)
19. Cartridge Start Circuit Breakers - Pulled (P)
20. AGM-28 B-52 Power Switches - OFF (N)
21. Interphone Switch - OFF (P)
22. ADM-20 Track Antijettison Tools - Installed (RN)

DAILY ALERT PREFLIGHT CHECKLIST (Airplane on Alert Line — Copilot reads)

1. Readiness Switch Cover - Closed and sealed (P)
2. ADM-20 Gear Jettison Circuit Breaker - Checked out (P)
3. Interphone Switch - ON (P)
4. SWESS Arm-Safe Switches - SAFE and sealed (P-RN)
5. Special Weapons Manual Lock Handle - Sealed (EW)
6. Radar Navigator's and Navigator's Station:
   a. Jettison Power Circuit Breaker - Checked out (RN)
   b. Normal Release Circuit Breaker - Checked out (RN)
   c. ADM-20 Launch Control (1) & Missile Release (3) Circuit Breakers - Checked out (RN)
   d. ASM Separation (4) & Jettison Control (2) Circuit Breakers - Checked out (N)
   e. All Other Circuit Breakers - In (RN-N)
   f. Release Circuits Disconnect PR - Disconnected (RN)
   g. Master Bomb Control Switch - OFF (RN)
   h. Bombing System Switch - MANUAL (RN)
   i. Forward & Rear Special Weapons Manual Release Handles - Stowed (RN)
   j. External Missile Manual Release Handle - Sealed (RN)
   k. DCU-9A Control Levers - OS and sealed (N)
   l. DCU-9A Selector Switches - OFF (N)
   m. AGM-28 Armament Selector Switches - OFF, safetied, and sealed (N)
   n. AGM-28 Launch Switches - OFF (guard closed) (N)
   o. AGM-28 Armament Warning Lights - OFF, tested (N)

      On AGM-28 missiles only, if light comes on during test, call qualified personnel immediately.

DAILY ALERT PREFLIGHT CHECKLIST (Airplane on Alert Line — Copilot reads) (Cont)

7. Standby Pump - OFF (P)
8. Pitot Heat & Windshield Anti-Ice - OFF (P)
9. Voltage - Checked (CP)
10. Electronic Warfare Station - Checked (EW)
    a. Chaff & Flare Circuit Breakers - Out
    b. DOC & SUD Covers - Closed
    c. ECM Power Switches - OFF
    d. ECM Transmitter Switches - OFF
11. Battery - ON (CP)
12. External Power - Checked and ON (CP)
13. Flaps - Clear, down (CP)
14. Ground, check hydraulic pack preloads and flap well (P)
15. Crew Report - Station check complete (ALL)
16. Parking Brake Preload Pressure - Normal (P)
17. Oxygen Quantity - Checked (P)
18. Forward TR Units - Checked (GC)
19. Hydraulic Pack Preloads & Flap Well - Checked (GC)
20. Portable Oxygen Bottles - Serviced and stowed (ALL)
21. Flaps - Clear, up, lever OFF (CP)
22. Landing Gear Standby Pumps - ON, pressure checked (P)
23. SWK Monitor Select Switch - First bomb to be released (RN)
24. DCU-9A Selector Switches - SAFE (N)
25. DCU-9A Warning Lights - Off, tested (for each position of SWK box) (RN-N)
26. SWK Monitor Select Switch - OFF (RN)
27. DCU-9A Warning Lights - Off, tested (N)

    If warning light(s) comes on when pressed to test, call qualified personnel.

28. DCU-9A Selector Switches - OFF (N)
29. SWK Box Illumination Control - Full CCW (RN)
30. AGM-28 - Checked (N)
    a. Safe Time Interval Knobs - 30 minutes
    b. Flight Control Power Switches - OFF
    c. Tactical Altitude Selector Switches - LOW

DAILY ALERT PREFLIGHT CHECKLIST (Airplane on Alert Line — Copilot reads) (Cont)

d. Missile Power Switches - OFF

e. B-52 Power Switches - ON

f. Armament Selector Switches - SAFE

g. Warning Lights - Off, tested

If light does not illuminate during test, refer to T.O. 1B-52C-30-1A.

h. Warhead Lights - Off, tested

i. Armament Selector Switches - OFF, safetied, and sealed

31. Hydraulic Packs 5, 6, 7, 8, 9 & 10 - ST (climatic) (P)

Hydraulic pack switches will be placed in ST only when OAT is 0° C (32° F) or below if external air is going to be applied for heating.

32. Chaff Dispenser Circuit Breakers - In (G)

33. External Power - Off (CP-GC)

34. Battery Switch - OFF (CP)

35. Interphone Switch - OFF (P)

36. Hydraulic Packs 5, 6, 7, 8 & 10 - OFF & RESET (climatic) (P)

37. Circuit Breakers - Checked (P-CP)

38. Pitot Heat & Windshield Anti-Ice - ON (P)

Exterior Check

1. Pilots will complete visual inspection checking for hydraulic leaks, fuel leaks, and general condition.

2. Bomb preflight inspections will include accomplishment of all steps in T.O. 1B-52B-25-2CL-1.

The Bomb Preflight need only be accomplished once during the current tour of alert unless there has been a change of aircraft or is required as a result of maintenance.

DEFCON 1

Normally, DEFCON 1 posture will be assumed from one of the following airplane configurations (based upon the degree of progression into the launch procedure):

- Alert configured and fully cocked
- One or more engines started
- All engines started

If engines have not been started, the "Starting Engines and Before Taxiing Checklist" will be accomplished up to "Start External Air." If the engines have been started, accomplish the following checklist to shut down the engines.

DEFCON 1 Shutdown (Pneumatic) Checklist

1. Hydraulic Packs 5, 6, 7, 8, 9 & 10 - OFF (P)
2. Air Conditioning - RAM (CP)
3. Air Bleed Switches - OPEN (CP)
4. Alternator Switches B-52E - OFF (CP)
5. Alternator Circuit Breakers B-52F - OPEN (CP)
6. External Power - OFF, checked, ON (CP)
7. Throttles - 75% rpm, then CLOSED (P-CP)
8. Ground, Connect External Air Hose - Roger (GC)
9. Hydraulic Pack Switches - OFF & RESET (guards open) (P)

NOTE

Reaccomplish the "Starting Engines and Before Taxiing Checklist" up to "Start External Air."

DEFCON 1 Shutdown (Cartridge) Checklist

1. Air Bleed Switches - OPEN (CP)
2. Air Conditioning - RAM (CP)
3. Left Forward & Both Aft Alternators B-52E - OFF (CP)
3. Alternator Circuit Breakers for Engines 1, 3 & 7 B-52F - OPEN (CP)
4. Hydraulic Pack Switches - OFF & RESET (guards open) (P)
5. Throttles (except engine No. 5) - 75% rpm, then CLOSED (P-CP)
6. Cartridge Start Switches - Checked OFF (CP)

   Check that the spring-loaded switches are in OFF position.
7. Cartridge Start Circuit Breakers - Pulled (P)
8. Cartridges Installed on Engines 2 & 8 (GC)
9. Cartridge Start Circuit Breakers - Set (P)
10. Right Forward Alternator B-52E - OFF (CP)
10. Alternator Circuit Breaker for Engine No. 5 B-52F - OPEN (CP)
11. External Power - ON (CP)
12. Throttle No. 5 - 75% rpm, then CLOSED (CP)
13. Engine Starter Switches - No. 2 and 8 START and FLIGHT START (CP)

NOTE

Reaccomplish the "Starting Engines and Before Taxiing Checklist" up to "Start Engines."

MINIMUM REACTION POSTURE

When it becomes necessary to shut down six engines and maintain the airplane in minimum reaction posture, the following checklist will be utilized. All checklists through the "Before Lineup Checklist" must have been completed prior to starting the "Minimum Reaction Posture Checklist."

Cocking Checklist (Minimum Reaction Posture)

1. Parking Brakes - Set (P)
2. Water Injection Pump Switches B-52E - OFF (P)
3. BNS & Gunnery System - OFF or STANDBY (RN-G)
4. Air Conditioning - RAM (CP)
5. Starters B-52F - OFF (CP)
6. Starter Selector - GROUND START (CP)
7. Air Bleed Switches - OPEN (CP)
8. Aft Alternators B-52E - OFF (CP); Alternator Circuit Breakers for Engines 1 & 7 B-52E - OPEN (CP)
9. Packs 5, 6, 7, 8, 9 & 10 B-52E - OFF, master warning light reset (P)
10. Throttles 1, 2, 4, 6, 7 & 8 - 75% rpm, then CLOSED (P-CP)

Scramble Checklist (Minimum Reaction Posture)

1. Start Remaining Engines - Started (CP)
2. Air Bleed Switches - CLOSED (CP)
3. Alternators - Started (if applicable), checked (CP)
4. A-C Power - Checked, alternators on the line (CP)
5. Hydraulic Packs - ON, pressures checked (P)
6. Water Injection B-52E - ON (if applicable), lights checked (P)

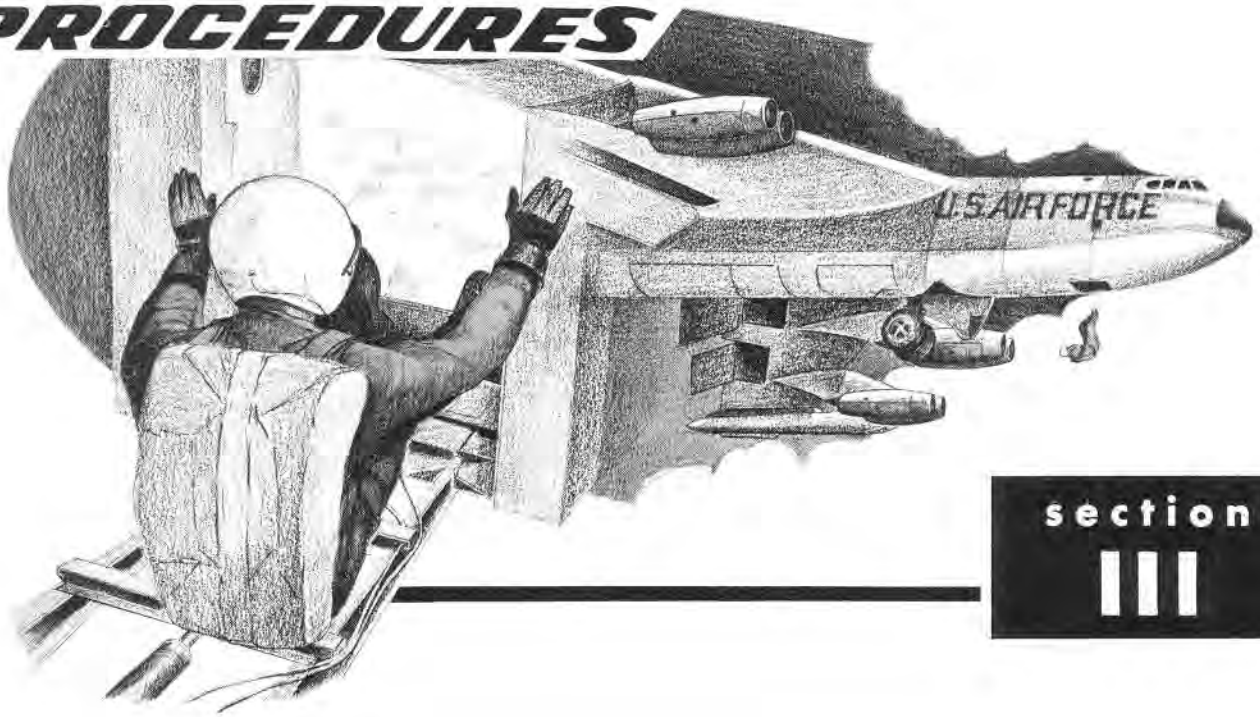
NOTE

For actual launch, proceed with the "Takeoff Checklist."

ACCEPTANCE AND/OR FUNCTIONAL CHECK FLIGHT CHECKS

Procedures and criteria for functional check flights will be accomplished in accordance with T.O. 1B-52E -1-5 and T.O. 1B-52E-1-5A, acceptance and/or functional check flight manuals. Each manual contains three amplified checklists identified as "Before Inflight Checklists," "Inflight System Operational Checks," and "After Inflight Checklists." Flight crew abbreviated checklists are contained in T.O. 1B-52E-CL-1-5-1 through -5. These abbreviated checklists are applicable to the "Before Inflight Checklists" and "After Inflight Checklists," and the numbered line items in these abbreviated checklists correspond identically to the numbered line items in the amplified checklists in the acceptance and/or functional check flight manuals. Worksheets containing only the headings of the "Inflight System Operational Checks" are contained in T.O. 1B -52E-WS-1-5-1-CF. The "Emergency Procedures" contained in T.O. 1B-52E-1 will be used. Aircraft requiring functional check flights are redelivered aircraft, modification maintenance aircraft, and aircraft wherein maintenance performed requires a functional check flight as specified in T.O. 1-1-300.

EMERGENCY PROCEDURES



section III

NOTE

This section contains text and amplified checklists to describe procedures to be followed in any emergency except those in connection with auxiliary equipment. The text is divided into primary paragraphs in accordance with the type of emergency and, where applicable, is followed by an amplified checklist for that particular emergency. Although it is not necessary to commit the descriptive text in this section to memory, each crew member should be thoroughly acquainted with the information covering emergencies which may directly affect his actions. Each descriptive paragraph of the text contains an analysis of some emergency. The amplified checklists describe in detail the actions to be taken. In the checklists in this section, certain actions are given in capital letters and bold face type. These actions are called "critical actions" and constitute the minimum required steps to be taken by a crew member to insure survival, and must be committed to memory. All steps in each checklist must be accomplished when time permits in order to insure complete control of each emergency. To facilitate correct actions in an emergency, the items in all emergency checklists are directive in nature rather than of the challenge and response type. Regular personnel coding is used to designate the crew members that will accomplish the actions.

STOP ——— THINK ——— COLLECT YOUR WITS

A thorough evaluation of each emergency should be made prior to initiating corrective action.

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ENGINE FAILURE

WITH ENGINE FAILURE FLIGHT CHARACTERISTICS

Single Engine Failure

The loss of an engine at any time during takeoff or while in flight is considered an emergency, regardless of the amount of thrust still available, since some emergency procedure must be executed. The loss of an engine during takeoff can be controlled easily by correct application of rudder pedal force and a slight amount of lateral control force. The rudder pedal force required in the event of an outboard engine failure is about 40 pounds at speeds below takeoff speed with zero trim. The force increases to about 80 pounds at the recommended climbout speed. All of this rudder correction usually can be removed by application of rudder trim. The rudder trim limits should be observed. See "Airspeed Limitations," Section V.

Multi-Engine Failure on One Side

During inflight emergencies involving multi-engine failures on one side, applications of large amounts of rudder and lateral control are necessary in order to maintain control when extreme amounts of asymmetrical thrust exist or are applied. Application of this control creates severe loads on the airplane structure. These loads vary in magnitude in accordance with the degree of thrust asymmetry, degree of deflection of corrective rudder, rate of rudder application, amount of yaw/roll displacement that has taken place prior to rudder application, abruptness with which engine thrust is removed, indicated airspeed, gross weight, center of gravity, fuel distribution, amount of air turbulence present, airplane configuration including flaps and landing gear positions, missile loading, external tank loading, etc. If these variables occur in certain combinations, critical structural loads can result. In view of the difficulty in controlling these variables, close observance of the following procedure will minimize the possibility of structural overload:

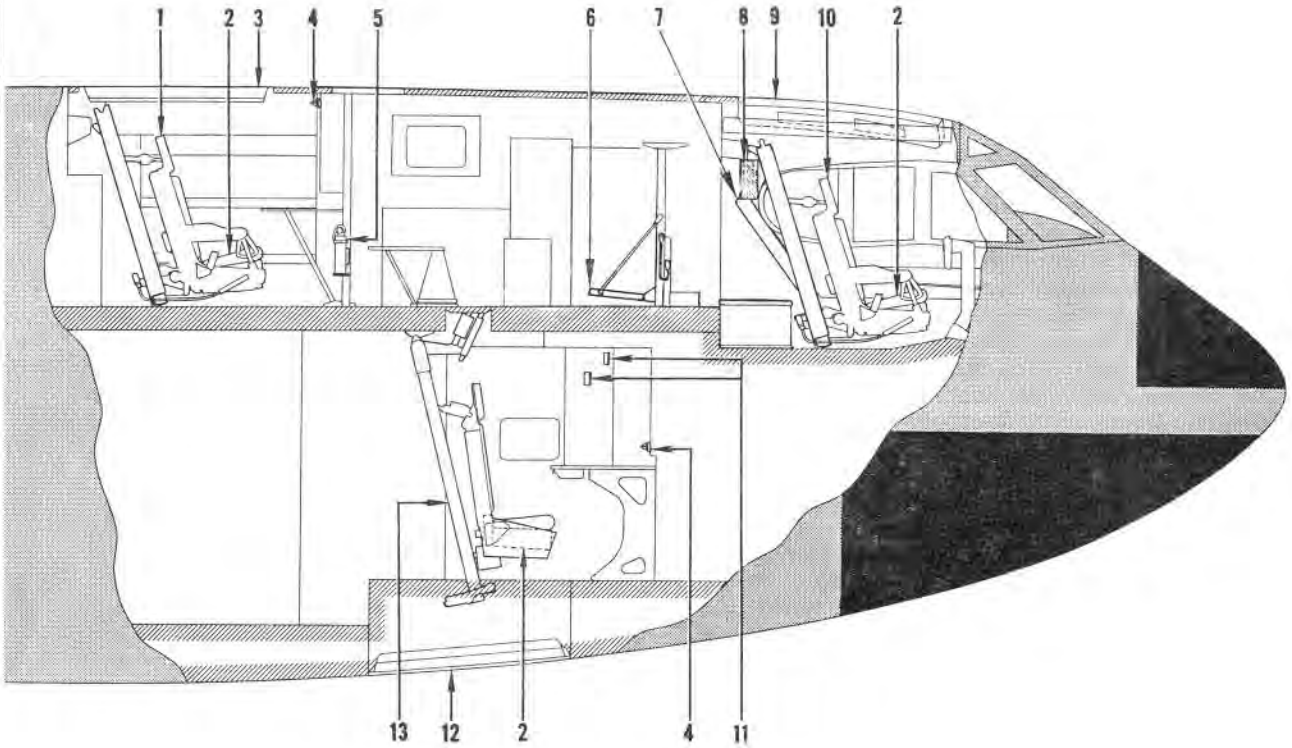
1. If asymmetrical thrust develops abruptly, the resulting yaw/roll tendency should be counteracted initially by means of lateral control. This should be followed by a steady rudder application and trimming as required to balance control forces.
2. If thrust requirements permit, readjust the power on the remaining engines to minimize control surface deflections. Power adjustments should be applied slowly and simultaneously with control surface movement.
3. Avoid turbulent air and limit bank angle to 20° maximum.

Performance

This airplane is unique in its ability to handle asymmetrical thrust conditions provided the prescribed procedures are followed. See "Multi-Engine Failure on One Side," this section. The takeoff and climbout performance of the airplane with inoperative engines is shown in Parts 2, 3, and 4 of the Appendix. In each case, the inoperative engines are assumed to be in the most outboard positions and all on the same side. This is the most adverse condition from the standpoint of trim drag which is associated with control surface deflections. Advancing the throttles to full travel in an emergency situation will give maximum thrust. This may exceed normal engine limits. Overthrusting the engines will accentuate the airplane control problems and reduce engine life. All instances of overthrust as indicated by excessive EGT and/or rpm will be recorded in Form 781. See "Engine Limitations," Section V.

Minimum Speed for Directional Control

Minimum speed for directional control is defined as the speed at which full rudder and half wheel will compensate for a given amount of thrust. Only half wheel is used in order to allow some reserve for maneuvering, gust loads, and dynamic conditions. Figure 3-2 may be used for takeoff planning by entering with the takeoff EPR and the field altitude. Knowing the takeoff speed, the criticality of the loss of various engines can be estimated. For a go-around, the charts may be used to estimate the maximum thrust (EPR) which can be applied at any time and still maintain directional control. Flaps up charts provide for an emergency wherein the flaps cannot be extended.



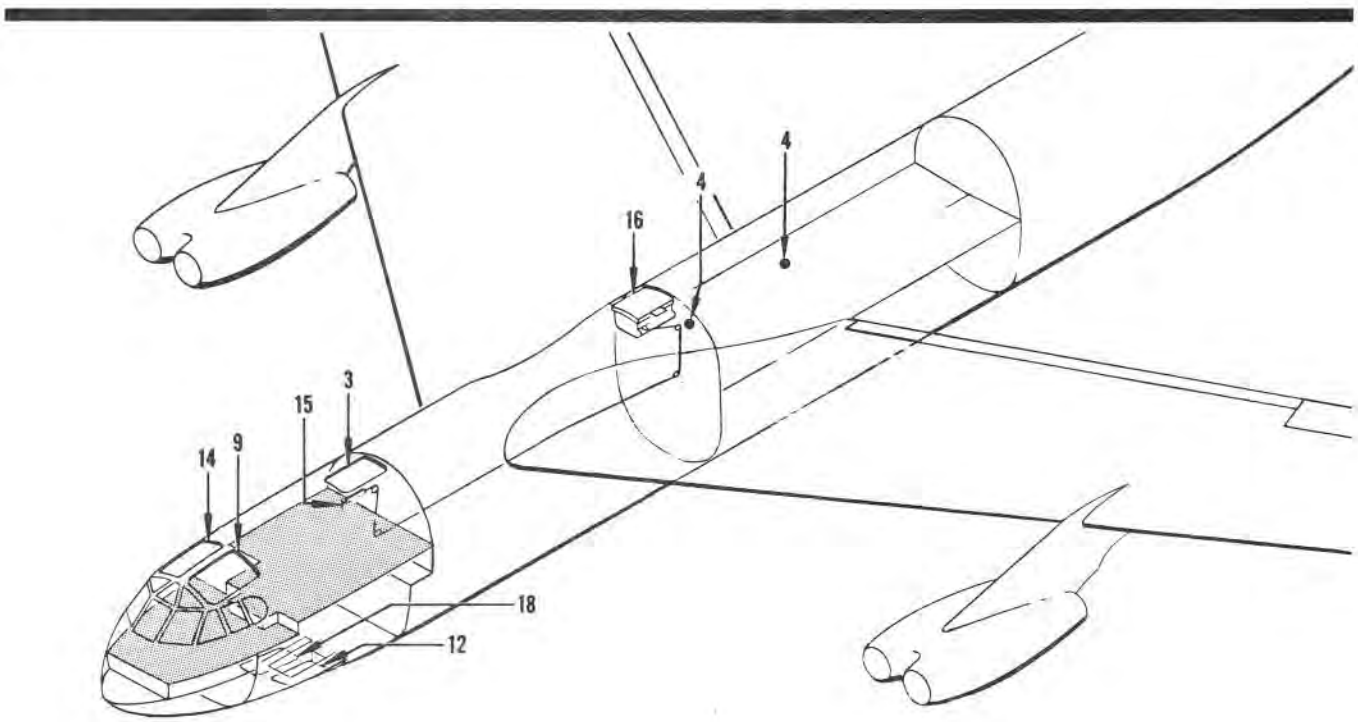
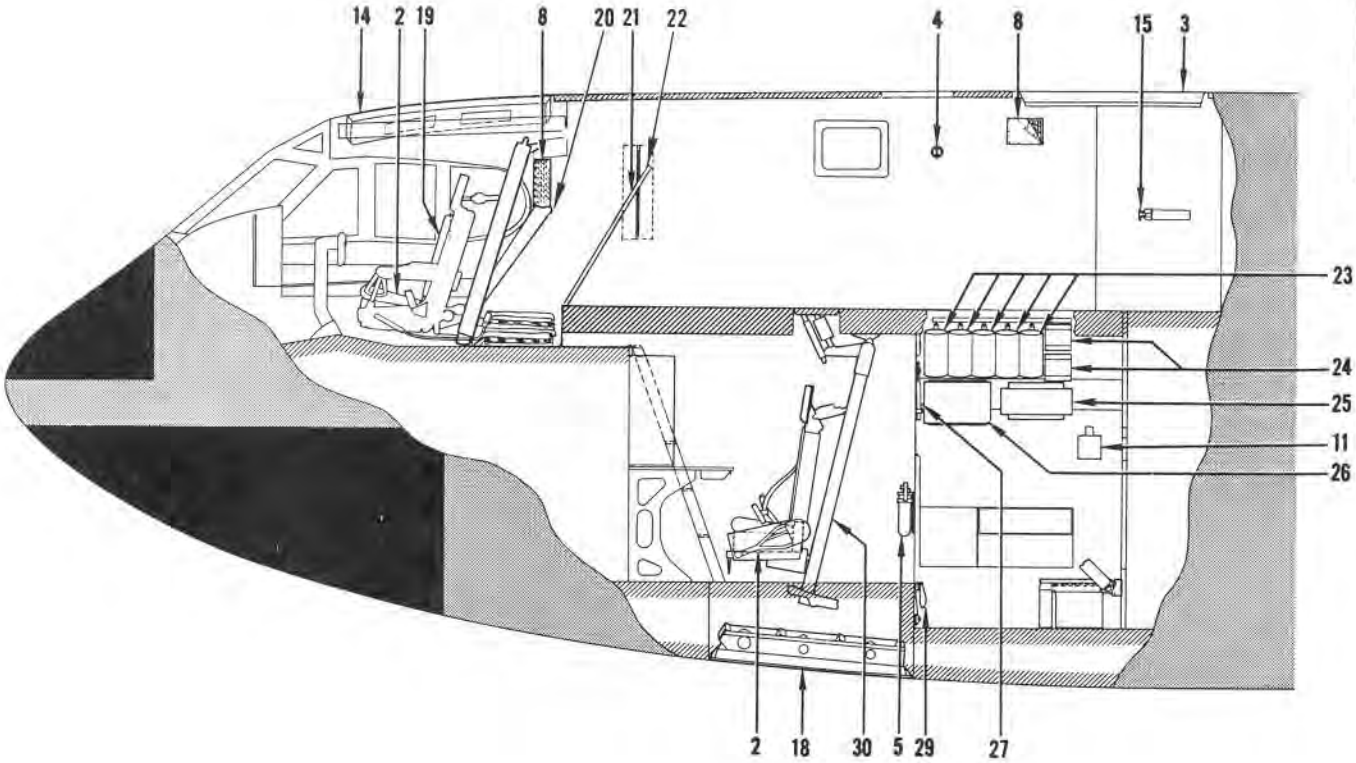


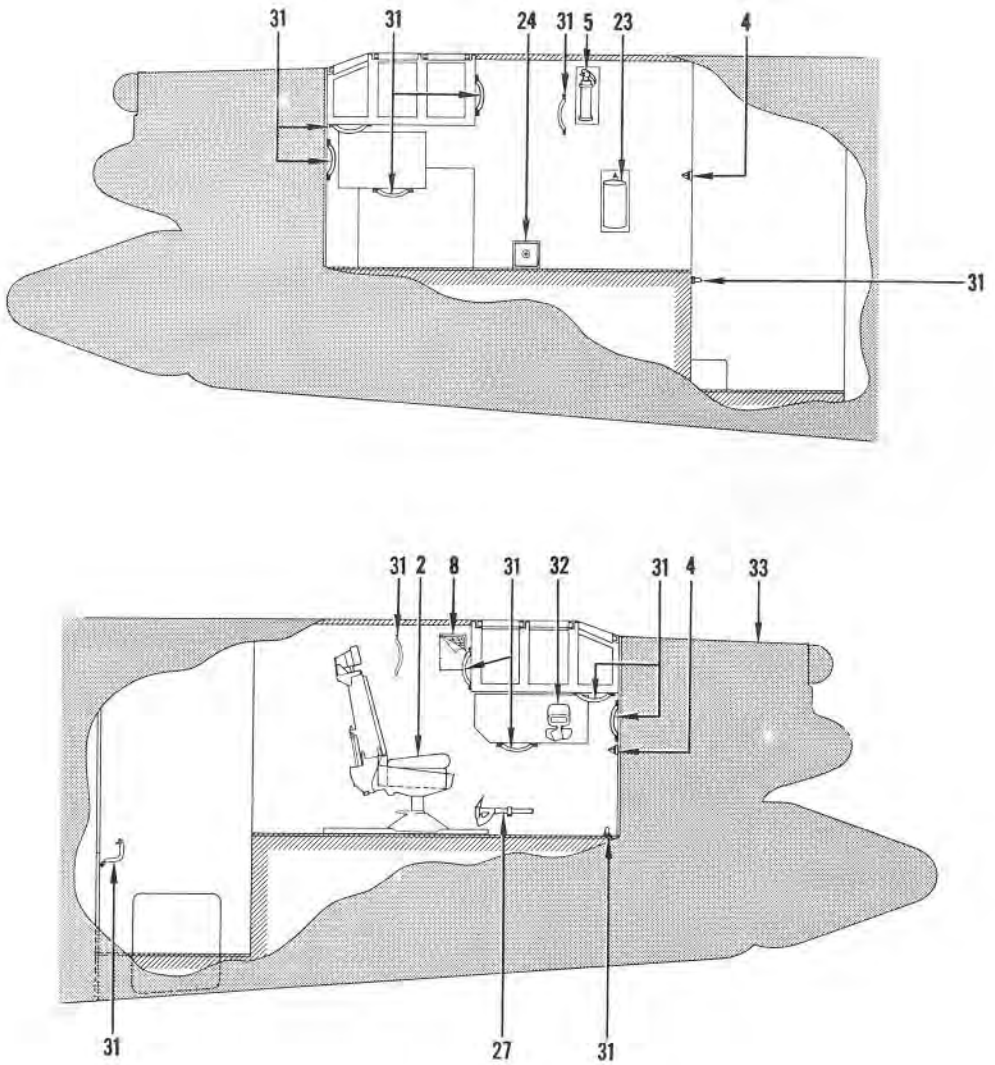
Figure 3-1 (Sheet 1 of 3).



1. EW OFFICER'S EJECTION SEAT
2. SURVIVAL KIT
3. EW OFFICER'S ESCAPE HATCH
4. EMERGENCY ALARM LIGHTS
5. FIRE EXTINGUISHER
6. INSTRUCTOR PILOT'S DITCHING STATION
7. NAVIGATOR'S DITCHING STATION
8. ESCAPE ROPE
9. PILOT'S ESCAPE HATCH
10. PILOT'S EJECTION SEAT
11. FORWARD EQUIPMENT BAY INSPECTION MIRRORS
12. RADAR NAVIGATOR'S ESCAPE HATCH
13. RADAR NAVIGATOR'S EJECTION SEAT
14. COPILOT'S ESCAPE HATCH
15. LIFERAFT EMERGENCY RELEASE HANDLE (INOPERATIVE)
16. LIFERAFT COMPARTMENT
17. DELETED
18. NAVIGATOR'S ESCAPE HATCH
19. COPILOT'S EJECTION SEAT
20. RADAR NAVIGATOR'S DITCHING STATION
21. DITCHING HAMMOCK
22. INSTRUCTOR NAVIGATOR'S DITCHING STATION
23. ANTIEXPOSURE SUITS (PROVISIONS FOR)
24. FIRST AID KITS
25. BATTLE DRESSING KIT (PROVISIONS FOR)
26. BLOOD PLASMA KIT (PROVISIONS FOR)
27. AXE
28. DELETED
29. PARACHUTE STATIC LINE
30. NAVIGATOR'S EJECTION SEAT

.....emergency equipment (typical)

Figure 3-1 (Sheet 2 of 3).



31. GUNNER'S EMERGENCY ESCAPE HANDLES
32. INSIDE TURRET JETTISON HANDLE
33. TURRET

.....emergency equipment (typical) (cont)

Figure 3-1. (Sheet 3 of 3).

EMERGENCY SHUTDOWN CHECKLIST

NOTE

This procedure will be used for all "Engine Fire" and "Emergency Shutdown" situations.

1. **CLOSE THROTTLE(S) (P)**
2. **PULL FIREWALL SWITCH(ES) (P-CP)**

CAUTION

On an engine windmilling above 25% rpm, have fuel available to the firewall fuel shutoff valve, push the firewall fuel shutoff switch in, and advance the throttle to IDLE for 3 minutes out of every hour to prevent overheating the fuel control unit.

3. Bleed Selector Switch to ALTERNATE Position if Engines 3 & 4 are Shut Down - Selected (CP)
4. Check for Pneumatic Leak - Checked (CP)

   See "Air Bleed System Emergency Operation," this section.

5. Check A-C Electrical Loads B-52F - Checked (CP)

   Check remaining alternators are not overloaded.

NOTE

B-52F

The failure of engine 1, 3, 5, or 7 will be accomplished by the loss of electrical power from the alternator geared to that engine. See "Electrical System Emergency Operation," this section.

6. Open Air Bleed Interconnect Valve - OPEN (as required if no pneumatic system leak is suspected) (CP)

   Until a more complete method is devised for determining the presence of a pneumatic system leak, maintain the pneumatic system interconnect valves in CLOSED position at all times during flight unless extreme emergencies determine otherwise. Open body and wing air bleed manifold interconnect valves as required if more than one engine failure is experienced on the same side. See "Air Bleed System Emergency Operation," this section.

CAUTION

An engine air start after an emergency shutdown should not be attempted unless it is ascertained that it is reasonably safe to do so. A recurrence of the emergency condition could be more serious than the first occurrence.

7. Uncontrollable Fire - Abandon (ALL)

   If engine fire becomes uncontrollable, several steps may be taken:

   a. Reroute fuel away from the affected nacelle and allow the adjacent engine to starve the lines of fuel.

   b. If fire persists, it may be possible to save the airplane by allowing the fire to burn the nacelle off the strut.

   c. If fire appears to be burning into the wing, abandon the airplane. See "Bailout," this section.

DATA BASIS:
FLIGHT TEST
DATE: MAY 1961

CONDITIONS:

- FULL RUDDER AND HALF WHEEL DEFLECTION
- ENGINES OUT ARE WORST CONDITION (MOST OUTBOARD)

REMARKS:

The MRT temperature lines are for quick reference only and were calculated for an average pattern speed. Refer to T.O. 1B-52B-1-2 for precise settings. MRT should not be applied for a go-around unless necessary. See text for amplification.

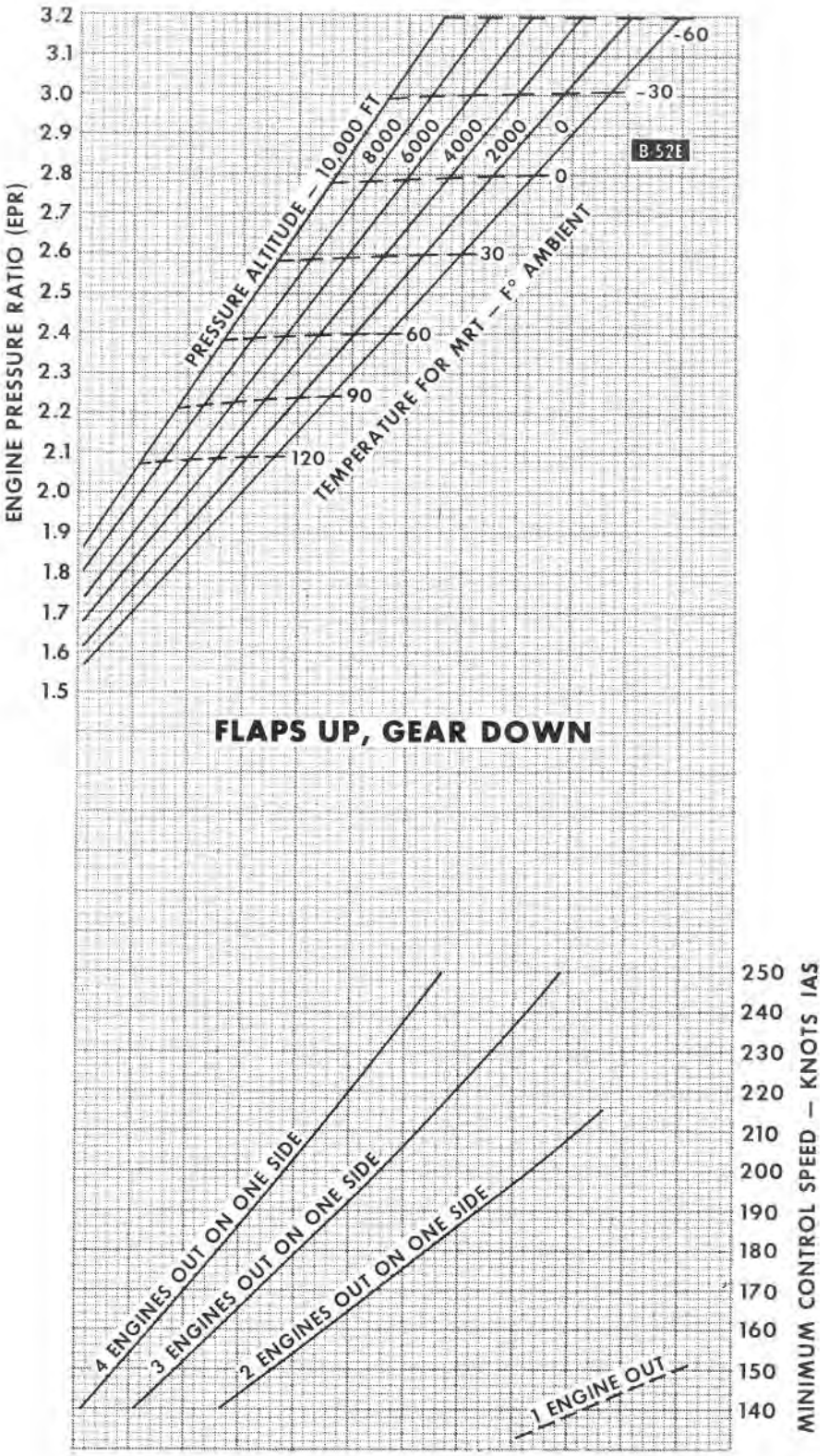


Figure 3-2 (Sheet 1 of 4).

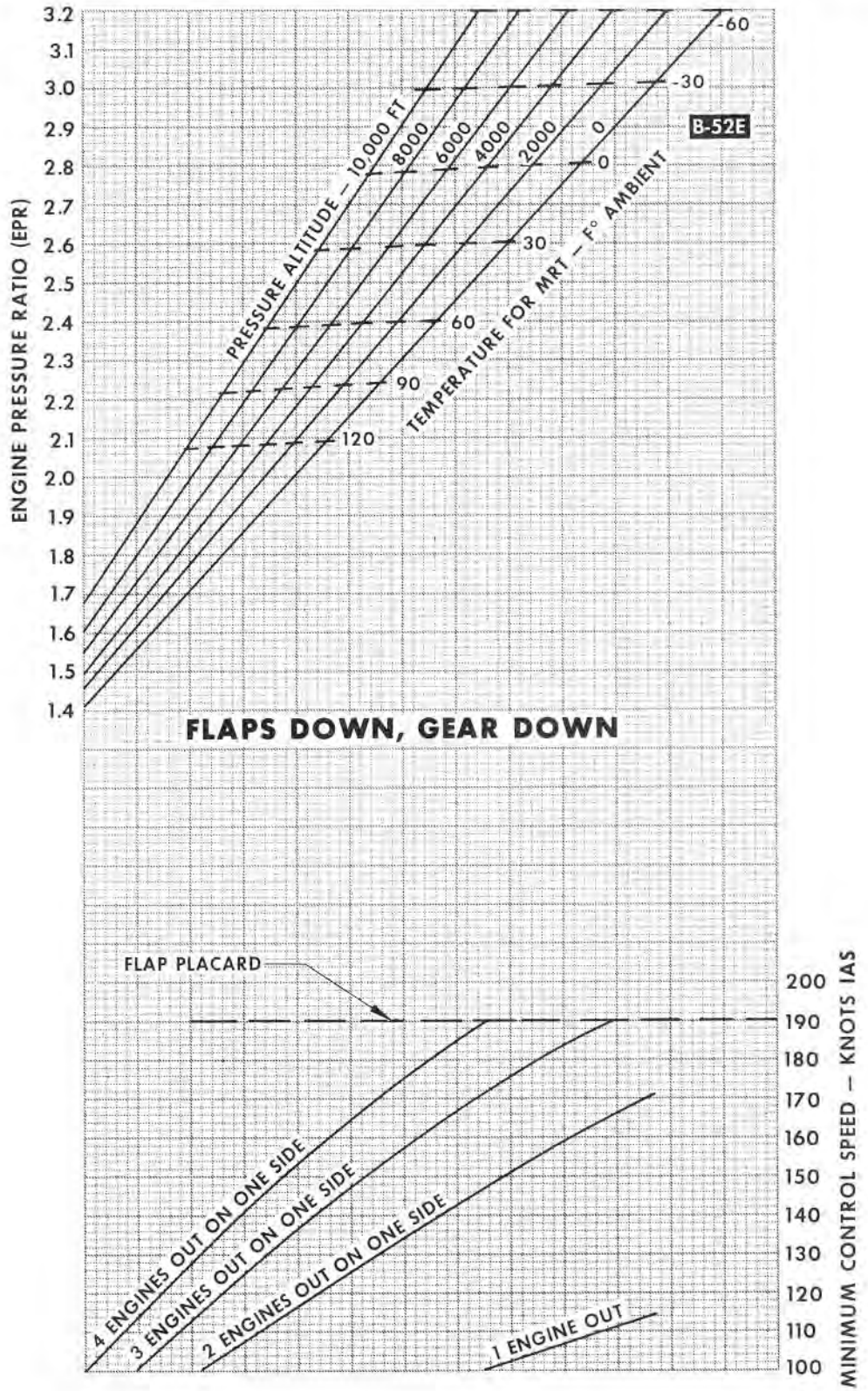
DATA BASIS:
FLIGHT TEST
DATE: MAY 1961

CONDITIONS:

- FULL RUDDER AND HALF WHEEL DEFLECTION
- ENGINES OUT ARE WORST CONDITION (MOST OUTBOARD)

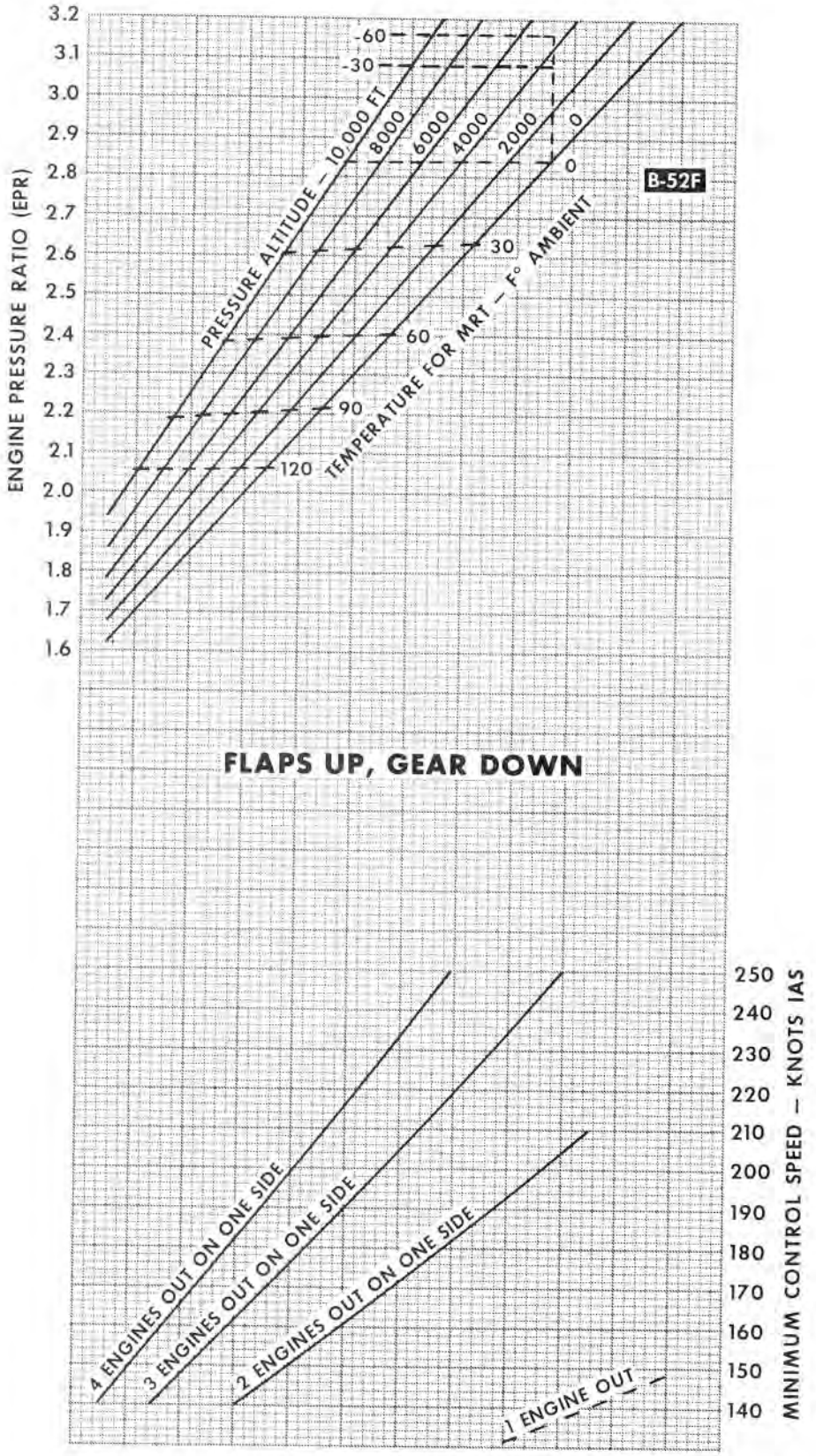
REMARKS:

The MRT temperature lines are for quick reference only and were calculated for an average pattern speed. Refer to T.O. 1B-52B-1-2 for precise settings. MRT should not be applied for a go-around unless necessary. See text for amplification.



..... minimum speed for directional control

Figure 3-2 (Sheet 2 of 4).



DATA BASIS:
FLIGHT TEST
DATE: MAY 1961

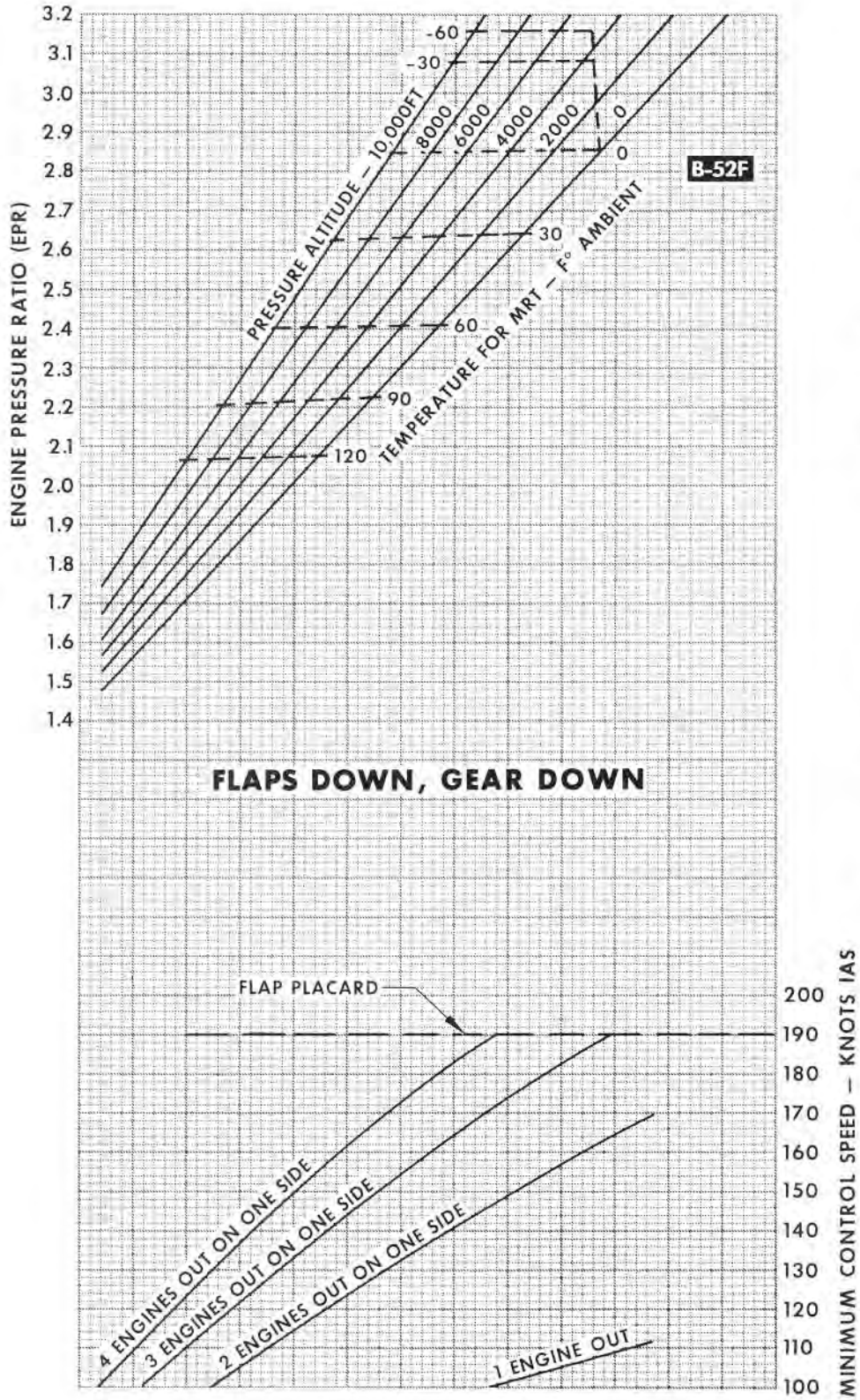
CONDITIONS:

- FULL RUDDER AND HALF WHEEL DEFLECTION
- ENGINES OUT ARE WORST CONDITION (MOST OUTBOARD)

REMARKS:

The MRT temperature lines are for quick reference only and were calculated for an average pattern speed. Refer to T.O. 1B-52E-1-2 for precise settings. MRT should not be applied for a go-around unless necessary. See text for amplification.

Figure 3-2 (Sheet 3 of 4).



DATA BASIS:
FLIGHT TEST
DATE: MAY 1961

CONDITIONS:

- FULL RUDDER AND HALF WHEEL DEFLECTION
- ENGINES OUT ARE WORST CONDITION (MOST OUTBOARD)

REMARKS:

The MRT temperature lines are for quick reference only and were calculated for an average pattern speed. Refer to T.O. 1B-52E-1-2 for precise settings. MRT should not be applied for a go-around unless necessary. See text for amplification.

minimum speed for directional control (cont)

Figure 3-2 (Sheet 4 of 4).

ENGINE FAILURE INDICATIONS

The first and most positive indication of an engine failure affecting thrust will be a change in the engine pressure ratio gage reading. This method will determine the failure of any engine during takeoff, climb, cruise, or descent. In addition, rpm, exhaust temperature, oil pressure, and fuel flow may change, depending upon the type of failure. Severe engine vibration may indicate internal failure of an engine. Oil or fumes may enter the cabin through the air conditioning system or there may be visual evidence of smoke or fire at the engine. Airplane yaw may give a good indication of failure if an outboard engine fails. The failure may be overlooked however if one of the inboard engines fails, especially if the airplane is in a turn. Also see "Air Bleed System Emergency Operation," this section, for failure indications due to an air bleed manifold leak.

Erratic Oil Pressure

See "Oil System Emergency Operation," this section.

ENGINE FAILURE DURING TAKEOFF

Takeoff Run

The possibility of an engine failure during the takeoff run influences takeoff procedure and should always be considered and planned for prior to the time the takeoff run is started. When an engine failure occurs on takeoff, the pilot must be able to stop on the runway remaining or continue the takeoff safely. To aid the pilot in making a decision to stop or continue takeoff, charts are presented in Parts 2 and 3 of the applicable Appendix from which may be determined the decision speed and time (S_1). A check of the airspeed at S_1 will indicate how the airplane is accelerating. A failing engine may be detected in this manner and, if the decision speed has not been reached, the takeoff must be aborted. If an engine failure occurs after S_1, a safe takeoff can be made on seven engines. Takeoff will not be aborted after S_1. In those cases where the pilot attempts to abort after S_1, he must accept the fact that he will probably fail to stop within the confines of the runway.

Takeoff Continued

NOTE

If for some reason a crash landing must be made, the touchdown should be accomplished in a wings-level attitude.

LANDING GEAR. If an engine fails during or immediately after the takeoff, climb performance is considerably reduced until the landing gear is retracted. Gear drag lowers the rate of climb approximately 450 fpm at takeoff with flaps down on a 400,000-pound airplane. Therefore, the landing gear should be retracted as soon as possible after the airplane is airborne. An engine failure decreases the rate of climb about 420 fpm under the same conditions.

WING FLAPS. Wing flap drag increases as the flaps are retracted to the 37.5% position, an increase about equal to the drag that would occur if the landing gear were extended again. After this point in retraction, drag decreases rapidly. It is therefore recommended that with an engine failure on a high weight takeoff, the flaps be left down until a safe altitude is reached and flap retraction can be accomplished in level flight or in a slight dive. Full flap retraction should be accomplished as soon as feasible after reaching 1000 feet above terrain because the resulting acceleration to the proper climb speed will increase the rate of climb about 700 fpm. Speeds for maximum rate of climb with flaps down while operating on eight or seven engines are presented in Part 4 of the applicable Appendix.

DROP TANKS. The drag effect of drop tanks on takeoff is negligible because of the low airspeeds involved. The weight effect of full tanks however is important enough to warrant consideration. The rate of climb can be increased about 300 fpm if the full 3000-gallon tanks are dropped. This action needs to be accomplished only when climb is extremely marginal. See "Drop Tank Emergency Operation," this section.

WARNING

The aircraft has reduced strength capability when flown without drop tanks at gross weights above 370,000 pounds. At these weights, the drop tanks should be jettisoned as an emergency procedure only. The airplane should then be flown in a wings level attitude to keep the "g" loading to an absolute minimum. Turbulent air and severe maneuvers or sharp turns should be avoided.

ENGINE FAILURE DURING TAKEOFF CHECKLIST

Takeoff Refused

1. **ABORT TAKEOFF**

   See "Aborted Takeoff" procedure under "Takeoff and Landing Emergencies," this section.

Takeoff Continued

1. **USE "EMERGENCY SHUTDOWN" PROCEDURE WHEN SAFE ALTITUDE AND AIRSPEED ARE REACHED.**

ENGINE FAILURE DURING CLIMB

Engine failure during a climb is not considered critical provided the recommended airspeed climb schedule is followed. If an engine failure is encountered during a climb, the airspeed or rate of climb or both will decrease. If the mission is to be continued, a new climb schedule will have to be flown. Directional control can be maintained easily by adding rudder trim and a slight amount of lateral trim.

ENGINE FAILURE DURING CRUISE

If an engine fails during a cruise condition, cut the engine by moving the throttle to CLOSED position. Compensate for the unbalanced thrust condition by adding appropriate directional and lateral trim. Failure of an engine during cruise will not appreciably affect directional control but will result in a decrease in the speed being flown. Normally, the cruise altitude will also be decreased depending upon the amount of fuel remaining, type of mission being flown, etc. Applicable charts covering eight-, seven-, and six-engine operation are included in Part 5 of the applicable Appendix. If the engine which failed was not on fire and the malfunction can be corrected, restart the engine as outlined under "Engine Air Starting" below.

ENGINE AIR STARTING

The air start envelope (figure 3-3) indicates the altitude and indicated airspeed envelope in which windmilling starts normally should be attempted. The rpm lines on the curve are approximate. Starts may be attempted up to the airspeed limits of the airplane. Starts made at an rpm below 65% are termed air starts. Starts made above 65% rpm are termed relights.

ENGINE AIR STARTING CHECKLIST

1. Reset Firewall Switch - Reset (P-CP)
2. Route Fuel to Engine - Routed (CP)

   Have fuel boost pressure available to the firewall fuel shutoff valve.

3. Advance Throttle to IDLE, then CLOSED - Accomplished (P)

   If shutdown was caused by fuel starvation, open the throttle to IDLE until fuel flow is established and retard to CLOSED for 30 seconds. This will purge the fuel control unit of air and the engine of fuel.

ENGINE AIR STARTING CHECKLIST (Cont)

4. Check Engine Rpm - Checked (P)

   Establish an indicated airspeed which will give an engine speed within the "normal windmilling start" range of the air start envelope. If sufficient airspeed cannot be obtained, use engine starter to increase rpm above 12%. See figure 3-3 for recommended airspeed and altitude for engine airstarting.

5. Check Oil Pressure - Checked (P)

6. Turn Starter Selector to FLIGHT START - FLIGHT START (CP)

   The starter selector switch should be placed in FLIGHT START unless the engine starter is to be used to aid in the start.

CAUTION

Use of the engine starters for air starts is restricted to emergencies only.

6A. Turn Engine & Nacelle Anti-Icing Switch Off - OFF (P)

7. Turn Starter Switch to START - Started (CP)

8. Move Throttle to IDLE - IDLE (P)

9. Check Flowmeter - Checked (P)

   Fuel flow should be between 570 B-52E (or 560 B-52F) and 1250 pph prior to combustion. Starts with less than 570 (or 560) pph may be attempted. When flow is more than 1250 pph, retard the throttle below IDLE to reduce the flow below 1250 pph. During acceleration from combustion to idle rpm, the normal fuel flow will increase to approximately 2000 pph. In both cases, the engine operation should be watched carefully for evidence of further malfunctioning of the fuel control unit.

10. Check Engine Indicators - Checked (P)

    Leave the throttle at IDLE until engine indicator readings have stabilized as follows:

    a. Tachometer - 65% to 85% rpm B-52E
       57% to 85% rpm B-52F

    b. Exhaust Gas Temperature - 340° C maximum

    c. Oil Pressure - Within limits (Section V)

NOTE

Normally, combustion should occur within 20 seconds or less and will be evidenced by a rise in exhaust gas temperature. If the exhaust gas temperature exceeds limits, if the engine fails to accelerate to idle rpm, or if the oil pressure does not reach 35 psi, discontinue the restart by retarding the throttle to CLOSED and place the starter switch OFF. Allow the engine to windmill for 30 seconds before attempting another restart.

11. Advance Throttles - Desired setting (P)

12. Turn Starter Switch to OFF - OFF (CP)

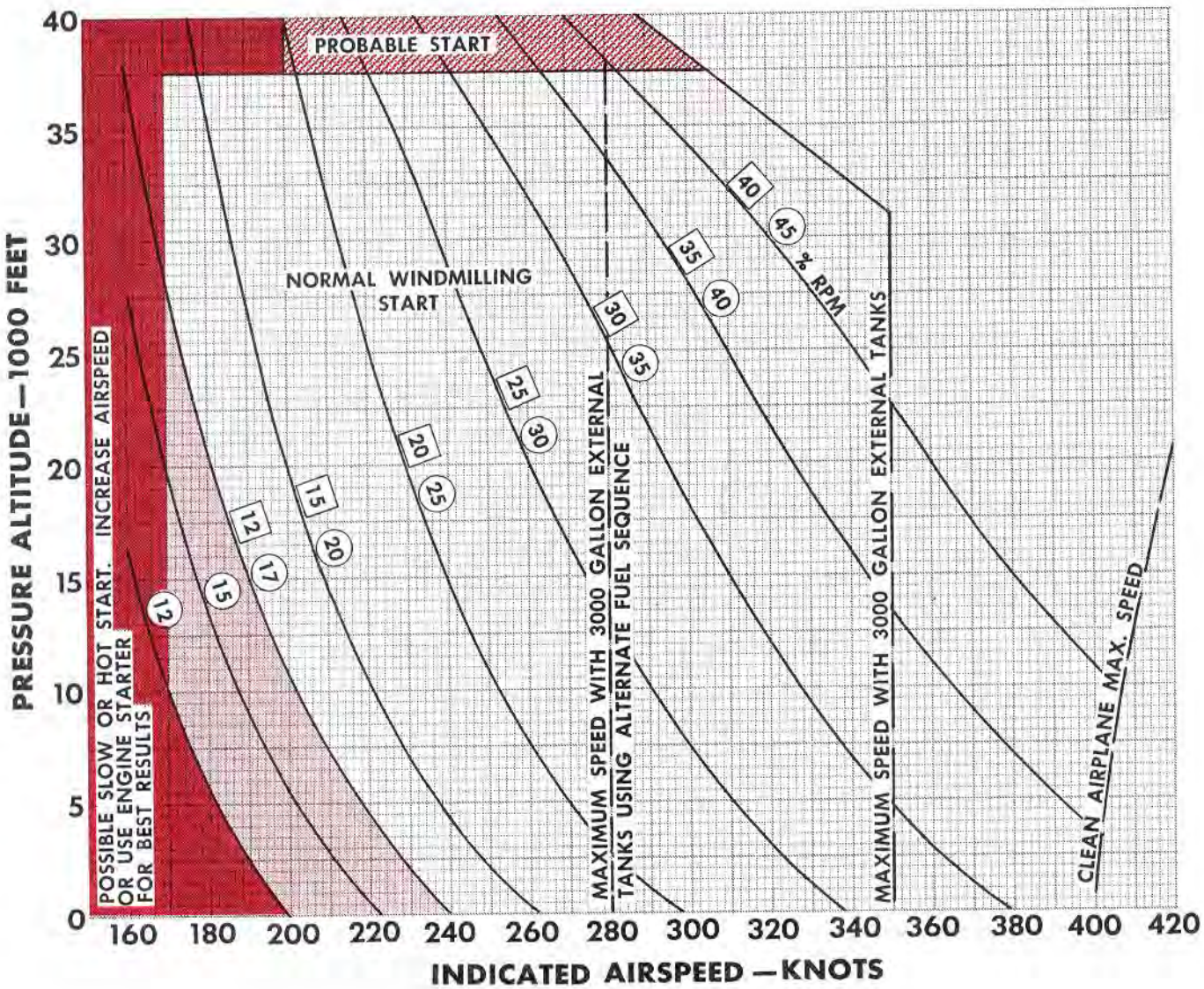
13. Turn On, Check, Reparallel Alternator (if applicable) B-52F - Accomplished (CP)

14. Engine & Nacelle Anti-Icing Switch - CLIMATIC (P)

DATA BASIS: FLIGHT TEST
DATE: NOVEMBER 1958

NACA STANDARD DAY

Boxed figures indicate RPM for alternator equipped engines 1, 3, 5, and 7 installed on B-52F airplanes.
Circled figures indicate RPM for all engines installed on B-52E airplanes and engines 2, 4, 6, and 8 installed on B-52F airplanes.



air start envelope

Figure 3-3.

ENGINE FLAMEOUT AND RELIGHT

Immediate response by the pilots to an engine flameout can make a relight possible without the necessity of descending to the altitudes and rpm limits shown on figure 3-3. Relights may be made at as low as 65% rpm. To simplify relight procedure, the starter selector switch should always be positioned to FLIGHT START when the airplane is in flight. See "Engine Flameout and Relight Checklist" below. For recommended procedures in the event of multiple engine flameout at higher altitudes, see "Engine Operation," Section VII, and "Turbulence and Thunderstorms," Section IX.

ENGINE FLAMEOUT AND RELIGHT CHECKLIST

NOTE

This procedure applies to starts at altitudes above the "probable start" range of the air start envelope (figure 3-3). Successful relights can be accomplished only before rpm drops below 65% after a flameout. Immediate response by the pilot is necessary.

1. **RETARD THROTTLE(S) TO IDLE (P)**
2. **ACTUATE STARTER SWITCH(ES) TO START (CP)**
3. Monitor Fuel Flow and EGT - Accomplished (P)
4. Advance Throttle(s) - Desired setting (P)

   When engine relight is indicated by fuel flow and EGT, advance throttle to desired setting.

NOTE

If the adjacent engine in the same nacelle starts to surge or vibrate during the engine relight procedure, retard the adjacent engine throttle to IDLE and advance both engine throttles to the desired setting after the relight has been accomplished.

5. Close Throttle(s) - If no relight (P)

   If the engine does not relight, retard the throttle to CLOSED. After one unsuccessful attempt to restart the engine at high altitudes, it will be necessary to descend within the altitudes and rpm limits shown on figure 3-3 if the engine is to be restarted.

6. Open Alternator Circuit Breaker Switch B-52F (if applicable) - Opened (CP)

   If the failed engine drives an alternator and if it appears that some time will elapse before the engine can be restarted, the alternator should be taken off the line so that it will not be motored by power from the others. Check that the alternator circuit breaker light comes on. Make certain that the remaining alternators are not overloaded.

LANDING WITH ONE OR MORE ENGINES INOPERATIVE

Landing with an engine failure can be accomplished by following the normal landing procedure with the addition that, as thrust is decreased, trim will have to be decreased to compensate for reduction of the unequal thrust. Under any approach conditions involving reduced power, the necessity of early anticipation of additional power requirements cannot be overemphasized. Engine failure will not materially affect the landing gear extension time. The gear is fully extended in 10 to 12 seconds.

Landing with Three or Four Engine Failure on One Side

WARNING

- With three or four engines inoperative on one side, altitude cannot be maintained with gear and flaps extended except at very light gross weights of approximately 230,000 pounds or less.
- It is recommended that a landing under this condition should not be attempted at gross weights in excess of 270,000 pounds.

Flight tests have demonstrated that landings can be successfully accomplished with three or four engines inoperative on one side provided proper techniques and procedures are followed. Figure 3-3A illustrates two landing patterns from which landing may be accomplished with three or four engines inoperative on one side. From an operational standpoint it is desirable to make the emergency patterns as near normal as possible. With three or four engines inoperative on one side for any given speed, there is a thrust level which will make that speed the minimum directional control speed. In order to keep the landing pattern speeds normal, the only way to reduce the thrust level is to increase the rate of descent. For example, an approach slope of 10 to 1 is required on the final approach leg to keep the thrust below the critical value as contrasted to the normal approach slope of approximately 20 to 1.

NOTE

With three or four engines inoperative on one side, a flaps down landing is recommended rather than a flaps up landing. During a flaps down landing, the variables from a normal landing are fewer and pilot effort required to cope with the emergency is considerably reduced.

The downwind entry pattern landing is accomplished as follows:

1. The downwind entry pattern shown in figure 3-3A may be flown making turns into or away from the inoperative engines with no appreciable difference in airplane flight handling characteristics. The downwind leg, which is the same distance out from the runway as for a normal landing, should be intercepted with the airplane in clean configuration (flaps up, gear up, airbrakes down) at 225 knots IAS, 4000 feet above the runway elevation. The master bomb control power switch should be placed ON to ascertain operation of hydraulic packs.

2. Maintain 4000 feet and 225 knots IAS until opposite the landing end of the runway. At this point start the flaps down. Continue downwind 1 minute, maintaining 4000 feet altitude by accepting a decrease in airspeed to approximately 170 knots IAS.

NOTE

- No thrust adjustment will be required during flap extension if 225 knots IAS is maintained with constant thrust prior to initiating flap extension. Thrust reduction is required after full flap extension is accomplished in order to descend properly throughout the remainder of the landing pattern.
- It is recommended that directional control be maintained using lateral control only without use of lateral or rudder trim. This eliminates the requirement for trim changes throughout final approach, flare, and touchdown. Sideslip may be decreased slightly by use of the rudder.

3. After 1 minute on downwind from a point opposite the landing end of the runway, commence turn on base leg from 4000 feet altitude at 170 knots IAS. Extend the landing gear on base leg and plan to roll out on final approach 3 miles from end of runway, at 150 knots IAS, 2000 feet above the runway, with landing gear and flaps down. If a go-around is to be made, it must be initiated prior to descending below 2000 feet above the terrain. MRT may be required in order to arrest the rate of descent and accelerate the airplane to climb speed within the 2000-foot altitude and still retain a satisfactory safety margin.

WARNING

A successful go-around with three or four engines inoperative on one side cannot be assured any time the airplane descends below 2000 feet above the terrain. Flight tests have indicated that a minimum of 1000 feet altitude must be sacrificed in order to arrest the descent and accelerate the airplane to minimum directional control speed if flaps and landing gear are retracted simultaneously with thrust increase. Thrust increase must be commensurate with the pilot's ability to control the sideslip and maintain the heading. The use of rudder will assist in keeping sideslip to a minimum during a go-around. Any hesitation on the part of the pilot in performing any of the above steps will result in a loss of altitude in excess of 1000 feet. It is recommended that climb back to pattern altitude be accomplished at 225 knots IAS.

4. Commence turn to final approach leg, planning to roll out on final approach at 2000 feet, 150 knots IAS.

WARNING

- If a landing is necessary at gross weights above 270,000 pounds, final approach leg should be flown at best flare speed plus 10 knots. However, landing above 270,000 pounds should not be attempted unless no other alternative exists.

- For weights above 270,000 pounds, do not attempt a go-around since the thrust required to arrest the loss of altitude may exceed the thrust permitted to maintain directional control.

5. After rollout from base leg, commence final approach at 150 knots IAS, 2000 feet above the runway altitude, with landing gear and flaps down. This altitude initially appears high for landing; however, since a rate of descent of approximately 1500 feet per minute can be expected, it is necessary to be at this altitude in order to accomplish a normal touchdown with minimum thrust.

WARNING

This is the final point in the landing pattern from which a successful go-around can be initiated. In addition, 150 knots IAS is below minimum directional control speed for four engines inoperative on one side and operating engines at MRT. A go-around from such a speed is potentially hazardous. Flight tests conducted from this speed and configuration demonstrated that this maneuver required loss of altitude but could be made within the control capability of the pilot.

6. Continue the approach, maintaining 150 knots IAS until assured the runway can be reached. From this point, thrust may be gradually further reduced, sideslip and bank angle further decreased, and a normal landing accomplished. Airbrake response may be limited as dictated by engine-out configuration. Airbrakes should be used if available to decrease altitude and airspeed to compensate for wind effect and/or pilot technique. Avoid abrupt lateral control movements by raising airbrakes in increments of two. If airbrake position 6 is to be used to decrease speed on the runway, raising airbrakes in increments of two will prevent an abrupt wing dip should an unbalanced airbrake condition exist.

7. It is also recommended that, prior to approach for landing, crossfeed valve switches No. 9, 10, 11, and 12 be opened. This will prevent possible fuel starvation of the operative engines in event any pumps become uncovered due to bank angle and sideslip created by the asymmetrical thrust condition.

The straight-in approach landing is accomplished as follows:

1. The straight-in approach is shown in figure 3-3A and is basically an extended downwind entry pattern which has been straightened out and aligned with the centerline of the landing runway. It should be planned to intercept a point 20 miles downwind from and lined up with the runway, 4000 feet above runway elevation, in level flight at 225 knots IAS, with the airplane in clean configuration (flaps up, landing gear up, airbrakes down).

2. Continue approach to the runway, maintaining 4000 feet altitude and 225 knots IAS in clean configuration to a point 12 miles from the runway. At this point, start the flaps down, maintaining 4000 feet altitude by accepting a decrease in airspeed to approximately 170 knots IAS.

NOTE

- No thrust adjustment will be required during flap extension if 225 knots IAS is maintained with constant thrust prior to initiating flap extension. Thrust reduction is required after full flap extension is accomplished in order to maintain proper rate of descent throughout the remainder of the landing approach.

- It is recommended that directional control be maintained using lateral control only without use of lateral or rudder trim. This eliminates the requirement for trim changes throughout final approach, flare, and touchdown. Sideslip may be decreased slightly by use of rudder.

3. Flaps should be fully extended at a point approximately 9 miles from the runway at an altitude of 4000 feet and an indicated airspeed of 170 knots.

4. Maintain 170 knots IAS, planning to reach a point 6 miles from the runway, at 3000 feet and 170 knots IAS. At this point, extend landing gear. Plan to arrive at a point 3 miles from the landing end of the runway at 2000 feet altitude and 150 knots IAS with landing gear and flaps down. If a go-around is to be made, it must be initiated prior to descending below 2000 feet above the terrain. MRT may be required to arrest the rate of descent and accelerate the airplane to climb speed within the 2000-foot altitude and still retain a satisfactory safety margin.

WARNING

A successful go-around with three or four engines inoperative on one side cannot be assured any time the airplane descends below 2000 feet above the terrain. Flight tests have indicated that a minimum of 1000 feet altitude must be sacrificed in order to arrest the descent and accelerate the airplane to minimum directional

control speed if flaps and landing gear are retracted simultaneously with thrust increase. Thrust increase must be commensurate with the pilot's ability to control the sideslip and maintain the heading. The use of rudder will assist in keeping sideslip to a minimum during a go-around. Any hesitation on the part of the pilot in performing any of the above steps will result in a loss of altitude in excess of 1000 feet. It is recommended that climb back to altitude be accomplished at 225 knots IAS.

5. Start down final leg of approach from a point 3 miles from the runway, 2000 feet altitude, 150 knots IAS. This altitude initially appears high for landing; however, since a rate of descent of approximately 1500 feet per minute can be expected, it is necessary to be at this altitude to accomplish a normal touchdown with minimum thrust.

WARNING

- If a landing is necessary at gross weights above 270, 000 pounds, final approach leg should be flown at best flare speed plus 10 knots. However, landing above 270, 000 pounds should not be attempted unless no other alternative exists.

- For weights above 270, 000 pounds, do not attempt a go-around since the thrust required to arrest the loss of altitude may exceed the thrust permitted to maintain minimum directional control.

- This is the final point in the landing pattern from which a successful go-around can be initiated. In addition, 150 knots IAS is below minimum directional control speed for four engines inoperative on one side and the operating engines at MRT. A go-around from such a speed is potentially hazardous. Flight tests conducted from this speed and configuration demonstrated that this maneuver required loss of altitude but could be made within the control capability of the pilot.

6. Continue the approach, maintaining 150 knots IAS until assured the runway can be reached. From this point, thrust may be further gradually reduced, sideslip and bank angle further decreased, and a normal landing accomplished. Airbrake response may be limited as dictated by engine-out configuration. Airbrakes should be used if available to decrease altitude and airspeed as required to compensate for wind effect and pilot technique. Avoid abrupt lateral control movements by raising airbrakes in increments of two. If airbrake position 6 is to be used to decrease speed on runway, raising airbrakes in increments of two will prevent an abrupt wing dip should an unbalanced airbrake condition exist.

7. It is also recommended that, prior to approach for landing, crossfeed valve switches No. 9, 10, 11, and 12 be opened. This will prevent possible fuel starvation of the operative engines in event any pumps become uncovered due to bank angle and sideslip created by the asymmetrical thrust condition.

GO-AROUND WITH ONE OR MORE ENGINES INOPERATIVE

One Engine Failure

When attempting a landing with one engine inoperative and a go-around becomes necessary, adequate control can be maintained quite easily by applying proper rudder pedal force and a slight amount of lateral control force. All corrective control power required can be trimmed out to fly hands off, even though military rated thrust is applied on the remaining good engines and the engine which failed is located at the outboard position. However, at landing weights below approximately 290, 000 pounds, a small amount of sideslip will result.

Two Engine Failure

If two outboard engines located on the same side become inoperative and a go-around becomes necessary, there will be an insufficient amount of rudder trim available to completely balance out the yawing moment encountered at the low go-around speeds with no sideslip. However, by applying appropriate lateral control as well as full rudder, straight ahead directional control can be maintained by sideslipping. See figure 3-2 for minimum speeds for directional control with asymmetrical thrust. If full rudder trim is used at speeds above 180 knots IAS, rapid rudder manipulations must be avoided because of the structural limits of the vertical tail and rudder. Steady flight conditions can be established only with the thrust deficient wing a few degrees high.

Three or Four Engine Failure

Five engine climb curves are presented in Part 4 of the applicable Appendix. Any go-around which must be made with more than two outboard engines inoperative on the same side should be accomplished with utmost caution. Pilot application of directional and lateral control must be simultaneous with throttle movement. It is recommended that the throttles be moved to some position less than full forward until the pilot has determined his capabilities for handling such an emergency. Many different combinations of engine failures are possible and go-around techniques will vary slightly with each. The most critical conditions are those go-arounds which occur when the outboard engines have failed, since directional control is the limiting condition. Engine failure will not materially affect the landing gear retraction time. The gear is fully retracted in 8 to 10 seconds. For additional information, see "Landing with Three or Four Engine Failure on One Side," this section.

Figure 3-3A (Sheet 1 of 2).

landing with three or four engines inoperative on one side

1. Commence approach 20 miles downwind from the landing end of the runway with the airplane in clean configuration (flaps up, gear up, airbrakes down), 4000 feet above runway elevation in level flight at 225 knots IAS.
2. After maintaining 4000 feet altitude and 225 knots IAS in clean configuration to a point 12 miles from the runway, start the flaps down maintaining 4000 feet altitude by accepting a decrease in airspeed to approximately 170 knots IAS.
3. Flaps should be fully extended approximately 9 miles from the runway at an altitude of 4000 feet and an airspeed of 170 knots IAS.
4. After maintaining 170 knots IAS to a point 6 miles from the runway at 3000 feet, extend landing gear and plan to arrive at a point 3 miles from the landing end of the runway at 2000 feet altitude and 150 knots IAS, with landing gear and flaps down.
5. From a point 3 miles from the landing end of the runway at 2000 feet altitude and 150 knots IAS, continue the approach maintaining 150 knots IAS until assured the runway can be reached. Then accomplish a normal landing.

NOTE

Landing with three or four engines inoperative on one side should not be attempted at gross weights in excess of 270,000 pounds.

WARNING

If a landing is necessary at gross weights above 270,000 pounds, final approach should be flown at best flare speed plus 10 knots.

STRAIGHT IN APPROACH PATTERN

Figure 3-3A (Sheet 2 of 2).

TAKEOFF WITH ONE OR MORE ENGINES INOPERATIVE

Takeoff with one or more engines inoperative is not recommended. However, if conditions are such that it becomes necessary or desirable to fly the airplane to another location, such takeoffs are possible. It will be necessary to consider carefully the field altitude, ambient runway temperature, available runway length, wind velocity, and gross weight at takeoff. With low takeoff gross weight plus the added thrust which can be obtained by water injection to compensate for high ambient field temperatures or high field elevations, or both, a successful takeoff will be possible by use of the normal takeoff procedure. Charts are provided in Parts 2 and 3 of the applicable Appendix giving takeoff distances required for seven- and six-engine takeoffs with water injection and for seven engines without water injection.

CAUTION

It is recommended that no takeoffs be made with more than two engines inoperative on the same side.

FIRE

NOTE

Intermittent or continuous operation of the engine fire detector system lights or erratic operation of engine instruments may be an indication that an air bleed manifold pneumatic duct has failed, burning or scorching the electrical wire bundles. See "Air Bleed System Emergency Operation," this section.

ENGINE FIRE DURING GROUND OPERATION

Air Available for Motoring

An engine fire on the ground may be originated and supported by fuel, oil, or hydraulic fluid. When an indication of engine fire is evidenced, the throttle should be closed and the firewall fuel shutoff switch pulled out. If practicable, close the throttle for the adjacent engine to aid personnel in putting out the fire. The most effective means of extinguishing an engine fire is to motor the engine; therefore, it is necessary to have air available to the starter and the starter switch on.

CAUTION

If an engine fire occurs after starter dropout, it will be necessary to turn the starter switch to OFF and back to START in order to motor the engine.

Continue motoring of the engine until all evidence of the fire has disappeared. Notify the ground crew and control tower as soon as possible. When the fire is out, turn the starter switch OFF. If the fire becomes uncontrollable, shut down the remaining engines and direct the crew to abandon the airplane. Before leaving his position, the copilot will turn all fuel controls off or closed and will turn off the starter switch, battery switch, and external power switch.

CAUTION

CO_2 should not be directed into the engine tailpipe unless a fire of serious proportions is restricted to this area and a bleed air supply or ground air source of supply is not immediately available. Engine motoring should be maintained to extinguish the fire in preference to the use of CO_2. However, if the application of CO_2 is necessary, allow the engine to be shut down, if possible, in order to minimize engine damage.

Air Not Available for Motoring

An indication of engine fire without air available for motoring will result in a fire which is uncontrollable by the flight crew. The pilot will activate the abandon light and crew members will immediately evacuate the airplane. The pilot will direct the ground fire crew to extinguish the fire.

NOTE

If external power is connected, the pilot will notify the control tower of the fire prior to his evacuation.

ENGINE FIRE ON TAKEOFF

If a fire warning light comes on during takeoff, the engine indicators should be checked for evidence of fire. Do not retard the throttle for the engine on fire if its thrust is needed for takeoff unless the engine has completely lost thrust or is vibrating seriously. When the landing gear and wing flaps have been retracted and a safe altitude is reached, retard the throttle for the engine on fire to IDLE to see if the fire warning light will go out. If light remains on, retard throttle to CLOSED and use "Emergency Shutdown" procedure, this section.

ENGINE FIRE ON TAKEOFF CHECKLIST

1. Retard Throttle to IDLE at Safe Altitude & Airspeed - Retarded (P)
2. If fire warning light remains on, use "Emergency Shutdown" checklist (P-CP)

WING FIRE CHECKLIST

NOTE

If a fire occurs in the wing, it probably will be in the area aft of the rear spar. Trailing smoke probably will be the only indication of a wing fire. However, fuel and hydraulic fluid leaks will give an indication similar to trailing smoke.

1. **STOP FUEL TRANSFER (CP)**

   Check fuel tank gage levels to assure that the fire indication is not caused by fuel spillage from over-filled tanks or a ruptured tank or transfer.

2. **TURN AFFECTED HYDRAULIC PACK SWITCHES OFF & RESET, GUARDS UP (P)**

   Shut down the two hydraulic packs in the affected wing. A malfunctioning pack may give an indication of the source of the smoke.

3. **CHECK SPOILERS STANDBY PUMP SWITCH OFF (P)**

4. **LOWER WING FLAPS (P)**

   Conditions permitting, as airspeed is reduced to lower flaps, check for air bleed leak. (Refer to "Air Bleed Manifold Leak," this section.)

5. Close Throttles for Side on Fire - Closed (P)

   Shut down engines in vicinity of fire. If fire is not then extinguished, shut down other engines on the side on fire.

6. Turn Off Applicable Fuel Switches - OFF (CP)

   Close fuel feed valves for engines which have been shut down.

7. Uncontrollable Fire - Abandon Airplane (All)

   If it is apparent that the fire is being supplemented by fuel, immediately abandon the airplane. See "Bailout," this section.

8. Raise Wing Flaps - UP (P)

   At the pilot's discretion, the wing flaps may be raised and the hydraulic packs turned back on after the fire is out.

9. Turn Hydraulic Pack Switches On - ON, guards closed (P)

ELECTRICAL FIRE

Since the airplane electrical circuits have fault-clearance protection, it is not likely that short circuits will cause electrical fires. If an electrical fire does occur however, the only practical means of stopping it is to deenergize the circuits in the affected area and cautiously put essential equipment back in operation, one circuit at a time.

WARNING

When fighting a fire with the CB extinguisher, remember that the fumes from the CB fluid are toxic. When using a portable oxygen bottle, the regulator setting will be 30M or higher, commensurate with cabin altitude. This setting should be used where there is the possibility of heavy concentrations of fumes. This supply will last 3 to 4 minutes. The CB extinguisher must be held above the horizontal position (not upside down) to prevent the propellant charge from escaping.

FUSELAGE OVERHEAT WARNING

Illumination of a word warning light on the fuselage overheat warning panel calls for immediate action by all crew members. Illumination of a warning light should not cause undue alarm, but should be followed by an immediate investigation of the cause of the warning. Although the system is designed primarily to detect overheat conditions before fire has developed, the possibility of fire is always present. The master overheat warning light and a word warning panel will illuminate when the temperature rises to 300° F in the vicinity of the corresponding overheat warning detector. When this occurs, the copilot will alert the crew by interphone, announcing the number and the word warning. Upon being alerted by the copilot, the crew will accomplish the "Fuselage Overheat Warning Checklist." Each time the master overheat warning light illuminates, the copilot should reset it by pushing the master warning reset button. The light will then provide a warning should additional word warning panels illuminate. Following each alert, the gunner will check for signs of smoke trailing the fuselage, reporting only if smoke is observed. All operating equipment in the area of the fuselage overheat detector should be turned off as indicated in the "Fuselage Overheat Warning Checklist" and figure 3-4.

NOTE

In the event the left forward and right forward B-52E or the No. 3 and 5 B-52F alternators are shut down and their respective bus tie circuit breakers are open, emergency instrument lighting will be lost. The pilot must pull the "Pilot's Switched Battery Forward Bus" circuit breaker on the "TR Power" portion of his circuit breaker panel before emergency instrument lighting can be restored.

Followup action consists, in part, of the navigator observing the alternator deck. The navigator can also observe the right side of the forward wheel well by looking through the window in the pressure bulkhead door. Each crew member should check all the available instruments for indications of malfunctioning equipment. Certain members of the crew are designated in the chart as crew monitors to avoid confusion and unnecessary interphone conversation. The monitors have primary responsibility for reporting the progress of the overheat warning check. Any equipment suspected of malfunctioning should be shut off and reported. If shutting off the equipment in the affected area alleviates the overheat condition, the warning lights should go out as the area cools or as the supply of heated air from the pneumatic system is shut off. A second light coming on indicates a spreading overheat condition. The condition may be caused by a broken pneumatic manifold or, if shortly after takeoff, by an overheated landing gear wheel. If an overheated landing gear wheel is suspected, the affected gear should be lowered (figure 3-4). A series of lighted warning panels could be an indication of fire, particularly if shutting down the equipment does not put out all lights and if additional panels illuminate. If an overheat warning alert occurs on takeoff before S_1 is reached, the takeoff should be aborted. Depending on variable conditions, flight action taken will be at the pilot's discretion, as he closely monitors crew action following a fuselage overheat warning. Reports from the crew monitors, the number of word warning panels illuminated, the amount of equipment shut down, the gross weight of the airplane, and weather conditions should be considered by the pilot. In all cases, prompt and careful completion of the "Fuselage Overheat Warning Checklist" shall be made to avoid possible loss of the airplane or to facilitate a safe abandonment of the airplane should it become necessary.

GAM-72 FIRE WARNING

Refer to "Emergency Procedures," Section III, T. O. 1B-52G-1-2 and T. O. 1B-52E-1-4.

FUSELAGE OVERHEAT WARNING CHECKLIST

NOTE

To be accomplished by applicable crew members each time fuselage overheat word warning panel is illuminated.

1. **ALERT CREW (CP)**

   Copilot will alert crew over interphone by announcing the number of the word warning panel or panels illuminated. For example: "Attention crew, No. 2 fuselage overheat warning light which is for the right forward alternator deck B-52E (equipment bay B-52F) is on, repeat, No. 2 overheat light which is for the right forward alternator deck B-52E (equipment bay B-52F) is on. Execute checklist." Crew will check equipment and prepare to bail out.

2. Move Oxygen Regulator Diluter Lever to 100% OXYGEN - 100% OXYGEN (ALL)

3. Move Oxygen Emergency Toggle Lever to EMERGENCY - EMERGENCY (ALL)

4. Turn Operating Equipment in Affected Area Off - Off (ALL)

   See figure 3-4.

5. Discontinue Fuel Transfer - Discontinued (CP)

   Shut off all transfer switches and transfer valves.

6. Reset Master Overheat Warning Light - Reset (CP)

7. Monitor Trailing Smoke - Monitored (G)

   Report only if smoke trailing from fuselage is observed.

8. Check for Pneumatic Leak - Checked (CP)

   If the applicable fuselage overheat warning light does not go out after the equipment in that area has been shut down, the cause may be a pneumatic leak. See "Air Bleed System Emergency Operation," this section.

NUMBERED WORD WARNING PANELS	IMMEDIATE ACTION		FOLLOW UP ACTION	
1. ALT. DECK FWD. L.H.	P	Pilot's Switched Battery Forward TR Bus Circuit Breaker – Pulled		
	CP	Left Forward Alternator – OFF	N	Monitor alternator deck
2. ALT. DECK FWD. R.H.	CP	Air Conditioning Master Switch – OFF or RAM	CP	Oxygen check – Completed (if applicable)
	CP	Right Forward Alternator – OFF	N	Report to copilot
3. FWD. L.H. ALT.	CP	L. Fwd. Alt. Bus Tie Circuit Breaker – OPEN		
4. FWD. R.H. ALT.	CP	R. Fwd. Alt. Bus Tie Circuit Breaker – OPEN		
	CP	Forward Air Conditioning Pack – OFF	N	Monitor forward wheel well using window in pressure bulkhead door
5. FWD. A/C PACK	P	Descend to 40,000 feet or lower	N	Report to copilot
	P	Left Forward Landing Gear – Lower (If within 20 min of takeoff)	CP	Oxygen check – Completed
6. Deleted				
7. HYD. PACK 1	P	Hydraulic Pack No. 1 – OFF, depressurize system	N	Monitor forward wheel well using window in pressure bulkhead door
	P	Left Forward Landing Gear (If second panel to light) – Lower	N	Report to copilot

Figure 3-4 (Sheet 1 of 5).

NUMBERED WORD WARNING PANELS	IMMEDIATE ACTION		FOLLOW UP ACTION	
1. FWD. EQUIP. BAY L.H.	P	Pilot's Switched Battery Forward TR Bus Circuit Breaker – Pulled		
	CP	Eng. No. 3 Alternator – OFF	N	Monitor forward equipment bay
2. FWD. EQUIP. BAY R.H.	CP	Air Conditioning Master Switch – OFF or RAM	CP	Oxygen check – Completed (if applicable)
	CP	Eng. No. 5 Alternator – OFF	N	Report to copilot
	CP	Eng. No. 3 Bus Tie Circuit Breaker – OPEN		
	CP	Eng. No. 5 Bus Tie Circuit Breaker – OPEN		
3. AND 4. BLANK				
5. FWD. A/C PACK	CP	Forward Air Conditioning Pack – OFF	N	Monitor forward wheel well using window in pressure bulkhead door
	P	Descend to 40,000 feet or lower	N	Report to copilot
	P	Left Forward Landing Gear – Lower (If within 20 min of takeoff)	CP	Oxygen check – Completed
6. Deleted				
7. HYD. PACK 1	P	Hydraulic Pack No. 1 – OFF, depressurize system	N	Monitor forward wheel well using window in pressure bulkhead door
	P	Left Forward Landing Gear (If second panel to light) – Lower	N	Report to copilot

B-52F

fuselage overheat warning emergency procedures

Figure 3-4 (Sheet 2 of 5).

NUMBERED WORD WARNING PANELS	IMMEDIATE ACTION		FOLLOW UP ACTION	
8. FWD. W/W FWD. R.H.	P	Pilot's Switched Battery Forward TR Bus Circuit Breaker – Pulled		
	CP	Left Forward Landing Gear – Lower (If within 20 minutes of takeoff)	N	Monitor forward wheel well using window in pressure bulkhead door
	CP	Left Forward Alternator – OFF	N	Report to copilot
	CP	Right Forward Alternator – OFF		
	CP	L. Fwd. Alt. Bus Tie Circuit Breaker – OPEN		
	CP	R. Fwd. Alt. Bus Tie Circuit Breaker – OPEN		
9. FWD. W/W UPPER L.H.	CP	Forward Air Conditioning Pack – OFF	N	Monitor forward wheel well using window in pressure bulkhead door
10. FWD. W/W UPPER R.H.	P	Descend to 40,000 feet or lower	N	Report to copilot
	P	Both Forward Landing Gears – Lower (If within 20 minutes of takeoff)	CP	Oxygen Check – Completed
11. AFT. L.H. ALT.	P	Pilot's Switched Battery Forward TR Bus Circuit Breaker – Pulled MN		
	CP	Left Aft Alternator – OFF	N	Monitor forward wheel well using window in pressure bulkhead door
	CP	Right Aft Alternator – OFF	N	Report to copilot
	CP	L. Aft. Alt. Bus Tie Circuit Breaker – OPEN		
	CP	R. Aft Alt. Bus Tie Circuit Breaker – OPEN		
12. AFT. R.H. ALT. AND HYD. 2	CP	Right Aft Alternator – OFF	N	Monitor forward wheel well using window in pressure bulkhead
	P	Hydraulic Pack No. 2 – OFF, depressurize system	N	Report to copilot
	P	Right Forward Landing Gear – Lower (If within 20 minutes of takeoff)		

B-52E

Figure 3-4 (Sheet 3 of 5).

NUMBERED WORD WARNING PANELS	IMMEDIATE ACTION		FOLLOW UP ACTION	
8. FWD. W/W FWD. R.H.	P	Pilot's Switched Battery Forward TR Bus Circuit Breaker – Pulled		
	P	Left Forward Landing Gear – Lower (if within 20 minutes of takeoff)	N	Monitor forward wheel well using window in pressure bulkhead door
	CP	Eng No. 3 Alternator – OFF	N	Report to copilot
	CP	Eng No. 5 Alternator – OFF		
	CP	Eng No. 3 Bus Tie Circuit Breaker – OPEN		
	CP	Eng No. 5 Bus Tie Circuit Breaker – OPEN		
9. FWD. W/W UPR. L.H.	P	Both Forward Landing Gears – Lower (if within 20 minutes of takeoff)	N	Monitor forward wheel well using window in pressure bulkhead door
	P	Hydraulic Pack No. 1 – OFF, depressurize system (secondary warning)	N	Report to copilot
10. FWD. W/W UPR. R.H.	P	Both Forward Landing Gears – Lower (if within 20 minutes of takeoff)	N	Monitor forward wheel well using window in pressure bulkhead door
			N	Report to copilot
11. FWD. W/W AFT. L.H.	P	Pilot's Switched Battery Forward TR Bus Circuit Breaker – Pulled MN		
	CP	Forward Air Conditioning Pack – OFF	N	Monitor forward wheel well using window in pressure bulkhead door
	CP	Eng No. 1 Alternator – OFF	N	Report to copilot
	CP	Eng No. 7 Alternator – OFF		
	CP	Eng No. 1 Bus Tie Circuit Breaker – OPEN		
	CP	Eng No. 7 Bus Tie Circuit Breaker – OPEN	CP	Oxygen Check – Completed
	P	Descend to 40,000 feet or lower		
12. HYD. PACK 2	P	Hydraulic Pack No. 2 – OFF, depressurize system	N	Monitor forward wheel well using window in pressure bulkhead door
	P	Right Forward Landing Gear – Lower (if within 20 minutes of takeoff)	N	Report to copilot

B-52F

fuselage overheat warning emergency procedures (cont)

Figure 3-4. (Sheet 4 of 5).

NUMBERED WORD WARNING PANELS	IMMEDIATE ACTION		FOLLOW UP ACTION	
13. AFT. W/W FWD. L.H.	P	Left Aft Landing Gear – Lower (If within 20 minutes of takeoff)	G	Monitor – Look for trailing smoke from fuselage
			G	Report to copilot
14. WING R/S CTR. BODY	CP	Stop Flap Action	G	Monitor – Look for trailing smoke from fuselage
			G	Report to copilot
15. HYD. PACK 3	P	Hydraulic Pack No. 3 – OFF, depressurize system	G	Monitor – Look for trailing smoke from fuselage
	P	Right Aft Landing Gear – Lower (If within 20 minutes of takeoff)	G	Report to copilot
16. HYD. PACK 4	P	Hydraulic Pack No. 4 – OFF, depressurize system	G	Monitor – Look for trailing smoke from fuselage
	P	Left Aft Landing Gear – Lower (If within 20 minutes of takeoff)	G	Report to copilot
17. AFT A/C PACK	G	Aft Air Conditioning Pack – OFF	G	Monitor – Look for trailing smoke from fuselage
	G	FCS – OFF		
	G	Pull air compressor circuit breakers (if above 35,000 feet)		
	P	Descend to 40,000 feet or lower	G	Report to copilot upon reaching 40,000 feet altitude
18. AFT W/W AFT R.H.	P	Right Aft Landing Gear – Lower (If within 20 minutes of takeoff)	G	Monitor – Look for trailing smoke from fuselage
			G	Report to copilot
19. HYD. PACK 9	P	Hydraulic Pack No. 9 – OFF, depressurize system	G	Monitor – Look for trailing smoke from fuselage
	G	FCS – OFF NF	G	Report to copilot
	G	FEO/FEA – OFF MQ Evaluator D-C Circuit Breaker – Pulled		
20. HYD. PACK 10	P	Hydraulic Pack No. 10 – OFF, depressurize system	G	Monitor – Look for trailing smoke from fuselage
	G	FCS – OFF Pull Air Compressor Circuit Breakers	G	Report to copilot

B-52E and B-52F

fuselage overheat warning emergency procedures (cont)

Figure 3-4 (Sheet 5 of 5).

STRUCTURAL DAMAGE

Occasionally, structural damage may be incurred by an airplane while in flight. Such damage may be caused by midair collision, overstressing the airplane, and other causes. If the airplane is still controllable following structural damage, certain procedures may be accomplished to assist in assuring a safe landing. One basic rule which is generally applicable is to make no gross change in airplane configuration until the extent of the damage or adverse effect on flying characteristics can be determined. A chase plane may provide valuable assistance in determining the extent of damage. The reason for retaining the configuration existing at the time the damage occurs may be readily appreciated from the following: Flight loads imparted to the wing structure with flaps full up will vary considerably from the loads that exist with flaps full down. A wing can conceivably contain structural damage or failure of a type and in a location which will permit continued safe flight to a landing under certain prescribed operational conditions. To move the flaps to their opposite position however, could effect a change in wing loading which would result in further progression of the existing damage. If structural damage has occurred to a flap or portions of its mechanism, an attempt to move the flaps could result in loss of the damaged flap. Structural damage to an airplane sometimes results in tank rupture and leakage of fuel or other combustible materials. If this should occur, it is necessary under certain circumstances to take precautions in order to reduce to a minimum the possibility of inflight fire. Major sources of ignition are, of course, electrical arcs and high temperature surfaces or environment.

AIRPLANE STRUCTURE

NOTE

The following general description and definition of airplane structure is intended to aid in flight crew comprehension of the B-52 structural makeup and is not intended to be all-inclusive. For additional information, refer to applicable technical manuals.

Primary Structure

Primary structure is the major load carrying members or assemblies, the failure of which would materially decrease the safety of the airplane as a whole. Each of the airplane airfoil surfaces (wing, fin, and horizontal stabilizer) has a primary structural skeleton. This structure is generally described as follows: Wing - box beam encompassing structure between the forward and rear spars and extending from one tip through the center section to the other tip; Fin - box section between the main and auxiliary spars extending from the base up to the fiberglas insulator; Horizontal stabilizer - box section between the main and auxiliary spars extending through the center section to the middle of each surface, then becoming a single spar to each tip. Certain ribs running aft to the control surfaces and flaps are also regarded as primary structure. The primary structure of the fuselage is generally the entire fuselage with the exception of the radomes, wheel well doors and covering, bomb bay doors, and the turret.

Secondary Structure

Secondary structure is all structure that is not part of the primary structure and is normally used to maintain the aerodynamic contour of airplane components. Failure of a small portion of secondary structure will normally only affect airplane control characteristics or performance efficiency, while a major loss of that structure could destroy flight capability completely. Wing trailing edge is an example of secondary structure which could be damaged to a small extent and affect controllability and performance slightly whereas its complete loss would preclude further flight.

PRELIMINARY PROCEDURES

1. If the airplane is still controllable following inflight structural damage or failure, do not immediately make any major changes in existing configuration (retain flaps, gear, and airbrakes in the position existent at time damage was incurred).
2. Avoid turbulence or any maneuver that could apply unnecessary airloads to the airplane.

Damage Determination

If it is practical under the existing situation, request a chase plane to assist in determination of the extent of damage.

WARNING

For proper clearance to maintain during damage determination, see "Formation Flying Limitations," Section VI.

- If examination reveals that damage has occurred to secondary structure only and the damage does not include flaps or control surfaces, the flaps may be utilized as necessary.
- If damage has occurred to wing primary structure, the existing flap position should not be changed.
- If damage has occurred to elevator or horizontal stabilizer, flap position should not be changed until it is determined that sufficient longitudinal control is available to take care of the changing pitch trim requirements.
- If damage has occurred to one of the flaps, flap position should not be changed.

Controllability Check

If damage has occurred to any portion of the airplane structure sufficient to affect the airplane thrust, drag, lift, or in any other manner change the airplane normal flight and control characteristics, a controllability

check should be accomplished at a convenient altitude between 10, 000 and 15, 000 feet VFR. The check should be accomplished in the intended landing configuration and immediately prior to descent for landing so that the gross weight and airspeed checked will be valid. The controllability check should be accomplished down to, but not below, best flare speed for the existing airplane configuration and gross weight. Speed reduction for the last 30 knots above best flare speed should not exceed a rate of 1 knot per second. Following the controllability check, maintain airplane loads and accelerations at a minimum by making all turns and maneuvers as shallow and gentle as possible and avoiding turbulence during the descent and approach to landing.

NOTE

It is not always advantageous in modern airplanes to make large reductions of gross weight prior to landing after receiving structural damage. If the damage is a type that has reduced flight control capabilities, the reduced airspeed that would result from landing at low gross weights could result in control difficulties during the final portion of approach.

Fuel Leaks

If a fuel leak is known or suspected to exist, some of the following procedures may be required:

- Deenergize all electrical equipment not essential to continued safe flight and necessary communications.
- If the leak is such as to cause the emptying of a tank in a few minutes:

1. Close fuel feed valve for affected tank(s).
2. Stop transfer to affected tank(s).

NOTE

If the fuel leak is of a magnitude such as to deplete one or more tanks in a few minutes, the airplane may have a tendency to become rapidly wing heavy, tail heavy, or nose heavy. Compensating fuel management for any of these conditions should be set up as soon as possible.

- If the rate of leakage is not excessively high, it is desirable to remove fuel from the leaking tank as rapidly as possible in order to keep any possible fuel contamination of the airplane and its various compartments at a minimum. See "Fuel System Emergency Operation," this section, for tank emptying procedures.
- If the fuel leak exists in the area of any of the engine pods, the engines in the affected pod should be shut down.
- If the leak is in the bomb bay section, the airplane should not be depressurized since strong fuel fumes may enter the crew compartment.

Electrical Circuit Damage

All electrical components of the flap and landing gear control circuits are hermetically sealed or explosion proof; therefore, no special precautions will be required in the utilization of these circuits. If, however, structural damage has broken any wires or conduits, arcing could result from energizing these wires or conduits. If it is suspected that such damage may exist, explosion hazard may be minimized by utilizing the following procedure:

1. If damage to gear and flap circuitry is suspected, explosion possibility will be greatly reduced by energizing these circuits at altitudes above 30, 000 feet. When gear and flaps are extended at high altitude, pull all circuit breakers to these control systems before descending.

NOTE

At altitudes above 30, 000 feet, the possibility of accidentally igniting JP-4 fuel is reduced considerably. Altitudes between 15, 000 and 25, 000 feet may be more conducive to autoignition than either higher or lower altitudes.

2. Deenergize all circuitry suspected of being damaged by pulling the appropriate circuit breakers, to the extent that is possible, while still retaining the required functions.

ADDITIONAL PROCEDURE

It is seldom that two inflight emergencies are identical; therefore, the proper remedial measures will not necessarily be identical. When the necessary preliminary emergency procedures have been accomplished, contact the appropriate command within radio range for further assistance in determining additional emergency procedures.

SMOKE AND FUMES ELIMINATION

AIR CONDITIONING SYSTEM

The most probable source of smoke or fumes in the pressurized compartments is the air conditioning system ducts. If smoke or fumes are evident in a pressurized compartment, place the air bleed selector switch for the affected compartment in ALTERNATE position. This allows the air conditioning system for the compartment to use engine bleed air from the opposite air bleed system manifold. See "Air Bleed System," Section I, for further information on sources of bleed air used for air conditioning.

WARNING

Under takeoff power conditions and with low temperature selection, fog or vapor resembling smoke can occur. Reporting this vapor as smoke or fire at a critical point of the takeoff could create a hazard.

SMOKE AND FUMES ELIMINATION CHECKLIST

1. **OXYGEN REGULATOR DILUTER LEVER TO 100% OXYGEN (ALL)**
2. **OXYGEN EMERGENCY TOGGLE LEVER TO EMERGENCY (ALL)**
3. **AIR BLEED SELECTOR TO OPPOSITE POSITION (CP/G)**

   Place air bleed selector switch to its other position, ALTERNATE or NORMAL.

4. Monitor Affected Nacelle Engines for Malfunction - Monitored (P/CP)
5. Position Air Conditioning Master Switch As Required - Positioned (CP/G)

   If it can be determined that the smoke or fumes are coming from the air conditioning system, position the air conditioning master switch to RAM. For other sources of smoke, fumes, and/or heat, the air conditioning system master switch should be set according to existing requirements at 7.45 PSI or COMBAT 4.50 PSI and, if maximum airflow for ventilation is desired, pressure release switch may then be moved to DUMP.

DEPRESSURIZING

Since most missions of the airplane are at altitudes requiring cabin pressurizing, it is not practical to attempt to depressurize and clear the cabin of smoke or fumes. Crew members should experience no difficulty if they switch their regulator diluter levers to 100% OXYGEN and emergency toggle lever to EMERGENCY position. This type of operation reduces the oxygen range of the airplane. The source of the smoke or fumes should be found and eliminated as soon as possible. If they cannot be eliminated, it will be necessary to descend below 40,000 feet altitude (the maximum altitude for the combination of the A-13A mask and the airplane system regulator) and depressurize the airplane. To depressurize a compartment, position the air conditioning master switch to RAM position.

EXPLOSIVE DECOMPRESSION

An explosive decompression occurs when the cabin pressure is reduced to the outside pressure in less than 1 second. Any explosive decompression affects all crew members and can be extremely dangerous if occurring at high altitudes. Following are some of the effects accompanying explosive decompression:

- Rush of air from lungs
- A momentary dazed sensation that passes immediately
- Possible gas pains
- Hypoxia if oxygen equipment is not immediately available.

Following are precautions to observe in pressurized compartments:

1. Maintain a safe pressure differential.
2. Have oxygen equipment immediately available.
3. Have heavy flight clothing available.

If an explosive decompression occurs, ascertain, if possible, the cause of the trouble and if it cannot be fixed in flight, the pilot should decide whether to continue the mission or to descend to a safe altitude immediately.

WARNING

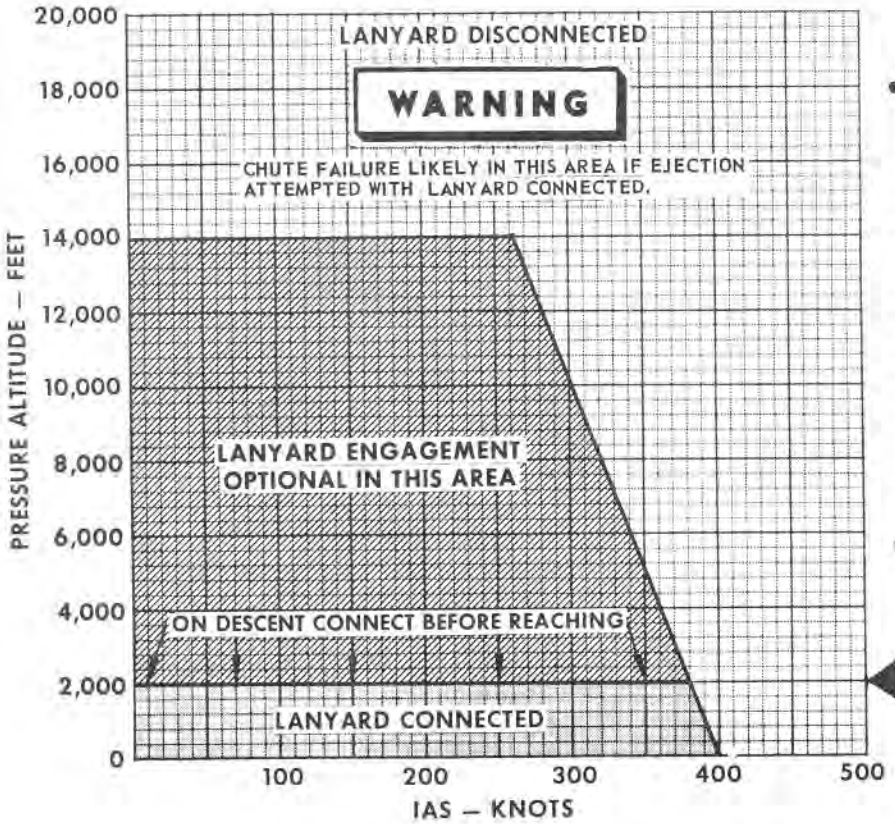
If explosive decompression occurs above 40,000 feet, descend immediately to 40,000 feet or below.

NOTE

If decompression occurs, an apparent loss of interphone volume may occur due to increased cabin noise level. This situation may be alleviated by increasing interphone volume.

OXYGEN SYSTEM FAILURE

Descend to safe cabin altitude using emergency oxygen supply available.



WARNING

- FOR MAXIMUM SAFETY DURING CLIMB-OUT, THE LANYARD SHOULD BE DISCONNECTED IMMEDIATELY UPON LEAVING THE "LANYARD CONNECTED" AREA. TO AVOID DISTRACTION DURING CRITICAL PHASES OF FLIGHT SUCH AS DURING INSTRUMENT OR FORMATION FLIGHT IT IS PERMISSIBLE TO DELAY DISCONNECTING THE LANYARD TO ANY POINT WITHIN THE OPTIONAL AREA. IF THE AIRCRAFT SHOULD EXCEED THE OPTIONAL AREA, THERE IS NO CAUSE FOR GRAVE ALARM UNLESS THE AIRCRAFT CANNOT BE RETURNED TO THE OPTIONAL AREA, OR THE LANYARD CANNOT BE DISCONNECTED BEFORE EJECTION IS INITIATED. IN ANY EVENT, WHEN CHART LIMITS ARE EXCEEDED, DISCONNECT THE LANYARD AS SOON AS POSSIBLE TO MINIMIZE TIME IN THE UNSAFE AREA.
- DO NOT CONNECT ZERO DELAY LANYARD TO PARACHUTE RIPCORD T-HANDLE WHEN USING DOWNWARD EJECTION SEAT EQUIPPED WITH MAN-SEAT SEPARATOR.

NOTE

THIS IS A VARIABLE PRESSURE ALTITUDE SINCE IT IS ALWAYS 2000 FEET ABOVE TERRAIN.

upward ejection seat zero delay lanyard engagement requirements

Figure 3-5.

BAILOUT

WARNING

Immediately following an alarm, crew members in ejection seats should ascertain that safety belts are fastened, that ejection seat flight safety pins are removed, and that emergency equipment is in readiness. Crew members not occupying ejection seats should check their equipment and proceed to the lower deck after depressurization.

The primary means provided for abandoning the airplane in flight are the ejection seats for the forward crew members and a jettisonable turret for the gunner. Both upward and downward ejection seats will function at any speed; however, if time permits, a reduction in airplane speed would be desirable since it will reduce the air blast on the seat occupants. Under level flight conditions, eject at least 2000 feet above the terrain whenever possible. During any low altitude ejection, the chances for successful ejection can be greatly increased by zooming the airplane (if airspeed permits) to exchange airspeed for altitude. Ejection should be accomplished while the airplane is in a positive climb and while the airspeed is above 120 knots IAS. This will result in a more nearly vertical trajectory for the seat and crew member, thus providing more altitude and time for seat separation and para-

chute deployment. When the airplane is descending and cannot be leveled out, ejection should not be delayed. **Under spin or dive conditions, eject at least 15,000 feet above the terrain whenever possible.** Time required to get free of the airplane may be the most important factor.

MINIMUM EJECTION ALTITUDES

No one minimum ejection altitude can be given to cover all types of ejections. Minimum altitude depends on airplane speed and attitude, time required for human response and actuation of ejection controls, whether ejection is upward or downward, harness release time delay, type of parachute, and parachute deployment time delay. The minimum ejection altitudes presented in figure 3-6 are based on the use of a B-5 parachute with C-9 canopy, a 1-second harness release time delay, and, on upward ejection seats only, a 0-second parachute deployment time delay (lanyard hooked to the ripcord T-handle). These minimum ejection altitudes represent equipment capability only, and do not include loss of airplane altitude occurring during actuation of ejection controls or resulting from improper use of equipment. In many instances, emergencies occur at "safe" altitudes but ejections are delayed to levels that make unsuccessful ejections inevitable. Also, improper or imperfect functioning of equipment or human response time may increase the minimum altitude required for escape. For increased safety, ejection should not be delayed to the minimum if higher ejection is possible. Ejection must be initiated at higher altitudes when in steep descent or dives. Therefore, to insure the highest degree of survival, the following rules must be observed:

- **Under level flight conditions, eject at least 2000 feet above the terrain whenever possible.**
- **Under spin or dive conditions, eject at least 15,000 feet above the terrain whenever possible.**

WARNING

Do not delay ejection below 2000 feet above the terrain in futile attempts to start engines or for any other reason that may commit you to an unsafe ejection or a dangerous landing. Accident statistics emphatically show a progressive decrease in successful ejections as altitude decreases below 2000 feet above the terrain.

MINIMUM NONEJECTION ALTITUDES

Crew members not occupying ejection seats and the gunner should consider an altitude of 500 feet above the terrain as the minimum altitude for bailout.

LOW ALTITUDE EJECTION

In order to provide an improved low altitude escape capability, a system incorporating a 1-second safety belt delay and a 0-second parachute delay ("one and zero" system) is provided for the upward ejection seat escape systems. This system makes use of a detachable lanyard that connects the parachute arming knob to the parachute ripcord T-handle. At low altitudes, this zero delay lanyard must be connected, thus providing parachute actuation immediately after separation of crew member from the ejection seat. At other altitudes and airspeeds, the zero delay lanyard must be disconnected from the D-ring, thus allowing the parachute timer to actuate the parachute below the critical parachute opening speed and below the parachute timer altitude setting (figure 3-5). The ring attached to the parachute harness is provided for stowage of the zero delay lanyard when it is not connected to the parachute D-ring. This "hookup" and "unhook" of the zero delay lanyard must be done manually by the crew member.

WARNING

Manually pull the ripcord T-handle immediately following seat separation for all altitudes below 14,000 feet. This is a strictly precautionary measure since the parachute should deploy automatically.

In order to provide for completely automatic separation of crew member from seat, the downward ejection seats on these airplanes are equipped with a man-seat separator.

WARNING

Do not connect zero delay lanyard to ripcord T-handle when using seat equipped with a man-seat separator.

WARNING

These are emergency minimums above the terrain. Ejection should be started at or above 2000 feet, if possible.

1. All figures applicable to LEVEL FLIGHT only and are to be used only as guides. They are optimistic for diving attitudes and conservative for climbing attitudes.
2. All altitudes given are contingent upon separation from the seat without delay following ejection.
3. Zero second parachute figures, used during takeoff and landing only, are applicable to airspeeds from 120 to 400 knots IAS.
4. All figures apply to modified B-5 parachute with a 1-second harness and lap belt release for upward ejection or a 0.3-second harness and lap belt release for downward ejection.

WARNING

Emergency minimum ejection altitudes quoted in this table were determined through extensive flight tests and are based on distance above terrain on initiation of seat ejection (i.e., time seat is fired). These figures do not provide any safety factor for such matters as equipment malfunction, delays in separating from the seat, etc. These figures are quoted only to show the minimum altitude you must go up to in the event of such low altitude emergencies as fire on takeoff. They shall not be used as the basis for delaying ejection when above 2000 feet since accident statistics show a progressive decrease in successful ejections as altitude decreases below 2000 feet. Therefore, whenever possible, eject above 2000 feet.

1 SECOND PARACHUTE	0 SECOND PARACHUTE
F-1B Timer	Lanyard Hooked To Ripcord T-Handle
C-9 Canopy	C-9 Canopy
UPWARD EJECTION — M-3 CATAPULT	
125 Ft	0 Ft
DOWNWARD EJECTION — M-4 CATAPULT	
400 Ft	

emergency minimum ejection altitudes - level flight

Figure 3-6.

The downward seats are one-control seats with two nylon straps installed in the seat under the survival kit and parachute. A reel-type ballistic actuator is connected to the integrated harness release actuation system. The straps are connected to a jackshaft driven by the reel-type actuator. During ejection immediately after integrated harness release, the actuator pulls the nylon straps tight to provide automatic-controlled separation of the seat occupant from the seat. Since this is completely automatic, the time delay incurred by a crew member making a conscious physical effort to kick free of the seat is eliminated. Further, injured or unconscious crew members will be automatically separated from the seat and the parachute deployed following ejection.

Figure 3-7. Deleted

EJECTION SPEEDS

Recent study and analysis of escape techniques from aircraft have revealed that ejection from the B-52 airplane may be successfully accomplished at airspeeds ranging from 120 knots to the limit speed of the airplane. The zero second delay parachute configuration used for low altitude escape is restricted to velocities up to approximately 400 knots IAS because of excessive chute opening shock forces at higher speeds. Whenever circumstances permit, slow the airplane down as much as possible prior to ejection. When ejecting at low altitudes, pull the nose of the airplane above the horizon if at all possible and use excess speed to gain altitude. Eject at the lowest practical airspeed above 120 knots IAS ("lowest practical" would be that speed below which level flight cannot be maintained). The need to be at the lowest possible airspeed down to 120 knots IAS prior to ejection is predicated on many factors such as avoiding bodily injury, precluding parachute or seat structural failure, and providing adequate tail clearance. Below 120 knots IAS, airflow is not sufficient to assure rapid parachute deployment. Therefore, it becomes extremely important during low altitude ejection to obtain at least 120 knots IAS, if possible, to assure complete parachute deployment at the greatest height above the terrain. During high altitude ejection, observing this minimum airspeed (120 knots IAS) becomes less important since there is adequate time (altitude) for parachute deployment.

REGULAR CREW MEMBER BAILOUT CHECKLIST

Preparatory Steps

1. **WARN CREW (P)**

Pilot announces over interphone "Prepare to abandon the airplane." If retention of drag chute is desired, requests gunner to raise turret-drag chute interconnect control knob prior to jettisoning the turret. If the interphone is inoperative, only the bailout execution order will be given and there will be no preparatory signal. To accomplish this, the pilot places the emergency alarm switch to ABANDON. Any time the pilot gives the bailout (steady) signal, personnel will immediately bail out. Therefore, the pilot should assure that he is above highest minimum bailout altitude prior to giving the signal.

NOTE

- Pilot will reduce airspeed, trim for level flight, and engage the autopilot.
- The gunner may have difficulty escaping from the tail if the airplane is in an extreme nose down attitude. It is recommended that the airplane be trimmed to level flight or a nose high attitude, if possible, to facilitate his bailout.
- At extremely low altitudes, it is recommended that the nose of the airplane be pulled up in a "zoom up" maneuver during ejection to provide more time for parachute deployment. If an open hatch or bomb bay is being used for bailout however, the airplane should be trimmed for level flight.

2. **JETTISON TURRET ON PILOT'S COMMAND (G)**

Gunner pulls turret jettison handle on the pilot's command and notifies pilot that the turret has jettisoned. If pilot requests retention of drag chute, the gunner should raise turret-drag chute interconnect control knob prior to jettisoning the turret.

NOTE

If the turret will not jettison, the right aft gear should be lowered with the emergency switch and the gunner should come forward and bail out of the right aft wheel well.

REGULAR CREW MEMBER BAILOUT CHECKLIST (Cont)

3. GIVE COMMAND "BAILOUT" (P)

Pilot gives command "Bailout" by interphone and by placing the emergency alarm switch in ABANDON. Bailout should be conducted in the following order; G, N, EW, RN, CP, and P. The navigator is ejected prior to the radar navigator in order to make this hatch available for bailout in case an ejection seat in the forward compartment fails or for use by extra personnel aboard. Extra crew members will commence bailout immediately following navigator in order briefed at crew inspection. The radar navigator waits to inform the pilot that all crew members using the navigator's escape hatch have left before ejecting himself. If time permits, each crew member will inform pilot just before leaving the airplane.

WARNING

In the event of fire in the forward wheel well area, the jettisoning of an escape hatch will cause smoke and flames to be drawn into the crew compartment. Therefore, the jettisoning of an upward escape hatch prior to the egress of all lower deck crew members could seriously hamper their escape.

NOTE

- Under adverse conditions such as bailout at low altitudes, simultaneous ejection may be accomplished with the calculated risk of interference between the seats as they leave the vicinity of the airplane.
- All additional crew members should bail out prior to firing of upward escape hatch.
- Under flight conditions of high cabin pressure differential, the best indication of a hatch having been jettisoned will be a rapid decompression within the crew compartment.
- Since the radar navigator has a single control seat, he must not initiate his ejection sequence until the additional crew members have bailed out.

Upward Ejection Seats (P-CP-EW)

1. Acknowledge Warning - Acknowledged

Acknowledge the pilot's warning signal in the normal crew report sequence.

WARNING

N F

The EW officer must insure that the ALR-20 rack is in the stowed and locked position before attempting ejection. Ejection with the rack extended would result in severe leg injuries.

2. FASTEN SAFETY BELT

REGULAR CREW MEMBER BAILOUT CHECKLIST (Cont)

3. Equipment Checked

   Crew member checks shoulder harness fastened, oxygen mask and chin strap fastened, and helmet visor down.

WARNING

At the EW officer's seat, the ALR-20 rack must be fully stowed and locked before ejection to prevent serious injury to the knees and legs. N F

4. Pull Bailout Bottle Release Cord - Pulled

   Pull bailout bottle release cord on receiving the pilot's signal to abandon the airplane.

5. Assume Position - Accomplished

   Raise armrests, place feet flat on floor, elbows in guards, head back against headrest, and sit erect.

WARNING

Do not manually open the safety belt prior to ejection at any altitude.

6. **ROTATE ARMING LEVERS**

   Rotating either or both arming levers forward and upward to their full travel locks the inertial reel, stows the control column (on pilots' seats), jettisons the escape hatch, and arms the seat.

WARNING

- If the control column fails to stow automatically, it should be stowed manually to prevent possible leg injury.
- Do not attempt manual release of the hatch. If hatch does not jettison, proceed with alternate bailout.

7. **SQUEEZE TRIGGER**

   Squeeze either trigger against the arming lever to fire the seat. The integrated harness release will operate automatically 1 second after ejection and release the safety belt and parachute shoulder straps from the seat. If the automatic feature fails, pull the yellow harness release handle. When the yellow harness release handle is pulled, the parachute arming lanyard will not have armed the automatic timer for parachute opening, and it will be necessary to manually pull the parachute arming lanyard immediately after separation from the seat. The automatic timer will start to operate at preset altitude then, after delay set on the timer expires, the parachute will open. If

REGULAR CREW MEMBER BAILOUT CHECKLIST (Cont)

bailout occurs below the preset altitude, the parachute will open 1 second after separating from the seat. Pulling the ripcord T-handle will override the automatic device and open the parachute immediately.

WARNING

- If the trigger does not fire the catapult, lift the manual catapult initiator pin-pull release handle and draw the pin-pull cylinder forward to remove the pin from the catapult initiator. This should be done by reaching under the armrest to avoid bodily injury. (Do not squeeze firing trigger while manually pulling manual catapult pin-pull cylinder release.) With the pin removed from the catapult initiator, again squeeze the trigger.
- Immediately after ejection, release arming levers and kick free of seat with positive action. Experience has shown many casualties caused by people freezing in the seat.
- If the integrated harness fails to release automatically, immediately pull the integrated harness release handle, kick free of the seat, and pull the parachute arming lanyard.
- If the safety belt should be unfastened by use of the buckle, the seat occupant will remain attached to the seat by the inertia reel and the survival kit attachment straps threaded through the safety belt.
- If the parachute automatic opening device obviously has failed, pull the ripcord T-handle manually to open the parachute.
- Manually pull ripcord T-handle to open automatic parachutes for all ejections below 14, 000 feet.
- Pull survival kit release to lessen impact shock as soon as stable in the parachute.

NOTE

If the seat fails to fire, remove survival kit and proceed with alternate bailout checklist. Pull survival kit release handle, then pull integrated harness release handle. Occupant can then leave seat, wearing the parachute and safety belt.

Downward Seat Ejection (N-RN)

1. Acknowledge Warning - Acknowledged

   Acknowledge the pilot's warning signal in the normal crew report sequence.

2. IFF - Set

   If over friendly territory, place IFF in EMERGENCY, Mode 3 toggle switch "in," and set Mode 3 code selector to 77.

REGULAR CREW MEMBER BAILOUT CHECKLIST (Cont)

3. FASTEN SAFETY BELT

WARNING

Do not attempt downward ejection with safety belt unfastened under any circumstances.

4. Equipment - Checked

Crew members check safety belt and parachute harness fastened, oxygen mask and chin strap fastened, and helmet visor down.

WARNING

Do not connect zero delay lanyard to ripcord T-handle.

5. RN Only Report Additional Crew Members Bailout - Reported

6. Pull Bailout Bottle Release Cord - Pulled

Pull bailout bottle release cord on receiving the pilot's signal to abandon the airplane.

7. Assume Position - Accomplished

Head back against headrest. Sit erect. If legs are not already in ankle restraints, press legs against restraint triggers.

8. PULL TRIGGER RING

Grasp the trigger ring with both hands and pull. This action will lock the shoulder harness inertia reel, rotate the leg guards, jettison the escape hatch, and eject the seat. Approximately 0.3 second after ejection, the integrated harness release will operate, automatically releasing the shoulder harness and safety belt from the seat. Simultaneously with integrated harness release, the man-seat separator actuates to provide controlled automatic man-seat separation and automatic parachute deployment. The parachute automatic timer will start to operate at a preset altitude, then, after the delay set on the timer expires or if bailout occurs below preset altitude, the parachute will open 1 second after separating from the seat. If the automatic feature of the integrated harness release fails, pull the yellow integrated harness manual release handle located on the left side of the seat to manually accomplish release. If the integrated harness release fails, the man-seat separator will not operate, and a positive effort must be made to kick free of the seat. The parachute arming lanyard must be pulled if integrated harness is released by actuation of the integrated harness release handle. In either case, pulling the ripcord T-handle will override the automatic device and open the parachute immediately.

WARNING

- The ring must be held tightly during ejection to prevent flailing of the arms. To prevent injury, the elbows must be kept in against the body when pulling the trigger ring.

REGULAR CREW MEMBER BAILOUT CHECKLIST (Cont)

WARNING

- In the event the trigger ring does not fire the seat, the catapult initiator safety pin may not have been retracted. Pull upward on the manual safety pin-pull release handle on the left side of the seat and again attempt ejection.
- Do not attempt manual release of the hatch. Manual release of the hatch involves pushing the hatch into the airstream which consumes valuable time during a period of crisis. Therefore, if hatch does not jettison, proceed with alternate bailout.
- If the integrated harness fails to release automatically, immediately pull the integrated harness release handle, kick free of the seat, and pull the parachute arming lanyard.
- If the safety belt should be unfastened by use of the buckle, the seat occupant will remain attached to the seat by the inertia reel and the survival kit attachment straps threaded through the safety belt.
- If parachute automatic opening device has obviously failed, pull the ripcord T-handle manually to open the parachute.
- Pull survival kit release to lessen impact shock as soon as stable in the parachute.
- Manually pull ripcord T-handle to open automatic parachutes for all ejections below 14,000 feet.

NOTE

- If the seat fails to eject, remove survival kit and proceed to alternate bailout exit. Pull survival kit release handle, then pull integrated harness release handle. Occupant can then leave seat wearing the parachute and safety belt.
- If hatch fails to jettison, radar navigator (and navigator Less UX Less UZ) pulls the manual jettison handle on the floor at the right side of the seat before attempting to eject. If this fails, proceed to your alternate exit and bail out. Navigator UX UZ proceed immediately to your alternate exit and bail out.

Gunner's Bailout

1. Acknowledge Warning - Acknowledged

   Acknowledge the pilot's warning signal in the normal crew report sequence.

2. Check Equipment - Checked

   Gunner will check safety belt, shoulder harness fastened, oxygen mask and chin strap fastened, helmet visor down, and on airplanes UJ parachute static line connected to parachute arming lanyard.

REGULAR CREW MEMBER BAILOUT CHECKLIST (Cont)

3. PULL TURRET JETTISON HANDLE

Pull up on turret-drag chute interconnect control knob if pilot requests retention of drag chute. Jettison turret on the pilot's command. After jettisoning turret, it may be possible to deactivate or jettison the drag chute by pushing down on the interconnect control knob prior to bailout.

WARNING

When the turret is jettisoned, the airplane has a tendency to pitch down. The gunner must be ready to abandon the airplane immediately when the turret is jettisoned.

NOTE

If turret does not jettison, request pilot to lower right aft landing gear. Follow alternate bailout procedure.

4. Report "Ready to Bail Out" - Accomplished

5. Pull Bailout Bottle Release Cord - Pulled

Pull bailout bottle release cord on receiving pilot's signal to abandon the airplane.

6. PULL INTEGRATED HARNESS RELEASE HANDLE

Pull integrated harness release handle only when equipped with a modified B-5 parachute and a modified safety belt. Pulling the integrated harness release handle will free the parachute harness and safety belt from the seat, permitting the gunner to leave the seat for bailout.

WARNING

- Pull integrated harness release handle only. Do not open safety belt when equipped with the modified parachute or integrated harness. Opening the safety belt will not release the occupant from the seat and may result in fatal delay.
- Hold up on the integrated harness release handle until safety belt and parachute are free of release fittings. It may be necessary to pull the belt from the release fittings.
- Before leaving the aircraft, do not pull the global survival kit release handle when the survival kit is not installed in the seat. Pulling the handle with the kit suspended will cause the liferaft to inflate, leaving the crew member attached to the inflated raft and open survival kit. In an emergency, this could cause fatal delay in escaping from the aircraft.

REGULAR CREW MEMBER BAILOUT CHECKLIST (Cont)

7. BAILOUT

Bail out of aircraft with arms and legs in close to the body. On aircraft Less [redacted], hold parachute arming lanyard (if using automatic parachute) and pull lanyard after leaving the aircraft. On aircraft [redacted], the static line will automatically pull the parachute arming lanyard after the gunner has left the aircraft. If bailout is accomplished above preset altitude, the automatic timer will start to operate at preset altitude, then after the delay set on the timer expires, the parachute will open. If bailout is accomplished below preset altitude, parachute will open in 5 seconds. In either case, pulling the ripcord T-handle (D-ring) will override the automatic device and open the parachute immediately. If conventional parachute is used, pull ripcord T-handle (D-ring) when altitude is reached where normal breathing is possible.

WARNING

- If parachute opening device has obviously failed, pull the ripcord T-handle (D-ring) manually to open the parachute.
- Pull survival kit release to lessen impact shock as soon as stable in the parachute.

ADDITIONAL CREW MEMBER BAILOUT CHECKLIST

NOTE

The open navigator's escape hatch is used for bailout. The open radar navigator's escape hatch may be used with equal success except for the slightly greater effort required to reach the proper bailout position. The seat will have been fired by this time and the ejection rails will be in the vertical position with the lower end at the aft end of the opening. If time permits, bailout may be made from the bomb bay. See "Bailout from Bomb Bay," this section.

WARNING

- On aircraft Less [redacted], the ladder must be unlatched and stowed against the right side wall in order to enter bailout position from the right side of the hatch. Extra crew members on the upper deck should proceed to the lower deck before the ladder is stowed.
- Unrestrained crew members are subject to injury during hatch jettison by air currents caused by the depressurization.
- Extra crew members will remain clear of the rear of the navigator's seat during the navigator's ejection sequence.

ADDITIONAL CREW MEMBER BAILOUT CHECKLIST (Cont)

1. Acknowledge Warning - Acknowledged

   Acknowledge the pilot's warning signal in the order briefed. Proceed to the lower deck after the aircraft is depressurized. If in the instructor navigator's position, remain strapped in position until the aircraft is depressurized or after the navigator's hatch has left the aircraft in his ejection sequence.

2. Check Equipment - Checked

   Crew member will check oxygen mask and chin strap fastened and helmet visor down.

3. Pull Bailout Bottle Release Cord - Pulled

   If walkaround oxygen bottle is used, pull bailout bottle release cord and disconnect walkaround bottle just before leaving the airplane.

4. **BAIL OUT AND PULL PARACHUTE ARMING LANYARD**

   Position is assumed by facing forward with feet placed on the diagonal rail braces on the outboard side of each rail. Crouch with hands placed on the compartment floor on each side of the hatch opening. Draw arms and legs in close to body. Exit head first, facing away from the slipstream, by rolling forward and downward through the opening. Hold parachute arming lanyard if using an automatic parachute. Be sure to duck head and crouch as much as possible to avoid hitting forward part of hatch. No serious turbulence exists in the area inside the open hatch. Altitude does not play a part in clearing the airplane satisfactorily.

   If using an automatic parachute, pull the arming lanyard immediately after clearing the airplane. If bailout is accomplished above preset altitude, the automatic timer will start to operate at preset altitude, then after the delay set on the timer expires, the parachute will open. If bailout is accomplished below preset altitude, parachute will open in 5 seconds (1 second for ejection seat parachutes). In either case, pulling the ripcord T-handle (D-ring) will override the automatic device and open the parachute immediately. If conventional parachute is used, pull ripcord T-handle (D-ring) when altitude is reached where normal breathing is possible.

WARNING

- Do not attempt to bail out from the side of the escape hatch as this type of bailout cannot be made in a crouched position. Bailout with the body in an extended or upright position would result in bodily injuries even at moderate airspeeds.
- If parachute opening device has obviously failed, pull the ripcord T-handle (D-ring) manually to open the parachute.
- Manually pull ripcord T-handle (D-ring) to open automatic parachutes for all ejections below 14,000 feet.

E1-74

E1-75

UPWARD SEAT

1. CHECK SAFETY BELT, OXYGEN MASK, CHIN STRAP FASTENED, HELMET VISOR DOWN, BAILOUT BOTTLE RELEASE KNOB PULLED
2. RAISE ARMREST
3. PLACE FEET FLAT ON FLOOR
4. ROTATE ARMING LEVER UPWARD.

NOTE

- Use either arming lever to accomplish ejection. Use of both arming levers is desirable since the levers also act as handgrips.
- Equipment shown may not be typical.

Figure 3-8 (Sheet 1 of 4).

3

UPWARD SEAT

bailout procedures

Figure 3-8 (Sheet 2 of 4).

3-1-670

DOWNWARD SEAT

NOTE

Equipment shown may not be typical.

1

A. CHECK SAFETY BELT LOCKED AND TIGHT, OXYGEN MASK FIRMLY SECURED, HELMET VISOR DOWN, BAIL-OUT BOTTLE RELEASE KNOB — PULLED.

B. PLACE HEAD AGAINST HEADREST.

C. PULL FEET FULL BACK AGAINST SEAT, THUS TRIPPING ANKLE RESTRAINT TRIGGERS WITH LEGS TO POSITION ANKLE RESTRAINTS.

D. GRASP EJECTION CONTROL TRIGGER RING AND PULL CONTINUOUSLY TO ROTATE LEG GUARDS, FIRE CATAPULT AND EJECT SEAT.

E. IF HATCH DOES NOT JETTISON — RADAR NAVIGATOR (AND NAVIGATOR Less UX Less UZ) PULL THE MANUAL JETTISON HANDLE. IF HATCH STILL DOES NOT JETTISON (OR NAVIGATOR UX UZ) — PROCEED TO ALTERNATE EXIT.

MANUAL JETTISON HANDLE
Less UZ

Figure 3-8 (Sheet 3 of 4).

BAILOUT FROM NAVIGATOR'S ESCAPE HATCH

GEAR UP — 275 KNOTS (IAS) OR LESS
GEAR DOWN — 250 KNOTS (IAS) OR LESS

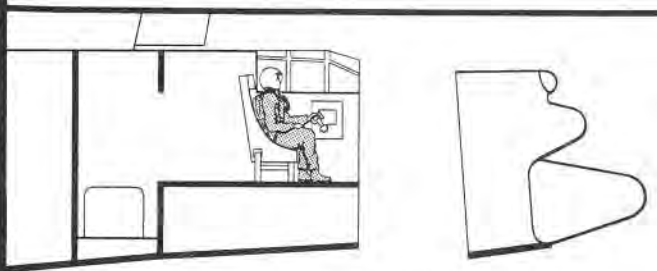
BAILOUT FROM RIGHT WHEEL WELL

AIRSPEEDS — 275 KNOTS (IAS) OR LESS

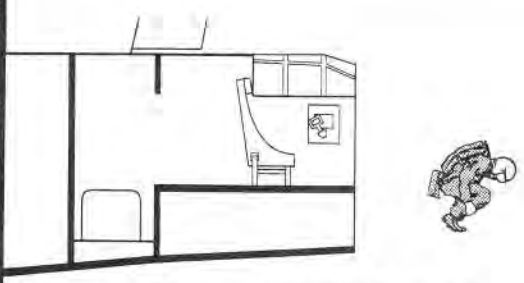
IF TURRET DOES NOT JETTISON REQUEST PILOT TO LOWER RIGHT AFT LANDING GEAR. FOLLOW ALTERNATE BAILOUT PROCEDURE

GUNNER'S BAILOUT PROCEDURE

1. CHECK SAFETY BELT, OXYGEN MASK, CHIN STRAP FASTENED, HELMET VISOR DOWN
2. PULL UP TURRET — DRAG CHUTE INTERCONNECT CONTROL KNOB AT PILOT'S COMMAND ONLY
3. PULL TURRET JETTISON HANDLE ON PILOT'S COMMAND • NOTIFY PILOT — READY TO BAIL OUT



4. PULL BAILOUT BOTTLE RELEASE KNOB
5. PULL INTEGRATED HARNESS RELEASE HANDLE



6. BAIL OUT WITH ARMS AND LEGS TO BODY
7. PULL PARACHUTE ARMING LANYARD KNOB Less LJ

bailout procedures

Figure 3-8 (Sheet 4 of 4).

ALTERNATE BAILOUT

WARNING

- Remove the survival kit before leaving the seat to bail out an alternate exit. Removal of the kit is necessary because the bulk of the kit would hamper or prevent egress. Pull the kit release handle to disconnect the kit. Be sure to pull the handle while sitting on the kit.
- Do not pull the kit release handle when the ML -2 global survival kit is not installed in the seat. Pulling the handle with the kit suspended will cause the liferaft to inflate, leaving the crew member attached to the inflated raft and survival kit. In an emergency, this could cause a fatal delay in escaping from the airplane.

Forward Crew Member's Alternate Bailout

If one of the forward crew member's ejection seat fails to fire, it is possible to bail out from one of the downward ejection hatches from which the seat has already been ejected. Bailout may also be made from the bomb bay if time permits. See "Additional Crew Member Bailout Checklist" and "Bailout from Bomb Bay," this section.

Gunner's Alternate Bailout

The right aft wheel well is designated as the first alternate bailout exit for the gunner if the turret fails to jettison during controlled bailout. Great effort is required to reach the wheel well with equipment and, therefore, the aircraft should be under control and a portable oxygen bottle should be used if at altitude. In case of uncontrolled bailout, the aft entry door should be used if unable to reach aft wheel well.

BAILOUT FROM BOMB BAY

Bailout from the open bomb bay is a safe and easy method, provided the time to reach this position is available. The crew member must traverse the walkway through the forward wheel well into the bomb bay. Due to the length of the bomb bay, no special technique is necessary for bailout from this position. The crew member drops out from the walkway at the forward end of the bomb bay, making certain not to hit either side of the opening. This bailout may be made at any airspeed.

WARNING

K S

With ADM-20 launch gear installed, bailout from the bomb bay cannot be successfully accomplished with the launch gear extended since the probability of contact with the gear or missile presents a definite hazard to survival.

NOTE

The bomb bay doors should be opened at either the radar navigator's or pilot's position prior to proceeding to the bomb bay for bailout. Doors can be opened by pushing down gang switches at aft actuator rod. This will allow the bomb doors to fully open and remain open.

ALTERNATE BAILOUT CHECKLIST

Forward Crew Members

See "Additional Crew Member Bailout Checklist" and "Bailout from Bomb Bay," this section.

Gunner

1. **REPORT TO PILOT "TURRET NOT JETTISONED. LOWER RIGHT AFT GEAR."**

   Inform pilot that the turret did not jettison and request that the right aft gear be lowered.

2. **DISCONNECT PARACHUTE STATIC LINE FROM PARACHUTE ARMING LANYARD** L J

WARNING

L J

On airplanes equipped with parachute static lines, it is necessary to manually unhook parachute arming lanyard from static line prior to vacating seat during alternate bailout to prevent premature actuation of parachute. The integrated release mechanism will not release the parachute from the static line.

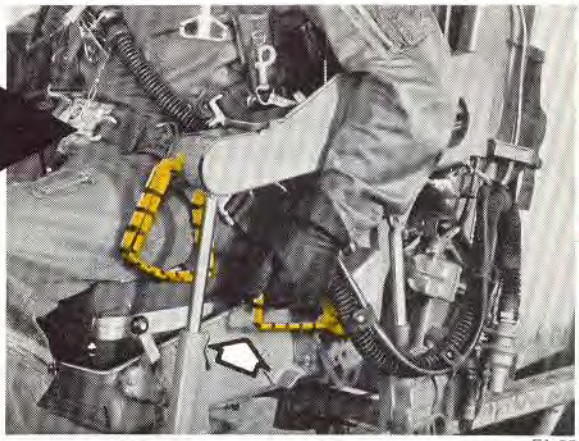
Pages 3-51 and 3-52, figure 3-9 deleted

1

E1-84

PULL SURVIVAL KIT RELEASE HANDLE

2



E1-85

PULL INTEGRATED HARNESS RELEASE HANDLE

3

- LEAVE SEAT
- DISCONNECT OXYGEN

E1-86

release from ejection seats for alternate bailout

Figure 3-10.

ALTERNATE BAILOUT CHECKLIST (Cont)

3. Assume Position in Right Aft Wheel Well - Accomplished

   Proceed to right aft wheel well with portable oxygen bottle. Stand on truss at rear of well holding on to walkway or other convenient structure for support. Check helmet visor down.

4. Check Equipment - Checked

   Gunner will check oxygen mask and chin strap fastened.

5. Pull Bailout Bottle Release Cord - Pulled

   Pull bailout bottle release cord and detach portable oxygen bottle immediately before leaving the airplane.

6. BAIL OUT AND PULL PARACHUTE ARMING LANYARD

From a crouched position, roll forward with arms and legs close to body. Hold parachute arming lanyard if using automatic parachute.

NOTE

Pull lanyard after leaving the airplane if using an automatic parachute. If bailout is accomplished above preset altitude, the automatic timer will start to operate at preset altitude, then after the delay set on the timer expires, the parachute will open. If bailout is accomplished below preset altitude, parachute will open in 5 seconds. In either case, pulling the ripcord T-handle will override the automatic device and open the parachute immediately. If conventional parachute is used, pull D-ring when altitude is reached where normal breathing is possible.

EMERGENCY COMMUNICATION WITH GUNNER

When communication with the gunner is lost, the following system will be used for transmitting signals by means of the call light for the following conditions:

WARNING

When the airplane is at altitude and the gunner does not respond to an interphone call, the pilot will immediately check the pilot's tail compartment altimeter and the copilot's tail compartment low pressure warning light. If either, or both, of these devices indicate an abnormal condition in the tail compartment, an emergency descent will immediately be initiated. If both of these devices indicate that pressurization is normal, the crew will be notified and the CALL position of the interphone selector switch may be used to contact the gunner. In the event that all other methods of communication with the gunner fail, an emergency descent will be accomplished and a crew member will initiate applicable portions of the "Emergency Inflight Movement Checklist" to investigate the condition of the gunner.

GUNNER CAN RECEIVE BUT CANNOT TRANSMIT BY INTERPHONE

Gunner transmits a series of dots using the call light. Pilot acknowledges over interphone.

GUNNER CANNOT RECEIVE OR TRANSMIT BY INTERPHONE

Gunner transmits a series of dashes using the call light. Pilot acknowledges by sending a series of dashes using the call light.

GUNNER CANNOT RECEIVE OR TRANSMIT BY INTERPHONE AND IS EXPERIENCING FLIGHT EMERGENCY

Gunner transmits a steady signal using the call light. Pilot immediately descends to 10,000 feet, terrain permitting, depressurizes the cabin, and sends a crew member aft to the tail compartment to aid the gunner.

WARNING

Normal interphone (except Call) is inoperative while selector is in CALL position. Gunner will release selector switch as soon as descent is started.

EMERGENCY INFLIGHT MOVEMENT

NOTE

Loss of temperature control in the tail gunner's compartment will be considered as an emergency, and emergency inflight movement to the forward compartment will be initiated.

An inflight emergency may make it necessary to bring the gunner forward during flight or to send a crew member from the forward crew compartment to the tail compartment. At least one spare parachute in each compartment will preclude the necessity of taking a parachute along during this movement. Although a parachute may be worn or carried while traversing the crawlway, its presence in either case will make the movement considerably more difficult and lengthy. Whenever possible, this movement should be made below 10,000 feet pressure altitude. At this altitude and without a parachute, the movement can be accomplished in 5 minutes or less. On training missions, if gunner's cabin altitude becomes greater than 20,000 feet, the pilot will initiate a descent to a pressure altitude of 10,000 feet and the gunner will go forward.

NOTE

- Prior to emergency movement of the gunner from the aft to forward compartment, it will be necessary for the pilot to raise the gear.
- A time delay (up to 2 minutes) may be expected between the time cabin pressure is dumped and residual pressure depleted, before the pressure door can be opened.

WARNING

- Complete loss of the aft TR units will result in an emergency situation for the gunner because of lack of control of the aft air conditioning pack and cabin temperature control.
- When a nuclear bomb is aboard and an emergency requires that the gunner be brought forward, his progress through the bomb bay will be monitored by the navigator or radar navigator.

EMERGENCY INFLIGHT MOVEMENT CHECKLIST

1. Stow Turret - Stowed (G)
   a. MD-9 FCS Power Switch - WARMUP

      If system malfunction is cause for the movement of the gunner, the FCS will be turned to OFF.

   b. Track Emergency Off Switch - OFF (down)
   c. Search Emergency Off Switch - OFF (down)
2. Compressor Three-Phase and Heater Circuit Breakers - Pulled (G)
3. Turn Window Defog Switch Off - OFF
4. Set Air Conditioning Master Switch to 7.45 PSI - Set (G)
5. Set Air Conditioning Temperature Selector Switch to 40° - Set (G)

CAUTION

If the emergency inflight movement of the gunner is caused by malfunctioning of the air conditioning system pressurization or uncontrollable temperature, then the air conditioning master switch will be turned OFF.

EMERGENCY INFLIGHT MOVEMENT CHECKLIST (CONT)

6. Service and Carry Oxygen Bottle - Serviced and carried (G)

   If above 10, 000 feet, a portable oxygen bottle will be carried. It will be recharged when necessary; possibly enroute. Recharging can only be accomplished at the bomb bay station while enroute (figure 4-23). Crew member will carefully monitor oxygen pressure and regulator setting.

7. Turn Oxygen Supply Lever Off - OFF (G)

   Disconnect oxygen hose from regulator and hook up to portable oxygen bottle before turning oxygen supply lever off.

8. Carry Crew Member Equipment - Carried (G)

   Crew member carries gloves, helmet, oxygen mask, and flashlight.

9. Report to Pilot - Accomplished

   Request the aft crawlway lights to be turned on by the radar navigator if applicable. The progress of the crew member making the movement will be monitored by another crew member both by timing and watching down the crawlway.

10. Operate Emergency Cabin Pressure Dump Handle - DUMP (G)

11. Open Aft Compartment Bulkhead Door, Close After Passage - Accomplished (G)

    Open and then close after entry into the 47 section. The gunner will close the bulkhead door behind him.

12. Close Emergency Cabin Pressure Dump Handle - CLOSED (G)

13. Turn Aft Compartment Section 47 Walkway Lights On - On (if applicable) (G)

WARNING

If an emergency inflight movement is made by other crew members to the tail compartment, the other crew member should actuate the depressurization request light switch for entrance. However, if the gunner is unconscious, the compartment will be depressurized using the emergency cabin pressure dump handle.

EMERGENCY DESCENT

This procedure involves flying a descent speed schedule which is determined by the initial buffet limit and should not be used unless it is necessary to descend to a low altitude at the maximum rate of descent. If buffeting is encountered, it can be stopped by reducing the speed of the airplane or by lowering the airbrakes to position

4. Do not subject the airplane to negative "g" maneuvers or nose down flight attitudes more severe than is necessary to maintain the emergency descent speed schedule. Maintain a push force of 30 to 40 pounds on the control column, using the stabilizer trim to keep this force constant during the descent down to an altitude of 20, 000 feet. Below 20, 000 feet, this control force may be trimmed out.

EMERGENCY DESCENT CHECKLIST

1. THROTTLES IDLE (P-CP)

Copilot will place GAM-77 engine control knobs in idle (if applicable).

2. GEAR DOWN (P)

3. AIRBRAKES SIX (P)

WARNING

To prevent loss of airplane control due to possible simultaneous loss of airbrakes and stabilizer trim, a push force of 30 to 40 pounds should be maintained on the control column when using full airbrakes above 20, 000 feet altitude. Below 20, 000 feet, this control force may be trimmed out.

CAUTION

Severe pitchup will be encountered if forward stabilizer trim is not started prior to raising airbrakes to position 6.

4. SWESS ARM-SAFE SWITCHES — SAFE (P-RN)

5. Descend to safe altitude at buffet (P)

This speed schedule is shown in Part 8 of the applicable Appendix.

EMERGENCY ALARM SIGNALS

WARNING

Immediately following an alarm, crew members in ejection seats should ascertain that safety belts are fastened, that ejection seat flight safety pins are removed, and that emergency equipment is in readiness. Crew members not occupying ejection seats should check their equipment and station themselves on the lower deck, or as briefed. Thus, if abandonment of the airplane should become necessary, the extra crew members can exit with a minimum of delay and confusion.

NOTE

The interphone must be considered the primary means for crew warning.

The crash landing, ditching, and bailout alarm signals are as follows: For bailout, one long steady signal. This signal is obtained by placing the emergency alarm switch in ABANDON position. In addition, a steady signal is obtained when either the pilot's or copilot's control column is stowed during the ejection sequence. For crash landing or ditching, the crew will be alerted over interphone, if possible, or by an alert (intermittent) signal. Automatic transmission of this signal is provided by use of ALERT position of the emergency alarm switch. This signal will remain on until all crew members have acknowledged over interphone. Just prior to touchdown, the emergency alarm switch will be placed in the ALERT position and crew members will be notified over interphone to brace for impact. Use of the abandon signal after contact with the ground will be the signal to exit from the aircraft.

WARNING

After the alert signal has been given to warn crew to stand by for ditching or crash landing, it must be realized that the situation which dictated the pilot's decision to crash land or ditch may become so critical that the pilot decides a bailout is mandatory. Therefore, if the bailout (steady) signal is given above minimum altitudes for bailout, the crew should bail out immediately.

At any time an emergency arises which may progress to a point where loss of airplane control is possible, the pilot will alert all aboard over interphone to prepare to abandon. It is recognized that emergencies can arise where loss of airplane control may be experienced without sufficient warning to allow the pilot to alert the crew before giving the command to bail out. Furthermore, in these cases time will not permit the pilot to receive an acknowledgment of his bailout command prior to initiating his own ejection sequence.

WARNING

If the pilot determines the airplane is out of control and immediate egress is mandatory, he will announce "Bail out" over interphone.

Upon hearing the bailout command, all personnel will initiate immediate action to bail out as expeditiously as possible. Before his own ejection, the pilot will determine insofar as possible that other crew members have left the airplane.

TAKEOFF AND LANDING EMERGENCIES

ABORTED TAKEOFF

In event a takeoff emergency arises as a result of engine fire, tire failure, fire during ground roll, or other airplane malfunction necessitating an aborted takeoff, the procedure to be followed for aborting shall always be the same. Refer to the following checklist for a standard step-by-step procedure for aborting takeoff.

ABORTED TAKEOFF CHECKLIST

1. **THROTTLES IDLE (P)**
2. **AIRBRAKES SIX (P)**
3. **DEPLOY CHUTE (CP)**

   The drag chute should be deployed at airspeeds above 90 knots. See "Airspeed Limitations," Section V, for maximum deployment speed.

4. **APPLY BRAKES (P)**

   Full brakes should be applied with the antiskid switch ON.

5. **GAM-77 ENGINE CONTROL KNOBS GRD START (CP)**

WARNING

In the event of complete loss of a-c power, no power is available to shut down GAM-77's with the engine control knobs. By using the emergency shutoff switches, switched battery power is available to shut down GAM -77's.

CAUTION

A ground loop should not be attempted at heavy gross weights since structural failure may occur at speeds above 30 knots. A turn of any kind should not be attempted unless conditions straight ahead appear more hazardous.

TAKEOFF OR LANDING WITH BADLY UNBALANCED TIRE

The landing gear can be seriously damaged under high speed taxiing conditions (such as a takeoff or landing ground run) with a badly unbalanced tire. A blowout and subsequent high speed wheel rotation may result in partial disintegration of the tire and cause such an unbalance. Therefore, prior to every takeoff following a braked landing (other than a taxi-back landing using normal braking) or refused takeoff, a visual inspection should be made to determine the safe condition of

the tires. In addition, if a tire failure is suspected on takeoff before S_1 is reached, the takeoff should be discontinued. If a tire failure should occur after S_1 is reached, brakes should be applied immediately after the airplane leaves the ground to minimize possible resultant vibration. Landing gear should not be retracted until wheel rotation has stopped. When an unbalanced or failed tire has occurred after S_1 has been reached and takeoff has been accomplished, a subsequent landing on the affected gear will not be attempted. Since there is no way to determine certain minor damage to the landing gear strut or assembly, a landing on that gear may induce initial damage or aggravate already existing damage resulting in possible complete failure of the landing gear. Before landing, pull the normal and emergency control circuit breakers for the affected gear to assure that it will remain up and locked when the landing gear lever is actuated to lower the landing gear. This procedure applies to main landing gear only. The outrigger gear may be lowered for landing; however, the landing checklists for one or both tip gears retracted will be followed. See "Landing With Partial Gear Checklist" when ready to land.

PARTIAL GEAR LANDINGS WITH AGM-28 MISSILES INSTALLED

When landing with both rear gears retracted, the AGM-28 engine(s) can be expected to contact the ground. With one main gear retracted, AGM-28 engine(s) will be in close proximity to the ground. If a AGM-28 engine contacts the ground, it will present no greater fire or structural hazard than an aircraft engine contacting the ground. For further information, see "Landing With Partial Gear Checklist."

LANDING WITH PARTIAL GEAR CHECKLIST

One Main Gear Retracted or One Forward and One Rear Retracted on Opposite Sides

1. Reduce Gross Weight - Accomplished (P)

   Reduce gross weight to 200,000 pounds or less if possible, but assure that 20,000 pounds of usable fuel remains when initiating the landing. If missiles and/or internal weapons are aboard, the landing gross weight may be above 200,000 pounds. Landing gear loading at 200,000 pounds with one gear retracted corresponds to a 400,000-pound landing with all gear extended. Weight reduction can be accomplished by flying at low altitude and high thrust settings (up to NRT) with airbrakes and landing gear extended.

2. Accomplish Normal Landing (P-CP)

   Make normal approach with airbrakes in position 2. Touch down on main gears simultaneously at the minimum rate of descent. Keep braking at a minimum, using all the runway available if one of the forward gear is retracted.

WARNING

Do not move steering ratio selector lever to TAXI during ground roll. Even if the retracted gear is a forward gear, sufficient steering normally should be available. Stop the airplane straight ahead on the runway. Do not attempt to taxi with a gear retracted.

One Forward and One Rear Gear Retracted on Same Side

1. Check Weight Distribution - Checked (CP)

   Reduce gross weight to 200,000 pounds or less if possible but assure that 20,000 pounds of fuel remain when initiating the landing. Distribution of the 20,000 pounds of asymmetrical fuel should be 7500 pounds in each main tank and 5000 pounds in the outboard wing tank on the side opposite the gear failure. Prior to initiating landing, fuel should be depleted from the main tanks on the side with gear failure and boost pumps turned off. Full lateral trim plus partial lateral control will be required at all flaps down speeds to compensate for asymmetrical fuel loading.

CAUTION

Fuel shall not be transferred directly between main tanks except through valve 46 and the refuel system. This is to prevent excessive surge pressures due to closure of transfer valve.

LANDING WITH PARTIAL GEAR CHECKLIST (Cont)

NOTE

If time is available, a controllability check should be made to determine the control characteristics which will be encountered on landing. This check is described under "Stall or Controllability Checks," Section VI.

2. Open Crossfeed Valves 9, 10, 11 & 12 - Opened (CP)

   The landing should be made by operating all engines on the fuel remaining in the main tanks on the side with gear extended.

3. Accomplish Normal Landing (P-CP)

   Make normal approach with airbrakes in position 2. Touch down with both main gears simultaneously at the lowest possible rate of descent. Hold the wings nearly level with the tip gear on the side with the extended main gear riding firmly on the runway. Apply minimum braking and steering. Use all of the runway if necessary to stop the airplane on minimum braking.

WARNING

Do not move the steering ratio selector lever to TAXI during ground roll. Stop the airplane straight ahead on the runway. Do not attempt to taxi the airplane.

Both Forward Gears Retracted

It is not recommended that a gear down landing be made when the forward landing gear cannot be extended. In such a case, all extended landing gear should be retracted if a crash landing must be made.

LANDING WITH PARTIAL GEAR CHECKLIST (Cont)

Both Rear Gears Retracted

WARNING

KS

With ADM-20 installed, it is recommended that prior to attempting any landing involving a partial landing gear configuration, all missiles aboard the airplane be jettisoned over an uninhabited area in order to minimize fire hazard on landing.

NOTE

When the rear main landing gears will not extend but the landing conditions are otherwise favorable, a landing on the runway with the forward and tip gears extended is recommended. This will probably result in less damage to the airplane than crash landing off the runway. The fire hazard due to the location of the fuel vent in the bottom of the fuselage is a small additional risk in a rear gear up landing on concrete. The gunner will bail out if a landing with both rear gears retracted is to be accomplished.

1. Reduce Gross Weight - Accomplished (P)

   Reduce gross weight to an absolute minimum. Weight reduction can be accomplished by flying at low altitudes and high thrust settings (up to NRT) with airbrakes and landing gear extended.

2. Accomplish Crash Landing and Ditching Checklist.

One or Both Tip Gears Retracted

1. Check Weight Distribution - Checked (CP)

   a. Landing with one tip gear retracted

      Establish a 6000-pound differential between tanks No. 1 and 4 with the greater weight on the side of the extended tip gear.

WARNING

If both spoiler groups are inoperative on the wing with the retracted tip gear due to hydraulic pack failures, do not follow the above procedure. Maintain a balanced wing fuel loading as closely as possible. Follow the procedure under "Landing with Loss of all Spoilers on One Wing," this section.

LANDING WITH PARTIAL GEAR CHECKLIST (Cont)

CAUTION

Fuel shall not be transferred directly between main tanks except through valve 46 and the refuel system. This is to prevent excessive surge pressures due to closure of transfer valves.

b. Landing with both tip gears retracted

(1) Landing without crosswind

Maintain symmetrical fuel load.

(2) Landing with crosswind

Establish a 3000-pound differential between tanks No. 1 and 4 with the greater weight on the upwind side.

NOTE

- If time is available, a controllability check should be made to determine the control characteristics which will be encountered on landing. This check is described under "Stall or Controllability Checks," Section VI.
- Every effort will be made to land into the wind avoiding crosswinds.

2. Accomplish Normal Approach & Landing - Accomplished (P)

a. With one tip gear retracted, make a normal approach and landing, touching down at the lowest possible rate of descent. Hold the wings nearly level with the extended tip gear riding firmly on the runway. Apply minimum braking and steering.

WARNING

Stop the aircraft straight ahead on the runway. Do not attempt to taxi the aircraft except in an emergency which requires clearing the runway. If taxiing is required, make only large radius turns and make all turns away from the extended tip gear if possible.

b. With both tip gears retracted, make a normal approach and landing, touching down at the lowest possible rate of descent. Hold the wings as level as possible. If a wing starts to drop while at low speeds during landing roll, even though full lateral control is used, a sharp turn toward the dropping wing may assist in bringing it back up. If crosswind crab is used, brake application may tend to cause the aircraft to heel over toward the downwind wing. Therefore, brake application should not be heavy until crosswind crab has been centered during the roll. Apply only small forward gear steering corrections during the roll unless steering is used to bring up a wing.

WARNING

Stop the aircraft straight ahead on the runway. Do not attempt to taxi the aircraft with the tip gears retracted.

LANDING WITH ONE FORWARD GEAR STEERING FAILURE

In case steering is lost on one forward main landing gear, the airplane may still be landed without undue concern. As the other main landing gear is turned, a sufficiently large turning moment is introduced to change the direction of the airplane path down the runway. The main landing gear on which steering has failed will tend to caster and normally will follow the wheels which are turning unless some unusual failure has occurred. More rudder pedal travel along with more rudder pedal force will be required to obtain the same amount of effective steering as when both steering systems are operating. Standby pump pressure is available for emergency steering if there is a failure of either No. 1 or 2 pack, or both, when the standby pump switch marked "Landing Gear" is in the ON position. Maintain the airplane in as near a level attitude as possible during the landing roll and, when the airplane slows down to taxi speed, move steering ratio selector lever to TAXI position. Drag chute deployment during a strong crosswind is not desirable since this tends to turn the airplane. If drag chute deployment is necessary, the chute should be jettisoned early.

NOTE

- If the standby pump is not used for emergency steering and the airplane comes to a complete stop, effective steering will be greatly reduced as the gear that is trailing will be difficult to caster.
- The rudder pedals should be in neutral when the steering ratio selector lever is moved to TAXI position.

LANDING WITH COMPLETE STEERING FAILURE

WARNING

- Prior to landing, crosswind crab should never be set if steering has failed on both forward gears. Rotation of rear gears only will produce turning moments which may result in a high speed ground loop.
- If the forward gear steering fails because of complete loss of forward hydraulic pressure, normal brake pressure will not be available and braking will be limited to brake accumulator pressure. See "Landing with Brake System Failure," this section.

With Failure of Forward Crosswind Crab System

It is quite unlikely that both of the forward gear steering systems will fail at the same time. This would require that two hydraulic packs as well as two hydraulic standby pumps must fail at the same time, or it would require some multiple failure of the steering or hydraulic mechanism. However, if such a combination of failures is encountered, the airplane can be steered by use of the rear gear through actuation of the crosswind crab system. Corrections should be made by turning the crosswind crab control knob and pushing the rudder pedals in the direction in which it is desired that the airplane go. For instance, if the airplane is about to run off the right side of the runway, the knob should be turned to the left by a very small amount. This will cause the rear wheels to turn to the right which in turn will result in the airplane turning to the left.

CAUTION

If the crosswind crab system is used on the rear gear in order to keep the airplane on the runway, only a very small turning correction should be applied since a small turning angle introduces large turning components.

With Complete Failure of Crosswind Crab System

If it is known that both forward gear steering systems have failed while the airplane is still in the air and the crosswind crab system is also inoperative, it is recommended that the landing be made at some field which has no crosswind. If no such field is located within the vicinity, the runway selected should be the one with the least amount of crosswind and the one that has the smoothest grading off the runway proper. Without use of the crosswind crab system on the rear gear, only small turns can be made by applying full rudder. Such action will cause the tires to corner slightly, but is only effective down to speeds of approximately 90% of touchdown speed. At speeds below 90% of touchdown speed, the rudder becomes ineffective in producing any change in direction. Some steering at lower speeds can be accomplished by banking the airplane in the direction in which it is desired to turn. In this manner, a roller skate turning effect is introduced which may aid in keeping the airplane on the runway. If the failure has occurred because of complete loss of hydraulic pressure, limited braking may be available from brake accumulator pressure. See "Landing with Brake System Failure," this section. If brakes are available, the drag chute should not be deployed unless the wind is straight down the runway since any wind at some angle off the runway will cause the chute to stream in a similar direction with the result that the airplane will turn further into the wind. The chute should be jettisoned at any time an insufficient amount of directional control is available to keep the airplane on the runway unless an overrun is probable.

LANDING WITH INSUFFICIENT STEERING ANGLE

Under certain emergency conditions on the ground, if a larger steering angle is necessary to control the airplane, the steering ratio selector lever may be actuated toward TAXI position. Applying pressure to the steering ratio selector lever steers the airplane further in the direction applied by the rudder pedals. Gaining this additional steering angle with the steering ratio selector lever may require the application of considerable force. The action must be smooth and firm.

CAUTION

Extreme caution must be exercised to avoid overcontrolling the airplane and causing structural damage.

LANDING WITH CROSSWIND CRAB SYSTEM INOPERATIVE

One Gear Inoperative

If the crosswind crab control knob is turned and the indicator shows that one or more of the gears has not turned with the others, additional checks must be made to determine whether or not the crosswind crab system should be used for the landing. It cannot be established from observations made in the cockpit that crosswind crab system has failed on any one gear since the indicator is electrically connected only to one forward and one rear gear. Therefore, in order to determine if a single or multiple failure has occurred, a visual inspection of the wheels must be made by a member of the flight crew at the wheel well. The bombsight may be used to determine if the forward gears are at approximately the same angle. If it can be determined that crosswind crab has failed on only one gear, a normal crosswind landing can be accomplished if the crosswind encountered is of such magnitude to warrant such use. Such a landing should be accomplished using the minimum rate of sink at touchdown so as to minimize the side loads which will be imposed on the misaligned gear. Depending upon the type of malfunction, the misaligned gear normally will caster so that it will trail in approximately the same direction as the remaining wheels. If the crosswind component is of low magnitude, the crosswind gear should not be used and a normal landing made. The decision to accomplish the landing with or without use of the crosswind crab system will depend upon the experience the pilot has had in making crosswind landings without use of the crosswind crab system.

CAUTION

When landing with left rear crosswind crab inoperative due to No. 4 hydraulic pump inoperative or No. 4 pack shut down, perform crosswind centering manually as the centered signal originates from the centered position of the left rear gear which will lag the powered gear.

Two or More Gears Inoperative

WARNING

Prior to landing, crosswind crab should never be set if forward gear steering has failed on both the forward gears. Rotation of rear gears only will produce turning moments which may result in a high speed ground loop.

If the magnitude of the crosswind is large and the crosswind crab system has failed on only the rear gear, then a landing may be made using crosswind crab on the forward gear only. Under such a condition, the gross weight should be decreased as low as possible and the computed crab angle applied to the forward gear by rotation of the crosswind crab control knob. The crab angle setting must not exceed 9° since the misalignment between the front and rear wheels will tend to swing the airplane in a circle which must be counteracted by the forward gear steering as the airplane swings parallel with the runway. Twelve degrees of steering are available to counteract the 9° of misalignment leaving a 3° margin in case the airplane starts heading off the downwind side of the runway. The approach should be made so as to remove most of the drift by crabbing. The landing should be accomplished using the minimum rate of sink at touchdown so as to minimize side loads imposed on the rear gear and, if possible, touch down all gears at the same time. The drag chute may be deployed but should be jettisoned if it starts to turn the airplane off the runway. This action will be especially noticeable if the runway is icy. Again, the decision to accomplish the landing with or without use of partial crosswind crab will largely depend upon the experience the pilot has had in making crosswind landings without use of the crosswind crab system.

LANDING WITH PART OR ALL OF SPOILERS INOPERATIVE

In case any or all of the wing hydraulic packs and corresponding standby pumps fail or the electrical or mechanical control of the spoilers fail, sufficient lateral control will still be available so that the airplane can be flown satisfactorily during normal flight operations. However, when a landing must be made with partial spoiler operation, the effect of reduced lateral control will be slower response and less maximum roll rate. Larger control wheel deflection will be required and its application should be anticipated and applied as early as possible. Any landing made in crosswind conditions

with reduced lateral control should be made using the crosswind crab system as this will make the use of lateral control less necessary.

Landing with Partial Spoiler Failure on One Wing

Loss of either an inboard wing hydraulic pack (No. 6 or 7) and its standby pump or an outboard pack (No. 5 or 8) and its standby pump will result in a loss of approximately half the lateral control power in the direction of the affected wing. A normal landing can be made using the following procedure: After the flaps are fully extended, extend the airbrakes to position 2. This will cause a roll toward the side with all packs operating. Trim the airplane by applying rudder and aileron trim toward the wing with the failed pack. Approximately half rudder and aileron trim will be required. For example, if the pack failure is on the right wing (No. 7 or 8), extending the airbrakes will cause a roll to the left. Right rudder and aileron trim will be required to trim the airplane and a small amount of left bank (less than 2°) will be required to maintain a straight flight path. By using this procedure, the available lateral control is more nearly equal in each direction. The sideslip angles which result are very small.

Landing with Loss of All Spoilers on One Wing

If both packs on one wing have failed, the lateral control is marginal. However, lateral control effectiveness can be balanced to some extent by applying full rudder and aileron trim toward the dead spoilers. Extending the airbrakes to position 2 will return the airplane approximately to trim and the available roll rate toward the dead spoilers will be approximately half that available in the opposite direction. Make a low speed control check. See "Stall or Controllability Checks," Section VI.

Landing with Three or All Spoiler Groups Inoperative

Lateral control effectiveness will be very low and a flaps down landing should not be attempted. A flaps up landing may be made under ideal conditions but should not be attempted in any sort of gusty conditions. See Part 9 of the applicable Appendix for flaps up landing and approach speeds and landing distances. With one pack operating, the lateral control effectiveness should be balanced by trimming with aileron and rudder away from the wing with the operating pack and extending airbrakes to position 2. Follow the procedure outlined under "Wing Flaps Up Landing Checklist," this section, except for airbrakes in position 2.

LANDING WITH STABILIZER TRIM FAILURE

If stabilizer trim should fail during flight, the airplane can still be flown satisfactorily through proper application of the elevator control. Normally, at the time of failure, the airplane would be trimmed to fly hands off for that particular weight and cg location. This cg location should be held at approximately the same value by shifting the fuel loading during the remainder of the flight. If such action is not possible or practicable, then the cg location may shift as required since the elevator is powerful enough to counteract for a shift within the limits of 18% and 34% MAC as long as the stabilizer fails within its normal operating range. Needless to say, the further the cg location moves from the location which existed at time of stabilizer trim failure, the greater the pilot control column forces will be at the original trim speed. The elevator is also sufficiently powerful to permit a safe landing if stabilizer trim fails within its normal operating range. If sufficient fuel remains to do so safely as the airplane approaches the landing base, the cg should be shifted aft to approximately 30% MAC position by transferring fuel so as to compensate for the nose up trim which will be required as the speed is decreased. Between 3° and 5° of stabilizer nose down trim normally is required when the wing flaps are moved rapidly from the flaps up to the fully extended position. The wing flaps therefore should be lowered in small increments. While lowering the wing flaps, the airspeed should be allowed to decrease. This will assist in compensating for the out-of-trim condition by keeping the control forces at a low level and will require less down elevator or forward control column travel. The change in trim due to wing flap extension will actually work to the advantage of the pilot and probably result in the requirement of down elevator and a push force on the control column during the final approach. For this reason, adequate up elevator travel will be available for producing the final flare. The airbrakes produce a nose up trim so that considerable trading is available between airbrake position and elevator position for obtaining a desirable trim and control situation for such an emergency. If the emergency is such that even with the aid of airbrakes little elevator can be made available for landing flare, a very flat approach should be made at normal approach speeds by carrying power. Under such conditions, it may not be possible to get the tail down far enough with the result that the forward landing gear will touch down first. Such a landing may cause the airplane to porpoise between the forward and rear landing gear.

NOTE

If time is available, a controllability check should be made to determine the control characteristics which will be encountered on landing. This check is described under "Stall or Controllability Checks," Section VI.

LANDING WITH WING FLAPS INOPERATIVE

Normally, landings should not be made with the wing flaps retracted since the touchdown speed is approximately 35 knots higher than for a wing flaps down landing. However, if the wing flaps malfunction or some other emergency exists, a safe landing can be made. The gross weight should be decreased to as low a value as practicable in order to keep touchdown speed low. The landing pattern should be similar to that shown on figure 2-19, allowing for the increased airspeed requirements. Control response during the entire landing pattern will be more positive than that experienced during a normal flaps down landing because of the higher speed requirements for a flaps up landing.

NOTE

If crosswind crab is used for a flaps up landing, use 70% of the normal crosswind crab setting.

WING FLAPS UP LANDING CHECKLIST

1. Accomplish Normal Descent Check & Landing Checklist (Except Airbrakes) - Accomplished (P-CP)

   The normal checks should be used for a flaps up landing except that the airbrakes should be left down (however, if landing with three spoiler groups inoperative, extend airbrakes to position 2).

2. Compute Landing Data - Computed (CP)

   The flaps up best flare speed with no airbrakes should be computed.

NOTE

If time is available, a controllability check should be made to determine the control characteristics which will be encountered on landing. This check is described under "Stall or Controllability Checks," Section VI.

3. Maintain Flaps Up Landing Airspeed Schedule - Maintained (P)

   The airspeed on the downwind leg should be 30 knots above the flaps up best flare speed with no airbrakes. This speed should be reduced gradually to 20 knots above best flare on the base leg and 10 knots above best flare when the airplane has rolled out on final approach. The reduction from 20 to 10 knots above best flare speed will not be made until the airplane has rolled out on final approach. Final approach should be planned so as to arrive over the end of the runway with the throttles at IDLE and at a speed as close as possible to best flare speed.

NOTE

If it is desired to increase the rate of descent to land over some obstacle near the end of the runway, the airbrakes may be extended. However, such action results in extreme nose high attitudes and causes the pilots to have an uncomfortable feeling. This same nose high attitude will result if the touchdown is made with airbrakes extended. Therefore, it is recommended that the approach be made without extending any airbrakes.

4. Touchdown Rear Gear First (Minimum Touchdown Speed) - Accomplished (P)

   The airplane should touch down with the rear gear first at a speed slightly above the flaps up minimum touchdown speed.

CAUTION

The gross weight must be low enough that the airplane will not touch down above the tire limitation ground speed. This speed is given on the "Landing Speeds" chart in Part 9 of the applicable Appendix. Corrections for wind, OAT, and runway pressure altitude are also included on the chart.

WING FLAPS UP LANDING CHECKLIST (Cont)

5. Raise Airbrakes - Position 6 (P)

   Full airbrakes should be extended as soon as all wheels are on the ground.

6. Deploy Drag Chute - Deployed (CP)

   Observe maximum deployment speed. See "Airspeed Limitations," Section V.

7. Apply Wheel Brakes - Applied (P)

   If the stop appears marginal, a maximum effort stop may be required.

NOTE

Any landing made with flaps up can result in a landing roll up to 90% greater than that for a minimum roll, flaps down landing. See the charts in Part 9 of the applicable Appendix for exact information.

LANDING WITH BRAKE SYSTEM HYDRAULIC FAILURE

It is probable that the only indication of reduced braking capabilities that will be known in advance by the pilot will be the loss of one or more hydraulic packs. If the loss of a hydraulic pack is experienced, pressure will be supplied to the respective systems by the standby pumps. If the loss of a pack is due to lack of hydraulic fluid, pressure will still be supplied by the standby pumps as each pump has a reserve supply of 3 quarts of hydraulic fluid. Further reduction of brake capabilities will result from the loss of the respective standby pumps. Charts and correction factors for stopping distances when brakes are applied at touchdown and for partial braking are included in Part 9 of the applicable Appendix.

Landing with Hydraulic Packs No. 1 and 2 Inoperative

When landing with standby pumps 1 and 2 as the only source of forward gear hydraulic pressure, the following procedure should be used: If pack failure is due to loss of hydraulic fluid, turn the antiskid switch to OFF position. If it can be determined that pack failure is not due to loss of fluid, it is recommended the antiskid switch be left in ON position. Normal approach and landing procedure should be followed, except if crosswind crab is to be used, the gear should be positioned to the selected crab angle far enough in advance of touchdown to allow time for system pressure to rebuild. Deployment of the drag chute and raising of full airbrakes should take place as soon after touchdown as possible. Initial braking should be light to moderate after the weight of the airplane is on the wheels, followed by heavier braking as more airplane weight is transferred to the wheels. This is necessary to reduce the antiskid cycles to within the capacity of the standby pumps and accumulators.

Landing with Hydraulic Packs No. 1 and 2 And Standby Pumps No. 1 and 2 Inoperative

When landing with both forward hydraulic packs and their respective standby pumps inoperative, the only source of hydraulic pressure for the forward brakes, and slave control pressure for the rear brakes, will be from the forward brake accumulators; therefore, the following landing procedure should be used: Reduce the airplane gross weight as low as practicable in order to keep touchdown speed low. Turn antiskid switch to OFF position.

WARNING

Prior to landing, the crosswind crab system should never be set, since forward gear steering will be inoperative. Rotation of rear gears only will produce turning moments which may result in a high speed ground loop.

Deployment of the drag chute and raising of full airbrakes should take place as soon after touchdown as possible. Brake application should take place as soon as the weight of the airplane is firmly on the wheels. One smooth and gradually increasing brake application should be made.

WARNING

Do not pump the brakes. Pumping will deplete brake accumulator pressure causing complete loss of all braking action.

NOTE

The number of brake applications available is dependent on the amount of preload in the brake accumulators and the amount of wear on the brake linings. If the parking brake pressure gage on the pilot's side panel reads 3000 psi, there will be approximately two to seven brake applications available depending on the condition of the brake linings.

If parking brake pressure is less than 3000 psi, the parking brake hydraulic hand pump located in the forward wheel well may be used to build up the brake pressure for the left forward main gear.

WARNING

This action should be considered as a last resort due to the location of the hand pump and handle.

LANDING WITH DRAG CHUTE INOPERATIVE

If the drag chute fails to deploy when the drag chute deployment lever is actuated, there is nothing else that the pilot can do to get the drag chute out of the compartment. The effect of the drag chute on ground roll distance is shown by the landing charts in Part 9 of the applicable Appendix.

LANDING WITH GAM-72 LAUNCH GEAR FULLY EXTENDED (MISSILE ATTACHED) KS

This condition is the result of three malfunctions; 1) missile will not retract, 2) missile will not jettison, and 3) launch gear will not jettison. During the XGAM -72 flight test program, a landing with a missile extended was accomplished with no damage to the carrier airplane and only superficial damage to the extended missile. The landing was required with the missile in the extended position because the launch gear jettison system was not armed. In this instance, the only one of its kind in the history of the GAM-72 program, the missile wings were folded. Prior to touchdown, the runway was covered with chemical foam until the supply was depleted after which liquid soap was used on the remainder of the runway to reduce friction. Such a landing should be attempted only as "last ditch" emergency action. Design provisions in the carriage drive actuator enable the clutch assembly to slip when a vertical force of from 7900 to 9600 pounds is applied as the weight of the airplane is forced on the missile. The carriage and missile will ride up the track to a point where the vertical force falls below 7900 to 9600 pounds (typically about 12 inches) and the brake assembly will hold the carriage in this position. When a landing must be accomplished with the missile wings fully or partially spread, more serious problems exist. The outboard wing is directly under the aft track leg and therefore will contact the leg on impact. The lower fin and wing will have to be sheared off to allow the missile and carriage to ride up the tracks. The possibility also exists that the impact and rolling moment created by the interfering wing contact with the track leg may tear the missile free of the shackle hooks allowing it to pass under the airplane aft main landing gear. The force of impact could also tear the launch gear from its fittings. With the inboard wing folded and outboard wing spread, the situation as described above exists except that the lower fin of the inboard wing is now below the missile and will contact the runway on landing. With the inboard wing spread but the outboard wing folded, a situation comparable to both wings being folded exists. With wings partially spread, the outboard wing may be sheared off as it contacts the track leg or it may be forced flush against the missile. In short, an emergency landing with the missile wings spread is considered more hazardous than with the wings folded. The following procedure is recommended:

1. Ascertain whether the wings are spread or folded so that the amount of difficulty to be encountered can be estimated.
2. Place the GAM-72 master power switch OFF.
3. Declare an emergency and advise the tower of the situation prior to landing. Have the runway prepared for landing. Every effort to minimize friction should be made; use of foam, etc, is highly recommended.
4. Make a normal approach and landing, being careful to hold carrier airplane yaw to a minimum and contact the runway as gently as possible.

NOTE

See "Crash Landing," this section, if any crew members are to bail out prior to landing.

LANDING WITH GAM-72 LAUNCH GEAR FULLY EXTENDED (MISSILE NOT ATTACHED) KS

A normal landing may be accomplished with a fully extended launch gear since the launch gear will not contact the runway.

LANDING WITH DROP TANK UNBALANCE

If one drop tank fails to feed fuel or one full drop tank fails to jettison, the pilot is faced with lateral and di-

rectional control problems during approach and landing. Fuel transfer should be accomplished initially in an attempt to decrease the amount of lateral unbalance. In the normal landing configuration (flaps and gear down, airbrakes position 2) with one full 3000-gallon tank and other fuel tanks symmetrical, approximately 50% of the lateral control and full rudder control will be required to maintain wings level at touchdown on a 350,000-pound aircraft. For a lighter weight aircraft, the lateral control required will be greater. For the same conditions as above, 100% of the lateral control will be required to hold the wings level on a 225,000-pound aircraft. Before landing with a large lateral unbalance, a controllability check should be accomplished as described in Section VI. Depending on the aircraft gross weight and the amount of lateral unbalance, a flaps up landing may be required. A last resort method of reducing the amount of lateral control required would be to increase the thrust on the outboard engine on the heavy wing. This technique should be practiced during the controllability check before attempting to use it on an actual landing. Refer to Part 9 of the applicable Appendix for the minimum landing weights, flaps up and down, with various amounts of unbalance.

LANDING WITH TAIL TURRET IN LOWER ELEVATION LIMIT

If it becomes necessary to make a landing with the tail turret in the lower elevation limit, use the following procedures:

1. Make a no-brake-chute landing provided the aircraft gross weight does not exceed 250,000 pounds on a dry runway and all criteria are complied with as outlined under "Taxi-Back Landing," in Section II.
2. If not possible, use normal procedures (drag chute deployed); however, the pilot must be prepared for possible drag chute entanglement with the turret. Turret damage may ensue when the drag chute is jettisoned with the turret in the lower limit.

If wind conditions permit, allow the drag chute to collapse when turning off the runway. If this is not feasible, the engines should be shut down after turning off the runway to facilitate collapsing the chute. After coordination with the ground crew personnel, the drag chute will be manually disconnected and the aircraft towed or taxied to the parking area. During extreme wind conditions, the chute may be jettisoned (normally) as a last resort action. This will preclude the possibility of additional damage to the tail surfaces by an uncontrollable drag chute.

CRASH LANDING

A crash landing is defined as a controlled landing under conditions such that damage to the aircraft is to be expected. A crash landing should not be considered unless the resultant risk to crew survival is considered to be less than would result from bailout. Even when conditions are ideal, serious consideration should be given to bailout or ejection of those crew members not essential for landing.

Emergency Exit

A manual hatch release handle (figure 3-11A) is provided inside each escape hatch in order that the hatch may be manually operated from inside the aircraft during ground emergency or after crash landing or ditching. If manual removal of the hatch is necessary, observe the following procedure:

UPPER DECK CREW MEMBERS (P-CP-EW)

1. Install armrest pins.
2. Unfasten safety belt.
3. Disconnect oxygen and interphone.
4. Remove parachute and survival kit by unfastening parachute leg and chest straps.
5. Stow control column (P-CP).
6. Stand facing aft.
7. Pull hatch release handle down and rotate full length of travel (approximately 80°).
8. Release hatch release handle.

NOTE

It is not necessary to hold the hatch release handle when removing the hatch. Although the hatch settles somewhat when the handle is released (because of hatch weight), the locking cam will not travel back past overcenter.

9. Push hatch upward and aft, stepping into seat while doing so. Continue pushing until hatch has rotated approximately 95° and falls free of airplane.

NOTE

As the hatch is rotated, the mechanical link connecting the hatch to the catapult safety pin-pull initiator will fire the initiator. Do not be alarmed; although the seat catapult is now armed, it will not fire unless the firing trigger on the armrest is squeezed.

LOWER DECK CREW MEMBERS (N-RN)

1. Install ejection control ring safety pin.
2. Unfasten safety belt.
3. Disconnect oxygen and interphone.
4. Remove parachute and survival kit by unfastening parachute leg and chest straps.
5. Reach down and aft of right side of seat approximately 15 inches and pull manual hatch jettison handle (except navigator UX UZ) (5, figure 3-11A). Navigator UX UZ , pull manual hatch release handle (1, figure 3-11A).

NOTE

As the hatch falls, the mechanical link connecting the hatch to the catapult safety pin-pull initiator will fire the initiator. Do not be alarmed; although the seat catapult is now armed, it will not fire unless the firing trigger ring is pulled.

POSITION	PRIMARY EXIT
PILOT'S EJECTION SEAT	PILOT'S ESCAPE HATCH
COPILOT'S EJECTION SEAT	COPILOT'S ESCAPE HATCH
NAVIGATOR'S EJECTION SEAT	PILOT'S OR COPILOT'S ESCAPE HATCH
RADAR NAVIGATOR'S EJECTION SEAT	PILOT'S OR COPILOT'S ESCAPE HATCH
EW OFFICER'S EJECTION SEAT	EW OFFICER'S ESCAPE HATCH
INSTRUCTOR PILOT'S SEAT	PILOT'S OR COPILOT'S ESCAPE HATCH
INSTRUCTOR NAVIGATOR'S SEAT	EW OFFICER'S ESCAPE HATCH
BUNK POSITION	EW OFFICER'S ESCAPE HATCH
GUNNER'S SEAT	THROUGH OPENING LEFT BY JETTISONED TAILCONE

NOTE

- Utilize escape ropes where applicable.
- If primary exit route is blocked, proceed to nearest available exit.
- Any additional passengers will exit as instructed at crew briefing.

takeoff and landing emergencies exit chart

Figure 3-11.

CRASH LANDING AND DITCHING CHECKLIST

WARNING

- If an emergency arises necessitating immediate abandonment of the airplane under unplanned circumstances, all crew members free themselves of parachute and survival kit in the quickest possible manner to evacuate the airplane.
- If a crash landing or ditching becomes imminent and time and conditions permit, a bailout of crew members is recommended. However, if conditions dictate for survival or other reasons, extra crew members may, at pilot's discretion, stay with the airplane. These people are taking a calculated risk and they should brace themselves as best they can. Individuals have crash landed in this airplane under these conditions and were not injured.
- Bold faced items should be accomplished for a crash landing immediately after takeoff.

1. ALERT CREW (P)

Pilot announces over interphone "Prepare for crash landing or ditching," and actuates emergency alarm switch to ALERT. Crew members will assume crash landing or ditching positions after completing required duties. Pilot will turn alarm switch to OFF after crew acknowledgment.

2. Lower Landing Gear (up for ditching) - DOWN (or UP) (P)

Landing gear will be lowered only after it has definitely been determined that a crash landing will be made (except when both forward gears will not extend, in which case all gears will be retracted).

3. Lower Wing Flaps - DN (CP)

4. Jettison Drop Tanks - Jettisoned (P)

WARNING

- Do not jettison drop tanks above 300 or below 150 knots IAS.
- After jettisoning the drop tanks at gross weights above 370,000 pounds, the airplane should be flown in a wings level attitude to keep the "g" loading to an absolute minimum. Severe maneuvers or sharp turns should be avoided.
- Since the airplane cg will move forward considerably when full 3000-gallon drop tanks are jettisoned, it is essential that the change in trim be anticipated by application of 2 to 3 units of nose up stabilizer trim in combination with nose down elevator prior to release.

5. Jettison Stores as Directed - Jettisoned (P-RN)

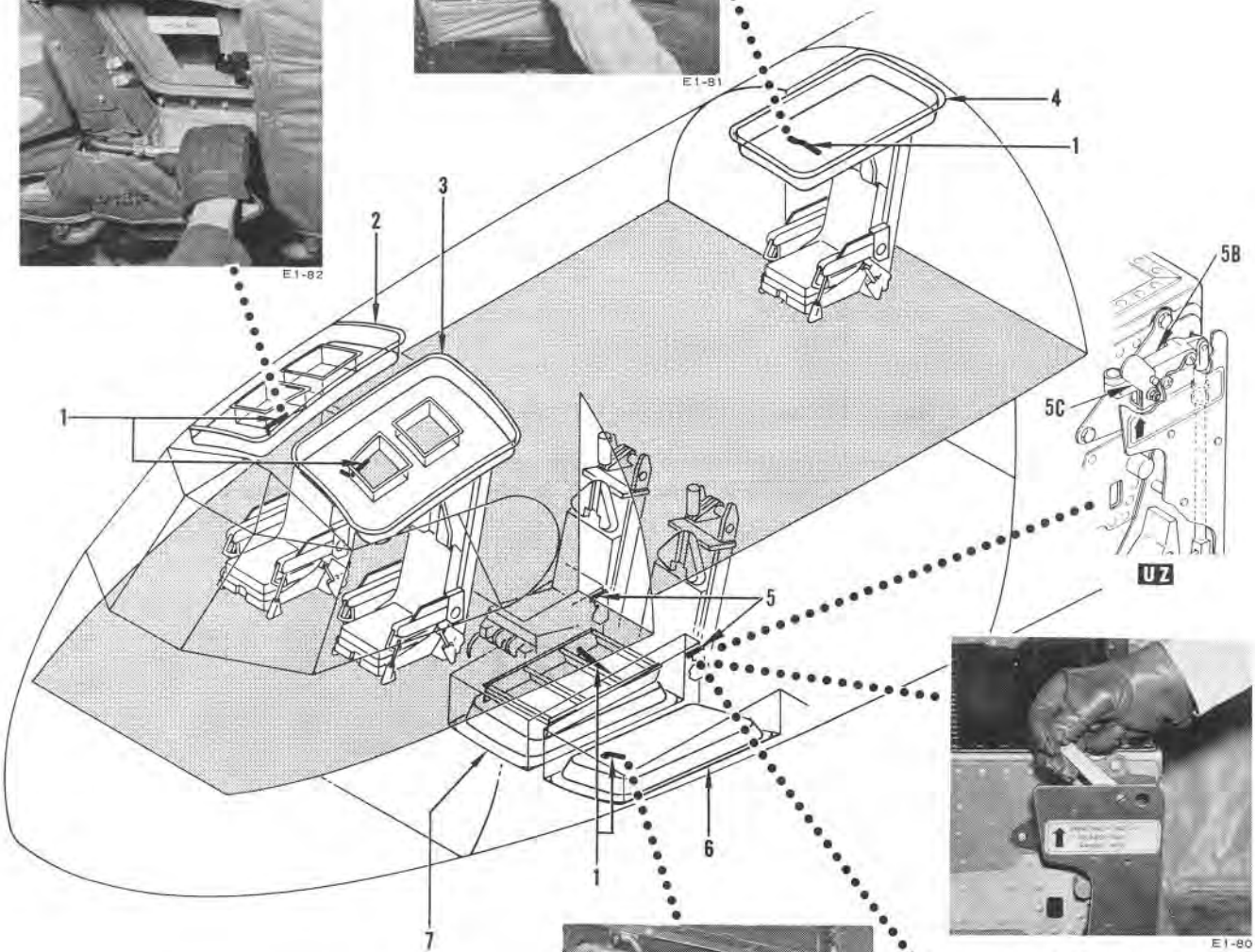
At the pilot's discretion, the stores may be jettisoned as directed.

6. Close Bomb Doors - Closed (RN)

The radar navigator will close the bomb doors immediately after jettison operation.

E1-81

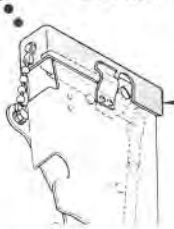
E1-82



E1-80

Less UZ WITHOUT TF GUARD INSTALLED

E1-83



Less UZ WITH TF GUARD INSTALLED

1. MANUAL HATCH RELEASE HANDLE
2. COPILOT'S ESCAPE HATCH
3. PILOT'S ESCAPE HATCH
4. EW OFFICER'S ESCAPE HATCH
5. MANUAL HATCH JETTISON HANDLE, RADAR NAVIGATOR'S (AND NAVIGATOR'S Less UX Less UZ)

5A. MANUAL HATCH JETTISON HANDLE GUARD, RADAR NAVIGATOR'S (AND NAVIGATOR'S TF Less UZ)

5B. MANUAL HATCH JETTISON HANDLE, RADAR NAVIGATOR'S UZ

5C. SAFETY LATCH, RADAR NAVIGATOR'S UZ

6. RADAR NAVIGATOR'S ESCAPE HATCH
7. NAVIGATOR'S ESCAPE HATCH (MAIN ENTRY DOOR)

ejection hatch manual release

Figure 3-11A.

CRASH LANDING AND DITCHING CHECKLIST (Cont)

7. Complete Emergency Radio Transmission - Accomplished (P-CP-N)

   The IFF will be set to EMERGENCY, Mode 3 toggle switch "in," and Mode 3 code selector to 77. The pilot will call "Mayday" over UHF.

8. Jettison Turret & Aft Upper Escape Hatch - Jettisoned (G-EW)

NOTE

Gunner pulls up on turret drag chute interconnect control knob if pilot requests retention of drag chute. If the drag chute is accidentally deployed when turret is jettisoned, jettison the chute by pushing down on the drag chute control knob.

WARNING

- The turret should be jettisoned as soon as possible to allow time for the gunner to come forward in the event the turret jettison system malfunctions. The turret will not be jettisoned below 1000 feet unless so directed by pilot.
- If the cg is forward of 27% MAC at the time the turret is jettisoned, airbrake position 2 will be required to supplement elevator control in order to accomplish the landing flare. Turret will be jettisoned immediately after impact if not previously accomplished.
- Because of high noise level, air buffeting, and the circulation of foreign particles by turbulent air, the EW officers' upward ejection hatch should be jettisoned below 250 knots IAS and at a low altitude, preferably not lower than 1000 feet. If the hatch does not jettison, do not attempt manual release until the aircraft has come to a complete stop. The forward upper escape hatches will not be removed until the aircraft comes to a complete stop.

NOTE

Although jettisoning the upper escape hatches arms the upward ejection seats, inertia forces due to crash landing or ditching normally are not great enough to fire these seats. To prevent accidental firing of the seat during egress, lower the armrests to the fully stowed position or, if time permits, stow the arming levers in accordance with the procedure outlined under "Upward Ejection Seat Control," Section I, and reinsert the safety pins.

WARNING

The seat cannot be safetied until the arming levers have been stowed. Installation of the safety pins with the arming levers rotated to the up position will not prevent the seat from firing if either firing trigger is squeezed.

9. Raise Airbrakes - Position 2 (P)

   At gross weights above 325, 000 pounds, the airbrakes should be used only as required to maintain pitch control.

CRASH LANDING AND DITCHING CHECKLIST (Cont)

10. Accomplish Final Crew Warning - Accomplished (P)

Warn crew members of impending impact over interphone and again actuate emergency alarm switch to ALERT. Crew members will unbuckle parachutes (on airplanes with integrated harness, unbuckle parachute leg straps only), lock inertia reels, disconnect the male bayonet connector on the end of the oxygen mask hose, and raise helmet visor. All personnel brace for impact.

CAUTION

The crew member is prevented from bending forward when the shoulder harness inertia reel is locked. Therefore, all switches not readily accessible should be properly positioned prior to locking the shoulder harness.

WARNING

Touch down at lowest possible rate of descent. Do not stall the aircraft; such action will probably result in complete destruction of the underside of the fuselage and may cause the fuselage to break completely apart.

11. AGM-28 Engine Control Knobs - OFF (CP)

NOTE

If additional thrust is needed for landing or ditching, delay this action until after touch down.

12. **CLOSE THROTTLES (AFTER IMPACT) (P)**

WARNING

Do not cut engines prior to touchdown. This would result in loss, after a few seconds, of all primary electrical power and all hydraulic pressure except that still remaining in the accumulators. Electrical control of the stabilizer trim will be lost and manual trim will exist only as long as accumulator pressure lasts. The spoilers will operate for only a few seconds on accumulator pressure.

13. Drag Chute Lever - DEPLOY (CP)

14. **TURN BATTERY SWITCHES OFF (CP)**

15. **ABANDON AIRPLANE (ALL)**

Remain in positions until airplane comes to a complete stop. After complete stop is made, pilot places emergency alarm switch to ABANDON. Pilot and copilot remove the two forward escape hatches. Crew exits through emergency escape hatches using escape ropes. Gunner exits through the turret opening or his entry door, depending on circumstances. Remove available survival kits and pass them to crew members who have already abandoned the airplane. See figure 3-11 for crew escape routes.

WARNING

To prevent personal injury, ascertain that the escape ropes are fully extended before using them.

EMERGENCY ENTRANCE

Entrance into the airplane during any emergency such as a fire or crash can best be accomplished by using the various hinged or latched access doors and escape hatches (figure 3-12) located throughout the airplane. The escape hatches in the top and bottom of the airplane and the opening left by jettisoning the turret are the primary entrances for use in crew rescue work. Each hatch, except the radar navigator's, has a push and pop-up type of flush surface latching handle for easy removal of the hatch from the outside. Secondary access for crew rescue and primary access to fuselage fires is gained through use of the bomb bay, the wheel wells, and the aft equipment entry door. Access to wing fires is accomplished through use of hinged flush latching doors in the wing surface and by placing the wing flaps down. The knock-in panels in the engine nacelles are hinged and spring-loaded. In case the escape hatches are jammed and access to a crew compartment is completely blocked, use must be made of one of the chop-in areas. However, this method must not be used except as a last resort since the structure of the airplane is such as to make this extremely difficult.

DITCHING

WARNING

Bailout of all crew members is recommended in a ditching situation. The airplane should be ditched only as a last resort.

If an emergency condition arises when over water which indicates that continued flight is impossible, it is not recommended that the crew ditch the airplane. The airplane is not structurally designed to withstand ditching, and no information is available to indicate the resultant structural condition of the airplane if ditched. Further, crew members with survival kits attached would find escape from the airplane difficult after ditching even though the airplane was not badly damaged. Therefore, it is recommended that the airplane commander bail out all crew members in any ditching situation where time and conditions will permit. This procedure will ensure that each crew member is equipped with liferaft and survival kit upon abandoning the airplane.

NOTE

For procedure to be followed when there is no alternative to ditching, see "Crash Landing and Ditching Checklist," this section.

DITCHING STATIONS

Unless the turret will not jettison, the gunner should remain at his station during ditching procedure even though there is time available to traverse the entire length of the fuselage to the control cabin.

DITCHING TECHNIQUE

The airplane should be prepared for ditching by transferring fuel to move the cg aft of 27% MAC. The gunner should jettison the tail turret above 1000 feet altitude so that the airplane can be safely retrimmed. After the alert signal has been given, the direction of the ditching operation should be chosen carefully. The recommended procedure is to ditch into the wind unless very high swells are running, accompanied with very light wind conditions. Try to touch down on the crest of the swell if landing across the swells. Under light wind conditions accompanied with uniform wave or swell patterns, best results will be achieved by ditching parallel to the waves or swells. Under such a condition, try to touch down on the crest of the swell or just after the crest passes. Touch down at a speed of approximately 5 knots above initial stall warning, if possible. Airbrakes do not provide a lower stalling speed but may be used as desired to vary the approach path and determine the point of touchdown. In a properly executed ditching, the control cabin and the body and wing fuel tanks should keep the airplane afloat long enough to allow the crew members to abandon the airplane. If the airplane remains afloat after ditching, stay with the airplane. However, if the airplane appears as though it will sink, get clear of the airplane prior to the time it sinks.

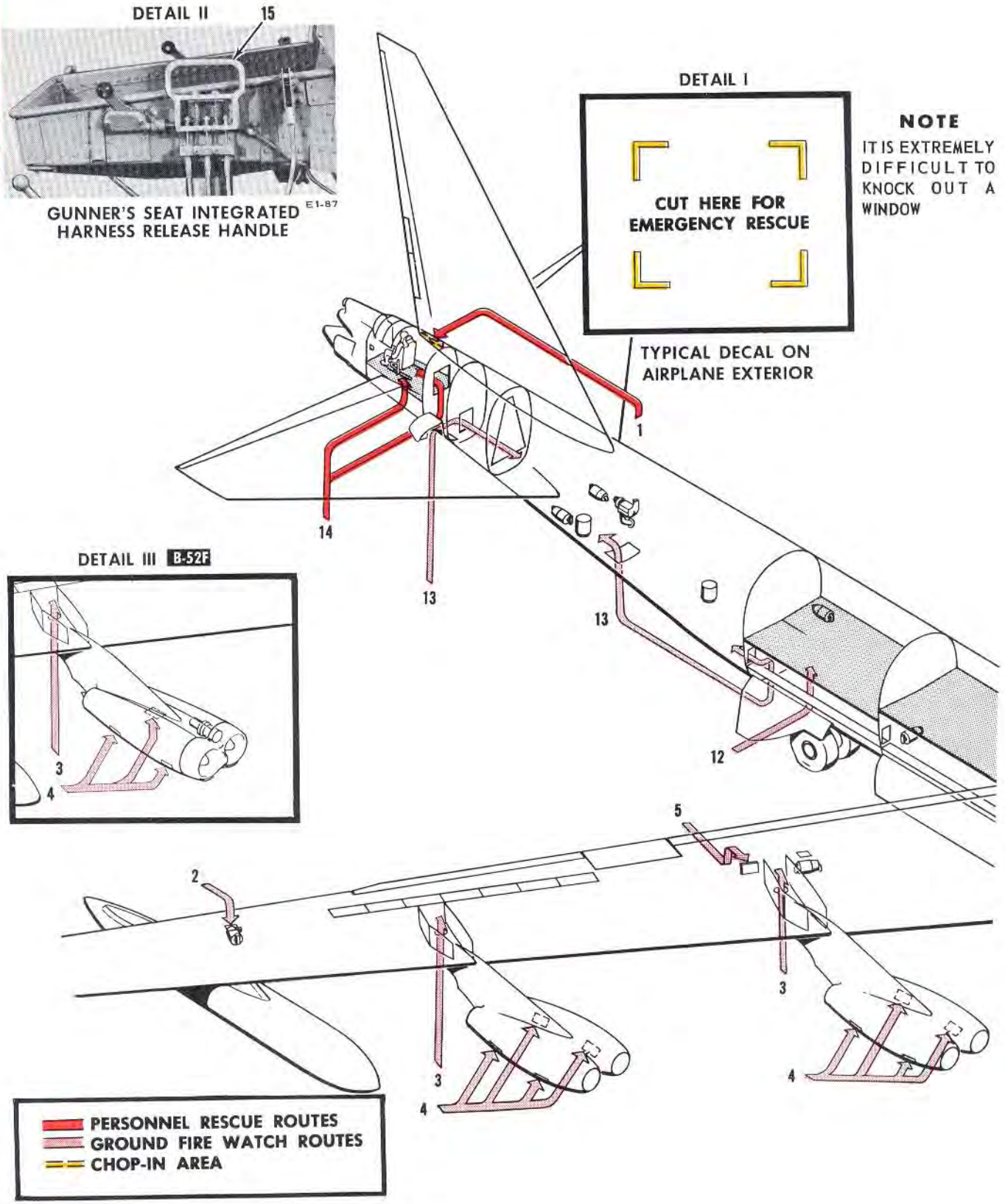
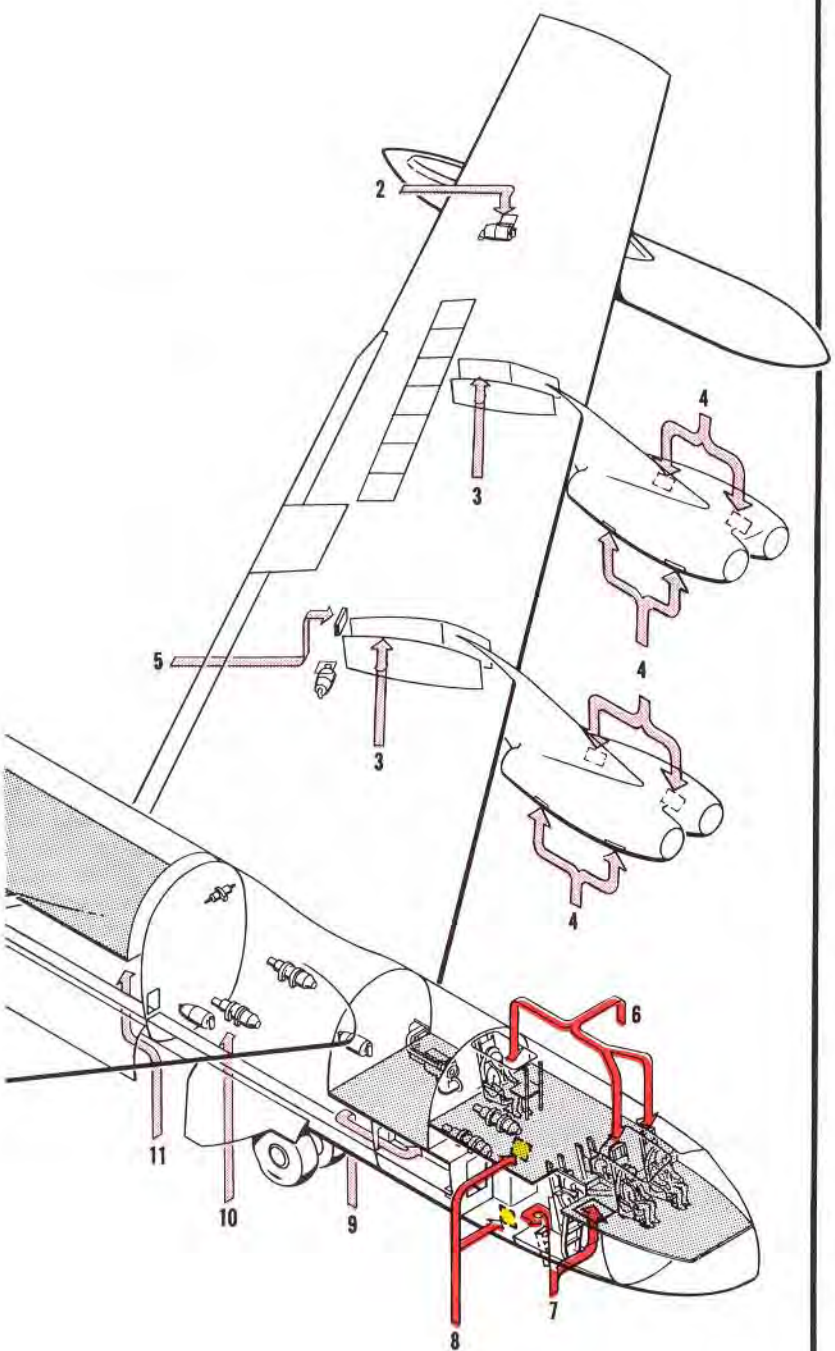


Figure 3-12 (Sheet 1 of 2).



1 Tail Compartment Chop-In Area (Detail I)

2 Hydraulic Packs – Access Through Panels in Top and Bottom of Wing

3 Wing Equipment Bays – Access Through Panels in Bottom of Wing

4 Engine Accessory and Combustion Section Knock-In Panels (Hinged Spring-Loaded Doors) (Detail III)

CAUTION

Do not put CO_2 in engine inlet or tail pipe. It will do no good and can cause serious damage to a hot engine

5 Electrical Equipment and Hydraulic Packs on Rear Spar – Access with Wing Flaps Down

6 Control Cabin Emergency Entry Through Pilot's, Copilot's, Radar Navigator's, and EW Officer's Ejection Seat Hatches

7 Control Cabin Normal Entry

8 Control Cabin Chop-In Areas (Detail I)

9 Electrical Equipment in Alternator Compartment – Access Through Front Wheel Well

10 Electrical Equipment and Air Bleed Turbines in Front Wheel Well

11 Wing Flap Motors in Center Wing Equipment Bay – Access Through Bomb Bay

12 Electrical Equipment and Air Bleed Turbines in Rear Wheel Well

13 Electrical Equipment, Liquid Oxygen Converters, and Air Bleed Turbines in Aft Equipment Compartment – Access Through Rear Wheel Well Aft Equipment Compartment Entrance Hatch or Aft Entry Door

14 Tail Compartment – Access Through Aft Entry Door or by Use of Turret Jettison Handle

15 Gunner's Seat Integrated Harness Release Handle – Pull to Release Seat Occupant (Detail II)

emergency entrance and ground fire watch areas (typical)

Figure 3-12. (Sheet 2 of 2)

OIL SYSTEM EMERGENCY OPERATION

NOTE

When an engine has windmilled in flight with zero oil pressure, an entry should be made on Form 781 indicating the elapsed time during which windmilling occurred without oil pressure. This information will aid maintenance personnel in determining the condition of engine bearings.

OIL PRESSURE

When engine oil pressure drops below 40 psi, the engine should be monitored closely; if engine oil pressure drops below 35 psi, oil pressure is considered low and the engine should be shut down unless its thrust is necessary to maintain flight. If the thrust of an engine with low oil pressure is required to maintain flight, the pilot should be aware of the results of operating an engine during oil starvation. If an engine oil system malfunction has caused prolonged oil starvation of engine bearings, the result will be a progressive bearing failure and subsequent engine seizure. This progression of bearing failure starts slowly and will normally continue at a slow rate up to a certain point at which the progression of failure accelerates rapidly to complete bearing failure. The time interval from the moment of oil starvation to complete failure depends on such factors as condition of bearings prior to oil starvation, operating temperature of bearings, and bearing loads. A good possibility exists for up to 30 minutes of operation after experiencing oil starvation. Bearing failure due to oil starvation is generally characterized by a rapidly increasing vibration; when vibration becomes moderate to heavy, complete failure is only seconds away and may be avoided only by immediate engine shutdown. Since the end result of oil starvation is engine seizure, at the first indication of oil system malfunction, the procedure outlined below should be followed to forestall engine seizure as long as possible.

1. Immediately shut the engine down unless its thrust is necessary to maintain flight.
2. If thrust is required from the affected engine, reduce thrust to minimum required to maintain flight. Avoid rapid and large variations in thrust settings on affected engine.
3. Jettison external stores not required, if necessary.
4. Avoid all abrupt maneuvers causing high "g" forces. This prevents unnecessary bearing loads.
5. After critical thrust conditions are past, immediately shut the affected engine down. Reduction in IAS and altitude will reduce the engine windmilling rpm and delay engine seizure after the engine is shut down.
6. Reset oil pressure circuit breaker, if applicable.

NOTE

If the oil pressure circuit breaker has popped, oil pressure indications are unreliable.

DROP TANK EMERGENCY OPERATION

EMERGENCY TRANSFER FROM DROP TANKS THROUGH REFUEL SYSTEM

If a drop tank transfer system fails, drop tank fuel can be routed through the refuel system provided 1) the drop tank pressurization system is functioning properly and 2) the drop tank is not full by volume (full by volume float switch has not closed the refuel valve). If the drop tank fuel quantity gage pointer is near the full line so that it cannot be determined if the drop tank is full by weight or full by volume, turn the master refuel control switch to ON and the drop tank refuel secondary valve switch to VALVE OPEN position. If the corresponding refuel secondary valve light does not go out, depress the corresponding fuel quantity gage push-to-test button. This rotates the gage pointer counterclockwise. If the refuel secondary valve light goes out as the gage pointer approaches a less than full condition, the tank is full by weight and fuel can be transferred from the drop tank through the refuel system. If the valve light does not go out, the tank is full by volume and fuel cannot be transferred from the drop tanks through the refuel system. Drop tank fuel transfer through the refuel system may be accomplished per the following checklist.

EMERGENCY TRANSFER FROM DROP TANKS THROUGH REFUEL SYSTEM CHECKLIST

1. Turn Off Drop Tank Transfer Valve Switch (17 or 21) - OFF (CP)

   This closes drop tank transfer valve 17 or 21.

2. Pull Fuel Feed Valve Control Circuit Breaker (as applicable; left drop 17, or right drop 21) - Pulled (CP)

   On copilot's circuit breaker panel, pull the fuel feed valve control circuit breaker for the malfunctioned tank.

Figure 3-13 Deleted

EMERGENCY TRANSFER FROM DROP TANKS THROUGH REFUEL SYSTEM CHECKLIST (Cont)

3. Turn On Drop Tank Transfer Valve Switch (17 or 21) - ON (CP)

   Transfer valve 17 or 21 will remain closed and pressurization of the drop tank routes fuel into the refuel system.

4. Turn On Master Refuel Control Switch - ON (CP)

5. Close Refuel Valve Switch - CLOSED (light out) (CP)

6. Open Refuel Secondary Valve Switch (33 or 41) - VALVE OPEN (CP)

7. Open Refuel Secondary Valve Switches (as required) - VALVE OPEN (CP)

   Open refuel secondary valves to tanks to which transfer is desired.

NOTE

If drop tank refuel secondary valve light does not go out, depress fuel quantity gage push-to-test button; light will go out when gage pointer indicates less than full tank condition. With light out, turn master refuel control switch OFF to prevent valve from closing when push-to-test button is released. Copilot will monitor fuel transfer and upon completion of transfer will place all refuel secondary valve switches in VALVE CLOSED position. (If master refuel switch is in OFF position as outlined above, it must be turned ON to provide a power source for closing refuel secondary valves.)

WARNING

Monitor the fuel quantity gages for those tanks being replenished by the refuel system. A failure of a primary refuel valve would result in overfilling of the tanks since the secondary refuel valves will not close automatically if the master refuel control switch is in the OFF position.

8. Close Refuel Secondary Valve Switches - VALVE CLOSED (CP)

   Upon completion of fuel transfer, close refuel secondary valves.

9. Turn Off Master Refuel Control Switch - OFF (CP)

FUEL MANAGEMENT WITH ONE DROP TANK INOPERATIVE

If one drop tank fails to transfer, fuel management procedures will vary depending on whether the drop tanks are to be retained or jettisoned. If drop tanks are to be retained, the amount of ballast fuel required to maintain a favorable cg location and also the minimum landing weight will be determined by the amount of trapped fuel in the inoperable tank. See "Landing with Lateral Unbalance" in Part 9 of the applicable Appendix. When retaining the tanks, it is desirable that fuel from the operable tank be used as late as possible in order to keep lateral trim drag to a minimum. Fuel must be transferred from the main tanks to the forward body tank to maintain a favorable cg location. Following is the fuel sequence to be followed if one drop tank is unable to transfer.

FUEL MANAGEMENT WITH ONE DROP TANK INOPERATIVE CHECKLIST

WARNING

If fuel from a drop tank cannot be transferred through the refuel system, land as soon as possible. Follow the procedure below only if fuel is required to reach landing base.

NOTE

Before making the decision to jettison an inoperable drop tank, check that the drop tank refuel valve is CLOSED and momentarily turn the master refuel control switch to ON. If the valve light does not illuminate, tank jettison circuitry may not be complete and tank jettison may be impossible.

1. 8% of Main Tanks 1, 2, 3 & 4
2. Aft Body to 1, 2, 3 & 4 until equalized with Fwd Body
3. Aft Body to 1 & 2; Fwd Body to 3 & 4
4. Mid Body to 1, 2, 3 & 4
5. Left Wing to 1; Center Wing to 2 & 3; Right Wing to 4
6. From Operable Drop Tank to 1 (or 4); Center Wing to 2, 3 & 4 (or 1, 2 & 3)
7. From Operable Drop Tank (until 9750 pounds less than inoperable drop) to 1, 2, 3 & 4
8. From Main Tanks 1, 2, 3 & 4 Crossfeed 20,000 Pounds to Fwd Body
9. Main Tanks 1, 2, 3 & 4
10. Jettison Inoperative Drop Tank

If the 29,750 pounds of ballast fuel from the forward body tank and the operable drop tank is required to reach landing base, descend to 10,000 feet and depressurize. Send a man to unpressurized compartment to pull tank drop power circuit breaker for the operable drop tank. The power circuit breakers for the drop tanks are located in the J-54 right forward a-c power load box. Jettison inoperative drop tank, repressurize, and climb back to altitude. Transfer fuel from drop tank and forward body tank to the main tanks.

WARNING

Use extreme caution when removing cover from right forward a-c power load box and when pulling tank drop power circuit breaker. Serious fires and injury may result.

JETTISONING OF DROP TANKS

Conditions For Jettison

The dropping of full external fuel tanks should not be considered unless one of the following emergency conditions exist:

1. Climb performance is marginal due to airplane or engine malfunctions or a condition exists where an increased rate of climb is required. (Rate of climb can be increased approximately 300 fpm if full 3000-gallon drop tanks are jettisoned.)
2. Crash landing is imminent.
3. Fuel system malfunctions make maintenance of the cg forward of 35% MAC impossible.
4. Range is critical and can be improved by the elimination of unusable fuel weight and drop tank drag. A range increase up to 500 nautical air miles can be obtained by jettisoning one full drop tank versus carrying it when it will not feed.

DROP TANK JETTISON CHECKLIST

After the decision to jettison full drop tanks has been made, the following criteria should be considered:

1. Maintain Reasonable Altitude

   The possibility exists that only one tank may jettison in which case altitude might be lost during re-trimming.

2. Airplane Weight is not a Factor

   From a control as well as a range standpoint, it is more advantageous to jettison tanks at a high gross weight.

3. Shift Airplane CG Aft

   Avoid exceeding forward cg limit after tank drop if time permits (figure 5-8).

4. Maintain 1 "g" Flight

   If possible, drop the tanks in 1 "g" flight, especially when the maximum allowable "tanks off" gross weight of 370,000 pounds will be exceeded.

5. Move Stabilizer Trim 2° to 3° Nose Up

   Trim nose up prior to tank drop so that the elevator trim changes can be handled with reasonable stick forces.

6. Maintain 180 Knots IAS - Flaps down

   Maintain 250 Knots IAS (or Mach .75, whichever is less) - Flaps up

   At higher airspeeds, control forces become greater and the larger response of the wing to the sudden loss of the tanks is undesirable.

FUEL SYSTEM EMERGENCY OPERATION

NOTE

With electrical system normal and with minimum fuel aboard (any main tank below 5000 pounds), the necessary crossfeed valves should be opened to insure a continued supply of fuel to the affected engines. If the fuel level drops to the minimum value in both tanks in either wing, valves 10 and 11 will be opened. See Section V for flutter limits for other than normal fuel sequences.

MAIN TANK FUEL LEAK

Upon detecting evidence of a main tank fuel leak (visual evidence reported by gunner, excessive consumption, or inability to maintain 92% of tank spillover-full during transfer), the following procedure should be used:

1. Stop transfer to affected tank.
2. Open crossfeed valve on affected wing (9 or 12).
3. Close main tank feed valve from affected tank (13, 14, 15, or 16). Observe tank gage for lowering fuel quantity.

   a. If gage indicates continued lowering of fuel, a leak exists in the tank and emergency emptying procedures should be continued.

   b. If the gage for that particular tank holds steady after completing the above procedure but increased fuel consumption is indicated for the tank now feeding the crossfeed manifold, the following procedure must be taken because of a fuel line leak.

4. If an outboard pod is affected, open the pneumatic air bleed wing manifold interconnect; if an inboard pod is affected, open the pneumatic air bleed body interconnect.
5. Close applicable crossfeed valve (9 or 12) to starve the engines in the affected pod.

6. When engines flame out, close throttles and pull firewall fuel shutoff switches.
7. Follow six-engine flight procedures.

NOTE

- Fuel which cannot be transferred because of a leaking fuel line will be trapped in a main tank and, in order to maintain cg and lateral balance, this fuel must be taken into consideration for subsequent routing of fuel.
- For a further discussion of fuel tank leaks, see "Structural Damage," this section.

EMERGENCY EMPTYING OF A MAIN TANK

Severe fuel leaks or combat damage could make it necessary to empty a main tank to prevent loss of fuel. In this event, the following procedure should be used:

1. Shut off replenishing fuel to main tank affected.
   a. If main 2 or 3, close valve 48 or 49.

NOTE

The master refuel control switch must be OFF to permit manual closing of valve 48 or 49.

b. If main 1 or 4, close valve 47 or 50. (See "Fuel Transfer Bypassing Outboard Main Tanks Checklist," this section.)

NOTE

Replenishing fuel to mains 1 or 4 may be stopped by closing the auxiliary tank valve switches from the corresponding drop and wing tanks and by closing transfer valve switch 26 or 28.

2. Route remaining fuel in main tank affected to all eight engines.

WARNING

- Do not close main tank valves 13, 14, 15, and 16 except as necessary. Pull the circuit breaker for the main tank valve and then close the main tank valve switch. (This will turn off boost pumps on desired tank with the valve failed in the open position.) When restarting the booster pumps, open the main tank valve switch, then reset the main tank valve circuit breaker.
- To avoid a flameout when operating all engines from a single main tank, extreme care must be exercised to prevent an interruption of fuel flow to the engines as the tank becomes empty. Discontinue emergency tank emptying procedure before the fuel quantity indication reaches the "0" marking on the fuel quantity gage.

CAUTION

Fuel shall not be transferred directly between main tanks except through valve 46 and the refuel system. This is to prevent excessive surge pressures due to closure of transfer valves.

3. Provide standby source of fuel.
   a. Route fuel from body or center wing tanks to crossfeed manifold.

NOTE

If body and center wing tanks are empty or if high engine power is required (total fuel flow in excess of 20,000 pph), route fuel from another main tank to the crossfeed manifold in addition to that being supplied by body or center wing tanks. In the latter case, fuel flow from the leaking main tank will be decreased and the second main tank should not be turned on until the fuel low warning light for the leaking main tank illuminates. See "Emergency Emptying of a Main Tank" on figure 3-13.

4. When leaking main tank is nearly empty, reposition fuel valve and applicable crossfeed valve switches to supply fuel to all engines from the remaining tanks. See "Main Tank Valve or Complete Boost Pump Failure" on figure 3-13.

EMERGENCY EMPTYING OF AN AUXILIARY TANK

An auxiliary tank may be emptied quickly by routing fuel to all main tanks simultaneously. An example of this procedure is shown in figure 3-14. The boost pumps of one auxiliary tank may not provide sufficient fuel to keep all main tanks full; however, when the auxiliary tank is empty and fuel is supplied from other auxiliary tanks, the main tank fuel can be easily maintained again at the maximum level.

MAIN TANK VALVE OR COMPLETE BOOST PUMP FAILURE

The main tank valves are normally open in flight and failure of the valve in this condition would not cause an emergency situation as fuel flow would not be interrupted. However, if a main tank valve is closed for some reason and fails to open, engines normally supplied by that tank can be supplied fuel from an adjacent tank by using the crossfeed manifold. Failure of a main tank valve in the closed position makes it impossible to use the fuel in the tank. An example of fuel routing recommended in the event of a main tank valve or complete boost pump failure is shown in figure 3-14.

NOTE

The engines may be operated at substantial power with the boost pumps inoperative. The engine-driven fuel pumps can supply sufficient fuel pressure to sustain power but fuel available will vary with altitude and temperature. See "Complete A-C Power Failure," this section.

EMERGENCY FUEL TRANSFER FOR WEIGHT REDISTRIBUTION

Emergency conditions may make it necessary to reroute fuel to correct airplane cg location. Airplane cg may be moved aft by transferring fuel to the rearward body tanks as discussed in "Landing with Stabilizer Trim Failure." Transfer of fuel to an outboard wing tank could be required when landing with one forward and one rear main gear on the same side of the airplane retracted. An example of fuel routing for this emergency situation is illustrated in figure 3-14. The emergency fuel transfer rate from the main tanks to any auxiliary tank may be as low as 300 pounds per minute. This rate is applicable with one or more main tanks transferring and with three boost pumps operating in each tank. The emergencies requiring weight redistribution by transfer of fuel are discussed under "Landing Emergencies," this section.

FUEL TRANSFER BYPASSING OUTBOARD MAIN TANKS CHECKLIST

NOTE

If battle damage or a known leak occurs in main tank 1 or 4, the following procedure will be used to avoid transferring fuel from the drop or outboard wing tanks to the damaged main tanks.

1. Turn Fuel Level Valve Switches 48 & 49 Off - OFF (CP)

   These are the secondary transfer valves on main tanks 2 and 3.

2. Pull Fuel Level Control Circuit Breaker - Pulled (CP)

   Pull the fuel level control circuit breaker for the affected main tank, depending on whether valve 47 or 50 is to be closed:
   Valve 47 - RIGHT OUTBD, CTR WING, & 1
   Valve 50 - LEFT DROP, MID BODY, & 4

3. Route Fuel as Desired from any Body Tank - Routed (CP)

   Route fuel from any body tank as desired to valve 46.

4. Turn Master Refuel Control Switch On - ON (CP)

5. Open Fuel Manifold Interconnect Valve Switch (46) - Opened (CP)

6. Actuate Refuel Ground Checkout Switch - Actuated (CP)

   Actuate the refuel ground checkout switch for the main tank to be isolated. Hold for minimum of 1 minute before proceeding to next step.

7. Pull Main Tanks Level Circuit Breaker - Pulled (CP)

   Pull the circuit breaker on the copilot's circuit breaker panel while actuating the checkout switch.

8. Reset Appropriate Circuit Breaker - Reset (CP)

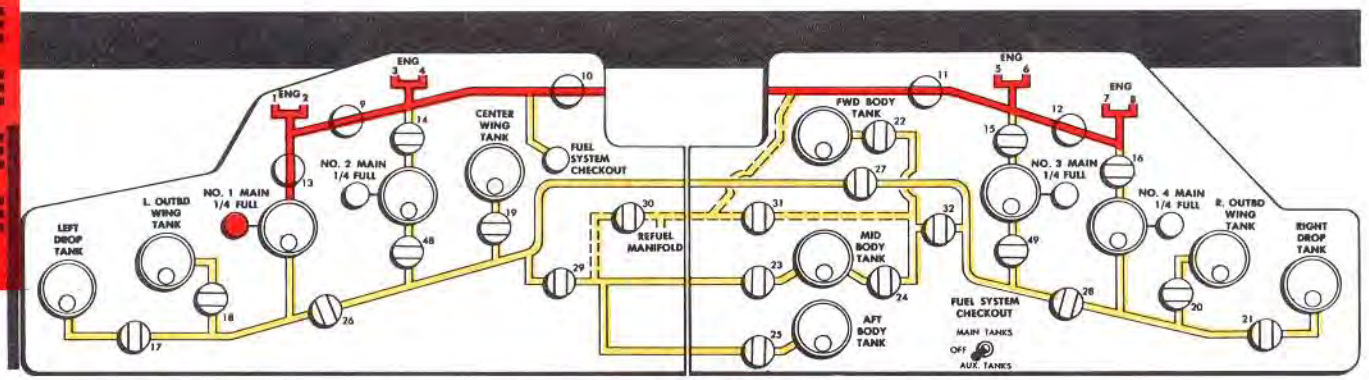
   Depending on whether valve 47 or 50 was closed, reset the following circuit breakers:
   Valve 47 - RIGHT OUTBD CTR WG & 1
   Valve 50 - LEFT DROP MID BDY & 4

9. Route Fuel to any Tank as Desired - Routed (CP)

   Route fuel to any tank desired through the refuel manifold.

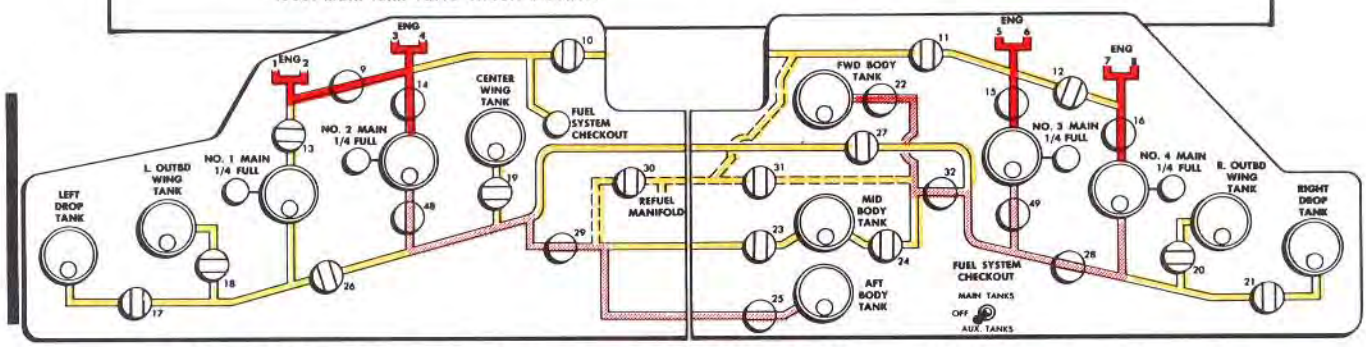
NOTE

When the main tanks level circuit breaker is pulled, the secondary transfer valves in the main tanks will not operate. Since the fuel transfer is to be accomplished through the refuel manifold, all tanks will have both primary and secondary fuel level control.

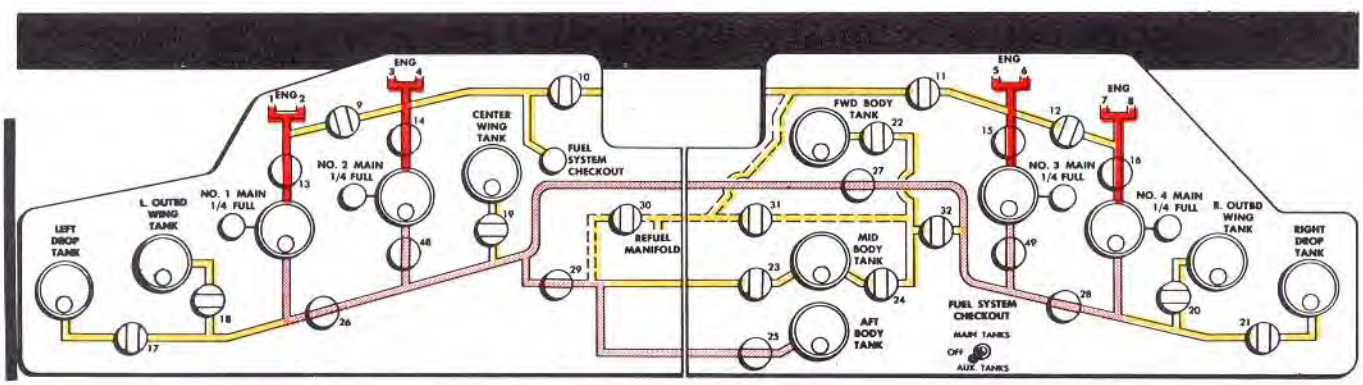


EMERGENCY EMPTYING OF A MAIN TANK — (Main Number 1 Shown)

WARNING Do not close main tank valves 13, 14, 15, and 16 except as necessary. Pull the circuit breaker for the main tank valve and then close main tank valve switch. (This will turn off boost pumps on desired tank with the valve failed in the open position.) When restarting the booster pumps, open the main tank valve switch then reset main tank valve circuit breaker.



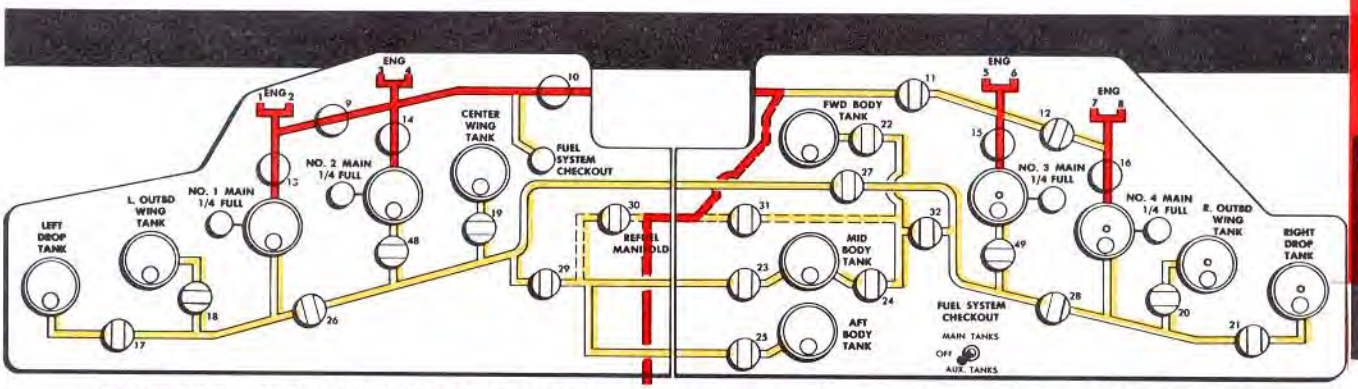
MAIN TANK VALVE OR COMPLETE BOOST PUMP FAILURE — (Main Number 1 Shown)



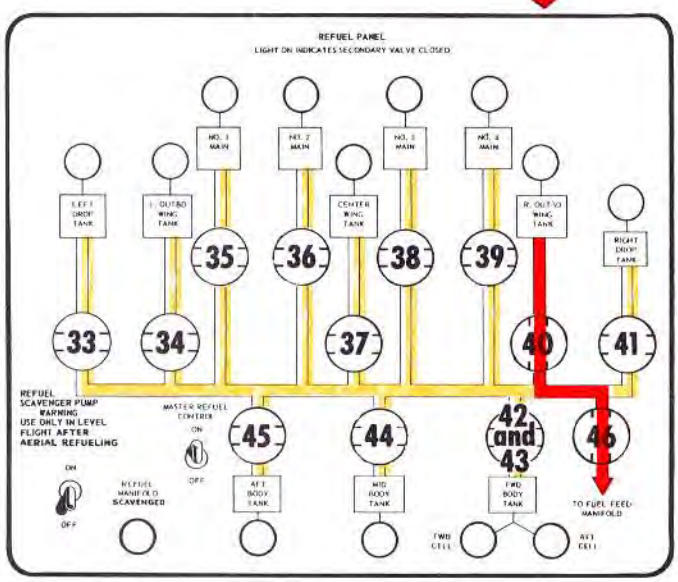
EMERGENCY EMPTYING OF AN AUXILIARY TANK — (Aft Body Shown)

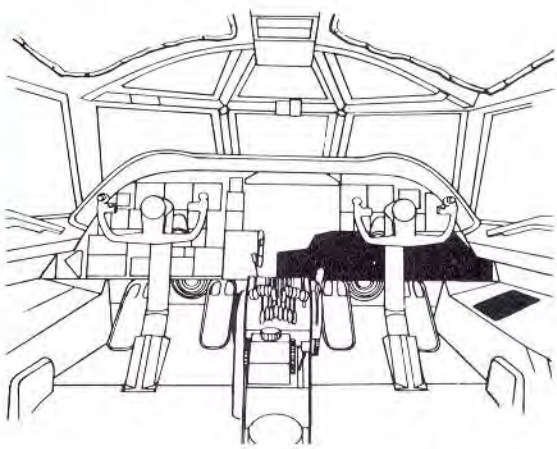
PRIMARY FLOW
SECONDARY FLOW
STATIC
LIGHT ON

Figure 3-14. (Sheet 1 of 2).



EMERGENCY FUEL TRANSFER FOR WEIGHT REDISTRIBUTION—To Right Outboard Wing Tank





.....fuel system emergency operation (typical)

Figure 3-14. (Sheet 2 of 2).

ELECTRICAL SYSTEM EMERGENCY OPERATION

NOTE

For a list of possible electrical system failures, probable causes, and the corrective action to be taken, see figure 3-15.

A-C POWER SYSTEM FAILURE

The a-c electrical power system has been designed to automatically clear system faults and shut down malfunctioning alternators. If an alternator fails to trip off automatically when an abnormal operating condition is indicated by the lights and instruments on the a-c control panel, its bus tie breaker should be opened manually, the alternator circuit breaker should be opened manually, or the alternator should be turned off, depending on the situation. When an alternator circuit breaker is open, its bus load can receive power from the remaining alternators through the central bus tie if the respective bus tie circuit breakers are closed. The bus tie circuit breaker of the affected alternator will close automatically in most cases when the alternator circuit breaker opens. Alternators which are operating normally should not be shut down in flight except, on B-52E aircraft, when air bleed is insufficient to operate all four drives. This low air bleed condition will be indicated by consistent illumination of the alternator overload lights on the pilots' instrument panel. Three alternators will supply the total aircraft load requirements; therefore, if air bleed supply is marginal and cannot be increased by increasing power, one alternator may be turned off.

NOTE

In the event of an alternator failure and/or alternator shutdown that would require reducing loads from the busses, a bus-by-bus listing of the a-c loads is in the emergency portion of the pilots' abbreviated checklist.

Less NF

When an alternator failure occurs while operating all four alternators with the bus tie circuit breakers open, a load transfer relay operates automatically to transfer the load to an alternate source alternator. Even though this load transfer relay provides automatic switching of loads, it is best to operate all alternators paralleled when possible so that all remaining alternators are available to supply loads should one or more alternators fail.

NF

When an alternator fails while operating isolated, it will be necessary to close the bus tie breaker for the failed alternator if it does not close automatically since the automatic transfer relays have been removed.

NOTE

Should it become necessary to operate all four alternators isolated, the bus tie breaker for one alternator should be left closed.

CAUTION

Under no circumstances should the respective bus tie breaker be left open after failure or shutdown of an alternator.

NOTE

If any alternator control circuit breaker on the copilot's circuit breaker panel pops and cannot be reset, hold the alternator switch in OFF position and push the control circuit breaker in. Check that all bus tie breakers are closed. If the alternator will not shut down, consideration should be given to landing at the nearest suitable base.

WARNING

- When the alternator system exhibits abnormal frequency, voltage, or load fluctuations, open the alternator circuit breaker B-52F (turn off alternator switch B-52E) for the offending alternator and check that the bus tie breaker is closed. Do not attempt to use the alternator unless additional alternators fail. Should additional failures occur, attempt to restart one or more of the failed alternators and to operate them isolated (not paralleled). Extreme care must be exercised if an attempt is made to reparallel the alternators as tripoff of a good alternator could result.

B-52E

- Closely monitor voltage and frequency on restart. Shut down the alternator manually if abnormal readings are observed.

NOTE

Consideration should be given to the termination of the flight if one alternator has become inoperative. The loss of two alternators will result in a shortage of power and the mission should be terminated as soon as practicable.

B-52E

A minimum waiting period of 1 minute should be observed before attempting a restart. This period is necessary to permit the alternator drive to slow down enough for all relays to relax so that a normal start sequence may be accomplished. In restarting alternators above 10,000 feet, engines on the same side as alternators being restarted should be retarded to IDLE and the body manifold interconnect valve should be kept closed. If below 10,000 feet, the body manifold interconnect should be closed during restart but the engines should be retarded only to the point where the pneumatic manifold pressure gage indicates 25 psi to avoid possible air starvation of other pneumatic packs supplied by the air bleed system.

NOTE

B-52F

- Load oscillations of 6 kw (total spread) are normal at the engine speed for which the alternator drive governor does not have to correct in order to hold proper a-c frequency. This "straight through" drive range occurs at an engine speed of approximately 80% rpm. Throttles should be slightly readjusted to stop the oscillations.

B-52F

- On aircraft NF, if one alternator is lost, closely monitor the alternator overload lights on the a-c control panel so that the remaining alternators do not become overloaded. If two are lost, electrical loads must be reduced sufficiently to avoid overload and the mission should be terminated as soon as practicable. On aircraft Less NF, if more than one alternator is being operated isolated, the same precaution applies as if two are inoperative. The reason for this is that a fault on one bus could very possibly cause the loss of its own alternator plus the alternate source which may suddenly be overloaded.

ND

- The boost pump shutoff switch and the window defog switch were installed to allow reduction of loads during combat cruise conditions. When one or more alternators fail and it becomes apparent that they will be inoperative for the balance of the flight, these switches should be turned off as required to avoid overload of the remaining alternators while retaining use of a maximum of combat essential equipment. It should not be necessary to turn the switches off during training missions except when three alternators are lost. Do not turn the boost pump shutoff switch off unless all bus tie breakers are closed.

A-C Power Loss Due to Engine Shutdown

B-52F

The shutdown of engine 1, 3, 5, or 7 will be accompanied by the loss of electrical power from the alternator geared to that engine. Although an engine at idling speed will transmit enough energy to the alternator drive to maintain full a-c power output, a windmilling engine will not. The differential reactive current protection relay will detect the low output and will energize the alternator failure light. If the alternator remains on (its field excited) and paralleled, it will be motored by power provided through the central bus tie from the other alternators. Since the motoring of an alternator will drain a-c power which may be needed for other equipment, the alternator on the dead engine should be disconnected from its bus. Pulling the firewall fuel shutoff switch in the course of engine shutdown will accomplish this. If the firewall fuel shutoff switch is not pulled, then either the alternator switch or the alternator circuit breaker switch may be used.

NOTE

Pulling the firewall fuel shutoff switch will open the alternator circuit breaker and turn the alternator off. Holding the alternator switch momentarily to OFF will also accomplish both of these actions. Holding the alternator circuit breaker switch momentarily to OPEN will open the circuit breaker but will leave the alternator excitation turned on.

A-C Transformer Failure

If the forward or aft 28-volt a-c transformer fails, there is no emergency spare and power cannot be regained to that equipment powered by the lost transformer. Failure of the forward 28-volt transformer will result in loss of forward cabin lighting except the pilot's essential flight instrument lights.

A-C CIRCUIT FAULTS

Current Limiters (Fuses)

One basic type of fuse is used in two sizes throughout the airplane to provide main circuit protection. Six ratings are used: ratings 10A, 20A, and 30A come in the small size and ratings 40A, 50A, and 60A come in the large size. Each fuse has a red indicator element which discolors if the fuse has blown. These fuses will carry eight times the rated load for 1 second and three times the rated load for 10 seconds before they will blow. In this manner, short time electrical faults will burn themselves out (with the multi-wire feeder system) without interruption of electrical power. The current limiters will blow for faults of longer duration. If possible, all electrical power including battery power should be shut off before changing fuses. All fuses which are discolored should be replaced with spare fuses from the rack on the inside of the load box cover. Care should be exercised to use fuses of the correct ratings. An attempt should be made to correct the cause of the electrical fault.

WARNING

Changing fuses in flight is extremely dangerous because of the high voltages involved and should not be attempted unless a serious emergency occurs.

NOTE

- Fuses which are in series with a blown fuse should be replaced since several fuses in series may blow, yet only one element may discolor. A fuse which has been directly exposed to a fault condition but has not blown should also be replaced since exposure to a fault can alter the normal rating of a fuse.

- It is possible that fuses, even though of higher amperage rating, may be blown instead of circuit breakers within a circuit due to a high current surge.

Circuit Breakers

A circuit breaker which has opened because of an existing fault condition (short circuit or overload) should be reset only when absolutely necessary. Two resets can be attempted. If, however, the circuit breaker continues to open, one additional reset may be attempted after a 5-minute time interval. If this procedure fails to close the circuit, the fault will not clear by itself and, unless the trouble can be located and corrected, the unit should be shut down.

NOTE

Checking for opened circuit breakers is necessary during the execution of most emergency checklists in this section; however, an item for specific circuit breakers appears on the checklists only where special emphasis or action is required.

COMPLETE A-C POWER FAILURE

NOTE

The most positive indication of complete a-c power loss (other than the a-c control panel indication) is the illumination of the essential flight instrument lights and battery not charging lights.

If all four alternators fail and the procedures outlined in figure 3-15 do not result in restarting any alternator, the only power source remaining will be the batteries. The units receiving battery power are also shown on figure 3-15. The battery system is designed to provide 4 hours of battery power to the loads connected to the emergency battery switch. This time is based on fully charged relatively new batteries. The procedures outlined under "Operation On Battery Power Checklist" should be followed.

Fuel Management

After complete electrical failure occurs, the only fuel available for the engines will be that which remains in the main tanks. Fuel will still be available from the drop tanks if transfer from the drop tanks is being accomplished at the time of complete a-c power failure. The transfer of fuel from body, center, and outboard wing tanks will not be possible because the boost pumps are powered by alternating current and the engine-driven fuel pumps are capable of drawing fuel from the main tanks only. The fuel valves that serve the main tank system, valves 1 through 9 and 12 through 16, are the only ones which can be operated by battery power. The engine-driven fuel pumps tend to cavitate without boost pump operation. This may cause some or all engines to flame out. A restart should be attempted since engine ignition will be available from battery power. See "Engine Flameout and Relight" and "Engine Air Starting," this section.

WARNING

When the fuel in the main tanks lowers to approximately one-fourth full, the boost pumps will become uncovered and cause air to be drawn into the fuel lines, resulting in fuel starvation. If the airplane is maintained in a level attitude, this condition will occur at a somewhat lower fuel level. The fuel management procedure should be such that each main tank is supplying its own nacelle with crossfeed manifold valves in CLOSED position. Fuel quantity gages will be inoperative.

Instrument Operation

The only instruments operating after complete a-c electrical failure will be:

- Airspeed indicators and machmeter (with pitot head heat for pilot's system only Less PP)
- Altimeters
- Pilot's turn and slip indicator
- Vertical velocity indicators
- Magnetic standby compass
- Clock
- EGT gages
- Tachometers.

In addition, the essential flight (emergency) instrument lights for the pilot's flight instruments, emergency alarm system, and interphone power for all stations will be available. The EPR gages and fuel quantity gages will be inoperative.

INSTRUMENT LIGHTING FAILURE

Forward Cabin Lights Failure (except essential flight instrument and side panel lights)

On aircraft NF, the loss of forward cabin lighting will be from one of the following malfunctions:

- By shutdown of the right forward alternator B-52E or engine No. 5 alternator B-52F if the respective bus tie circuit breaker is OPEN.
- Failure of the 28-volt a-c transformer or failure of the 28-volt a-c transformer circuit breaker located in the section 41 power distribution box.

On aircraft Less NF, loss of forward cabin lighting will be from one of the following malfunctions:

- By shutdown of the left forward alternator and right forward alternator B-52E or engine No. 3 alternator and engine No. 5 alternator B-52F if the respective bus tie circuit breakers are OPEN.
- Failure of the transfer relay in the forward a-c load box.
- Failure of the 28-volt a-c transformer or failure of the 28-volt a-c transformer circuit breaker in the section 41 power distribution box.

Essential (Emergency) Flight Instrument Lights

The essential flight instrument lights are those lights that are normally operated on a-c power but, in case of a complete a-c power failure, these lights will be operated by 24-volt battery power.

NOTE

- If the essential flight instrument lights are not automatically restored after complete a-c power failure, place the emergency battery switch to the EMERG position. This switches the lights to aft battery power and lighting should be restored immediately.
- If the essential flight instrument lights are not restored by the use of battery power, pull the pilot's switched battery forward TR bus circuit breaker on the pilot's circuit breaker panel. This will also switch several switched battery bus loads to battery power.

On aircraft NF, the loss of essential flight instrument lights will be from one of the following a-c malfunctions:

- By shutdown of the right aft alternator B-52E or No. 7 alternator B-52F if the respective bus tie circuit breaker is OPEN.
- Failure of the "Pilots Inst" circuit breaker on the ECM circuit breaker panel or failure of the Phase A ECM circuit breaker in the auxiliary section 41 power distribution box.

On aircraft Less NF, the loss of essential flight instrument lights will be from one of the following malfunctions:

- By shutdown of the left aft alternator and right aft alternator B-52E or engine No. 1 and engine No. 7 alternators B-52F if the respective bus tie circuit breaker is OPEN.
- Failure of the transfer relay in the aft a-c power box.
- Failure of the "Pilots Inst" circuit breaker on the ECM circuit breaker panel or failure of the Phase A ECM circuit breaker in the section 41 power distribution box.

ALTERNATOR EMERGENCY OPERATION

NOTE

The primary purpose of this chart is to maintain electrical power to the aircraft equipment while defining the characteristics of the electrical malfunction.

CAUTION

Under no circumstances should the respective bus tie breaker be left open after failure and/or shutdown of an alternator.

NOTE

- All forward cabin lights will go out when the right forward alternator and right aft alternator (engine No. 5 alternator and engine No. 7 alternator) bus is not receiving power from the alternator or through the respective bus tie circuit breaker. NF
- Under no circumstances will the boost pump shutoff switch be turned off unless the alternator bus tie breakers are closed. ND
- Check air bleed manifold pressure gages for sufficient bleed air before taking action. B-52E

ALTERNATOR EMERGENCY OPERATION B-52E

INDICATION OF TROUBLE	POSSIBLE CAUSE	ACTION TAKEN BY CREW
Bus tie circuit breaker light on	Abnormally high or fluctuating voltage	Check voltage and frequency and adjust by use of the voltage and frequency rheostats. If voltage and frequency can be adjusted within limits and are not fluctuating, continue to operate isolated. If voltage and frequency cannot be adjusted within limits or are fluctuating, shut down alternator and check the bus tie breaker closed.
Alternator circuit breaker light on	Alternator drive trip or protective circuit trip	Check bus tie breakers closed. If other three alternators are operating properly, shut down alternator and do not attempt a restart.
Alternator overload light(s) on	Bleed air insufficient or alternator drive faulty	Increase engine power. Check air bleed manifold pressure gage. If light does not go out, shut down alternator and check bus tie breaker closed.
Fluctuating KVAR's	Malfunctioning regulator or reactive load loop	Open alternator circuit breakers one at a time and check voltage. The voltage should not oscillate more than 4 volts total spread. If voltage is within limits, reparallel. If outside limits, shut down alternator and check bus tie breaker closed
Fluctuating KW's (9 KW or more total spread)	Malfunctioning alternator drive	Open alternator circuit breakers one at a time and adjust frequency. If frequency can be adjusted within limits and is stable, reparallel. If outside limits or unstable, shut down alternator and check bus tie breaker closed.
Alternator failure light on	Low reactive current output due to underexcitation or low voltage	Adjust KVAR's by use of voltage rheostats. If alternator will not adjust within limits and turn the light out, open alternator circuit breakers one at a time and check voltage. Shut down malfunctioning alternator and check bus tie breaker closed.
Abnormally unbalanced KW and/or KVAR readings	Malfunctioning voltage regulator or drive control	Adjust KVAR's by use of the voltage rheostats. Adjust KWATT's by use of the frequency rheostats. If load division cannot be adjusted within limits, open alternator circuit breakers one at a time to determine which alternator will not adjust within limits. Shut down malfunctioning alternator and check bus tie breaker closed.

Figure 3-15 (Sheet 1 of 6).

ALTERNATOR EMERGENCY OPERATION B-52E (CONT)

INDICATION OF TROUBLE	POSSIBLE CAUSE	ACTION TAKEN BY CREW
Multiple bus tie circuit breaker lights on	Multiple malfunctions	Do not attempt to reparallel. Be alert for additional malfunctions. If all four bus tie breaker lights are on, close the bus tie breaker for one alternator.
Alternator control circuit breaker pops	Control circuit fault	Reset circuit breaker. If circuit breaker will not reset, hold the alternator switch in OFF position and push in the control circuit breaker. Check bus tie breakers closed. If alternator will not shut down, consideration should be given to landing at the nearest suitable base.
Two alternator overload lights on for alternators on the same side	Bleed air insufficient	If a pneumatic leak is not suspected, open body manifold interconnect valve switch to supply additional bleed air.
Two or three alternator circuit breaker lights on **NOTE** Alternators will indicate little or no KWATT's and KVAR's when loads have been reduced.	Multiple malfunctions	1. Reduce unnecessary loads (e.g. BNS, FCS, and ECM) to avoid overload on remaining alternator(s). 2. Check all bus tie breakers closed. 3. Turn failed alternator switches on. Check voltage and frequency. 4. Open bus tie breaker of one failed alternator and quickly close alternator circuit breaker. This minimizes time that bus is not receiving power. Run alternator isolated. If alternator circuit breaker does not close or steady voltage and frequency are not maintained, shut down alternator and check bus tie breaker closed. 5. Repeat for other failed alternators until three or more alternators are operating. 6. Turn equipment on cautiously and monitor load meters.
All four alternator circuit breaker lights on. (Complete A-C Failure) **NOTE** ● Alternators will indicate little or no KWATT's and KVAR's when loads have been reduced. ● If no alternators can be started, refer to operation on battery power checklist.	Multiple malfunctions	1. Reduce unnecessary loads. (P) Pilot will notify crew to reduce unnecessary loads (e.g. BNS, FCS, and ECM). 2. TURN ALL ALTERNATOR SWITCHES ON. (CP) 3. OPEN ALL BUS TIE BREAKERS. (CP) 4. Check voltages and frequencies. (CP) 5. CLOSE ALL ALTERNATOR CIRCUIT BREAKERS. (CP) 6. Recheck voltages and frequencies to detect malfunctioning alternators. (CP) 7. Shut down malfunctioning alternator(s) and close respective bus tie breaker(s). (CP) 8. Close bus tie breaker on one operating alternator with the least load. (CP)

Figure 3-15 (Sheet 2 of 6).

ALTERNATOR EMERGENCY OPERATION B-52F

INDICATION OF TROUBLE	POSSIBLE CAUSE	ACTION TAKEN BY CREW
Bus tie circuit breaker light on	Abnormally high or fluctuating voltage	Check voltage and adjust by use of the voltage rheostats. If voltage can be adjusted within limits and voltage and frequency are not fluctuating, continue to operate isolated. If voltage and frequency cannot be adjusted within limits or are fluctuating, open the alternator circuit breaker and close the bus tie breaker.
Alternator circuit breaker light on	Alternator drive trip or protective circuit trip	Check bus tie breakers closed. If other three alternators are operating properly, do not attempt a restart.
Alternator overload light(s) on ND	Alternator overloaded	Adjust voltage as required to balance load between alternators. Turn overload light reset switch to reset momentarily. If overload light(s) comes back on, reduce load in increments until overload light will remain out after pushing reset switch.
Fluctuating KVAR's (6 KVAR or more total spread)	Malfunctioning regulator or reactive load loop	If engines are near 80% rpm, adjust throttles slightly. Open alternator circuit breakers one at a time and check voltage. The voltage should not oscillate more than 4 volts total spread. If voltage is within limits, reparallel. If outside limits leave alternator circuit breaker open and check bus tie breaker closed.
Fluctuating KW's (10 KW or more total spread)	Malfunctioning alternator drive	If engines are near 80% rpm, adjust throttles slightly. Open alternator circuit breakers one at a time and check frequency. If frequency is within limits and stable, reparallel. If outside limits or unstable, leave alternator circuit breaker open and check bus tie breaker closed.
NOTE Oscillations of 6 KW total spread will be normal at approximately 80% engine rpm.		
Alternator failure light on	Low reactive current output due to underexcitation or low voltage	Adjust KVAR's by use of voltage rheostats. If alternator will not adjust within limits and turn the light out, open alternator circuit breakers one at a time and check voltage. Leave alternator circuit breaker open for malfunctioning alternator and check bus tie breaker closed.
Abnormally unbalanced KW and/or KVAR readings	Malfunctioning voltage regulator or drive control	Adjust KVAR's by use of the voltage rheostats. Adjust KWATT's by use of the frequency rheostats **Less ND**. If load cannot be adjusted within limits, open alternator circuit breakers one at a time to determine which alternator will not adjust within limits. Leave malfunctioning alternator circuit breaker open. Check bus tie breaker closed.
Multiple bus tie circuit breaker lights on	Multiple malfunctions	Do not attempt to reparallel. Be alert for additional malfunctions. If all four bus tie breaker lights are on, close the bus tie breaker for one alternator.

Figure 3-15 (Sheet 3 of 6).

ALTERNATOR EMERGENCY OPERATION B-52F (CONT)

INDICATION OF TROUBLE	POSSIBLE CAUSE	ACTION TAKEN BY CREW
Alternator control circuit breaker pops	Control circuit fault	Reset circuit breaker. If circuit breaker will not reset, hold the alternator switch in OFF position and push in the control circuit breaker. Check bus tie breakers closed. If alternator will not shut down, consideration should be given to landing at the nearest suitable base.
Two or three alternator circuit breaker lights on **NOTE** Alternators will indicate little or no KWATT's and KVAR's when loads have been reduced.	Multiple malfunctions	1. Reduce unnecessary loads (e.g. BNS, FCS, and ECM) to avoid overload on remaining alternator(s). 2. Check all bus tie breakers closed. 3. Turn failed alternator switches on. Check voltage and frequency. 4. Open bus tie breaker of one failed alternator and quickly close alternator circuit breaker. This minimizes time that bus is not receiving power. Run alternator isolated. If alternator circuit breaker does not close or steady voltage and frequency are not maintained, open alternator circuit breaker and close bus tie breaker. 5. Repeat for other failed alternators until three or more alternators are operating. 6. Turn equipment on cautiously and monitor load meters.
All four alternator circuit breaker lights on (Complete A-C Failure) **NOTE** ● Alternators will indicate little or no KWATT's and KVAR's when loads have been reduced. ● If no alternators can be started, refer to operation on battery power checklist.	Multiple malfunctions	1. Reduce unnecessary loads. (P) Pilot will notify crew to reduce unnecessary loads (e.g. BNS, FCS, and ECM). 2. TURN ALL ALTERNATOR SWITCHES ON. (CP) 3. OPEN ALL BUS TIE BREAKERS. (CP) 4. Check voltages and frequencies. (CP) 5. CLOSE ALL ALTERNATOR CIRCUIT BREAKERS. (CP) 6. Recheck voltages and frequencies to detect malfunctioning alternators. (CP) 7. Open alternator circuit breaker for malfunctioning alternator(s) and close respective bus tie breaker(s). (CP) 8. Close bus tie breaker on <u>one</u> operating alternator with the least load. (CP)

..... electrical system emergency operation

Figure 3-15 (Sheet 4 of 6).

BATTERY SYSTEM LOADS

1. D-C loads available with battery switch ON and emergency battery switch NORMAL

FORWARD BATTERY

FORWARD SWITCHED BATTERY BUS
- Alternator circuit breaker indicator lights, engines No. 1 and 7 or aft alternators
- Alternator control: engines No. 1 and 7 or left and right aft alternators; exciter control B-52F, turbine controls B-52E; alternator circuit breakers; alternator switches B-52E; bus tie circuit breakers
- Antiskid: left and right forward main landing gear

Battery not charging lights
Bomb door forward alternate control valve
Bus tie breaker indicator lights
Cartridge start, engine 2 QN
Depressurization warning
Engine fire detection

Engine starter selector switch
Engine starter valves, engines 1 & 2
Firewall fuel shutoff valves 1, 2, 3 & 4
Fuel crossfeed valve No. 12
Fuel feed valves 13 & 15
Fuel level control: main tanks
ADM-20 fire warning RL
Hydraulic pack control for packs 1, 4, 5, 6 & 10
Ignition for engines 2, 4, 6 & 8
Landing gear normal control; left forward and right aft main
Landing gear safety switch relay No. 1
Tip gears normal control
Missile system (AGM-28)
- Armament control No. 1
- Emergency shutoff No. 1
- Fuel control No. 1
- Lock control A
- Missile jettison A
- Separation A
- Temperature control No. 1

AFT BATTERY

AFT SWITCHED BATTERY BUS
- Alternator circuit breaker indicator lights, engines No. 3 and 5 or forward alternators
- Alternator control: engines No. 3 and 5, or left and right forward alternators; exciter control B-52F, turbine control B-52E; alternator circuit breakers; alternator switches B-52E; bus tie circuit breakers
- Antiskid: left and right aft main landing gear
- Automatic paralleling

Bomb door forward and aft normal control valves and relays

Cartridge start, engine 8 QN

External power trip

Engine starter valves, engines 7 & 8
Firewall fuel shutoff valves 5, 6, 7 & 8
Fuel crossfeed valve No. 9
Fuel feed valves 14 & 16

Hydraulic pack control for packs 2, 3, 7, 8 & 9
Ignition for engines 1, 3, 5 & 7
Landing gear normal control: right forward & left aft main
Landing gear safety switch relay No. 2
Tip gears emergency control
Missile system (AGM-28)
- Armament control No. 2
- Emergency shutoff No. 2
- Fuel control No. 2
- Lock control B
- Missile jettison B
- Separation B
- Temperature Control No. 2

CONTINUED

Figure 3-15. (Sheet 5 of 6).

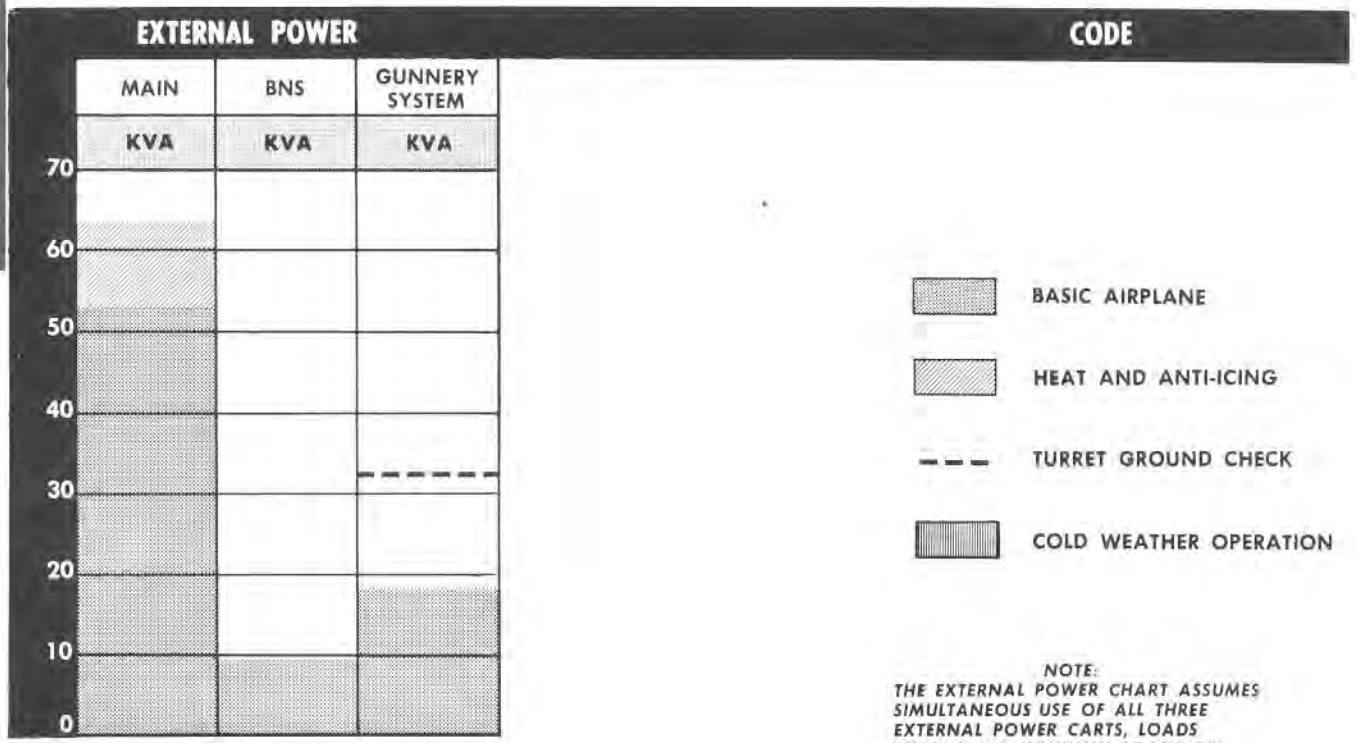
BATTERY SYSTEM LOADS (CONT)

FORWARD BATTERY	AFT BATTERY
FORWARD BATTERY BUS Aft emergency alarm lights Bomb salvo Entry lights ADM-20 fire warning **KS Less RL** ADM-20 jettison **KS** Left aft and right forward main landing gear emergency control	**AFT BATTERY BUS** Aft emergency alarm lights Right aft and left forward main landing gear emergency control
EMERGENCY BUSES Airbrake control Emergency alarm system Fuselage fire warning system Interphone power Landing gear position indicators Pilot's emergency flight instrument lights Pilot's pitot tube heater **Less PP** Pilot's turn-and-slip indicators	**EMERGENCY BUSES** (No aft battery loads. Emergency instrument bus and emergency battery bus are energized by forward battery)

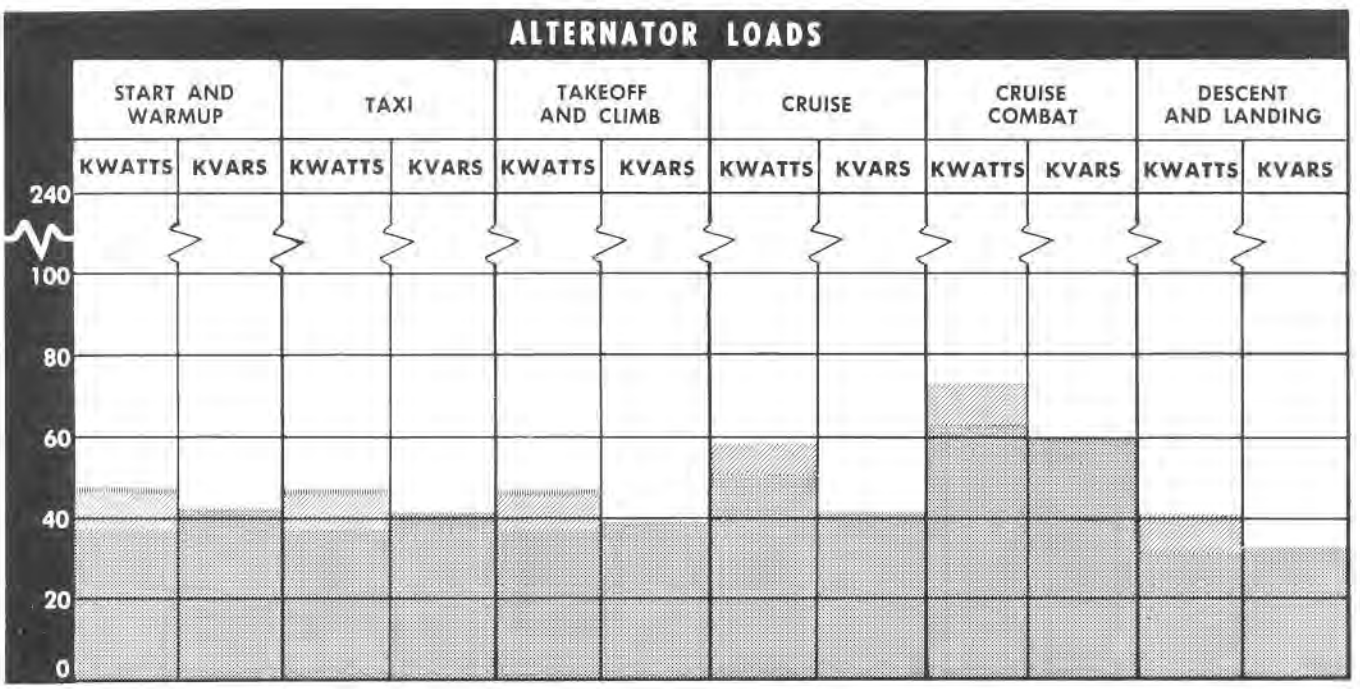
2. D-C loads available with battery switch ON and emergency battery switch EMERG

FORWARD SWITCHED BATTERY BUS (Same loads as with emergency battery switch NORMAL)	**AFT SWITCHED BATTERY BUS** (Same loads as with emergency battery switch NORMAL)
FORWARD BATTERY BUS (Same loads as with emergency battery switch NORMAL)	**AFT BATTERY BUS** (Same loads as with emergency battery switch NORMAL)
EMERGENCY BUSES (No forward battery loads. Emergency instrument bus and emergency battery bus are energized by aft battery)	**EMERGENCY BUSES** Airbrake control Emergency alarm system Fuselage fire warning system Interphone power Landing gear position indicators Pilot's emergency flight instrument lights. Pilot's pitot tube heater **Less PP** Pilot's turn-and-slip indicators

Figure 3-15. (Sheet 6 of 6).



Less NF



NOTE: THESE ARE THE MAXIMUM LOADS OF SIGNIFICANT DURATION LIKELY TO BE ENCOUNTERED

Figure 3-16 (Sheet 1 of 9).

D-C POWER SYSTEM FAILURE

Transformer - Rectifier Unit Failure

The forward and aft TR busses are not interconnected. Four of the forward TR units and two of the aft TR units are sufficient to carry the respective TR bus loads.

If a TR unit fails, proceed as follows:

1. Monitor the remaining TR units on that bus with the loadmeter.

2. If the loadmeter indicates a load over 1.0 for any TR unit, reduce the TR load on the affected bus until all TR units indicate a load of 1.0 or less.

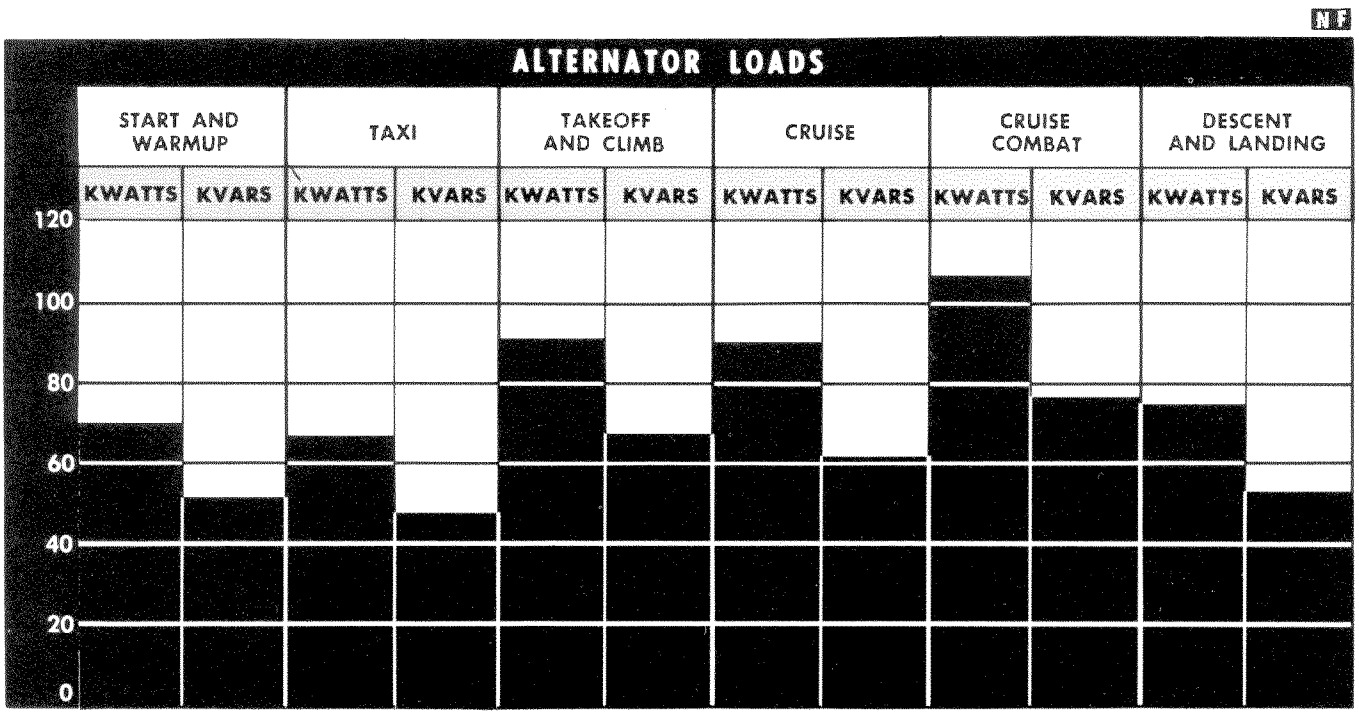
CAUTION

Failure to monitor and adjust the TR loads may result in progressive overload and failure of each remaining TR unit which may result in the loss of d-c power from the affected TR bus.

Complete Failure of Aft TR Units

WARNING

Complete loss of the aft TR units will result in an emergency situation for the gunner because of lack of control of the aft air conditioning pack and cabin temperature control. The gunner will notify the pilot of the emergency and emergency inflight movement to the forward compartment will be initiated. (Cabin pressure will have to be released by means of the emergency cabin pressure release handle since there is no d-c control power available.)



NOTE: THESE ARE THE MAXIMUM LOADS OF SIGNIFICANT DURATION LIKELY TO BE ENCOUNTERED

electrical loads chart

Figure 3-16. (Sheet 2 of 9).

A-C LOADS

REQUIREMENTS PER UNIT

EQUIPMENT	NO. OF UNITS	KWATTS			KVARS			TOTAL		ALTERNATOR BUS			
		ØA	ØB	ØC	ØA	ØB	ØC	KWATTS	KVARS	L. AFT OR NO. 1	L. FWD OR NO. 3	R. FWD OR NO. 5	R. AFT OR NO. 7
ARMAMENT													
Fire Control (A3A or MD-5 or MD-9)	1	2.71	2.71	2.71	2.04	2.04	2.04	8.14	6.13	X			
Momentary (A3A or MD-9)		6.70	6.70	6.70	4.88	4.88	4.88	20.10	14.65	X			
AIR CONDITIONING SYSTEM (FWD)													
Bleed and Shutoff Valves	5			0.03			0.02	1.5	1.0			X	
Modulation Valve	1	0.03	0.03	0.03	0.02	0.02	0.02	0.09	0.06			X	
AIR CONDITIONING SYSTEM (AFT)													
Bleed and Shutoff Valves	4			0.03			0.02	0.03	0.02	X			
Modulation Valve	1	0.03	0.03	0.03	0.02	0.02	0.02	0.09	0.06	X			
ECM													
AN/APR-9	1		0.42			0.20		0.42	0.20				X
AN/APR-14	1		0.21			0.10		0.21	0.10				X
AN/ALT-6B, Sys 2 and 3	2	0.80		0.80	0.39		0.39	1.58	0.77				X
AN/ALT-6B (AN/ALR-18) Sys 15	1	1.06			0.68			1.06	0.68		X		
AN/ALT-6B (AN/ALR-18) Sys 16	1	1.06			0.68			1.06	0.68				X
AN/ALT-13, Sys 7 and 8	2	1.77	1.77	1.77	0.57	0.57	0.57	5.32	1.73		X		
AN/ALT-13, Sys 5 and 6	2	1.77	1.77	1.77	0.57	0.57	0.57	5.32	1.73	X			
AN/ALT-15 (Lo), Sys 1	1	0.76	0.76	0.76	0.25	0.25	0.25	2.29	0.75				X
AN/ALT-15 (Hi), Sys 13 and 14	2	1.64	1.64	1.64	0.54	0.54	0.54	4.92	1.62		X		
AN/ALT-16, Sys 11 and 12	2	0.98	0.98	0.98	0.32	0.32	0.32	2.95	0.97		X		
Chaff Dispenser, Sys 1, 2, 3, and 4	4	0.09	0.09	0.09	0.20	0.20	0.20	0.28	0.61	X			
Chaff Dispenser, Sys 5, 6, 7, and 8	4	0.09	0.09	0.09	0.20	0.20	0.20	0.28	0.61		X		
Flare Ejector	1			0.23			0.11	0.23	0.11				X
ENGINE INSTRUMENTS													
Engine Pressure Ratio	8	0.07			0.06			0.07	0.06			X	
FLIGHT CONTROLS													
Aileron Trim	2			0.32			0.16	0.32	0.16			X	
Autopilot	1	0.51				0.27		0.51	0.27			X	
Flaps (L and R)	1	5.23	5.23	5.23	1.70	1.70	1.70	15.69	5.10			L	R
Stabilizer Trim	1	0.95	0.95	0.95	0.84	0.84	0.84	2.85	2.52	X			
Yaw Damper	1		0.14			0.07		0.14	0.07			X	
FLIGHT INSTRUMENTS													
Flight Gyro (Pilot)	1	0.02	0.02	0.02	0.01	0.01	0.01	0.06	0.04			X	
Flight Gyro (Copilot)	1	0.03	0.03	0.03	0.02	0.02	0.02	0.09	0.06				X
N-1 Compass	1	0.03	0.03	0.03	0.03	0.03	0.03	0.09	0.09			X	
True Airspeed	1			0.08			0.04	0.08	0.04			X	

NOTE

- Total alternator loads cannot be determined from the chart since the loads are single- and three-phase loads. In the event an alternator becomes overloaded, the chart will help the crew to determine the loads to drop for completion of the mission.
- Fuel boost pumps No. 3, 6, 11, and 14 are controlled by the fuel boost pump shutoff switch located on the upper center portion of the fuel panel. See "Boost Pump Shutoff Switch," Section I, for description of the switch. ND

Figure 3-16. (Sheet 3 of 9).

A-C LOADS

REQUIREMENTS PER UNIT

EQUIPMENT	NO. OF UNITS	KWATTS			KVARS			TOTAL		ALTERNATOR BUS			
		ØA	ØB	ØC	ØA	ØB	ØC	KWATTS	KVARS	L. AFT OR NO. 1	L. FWD OR NO. 3	R. FWD OR NO. 5	R. AFT OR NO. 7
FUEL													
Fuel Boost Pumps (Main)	12	0.36	0.36	0.36	0.54	0.54	0.54	1.09	1.63				
● Wing Tank No. 1, Pump No. 3												X	
● Wing Tank No. 1, Pump No. 4		EACH INDIVIDUAL BOOST PUMP HAS THE SAME THREE-PHASE POWER AND LOAD REQUIREMENT											X
● Wing Tank No. 1, Pump No. 5										X			
● Wing Tank No. 2, Pumps No. 6 and 8												X	
● Wing Tank No. 2, Pump No. 7													X
● Wing Tank No. 3, Pump No. 9													X
● Wing Tank No. 3, Pump No. 10												X	
● Wing Tank No. 3, Pump No. 11											X		
● Wing Tank No. 4, Pump No. 12													X
● Wing Tank No. 4, Pump No. 13												X	
● Wing Tank No. 4, Pump No. 14											X		
FUEL TRANSFER PUMPS	17	0.18	0.18	0.18	0.21	0.21	0.21	0.55	0.64				
● Aft Body Tank, Pump No. 27													X
● Aft Body Tank, Pump No. 28		EACH INDIVIDUAL TRANSFER PUMP HAS THE SAME THREE-PHASE POWER AND LOAD REQUIREMENT								X			
● Center Wing Tank, Pumps No. 29 and 30												X	
● Center Wing Tank, Pump No. 31													X
● Forward Body Tank, Pumps No. 19 and 21												X	
● Forward Body Tank, Pump No. 20													X
● Forward Body Tank, Pump No. 22										X			
● Left Outboard Wing Tank, Pump No. 1												X	
● Left Outboard Wing Tank, Pump No. 2													X
● Mid Body Tanks, Pumps No. 23 and 25										X			
● Mid Body Tanks, Pumps No. 24 and 26													X
● Right Outboard Wing Tank, Pump No. 15												X	
● Right Outboard Wing Tank, Pump No. 16											X		

electrical loads chart

Figure 3-16. (Sheet 4 of 9).

A-C LOADS

REQUIREMENTS PER UNIT

EQUIPMENT	NO. OF UNITS	KWATTS			KVARS			TOTAL		ALTERNATOR BUS			
		ØA	ØB	ØC	ØA	ØB	ØC	KWATTS	KVARS	L. AFT OR NO. 1	L. FWD OR NO. 3	R. FWD OR NO. 5	R. AFT OR NO. 7
Fuel Drop Tank Release				★								X	
Fuel Flow Indicators				★								X	
Fuel Scavenge Pump				0.13			0.12	0.13	0.12			X	
Fuel Quantity Indicators	13			0.01			0.01	0.01	0.01			X	
Fuel Quantity Totalizer	1			0.02			0.01	0.02	0.01			X	
Water Injection B-52F	4	2.90	2.90	2.90	1.87	1.87	1.87	8.72	5.63				
● Pump No. 1												X	
● Pump No. 2										X			
● Pump No. 3													X
● Pump No. 4											X		
HEAT AND ANTI-ICE													
Anti-Ice, Nacelles No. 1 and 2 B-52E	4 Valves	0.3	0.3	0.3	0.2	0.2	0.2	0.9	0.8			X	
Anti-Ice, Nacelles No. 3 and 4 B-52E	4 Valves	0.3	0.3	0.3	0.2	0.2	0.2	0.9	0.8		X		
Battery Heat (AGM-28)	1	0.26			0.12			0.26	0.12				X
Escape Hatch (Aft)	2			0.14			0.03	0.14	0.03				X
Escape Hatch (Fwd)	2			0.13			0.03	0.13	0.03				X
Forward Window Heat Control	5			0.02			0.01	0.02	0.01				X
Forward Window Heat													
● No. 1	1			2.59			0.64	2.59	0.64				X
● No. 2	2		2.74			0.68		2.74	0.68				X
● No. 3	2	0.57			0.14			0.57	0.14				X
● No. 4	2		1.35			0.33		1.35	0.33				X
● No. 5	2		0.27			0.07		0.27	0.07				X
● No. 7	1		0.17			0.17		0.17	0.17				X
Hydraulic Pack Heaters													
No. 1, 2, 5, and 6	4	No. 1	No. 1, No. 5	No. 6				0.25				X	
● No. 3 and 4	2		No. 3	No. 4				0.25					X
● No. 7 and 8	2		No. 7	No. 3				0.25			X		
● No. 9 and 10	2	No. 10		No. 9				0.25		X			
Observer Heat	3	0.10						0.10					X
Pitot Heat PP	2							0.29				P	CP
Q-Spring Scoop Anti-Ice	1		0.27					0.27		X			
Stabilizer Trim Heat	2		0.20					0.20		X			
Tail Window Defog	1	1.0			0.29			1.0	0.29	X			
HYDRAULIC PUMPS	10	0.64	0.64	0.64	0.48	0.48	0.48	1.94	1.45				
● No. 1		EACH INDIVIDUAL PUMP HAS THREE-PHASE POWER AND LOAD REQUIREMENT											X
● No. 2, 5, and 6												X	
● No. 3, 4, 9, and 10										X			
● No. 7 and 8											X		

★ Insignificant Loads

Figure 3-16. (Sheet 5 of 9).

A-C LOADS

REQUIREMENTS PER UNIT

EQUIPMENT	NO. OF UNITS	KWATTS			KVARS			TOTAL		ALTERNATOR BUS			
		ØA	ØB	ØC	ØA	ØB	ØC	KWATTS	KVARS	L. AFT OR NO. 1	L. FWD OR NO. 3	R. FWD OR NO. 5	R. AFT OR NO. 7
LIGHTING (EXTERIOR)													
• Air Refueling												X	
• Anticollision	3	0.09						0.09					X
• Crosswind Landing	1	0.70						0.70				X	
• Landing	2	(LH) 0.35	(RH) 0.35					0.70				X	
• Navigational (Wing)	4			0.17				0.17				X	
• Taxi (Crosswind)	1			0.29				0.29				X	
• Taxi (Wing)				0.17				0.17				X	
• Terrain Clearance	1		0.70			0.18		0.70	0.18			X	
LIGHTING (INTERIOR)		3.87			1.89								
Cabin												X	
• Aisle and Ladder		EACH INDIVIDUAL LIGHT HAS SINGLE-PHASE POWER AND LOAD REQUIREMENT (INCLUDES 28-VOLT AC)										X	
• Dome												X	
• Flood												X	
• Instrument (except Pilots' Flight and Side Panel)												X	
• Instrument (Essential Emergency, Pilot's)													X
• Panel												X	
• Panel (EWO)													X
• Periscopic Sextant												X	
• Scan Receptacle												X	
• Spot												X	
• Table												X	
• Thunderstorm												X	
• Walkway												X	
• Work												X	
Gunner's Lights													
• Dome										X			
• Instrument										X			
• Panel										X			
• Signal Light Receptacle										X			
• Spot										X			
MISCELLANEOUS													
Alternator Ground Blowers B-52E	4	0.69	0.69	0.69	0.61	0.61	0.61	2.07	1.83			FWD	AFT
BNS Ground Blowers	2	0.47	0.47	0.47	0.29	0.29	0.29	1.47	0.91			X	
Hot Cup	2	0.68						0.68		AFT		FWD	
Hydraulic Pressure Indicators			*									X	
Food Warming Oven RD		0.59										X	
IFC Lighting Transformer	2	*										X	
Seat Position (P-CP-N-RN)			*									X	
Seat Position (EW)			*										X

* Insignificant Load

electrical loads chart

Figure 3-16 (Sheet 6 of 9).

A-C LOADS

REQUIREMENTS PER UNIT

EQUIPMENT	NO. OF UNITS	KWATTS			KVARS			TOTAL		ALTERNATOR BUS			
		ØA	ØB	ØC	ØA	ØB	ØC	KWATTS	KVARS	L. AFT OR NO. 1	L. FWD OR NO. 3	R. FWD OR NO. 5	R. AFT OR NO. 7
Section 49 Pressure Indicator (Pilots)			*									X	
Manifold Pressure Indicator		*										X	
Oil Pressure Indicator		*										X	
Oil Cooler Flaps B-52E		0.01			0.01			0.01	0.01			X	
Manifold Bleed Valves, Wing and Body				*								X	
MISSILE SYSTEMS													
ADM-20 (Momentary) B-52E	4	0.67	0.67	0.67	0.34	0.34	0.34	2.01	1.02			X	
AGM-28	2	1.01	1.01	1.01	0.37	0.37	0.37	3.04	1.11			X	
PHOTOGRAPHIC													
Camera Door			0.13			0.11		0.13	0.11			X	
POWER (DC)													
TR Units (Aft)	3												
Expected Maximum		0.70	0.70	0.70	0.26	0.26	0.26	2.4	0.80	X			
With Full Load		1.0	1.0	1.0	0.33	0.33	0.33	3.0	0.99				
TR Units (Fwd)	5												
Expected Maximum		0.60	0.60	0.60	0.26	0.26	0.26	1.81	0.80	No. 3	No. 2	No. 1	No. 4 & 5
With Full Load		1.0	1.0	1.0	0.33	0.33	0.33	3.0	0.99				
RADIO													
Direction Finder Heater (AN/ARA-25)	1	0.22						0.22			X		
Glide Slope (AN/ARN-18 or AN/ARN-31)	1			0.13				0.13				X	
Liaison Radio (AN/ARC-65)	1			0.92			0.44	0.92	0.44	X			
TACAN (AN/ARN-21)	1		0.41			0.20		0.41	0.20			X	
RADAR													
Astrocompass	1	0.16	0.16	0.16	0.10	0.10	0.10	0.48	0.30			X	
BNS System (AN/ASB-4A)	1	3.08	3.58	3.49	1.91	2.22	2.16	10.15	6.29			X	
BNS Heaters (Equipment)		0.74	0.74	0.74				2.22				X	
BNS Pressure Kit	1			0.55			0.48	0.35	0.48			X	
Doppler (AN/APN-89A)	1	0.79	0.37	0.31	0.36	0.16	0.15	1.48	0.68				
Doppler Ground Cooling		0.47	0.47	0.47	0.29	0.29	0.29	1.41	0.87			X	
IFF (AN/APX-25)	1		0.27			0.13		0.27	0.13			X	
Monitoring Set (AN/AJM-14(V))	1			0.65				0.65				X	
Radar Altimeter (AN/APN-150) SQ	1	0.76			0.38			0.76	0.38	X			
Rendezvous Radar (AN/APN-69)	1	0.60			0.28			0.60	0.28	X			
Radar Warning (AN/APS-54) No. 1	1		0.72			0.35		0.72	0.35				X
Radar Warning (AN/APS-54) No. 2	1			0.72			0.35	0.72	0.35				X

* Insignificant Load

Figure 3-16. (Sheet 7 of 9).

FORWARD D-C LOADS

EQUIPMENT	AMPERES
AIRBRAKES, Each	4.4
ANTI-ICING SYSTEMS	
Pitot Heaters, Each **Less** PP	6.4
Relays and Valves	9.3
AUTOPILOT, Steady	23.0
Turn	46.0
BOMBING NAVIGATION SYSTEM	
Bomb Control	30.0
IFC, Momentary	120.0
Steady	24.0
Pressurizing Kit	.5
Weapons Release	2.5
Weapon Door	2.8
COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT	
AN/ASB-4A	17.9
Automatic Nav AN/APN-89	2.5
Control Pulse Generator ALA-7	.3
Glide Slope, AN/ARN-18 or -31	2.0
IFF, AN/APX-25	2.0
Interphone, AN/AIC-10	5.5
Rendezvous AN/APN-76	2.5
UHF Command Radio (Standby) AN/ARC-34	
Receive	13.0
Transmit	18.0
TACAN (AN/ARN-21)	.7
ECM EQUIPMENT	
Chaff Dispenser Control, Per Unit	3.0
ECM Receiver (AN/APR-9)	2.0
ECM Receiver (AN/APR-14)	.7
ECM Transmitter System No. 1 (AN/ALT-15)	1.1
ECM Transmitter System No. 2 (AN/ALT-6B)	13.6
ECM Transmitter System No. 3 (AN/ALT-6B)	13.6
ECM Transmitter System No. 16 (AN/ALT-6B & ALR-18)	15.3
Warning Receiver (AN/APS-54)	1.8
ELECTRICAL SYSTEM	
D-C Power Relays, Each	0.3
Relays	8.0
ENGINE CONTROL	
Ignition Starts, Each	7.5
Starter Valves, Each	3.0
FACE PLATE DEFOG, Each	0.1
FLIGHT INSTRUMENTS	
Flight Gyros	1.0
N-1 Compass	1.0
True Heading Computer	1.0
Turn-and-Slip Indicator, Each	2.0
FUEL SYSTEM	
Boost Pump Relays, Each	0.3
Shutoff Valves	7.7
Air Refueling	5.0
LANDING GEAR	6.0
LIGHTING	
Navigation	10.0
Cabin	1.0
MISSILE SYSTEM (ADM-20) Each	4.4
MISSILE SYSTEM (AGM-28) Each	3.6
PHOTOGRAPHIC SYSTEM	
Camera	10.0
WINDSHIELD WIPER, Each	6.0

electrical loads chart

Figure 3-16 (Sheet 8 of 9).

AFT D-C LOADS

EQUIPMENT	AMPERES
ARMAMENT	
Fire Control System	73.2
COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT	
Antenna Coupling (AN/ARC-65)	2.0
Directional Finder (AN/ARA-25 ADF)	1.3
Interphone (AN/AIC-10A)	.2
Liaison Radio (AN/ARC-65), Receive	17.5
Transmit	21.5
Marker Receiver (AN/ARN-32)	1.5
Omni-Range (AN/ARN-14)	6.0
Rendezvous Beacon (AN/APN-69)	1.0
TACAN (AN/ARN-21)	4.0
UHF Command Radio (AN/ARC-34) Receive	13.5
Transmit	18.0
ECM EQUIPMENT	
Chaff Dispenser	15.0
ECM System No. 5 (AN/ALT-13)	1.8
ECM System No. 6 (AN/ALT-13)	1.8
ECM System No. 7 (AN/ALT-13)	1.8
ECM System No. 8 (AN/ALT-13)	1.8
ECM System No. 11 (AN/ALT-16)	12.1
ECM System No. 12 (AN/ALT-16)	12.1
ECM System No. 13 (AN/ALT-15 Hi)	1.1
ECM System No. 14 (AN/ALT-15 Hi)	1.1
ECM System No. 15 (AN/ALT-6B) (AN/ALR-18)	15.3
INSTRUMENTS	
Cabin Pressure Warning	1.0
Cabin Depress, Request	.2
Radar Altimeter SQ	2.5
HEATING	
Face Plate Defog	.1
Water Separation Bypass	2.0

NOTE

TR units are rated at 100 amperes each. A reading of 1.0 on the loadmeter corresponds to 100 amperes on the respective TR unit.

electrical loads chart

Figure 3-16 (Sheet 9 of 9).

ALTERNATOR MALFUNCTION CHECKLIST

NOTE

- This procedure is to be used if any alternator has or is suspected of having a malfunction. In addition, it should be used for individual check of the alternators.

- The intent of this checklist is to maintain electrical power to the equipment of a malfunctioning alternator. See "Alternator Emergency Operation," figure 3-15, this section, for various types of malfunctions and possible corrective action to be taken by the crew.

- Less NF If a single alternator fails, load transfer contactors are designed to automatically switch the loads to another alternator. Since service experience has shown the load transfer contactors may not be dependable, the following checklist should be used in the event of an alternator malfunction.

CAUTION

NF In the event an alternator has a malfunction which cannot be corrected, under no circumstances open its bus tie circuit breaker.

NOTE

Check air bleed manifold pressure gages for insufficient bleed air before performing this checklist.

1. Check Bus Tie Circuit Breakers Closed - CLOSED, light out (CP)

   If bus tie circuit breakers are open, place bus tie circuit breaker switches to CLOSE and check their respective bus tie circuit breaker light out. If a bus tie circuit breaker fails to close, immediately shut down the alternator and discontinue the remaining steps.

2. Check Alternator Circuit Breaker Open - OPEN, light on (CP)

   If alternator circuit breaker is not open, place alternator circuit breaker switch to OPEN and check alternator circuit breaker light on.

3. Check Voltage and Frequency - Checked (CP)

   If voltage and frequency is out of tolerance, adjust voltage with the voltage rheostat and, on aircraft Less ND, the frequency with the frequency rheostat. On aircraft ND, there are no means to adjust frequency.

4. Reparallel Alternator - Reparalleled (CP)

   Reparallel alternator by pressing the automatic paralleling switch and checking alternator and bus tie circuit breaker lights out.

5. Shut Down Alternator (If Fails to Parallel) - Accomplished (CP)

   Place alternator switch OFF and check alternator circuit breaker light on and all bus tie breaker lights out.

ALTERNATOR RESTART AND REPARALLELING CHECKLIST B-52E

1. Check Alternator Circuit Breaker Light On - On (CP)

   Alternator circuit breaker must be open (light on).

2. Check Alternator Bus Tie Breaker Light Out - Out (CP)

   Alternator bus tie breaker should be closed (light out).

3. Check Alternator Indicators - Checked (CP)

   Check voltage, frequency, and indicator lights for any unusual indications.

4. Close Body Manifold Interconnect Valve Switch - CLOSED (CP)

5. Retard Throttles for Engines on the Same Side as Alternator Being Restarted - Retarded (P)

   Retard throttles on same side as alternator being restarted to IDLE if above 10,000 feet; retard to point where pneumatic manifold pressure gage indicates 25 psi if below 10,000 feet. This reduces pneumatic pressure to the drive being started but avoids possible air starvation of other pneumatic packs supplied by the system.

6. Turn Alternator Switch On Momentarily - ON (CP)

7. Monitor Voltage & Frequency - Monitored (CP)

   During restart of an alternator, its voltage and frequency should be watched closely.

WARNING

If voltage cannot be held within limits, is fluctuating, or if frequency is out of limits, shut down the alternator and do not attempt a restart.

8. Reparallel Alternator - Reparalleled (CP)

   Use normal procedure to reparallel alternator.

9. Monitor Alternator Loads (kwatts and kvars) - Monitored (CP)

   Check the loads as the alternator is put on the line. If load is excessive, shut down alternator.

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ALTERNATOR RESTART AND REPARALLELING CHECKLIST B-52F

1. Alternator Circuit Breaker Light On - On (CP)

   Alternator circuit breaker should be open (light on).

2. Check Alternator Indicators - Checked (CP)

   Check voltage, frequency, and indicator lights for any unusual indications.

3. Turn Alternator Switch ON - ON (CP)

   Reexcite the field by momentarily placing the alternator switch to ON. Recheck for voltage.

4. Reparallel Alternator - Reparalleled (CP)

   Use normal procedure to reparallel alternator.

5. Monitor Alternator Loads (kwatts and kvars) - Monitored (CP)

   Monitor the load meters for proper load division between alternators.

OPERATION ON BATTERY POWER CHECKLIST

1. Check Battery Switch On - Checked (CP)

2. Extend Gear - GEAR DOWN (CP)

   If fuel, gross weight, and other conditions permit, the landing gear should be lowered as soon as it is determined that alternator power will not be available for the remainder of the flight. Landing gear extension may be delayed if a landing cannot be made immediately and fuel quantity is such that a suitable landing field could not be reached due to the increased drag; however, gear must be lowered before batteries go dead.

3. Close Crossfeed Valves - Closed (CP)

4. Check Emergency Battery Switch NORMAL - Checked (CP)

5. Check Forward Battery Voltage - Checked (CP)

   When forward battery voltage decreases to 19 (±1/2) volts, the battery is no longer usable and its emergency loads should be switched to the aft battery.

6. Pull All "Alternator Control" Circuit Breakers - Pulled (CP)

NOTE

When forward battery voltage decreases to 19 (±1/2) volts, proceed with the following steps.

7. Place Emergency Battery Switch on EMERG - Accomplished (CP)

8. Reduce Battery Loads - Reduced (P-CP)

   Turn off all unneeded switches. Pitot heat Less P-P and airbrakes should be deenergized if practicable.

9. Check Aft Battery Voltage - Checked (CP)

NOTE

When aft battery voltage decreases to 21 (±1/2) volts, the battery is practically depleted.

10. Notify Crew That Interphone and Bailout Warning Will No Longer Be Operative - Accomplished (P)

HYDRAULIC SYSTEM EMERGENCY OPERATION

HYDRAULIC SYSTEM FAILURE

If any hydraulic system fails to operate, the cause may be hydraulic fluid loss, electrical fault, an inadequate air supply to drive the turbine, or mechanical failure. All important and necessary hydraulically operated systems have an alternate source of hydraulic pressure available as described in "Hydraulic Power Supply Systems," Section I. Also see "Air Bleed System Emergency Operation," this section, for hydraulic pack failure due to an air bleed manifold leak.

FAILURE OF A UTILITY PACK TO SHUT DOWN

In the event that a utility pack fails to shut down after retraction of the main landing gear, provide adequate pack cooling by lowering a single main gear as follows:

1. Turn the faulty hydraulic pack switch to OFF AND RESET.
2. Turn the alternate hydraulic pack switch to OFF AND RESET.
3. Check that standby pump control circuit breakers are pulled.
4. Lower the opposite landing gear by using the faulty pack and emergency extend system and leave switch in EXTEND position.

CAUTION

To reduce the possibility of system damage, do not place switch to OFF or RETRACT position while the gear is in motion.

NOTE

Emergency switch must be left in EXTEND position to prevent the normal system from retracting the gear.

HYDRAULIC SYSTEM FAILURE CHECKLIST

NOTE

Failure of a hydraulic system normally will be indicated by illumination of the respective hydraulic pack pressure low light on the hydraulic control panel and the hydraulic pack pressure low master light on the forward instrument panel.

1. Check Hydraulic Pressure - Checked (P)

   a. If Pressure Low - OFF & RESET (P)

   b. If Pressure Normal - Bleed down (standby pumps OFF) (P)

      If hydraulic pressure builds up rapidly, warning system has malfunctioned.

2. Check Hydraulic Pack & Standby Pump Circuit Breakers - Set (P)

   Hydraulic package control circuit breakers supply power to the hydraulic pack switches.

CAUTION

A restart may be attempted as outlined in the following steps. If no indication of proper pressure output is obtained within 20 seconds, the switch for that pack will immediately be moved to OFF & RESET. Additional starts will not be attempted unless a critical need for hydraulic power exists. In no case will the switch be left in ON for longer than 20 seconds if the pack is not producing pressure.

3. Turn Hydraulic Pack Switch On - ON (P)

   Packs 5 through 10 require selection of ST position momentarily, not to exceed 6 seconds, before placing in ON position.

4. Check Hydraulic Pressure & Light - Checked for buildup (P)

   a. If Hydraulic Pressure Stays Down, Turn Hydraulic Pack Switch Off - OFF & RESET (P)

HYDRAULIC SYSTEM FAILURE CHECKLIST (Cont)

5. Check Hydraulic System - Check for air bleed leak if hydraulic pack 5, 6, 7, or 8 fails (P-CP)

   See "Hydraulic Pack Failure Due to Air Bleed Manifold Leak" under "Air Bleed Emergency Operation," this section.

6. Turn Standby Pumps Switch On - ON (P)

   Move the respective group standby pumps switch to ON; the pressure will rise slowly (30 seconds approximately). The standby pumps switch will not operate the standby pumps for systems 1, 2, 3, and 4 with the gear handle in the up position and the gear up and locked.

CAUTION

After once using a standby pump, no more than one effort should be made to restart the pack, since damage to the pack will result if fluid level is below pump inlet.

NOTE

The standby pumps are capable of operating continuously at pressures up to 3000 psi. Therefore, there is no time limit on operation of the standby pumps except when the landing gear is extended with the emergency switches and the switches are left in EXTEND. In this case, the system pressure is determined by the setting of the relief valve and the standby pump pressure switch control is bypassed, causing the standby pump to operate in an overload condition. See "Landing Gear System Emergency Operation," this section.

a. If Hydraulic Pressure Still Down, Pull Normal Standby Pump Circuit Breaker - Pulled (P)

   If the pressure is not increased by the standby pump, it is possible that a tubing break exists and the fluid is depleted. Check that the respective standby pump circuit breaker is pulled out.

CAUTION

Do not actuate the emergency switch for the affected gear if standby pressure for that gear does not build up. With a ruptured main hydraulic system, actuation of the emergency switch may deplete the alternate hydraulic system, seriously decreasing or eliminating crosswind crab, steering, braking, and air refueling capabilities.

b. If Hydraulic Pressure Rises, Turn Standby Pumps Off - OFF (until needed for approach and landing) (P)

NOTE

Since the fluid level supply for the standby pump is below that which the main pump can use, the standby pump switches are normally left off until needed in order to utilize this protective feature of a reserve supply. If hydraulic failure occurs during flight, save this reserve supply for the approach and landing.

7. Turn Standby Pumps Off - OFF (P)

NOTE

For malfunctions involving lateral control, see "Asymmetrical Airbrake Control," this section.

AIR BLEED SYSTEM EMERGENCY OPERATION

WARNING

If an air bleed manifold leak is suspected or confirmed, land as soon as possible.

ONE ENGINE INOPERATIVE

With any one engine inoperative in a nacelle on either side of the airplane, systems that normally receive bleed air from this engine are supplied by the other engine in that nacelle.

TWO INBOARD ENGINES INOPERATIVE

With two inboard engines on the same nacelle inoperative on either side of the airplane, systems that are normally supplied bleed air from these engines can best be supplied by opening the body manifold valve.

TWO OUTBOARD ENGINES INOPERATIVE

With two outboard engines in one nacelle inoperative on either side of the airplane, systems that are normally supplied bleed air from these engines can be supplied by opening the wing manifold interconnect valve on the side of the failed engines. This is accomplished by placing the wing air bleed manifold interconnect switch on the failed side in OPEN position.

FOUR ENGINES INOPERATIVE ON ONE SIDE

With four engines on either side of the airplane inoperative, systems that are normally supplied bleed air from these engines can be supplied by opening interconnect valves. This is accomplished by placing both the body manifold interconnect switch and the two wing manifold interconnect switches in OPEN position.

CAUTION

Do not open the body and wing manifold interconnect valves if an air bleed system leak is suspected.

AIR BLEED MANIFOLD LEAK

A pneumatic leak can cause different symptoms in the cockpit depending upon its size and location.

WARNING

When an air bleed manifold leak is suspected or confirmed, the aircrew should consider all factors involved with the emergency and plan to land as soon as possible at the nearest suitable airbase. A failed pneumatic duct should be regarded as critical impending disaster and the pilot should not prolong the flight unnecessarily in the interest of reducing weight or establishing contact with his home base.

Air Conditioning Failure Due to Air Bleed Manifold Leak

If a bleed air manifold leak is suspected as the cause of loss or reduction of cabin air conditioning airflow, place the bleed air selector switch to the opposite position (ALTERNATE or NORMAL). If the opposite position does not result in restored cabin airflow, place the air conditioning master switch to RAM. RAM position closes the air bleed body manifold interconnect valves when the body manifold interconnect valve switch is in the guarded CLOSED position, closes the air conditioning system shutoff valve, and opens the ram air valve. Ram air will then be available for electronic equipment cooling when use of that equipment is necessary to arrive at the nearest suitable air base and to effect a safe landing.

Hydraulic Pack Failure Due to Air Bleed Manifold Leak

A pneumatic leak of sufficient size in any one of the wing manifolds will cause failure of the corresponding hydraulic pack. When either 5, 6, 7, or 8 pack is lost, the following procedure is recommended:

1. Complete the "Hydraulic System Failure Checklist" through item "5," and then continue as follows:
2. Check for slight loss in EPR on appropriate pod relative to other engines.
3. Move throttles of adjacent wing pod; i.e., 7 pack failed - engines 7 and 8 toward IDLE while observing appropriate body manifold pressure gage. If pressure gage drops steadily along with retardation of throttles, an air bleed leak definitely exists in the manifold of the failed hydraulic pack.
4. If pressure continues to drop, use shutdown procedure on both engines of affected pod (assuming six-engine operation is feasible).

CAUTION

Do not open air bleed interconnect valves to affected manifold as this will cause additional loss of air bleed pressure.

5. Route fuel as desired.

NOTE

Until a more complete method is devised for determining the presence of a pneumatic system leak, maintain the pneumatic system interconnect valves in the CLOSED position at all times during flight unless extreme emergencies determine otherwise.

6. If no air bleed leak is evident, complete remainder of "Hydraulic System Failure Checklist."

Engine Instrument Failure Due to Air Bleed Manifold Leak

WARNING

Intermittent or continuous operation of the engine fire warning lights or erratic operation and loss of engine instruments may be an indication of an air bleed system leak resulting in scorching or burning of electric wire bundles. Upon such an indication, shut down the engines in the affected pod. After engine shutdown, check that air bleed manifold valves to the affected pod are turned off to prevent bleed air from other engines entering the damaged duct.

CAUTION

Do not open the body and wing manifold interconnect valves if an air bleed system leak is suspected.

WHEEL BRAKE EMERGENCY OPERATION

If loss of braking occurs or is suspected while taxiing, accomplish the following:

1. Turn antiskid switch OFF.

NOTE

When the antiskid switch is OFF, braking action depends entirely on the pressure applied to the brake pedals.

2. Check hydraulic pressure and that landing gear standby pump is ON. If hydraulic pressure is low on packs 1 and 2, momentarily place both 1 and 2 hydraulic pack switches to OFF & RESET then back to ON. If adequate braking is not available, continue with the following steps.
3. Shut down all engines except 3, 4, 5, and 6.
4. Steer to avoid collision.

NOTE

If it is necessary to taxi off prepared surfaces to avoid collision or if collision is imminent, engines 3, 4, 5, and 6 should not be shut down until the best ground course has been selected due to the engine bleed air required to provide steering.

The above procedure is based on a minimum reaction time after brake failure occurs. Provided sufficient time is available and there are no requirements for electrical power (lighting, communications, etc), the total idle thrust may be further reduced by shutting down engines 3 and 6 after reducing bleed air requirements. In this instance, the procedure above could be modified beginning with step "4" above as follows:

5. Hydraulic packs 5 through 10 OFF.
6. Air inlet, engine, and nacelle anti-icing OFF.
7. All alternator switches OFF [3-52E].
8. Shut down engines 3 and 6.
9. Steer to avoid collision.

NOTE

If it is necessary to taxi off prepared surfaces to avoid collision or if collision is imminent, engines 4 and 5 should not be shut down until the best ground course is selected because engine bleed air is required to provide steering.

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FLIGHT CONTROL SYSTEM EMERGENCY OPERATION

NOTE

The following correctional procedures apply to recovery from unusual pitch attitudes (Section VI).

AILERON TRIM MALFUNCTION

Unscheduled operation of the aileron trim system due to an electrical control circuit malfunction can be stopped by actuation of the guarded aileron trim cutout switch on the forward end of the aisle stand. If at any time it is observed that both aileron trim tabs are traveling in the same direction, trim actuation must be stopped immediately and not be attempted for the remainder of the flight. Continued operation of the system will cause the actuator on the malfunctioning side to drive into its limit and become completely inoperable in that position. Under this condition of extreme tab travel, the amount of spoiler deflection required to maintain lateral trim will result in some range loss due to the added drag. An aileron trim malfunction of this type can be detected by observing both left and right aileron trim position indicators when actuating the aileron trim switch.

STABILIZER TRIM MALFUNCTION

Unscheduled stabilizer trim operation in flight can cause severe attitude changes if immediate corrective action is not taken. The time required for the stabilizer to travel beyond the limit of elevator control capability is approximately 5 seconds under most conditions. However, at maximum indicated airspeeds, the time may be as short as 2 seconds; therefore, it is essential that immediate corrective action be taken by the pilots when an unscheduled or runaway trim condition arises in flight. In most cases of runaway stabilizer trim, one of the following has occurred to give the pilots the idea that the stabilizer trim was running away:

1. A malfunction of the autopilot, causing the trim to move.
2. One of the pilots' trim buttons stuck in NOSE UP or NOSE DN position.
3. The airplane has been thrown out of trim by the use of flaps and/or airbrakes. For complete information on flaps and airbrakes, see "Flight Controls," Section VI.
4. One of the pilots actuating the trim button, causing the other pilot to believe that the trim was malfunctioning.

Any of the above situations can cause the pilots to take emergency actions resulting in a dangerous flight condition; therefore, the "Runaway or Unscheduled Stabilizer Trim Checklist" should be used whenever stabilizer trim malfunction is suspected.

Stabilizer Trim System Force Switches

NM

To provide the pilots with a means of instantly terminating unscheduled stabilizer trim, a pitch attitude control force switch assembly is installed in the control column linkage. The pilot's trained reaction with the control column in counteracting undesired airplane pitch attitude variation operates to cut out any opposing electrical stabilizer trim (figure 1-33).

NM

FORCE SWITCH OPERATION. Application of a forward load of more than the preset value (24 to 36 pounds) on a spring in the force switch assembly compresses the spring to interrupt the stabilizer nose up trim circuit. When this same preset value is exceeded in the aft direction, the spring is also compressed and the nose down trim circuit is interrupted. The autopilot, if engaged, will disengage upon actuation of the force switches in either direction. Since the electrical circuit opposite the fault side continues to be operative, unless deactivated by the trim circuit cutout switch or circuit breakers, electrically controlled trim opposing the unscheduled trim movement is available through actuation of the trim button. Normally, trim cutout switch actuation should be delayed until the opposing force on the control column is reduced to the preset value by corrective trimming because an out of trim condition can be corrected more rapidly by using electrical trim. It should be noted that as soon as the control column force is reduced to this point, the force switches will close and allow an unscheduled trim to be reactivated. To prevent continuation of the unscheduled stabilizer trim operation and to permit manual trimming for the remainder of the flight, the trim cutout switch should then be placed in the CUTOUT position in sequence with the other corrective action measures noted in the following "Runaway or Unscheduled Stabilizer Trim Checklist."

RUNAWAY OR UNSCHEDULED STABILIZER TRIM CHECKLIST

NOTE

For complete information on nose high and dive recoveries, see "Recovery from Unusual Maneuvers," Section VI.

1. OPERATE AUTOPILOT RELEASE BUTTON, CONTROL COLUMN & TRIM BUTTON Less NM (P-CP)

As soon as an unscheduled trim indication is noted, both pilots will depress the autopilot release button; at the same time, the pilot not flying the airplane will turn the autopilot master switch OFF. The pilot flying the airplane will apply immediate control column movement and move the stabilizer trim button in the opposite direction to the nose up or nose down condition. He should monitor the manual trim wheel to make sure the trim is actuating in the proper direction.

1. OPERATE CONTROL COLUMN & TRIM BUTTON NM (P-CP)

As soon as an unscheduled trim indication is noted, the pilot flying the airplane will immediately apply control column movement and stabilizer trim in the direction opposite that of the unscheduled trim being induced and monitor the manual trim wheel to make sure the trim is actuating in the proper direction. At the same time, the pilot not flying the airplane turns the autopilot master switch OFF.

2. OPERATE AIRBRAKES (P)

The pilot will apply airbrakes to correct for a nose down condition and lower the airbrakes, if they are up, for a nose up condition.

WARNING

Incorrect actuation of the airbrakes during recovery from a runaway or unscheduled trim condition will aggravate an already dangerous situation. Caution should be exercised not to retract extended airbrakes during a nose down trim condition and, conversely, airbrakes should not be extended during a nose up trim condition.

3. CUT OUT STABILIZER TRIM (P/CP)

If electrical trim cannot be obtained or continued in the desired direction, the stabilizer trim switch will be actuated to CUTOUT.

WARNING

Do not use the stabilizer trim cutout switch until positive that the attitude change is due to runaway trim.

4. MANUALLY TRIM (P/CP)

The pilot utilizes the manual trim wheel to reposition the stabilizer. If the application of opposing trim and the actuation of the cutout switch plus the autopilot disengagement fail to stop the trim runaway, the manual trim wheel must be held against rotation.

5. Extend Landing Gear for Nose Up - As required (P)

Pilot extends landing gear if additional trim compensation is required, but only if a performance penalty can be tolerated.

RUNAWAY OR UNSCHEDULED STABILIZER TRIM CHECKLIST (Cont)

6. Transfer Fuel - As required (CP)

Copilot transfers fuel, if required, to accomplish a cg shift.

NOTE

The manual trim wheel should be used to make any additional trim adjustments required during the remainder of the flight. The stabilizer trim cutout switch should be retained in CUTOUT (guard open) during this period to insure that the electrical trim circuit remains interrupted. Leaving the switch in CUTOUT will also aid ground maintenance personnel in trouble shooting.

ELEVATOR AND RUDDER CONTROL MALFUNCTION

Loss of Artificial Feel

If at any time loss of artificial feel is encountered, check the flight instruments for airplane response to control movement. Loss of feel may be interpreted as loss of control response especially in the yaw axis. The start of yaw with rudder deflection is slow and close observance of flight instruments is necessary to detect airplane response to control movement. If abnormally light elevator or rudder control forces are encountered, abrupt maneuvers should be avoided to prevent overstressing the airplane. Loss of artificial feel can occur as a result of Q-spring ram air inlet ice or loss of ram air pressure from other causes. On airplanes RG, the installation of an additional tension spring will provide partial feel in the elevator axis in event Q-spring pressure is lost. The most significant indication of loss of Q-spring pressure is loss of rudder feel. The loss of elevator feel is masked for small control column displacements by the centering spring. Therefore, in event of loss of rudder feel, it should always be suspected that the elevator feel has also been lost and caution should be exercised when applying large control column inputs.

Control Stiffness

Stiffness of elevator and rudder control may be encountered when Q-spring ram air duct blockage from ice or other foreign material has occurred, or when mechanical jamming or failure has taken place. Blockage of this duct may result in pneumatic locking of the feel system. If such a condition occurs, descend to a warmer altitude. If a landing must be made with stiff controls, accomplish the following:

1. Check airplane center of gravity location.

Forward center of gravity loadings should be avoided and a more aft cg utilized, since elevator requirements to maneuver during flare diminish as cg moves aft. In no case should a landing be made with cg outside the normal flight and ground handling limits.

2. Trim airplane carefully during approach.

During approach, the flare may require judicious use of stabilizer trim and airbrakes for a safe landing.

3. If steering control is inadequate after touchdown, place steering ratio selector lever to TAXI.

Steering in TAXI position requires cautious use of rudder pedals, especially if steering control returns to normal during the landing roll.

CAUTION

Steering in TAXI during high speeds produces excessive steering when small amounts of rudder displacement are induced which can produce critical side loads on airplane structure.

If the above procedure does not provide sufficient steering, application of spoiler control in the desired direction may produce enough landing gear bicycling effect to maintain the desired heading.

ASYMMETRICAL AIRBRAKE CONTROL

Whenever a hydraulic or mechanical malfunction occurs to a spoiler group, pulling the respective (inboard or outboard) airbrake control circuit breaker will assure symmetrical airbrake position during subsequent airbrake operation. Airbrake effect will be reduced for a selected airbrake position but the desired results can be obtained by using a higher airbrake position, if available. If airbrakes are used after a hydraulic failure has occurred and the applicable circuit breaker is not pulled, a sudden roll to the side of the operating airbrakes will occur. The character of the roll will depend upon the spoiler group or groups inoperative and the position of the airbrakes used. Although the airplane is less maneuverable, it can be flown without the assistance of one or two spoiler groups. With one or more spoiler groups inoperative, see "Landing With Spoiler Control Failure" under "Takeoff and Landing Emergencies," this section.

WING FLAP SYSTEM EMERGENCY OPERATION

WING FLAP EMERGENCY OPERATION CHECKLIST

1. Move Wing Flap Lever Off - OFF (CP)

NOTE

The wing flap lever must be OFF when operating by the emergency system to prevent subsequent actuation of the flaps by the normal system when the wing flap emergency switch is returned to OFF.

2. Retract or Extend Wing Flap Emergency Switch, then OFF - OFF (P)

Hold the selected wing flap emergency switch in the desired position. Release switch when the proper flap setting is attained.

CAUTION

Use extreme caution when operating the wing flap emergency system switches during the last 10% of a cycle. Since no limit switches are provided, operation of the flap switches after flap contact with the mechanical stops can result in damage to the motor from overheating.

WING FLAP DRIVE UNIT MALFUNCTION

Repeated failures to extend the wing flaps after prolonged flight at high altitude can be caused by frozen moisture in the flap drive overspeed brake. At low altitudes, pneumatic ducts should warm the flap drive power unit area to approximately 20° C above the OAT. Therefore, if wing flaps fail to respond to actuation by either the normal or emergency method, the following procedure should be employed:

1. If conditions permit, conduct flight at low altitude long enough for the system to warm up.
2. Repeat efforts to extend the flaps at 15-minute intervals during the warmup period.

CAUTION

Wing flap operation, either normal or emergency, shall be discontinued within 10 seconds if flaps fail to start moving. Do not use either flap motor for more than eight attempted starts in any 30-minute period.

3. If extension is not successful within 45 minutes, plan a flaps up landing.

ASYMMETRICAL WING FLAP CONDITIONS

An asymmetrical wing flap condition will be evidenced to the pilot by an unusual rolling and yawing moment. This latter effect arises from the increased drag of the flaps down wing as compared to that of the wing with flaps up. When the rolling moment is counteracted by spoiler action, the resulting yawing moment adds to that of the flaps. If only ailerons were available for roll correction, the resulting yawing moment would oppose that due to the flaps, but in most cases would not equal it. Effective countermeasures for asymmetrical wing flap conditions include the application of opposite rudder in addition to lateral control. Flap damage which could result in an asymmetrical condition is most likely to occur during extension or retraction. To successfully counteract the adverse rolling moment due to asymmetrical flaps, it is essential that corrective action be taken immediately. The possible conditions which could cause asymmetrical flaps and the results expected are as follows:

1. An outboard section could leave the airplane instantaneously with the other three sections either full or partially down. This condition can be adequately counteracted at all speeds above unstick speed by the application of full lateral control and rudder.
2. An inboard section could leave the airplane instantaneously with the other three sections either full or partially down. Experience shows that this condition can be counteracted by application of one-half to two-thirds of the lateral control.
3. If a torque tube fails between the two sections on one side, the outboard section could go to full up while the others went to full down (corrective capabilities are the same as for the first condition above) or could go to full down when the other three sections went to full up. In the latter case, full lateral control and rudder can counteract the rolling moment at speeds over 20% above unstick speed.
4. If a torque tube breaks between an inboard flap section and the power unit, both sections on one side could go up or down while the two sections on the other side went in the opposite direction. This condition will be uncontrollable unless immediate action is taken to

"chase" the free flap sections with the driven sections. Full lateral control and rudder can control a maximum of 25% asymmetry in the up position (flaps up on one side and 25% extended on the other side) and a maximum of 60% asymmetry in the down position (flaps down on one side and 40% down on the other side).

Wing Flap Movement Following Torque Tube Failure

If the flaps are less than 20% extended and a section becomes disconnected from the torque tube drive, airloads will probably carry the section to the full up position. If the break occurs when the flaps are 30% or more extended, the airloads will probably move the section to the full down position. In the range between 20% and 30% extended, airloads could move the section either up or down with the probable crossover point at 25%. An overspeed brake is provided on each section which limits its free travel to 5% per second. The flap drive moves the flap at a rate of 2.5% per second. Therefore, if a torque tube broke when the flaps were 30% extended and the flap lever was immediately moved to DN, the free section would reach full down in 14 seconds. The maximum asymmetry would occur at that time with the free section full down and the driven section 65% down.

Action To Be Taken With Asymmetrical Wing Flaps

When any unusual rolling moment is encountered during wing flap operation, action must be taken immediately. The copilot must be prepared to take the following steps while monitoring flap retraction:

1. If the flap position indicator needles become unsynchronized during either extension or retraction and the flaps are more than 25% down, move the flap lever to DN. Monitor the needles to insure that both are moving in the down direction. If one needle has stopped or is going in the up direction, reposition the flap lever to OFF or UP as required to synchronize the needles.
2. If the needles become unsynchronized and the flaps are less than 25% down, move the flap lever to UP. Monitor the needles to insure that both are moving in the up direction. If one needle has stopped or is going in the down direction, reposition the flap lever to OFF or DN as required to synchronize the needles.
3. If the wing flap indicator needles remain synchronized during extension or retraction but an airplane rolling moment is experienced, move the flap lever to OFF. Be prepared to move the lever to UP or DN if the moment becomes uncontrollable. The movement of the lever to UP or DN will normally depend on whether the rolling moment occurred during flap extension or retraction.
4. If both needles stop during extension or retraction and no rolling moment is experienced, immediately move the flap lever to OFF. Use caution in reactuating the flap lever or in using the emergency switches and be prepared to counteract any unusual rolling moment that may be encountered. Discontinue actuation if flap motion becomes jerky (as indicated by the needles) or if the needles stop or become unsynchronized.

NOTE

If time is available, the use of a chase plane to observe the wing flaps will greatly aid the pilot in determining the best corrective action to be taken. If the observation reveals that one of the flap sections is cocked, further operation of the flaps must be discontinued and a landing made with the flaps remaining in the position in which they stopped. If the observation reveals no unusual position or alignment of the flaps, the operation of the flaps can be continued under the observation of the chase plane pilot.

5. After any asymmetrical flap condition has been encountered, the flaps must be left in as near a symmetrical condition as possible and, if necessary, a flaps up landing made. See "Landing Emergencies," this section.

NOTE

When an asymmetrical flap condition exists, a check of airplane controllability should be made. See "Stall or Controllability Checks," Section VI.

LANDING GEAR SYSTEM EMERGENCY OPERATION

Failure of a landing gear to retract or extend could be caused by a malfunction of the electrical control system, loss of hydraulic pressure, or a malfunction of the retraction mechanism itself. If all the main gears fail to retract, the probable cause is failure of the centering motor or its circuits or maladjustment of left aft gear centering switches which control the centering motor circuit. A maladjustment of one or more of the other main landing gear centering switches may result in failure of the respective gears to retract.

CAUTION

If a gear is partially down and cocked, it would not contact the runway unless it was more than 60% extended, under the worst conditions (high gross weight, hard landing, etc). At 60% extension, the tire would be approximately 18 inches above the three remaining gears upon contact with the runway and cocked about 30°. When the right gear is extended to the point that it will contact the runway with any significant amount of impact, the gear will be sufficiently aligned so that it will withstand the friction forces incurred without blowing out the tire or shearing the strut. If a left gear is not down and locked but extended sufficiently to allow tire contact with the runway, drag forces resulting from wheel spinup inertia will cause the gear to accelerate toward the downlock position. This acceleration may fail the drag strut as it extends and/or shear the strut from the aircraft.

LANDING GEAR SYSTEM EMERGENCY OPERATION CHECKLIST

CAUTION

If a ruptured main gear hydraulic system is known or suspected, unnecessary loss of hydraulic fluid may be prevented as follows:
- Pull the normal gear control circuit breaker for the affected gear to deactivate the gear normal control valve before actuating the normal gear handle.
- Do not operate the emergency landing gear switch for the affected gear as it may deplete the alternate gear hydraulic system and seriously decrease or eliminate crosswind crab, steering, braking, and air refueling capabilities.

Emergency Retraction (Main Gear Only)

1. Position Landing Gear Lever to GEAR UP - Accomplished (P)

   Leave lever in GEAR UP position.

2. Turn Battery Switch ON - ON (CP)

   If battery switch is OFF and no a-c power is available when landing gear lever is placed in GEAR UP, utility hydraulic packs will not start even though battery switch is subsequently moved to ON position. It will be necessary to place battery switch ON and momentarily place hydraulic pack switches to OFF & RESET, then ON position, before packs can be started.

3. Check Crosswind Knob Centered - Centered (P)

   If landing gear appears to be centered and fails to retract, leave landing gear lever in GEAR UP position and use 5° crosswind crab control either left or right until gear retraction occurs.

4. Check Standby Pump Switches OFF - Accomplished (P)

5. Check Hydraulic System Pressure - Checked (P)

   Check hydraulic pressure on failed gear or gears. If pressure is low, use "Hydraulic System Failure Checklist." If pressure is normal, proceed as follows:

6. Position Landing Gear Lever to GEAR DOWN - Accomplished (P)

   Check for gear down indication.

7. Position Landing Gear Lever to GEAR UP - Accomplished (P)

8. Actuate Emergency Landing Gear Switch(es) to RETRACT (EWO only) - Accomplished (P)

CAUTION

To reduce the possibility of system damage, do not place switch to OFF or EXTEND position while the gear is in motion.

LANDING GEAR SYSTEM EMERGENCY OPERATION CHECKLIST (Cont)

After checking hydraulic system, actuate emergency switch(es) for failed gear. The following indicates alternate pack operation by emergency landing gear switch:

GEAR	NORMAL PACK	ALTERNATE PACK
Left Front	1	2
Right Front	2	1
Left Rear	3	4
Right Rear	4	3

NOTE

- The tip gear cannot be retracted on the emergency system.
- Limit emergency landing gear switch actuation to 10 seconds maximum if gear has failed to retract after unlocking by use of the normal system.
- When retracting any main gear by the emergency system, if gear fails to operate, first turn landing gear standby pump and hydraulic pack switches OFF and bleed the gear normal system down by operating the brakes, then repeat actuation of the emergency switch.

9. Turn Emergency Landing Gear Switch(es) OFF - OFF (P)

   As soon as landing gear is locked in up position, return emergency switch(es) to OFF.

Emergency Extension

1. Position Landing Gear Lever to GEAR DOWN - Accomplished (P)

   Leave lever in GEAR DOWN position.

2. Turn Battery Switch ON - ON (CP)

   If battery switch is OFF and no a-c power is available when landing gear lever is placed in GEAR DOWN, the utility hydraulic packs will not start even though the battery switch is subsequently moved to ON position. It will be necessary to place battery switch ON and momentarily place hydraulic pack switches to OFF & RESET, then ON position, before packs can be started.

3. Check Hydraulic System Pressure - Checked (P)

   Check hydraulic pressure on failed gear or gears. If pressure is low, use "Hydraulic System Failure Checklist." If pressure is normal, proceed with the following:

4. Pull and Reset Normal Control Circuit Breaker(s) for Affected Gear - Pulled and reset (P)

   Should an intermediate gear position be indicated as a result of a malfunctioning position switch, pulling and resetting the normal control circuit breaker will break the holding circuit of the position switch relay, allowing the gear indication to become compatible with the physical location of the gear. The remainder of the checklist will be accomplished if the gear down indication is not obtained.

5. Position Landing Gear Lever to GEAR UP - Accomplished (P)

   Check for gear up indication.

6. Position Landing Gear Lever to GEAR DOWN - Accomplished (P)

   If a gear down indication is not shown, proceed with step "7."

LANDING GEAR SYSTEM EMERGENCY OPERATION CHECKLIST (Cont)

7. Actuate Emergency Landing Gear Switch(es) to EXTEND - Accomplished (P)

CAUTION

To reduce the possibility of system damage, do not place switch to OFF or RETRACT position while the gear is in motion.

After checking hydraulic system, actuate emergency switch(es) to EXTEND for failed gear; however, limit operation to 10 seconds maximum if gear has failed to extend after unlocking by use of the normal system. Actuation of the emergency switch(es) to EXTEND automatically turns on the respective alternate pack and its standby pump. The following indicates alternate pack operation by emergency landing gear switch:

GEAR	NORMAL PACK	ALTERNATE PACK
Left Front	1	2
Right Front	2	1
Left Rear	3	4
Right Rear	4	3
Left Tip	5	6
Right Tip	8	7

If a tip gear fails to extend after using the normal system and if subsequent use of the emergency system fails to extend the tip gear, pull No. 5 or 8 standby pump circuit breaker, turn hydraulic pack switch 5 or 8 OFF, and bleed the normal system down by operating the spoilers. Repeat actuation of emergency switch and continue to bleed down the normal system as the gear extends. After the gear is down and locked, turn emergency tip gear switch to OFF. Restart pack 5 or 8. If tip gear retracts, shut down pack 5 or 8 and bleed down as before. After the gear is down and locked, leave emergency tip gear switch in EXTEND position and do not restart pack 5 or 8. This will result in loss of the use of the outboard spoilers and airbrakes on the side of the affected gear.

8. Turn Emergency Landing Gear Switch(es) OFF - OFF (P)

As soon as landing gear is down and locked, return emergency switch(es) to OFF position. Return landing gear emergency switch(es) to EXTEND only if landing gear attempts to move to opposite position when emergency switch is returned to OFF position.

CAUTION

Continuous overload operation of the standby pumps will occur if the landing gear emergency switch is left in EXTEND position.

NOTE

Since the standby pump switches are turned ON for all landings, standby pump pressure will be available as needed for braking regardless of the position of the landing gear emergency switches.

CAUTION

If the normal standby pump circuit breaker has been pulled because of low hydraulic pressure, pushing the normal standby pump circuit breaker back in could cause the standby pump to run in a dry hydraulic system which will damage the pump and possibly constitute a safety of flight hazard.

LANDING GEAR SYSTEM EMERGENCY OPERATION CHECKLIST (Cont)

NOTE

If one main gear will not indicate down and locked after executing proper emergency procedures, leave the gear down and land, using procedures outlined under "Landing With Partial Gear Checklist," this section.

WARNING

Due to the hazards involved, installation of downlocks in flight should not be attempted except in a serious emergency.

ACCIDENTAL DRAG CHUTE DEPLOYMENT

The drag chute is designed to operate without failure at indicated airspeeds of 135 knots or less. If chute is fully inflated at higher speeds, it will seriously weaken the risers and failure may result; also a shear pin may fail, thus releasing the chute. Such accidental deployment will exert only minor effect upon the aircraft handling characteristics but deployment at lower airspeeds would be critical in that it would induce considerable drag causing a pitch down tendency with wing flaps up or a slight pitchup with the wing flaps extended. This pitching would be controllable but the sudden decrease in airspeed could result in a stall condition. It is necessary therefore to increase thrust and to jettison the drag chute immediately under these conditions. If the drag chute is jettisoned or deployed over 135 knots IAS, the pilot shall so note on Form 781.

WARNING

Jettison the drag chute at once if accidental deployment occurs after attaining S1 speed during takeoff or any time accidental deployment occurs in the air at an airspeed too low for the shear pin to fail and release the chute. Move the drag chute lever directly from LOCKED to JETTISON position.

NOTE

Normal jettisoning of the drag chute is accomplished by the drag chute lever on the pilots' aisle stand. If this unit fails, the gunner may jettison the deployed drag chute by checking the gunner's drag chute control knob in the down position at pilot's command and jettisoning the turret.

ADM-20 EMERGENCY OPERATION KS

Amplified checklists for B-52/ADM-20 emergency operation are published in T.O. 1B-52G-1-2 and T.O. 1B-52E-1-4. Corresponding ADM-20 fire warning abbreviated checklists are published in T.O. 1B-52E-CL-1-1, pilots'.

AGM-28 EMERGENCY OPERATION KS

Amplified checklists for B-52/AGM-28 emergency operation are published in T.O. 1B-52C-30-1 and T.O. 1B-52C-30-1A. The corresponding abbreviated checklists are published in T.O. 1B-52E-CL-1-1, pilots'; T.O. 1B-52E-CL-1-2, navigator's; and T.O. 1B-52E-CL-1-3, radar navigator's.

EMERGENCY OPERATION WITH CONVENTIONAL MUNITIONS INSTALLED ON EXTERNALLY MOUNTED MULTIPLE EJECTOR RACKS UM

WARNING

In the event of a "hung store" or should any abnormal vibrations be encountered, it is recommended that the aircraft speed be reduced to a comfortable margin above low speed buffet and the mission aborted immediately.

Refer to "Emergency Procedures," Section III, of T.O. 1B-52B-34-2-1 for further information.

RADOME FAILURE

Failure of the lower nose radome may begin as a collapse in the form of an inward bulge against the radar antenna. Such a collapse could result from a delaminated or soft spot in the radome caused by inflight collision with birds or hailstones or by ground damage. Failure will be audible as a loud thump accompanied by noise of the antenna bumping or scraping against the radome. If the antenna is completely jammed, the scope will so indicate. Therefore, in the event of a collapsed radome:

1. Immediately shut down radar.
2. Reduce airspeed to the lowest value that will leave a safe and reasonable margin above stall. (See "Airspeed Indication Failure," this section, in case of lost airspeed indication.)
3. Continue flight only as long as necessary.

WARNING

- Continued flight with radome collapsed may result in further structural failure with subsequent departure of the radome and loss of airspeed indications.
- Inflight loss of the lower nose radome will cause complete loss of airspeed and Mach indications during all flight conditions. An extreme increase in noise level will occur accompanied by possible buffeting.
- Inflight loss of the upper nose radome will cause the airspeed indicators to fluctuate 2 to 3 knots. Large instrument errors occur at airspeeds above 145 knots IAS with flaps down and above 270 knots IAS or .80 Mach with flaps up. Limit airspeeds to the above to avoid inadvertently exceeding flight limitations.

AIRSPEED INDICATION FAILURE

Loss of the lower nose radome will result in complete loss of airspeed and Mach indications accompanied by extreme increase in noise level and possible buffeting. Loss of airspeed indication can also result from pitot ice, leaks, and other system malfunctions. The airplane can be successfully operated without airspeed indications as follows:

1. In the event of inaccurate or non-existent airspeed indication as a result of radome loss, all crew members will assume their egress stations. Additional airplane damage is possible when a radome is lost.
2. Request the immediate services of a chase airplane for obtaining accurate airspeed checks, and land as soon as conditions permit.

NOTE

A VFR landing with chase airplane to monitor approach speed would be the most desirable procedure after due consideration of the following factors: gross weight, weather conditions at intended place of landing, length of time chase airplane can remain in formation with B-52, and advisability of reducing gross weight prior to landing. If landing above 325,000 pounds gross weight becomes necessary, see "Heavy Weight Landing," Section II.

WARNING

Pacer airplane should fly only wing formation. It is unsafe to fly two airplanes in close vertical proximity because of the magnitude of interrelated aerodynamic effect.

3. Maintain the altitude and power setting existing at the time of loss of airspeed indication if the airplane is in level flight.
4. If the airplane is in climb or descent when airspeed indication is lost, maintain if possible the existing attitude and power setting until level flight fuel flow value is obtained and level flight is established.
5. Level flight fuel flow value is obtained from figure 3-17 by entering chart with altitude and gross weight. Adjusting fuel flow to this value provides a safe airspeed which will be the Mach number shown on the chart.
6. If altitude changes become necessary because of weather or other reasons before chase airplane arrival, the rate of change shall not exceed 200 feet per minute.

8 ENGINES FUEL FLOW FOR RADOME LOSS (1000 LBS/HR) B-52E

ALTITUDE — 1000 FEET	MACH	GROSS WEIGHT X 1000 LBS 200	240	280	320	360	400	440	450
SEA LEVEL	.35	19.5	20.4	21.9	23.0	24.5	26.3	28.2	28.9
5	.38	17.5	18.6	19.7	21.1	22.9	24.6	26.9	27.6
10	.41	16.2	17.3	18.7	20.1	22.0	24.0	26.2	27.2
15	.45	15.8	16.7	17.6	19.4	21.3	23.8	26.4	26.8
20	.50	15.0	15.8	17.2	18.5	20.6	22.8	24.9	25.8
25	.55	13.9	14.8	15.8	16.7	18.7	21.3	23.8	24.5
30	.575	11.5	12.6	14.1	16.1	19.0	22.2	24.5	25.5
30	.70	14.8	15.5	16.5	17.6	19.4	21.1	22.9	23.6
35	.60	10.6	11.9	13.5	15.8	19.5	24.2		
35	.77	14.8	15.2	16.6	17.8	20.0	24.2		
40	.65	10.4	12.1	14.5	17.8	22.2			
40	.77	12.8	13.7	15.8	17.6	20.2	24.6		
45	.70	10.7	12.9	16.2	21.3				
45	.77	11.8	13.3	15.9	20.1				

NOTE

SUBSTRACT 10% FROM INDICATED FUEL FLOW IF FAILURE OF AIRSPEED WAS CAUSED BY OTHER THAN RADOME LOSS

CONDITIONS:
- 8 ENGINES
- LEVEL FLIGHT
- STANDARD DAY
- CLEAN CONFIGURATION WITH DROP TANKS

8 ENGINES FUEL FLOW FOR RADOME LOSS (1000 LBS/HR) B-52E

ALTITUDE — 1000 FEET	MACH	GROSS WEIGHT X 1000 LBS 200	240	280	320	360	400	440	450
SEA LEVEL	.35	17.9	18.8	20.0	21.4	23.2	25.2	27.2	27.7
5	.38	16.3	17.5	18.6	20.2	21.8	23.5	25.5	26.1
10	.41	15.0	16.0	17.5	18.6	20.3	22.2	24.2	24.8
15	.45	14.5	15.1	16.4	17.6	19.5	21.6	23.8	24.6
20	.50	13.7	14.8	15.8	17.0	19.1	21.0	23.8	24.6
25	.55	13.2	14.1	15.1	16.7	18.6	20.5	22.7	23.6
30	.575	10.6	12.9	14.8	16.6	18.7	21.1	24.2	25.3
30	.70	14.3	15.1	16.1	17.4	19.1	20.7	22.9	23.3
35	.60	10.6	12.2	13.9	16.4	19.7	25.5		
35	.77	13.9	15.0	16.1	17.6	19.4	21.2	23.6	24.5
40	.65	10.6	12.3	14.6	17.8	23.4			
40	.77	12.5	13.7	15.2	17.4	19.8	24.0		
45	.70	10.6	12.6	16.0	21.9				
45	.77	11.4	13.2	15.9	20.0				

NOTE

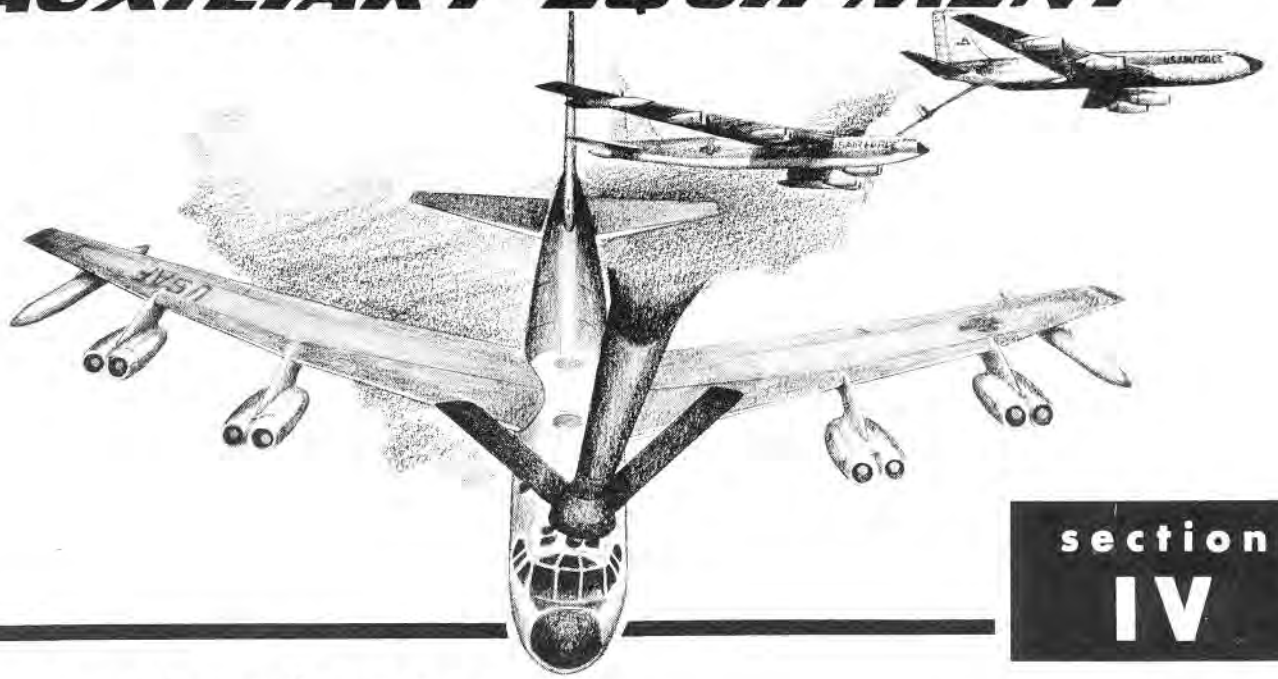
SUBSTRACT 10% FROM INDICATED FUEL FLOW IF FAILURE OF AIRSPEED WAS CAUSED BY OTHER THAN RADOME LOSS

CONDITIONS:
- 8 ENGINES
- LEVEL FLIGHT
- STANDARD DAY
- WITH DROP TANKS
- SURGE VALVES CLOSED

....fuel flow for airspeed indication failure

Figure 3-17.

AUXILIARY EQUIPMENT



section IV

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AIR CONDITIONING SYSTEMS

An air conditioning system (figure 4-2), for each compartment (2, 3, figure 1-2) provides independent air conditioning and pressurizing. Air conditioning packs (7, figure 1-60), located outside each compartment, condition air obtained from the air bleed system. This conditioned air is directed to cool electronic equipment and to heat, cool, ventilate and pressurize the occupied compartments.

AIR CONDITIONING PACK

An air conditioning pack supplies each pressurized compartment with conditioned engine bleed air for heating and pressurizing. Alternate and normal sources of bleed air to the aft pack are controlled by two shutoff valves in the aft air conditioning system. Bleed air delivered to the forward air conditioning pack is controlled by a single shutoff valve which operates in conjunction with the body air bleed manifold interconnect valves. See "Air Bleed System," Section I, for further information about the body manifold interconnect valves. From the shutoff valve(s) for each pack, bleed air flows through a filter, a flow limiter, two air to air heat exchangers and a cooling turbine. The turbine cools and reduces the pressure of the engine bleed air delivered from the heat exchangers. Protection against turbine and blower wheel fragmentation is incorporated in the air cycle machine. An electronic anti-icing controller receives signals from the temperature sensor and operates the anti-icing valve electrically to keep air discharged from the cooling turbine above freezing temperature. The cooled air flows from the turbine anti-icing system through a water separator or bypass, with a portion of the cooled air being diverted to cool electronic equipment. The remaining flow of cooled air is brought up to cabin heating temperature by mixing it with hot engine bleed air which bypasses the pack. This air flows into the cabin through the air outlets. After landing, a ground cooling air valve automatically changes the source of cooling air for the ram air heat exchanger from the wing duct to an opening in the forward wheel well. This opening increases the flow of cooling air through the ram air heat exchanger during ground operation.

Water Separator

The centrifugal-type water separator removes part of the moisture precipitated by refrigeration of engine bleed air to minimize fogging and snow conditions in the cabin. The separator is installed with an automatically controlled bypass just downstream of the air cycle machine. Water collected is drained overboard. The water separator bypass valve is opened automatically at altitudes above 25,000 feet and opens at any other altitude as a fail-safe feature if a malfunction or a freeze-up restricts the airflow.

CABIN PRESSURIZING

Cabin pressurizing is achieved by regulating the outflow of conditioned air from the pressurized compartments. An automatic cabin pressure regulator governs this outflow of air which escapes overboard through cabin pressure safety and outflow valves. The cabin pressure regulator maintains a preselected maximum pressure differential (figure 4-1) between outside and cabin pressures above 8000 feet altitude. A high differential (7.45 psi) and a low differential (4.50 psi) pressure bellows is provided in the regulator. When energized by 24 volt d-c TR power, a solenoid valve in the regulator switches operation from high to low differential operation.

NOTE

When changing the cabin pressure differential from 7.45 PSI to COMBAT 4.50 PSI, a maximum initial cabin altitude overshoot of 3000 feet above that selected may occur and should be considered normal. See figure 4-1 for cabin altitude vs. airplane altitude for the two pressurization schedules.

The rate at which the compartments may be pressurized is automatically controlled by the pressure regulator to a maximum change of one psi per minute. In unpressurized operation the regulator will maintain the cabin at outside air pressure. In pressurized operation, a cabin altitude of 8000 feet will be maintained up to the altitude where a differential pressure exists equal to the pressure setting selected. Above this altitude (where the differential pressure is equal to the setting selected) a constant differential pressure between cabin and outside air pressure is maintained. Cabin pressure safety and outflow valves are provided for each compartment. These valves provide a means of normal pressure outflow and are also used to dump cabin pressure. Relief of both positive and negative cabin pressures is provided by these valves. The control chambers of each group of safety valves are vented to the atmosphere through a cabin pressure dump control valve which is operated either manually or electrically. When open, this valve vents the safety valve control chamber to the atmosphere allowing it to open and dump cabin pressure. An additional dump control valve is provided for the gunner which is operated by the tail turret jettison handle when the tail turret is jettisoned.

CAUTION

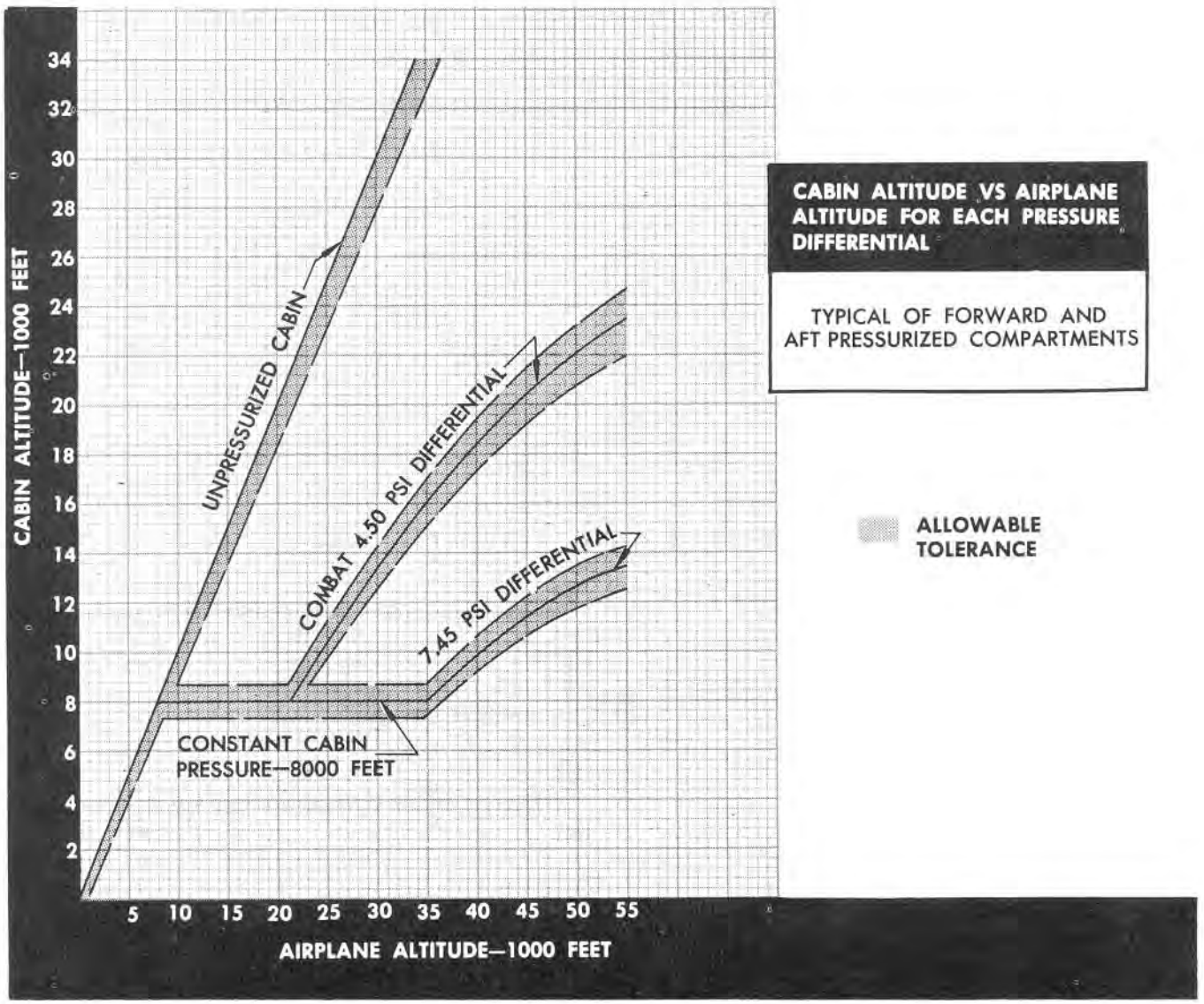
When the main landing gear is extended and crabbed in flight to an angle equal to or exceeding 14 degrees through any combination of crosswind crab setting and rudder motion, the landing gear squat switch will be actuated causing forward cabin pressure to be dumped. Up to 8000 feet this is not critical, since cabin pressure is regulated to approximately 1/2 inch Hg differential.

CABIN HEATING AND VENTILATING

Pressurized Compartments

Air used for pressurizing is also used to cool electronic equipment and to heat and ventilate the crew compartments. During pressurized flight this air is obtained from the air bleed system (figure 1-28). It passes through the air conditioning pack and distribution ducts to air outlets at each crew member's station. During unpressurized operation, air for cooling electronic equipment and for ventilating compartments is obtained from ram airscoops. An electrically operated ram air valve, provided for each compartment, is closed during pressurized operation and may be opened during unpressurized operation. The ram airscoops are anti-iced; see "Anti-Icing Systems," this Section.

Heating of the pressurized compartments is provided only during operation with the air conditioning master switch in 7.45 PSI or COMBAT 4.50 PSI. Cooled and depressurized engine bleed air discharged from the air conditioning pack is mixed with hot engine bleed air which bypasses the pack. In each compartment, a 200-volt three-phase a-c motor operated temperature modulating valve controls the flow of this hot, bypassed bleed air. These valves are controlled by TR powered open and close relays. An electronic cabin temperature regulator automatically governs operation of the temperature modulating valve through the relays. The temperature regulator is supplied with both duct and cabin temperature sensing elements which control the action of the regulator. A cabin temperature selector switch is provided to permit automatic or manual control of cabin temperature.



cabin pressure schedule

Figure 4-1.

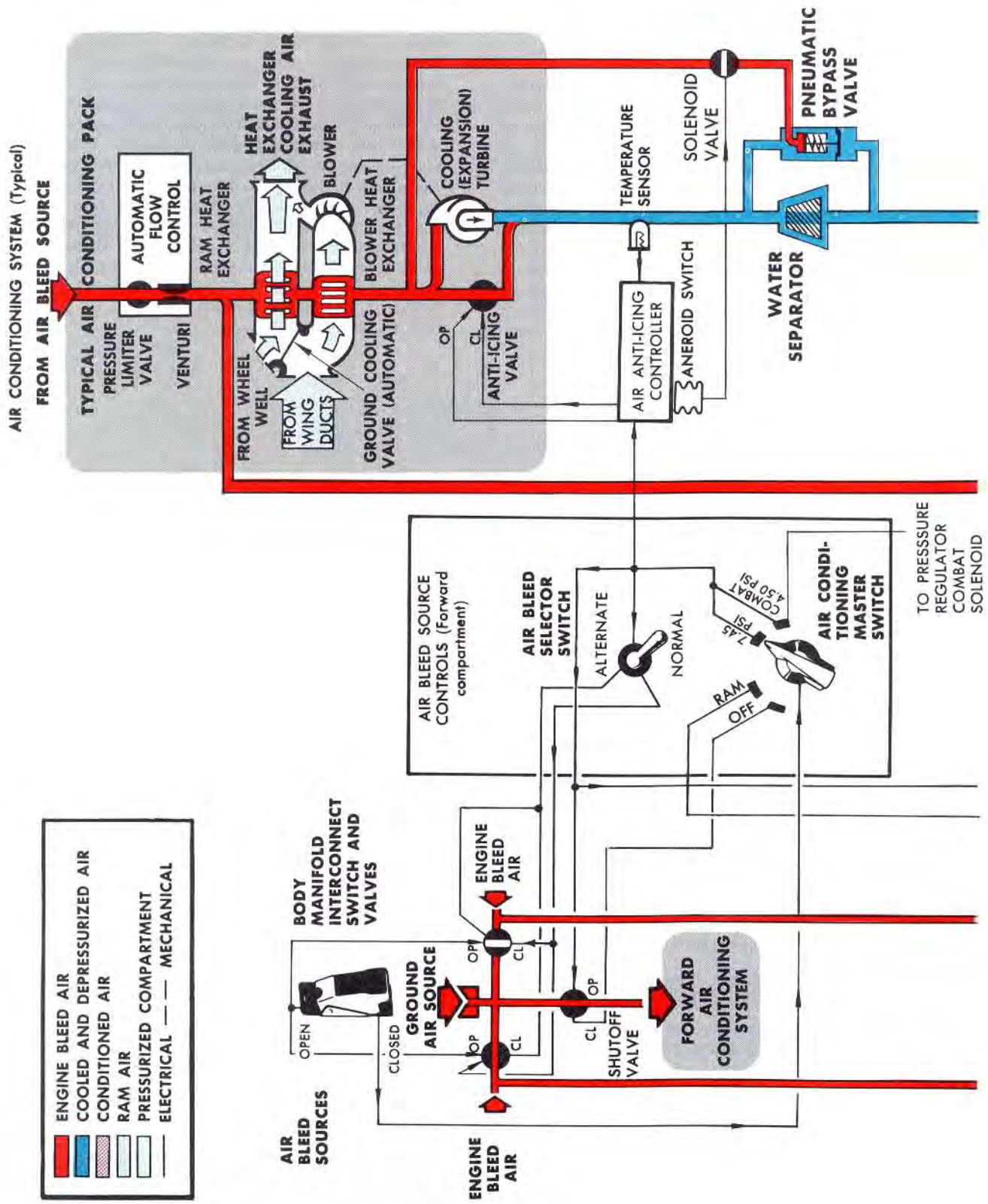
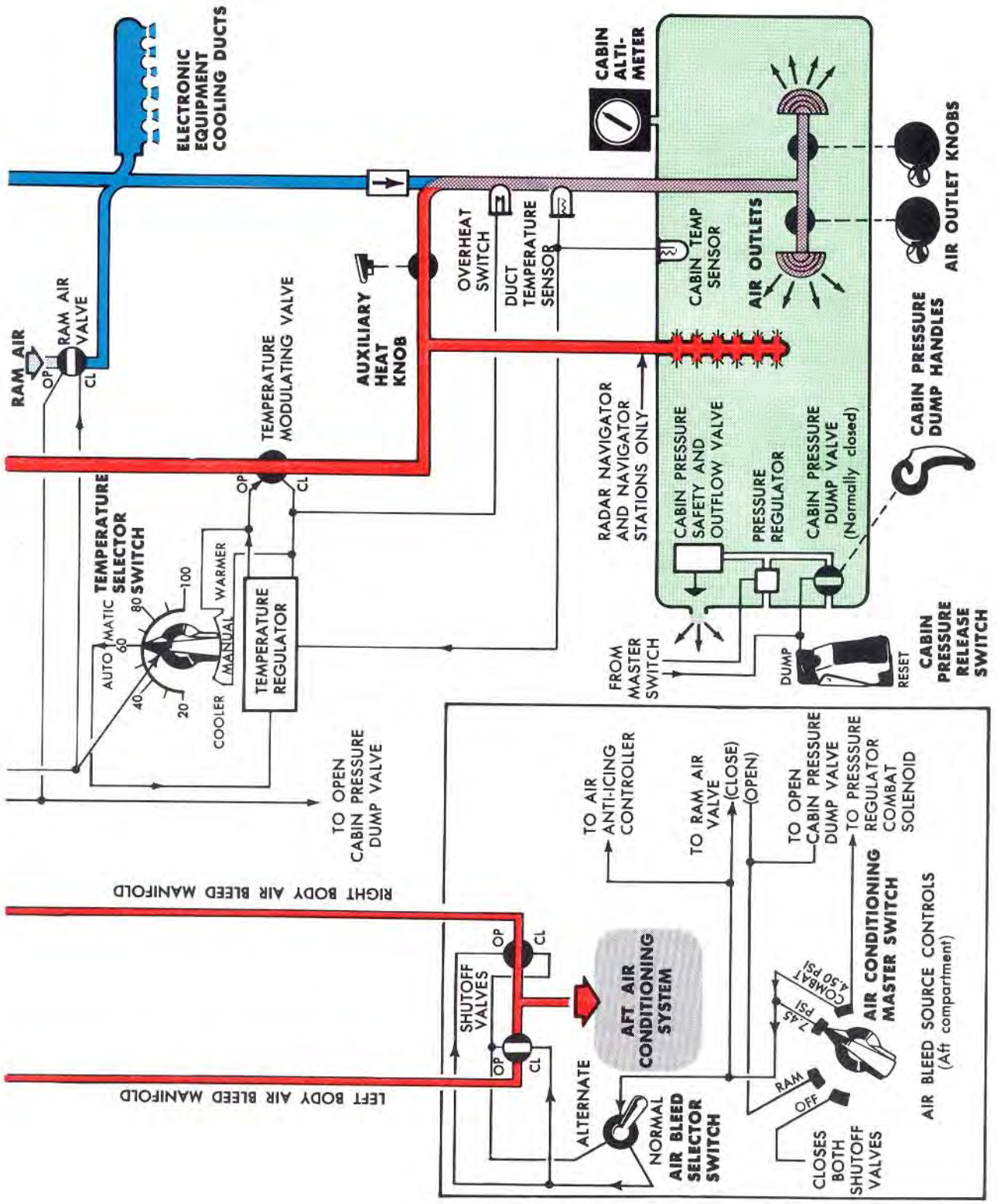


Figure 4-2. (Sheet 1 of 2).



air conditioning systems

Figure 4-2. (Sheet 2 of 2).

Camera Compartment

The camera compartment in the aft equipment compartment is heated by air obtained from the air bleed system. For additional information on the source of bleed air see "Air Bleed System," Section I. Air flow for heating the camera compartment is controlled by TR powered solenoid operated shutoff valve. This valve is controlled by an overheat switch and is supplied power through the ON position of the camera master switch.

AIR CONDITIONING SYSTEM CONTROLS

Body Manifold Interconnect Switch

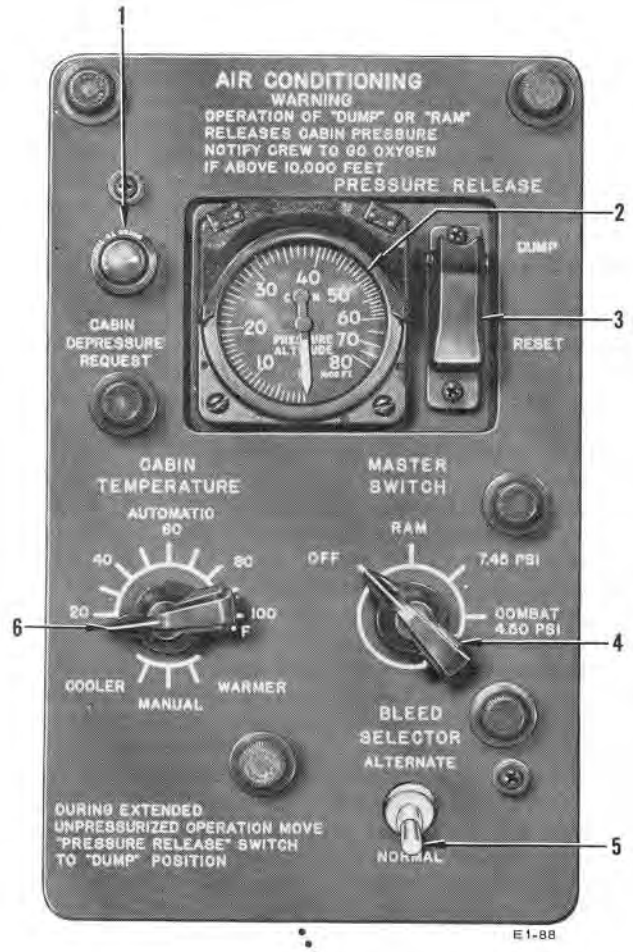
An OPEN--CLOSED body manifold interconnect switch (2, figure 1-30), guarded in the CLOSED position, is on the copilot's auxiliary side panel. This switch electrically controls the positioning of the two body air bleed manifold interconnect valves. Moving this switch to the CLOSED position, with the air conditioning master switch in either the 7.45 PSI or COMBAT 4.50 PSI position, supplies 118-volt single-phase a-c power through a circuit breaker marked "Air Conditioning Air Bld Body" on the "Miscellaneous" portion of the pilot's circuit breaker panel to close one interconnect valve. The interconnect valve that remains open to supply air conditioning for the forward compartment is determined by the position of the air bleed selector switch for the forward compartment. With the air conditioning master switch in either OFF or RAM, the CLOSED position of this switch supplies power to close both body interconnect valves. Lifting the guard and moving this switch to the OPEN position, supplies power to open both body manifold interconnect valves regardless of the position of the air conditioning master switch or air bleed selector switch. This permits crossfeeding of bleed air between inboard pods. For additional information on this switch, see "Air Bleed System," Section I.

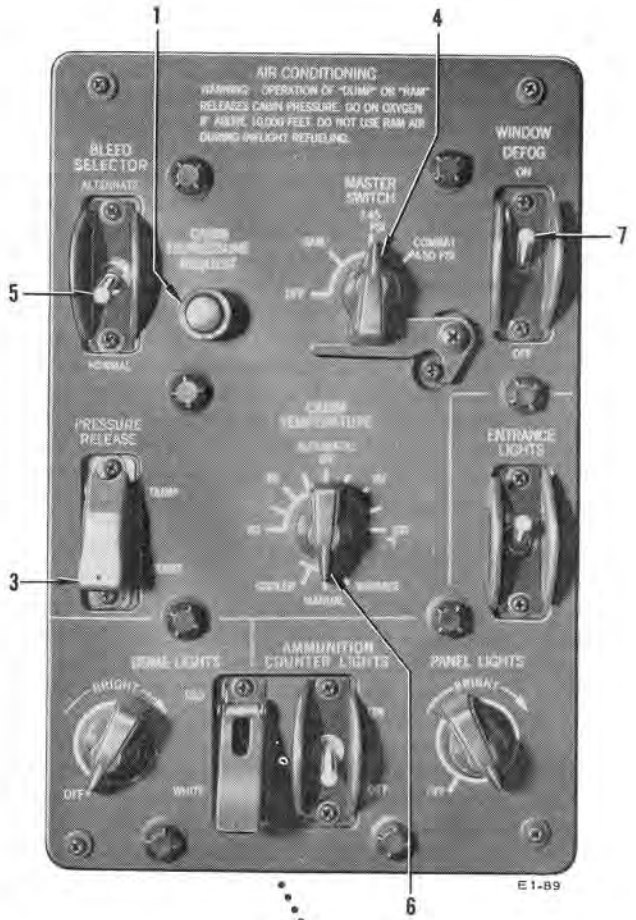
Air Conditioning Master Switches

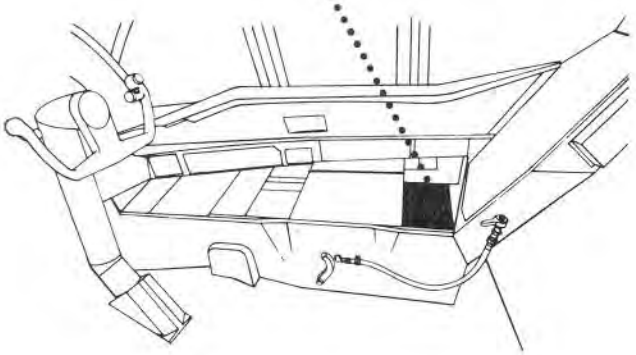
A four position OFF--RAM--7.45 PSI--COMBAT 4.50 PSI air conditioning master switch (4, figure 4-3) is on the air conditioning panel in each pressurized compartment. The aft compartment switch is guarded to prevent inadvertent depressurizing of the gunner's compartment. This multi-purpose switch controls electrical power for cabin pressurizing as well as for heating and ventilating. When this switch is in the OFF or RAM position, 118-volt single-phase a-c power is supplied to close the air conditioning shutoff valves and the air conditioning pack does not operate. In RAM position, TR power is supplied to open the cabin pressure dump control valve and 118-volt single-phase a-c power is supplied to open the ram air valve. In OFF or RAM position, it is impossible to obtain cabin heat and no power reaches the cabin temperature selector switch. Positioning the switch to OFF closes the ram air valve and shuts down the air conditioning pack without depressurizing the airplane, provided the switch is turned quickly past RAM position. Pressure will bleed down gradually due to normal leakage of the airplane. In 7.45 PSI or COMBAT 4.50 PSI position, TR power is supplied to the cabin temperature selector switch for either manual or automatic control of the temperature modulating valve and 118-volt single-phase a-c power is supplied to close the ram air valve and to open the air conditioning shutoff valve. The position of the air bleed selector switch then determines which source of bleed air will be used to operate the air conditioning packs. COMBAT 4.50 PSI position, in addition to the power supplied in 7.45 PSI position, supplies TR power to energize a solenoid valve in the pressure regulator shifting the regulator from high to low pressure differential operation. The forward air conditioning master switch is supplied TR power through a circuit breaker marked "Cabin Cont" and 118-volt a-c power through circuit breakers marked "Air Conditioning Eng Bld Ram Air" and "Air Conditioning Air Bld Body." The circuit breakers are on the "Miscellaneous" portion of the pilot's circuit breaker panel. The aft air conditioning master switch is supplied TR power through a circuit breaker marked "Cab" and 118-volt a-c power through circuit breakers marked "Body Bleed" and "Bleed Ram Air." The circuit breakers are on the "Air Conditioning" portion of the gunner's circuit breaker panel.

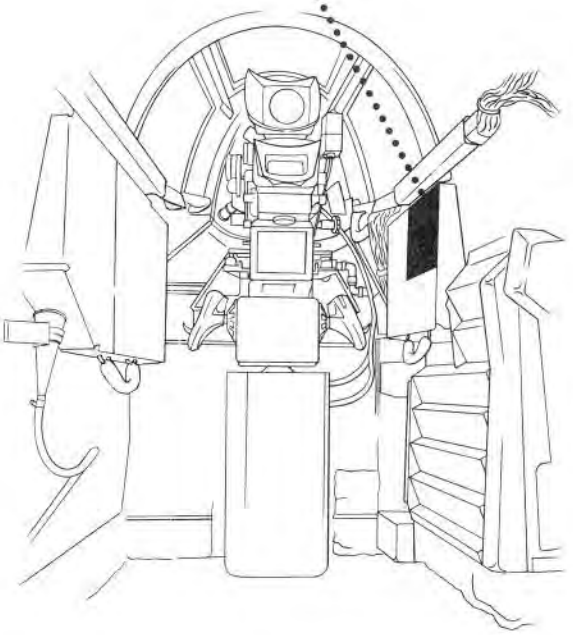
Air Bleed Selector Switch (Forward Compartment)

A NORMAL--ALTERNATE air bleed selector switch (5, figure 4-3) is provided on the air conditioning panel for the forward compartment at the copilot's station. This switch is used to supply power to reverse the positions of the body manifold interconnect valves provided the body manifold interconnect valve switch is in the CLOSED position and the air conditioning master switch is in either pressurized setting. With the conditions as above, the NORMAL position provides 118-volt single-phase a-c power through a circuit breaker marked "Air Conditioning Air Bld Body" on the "Miscellaneous" portion of the pilot's circuit breaker panel to open the left and close the right body manifold interconnect valve. This condition supplies bleed air for air conditioning from the No. 2 nacelle when the left wing manifold interconnect valve is closed. In the ALTERNATE position of this switch, the valve positions are reversed and bleed air is supplied from the No. 3 nacelle. See "Air Bleed System," Section I, for further information on the body manifold interconnect switch.









1. CABIN DEPRESSURE REQUEST LIGHT
2. CABIN ALTIMETER 190 ▶ 254 W70 ▶ W143
3. CABIN PRESSURE RELEASE SWITCH
4. AIR CONDITIONING MASTER SWITCH
5. AIR BLEED SELECTOR SWITCH
6. CABIN TEMPERATURE SELECTOR SWITCH
7. WINDOW DEFOG SWITCH

..... air conditioning panels (typical)

Figure 4-3.

Air Bleed Selector Switch (Aft Compartment)

A guarded NORMAL--ALTERNATE air bleed selector switch (5, figure 4-3) is provided on the air conditioning panel in the aft compartment. The body manifold interconnect switch is not involved in the operation of the air bleed selector switch for the aft compartment. When the air conditioning master switch is in either pressurized setting, the NORMAL position of this switch provides 118-volt single-phase a-c power through a circuit breaker marked "Body Bleed" on the "Air Conditioning" portion of the gunner's circuit breaker panel to open the right and close the left air conditioning shutoff valve supplying bleed air from the right body air bleed manifold. With the air conditioning master switch for the aft compartment in the OFF or RAM position, both air conditioning shutoff valves are closed regardless of the position of the air bleed selector switch.

Cabin Pressure Release Switches

A two position DUMP--RESET cabin pressure release switch (3, figure 4-3) guarded to the RESET position, is located on each air conditioning panel. When the guard is lifted and the switch is moved to DUMP position, cabin pressure is released by supplying TR power to the cabin pressure dump control valve. A TR power operated safety valve dump relay is provided which opens the dump control valve when the weight of the aircraft is on the wheels. TR power is supplied to the aft pressure dump control valve through a circuit breaker marked "Cab" on the "Air Conditioning" portion of the gunner's circuit breaker panel. TR power is supplied to the forward pressure dump control valve through a circuit breaker marked "Air Conditioning Cabin Cont" on the "Miscellaneous" portion of the pilot's circuit breaker panel.

Cabin Depressure Request Switch

A guarded cabin depressure request switch (figure 4-4), spring-loaded to OFF, is provided on the nonpressurized side and adjacent to each pressure bulkhead door. When the guard is lifted and the switch actuated, TR power is supplied to the cabin depressure request light on the air conditioning panel of the corresponding compartment. Switched battery power for the forward cabin depressure request light is supplied through a circuit breaker marked "Depress Warn" on the "Miscellaneous" portion of the pilot's circuit breaker panel. The aft cabin depressure request light is supplied TR power through a circuit breaker marked "Cab Depress Request" on the gunner's circuit breaker panel.

Emergency Cabin Pressure Dump Handles

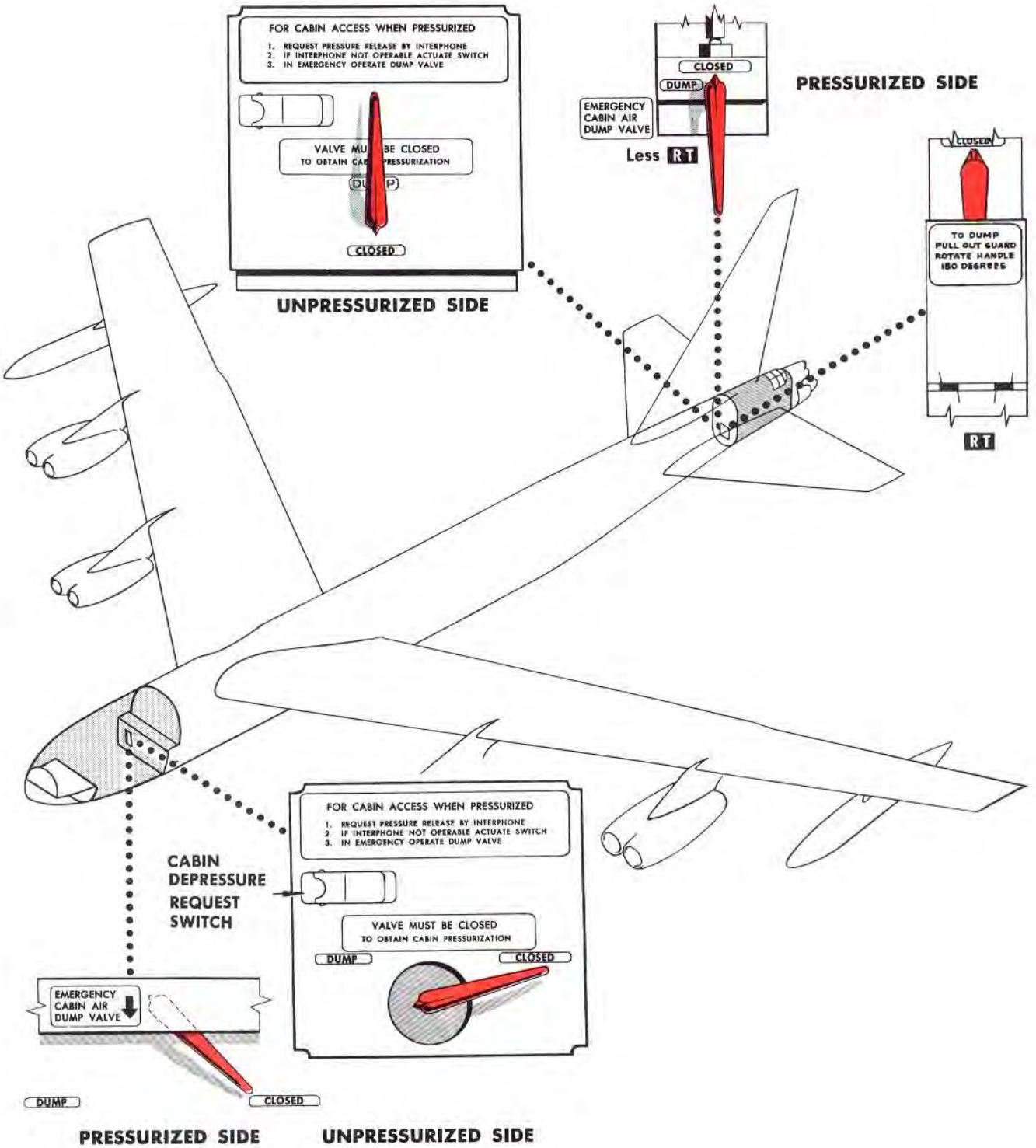
An emergency cabin pressure dump handle with DUMP --CLOSED positions (figure 4-4) is provided for each pressurized compartment. A dump handle for each compartment is located adjacent to each pressure bulkhead door and may be operated from either side of the bulkhead. Moving the handle to DUMP position manually opens the dump control valve allowing cabin pressure to be released through the cabin pressure safety and outflow valves. In CLOSED position, the cabin pressure dump control valve is closed and the cabin pressure safety and outflow valves operate normally.

Cabin Temperature Selector Switches

A cabin temperature selector switch (6, figure 4-3) is located on each air conditioning panel. This switch is marked AUTOMATIC--MANUAL--COOLER--WARMER and is used in conjunction with the temperature regulator to operate the cabin temperature modulating valve. When the switch is in the AUTOMATIC range, cabin temperature is maintained by positioning the switch to the desired temperature between 20° and 100° F. When in this automatic range, a power relay supplies 118-volt single-phase a-c and 24-volt d-c TR power to the temperature regulator. In MANUAL position, the cabin temperature regulator is inoperative. When the switch is held in COOLER or WARMER position, TR power is supplied to the temperature modulating valve relay which repositions the modulating valve. An overheat switch is provided which closes the temperature modulating valve when duct air temperature exceeds 350° F. The forward cabin temperature selector switch is supplied TR power through a circuit breaker marked "Air Conditioning Cabin Cont" and 118-volt a-c power through a circuit breaker marked "Air Conditioning Temp Reg." Both circuit breakers are on the "Miscellaneous" portion of the pilot's circuit breaker panel. The aft cabin temperature selector switch is supplied TR power through a circuit breaker marked "Cab" and 118-volt a-c power through a circuit breaker marked "Cab Temp." Both circuit breakers are on the "Air Conditioning" portion of the gunner's circuit breaker panel. The modulating valves operate on 205-volt a-c power through circuit breakers marked "Cabin Temp Air Cond Valves" in the aft and right forward a-c power shields.

Air Outlet Knobs

Air outlet knobs control the flow of heating and pressurizing air delivered to each compartment. No controls are provided for the electronic equipment cooling ducts. In the forward pressurized compartment, these knobs are mounted near the air outlets and are pulled out to increase airflow and pushed in to decrease the flow of air. The pilots' air outlet knobs are located below the pilots' instrument panel. The two air outlet knobs for the radar navigator and navigator are located on the radar navigator's side panel. The EW officer's two air outlet knobs and on aircraft RU one spray bar knob are to his left below his circuit breaker panel. The gunner's air outlets are controlled by pointer-type knobs which decrease airflow when rotated toward OFF. The gunner's air outlet knobs are located below both the left and right panels.



.....emergency cabin pressure dump handles

Figure 4-4.

Auxiliary Heat Knob

An auxiliary heat knob (10, figure 4-38) is located at the radar navigator's station to provide more heat for the radar navigator and the navigator. To operate the knob, turn it counterclockwise to unlock, pull or push it to the desired position, then turn clockwise to relock. Pulling out the knob increases the flow of hot air through perforated dispersal tubes near the feet of both the radar navigator and navigator by restricting the hot airflow to the pilots' compartment.

Spray Bar Knob RU

A spray bar knob (3A, figures 4-15 and 4-15A) is located under the EW officer's air outlet knobs and is used to reduce the air pressure at the pilot's and copilot's air outlets and to reduce the air conditioning noise level in the forward crew compartment.

AIR CONDITIONING SYSTEM INDICATORS

Cabin Altimeters

Each pressurized compartment is equipped with a 0- to 80,000-foot cabin pressure altimeter. The cabin altimeter for the forward compartment (2, figure 4-3; 23, figure 1-13; and 19, figure 1-13A) is located on the forward air conditioning panel 190 ▶ 255 W70 ▶ W143 or above the pilots' instrument panel 255 ▶ W144 ▶. The tail compartment cabin altimeter (13, figure 4-54) is located aft of the gunner's right panel. As the rate of cabin pressurizing is automatically controlled by the pressure regulators, no cabin pressure rate of change indicator is provided.

PILOT'S TAIL COMPARTMENT ALTIMETER. A remote indicating cabin pressure altimeter (53A, figure 1-13 and 35, figure 1-13A), energized by 118-volt a-c power from the right forward a-c power load box, is on the pilots' instrument panel. This altimeter indicates the cabin altitude of the gunner's compartment. The dial face is graduated clockwise from 0 to 80,000 feet, with numbered major graduations every 10,000 feet and minor graduations every 2,000 feet.

Cabin Depressure Request Lights

A cabin depressure request light (1, figure 4-3) is located on the air conditioning panel of each pressurized compartment. The forward light receives switched battery power through a circuit breaker marked "Depress Warn" on the "Miscellaneous" portion of the pilot's circuit breaker panel and the aft light receives TR power through a circuit breaker marked "Cab Depress Request" on the gunner's circuit breaker panel when the corresponding cabin depressure request switch is actuated.

Gunner's Cabin Pressure Warning Light

A press-to-test cabin pressure warning light (15, figure 4-55) located on the gunner's left side panel illuminates when cabin altitude is between 13,980 and 16,020 feet mean sea level. The warning light is energized by TR power through a circuit breaker marked "Cab Press Warning" on the gunner's circuit breaker panel. The initial low pressure signal consists of a bright flashing of the light. A three-position switch having STEADY --NEUTRAL--DIM positions is provided on the panel above the lights. The STEADY position changes the light from a flashing to a steady light, and the DIM position decreases the light by the same amount provided by the forward cabin automatic night light dimmers while allowing the light to continue flashing. When the switch is in the NEUTRAL position, it provides the bright flashing signal. After the low pressure condition is corrected, the indicating circuit is automatically reset so that a subsequent low pressure condition in the gunner's cabin again provides a bright flashing light for an initial signal.

Copilot's Tail Compartment Pressure Low Warning Light

A copilot's tail compartment pressure low warning red light (32, figure 1-13 and 25, figure 1-13A) located on the copilot's instrument panel illuminates when the cabin pressure in the gunner's compartment is between 21,750 and 24,100 feet mean sea level. The light is supplied TR power through a circuit breaker marked "Sect 49 Press Warn" on the "Misc" portion of the copilot's circuit breaker panel and, on aircraft Less PZ, is dimmed by means of the indicator (warning) light dimming control switch on the pilot's light control panel.

NOTE

There is a time lag between the illumination of the gunner's and the copilot's tail compartment low pressure warning lights. Duration of this time lag depends upon the rate of loss of gunner's cabin pressure differential.

AIR CONDITIONING SYSTEM NORMAL OPERATION

CAUTION

Do not run an air conditioning unit with the wing duct plugs in place as the cooling (expansion) turbine-driven blower will overspeed resulting in the destruction of the unit and possible damage to the airplane.

For normal pressurized operation, the air conditioning system is placed in operation as follows:

1. Emergency cabin pressure dump handle - CLOSED

CAUTION

The emergency cabin pressure dump handle must be set positively in CLOSED position for cabin pressurizing. If the dump handle is cocked slightly from CLOSED position because the handle detent is difficult to detect, it may allow cabin pressure to be dumped overboard.

2. Cabin pressure release switch - RESET
3. Body manifold interconnect valve switch - CLOSED (forward compartment only)
4. Air bleed selector switch - NORMAL
5. Air conditioning master switch - 7.45 PSI

NOTE

- Heating or cooling, according to cabin temperature selector switch settings and availability of pneumatic system hot air, is provided with the air conditioning master switch in 7.45 PSI (or COMBAT 4.50 PSI) whether the cabin is pressurized or not.

- During extended periods of unpressurized operation, move cabin pressure release switch to DUMP position in order to provide additional airflow for cooling of electronic equipment.

- Continuous ground operation of the air conditioning packs is permissible at manifold pressures of 100 psi or less. At manifold pressures above 100 psi, limit continuous operation to 15 minutes.

- If excessive noise tends to blank out interphone or radio communication, the air conditioning master switch may be positioned to RAM for takeoff and initial climb or during low altitude operation at power settings which cause difficulty in communication. On climbout, return master switch to 7.45 PSI before reaching 10,000 feet.

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- To preclude nuisance tripoff of air conditioning pack, retard throttles on engines supplying air to 80% rpm before switching from RAM to 7.45 PSI. After switching to 7.45 PSI, wait a minimum of 15 seconds before returning to desired engine power setting.

- On B-52E aircraft, do not turn the air conditioning ON or OFF when engines supplying air are above 80% rpm. To do so could cause shutdown of the system on airplanes which have an early unimproved automatic pressure limiter valve installed at the air conditioning pack. It is necessary to enter the forward wheel well to reset a tripped valve.

6. Cabin temperature selector switch - AUTOMATIC (set at desired cabin temperature)
An initial setting between 60° and 70° will provide for maximum crew comfort with the least additional attention.

NOTE

Moving the temperature selector switch through an increment greater than 5° F causes the modulating valve to move to its extreme travel, either fully open or fully closed. This will result in extreme fluctuations in cabin temperatures. Since the cabin temperature will automatically stabilize at the selected temperature within 3 to 10 minutes, the temperature selector switch should be moved in the desired direction in increments not to exceed 5° F until the stabilized desired cabin temperature is obtained.

7. Air outlet knobs (aft compartment) - As desired
8. Air outlet and auxiliary heat knobs (forward compartment) - As follows:
- Upper outlet knobs - 1/2 to full out
- Lower outlet knobs - Full out
- Auxiliary heat knob - Full in

These initial settings are for maximum crew comfort until cabin temperature has stabilized. Thereafter, knob adjustment may be varied slightly for crew comfort. When more heat is needed in the lower compartment than on the upper deck, pull the radar navigator's auxiliary heat knob partially out before requesting a higher setting on the temperature selector switch. With the knob completely out, hot airflow to the pilots' compartment will be shut off and redirected to the navigator's compartment causing possible overheating in that area.

WARNING

To prevent injury to ground crewmen, the crew compartment should be depressurized and the copilot's side window opened approximately 2 inches before the main entry door is opened. Otherwise, a small residual cabin pressure will build up during ground operation of the air conditioning system. This pressure may impose sufficient load on the door to cause injury to anyone in its path when it is unlatched. The residual pressure is due to the need to maintain the outflow valve preloaded to the closed position by a slight spring pressure when the cabin is depressurized. With the crew compartment closed and the air conditioning system operating, a residual cabin pressure must build up to balance the spring pressure before the outflow valve will open to permit the necessary airflow for ventilation. An unusually high residual cabin pressure, as noted by means of the cabin altimeter, can be relieved by turning the air conditioning master switch to RAM and then opening the side window. The air conditioning master switch should then be returned to the 7.45 PSI position to insure cooling of electronic equipment, if operating. Prior to ground operations, opening the copilot's side window before closing the entry door will prevent buildup of residual pressure.

AIR CONDITIONING SYSTEM EMERGENCY OPERATION

Failure of Water Separator

Under this condition, system operation will differ from normal, and the following procedures should be used when fogging occurs:

1. During takeoff, increase the cabin temperature setting if fog streamers form and tend to reduce visibility.
2. During descent and at approximately 10,000 feet altitude, fog streamers in excess of 15 inches may issue from air outlets. Increase the temperature setting until fog streamers are reduced to approximately 6 inches in length.
3. During descent at approximately 5000 feet altitude, if fog streamers exceed 6 inches in length, move the air conditioning master switch to RAM and continue descent and landing.

Failure of Normal Bleed Air Source

In the event of failure of the normal source of bleed air for air conditioning, move the air bleed selector switch to ALTERNATE position. If alternate procedure does not provide adequate cabin air flow, place the air conditioning master switch in RAM position and see "Air Bleed System Emergency Operation," Section III.

WARNING

- An engine or system failure in a nacelle supplying air for an air conditioning system may cause oil or fumes to enter the pressurized compartment(s). If this should occur, go on 100% OXYGEN and EMERGENCY and place the air bleed selector switch to its other position, ALTERNATE or NORMAL. Monitor the engines in the affected nacelle for signs of malfunction. If the condition persists, use the manifold interconnect switches to isolate the outboard nacelle or the entire wing on the side affected. See "Smoke and Fumes Elimination," Section III.

- If an air bleed manifold leak is suspected or confirmed, land as soon as possible. See "Air Bleed System Emergency Operation," Section III.

Failure To Regulate Cabin Temperature

If difficulty is encountered in controlling cabin temperature, proceed as follows:

1. If the automatic control system fails to provide the proper temperature regulation, place the cabin temperature selector switch in MANUAL. Move the switch to COOLER or WARMER as necessary to provide proper cabin temperature.

NOTE

Allow sufficient time for the manual control to change the cabin temperature before attempting additional readjustment. It is very easy to overcontrol using this system.

2. If only hot air is available from the air outlets and a check of the electronic equipment cooling ducts shows that relatively cool air (in the order of 80° F) is still available to these units, the decision to continue the mission pressurized or to go on ram air is at the discretion of the pilot.
3. If a puff of smoke is observed from the air outlets accompanied by vibration from the air conditioning pack and followed by hot air from the air outlets, it is probable that the air cycle machine (expansion turbine) in the air conditioning pack has stopped. If this occurs on a hot day at low altitudes or at high power settings, the air from the air conditioning system will be quite hot (in the order of 125° to 160° F) and the air conditioning pack should be shut down until cruising altitude is reached. If it occurs at cruising altitudes and cruising power settings, the air conditioning air will be fairly cool (the failure may not be apparent until descent is made) and the flight can be continued pressurized until a descent is made. On descent, the air will become hot and the pack should be shut down. Operation of the electronic equipment during cruise can be continued if the panels are removed from the compartment to the right of the EW officer. A small reduction in power will assist in reducing the air temperature.
4. If extremely hot air (over 150° F) comes out of the air outlets and the electronic equipment cooling ducts very soon after the air conditioning pack is turned on or after the engines are advanced to high power, it is possible that the cooling air to the air conditioning pack is partially or completely blocked. Continued operation of the pack would result in a fire hazard and the pack must be shut down.
5. If the navigator's compartment becomes overheated while normal cold air is being delivered from the pilots' air outlets, the navigator's auxiliary hot air supply should be shut off. Push the navigator's auxiliary heat knob all the way in.

WARNING

- In event an uncontrollable supply of hot air is experienced in all modes of operation of the air conditioning system during flight, the air conditioning system should be shut down by placing the air conditioning master switch in OFF or RAM position.

- Do not use ram air for tail compartment ventilation during air refueling. This is to prevent possibility of fuel vapors entering tail compartment through the air conditioning ducts.

- Moving the air conditioning master switch to the RAM position during pressurized flight will dump cabin pressure, open the ram air valve, and shut down the air conditioning pack. Moving the air conditioning master switch to OFF will shut down the air conditioning pack and close the ram air valve. Normal cabin leakage will bleed down cabin pressure. Go on oxygen if above 10,000 feet altitude.

Filter Failure

Filter failure in an air conditioning system is indicated by a finely divided black powder being deposited in the affected compartment.

WARNING

To avoid possible harmful effects of breathing the powder when failure of the filter occurs during flight, each crew member must place the oxygen regulator diluter lever in 100% OXYGEN and the oxygen emergency toggle lever in EMERGENCY position.

Releasing Cabin Pressure

Complete cabin depressurization can be accomplished in flight by placing the cabin pressure release switch in DUMP and the air conditioning master switch to OFF position. This will close off all incoming air, dump cabin pressure, and allow any residual pressure to bleed down through normal cabin leakage. This method of relieving cabin pressure should be used when it becomes necessary to open pressure bulkhead doors in flight. However, if some airflow through the cabin is desired, as during smoke and fume elimination, the air conditioning master switch should be placed in RAM rather than OFF position. If cabin depressurization cannot be accomplished because of electrical failure, the emergency cabin pressure dump handle (figure 4-4) should be placed in DUMP position.

Shut Down Air Conditioning System Without Depressurizing

To shut down the air conditioning system in flight without depressurizing, turn the air conditioning master switch rapidly past RAM to OFF position. The cabin will depressurize in a few minutes due to normal leakage and ram air will not be provided.

Repressurizing

To repressurize, check:
1. Cabin Pressure Release Switch - RESET
2. Air Conditioning Master Switch - 7.45 PSI (or COMBAT 4.50 PSI)
3. Emergency Cabin Pressure Dump Handles - CLOSED.

ANTI-ICING SYSTEMS

Several different methods are used to accomplish anti-icing of various parts of the airplane. The anti-icing systems provide for anti-icing of the engines and nacelles and certain airscoops by engine bleed air. The pilots' windshield and other airplane windows are anti-iced by electrical means. The pitot heads and fairings are also electrically heated. Anti-icing is provided for missile (AGM-28) engine nacelles and pitot-static probes. For further information on AGM-28 anti-icing, refer to T.O. 1B-52C-30-1.

ENGINE AND NACELLE ANTI-ICING

Thermal anti-icing of engines and nacelles (figure 4-5), where ice accumulations would constitute a hazard to safety of flight or engine operation, is accomplished by use of hot air bled from the high pressure compressors of all engines. Engine and nacelle anti-icing is controlled by a single switch on the pilots' forward instrument panel. No temperature indicator or overheat light is used in this system. TR control power is provided for engine and nacelle anti-icing through circuit breakers marked "Nacelle Control" - "1," "2," "3," and "4" on the "Anti-Ice" portion of the pilot's circuit breaker panel. Single-phase and three-phase a-c operating power is supplied through circuit breakers in the wing and aft a-c power distribution shields.

Engine Anti-Icing

Engine anti-icing is an integral part of each engine and is independent of the air bleed system. On each side of each engine, a duct with a thermal resistor and a TR powered motor-driven butterfly-type shutoff valve delivers hot air directly from an individual bleed port on the high pressure compressor through the hollow shroud ring and inlet guide vane assembly into the nose section and exhausting into the engine inlet.

Nacelle Anti-Icing

Nacelle leading edges are anti-iced by hot air from the air bleed system through fail-safe-to-closed, air-actuated, solenoid-operated shutoff valves. These valves may be operated to open only when the air bleed system is pressurized and the solenoids are energized by TR power.

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Nacelle anti-icing temperatures are controlled by a modulating valve upstream of the shutoff valve in each nacelle; also, the shutoff valve is tripped off upon action of an overheat switch in each right engine nose cowl. The modulating valves are actuated by three-phase 205-volt a-c power under control of an automatic temperature regulator using TR power and single-phase 118-volt a-c power.

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Venturi mixing of bleed air with ambient air in each nose cowl provides safe anti-icing temperatures without need for electronic temperature controls.

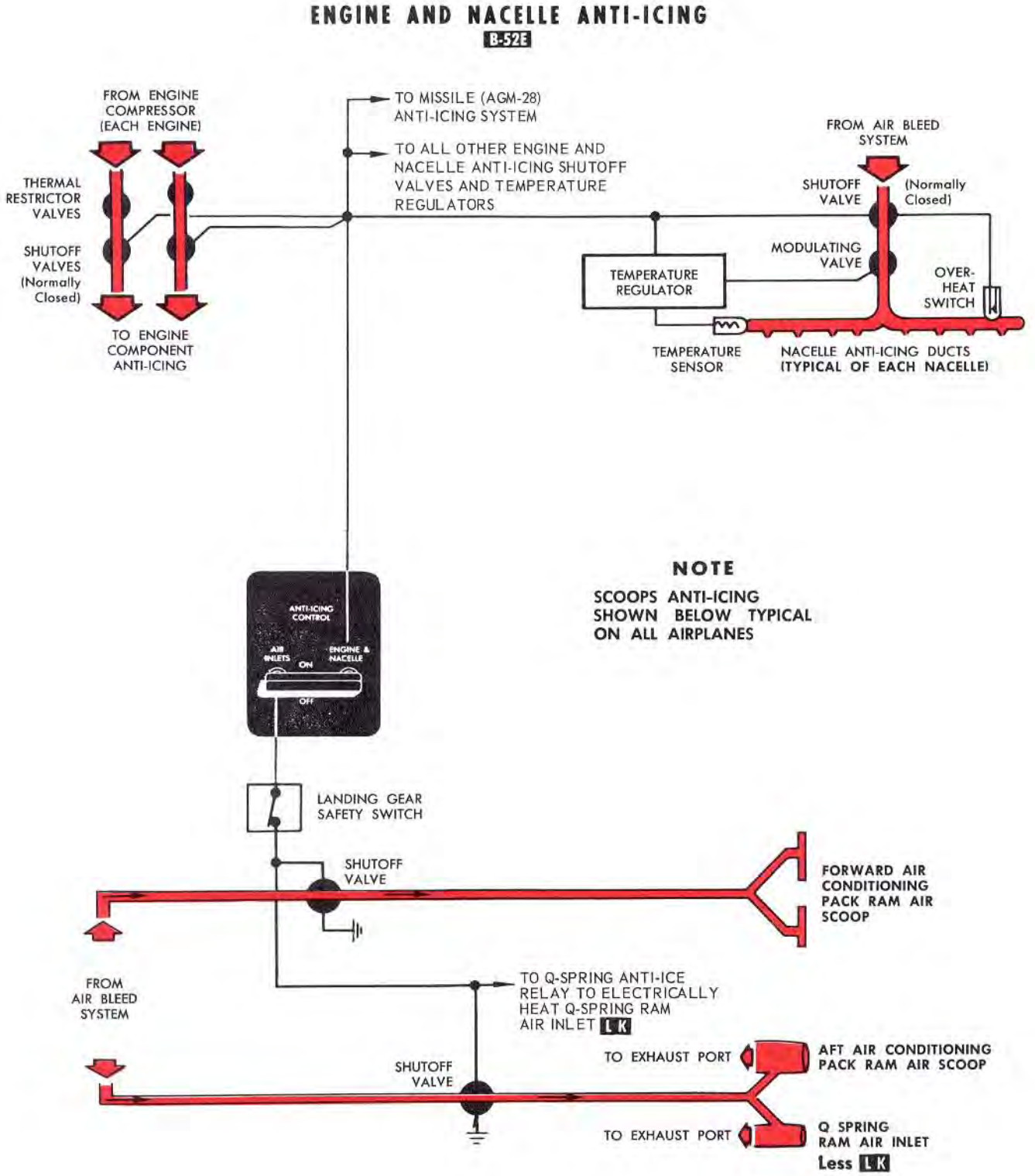
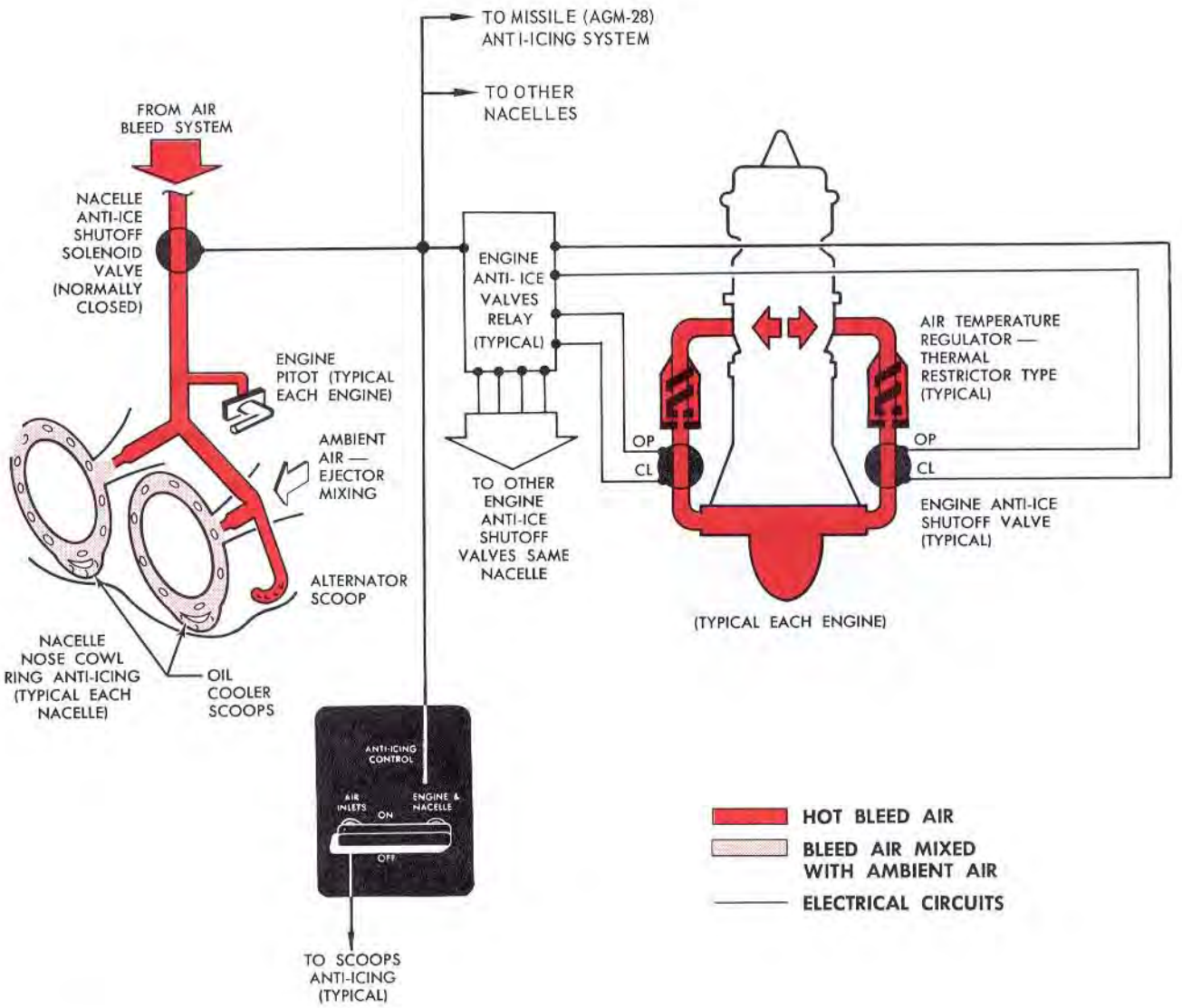


Figure 4-5. (Sheet 1 of 2).

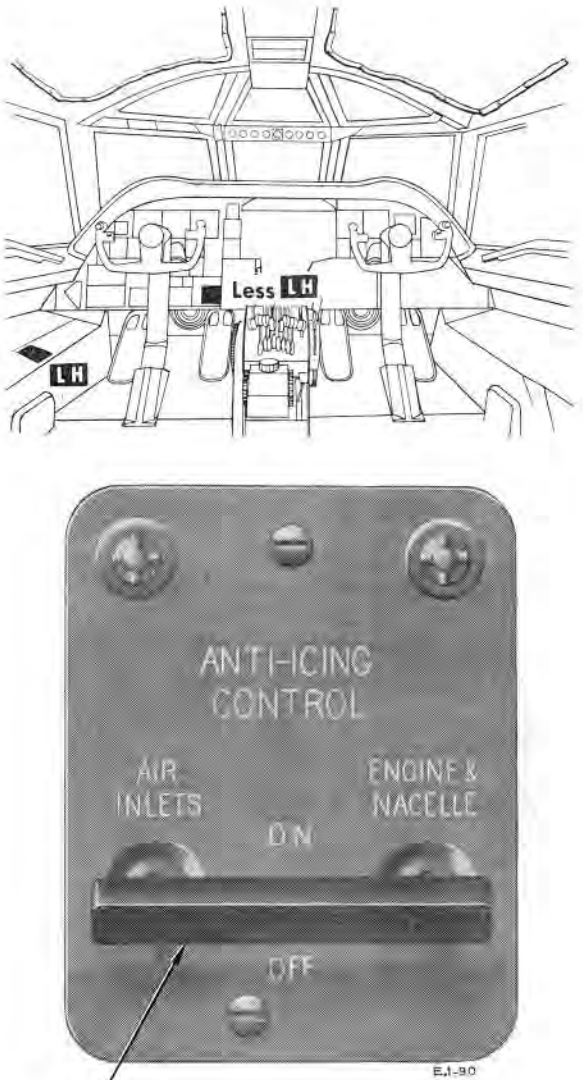
ENGINE AND NACELLE ANTI-ICING

B-52F



.....engine nacelle, and scoops anti-icing

Figure 4-5. (Sheet 2 of 2).



anti-icing control panel (typical)

Figure 4-6.

Anti-Icing Control Switch

A ganged ON--OFF anti-icing control switch (figure 4-6) on the pilot's forward instrument panel Less LH and (13A, figure 1-9) on the pilot's side panel LH controls engine and nacelle, ram airscoop, and missile (AGM-28) anti-icing. See "Airscoop Anti-Icing" for further information on that function.

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In ON position, connections are made for TR power to cause all engine and nacelle anti-icing shutoff valves to open. ON position also supplies TR power and 118-volt a-c power to the four nacelle temperature regulators. The temperature regulator in each nacelle uses TR control power to connect 205-volt three-phase a-c power to the modulating valve motor as required to maintain proper anti-icing temperature. In OFF position, the nacelle temperature modulating valves and the engine anti-icing shutoff valves are energized to close. OFF position deenergizes the nacelle anti-icing shutoff valve solenoids, allowing duct pressures to close the valves.

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ON position directly connects TR power to cause all engine and nacelle anti-icing shutoff valves to open. OFF position directly connects TR power to close the engine anti-icing shutoff valves and deenergizes the nacelle anti-icing shutoff valve solenoids, allowing duct pressures to close the valves.

Engine and Nacelle Anti-Icing System Normal Operation

WARNING

Actuating the engine and nacelle anti-icing above NRT settings may cause engine surge and flameout. Before turning on anti-icing, ascertain that engine starter switches are in START. Do not turn starter switches OFF until rpm and EPR have stabilized.

The engine and nacelle anti-icing system was designed to prevent the accumulation of ice in the inlet section of the engine, not to remove it. Thus, it is essential that icing conditions be anticipated. Therefore, the engine and nacelle anti-icing control switch will be turned on below 20,000 feet when the OAT gage reading is below 10° C during night flights or in areas of forecasted or suspected icing conditions. If ice should form, the engines must be above a minimum EPR to maintain adequate anti-icing. Flying at a speed of 340 knots IAS or above will insure that the minimum EPR required to anti-ice is available. When flying below 340 knots IAS, the EPR must be kept above the minimum values noted in the table below by extension of drag items as necessary.

	B-52E		B-52F	
Altitude	Minimum EPR Below 280 Knots IAS	Minimum EPR 280 Knots IAS & Above	Minimum EPR Below 280 Knots IAS	Minimum EPR 280 Knots IAS & Above
Sea Level	1.60	1.50	1.61	1.50
5,000 ft	1.60	1.50	1.75	1.57
10,000 ft	1.70	1.60	1.83	1.63
15,000 ft	1.82	1.72	1.90	1.69
20,000 ft & above	1.95	1.85	1.95	1.75

NOTE

If ice is inadvertently allowed to build up on the engine inlet, throttle setting should be reduced (if flight conditions permit) before anti-ice is activated to prevent or reduce engine damage. Throttle settings should be consistent with minimum EPR's for use of anti-ice heat and ignition should be turned on until engine stabilizes.

Proper operation of the anti-icing system is indicated when a noticeable EPR drop on all engines is noted upon actuating the anti-icing control switch to ON. Engine and nacelle anti-icing should remain ON at all times during icing conditions. This includes static ground operation, taxiing, and the takeoff ground run.

WARNING

Using engine and nacelle anti-icing during takeoff results in an increase in the takeoff ground roll of 2.5% B-52E or 5% B-52F.

CAUTION

Indiscriminate or prolonged use of the engine and nacelle anti-icing system at times when its use is not warranted may cause cracks to occur in the engine inlet guide vanes. When the possibility of encountering icing conditions no longer exists, the anti-icing control switch should be turned to OFF position.

Engine and Nacelle Anti-Icing System Emergency Operation

No provisions are made for emergency operation of the engine and nacelle anti-icing system.

AIRSCOOP ANTI-ICING

Airscoop anti-icing is accomplished by directing hot air from the air bleed system to the forward air conditioning pack ram airscoop, aft air conditioning pack ram airscoop, and on airplanes Less LK the Q-spring ram air inlet. Airscoop anti-icing from the air bleed system is controlled by two fail-safe air-actuated solenoid-controlled shutoff valves, one located in the left wing and the other in the fin leading edge. These valves are operated by TR power through the anti-icing control switch and landing gear safety switch relay supplied through a circuit breaker marked "Air Scoop Anti-Ice Control" on the "Anti-Ice" portion of the pilot's circuit breaker panel. The anti-icing control switch is a ganged ON--OFF switch (figure 4-6) located on the pilot's forward instrument panel. The switch also controls engine and nacelle anti-icing. With the switch in ON position and the weight off the landing gear, the two shutoff valve solenoids are energized, permitting hot air to flow to the air bleed anti-iced airscoop areas. In OFF position, the shutoff valve solenoids are de-energized and pneumatic pressure closes the valves. On aircraft LK, the Q-spring ram air inlet is electrically anti-iced by 118-volt single-phase ac supplied through a circuit breaker marked "Q-Spring Scoop Anti-Ice" on the aft a-c power distribution shield when the Q-spring scoop anti-ice relay is energized by TR control power through the anti-icing control switch.

PITOT ANTI-ICING

Less PP

Both left and right pitot heads are electrically heated to prevent or remove ice formation. In addition, an electrical heading element on the inside of the pitot tube fairing leading edge provides heat for anti-icing purposes when the normal power source is available. An automatic current control reduces overheating of the heads during ground operation and provides additional heating during extreme cold weather operation. Right (pilot's) tube heat is normally supplied switched battery power through a circuit breaker marked "Pilot Pitot Tube Ht" on the "Flight Indicators" portion of the pilot's circuit breaker panel. Right (pilot's) fairing heat is normally supplied switched battery power through a circuit breaker marked "Pilot Pitot Fairing Ht" on the "Flight Indicators" portion of the pilot's circuit breaker panel. Left (copilot's) pitot tube and fairing heat is normally supplied switched battery power through a circuit breaker marked "Copilot Pitot Fairing & Tube Ht" on the "Flight Indicators" portion of the pilot's circuit breaker panel.

PP

Right pitot tube and fairing heat is supplied 28-volt a-c power through a circuit breaker marked "Pilot Pitot Tube Ht" on the "Flight Indicators" portion of the pilot's circuit breaker panel. Left pitot and fairing heat is supplied 28-volt a-c power through a circuit breaker marked "Copilot Pitot Tube Ht" on the right aft a-c power load box. Automatic current control reduces overheating of the tubes during ground operation and provides additional heating during extreme cold weather operation. There is no emergency provision for pitot anti-icing.

Pitot Anti-Icing Controls

PITOT HEAT SWITCHES. Left and right ON--OFF pitot heat switches (55, figure 1-13 and 57, figure 1-13A) are located on the left side of the pilots' instrument panel and (13A, figure 1-9) on the pilot's side panel. ON position of each switch energizes the pitot tube and fairing heaters on the respective (left or right) side of the aircraft to prevent pitot tube stoppage by icing. OFF position removes power from the heaters.

Pitot Anti-Icing Normal Operation

Pitot heat switches should be in ON position prior to takeoff or in flight whenever icing conditions are anticipated to prevent ice formation and loss of airspeed indication. The switches should be turned to OFF position after landing.

CAUTION

To reduce overheating of the elements and current control, do not leave pitot heat switches in ON position for extended periods while the airplane is on the ground.

Pitot Anti-Icing Emergency Operation Less PP

Emergency power for heating the pilot's pitot head may be obtained from the forward battery if the battery switch is ON or from the aft 24-volt d-c direct battery bus by switching the emergency battery switch to the EMERG position.

WARNING

If operation is attempted with the emergency battery switch in the EMERG position, power will not be provided to the fairing heaters or the copilot's pitot head heater and caution must be observed when flying in known or suspected icing conditions. Flight tests in icing conditions have indicated that without fairing heat the pitot tubes will ice up even with pitot heat turned on and loss of airspeed indication at the pilot's or copilot's station can result.

WINDSHIELD ANTI-ICING AND WINDOW DEFOGGING

The airplane is equipped with electrically heated windows which include the pilots' windshield, auxiliary windows above and behind the windshield, and auxiliary windows in the upper escape hatches and at the EW officer's and gunner's stations. The pilots' windshield windows are numbered 1 through 4L and 4R; auxiliary windows at the pilots' station are numbered 5L, 5R, and 7 as shown in figure 1-8. Heating of all the windows is accomplished by a transparent electrically conductive film between the glass laminations. There are two types of windows, anti-ice and defog. The anti-ice windows have the conductive film next to the outer pane which serves to prevent the formation of ice on the outside of the window in addition to preventing fog formation on the inside of the window. The defog windows have the conductive film next to the inner pane to prevent fog formation on the inside of the window. Windows of the pilots' windshield, 1 through 4L and 4R, are the anti-ice windows; the remainder of the heated windows in the airplane are defog windows. A-C power passed across the conductive films is supplied by 118-volt, single-phase, a-c powered autotransformers for all windows except the EW officer's, which use 118-volt single-phase a-c power from the airplane bus. The temperatures of the pilots' windshield windows 1 through 4L and 4R (anti-iced) are regulated by a-c powered electronic temperature control units signalled by sensing elements in the conductive films. Temperatures of all the auxiliary (defog) windows are controlled by individual thermal switches mounted on the surface of each window glass. The anti-ice windows may be operated at two different heating rates while the defog windows have only a single heating rate. All windows in the forward cabin are controlled by a single windshield anti-ice and defogging switch on the pilot's instrument panel except on B-52F ND airplanes, the auxiliary (defog) window heating is controlled by a separate auxiliary window defog switch on the pilot's instrument panel. All windows in the tail compartment are controlled by a single defog switch on the aft air conditioning panel. When either of the pilots' sliding windows (3L and 3R) are opened, limit switches are actuated to discontinue anti-icing of all three windows 3L, 3R, and 4L. All control relays in the forward compartment utilize TR power for operation.

Windshield Anti-Icing and Window Defogging Controls

WINDSHIELD ANTI-ICE AND DEFOGGING SWITCH. A three-position rotary selector switch (53, figure 1-13 and 54, figure 1-13A) located on the pilots' instrument panel electrically controls the operation of all heated windows in the forward cabin. The switch has OFF--NORMAL--HIGH positions. OFF position deenergizes all equipment. In NORMAL position a-c power is passed across the conductive films of all the windows and gives a normal heating rate. In HIGH position increased a-c power is made available to pilots' anti-iced windshield windows 1 through 4L and 4R and gives a high heating rate to those windows in order to prevent icing under the most severe conditions; all other windows continue to operate at the normal rate. In both NORMAL and HIGH positions, 118-volt a-c power is supplied to the electronic temperature regulators, TR power controls the overheat and power relays, and 118-volt a-c power is supplied to the autotransformers and auxiliary windows on B-52F except ND airplanes. Auxiliary window heating is controlled by a separate ON--OFF auxiliary window defog switch (55A, figure 1-13A) on the left end of the pilot's instrument panel. The switch controls the circuitry and power source controlled by NORMAL position of the windshield anti-ice and defogging switch on other aircraft. TR power is supplied to the switch through circuit breakers marked "Left Windshield Relays," "Right Windshield Relays,"

and "Aux Windows Relays." A-C power is supplied through circuit breakers marked "Left Windshield Cont Units," "Right Windshield Cont Units"; "Windshield" - "1," "2" - "Left" and "Right," "3," "4" - "Left" and "Right," "5 & 7," "Obsvr," and "Escape Hatch." All circuit breakers are on the "Anti-Ice" portion of the pilot's circuit breaker panel.

GUNNER'S WINDOW DEFOG SWITCH. An ON--OFF toggle switch (7, figure 4-3) located on the aft air conditioning panel controls operation of all heated windows in the tail compartment. ON position of the switch directly connects 118-volt single-phase a-c power from a circuit breaker marked "Window Defog" on the gunner's circuit breaker panel to the autotransformer to heat the windows. A thermal snap switch protects each window from overtemperature. OFF position disconnects a-c power from the autotransformer.

Windshield Anti-Icing and Window Defogging Normal Operation

PILOTS' WINDSHIELD AND WINDOWS. Use the lowest power setting that will provide adequate anti-icing in order to prolong windshield life.

1. Place windshield anti-ice and defogging switch in NORMAL position prior to takeoff. Leave the switch in this position as long as satisfactory anti-icing and defogging is obtained. The NORMAL setting will give the longest windshield service life and will provide satisfactory anti-icing and defogging under normal flight conditions. On B-52F [ND] aircraft, use the auxiliary window defog switch as required.

CAUTION

To prevent damage to the anti-iced windows, operate on NORMAL 15 minutes before turning switch to HIGH position.

2. The windshield anti-ice and defogging switch should be set to HIGH at any time the NORMAL setting does not provide satisfactory defogging or anti-icing of the pilots' windshield windows 1 through 4L and 4R.
3. Turn the switches OFF after landing.

GUNNER'S HEATED WINDOWS. Turn the window defog switch ON prior to takeoff. No further manual control is provided. Turn the switch to the OFF position after landing.

Windshield Anti-Icing and Window Defogging Emergency Operation

If arcing at the heating power terminals, arcing at the sensing element, or discoloration or bubbles in the windows occurs, pull the individual circuit breakers for the affected window. These circuit breakers are marked "1," "2 Left," "2 Right," "3," "4 Left," "4 Right," "5 & 7," "Obsvr," and "Escape Hatch." They are grouped under "Anti-Ice Windshield" on the pilot's circuit breaker panel. The numbered circuit breakers apply to the various parts of the pilots' windshield respectively numbered as shown on figure 1-8.

NOTE

- The anti-ice control circuit breakers marked "Windshield Relays," "Windshield Cont Units," and "Aux Windows Relay" should not be pulled, since these circuit breakers provide power for the control of heat to more than one window.
- The structural integrity of a cracked window may be checked by sliding a hand across the inner surface to feel for the crack. Since the inner pane of a heated window is the primary structure, a crack in only the outer pane will not impair the strength. (Unheated windows 6L and 6R are made of laminated acrylic plastic and carry the load on the outer surface.)

COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT

The communication and associated electronic equipment (figure 4-7) includes an interphone system, UHF command radio, liaison radio, TACAN radio, omni-range radio, glide slope equipment, marker beacon receiver, radar altimeter, rendezvous radar, IFF radar, radar warning receiver, fire control radar, doppler radar, automatic astrocompass, AJA-1 true heading computer system, N-1 compass system, and BNS radar. For antenna locations, see figure 4-9.

INTERPHONE SYSTEM AN/AIC-10A

A transistorized interphone system provides intercommunication between the crew stations, transmission and reception on UHF command and liaison radio sets, and reception of audio signals from specialized receivers. Control panels (figure 4-8) vary according to station requirements. All crew stations have a control panel containing a selector switch and five mixing switches. The selector switch is used for selecting transmitting and receiving channels. The mixing switches permit simultaneous monitoring of channels essential to the station. The celestial navigation station has the same selector switch capabilities but no provisions for monitoring. Stations of limited use (stabilizer jackscrew, forward wheel well, bunk, and bomb bay) utilize interphone and call functions only. Only 24-volt d-c direct battery power is used to power

REVERSE SIDE INTENTIONALLY LEFT BLANK

the system, all stations being in parallel. All interphone power is supplied through circuit breakers on the pilots' overhead circuit breaker panel. Normal battery power is supplied through a circuit breaker marked "Fwd Bat Pwr" on the "Inph & Inbd Air Brake" portion of the panel. Emergency battery power is supplied through a circuit breaker marked "Aft Bat Pwr" on the same portion of the panel when the emergency battery switch is in the EMERG position. D-C control power is provided through a circuit breaker marked "Inph" on the center portion of the panel. The 24-volt dc is used for filament voltages and to energize the call channel.

Interphone System Controls

INTERPHONE SELECTOR SWITCH. A selector switch (9, figure 4-8) on each crew member's interphone panel has CALL--INTER--COMM--LIA--COMM NO. 2--PVT INTER positions. When any selector switch is held in the CALL position (the switch is spring-loaded away from this position) all stations are contacted simultaneously regardless of their selector switch positions. The INTER position provides normal interphone communication between crew members. COMM, LIA, and COMM NO. 2 positions permit corresponding transmission and reception via UHF command, liaison, and No. 2 UHF command radios. Both command radios may be used interchangeably and simultaneously in most airplanes. The PVT INTER position provides another interphone channel identical in function to the normal channel and can be used at the same time for private or extended communication between two or more crew members.

NOTE

When the call channel is energized, it is not necessary to depress any mike switch to talk on this channel, as the mike switches are bypassed. Use the call channel only in emergencies or to direct someone to another facility.

INTERPHONE VOLUME CONTROL KNOB. A volume control knob (10, figure 4-8) on each interphone panel regulates the volume level received at that station. Normally the volume control knob should be set at or less than the midposition (usually, but not necessarily, the 12 o'clock position). When the volume control knob is rotated beyond the midposition, distortion becomes excessive. When the auxiliary listen switch is in AUX LISTEN, the volume control knob is ineffective. It is also ineffective at all stations except the bomb bay, forward wheel well and stabilizer jackscrew stations when the auxiliary listen switch is on NORMAL and the call channel is energized.

AUXILIARY LISTEN SWITCH. An auxiliary listen switch (8, figure 4-8) on each interphone panel is used to provide listening facilities at that station if the amplifier in that panel fails. This switch has NORMAL--AUX LISTEN positions, and is lockwired in the NORMAL position. If the amplifier in the panel should fail, breaking the lockwire and positioning the switch to AUX LISTEN will permit a crew member to listen to one facility at a time at that panel. If the panel has mixer switches and they are off, or if the panel does not have mixer switches, then the facility heard will be selected by the selector switch. If the panel has mixer switches and any of them are on, then the facility heard will be the one associated with the farthest left mixer switch that is on. The mixer switches on the interphone control panel take precedence over the auxiliary mixer switches on the auxiliary interphone panel.

MIXER SWITCHES. The mixer switches (7, figure 4-8) allow monitoring of channels essential to individual crew positions. Placing one or more mixer switches to the ON (up) position provides listening to the corresponding channel(s) simultaneously with transmission or reception on any other channel selected on the interphone selector dial. The mixer switches allow listening to the interphone system, UHF command radio, liaison radio, ECM receiver (EW officer), No. 2 UHF command (pilot, copilot, radar navigator, EW officer, gunner, instructor pilot, and instructor navigator), TACAN or omni-range radio and marker beacon (pilot, copilot, navigator, radar navigator, instructor pilot, and instructor navigator), radar warning receivers (EW officer), and rendezvous radar beacon (EW officer). The ECM interphone panel has two banks of mixer switches for greater capability.

INTERPHONE (SYSTEM) POWER SWITCH. An ON--OFF interphone power switch (16, figure 1-9) is located on the pilot's auxiliary side panel. ON position provides direct battery power to the pilot's, copilot's, instructor pilot's, radar navigator's, navigator's, instructor navigator's, EW officer's, bunk, gunner's, and defense instructor's interphone facilities. In addition when positioned to ON, direct battery power is supplied to the interphone facilities in the bomb bay forward wheel well, and stabilizer jack screw provided the battery switch is ON.

NOTE

This switch provides a direct connection of a portion of the interphone system to the batteries, independent of the battery switch. To conserve batteries this switch should be placed in the OFF position whenever a-c power is lost or removed from the airplane and the interphone system is not to be operated.

INTERPHONE (ALTERNATE) POWER SWITCH. A toggle switch (2, figure 4-8) having NORMAL--ALTERNATE positions is located on the power switch panels at each of the following stations: pilot's, copilot's, navigator's, and gunner's. Both ALTERNATE and NORMAL positions are connected to the same 24-volt d-c power source and no alternate power is available through operation of this switch.

CALL BUTTON. A call button (11, figure 4-8) on the interphone panels at the bomb bay, forward wheel well, bunk station, and stabilizer jackscrew stations, when pressed down, is used to call all other stations on the call channel.

NOTE

The call button cover must be removed before the button can be depressed.

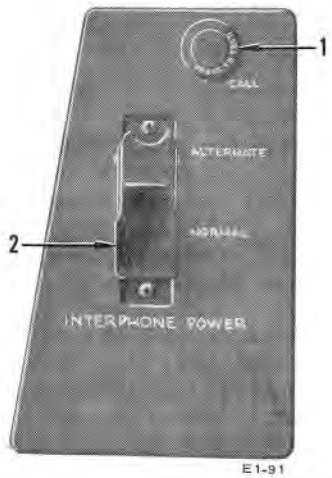
TYPE	DESIGNATION	FUNCTION	OPERATOR	HORIZONTAL RANGE	LOCATION OF CONTROLS
INTERPHONE	AN/AIC-10A	Intercrew communication	Any crew member		Each crew station
UHF COMMAND UHF COMMAND NO. 2	AN/ARC-34 AN/ARC-34	Short range, two-way, voice and code communication	Pilot and Copilot Pilot and Copilot	75-270 mi.	Pilots' overhead panel Pilots' overhead panel
UHF DIRECTION FINDER	AN/ARA-25	Determines direction of incoming UHF signals to the command radio	Pilot and Copilot	75-150 mi.	Operates through UHF command radio
LIAISON RADIO	AN/ARC-65	Long range, two way, voice and code communication	Pilot and EW officer	800-1500 mi.	Pilot's side panel, EW officer's radio panel
TACAN RADIO	AN/ARN-21	UHF navigation	Pilot	195 miles	Pilot's side panel
OMNI RANGE RADIO	AN/ARN-14	Indicates lateral alignment with runway and used for VHF navigation	Pilot and Copilot	Line of Sight	Pilot's overhead panel
GLIDE SLOPE	AN/ARN-13 190 215 W70▶ W83▶ AN/ARN-31 216 W84▶	Indicates glide angle for landing	Pilot and Copilot	15 miles	Operates through omni range radio
MARKER BEACON	AN/ARN-32	Receives location marker signals on navigation beam	Pilot and Copilot	Low altitude	Operates through omni-range radio
RADAR ALTIMETER	AN/APN-150	Measures terrain clearance	Pilot		Pilots' instrument panel

Figure 4-7 (Sheet 1 of 2).

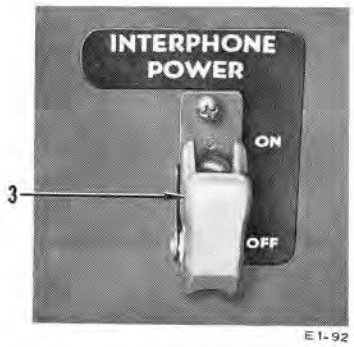
RENDEZVOUS RADAR	AN/APN-69	Aerial rendezvous	EW officer **Less** N/F Navigator N/F	150-200 mi	EW officer's side panel **Less** N/F Navigator's side panel N/F
IFF RADAR	AN/APX-25	Aircraft recognition	Navigator	Line of Sight	Navigator's side panel
N-1 COMPASS SYSTEM		Provides heading reference	Navigator		Navigator's station
DOPPLER RADAR (COMPONENT OF AN/ASQ-38(V))	AN/APN-89A	Ground speed and wind drift	Navigator		Navigator's forward panel
BOMBING NAVIGATION SYSTEM (COMPONENT OF AN/ASQ-38(V))	AN/ASB-4A	Bombing	Radar Navigator		Radar Navigator's station
AUTOMATIC ASTRO-COMPASS SYSTEM (COMPONENT OF AN/ASQ-38(V))	MD-1	Provides heading reference	Navigator		Navigator's station
AJA-1 TRUE HEADING COMPUTER SYSTEM (COMPONENT OF AN/ASQ-38(V))	AN/AJA-1	Provides heading reference	Navigator		Navigator's station
BNS RADAR SYSTEM (COMPONENT OF AN/ASQ-38(V))		Provides low level flight assist	Pilot, Copilot, and Radar Navigator		Pilot, copilot, and radar navigator's station
FIRE CONTROL SYSTEM	MD-9	Fire control	Gunner		Gunner's station

communication and associated electronic equipment

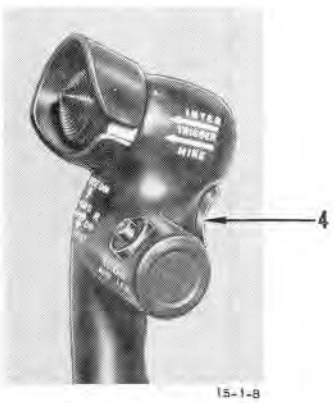
Figure 4-7 (Sheet 2 of 2).



TYPICAL INTERPHONE (ALTERNATE) POWER SWITCH PANEL (PILOT, COPILOT, NAVIGATOR, AND GUNNER)

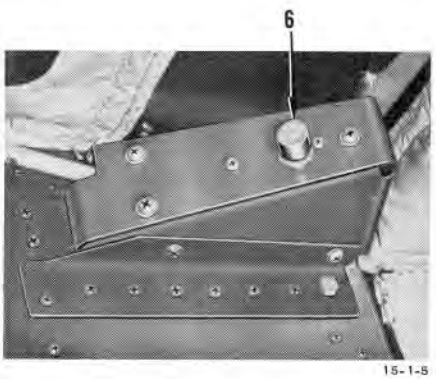


INTERPHONE (SYSTEM) POWER SWITCH (PILOT)



TRIGGER SWITCH (PILOT AND COPILOT)

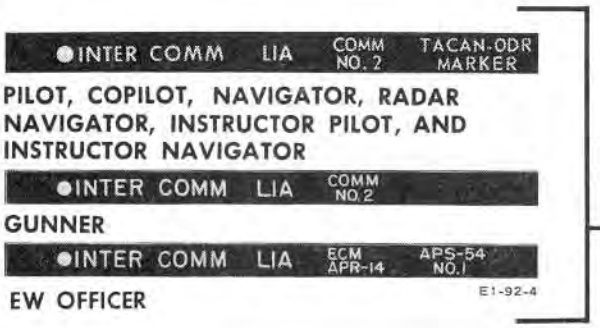
HAND SWITCH (BOMB BAY, FORWARD WHEEL WELL, STABILIZER JACK SCREW, BUNK, INSTRUCTOR PILOT, INSTRUCTOR NAVIGATOR, GUNNER, AND CELESTIAL NAVIGATION STATIONS)

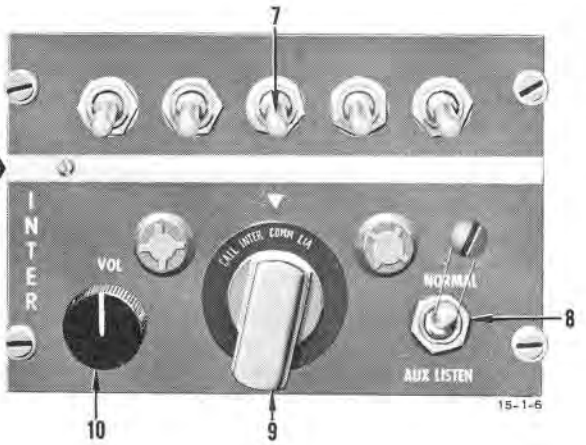


FOOT SWITCH (RADAR NAVIGATOR, NAVIGATOR, EW OFFICER, AND GUNNER)

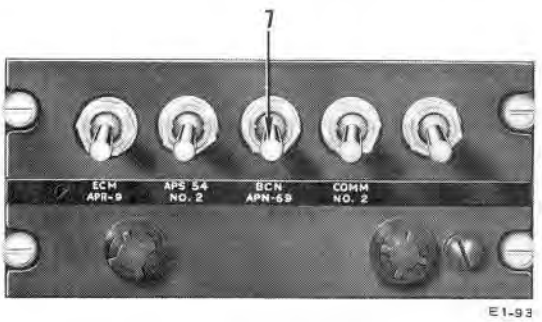
1. CALL LIGHT
2. INTERPHONE (ALTERNATE) POWER SWITCH
3. INTERPHONE (SYSTEM) POWER SWITCH
4. TRIGGER SWITCH
5. HAND SWITCH
6. FOOT SWITCH
7. MIXER SWITCH
8. AUXILIARY LISTEN SWITCH
9. INTERPHONE SELECTOR SWITCH
10. INTERPHONE VOLUME CONTROL KNOB
11. CALL BUTTON

Figure 4-8. (Sheet 1 of 2).

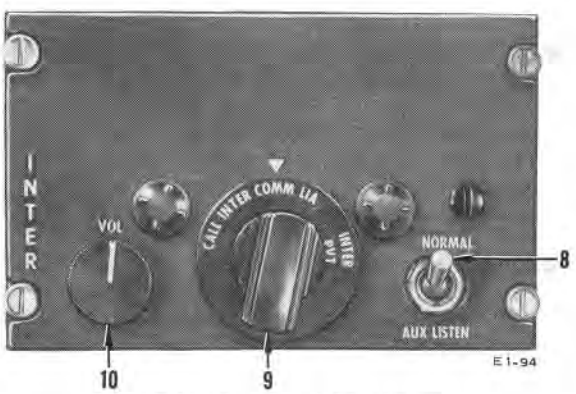




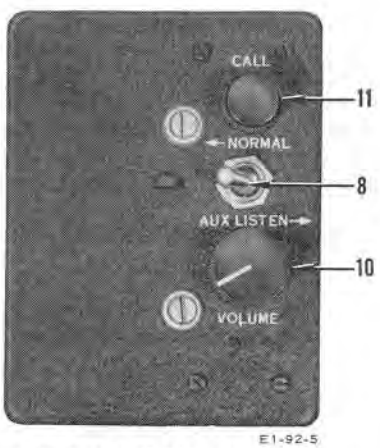
INTERPHONE CONTROL PANEL (PILOT, COPILOT, NAVIGATOR, RADAR NAVIGATOR, EW OFFICER, GUNNER INSTRUCTOR PILOT, AND INSTRUCTOR NAVIGATOR)



INTERPHONE MIXER CONTROL PANEL (EW OFFICER)



INTERPHONE CONTROL PANEL (CELESTIAL NAVIGATION STATION)



INTERPHONE CONTROL PANEL (BOMB BAY, FORWARD WHEEL WELL, STABILIZER JACK SCREW, AND BUNK STATION)

.....interphone system controls

Figure 4-8. (Sheet 2 of 2).

TRIGGER SWITCH. A trigger switch (4, figure 4-8) on the pilot's and copilot's control wheels has three positions, INTER--OFF--MIKE, and is spring-loaded to the OFF position. When the switch is held in the MIKE position the crew member may speak through the facility selected on the interphone selector switch. When the switch is held in the INTER position the crew member can speak on the interphone channel only. The purpose of the trigger switches is to provide the pilots with a microphone switch and a quick method for speaking on the interphone without changing the selector switch. When the interphone selector switch is in the CALL position, the trigger switch need not be actuated to speak to the crew.

FOOT SWITCH. A foot switch (6, figure 4-8) on the floor at the EW officer's, radar navigator's, navigator's, and gunner's stations is the microphone switch for the respective crew members. When the switch is depressed, the crew member may speak through the facility selected on the interphone selector switch. When the interphone selector switch is in CALL position, the foot switch need not be depressed in order to speak to the crew.

HAND SWITCH. The microphone hand switch (5, figure 4-8) is a pushbutton contained in the headset plug connector on the end of the microphone cord. This type of switch is provided at the following stations: bomb bay, forward wheel well, stabilizer jackscrew, bunk, instructor pilot, instructor navigator, gunner, and celestial navigation. The switch is depressed for talking over the interphone. The switch must be released for listening. This hand switch is provided at the gunner's station in addition to a foot switch to permit the gunner to move about the compartment.

Interphone System Indicators

CALL LIGHT. An amber call light (1, figure 4-8) on the power switch panel at the pilot's, copilot's, navigator's, and gunner's stations, and also on the cabin altimeter bracket (4, figure 4-54) at the gunner's station indicates when the call channel is energized.

Interphone System Normal Operation

WARNING

All crew members must be on interphone at all times as the interphone is considered the primary means for crew warning.

To transmit or receive over any interphone facility, observe the following procedure:

1. Turn volume knob to or slightly less than its midpoint. Reception will become distorted if volume is turned too high.
2. Turn interphone selector switch to desired facility (i. e., COMM, LIA). It is necessary to hold CALL switches or buttons in position.

NOTE

As only the pilots or EW officer can turn on or select channels on the UHF command, liaison, and omni radios, it will be necessary for other crew members to contact these stations on interphone and request the respective set be turned to the desired channel.

3. Close mike switch to talk. The speaker will hear only his own voice unless someone else is speaking on CALL.
4. Place mixer switch(es) in ON (up) position for any channel(s) to be monitored.

Interphone System Emergency Operation

In an emergency the interphone system can be operated from the aft battery by placing the emergency battery switch in the EMERG position. This provides normal interphone operation for all stations.

UHF COMMAND RADIO AN/ARC-34

The AN/ARC-34 radio provides voice and modulated code communication from airplane to airplane and airplane to ground. There are 1750 frequencies available in steps of one-tenth of a megacycle within the frequency range of 225. 0 to 399. 9 megacycles. Any 20 frequencies may be preset in any order at the control panel (figure 4-10) located on the pilots' overhead panel. If it is desired to tune to a frequency other than one which has been preset, that frequency may be set manually without disturbing any of the preset channels. Receiver and transmitter tuning is automatically completed after a channel or frequency change. Both a main receiver and a preset guard receiver are provided to permit a selected frequency and the guard frequency to be received simultaneously. A No. 2 AN/ARC-34 radio is installed with the control panel located on the pilots' overhead panel. The No. 2 set, however, is not connected to the UHF direction finder.

NOTE

- No transmission will be made on emergency (distress) frequency channels except for emergency purposes. For test, demonstration, or drill purposes, this radio equipment will be operated in a shielded room to prevent transmission of messages that could be construed as actual emergency messages.
- When the aircraft is equipped with ice-tread tires, radio noise is generated in the No. 1 AN/ARC-34 radio during the takeoff roll and the landing roll.

Each AN/ARC-34 radio set has its own antenna as shown in figure 4-9. When both No. 1 and 2 radios are operated simultaneously, more efficient operation may result if the radios are tuned at least one-half megacycle apart. The No. 1 AN/ARC-34 set receives TR power through a circuit breaker marked "UHF Command" located on the gunner's circuit breaker panel **Less** P.W. and on the aft d-c power shield P.W. The No. 2 AN/ARC-34 set operates on TR power provided through a circuit breaker marked "UHF Com No. 2" located on the pilots' overhead circuit breaker panel **Less** P.W. and on section 41 power distribution panel P.W.

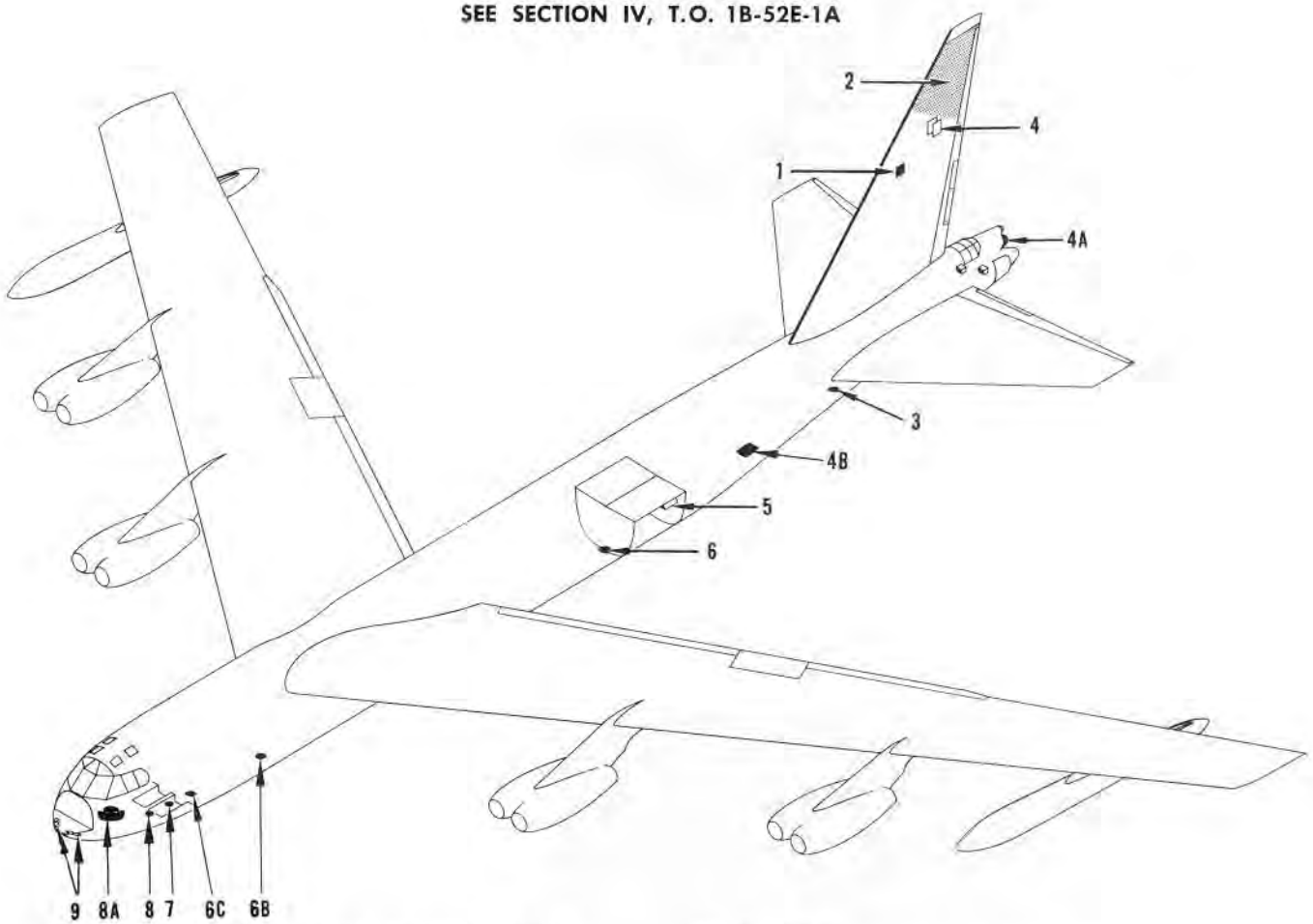
The following values of range for various aircraft altitudes are typical for the AN/ARC-34 radio set:

Altitude (1000 feet)	Average Range (Nautical Miles)
50	270
40	240
30	210
20	170
10	120

UHF Command Radio Controls

MANUAL FREQUENCY SELECTOR KNOBS. Manual frequency selector knobs (2, figure 4-10) on the UHF command radio control panel are used to set up any of the operating frequencies other than those already available on the preset channels. This does not disturb any of the preset channels. The manual-preset-guard switch must be in MANUAL position before the dial numbers above the control knobs will become visible. Each knob is turned until the proper digit appears in the window.

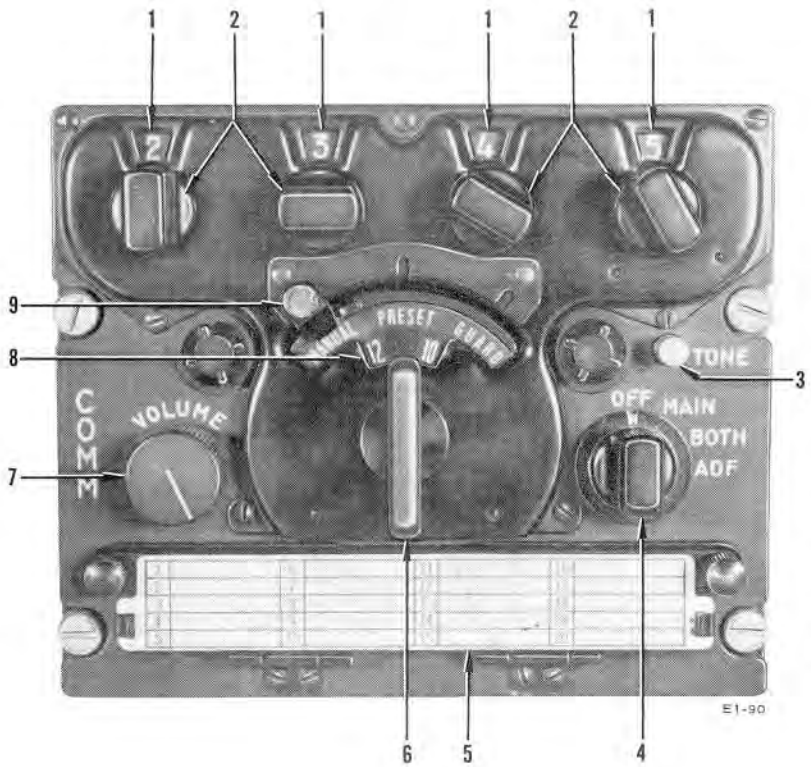
NOTE
FOR ECM ANTENNA LOCATIONS
SEE SECTION IV, T.O. 1B-52E-1A

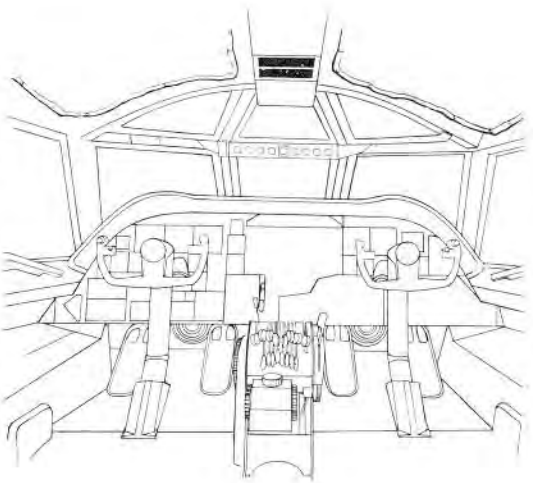


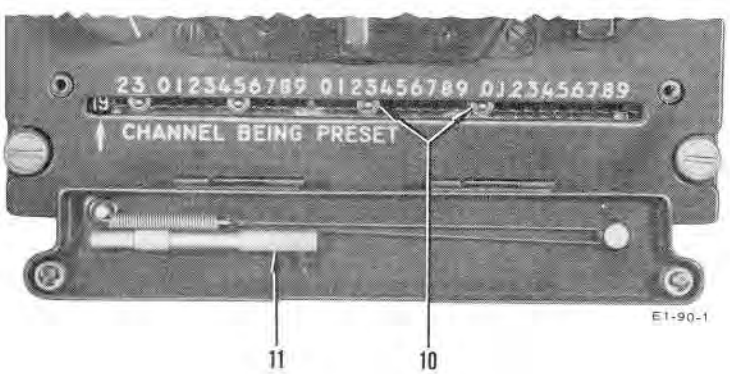
1. RENDEZVOUS RADAR BEACON ANTENNA
2. LIAISON RADIO ANTENNA
3. UHF COMMAND RADIO ANTENNA
4. OMNI RANGE RADIO ANTENNA
4A. FCS SEARCH RADAR ANTENNA
4B. RADAR ALTIMETER ANTENNA APN-150
5. MARKER BEACON ANTENNA
6. DIRECTION FINDER ANTENNA
6A. DELETED
6B. DOPPLER RADAR ANTENNA APN-89A
6C. TACAN ANTENNA
7. IFF ANTENNA
8. UHF COMMAND NO. 2 RADIO ANTENNA
8A. BNS RADAR ANTENNA
9. GLIDE SLOPE ANTENNA

.....antenna locations (except ECM)

Figure 4-9.







1. MANUAL FREQUENCY INDICATORS
2. MANUAL FREQUENCY SELECTOR KNOBS
3. TONE BUTTON
4. OFF-MAIN-BOTH-ADF SWITCH
5. PRESETTING DRUM COVER
6. PRESET CHANNEL SELECTOR SWITCH
7. VOLUME CONTROL KNOB
8. PRESET CHANNEL INDICATOR DIAL
9. MANUAL-PRESET-GUARD SWITCH
10. CHANNEL PRESETTING BUTTONS
11. FREQUENCY PRESETTING TOOL

UHF command radio controls

Figure 4-10.

TONE BUTTON. The tone button (3, figure 4-10) located on the UHF command radio control panel energizes an oscillator and turns on the transmitter when depressed and held. A continuous tone is transmitted until the button is released.

OFF-MAIN-BOTH-ADF SWITCH. A four-position rotary switch (4, figure 4-10) on the UHF radio control panel has OFF--MAIN--BOTH--ADF positions. The set is inoperative in OFF position. In MAIN position, the transmitter and main receiver are operative at the same frequency. The guard receiver is inoperative and the guard frequency can be received only if it is one of the preset channels or if it is manually set up using the manual frequency control knobs. In BOTH position, it is possible to transmit on a selected frequency and simultaneously receive the main receiver frequency and the fixed guard receiver frequency. A UHF direction finder is installed to provide bearing information on incoming UHF signals. ADF position will place the bearing indication on the pilots' radio magnetic indicator (figure 4-12).

PRESET CHANNEL SELECTOR SWITCH. A rotary-type preset channel selector switch (6, figure 4-10) on the UHF radio control panel is used to select any one of 20 preset frequencies.

VOLUME CONTROL KNOB. A volume control knob (7, figure 4-10) on the UHF radio control panel is used to adjust the volume of both main and guard receivers. However, receiver output cannot be reduced below a fixed audible level.

MANUAL-PRESET-GUARD SWITCH. A manual-preset-guard switch (9, figure 4-10) on the UHF radio control panel selects the method of frequency selection. In MANUAL position, the covers over the digit windows are retracted, exposing the frequency numbers. The frequency can then be set using the manual frequency selector knobs. Preset channels can be checked or changed without disturbing the MANUAL operating frequency. The preset channel number is covered in this switch position and PRESET and GUARD are seen through a green window. PRESET position allows the preset channel selector to be used to select any one of 20 preset frequencies. MANUAL and GUARD are covered by a green window. In GUARD position, only the main receiver and transmitter are operative even though the off-main-both-ADF switch is set to BOTH. The guard frequency is set up prior to installing the equipment in the airplane and can be changed only by removal of the control panel. MANUAL and PRESET can be seen through a green window.

CHANNEL PRESETTING BUTTONS. The channel presetting buttons (10, figure 4-10) on the presetting drum behind the drum cover are used for presetting channel frequencies. Each channel has four buttons and only one channel is accessible at a time. With the drum cover open, the preset channel selector is turned to rotate the presetting drum until the desired channel appears in the opening. The presetting tool then can be used to position the preset buttons under the digits corresponding to the frequency. Only the channel number appearing on the left end of the drum is used for reference when presetting.

FREQUENCY PRESETTING TOOL. A small tool (11, figure 4-10) on the back of the drum cover (5, figure 4-10) is used to position the frequency preset buttons on the preset drum. Access to the tool and preset drum is gained by opening the drum cover.

CAUTION

Do not set the preset buttons or select a frequency on MANUAL that is below 225.0 megacycles (the lowest operating frequency) as the automatic tuning mechanism cannot set up on that frequency and will hunt. If the set does not channel within 2 minutes or is shut down by a protective relay, reset to a frequency within the operating range. Turn the off-main-both-ADF switch to OFF then to BOTH, and allow approximately 1 minute for the set to resume operation.

UHF Command Radio Indicators

MANUAL FREQUENCY INDICATORS. The manual frequency indicators (1, figure 4-10) on the UHF radio control panel consist of four windows which indicate the manual operating frequency set by the manual frequency selector knobs. The manual-preset-guard switch must be on MANUAL before the frequency numbers will appear in the windows indicating that manual selection is possible.

PRESET CHANNEL INDICATOR DIAL. An indicator dial (8, figure 4-10) indicates the channel to which the preset channel selector switch is set. The dial numbers are visible only when the manual-preset-guard switch is on PRESET.

Normal Operation

To put the set in operation on a preset command frequency and the fixed guard frequency, proceed as follows:

1. Manual-Preset-Guard Switch - PRESET
2. Preset Channel Selector Switch - Set to desired channel.
3. Off-Main-Both-ADF Switch - BOTH

NOTE

- A minimum warmup time of 1 minute, that includes a 4-second tuning cycle, is required before operating the command radio.
- On aircraft equipped with ARC-34A command radio, when switching from ground power to aircraft power, the command radio OFF-MAIN BOTH-ADF switch may have to be turned OFF then back to MAIN or BOTH to obtain proper system operation. This procedure is necessary since the master voltage oscillator circuit in the power supply may be unable to recover itself and start oscillation after momentary interruption of power.

4. Volume Control Knob - Turn to maximum clockwise position.

To turn the set off:
1. Off-Main-Both-ADF Switch - OFF

To select frequencies manually:
1. Off-Main-Both-ADF Switch - MAIN or BOTH
2. Manual-Preset-Guard Switch - MANUAL

Ascertain that the tabs in the frequency indicator windows have retracted, exposing the numbers.
3. Manual Frequency Selector Knobs - Set to desired frequency.

NOTE

Operator should wait approximately 4 seconds for tuneup and the set will be ready for operation.

To transmit and receive on the guard frequency:
1. Off-Main-Both-ADF Switch - MAIN or BOTH
2. Manual-Preset-Guard Switch - GUARD

Emergency Operation

If the set fails to tune properly, the difficulty often can be corrected by switching to a different channel or trying either of the two remaining positions on the manual-preset-guard switch. If this fails, turn the set off for a few minutes and try again.

UHF Direction Finder AN/ARA-25

The UHF direction finder is used with the UHF command set to determine the bearing of incoming UHF signals as a navigational aid. It is operated from the UHF command control panel (figure 4-10) on the pilots' overhead panel. Incoming UHF signals will be relayed to the No. 1 needle on the pilot's radio magnetic indicator (44, figure 1-13 and 46, figure 1-13A) when the control knob on the UHF control panel is on ADF.

LIAISON RADIO AN/ARC-65

This radio provides long range voice communication from plane-to-plane and plane-to-ground in the high frequency range. The radio operates over a frequency range of from 2 to 23.995 megacycles in 500-cycle steps, giving a total of 44,000 available frequencies. The set includes control panels (figure 4-11) for both the pilot and EW officer and uses both TR power and 118-volt single-phase a-c power for operation. Power and control circuit breakers are marked "AC" and "DC" on the "AN/ARC-21X" portion of the gunner's circuit breaker panel. To turn the radio on, position the control switch on either panel to ON position. To turn the set off, reposition the control switch to OFF position.

NOTE

- No transmission will be made on emergency (distress) frequency channels except for emergency purposes. For test, demonstration, or drill purposes, this radio equipment will be operated in a shielded room to prevent transmission of messages that could be construed as actual emergency messages.

- Either the pilot or EW officer can interrupt the other's transmission simply by placing the respective control switch to ON position.

Liaison Radio Controls

LIAISON RADIO CONTROL KNOB. A two-position ON--OFF rotary switch (2, figure 4-11) on both liaison radio control panels is used to turn the equipment on and also to secure control of the equipment.

VOLUME CONTROL KNOB. A volume control knob (1, figure 4-11) on both liaison radio control panels provides a means of adjusting the audio output during voice operation and signal sensitivity during CW operation from the liaison radio to the interphone system.

CHANNEL SELECTOR SWITCH. A channel selector switch (5, figure 4-11) on both liaison radio control panels has channel positions numbered from 1 to 20, providing selection of any of the preset channel frequencies.

POWER SWITCH. A power switch (6, figure 4-11) on the EW officer's liaison radio control panel has HI--LOW positions to provide means for selecting the power output in a 10 to 1 ratio. HI position is provided for use in making maximum range transmissions and LOW position for short range transmissions.

NOISE CONTROL KNOB. A control knob (7, figure 4-11) marked "Noise" located on both liaison radio control panels allows adjustment of the background noise level of the receiver for best voice reception.

PRESETTING DRUMS. Two drums (4, figure 4-11) on the EW officer's liaison radio control panel provide means for manually presetting the frequency of each channel to be selected by the channel selector switch. Each drum is protected by a hinged cover. A special presetting tool is stowed inside the top drum cover which also contains a card for recording the preset frequencies.

CW TUNING KNOB. A CW tuning knob (3, figure 4-11) on the EW officer's liaison radio control panel is used to adjust the CW beat frequency.

EW OFFICER'S LIAISON OPERATION SELECTOR SWITCH. An operation selector switch (8, figure 4-11) on the EW officer's liaison radio control panel has AME--CW--SSB--FSK positions. AME position places the liaison radio in equivalent amplitude modulation operation for voice communication with stations not equipped for single side band operation. CW position provides for continuous wave communication with a 7-kilocycle band width. SSB position places the liaison radio in single side band voice operation. The FSK position is provided for teletypewriter operation; this equipment, however, is not installed in the airplane.

PILOT'S LIAISON OPERATION SELECTOR SWITCH. A pilot's operation selector switch (9, figure 4-11) located on the pilot's liaison radio control panel has SSB--AME positions. SSB position places the liaison radio in a single side band voice operation. AME position places the liaison radio in equivalent amplitude modulation operation for voice communication with stations not equipped for single side band operation.

Normal Operation of Liaison Radio

CAUTION

Operating of the ARC-65 during periods of abnormally high voltage or fluctuating power will decrease the operational life of the equipment and can cause materiel failure.

FREQUENCY PRESETTING. The frequency presetting operation is accomplished on the master control panel with the equipment turned off. Presetting is normally done before flight but may be done in flight if necessary and is accomplished as follows:

1. Loosen two screws holding drum covers in position and open covers.
2. Remove presetting tool from clip inside top drum cover.
3. Rotate channel selector switch until number of channel to be preset appears at left end of selector drum.
4. Using the presetting tool, move four buttons, one at a time, to a position under the respective numbers sliding socket end of tool over buttons and moving them along the drum to coincide with the desired numbers.
5. Move top drum left button to coincide with the figure representing thousands of kilocycles.

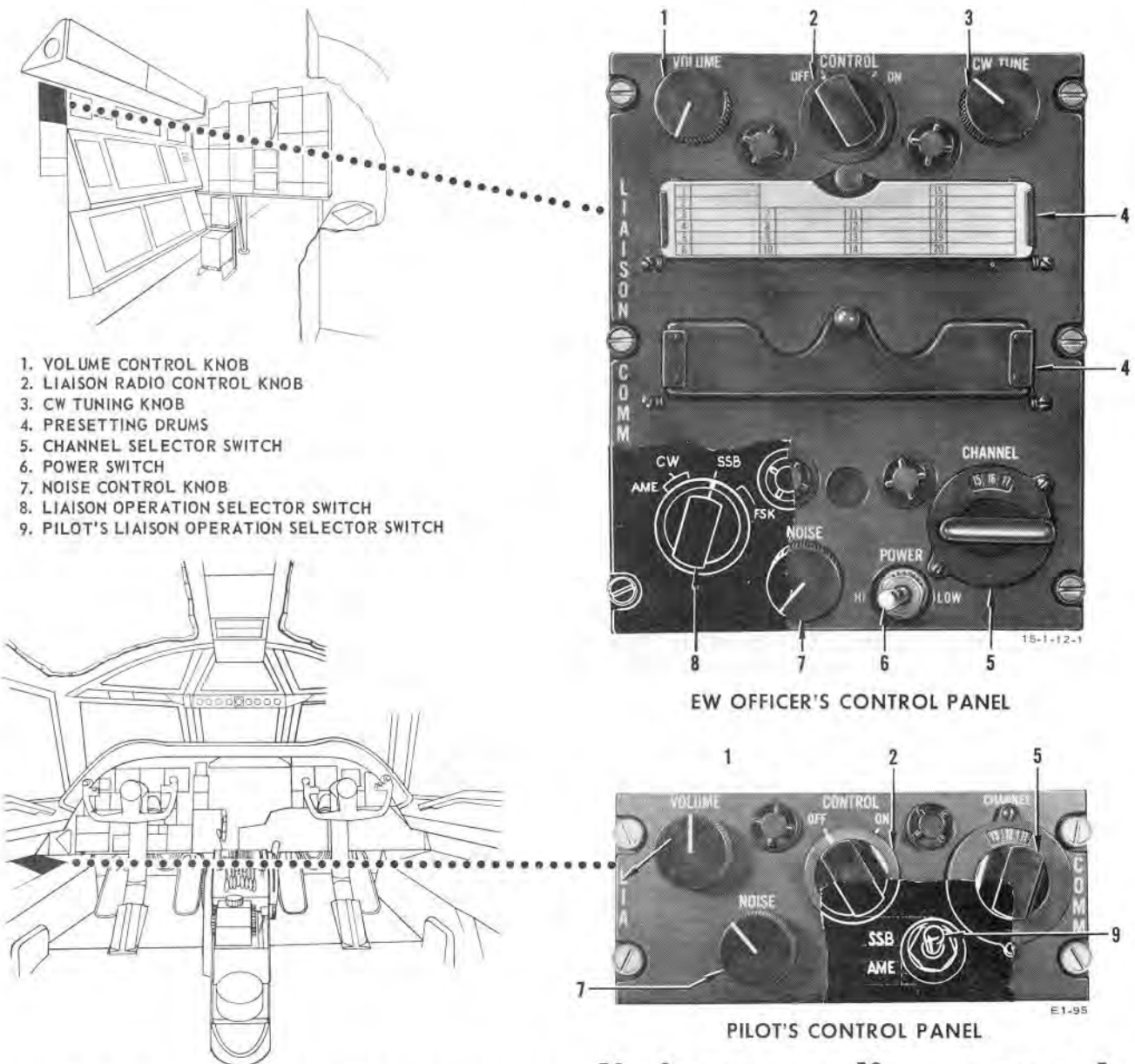


Figure 4-11.

6. Move top drum right button to coincide with the figure representing hundreds of kilocycles.
7. Move bottom drum left button to coincide with the figure representing tens of kilocycles.
8. Move bottom drum right button to coincide with the figure representing units and halves of kilocycles.
9. Record the frequency adjacent to the applicable channel number on the card mounted on the top drum cover.
10. Turn channel selector switch to next channel number to be preset and repeat steps "4" through "9." Preset remaining channels in the same manner.
11. Close drum covers and tighten screws.

NOTE

If the drum cover doors on the master control panel are not securely closed, a door interlock switch will remain open and prevent operation of the liaison radio.

VOICE COMMUNICATION. Liaison radio voice communication can be accomplished as follows:
1. Place interphone selector switch in LIA to receive and transmit liaison radio signals.
2. Place liaison radio control knob to ON.

NOTE

A 40-second warmup period is required. The first 30 seconds allow for tube warmup and the remaining 10 seconds allow for automatic tuning. If automatic tuning is not accomplished in the normal 40-second period, the control switch will go to OFF and must be returned to the ON position.

CAUTION

Do not hold liaison radio control knob to ON position.

3. Turn channel selector switch to desired frequency and rock the knob slightly to feel the switch click into its seat. The channel in use will be shown in the center of the selector window.
4. Rotate liaison operation selector switch to the desired position.
5. Place power switch in HI or LOW. Operate transmitter in LOW power except when necessary to use HIGH power to insure communications.

NOTE

Should the air pressure within the equipment be reduced by leakage, an aneroid switch will automatically shift the set to low power to reduce the possibility of electrical arcing within the equipment. No indication is given when this occurs.

6. Momentarily depress mike switch to initiate the transmit tune cycle. Completion of the "transmit tune cycle" is indicated by the return of the receiver background noise. The transmitter is now ready for transmission. Adjust volume control for proper audio level and noise control for a slight background noise in absence of signals. A sidetone will be heard in the headset when talking if the transmitter is on the air.
7. Turn set off by rotating the liaison radio control knob on the panel to OFF.

Emergency Operation of Liaison Radio

When a frequency selection cycle is not completed in the normal time interval causing the liaison radio control knob to return to OFF position, a second try on another channel is recommended. If tuning is normal, return to the initially selected channel. Malfunction within the equipment is indicated by the control knob moving to OFF position. If damage to the equipment is less important than getting the message through, transmission or reception can be resumed by holding the knob in ON position. If no sidetone is heard when attempting to transmit, the transmitter is not on the air.

TACAN RADIO AN/ARN-21

AN/ARN-21 TACAN (Tactical Air Navigation) radio is provided to operate in conjunction with AN/URN-3 surface navigation beacons. TACAN radio and beacons form a radio navigation system which enables the aircraft to obtain continuous indications of its range and bearing to any selected surface beacon located within a line-of-sight distance from the aircraft up to 195 nautical miles. Range information is displayed on the range indicator (47, figure 1-13 and 47, figure 1-13A). Course information is displayed on the radio course indicator (17, figure 1-13 and 50, figure 1-13A). Both instruments are located on the pilots' instrument panel. The receiver-transmitter of the TACAN radio initiates the interrogation process by radiating pulse signals. These signals, known as distance interrogation pulses, are detected at the particular beacon installation to which the TACAN radio is tuned, causing the beacon to respond with its own transmitted pulses. These response pulses are received by the receiver portion of the TACAN radio and are converted into a range indication which is displayed on the range indicator. In addition, the beacon transmits a continuous reference signal which can be received by the TACAN radio any time the receiver portion is in operation. This reference signal is displayed as a bearing indication on the radio magnetic indicator. Bearing information may be received even though interrogation pulses are not being transmitted by the TACAN radio. Each beacon may be identified by a tone identification signal in International Morse Code. Placing the TACAN-ODR (VHF Omnidirectional Range) marker mixer switch to ON position provides the tone identification signal in the crew member's headset. The TACAN

control panel is located on the pilot's side panel. The system is supplied 118-volt single-phase a-c power through a circuit breaker marked "AN/ARN-21 AC" located on the pilots' circuit breaker panel. A circuit breaker marked "AN/ARN-21 DC" located next to the a-c circuit breaker provides d-c power for the system.

TACAN Radio Controls

Less [L]

NAV SYSTEM SELECT SWITCH. Two ganged two-position toggle switches marked "Instrument Select" located on the pilots' instrument panel (10, figure 4-12) have TACAN--VOR-ILS positions. VOR-ILS position disconnects the TACAN system and makes possible the use of the omni-range radio equipment when placed in operation in the normal manner. In TACAN position, the TACAN system may be placed in operation in the normal manner as outlined under "Normal Operation of TACAN Radio."

[L]

MODE SELECT SWITCH. A mode select switch (9A, figure 4-12) is located on the aisle stand. The rotary switch has TACAN--VOR--ILS--ILS APP positions. In TACAN position, the TACAN system can be placed in operation in the normal manner as outlined under "Normal Operation of TACAN Radio." In VOR position, the omni-range radio navigation system is selected and may be placed in operation as noted under "Omni-Range Radio AN/ARN-14," this section. VOR, ILS, and ILS APP positions are tied together. Placing the selector switch in any of these positions provides VOR-ILS system operation.

TACAN CHANNEL SELECTOR SWITCH. A TACAN channel selector switch marked "Channel" located on the TACAN radio control panel (4, figure 4-12) provides a means by which the desired navigation beacon channel may be selected. Combinations of dial settings can be made from 00 to 129; however, the equipment only operates on channels 01 to 126, a total of 126 channels.

CAUTION

No attempt should be made at any time to set the channel selector switch below channel 01 or above channel 126.

OFF-REC-T/R SWITCH. A three-position rotary switch located on the TACAN radio control panel (5, figure 4-12) has OFF--REC--T/R positions. In OFF position, the system is inoperative. In REC position, only the receiver portion of the receiver-transmitter is placed in operation. When in this position, only bearing information is furnished by the TACAN system. In T/R position, the TACAN radio interrogates the ground beacon and receives a reply signal which incorporates both range and bearing information.

VOLUME CONTROL KNOB. A volume control knob (6, figure 4-12) marked "Vol" located on the TACAN control panel is used to adjust the volume of the audio identification signal received from the beacon through the headset.

TACAN Radio Indicators

Less [L]

TACAN--VOR-ILS OPERATION LIGHTS. Two lights are located on the pilots' instrument panel (11, figure 4-12) adjacent to the navigation system select switch. When the switch is in TACAN position, the light marked "TACAN" will illuminate which indicates the TACAN navigational system may be placed in operation as outlined under "Normal Operation of TACAN Radio." When the switch is in VOR-ILS position, the light marked "VOR-ILS" will illuminate which indicates the omni-range navigational system may be placed in operation.

TACAN DISTANCE INDICATOR. The TACAN distance indicator (figure 4-12) located on the pilots' instrument panel provides the pilot with the range in nautical miles to the AN/URN-3 beacon to which the system is tuned.

RADIO COURSE INDICATOR. The radio course indicator (figure 4-12) is located on the pilots' instrument panel. The indicator used in the TACAN system is the same indicator used by the omni-range system when it is in operation.

Normal Operation of TACAN Radio

The following procedure is used to place the TACAN system in operation:

1. Place navigation system select switch to TACAN position.
2. Select desired beacon channel by setting the channel selector switch.
3. Place OFF-REC-T/R switch to REC or T/R position as desired. After closure of the thermal delay relay allowing warmup, equipment should be operational.

CAUTION

When outside the effective range of the station, as indicated by the DME range indicators rotating continuously, the OFF-REC-T/R switch will be placed in REC or OFF position to prevent damage to the DME equipment.

4. Identification of the selected beacon is accomplished by listening to the call letters of the beacon in International Morse Code over the interphone system by placing the TACAN-ODR (VHF Omnidirectional Range) marker mixer switch to ON position. Adjust volume of audio signal with the TACAN volume control.

NOTE

Occasionally, TACAN equipment will "lock-on" a false bearing which will be 40° or a multiple of 40° in error. These errors can be on either side of the correct bearing. The possibility of this error is inherent in the TACAN system and can only be avoided by use of other navigation equipment in addition to the TACAN. This false "lock-on" does not affect the DME display.

5. When the TACAN is first turned on or channels have been switched, check for proper lock-on as follows:

a. Cross-check for false lock-on with ground radar, airborne radar, VOR, dead reckoning, or other available means.

b. If a false lock-on is suspected, switch to another channel, check it for correct bearing, and then switch back to the desired channel.

c. Check for correct lock-on.

d. If false lock-on is still suspected, turn the set off and then back on.

e. Recheck for correct lock-on.

f. If false lock-on persists, turn the set off and utilize other available navigation equipment.

NOTE

During an emergency, if the size and duration of error can be determined, TACAN can be utilized if compensation is made for the error in bearing.

6. To turn the TACAN system off, place the OFF-REC-T/R switch to OFF position.

Emergency Operation of TACAN Radio

If the transmitter or range unit of the TACAN system becomes faulty, satisfactory beacon bearing information may be obtained by placing the OFF-REC-T/R switch to REC position. If satisfactory distance and bearing indications are not available on a particular channel, switch to another channel known to be on the air within the 195-mile range (if such a channel is available). If satisfactory distance and bearing indications are received for the alternate channel and the proper code signals are heard, it may be assumed the TACAN radio is operating properly. Once the equipment has been checked on an alternate channel, the operator should return to his original channel to assure himself that the faulty indication was not the result of a temporary pause in beacon transmission or a temporary obstruction between the airplane and beacon which prevented proper reception. If a second attempt fails to provide bearing and distance information on the original channel, either select an alternate channel for navigation purposes or employ other navigational means.

OMNI-RANGE RADIO AN/ARN-14

The omni-range radio provides a very high frequency receiver for navigation over land and for runway localizer instrument approaches. The omni-range radio includes a receiver, a control panel on the pilots' overhead panel, a radio course indicator, and a radio magnetic indicator (figure 4-12) on the pilots' instrument panel. The omni-range radio uses TR power for both control and operation of a dynamotor through a circuit breaker marked "Dynamotor" on the "AN/ARN-14" portion of the gunner's circuit breaker panel. To start the omni-range radio, position the power switch to ON. To turn off the omni-range radio, position the switch to OFF. For additional information on the indicators, see "Instrument Landing System Indicators," this section.

GLIDE SLOPE EQUIPMENT
AN/ARN-18 190▶215 W70▶W83
AN/ARN-31 215▶ W84▶

This equipment indicates glide angle of the aircraft with relation to the runway for instrument approach. The controls and indicators are common to the omni-range radio. A glide slope indicator on the omni-range radio course indicator (figure 4-12) indicates aircraft position relative to a glide slope beam. A warning flag on the left side of the indicator moves out of sight when a glide slope signal is being received. The equipment operates on TR power through a circuit breaker marked "Glide Path DC" and 118-volt single-phase a-c power is supplied through a circuit breaker marked "Glide Path AC." Both circuit breakers are on the "Flight Indicators" portion of the pilot's circuit breaker panel. To start the glide slope equipment, position the omni-range radio power switch to ON, and to cease operation, position the switch OFF.

MARKER BEACON RECEIVER AN/ARN-32

This receiver, located in the gunner's compartment, is used both as a navigational and as a landing aid. When flying over a beacon, a signal is heard on the interphone and observed as a light illumination on the omni-range radio course indicator (figure 4-12). Power is received through the omni-range radio dynamotor. For circuit breaker information, see "Omni-Range AN/ARN-14," this section.

RADAR ALTIMETER AN/APN-150 50

A Type AN/APN-150 radar altimeter (figure 4-11A) is located on both sides of the pilots' forward instrument panel (14, figure 1-13A). The instrument provides for measuring absolute altitude from 0 to 5000 feet. An altitude indicator needle (2, figure 4-11A) indicates altitude from 0 to 1000 feet in 20-foot increments and from 1000 to 5000 feet in 100-foot increments. When power is not being supplied to the radar altimeter system, the altitude indicator needle disappears behind a black mask (3, figure 4-11A) painted on the indicator cover glass. When the altitude indicator needle is in this position, an internal mechanical linkage positions a red function flag (5, figure 4-11A) on the indicator face to FAIL. This action is also prevalent when system power is on and the aircraft absolute altitude is above 5000 feet. When the aircraft absolute altitude is below 5000 feet and power is on, the indicator needle will point to the respective altitude and the function flag

will show ON. An adjustable index or cursor (4, figure 4-11A) is provided on the circumference of the indicator dial. This index can be manually set between indicator altitudes of 0 and 5000 feet and serves as a reference point to the altitude indicator needle when the system is in operation. The radar altimeter has a single operating control. This is a knob (1, figure 4-11A) located on the upper right corner of the instrument and is marked "ON-ALT." The ON-ALT control knob turns the system on and off and also provides a means of setting the cursor at any desired altitude. The radar altimeter system is provided aft TR power through a circuit breaker marked "Radar Altimeter" in the aft d-c power box and 118-volt a-c power through a circuit breaker marked "Radar Altimeter" in the aft a-c power box.

WARNING

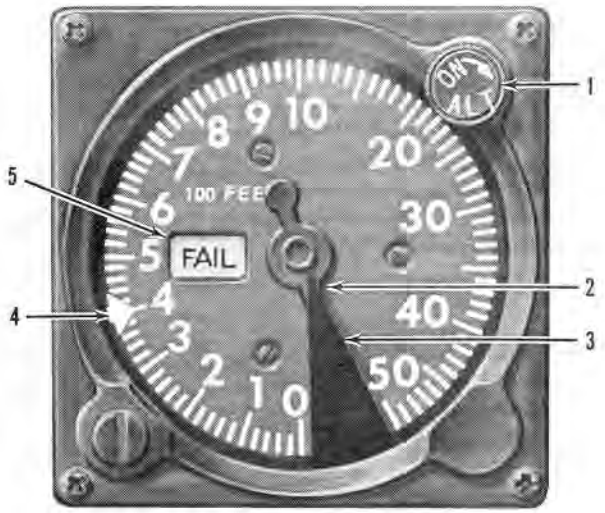
- The radar altimeter FAIL/ON function (warning) flag does not indicate all failures of this system.
- Over rough terrain, the radar altimeter has been observed to indicate the crossing clearance as much as 30% higher than actual clearance.

NOTE

- At terrain clearance altitudes above 5000 feet, the altimeter may accomplish lock-on. In this event, the function flag will indicate ON and the indicator needle will move from behind the mask to a false altitude. Movement of the indicator needle may be opposite to movement of the aircraft as it changes altitude. Ignore all altimeter readings when the aircraft is more than 5000 feet above terrain.
- When the radar altimeter is operated on the ground and the aircraft is parked or during taxiing, takeoffs, and landings, the altimeter may not maintain a continuous ground lock-on. This results from the multiple bounce paths between the system transmitting and receiving antennas during operation in close proximity to the ground. After takeoff, the radar altimeter should regain lock-on within 1 minute and will then indicate the proper altitude. Also, when on the ground and in the vicinity of reflective objects, the altimeter may lock on returns from these objects and indicate an erroneous altitude. This condition is a normal function of the altimeter.

Normal Operation of Radar Altimeter

The following procedure is used to place the radar altimeter in operation.



1. ON-ALT CONTROL KNOB
2. ALTITUDE INDICATOR NEEDLE (BEHIND MASK)
3. MASK
4. CURSOR
5. FAIL/ON FUNCTION FLAG

radar altimeter SQ

Figure 4-11A.

NOTE

The copilot has no control of system turn-on. However, by rotating the ON-ALT knob, he may set the cursor on his indicator to any desired altitude.

1. Rotate ON-ALT knob to its limit stop in the counterclockwise direction.
2. Rotate ON-ALT knob approximately 8° in the clockwise direction or enough to move the cursor off 0 feet indication. This will supply power to the system.
3. Allow approximately 2 minutes for warmup and for the system to search for and lock on a return signal from the ground. At the end of this period, the following will occur:
   a. The altitude indicator needle will appear from under the mask and rotate in a counterclockwise direction toward 0 feet altitude. Full tracking from 5000 feet to 0 feet will take approximately 12 seconds.
   b. With the appearance of the altitude indicator needle, the red FAIL flag will be removed from view on the instrument face and be replaced by the system ON flag.
4. Rotate ON-ALT knob in a clockwise direction to move cursor and set cursor at any desired altitude from 0 to 5000 feet.
5. To turn system off, rotate ON-ALT knob counterclockwise to its limit stop.

RENDEZVOUS RADAR AN/APN-69

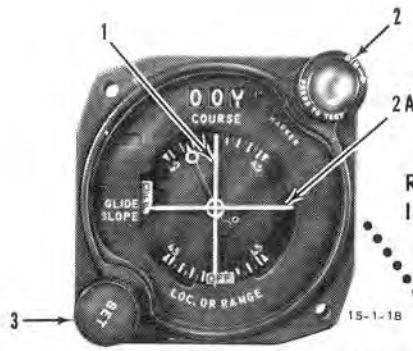
The APN-69 radar is used for air refueling rendezvous. The set includes a receiver, transmitter, and a control panel (figure 4-13) which is located at the EW officer's station on airplanes Less NF and at the navigator's station on airplanes NF. The beacon responds automatically when interrogated by the APS-42 (KC-97), APN-59 (KC-135), or APS-64, ASB-4, or ASB-9 (B-52) search radars, providing range and bearing information for the interrogating airplane to "home" on the beacon signal. Transmissions are coded to permit positive identification between aircraft. The set operates on TR power through a circuit breaker marked "Radar Beacon DC" and 118-volt single-phase a-c power through a circuit breaker marked "Radar Beacon AC." Both circuit breakers are on the "AN/APN-69" portion of the gunner's circuit breaker panel.

Rendezvous Radar Controls

POWER SWITCH. A rotary-type power switch (4, figure 4-13) on the rendezvous radar control panel has OFF--STDBY--OPERATE positions. STDBY position supplies power to all system circuits except the high voltage circuits. OPERATE position completely energizes the system provided a 3-minute warmup period is observed after turning to STDBY. OFF position removes all power from the set.

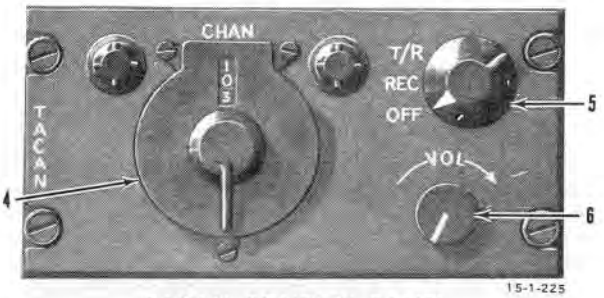
CODE SELECTOR SWITCH. Eight code selector slide switches (5, figure 4-13) on the rendezvous radar control panel are used to set up the code combinations in the response transmission. The code element corresponding to an individual switch can be included in the reply by pulling out on the spring-loaded knob and sliding the switch to ON (up) position.

COMMON CODE SELECTOR SWITCH. A common code selector switch (7, figure 4-13) on the rendezvous radar control panel which corresponds to the first code element is stationary. This code element is common to all code combinations.



TACAN AND OMNI-RANGE

RADIO COURSE INDICATOR

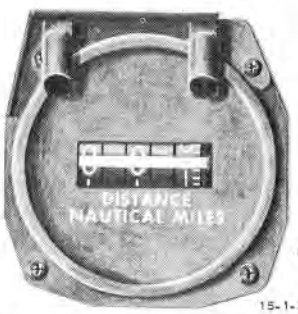


TACAN CONTROL PANEL

OMNI-RANGE

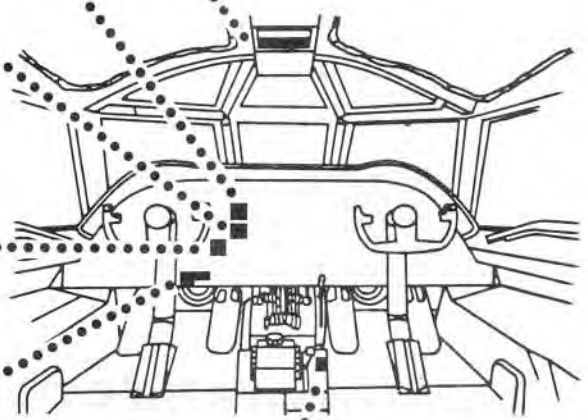
RADIO MAGNETIC INDICATOR

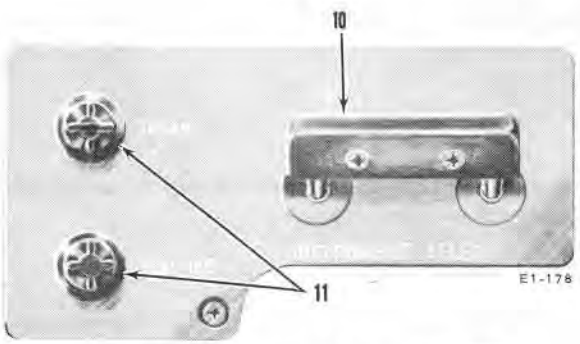
OMNI-RANGE CONTROL PANEL



TACAN AND OMNI-RANGE

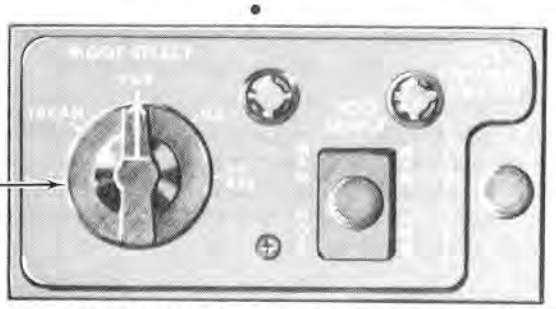
DISTANCE INDICATOR





TACAN AND OMNI-RANGE Less LH

NAVIGATION SYSTEM SELECT SWITCH

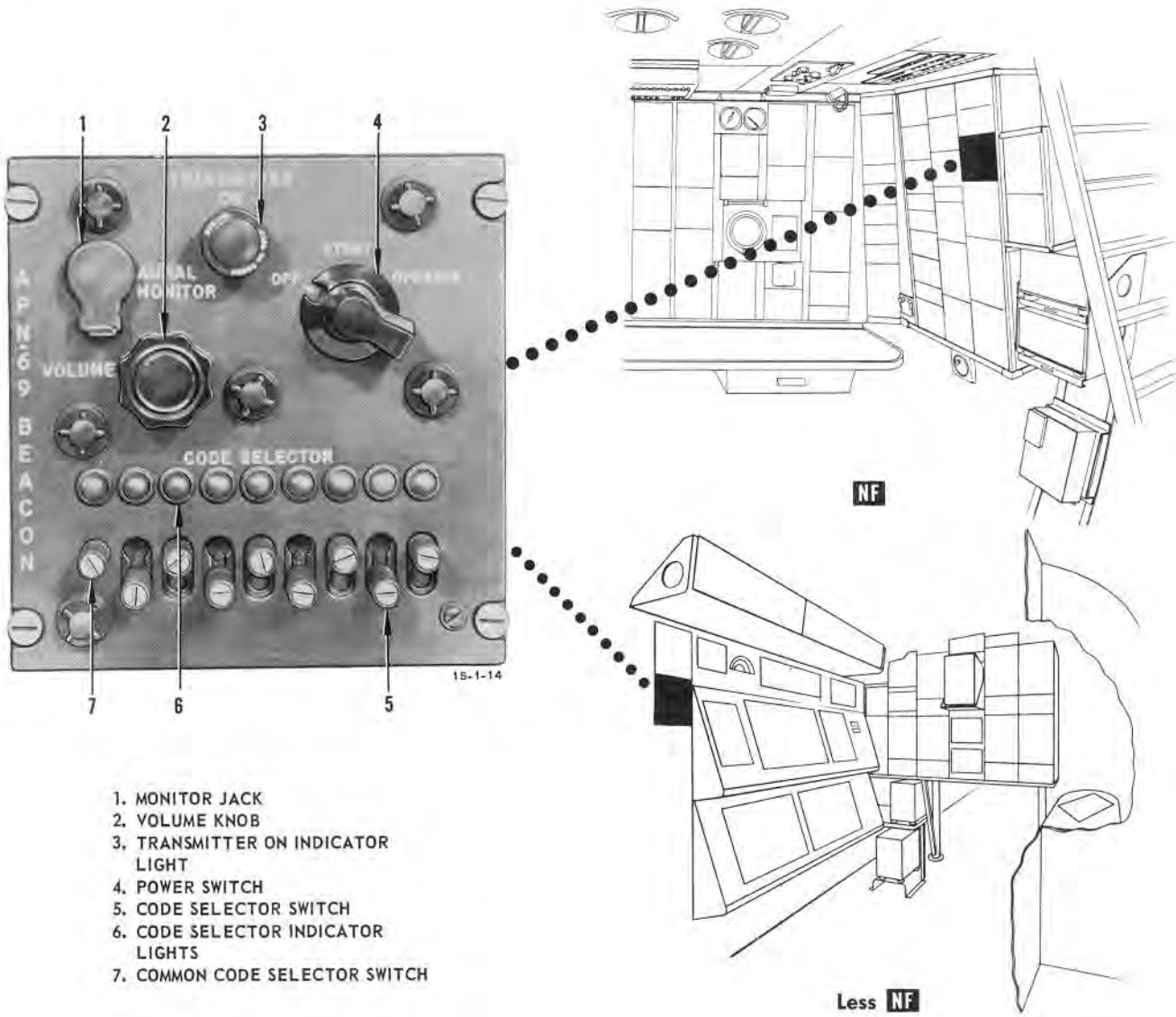


MODE SELECT SWITCH PANEL LH

1. COURSE DEVIATION INDICATOR
2. MARKER BEACON INDICATOR LIGHT
2A. GLIDE SLOPE INDICATOR
3. COURSE SET KNOB
4. TACAN CHANNEL SELECTOR SWITCH
5. OFF-REC-T/R SWITCH
6. TACAN VOLUME KNOB
7. OMNI-RANGE SELECTOR SWITCH
8. OMNI-RANGE POWER SWITCH
9. OMNI-RANGE VOLUME KNOB
9A. MODE SELECT SWITCH LH
10. NAVIGATION SYSTEM SELECT SWITCH Less LH
11. TACAN-VOR-ILS OPERATION LIGHTS Less LH

.....tacan and omni-range radio controls

Figure 4-12.



1. MONITOR JACK
2. VOLUME KNOB
3. TRANSMITTER ON INDICATOR LIGHT
4. POWER SWITCH
5. CODE SELECTOR SWITCH
6. CODE SELECTOR INDICATOR LIGHTS
7. COMMON CODE SELECTOR SWITCH

.....rendezvous radar control panel

Figure 4-13.

VOLUME KNOB. A volume knob (2, figure 4-13) on the rendezvous radar control panel is used to adjust the audio signal level when monitoring the set over the interphone. See figure 4-8 for proper mixer toggle switch selection.

MONITOR JACK. A jack (1, figure 4-13) on the rendezvous radar control panel is used for test purposes. When a headset is connected to the jack, random noises (or periodic triggering of the system) may be heard and is indicative of set operation.

Rendezvous Radar Indicators

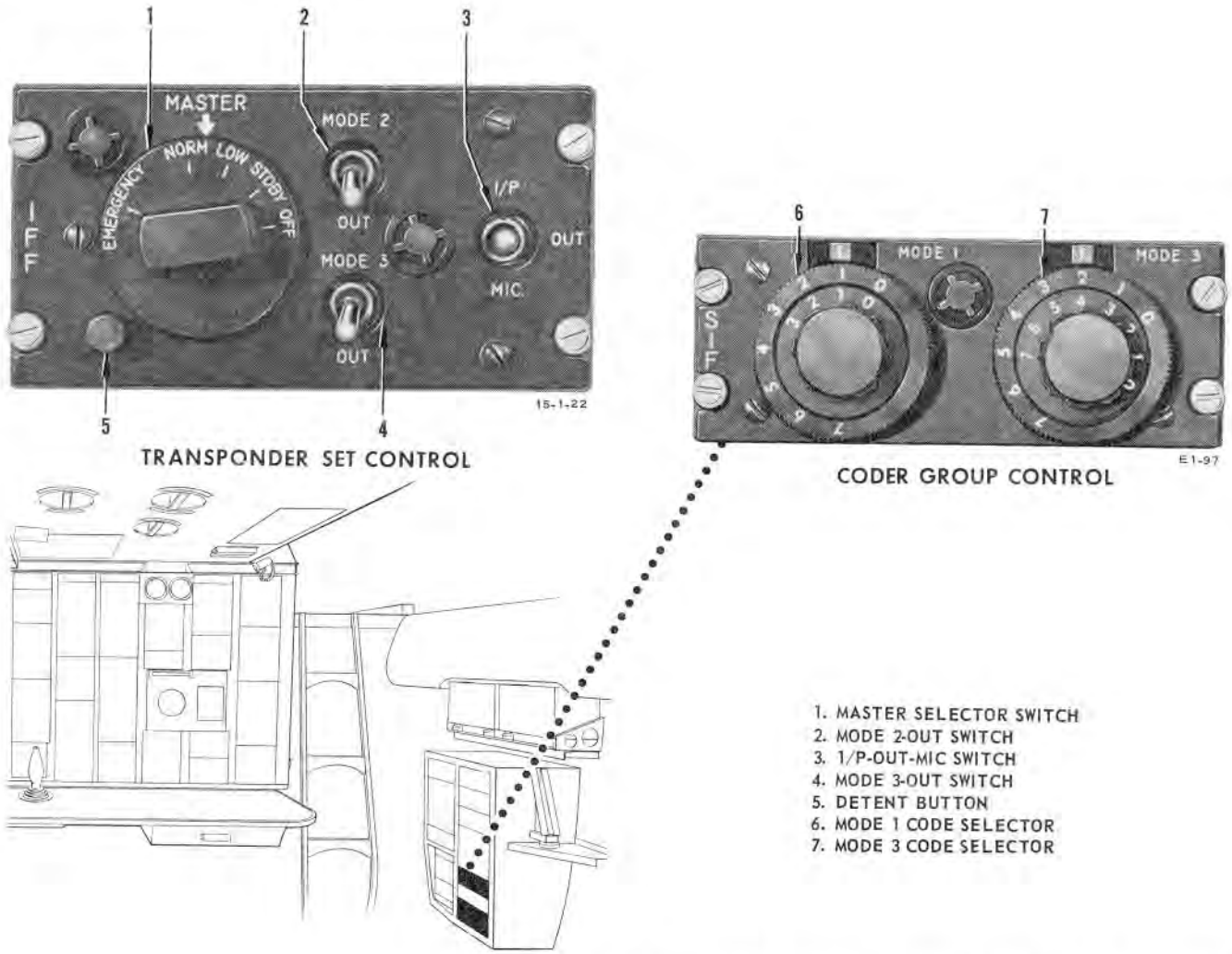
TRANSMITTER ON INDICATOR LIGHT. A green indicator light (3, figure 4-13) on the rendezvous radar control panel illuminates when high voltage has been applied to the transmitter and indicates that the set is ready for operation.

CODE SELECTOR INDICATOR LIGHTS. Nine indicator lights (6, figure 4-13) on the rendezvous radar control panel indicate when the respective code element is included in the radar response.

Normal Operation of Rendezvous Radar

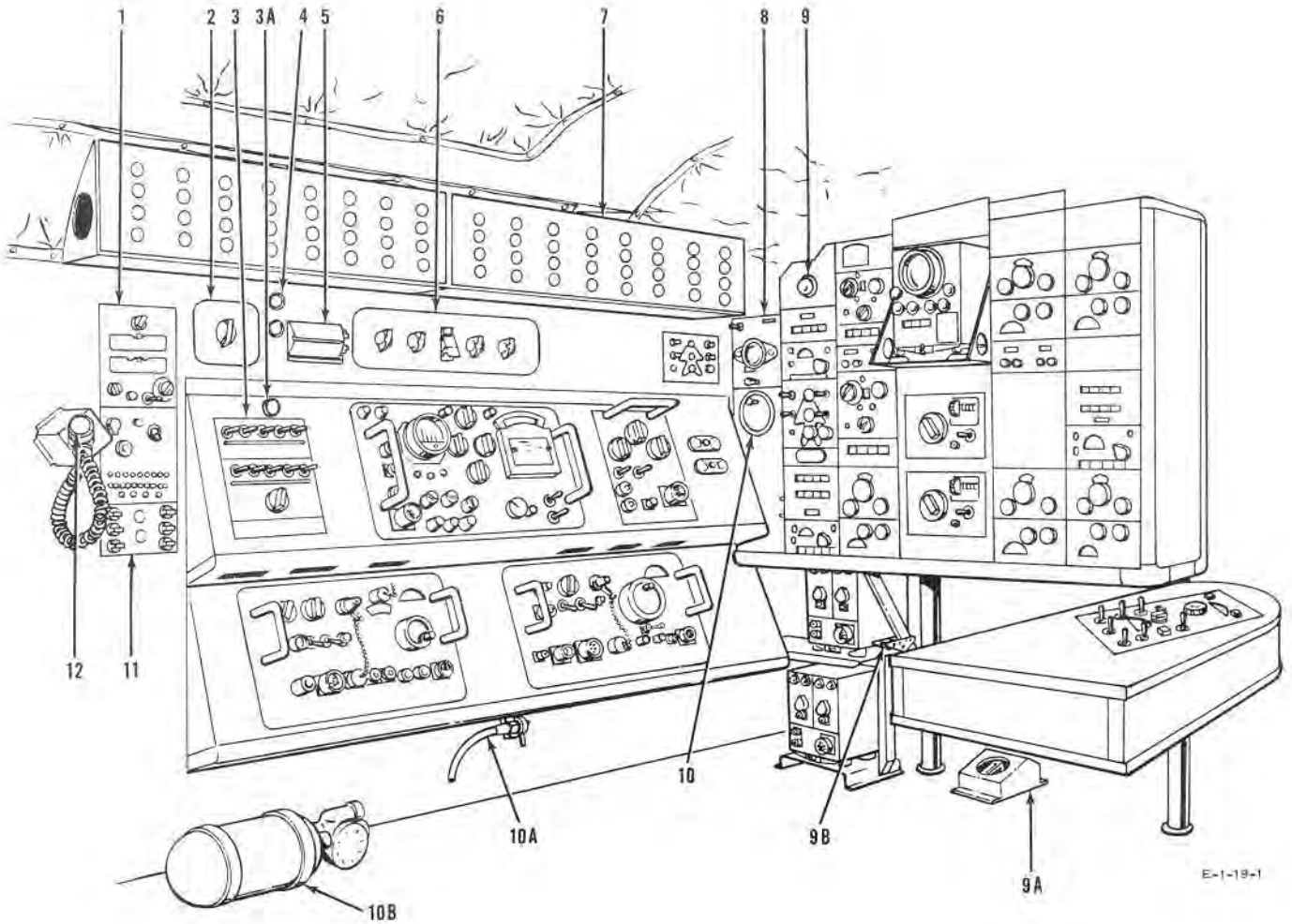
The following procedure is used to place the rendezvous radar in operation:

1. Place power switch to STDBY.
2. Allow approximately 3 minutes for warmup and place power switch to OPERATE. After the warmup period, the transmitter-on light will come on indicating that the set is ready for automatic operation and will reply to interrogating pulses of the proper characteristics.
3. Select code. As an example of a 3-2 code, the first (which is stationary and common to all code combinations), second, third, fifth, and sixth code selector switches would be in the up (ON) position; all other code selector switches would be in the down (OFF) position. Do not insert more than six code elements, including the stationary element, at one time.
4. The operation of the rendezvous radar may be monitored, over the interphone, by placing the proper interphone mixer switch to the ON position.
5. If it is desired to discontinue operation temporarily, place the power switch to STDBY. In this manner, the equipment is kept ready for immediate use.
6. To deenergize the equipment, reset code selector switches to the down position and place the power switch to OFF.



IFF radar control panels

Figure 4-14.



1. AN/ARC-65 LIAISON RADIO CONTROL PANEL
2. FACE PLATE SWITCH
3. INTERPHONE PANEL

3A. SPRAY BAR KNOB RU

4. AIR OUTLET KNOBS
5. UPPER AIR OUTLET
6. LIGHTING PANEL
7. ECM CIRCUIT BREAKER PANEL
8. OXYGEN REGULATOR
9. EMERGENCY ALARM LIGHT

9A. SPECIAL WEAPONS MANUAL LOCK HANDLE

9B. SPECIAL WEAPONS MANUAL LOCK HANDLE STOWAGE BRACKET

10. ASH TRAY

10A. PORTABLE OXYGEN BOTTLE RECHARGER HOSE

10B. PORTABLE OXYGEN BOTTLE

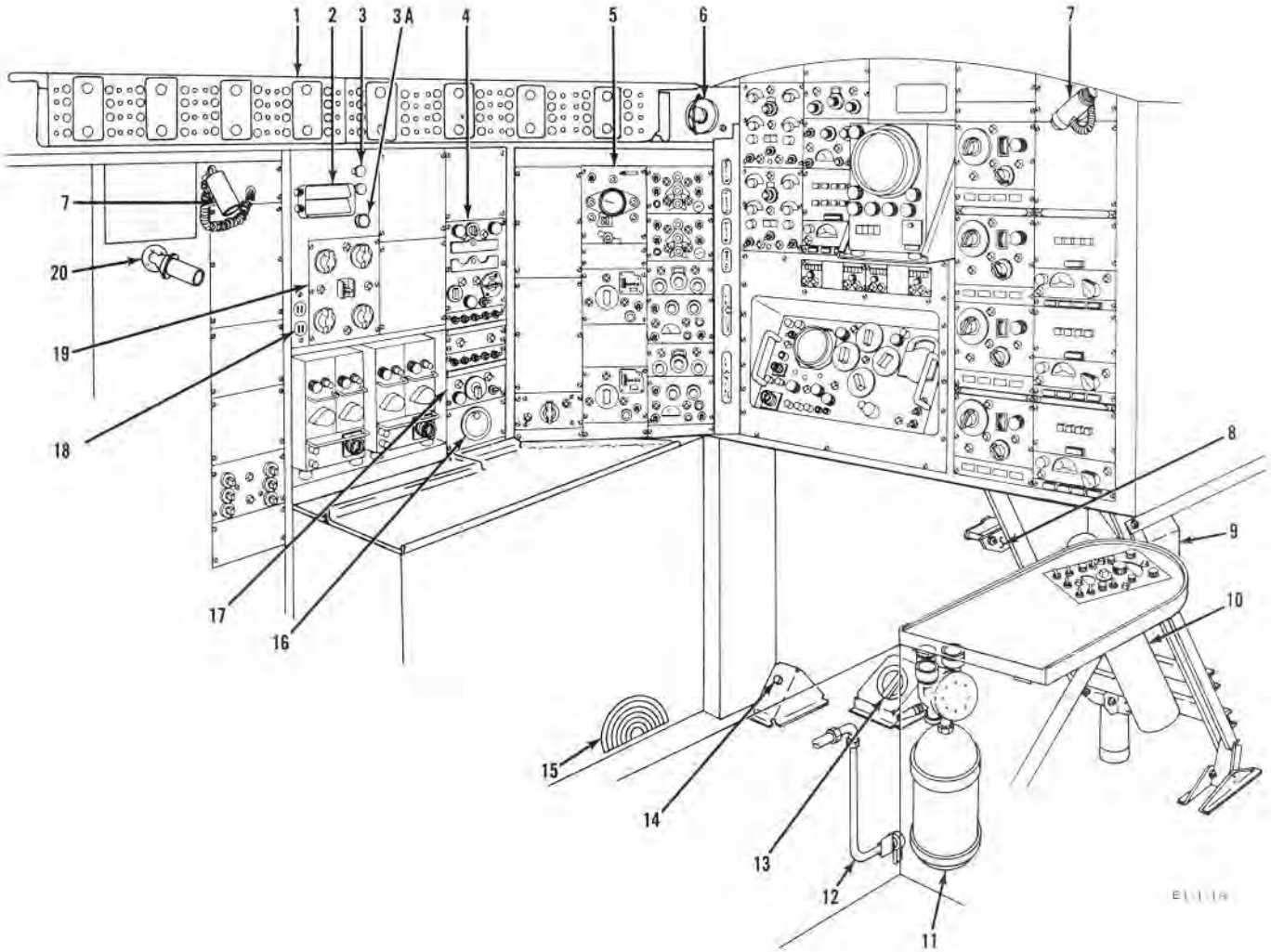
11. AN/APN-69 RENDEZVOUS RADAR CONTROL PANEL
12. SPOTLIGHT

NOTE

FOR ECM EQUIPMENT REFER TO SECTION IV IN T.O. 1B-52E-1A.

EW officer's station Less NF

Figure 4-15.



1. ECM CIRCUIT BREAKER PANEL
2. UPPER AIR OUTLET
3. AIR OUTLET KNOBS
3A. SPRAY BAR KNOB RU
4. AN/ARC-65 LIAISON RADIO CONTROL PANEL
5. OXYGEN REGULATOR
6. EMERGENCY ALARM LIGHT
7. SPOTLIGHT
8. SPECIAL WEAPON MANUAL LOCK HANDLE STOWAGE BRACKET
9. SAFETY PIN STREAMER STOWAGE BOX
10. FIRE EXTINGUISHER
11. PORTABLE OXYGEN BOTTLE
12. PORTABLE OXYGEN BOTTLE RECHARGER HOSE
13. SPECIAL WEAPON MANUAL LOCK HANDLE
14. INTERPHONE FOOT SWITCH
15. LOWER AIR OUTLET
16. ASH TRAY
17. INTERPHONE CONTROL PANELS
18. 115 VOLT A-C RECEPTACLES
19. LIGHT CONTROL PANEL
20. FLOOD LIGHT

NOTE

FOR ECM EQUIPMENT REFER TO SECTION IV IN T.O. 1B-52E-1A.

EW officer's station NF

Figure 4-15A.

IFF TRANSPONDER SET AN/APX-25

The transponder set AN/APX-25 installed on the aircraft consists of basic Mark X IFF system equipment with additional components which enable it to operate as a selective identification feature (SIF) system. This transponder set, with controls at the navigator's station (figure 4-14), is an airborne transponder-interrogator set which forms a two-way link between the aircraft and ground IFF recognition installations. The ground interrogator station sends a special signal which is received by the aircraft; the aircraft transponder (reply system) then replies by sending a signal which is received on the ground and displayed as a unique signal on the scope. The ground controller may use any of three special interrogations which are known as mode 1, 2, and 3. The aircraft transponder can reply to any of the modes of interrogation received from the ground station as well as transmit a special emergency reply consisting of either a mode 1 reply with a single pulse, a mode 2 reply represented by a pair of pulses spaced 16 microseconds apart, or a mode 3 reply appearing as a single pulse which is identical to the mode 1 reply. The fourth reply capability of the airborne transponder is transmitted in place of the normal mode 1, 2, and 3 reply, and is known as the emergency reply. This signal appears on ground interrogations as four pulses spaced 16 microseconds apart and has the capability of appearing in any or all of the three modes. The transponder set also has an "identification of position" feature by the use of an I/P-OUT-MIC switch. The principal units of the transponder set are a pulse-type receiver-transmitter, with a separately housed coder, connected to a common omni-directional receiving and transmitting antenna. The transponder set control (figure 4-14) permits turning the equipment on and selecting various modes of operation. The coder group control (figure 4-14) permits selection of reply codes (generated in the coder) to two modes of operation. Switches on the coder permit selection of the reply code to the third mode. The IFF receiver-transmitter contains circuits which enable it to receive and properly decode coded interrogation pulse-pairs, depending upon the mode of operation selected, and to transmit various coded replies modulated either from its own reply-pulse generator or from the coder unit. The transponder set coder, triggered by the decoded pulse from the receiver-transmitter, generates a train of pulses with a variable interval and number depending upon the reply code selected. The reply code is returned to modulate the transmitter of the receiver-transmitter.

The power requirements are as follows: The transponder set control and the coder group control require 28-volt d-c power; the operating units, receiver-transmitter, and coder require 118-volt a-c power. The circuit breakers are located on the radar navigator's circuit breaker panel and are marked "IFF DC" and "IFF AC." The antenna (7, figure 4-9) is installed on the centerline on the underside of the aircraft just forward of the entrance hatch.

IFF Transponder Set Controls

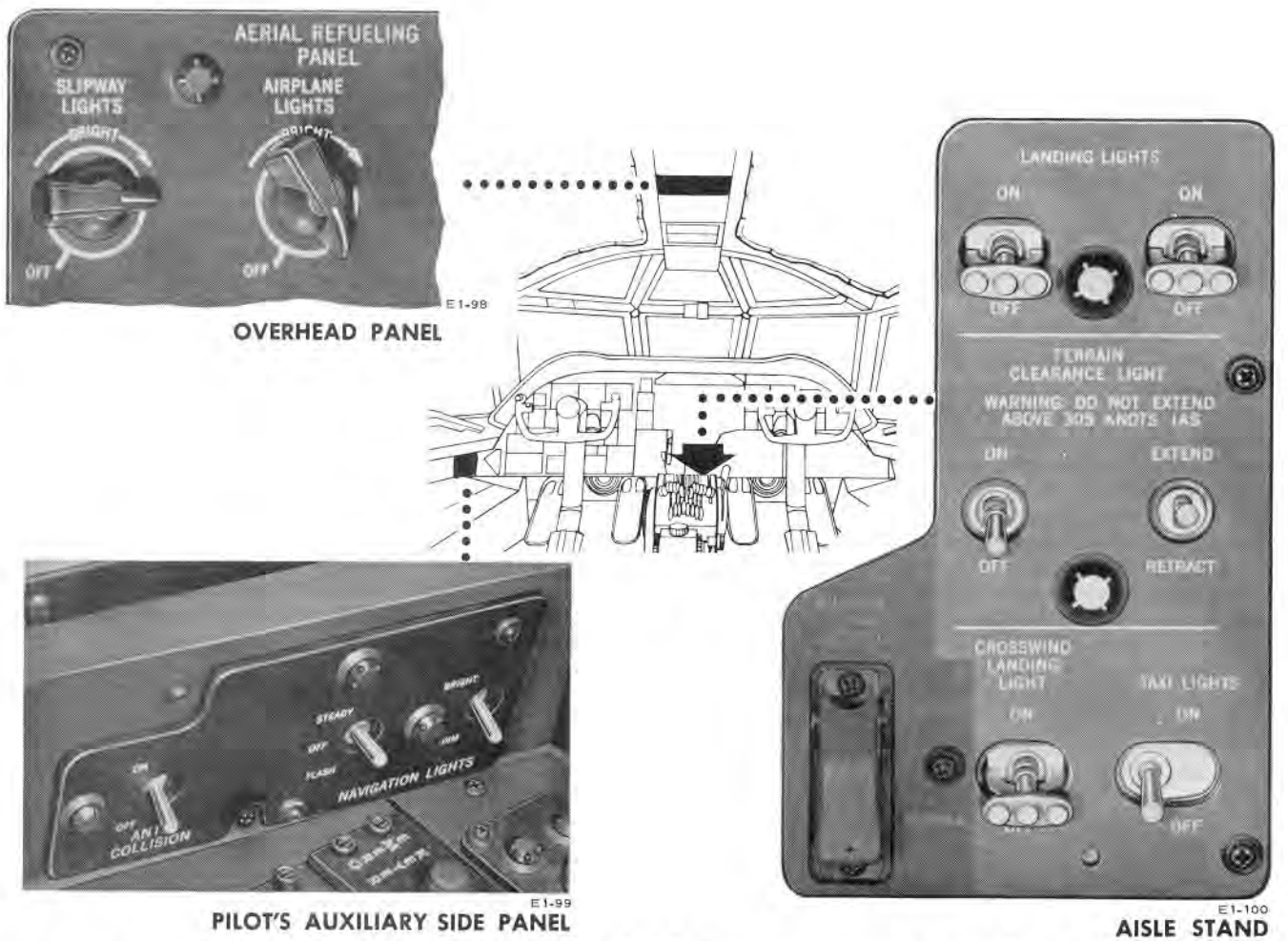
MASTER SELECTOR SWITCH. The master selector switch on the transponder set control (1, figure 4-14) is a dial-type selector switch having OFF--STDBY--LOW--NORM--EMERGENCY positions. In OFF position, all power is removed from the set. In STDBY position, power is applied to the tubes for warmup. The warmup period should be at least 1 minute. In LOW position, the set is operating at a partially sensitive performance. In NORM position, the set is operating at maximum sensitive performance. In EMERGENCY position, the set is operating at full sensitivity for responses to mode 1 interrogations with four successive groups of mode 1 reply code trains. Due to FAA requirements and SAGE equipment limitations, emergency aircraft transmissions will not normally be seen in the SAGE environment. In order to insure emergency recognition by these agencies, the following actions must be taken: the master switch on the transponder set control must be in EMERGENCY position, mode 3 toggle switch "in," and mode 3 code selector to 77. The master control switch must be in LOW, NORM, or EMERGENCY position for operation in mode 1. The master control switch must also be in one of the operating positions before activating the mode 2 or mode 3 switches. A detent button must be pressed before the dial can be turned to EMERGENCY position.

I/P-OUT-MIC SWITCH. The I/P-OUT-MIC switch on the transponder set control (3, figure 4-14) provides for special identification features which are of use to the air traffic controller. The reply in this function consists of a double train of mode 1 responses which is transmitted by holding the switch in the spring-loaded I/P position or by putting it in the MIC position and depressing the pilot's microphone button. The response will continue for 30 seconds after the I/P switch or the pilot's microphone switch has been released. This operation does not affect mode 2, mode 3, or emergency operation.

Figure 4-16. Deleted

Normal Operation of IFF Transponder Set

Normal operation consists of three modes of operation in which the transponder responds to challenging signals. These signals are 1 microsecond wide pulse-pairs on an assigned carrier frequency. The spacing between the pulse-pairs differs with the mode of operation selected. Pulse intervals (leading edge to leading edge) of 3, 5, and 8 microseconds are used for modes 1, 2, and 3 respectively. The receiver, a superheterodyne receiver, detects the signal, converts it to a 59.5 mc IF frequency, amplifies it, and delivers the pulse-pairs (video) to the decoder circuits. The decoder examines the pulse-pair spacings. The pulse from the decoders is then used to trigger the reply pulse generation circuit. If the emergency code is on, the gating time is extended to permit a total of four pulses to be developed. The pulse widths are shaped to 1 microsecond by a cutoff timing line and applied to the modulator. The modulator circuit uses these developed reply pulses to energize the transmitter on the carrier frequency. The coded responses are transmitted and are shown as a reply on the interrogator PPI scope. The I/P-OUT-MIC switch and the master selector switch in EMERGENCY position have effect in the coder but not in the receiver-transmitter. The SIF system allows for a selection from a large number of coded replies to interrogation. There are 32 possible coded responses in mode 1, 400 possible coded responses in mode 2, and 64 possible coded responses in mode 3. Additional responses in mode 1 and mode 3 are selected by the code selector switches on the coder group control. When setting a desired response code, the first digit of the code must be selected on the outer ring of the selector switch. The second digit of the code must be selected on the inner ring of the selector switch; i.e., if mode 3 normal code 02 is desired, the master switch on the transponder set control must be in the NORM position, the MODE 3-OUT switch must be in the MODE 3 position, the number 0 on the outer ring of the selector switch on the coder group control must be positioned beneath



exterior lighting controls (typical)

Figure 4-17.

the white arrow above the dial, and the number 2 on the inner ring of the selector switch must also be beneath the white arrow above the dial. The switches for presetting mode 2 are not accessible as operating controls in flight since the code will be assigned according to airplane type and use or will be based on some characteristics which will not change over a lengthy period of time. To operate in this mode, it is necessary to turn on the mode 2 toggle switch on the IFF transponder control panel.

FIRE CONTROL RADAR

For details of the fire control system, refer to T.O. 1B-52B-1-5.

BNS RADAR

For description of this equipment, see "Weapons Control System - Offensive," this section. Also refer to T.O. 1B-52E-1-6-1.

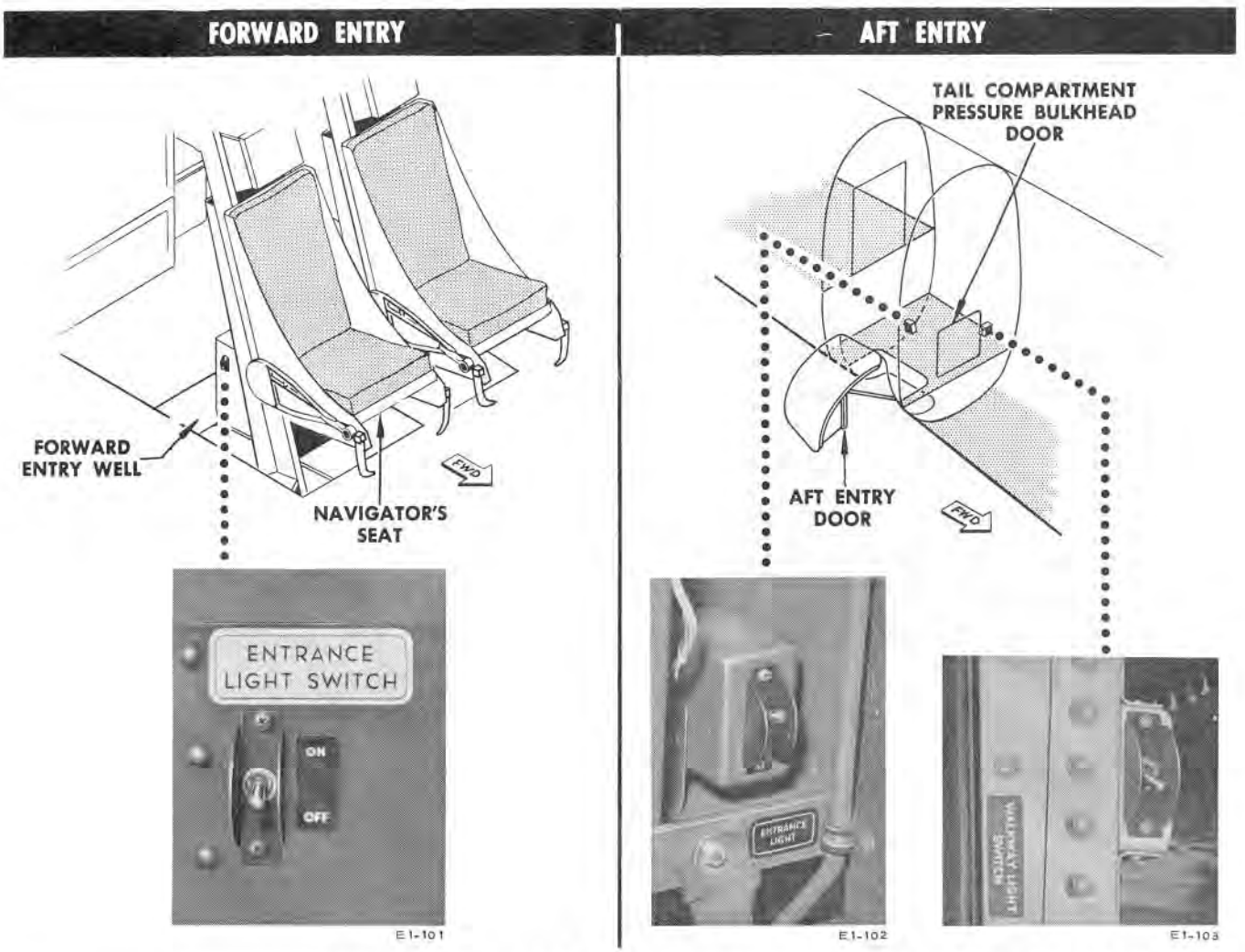
ECM EQUIPMENT

Refer to Section IV in T.O. 1B-52E-1A.

LIGHTING EQUIPMENT

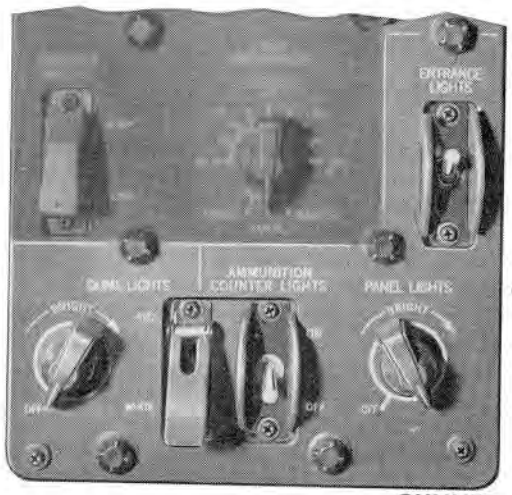
EXTERIOR LIGHTING

Exterior lighting (figure 4-20) consists of navigation lights on the wings, tail, and midbody; anticollision lights on the upper and lower fuselage; taxi lights on right forward landing gear and in wing leading edges; landing lights in forward landing gear doors; crosswind landing light on right forward landing gear; air refueling lights on slipway doors and in refueling receptacle; and a retractable terrain clearance light on forward bottom fuselage. The center taxi light and crosswind landing light turn with the right forward gear for lighting the turning or landing area. The air refueling lights illuminate the wings and can aid the tanker boom operator in checking the receiver airplane engines, nacelles, wing flaps, and spoilers. These lights also

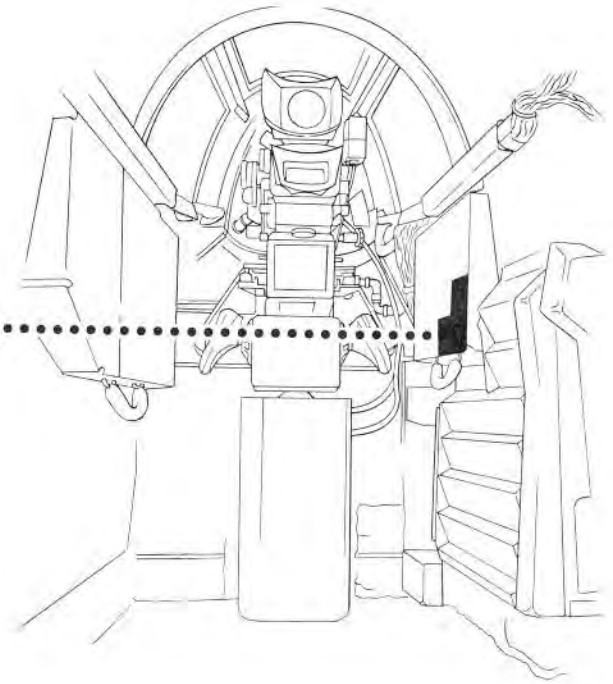


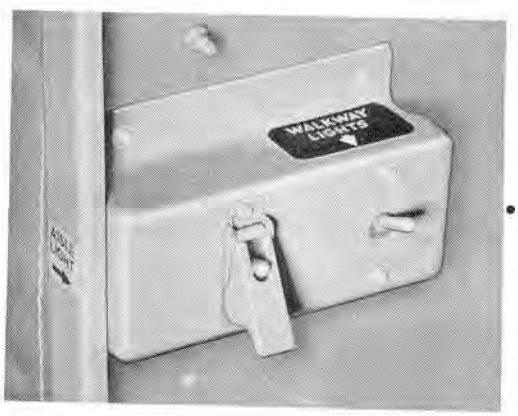
.....entry and walkway light switches

Figure 4-18.



GUNNER





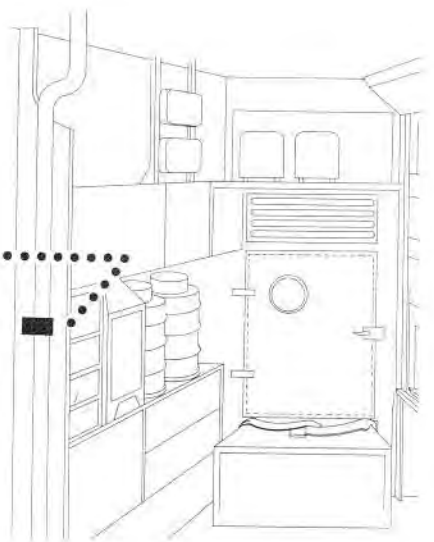
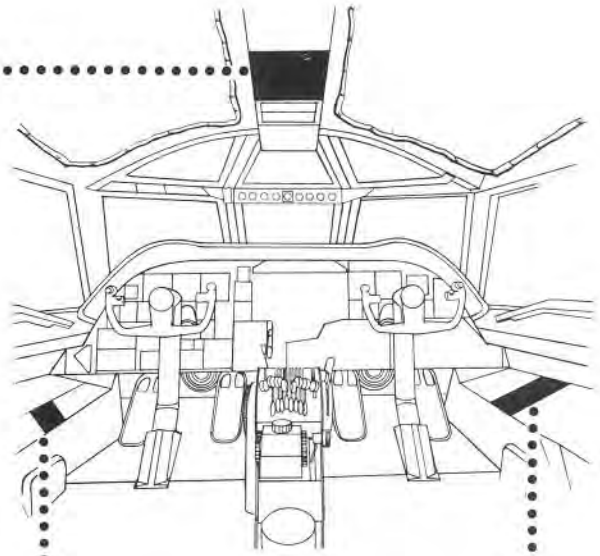


Figure 4-19. (Sheet 1 of 3).

11-1-140

OVERHEAD

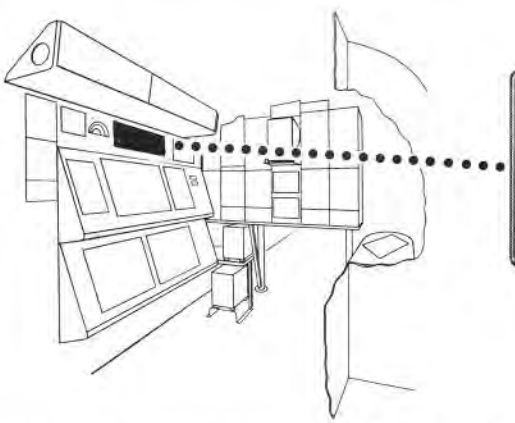


E1-107

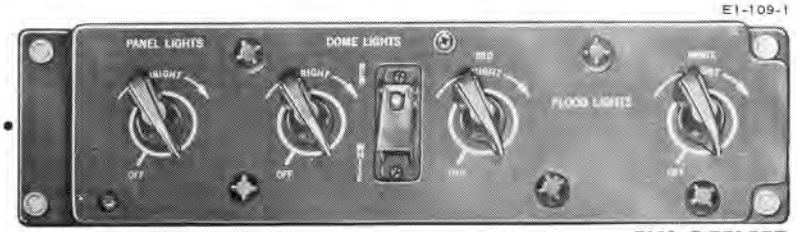
PILOT

E1-109

COPILOT



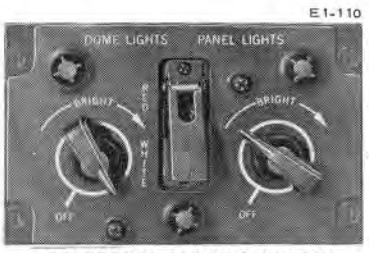
E1-109-1



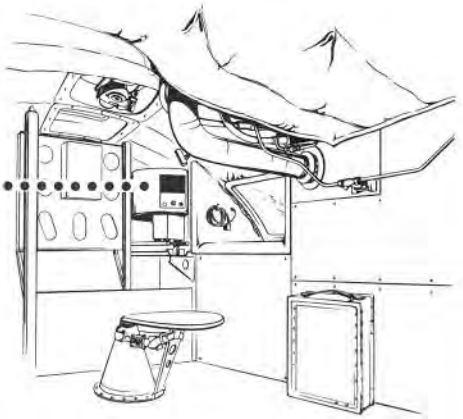
EW OFFICER

interior lighting panels (typical)

Figure 4-19 (Sheet 2 of 3).

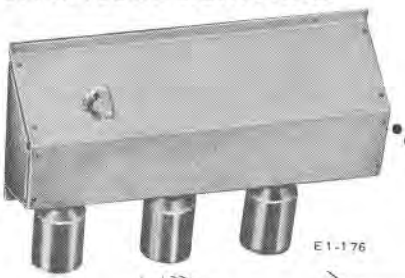


CELESTIAL NAVIGATION

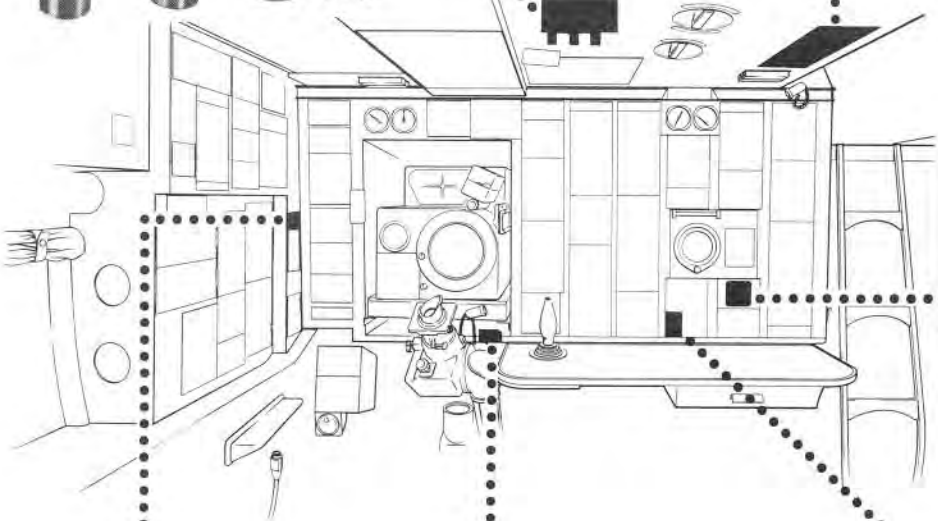


E1-111

UPPER FLOOD LIGHT PANEL



E1-176



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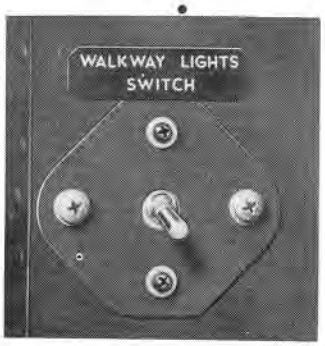

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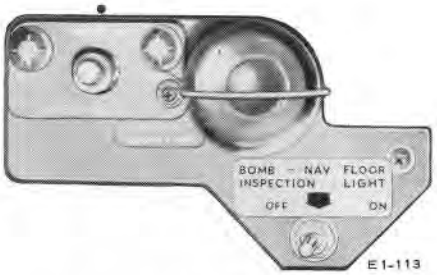
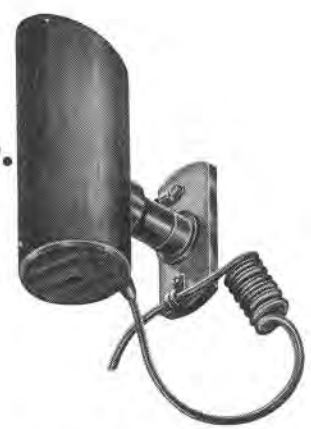


E1-113

RADAR NAVIGATOR AND NAVIGATOR



E1-177

WORK TABLE LIGHT

.....interior lighting panels (cont)

Figure 4-19. (Sheet 3 of 3).

NAVIGATION

LIGHT	QUANTITY	LOCATION	SWITCH	CIRCUIT BREAKER
Yellow White Red Green White	1** 1** 1** 1** 3†	Rudder trailing edge Rudder trailing edge Left wing tip Right wing tip Mid body (Non-flashing)	STEADY--OFF--FLASH toggle and one BRIGHT--DIM toggle on pilot's auxiliary side panel	190 ▶ 236 W70 ▶ W117 Less G N Pilots' overhead circuit breaker panel. On airplanes 236 ▶ W118 ▶ Plus G N navigation light transformers are fused at the pilot's auxiliary circuit breaker panel.
ANTI-COLLISION (Rotating Beacon)				
Red	3**	Aft body; one on bottom of fuselage, two near top	ON--OFF switch on pilot's auxiliary side panel	Pilots' overhead circuit breaker panel.
TAXI				
White White White	2** 2* 1*	Right and left tip gear doors Less JG In wing leading edge JG Right forward landing gear	ON--OFF toggle on aisle stand	Pilots' overhead circuit breaker panel.
LANDING				
White	2**	Right and left forward landing gear doors	Two ON--OFF toggles on aisle stand	Pilots' overhead circuit breaker panel.
CROSSWIND LANDING				
White	1**	Right forward landing gear	ON--OFF toggle on aisle stand (Light also turned on by taxi light switch)	Pilots' overhead circuit breaker panel.
TERRAIN CLEARANCE				
White	1**	Bottom of fuselage, forward body (retractable)	EXTEND--RETRACT toggle and ON--OFF toggle on aisle stand	Pilots' overhead circuit breaker panel.
AIR REFUELING				
White	2*	One on each slipway door for illuminating each wing	OFF--BRIGHT powerstat on air refueling panel	Pilots' overhead circuit breaker panel.
White	3*	One on each slipway door for illuminating slipway and one in the air refueling receptacle	OFF--BRIGHT powerstat on air refueling panel	Pilots' overhead circuit breaker panel.

*Operates on 28 volt a-c power
**Powered from individual 115 volt single-phase a-c to 28 volt a-c transformers located near each light.
†Operates on 24 volt d-c TR power

NOTE

Flasher mechanism requires 24 volt d-c TR power and 115 volt single-phase a-c.

exterior lighting

Figure 4-20.

LIGHT	QUANTITY	LOCATION	SWITCH	CIRCUIT BREAKER
PILOT'S				
FLIGHT INSTRUMENT Red	15*	On pilots' instrument panel (include six emergency flight instrument lights)	OFF--BRIGHT powerstat on pilot's lighting panel	Pilot's circuit breaker panel **Less** MN ECM circuit breaker panel MN
SIDE INSTRUMENT Red	7*	On pilot's side panels	OFF--BRIGHT powerstat on pilot's lighting panel	Pilot's circuit breaker panel
FORWARD PANEL Red	1**	On pilots' instrument panel	OFF--BRIGHT powerstat on pilot's lighting panel	Pilot's circuit breaker panel
SIDE PANEL Red	12**	On pilot's side panels	OFF--BRIGHT powerstat on pilot's lighting panel	
FORWARD FLOOD Red	5*	On pilot's side and forward visors for forward illumination	OFF--BRIGHT powerstat on pilot's lighting panel	Pilot's circuit breaker panel
SIDE FLOOD Red	3	On pilot's side visor for side illumination	OFF--BRIGHT powerstat on pilot's lighting panel	
CIRCUIT BREAKER Red	3	On pilot's side visor and overhead panel for circuit breaker illumination	OFF--BRIGHT powerstat on pilot's lighting panel	
SPOT White	1	Overhead on pilot's escape hatch	Rheostat switch on light	Pilot's circuit breaker panel
PILOTS' CENTER				
CENTER INSTRUMENT Red	34*	On center pilots' instrument panel	OFF--BRIGHT powerstat on overhead lighting panel	Pilot's circuit breaker panel
STANDBY COMPASS Red	1*	On standby compass above pilots' instrument panel	OFF--BRIGHT powerstat on overhead lighting panel	
CENTER CONSOLE Red	3* 190▶224 W70▶W98 4** 11* 225▶ W99▶	On aisle stand	OFF--BRIGHT powerstat on overhead lighting panel	

*Light assemblies. **Edge lighted panels.
***Operate on 24 volt d-c; all other lights are on 28 volt a-c.

Figure 4-21 (Sheet 1 of 6).

illuminate the refueling slipway and receptacle. No passing or formation lights are provided.

Landing Lights

A fixed landing light is installed in each forward landing gear door for use during approach and landing. The landing lights are controlled by an ON--OFF switch (figure 4-17) on the aisle stand and will not illuminate when the landing gear is up and locked. D-C control power for these lights is provided through circuit breakers marked "RH Landing" and "LH Landing" on the "Exterior Lights" portion of the overhead circuit breaker panel.

NOTE

- The landing lights generate sufficient heat to remove, within a few minutes, any ice which may accumulate on them while the wheels are down during descent.
- The landing lights will not be available for night ditching as the landing gear doors will be kept closed. A retractable terrain clearance light located on the forward bottom fuselage will provide illumination during a night ditching or crash landing.

Navigational Lights

The navigation lights consist of a yellow and white light on the rudder trailing edge, a red light on the left wing tip, a green light on the right wing tip, and three mid body (nonflashing) lights. The lights are controlled by a STEADY--OFF--FLASH toggle switch and a BRIGHT --DIM toggle switch on the pilot's auxiliary side panel. STEADY position selects steady illumination of all the lights. FLASH position selects a flashing of the wing and tail lights with steady illumination of the fuselage lights, while the OFF position turns the lights out. The other switch has BRIGHT--DIM positions and selects bright or dim illumination of all the navigation lights. Light power is provided through circuit breakers marked "Nav A-C" and "Nav D-C" on the "Exterior Lights" portion of the pilot's overhead circuit breaker panel.

Anticollision Lights

Three rotating anticollision lights, one on each side of the fuselage and one on the bottom of the fuselage, are used to safeguard against midair collision. The lights are controlled by an ON--OFF switch (figure 4-17) on the overhead panel. Light power is provided through circuit breakers marked "Anti-Collision Upper" and "Anti-Collision Lower" on the "External Lights" portion of the pilot's overhead circuit breaker panel.

NOTE

The rotating anticollision light should be turned off during actual instrument flight conditions. With the light on, a pilot may experience vertigo from the rotating light reflections. In addition, the light will be ineffective during instrument flight conditions.

Crosswind Landing Light

A crosswind landing light is installed on the right forward landing gear to provide lighting on the landing area during crosswind landings. The light is controlled by an ON--OFF switch (figure 4-17) marked "Crosswind" on the aisle stand. Also, the light may be controlled by a switch marked "Taxi" on the aisle stand. D-C control power is provided through a circuit breaker marked "Crosswind Ldg" on the "Exterior Lights" portion of the pilot's overhead circuit breaker panel.

Terrain Clearance Light

A retractable terrain clearance light installed on the forward bottom fuselage will provide illumination during a night crash landing. In addition, the light may be used on night takeoffs since the landing lights will not illuminate after the landing gear has been retracted. See "Emergency Equipment," Section I.

NOTE

Inflight operation of the terrain clearance light should not exceed 15 continuous minutes without allowing a 4-minute cooling period before subsequent operating periods.

Taxi Lights

Three taxi lights and the crosswind landing light provide lighting for taxi operation. One light is installed on the right and left tip gear doors. A crosswind taxi light and a crosswind landing light are installed on the right forward landing gear door and will not illuminate unless the landing gear lever is in DOWN position. The lights are controlled by an ON--OFF switch on the aisle control stand. D-C control power is provided through a circuit breaker marked "Wing Taxi" and "Main Taxi" on the "Exterior Lights" portion of the pilot's overhead circuit breaker panel.

Air Refueling Lights

Air refueling lights consist of five white lights, one installed in the receptacle and two in each slipway door. The lights illuminate the receptacle, slipway, and wing areas during night air refueling operations. In addition, the lights aid the tanker boom operator in checking the receiver aircraft. The lights in the slipway doors may be used for scanning the wing leading edges, nacelles, struts, and spoilers. The lights are controlled by two OFF--BRIGHT rotary switches (figure 4-17) on the overhead panel. The slipway lights rotary switch controls the receptacle light and slipway lights. The aircraft lights rotary switch controls the left and right wing illuminating lights. The air refueling lights will

Figures 4-20 and 4-21 deleted.

All data on pages 4-41 and 4-42 deleted.

not illuminate unless the master refuel switch is ON and either the slipway door normal or alternate switch is in OPEN position. Light power is provided through a circuit breaker marked "Ext Lights" on the "IFR" portion of the pilots' overhead circuit breaker panel.

Protective Features

The landing lights will not illuminate when the landing gear is up and locked. The air refueling (IFR) lights will not illuminate unless the air refueling system master switch is in ON and either the slipway door normal or alternate switch is in OPEN position. The terrain clearance light will not illuminate within 10° of the retracted position.

INTERIOR LIGHTING

Interior lighting is provided by red and white lights. Red lights are used during night flights since red color does not adversely affect night vision. White lights are used for daytime flights during dull light conditions and during thunderstorms to lessen the blinding effect of lightning flashes. All lights utilize 28-volt a-c power reduced from 118-volt ac by autotransformers, except the entry lights and in an emergency the essential instrument lights which use 24-volt d-c battery power.

Pilot's and Copilot's Station Lighting

PANEL LIGHTS. Lights within edge-lighted panels, which illuminate indirectly from the underside, are red. The lights are the primary source of instrument lighting and are controlled by OFF--BRIGHT rotary switches (figure 4-19) on the pilot's side panel and the overhead lighting panel. Light power is supplied through circuit breakers marked "Pilot Panel," "Center Panel," and "Copilot Panel" on the "Interior Lighting" portion of the pilot's circuit breaker panel.

INSTRUMENT LIGHTS. Red lights in the instrument hoods provide illumination for individual instruments. The lights are controlled by OFF--BRIGHT rotary switches (figure 4-19) on the pilot's side panel and the overhead lighting panel. Light power is received through circuit breakers marked "Pilot Inst," "Copilot Inst," and "Center Instrument" on the "Interior Lighting" portion of the pilot's circuit breaker panel.

ESSENTIAL (EMERGENCY) FLIGHT INSTRUMENT LIGHTS. The essential flight instrument lights provide lighting for the pilot's pitot-static altimeter, pilot's radar altimeter SQ, clock, rate of climb, turn and slip, airspeed indicator, standby compass, and machmeter. The lights normally receive 118-volt ac through a circuit breaker marked "Pilot's Inst" on the ECM circuit breaker panel. In the event a-c power is lost to the lights, the lights will receive d-c emergency power through a circuit breaker marked "Emer Flight Inst" on the pilot's circuit breaker panel provided the pilot's forward TR switched battery bus circuit breaker is pulled. In the event complete a-c power is lost, the lights will automatically receive emergency d-c power. See "Instrument Lighting Failure," Section III.

FLOODLIGHTS. Floodlights are a secondary source of instrument lighting and are mounted in a manner so as to provide illumination on a group of instruments located in the same area. The lights are controlled by OFF--BRIGHT rotary switches (figure 4-19) on the pilot's lighting panel and the overhead lighting panel. The lights are provided power through circuit breakers marked "Pilot Flood," "Center Flood," and "Copilot Flood" on the "Interior Lighting" portion of the pilot's circuit breaker panel.

SPOTLIGHTS. Two adjustable spotlights, one on the pilot's escape hatch and one on the copilot's escape hatch, provide a means of supplying light on any object desired by the pilot or copilot. The lights are controlled by a rheostat switch on the individual light. Light power is provided through a circuit breaker marked "Aisle, Ladder & Spot" on the "Interior Lighting" portion of the pilot's circuit breaker panel.

DOMELIGHTS. One red and one white domelight are located on the pilot's and copilot's escape hatches and one in ceiling aft of the pilot's seat. The lights are controlled by an OFF--BRIGHT rotary switch and the color is selected by a RED--WHITE toggle switch on the overhead lighting panel. Light power is provided through a circuit breaker marked "Dome" on the "Interior Lighting" portion of the pilot's circuit breaker panel.

THUNDERSTORM LIGHTS. Two white thunderstorm lights located above and behind the pilot's and copilot's seats provide illumination during thunderstorms to lessen the blinding effect of lightning flashes. The lights are controlled by a switch on the overhead lighting panel. Light power is provided through a circuit breaker marked "Thunderstorm" on the "Interior Lighting" portion of the pilot's circuit breaker panel.

STANDBY COMPASS LIGHT. The standby compass and light are located above the pilots' instrument panel. The light is controlled by a switch marked "Center Instrument" on the overhead lighting panel. The light normally operates on 28-volt a-c power through a circuit breaker marked "Center Instr" on the "Lighting" portion of the pilot's circuit breaker panel. In the event a-c power is lost, the light will operate on battery power. With the emergency battery switch in NORMAL position, forward battery power is supplied through a circuit breaker marked "Emer Flt Instr" on the "Lighting" portion of the pilot's circuit breaker panel. With the emergency battery switch in the EMERG position, aft battery power is supplied through a circuit breaker marked "Power" on the "Emer Flt Inst" portion of the pilot's overhead circuit breaker panel.

INDICATOR (WARNING) LIGHT DIMMING CONTROL SWITCH. An indicator light dimming control switch on the pilot's lighting panel controls the brightness of all indicator and warning lights at the pilot's and copilot's stations with the exception of the fire warning lights, landing gear warning light, pilot's call light, and copilot's tail compartment pressure low warning light. The switch has momentary BRIGHT--DIM positions and is spring-loaded to neutral. When the switch is momentarily placed to BRIGHT position, all the indicator lights are at their brightest illumination. Momentarily moving the switch to DIM position will dim all indicator lights, with the exception of those named above, to reduce glare. The dimming circuit is mechanically linked to the flight instrument lights rheostat on the pilots' lighting panel so that when the flight instrument lights have been reduced to a specified low intensity, the warning lights will be automatically reset to BRIGHT position.

Radar Navigator's and Navigator's Station Lighting

PANEL LIGHTS. Lights within all of the edge-lighted panels are controlled by an OFF--BRIGHT rotary switch on the radar navigator's and navigator's lighting panel. Light power is provided through a circuit breaker marked "Front and Side Panel Lts" on the "BMDR/NAV Compartment Lighting" portion of the navigator's auxiliary circuit breaker panel.

FLOODLIGHTS. Floodlights for the entire compartment are controlled by an OFF--BRIGHT rotary switch on the radar navigator's, navigator's, and upper floodlight lighting panels. The lights are provided power through circuit breakers marked "Flood Red" and "Flood White" on the "BMDR/NAV Compartment Lighting" portion of the navigator's auxiliary circuit breaker panel.

SPOTLIGHTS. Spotlights for the entire compartment are controlled by a rheostat switch on the individual lights. The lights are provided power through a circuit breaker marked "Spot Light" on the "BMDR/NAV Compartment Lighting" portion of the navigator's auxiliary circuit breaker panel.

DOMELIGHTS. Two domelights, one red and one white, are located above the radar navigator's and navigator's seats. In addition, one light is located in ceiling over celestial navigation station. The lights are controlled by an OFF--BRIGHT rotary switch and the light color is selected by a RED--WHITE toggle switch. Both switches are on the radar navigator's and navigator's lighting panel. Light power is provided through circuit breakers marked "Dome Bmdr & Nav" and "Dome Misc" on the "BMDR/NAV Compartment Lighting" portion of the navigator's auxiliary circuit breaker panel.

TABLE LIGHT. A white table light is located on the right side of navigator's forward control panel and is controlled by an OFF--BRIGHT rotary switch on the table light panel. Light power is provided through a circuit breaker marked "Front Panel Lights" on the "BMDR/NAV Compartment Lighting" portion of the navigator's auxiliary circuit breaker panel.

ECM and Celestial Navigation Station Lighting

PANEL LIGHTS. Lights within all edge-lighted panels at the EW officer's and celestial navigation stations are controlled by an OFF--BRIGHT rotary switch on the EW officer's lighting panel. Light power is provided through a circuit breaker marked "Panel" on the "Lights" portion of the ECM circuit breaker panel.

FLOODLIGHTS. Red floodlights at the EW officer's station are controlled by an OFF--BRIGHT rotary switch on the EW officer's lighting panel. Light power is provided through a circuit breaker marked "Red Flood" on the "Lights" portion of the ECM circuit breaker panel.

SPOTLIGHTS. Two adjustable spotlights, one on aft end of EW officer's upper control panel and one behind the pilot's seat, provide a means of supplying light upon any object desired by the operator. The lights are controlled by a rheostat switch on the individual light. Light power is provided through a circuit breaker marked "Dome & Spot" on the "Lights" portion of the ECM circuit breaker panel.

DOMELIGHTS. One red and white domelight is located in the ceiling over the EW officer's station and is controlled by an OFF--BRIGHT rotary switch and the light color selected by a RED--WHITE toggle switch on the EW officer's lighting panel. Light power is provided through a circuit breaker marked "Dome & Spot" on the "Lights" portion of the ECM circuit breaker panel.

Gunner's Station Lighting

PANEL LIGHTS. Lights within all edge-lighted panels at the gunner's station are controlled by a rotary switch on the gunner's lighting panel. Light power is provided through a circuit breaker marked "Panel & Instr" on the "Lights" portion of the gunner's circuit breaker panel.

INSTRUMENT LIGHTS. Red lights in the instrument hoods provide illumination for individual instruments. The lights are controlled by an OFF--BRIGHT rotary switch on the gunner's lighting panel. Light power is provided through a circuit breaker marked "Panel & Instr" on the "Lights" portion of the gunner's circuit breaker panel.

DOMELIGHTS. One white domelight located in the ammunition bay and one red-white domelight in ceiling over gunner's seat provide a means of supplying light upon any object desired by the operator. The white lights are controlled by an ON--OFF toggle switch on the right side of the ammunition bay while the red-white light is controlled by an OFF--BRIGHT rotary switch on a RED--WHITE toggle switch on the gunner's lighting panel. Light power is provided through a circuit breaker marked "Dome & Spot" on the "Lights" portion of the gunner's circuit breaker panel.

SPOTLIGHTS. Two adjustable spotlights, one to the right of the gunner's seat and one to the right of the entry door, provide a means of supplying light upon any object desired by the operator. The lights are controlled by a rheostat switch on the individual light. Light power is provided through a circuit breaker marked "Dome & Spot" on the "Lights" portion of the gunner's circuit breaker panel.

Passageway Lights

ENTRY LIGHTS. White entry lights are located in the ceiling above forward door and on bulkhead forward of aft entry door. The forward entry light is controlled by an ON--OFF toggle switch right and aft of the entry door. The aft entry light is controlled by dual toggle switches, one to the right of the aft entry door and one on the gunner's lighting panel. Light power is provided through a circuit breaker marked "Entrance" on the "BMDR/NAV Compartment Lighting" portion of the navigator's auxiliary circuit breaker panel.

AISLE LIGHTS. One red aisle light is located in upper deck floor at top of deck ladder and one white aisle light is located above the bunk and one in ceiling to the right of the navigator's station. The red light has no switch for control. The white lights are controlled by an ON --OFF toggle switch on the aft side of galley wall and one aft of copilot's escape hatch. Light power is provided through a circuit breaker marked "Aisle Ladder & Spot" on the "Interior Lighting" portion of the pilot's circuit breaker panel.

Electronic Rack Lighting

UPPER ELECTRONIC COMPARTMENT. A white spotlight located on the upper equipment rack is controlled by a rheostat switch on the light. Light power is provided through a circuit breaker marked "Work" on the "Lights" portion of the ECM circuit breaker panel.

GALLEY AND LOWER ELECTRONIC ENCLOSURE. One red-white dome located in corner of ceiling over galley and one white spotlight on the lower equipment rack are controlled by a RED--OFF--WHITE toggle switch adjacent to the light and a rheostat switch on light. Light power is provided through circuit breakers marked "Spot" and "Red and White Flood" on the "BMDR/NAV Compartment Lighting" portion of the navigator's auxiliary circuit breaker panel.

Miscellaneous Lights

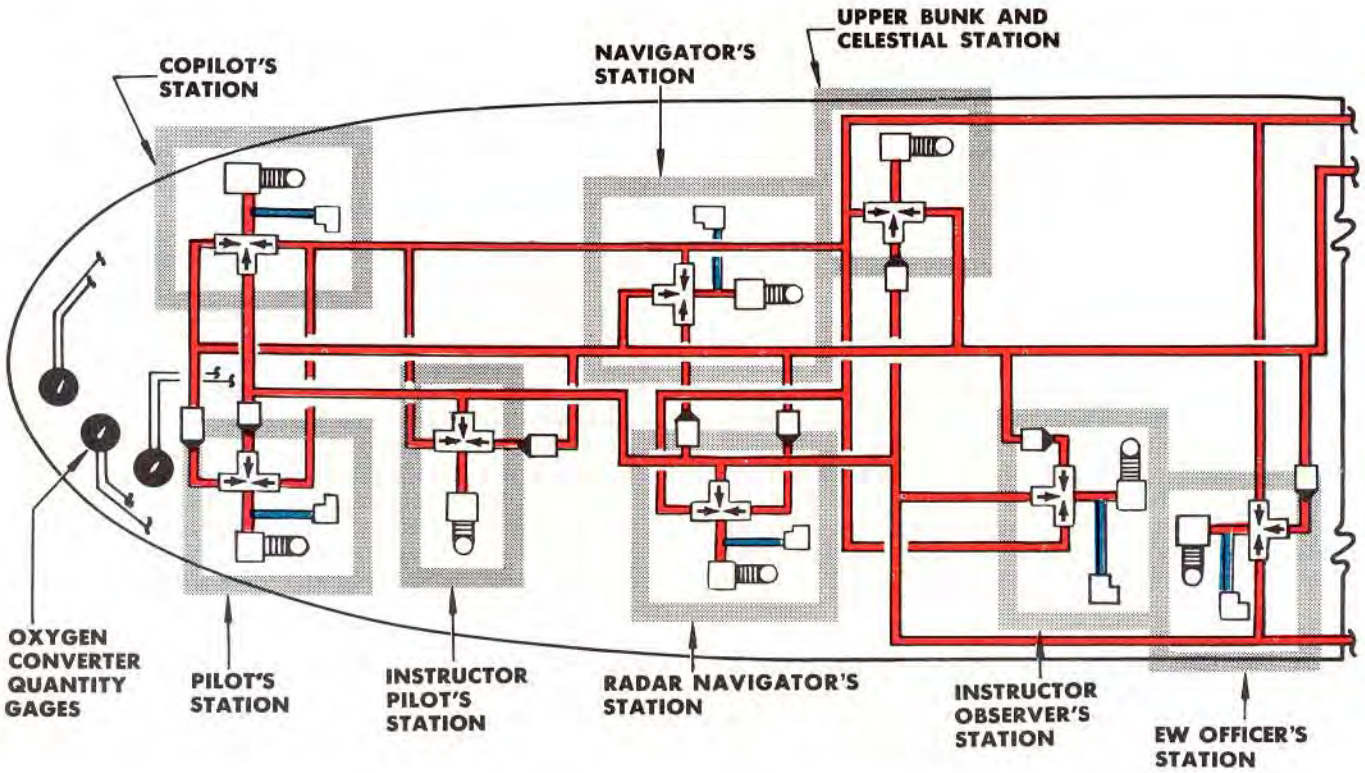
Three white spotlights and three red-white domelights are located forward of navigator's and radar navigator's instrument panel and on aft wall at the relief station. The spotlights are controlled by a rheostat switch on the individual light. The domelights forward of the instrument are controlled by a RED--OFF--WHITE toggle adjacent to the right light, while the domelights at the relief station are controlled by an OFF--BRIGHT rheostat and a RED--WHITE toggle switch on the relief station lighting panel. Light power is provided through circuit breakers marked "Dome BMDR/NAV" and "Dome Misc" on the "BMDR/NAV Compartment Lighting" portion of the navigator's auxiliary circuit breaker panel.

Bomb Bay Lights

Six white floodlights located on the forward end and each side of the bomb bay are controlled by an ON--OFF toggle switch on right side of forward bomb bay below the crawlway. In addition, two white service lights are installed in top of bomb bay and are controlled by individual toggle switches on the equipment panel near the lights. Power for the lights is provided through a circuit breaker marked "Flood" on the "Bomb Bay Lights" portion of the navigator's auxiliary circuit breaker panel.

Walkway and Crawlway Lights

Twelve domelights are located along walkway, crawlway, wheel well, and aft equipment bay. The lights are controlled by ON--OFF toggle switches on the left side panel at the radar navigator's station, on the aft side of the galley wall, and on the left forward side of aft pressure bulkhead. Power for the lights is provided through circuit breakers marked "Pwr" and "Cont" on the "Walkway Lights" portion of the navigator's auxiliary circuit breaker panel.



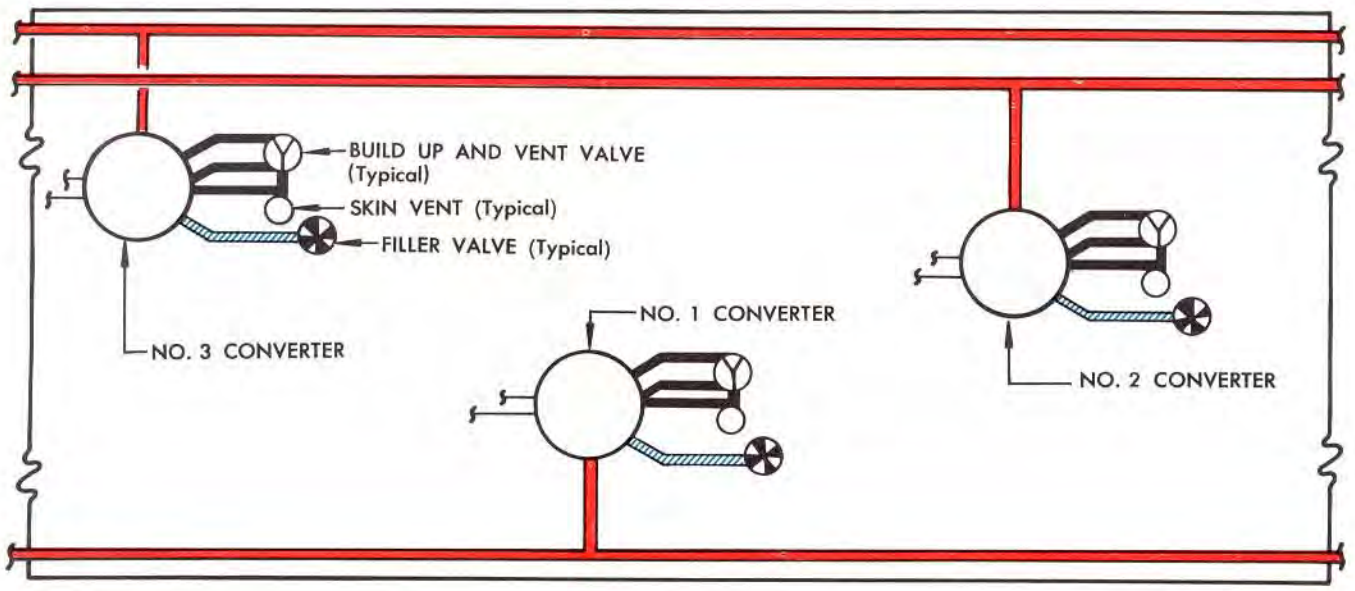
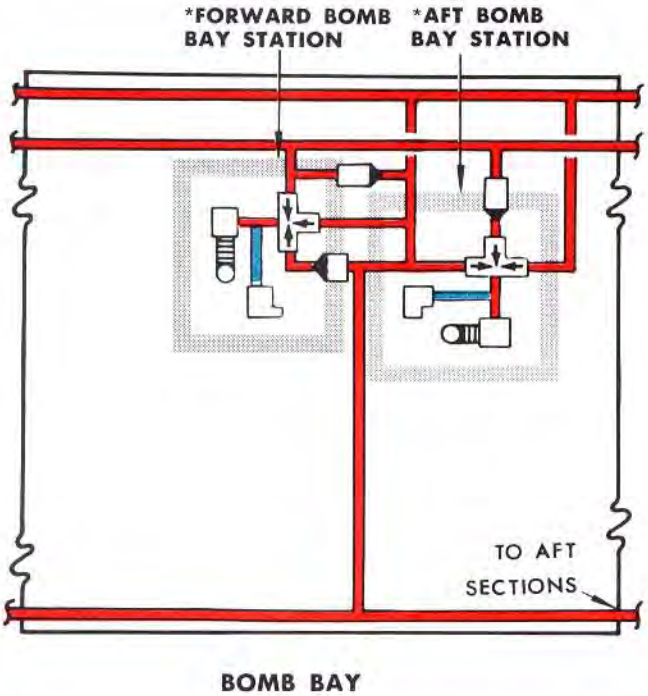
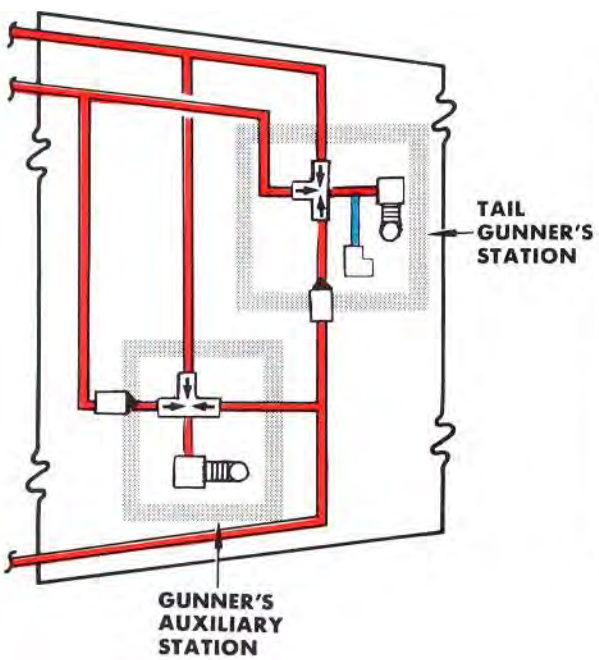
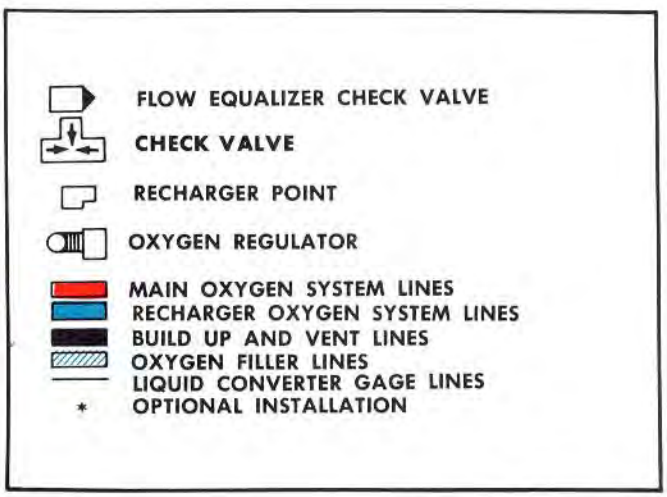


Figure 4-22.(Sheet 1 of 2)





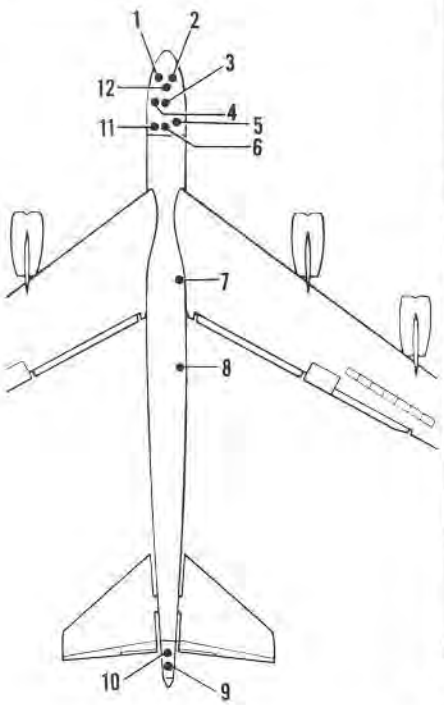


oxygen system

Figure 4-22. (Sheet 2 of 2)

OXYGEN SYSTEM

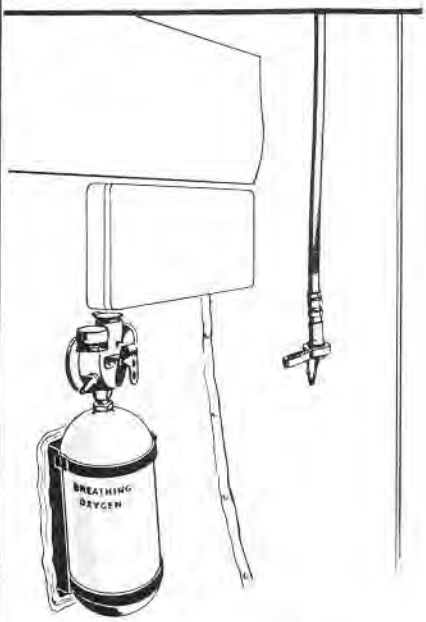
The airplane is provided with a 300 psi liquid oxygen system (figure 4-22). This system supplies all crew stations and the portable oxygen bottle rechargers. An automatic pressure breathing diluter demand oxygen regulator is provided at all crew stations and at the bomb bay station. An additional regulator is installed in the gunner's compartment for use when he is not in his normal operating position. The Type D-2A regulator is used at all stations except the copilot's station which utilizes a Type MD-1. The two regulators are functionally the same. A pressure breathing portable oxygen bottle recharger (figure 4-23) is located near each crew member's station. The oxygen system is supplied by three 20 liter 300 psi liquid oxygen converters (8, figure 1-60). Converter No. 1 is located on the forward left side of the aft equipment compartment. Converter No. 2 is located aft and converter No. 3 is located forward on the right side of the aft equipment compartment. A supply line from each converter connects with all oxygen regulators and portable oxygen bottle rechargers. Check valves at each regulator isolate the lines from each converter making three separate oxygen supply systems. An additional flow equalizer check valve is in the line from either converter No. 1 or No. 2 because one converter will generally supply oxygen at a slightly different pressure than the others. The additional flow equalizer check valve will open at a differential pressure of 10 to 14 psi so that the No. 1 and No. 2 converters will each



OXYGEN BOTTLES AND RECHARGER POINTS

Station	Bottle	Recharger
1 PILOT	ONE	ONE
2 COPILOT	ONE	ONE
3 NAVIGATOR	ONE	ONE
4 RADAR NAVIGATOR	ONE	ONE
5 UPPER BUNK	NONE	NONE
6 EW OFFICER	ONE	ONE
7 FWD BOMB BAY*	ONE	ONE
8 AFT BOMB BAY*	ONE	ONE
9 GUNNER	ONE	ONE
10 GUNNER'S AUXILIARY	NONE	NONE
11 INSTRUCTOR NAVIGATOR	NONE	ONE
12 INSTRUCTOR PILOT	NONE	NONE

*Optional installation



TYPICAL OXYGEN BOTTLE AND RECHARGER

•••••••••• oxygen bottles and recharger points

Figure 4-23.

supply roughly half the stations and oxygen from these two converters will be consumed at about the same rate. Converter No. 3, which has no such additional flow equalizer check valves in its lines usually will be depleted first. See figure 4-24 for oxygen duration.

NOTE

- Pressure indications as high as 420 psi may be attained due to pressure buildup in the heat exchanger line downstream of the liquid oxygen converter and check valve prior to use of oxygen. A relief valve having a high pressure setting of 395 (±25) psi governs system pressure.
- Frost buildup above the lower three or four coils is an indication of a possible deterioration of converter vacuum. During service or buildup period, icing above the lower three or four coils should dissipate within 1 hour after buildup if ground temperature is above 32° F. Icing on the lower three or four coils must be considered a normal condition during service or buildup period.

OXYGEN SYSTEM CONTROLS

Regulator Diluter Lever

A regulator diluter lever (3, figure 4-25) located on each oxygen regulator has NORMAL OXYGEN--100% OXYGEN positions. In NORMAL OXYGEN position, the regulator automatically supplies the proper mixture of oxygen and air at all altitudes. In 100% OXYGEN position, the air intake port is closed and pure oxygen is supplied for emergencies regardless of the altitude. At cabin altitudes above 30,000 feet, the lever should be placed in 100% OXYGEN position as a safety precaution. The lever should be left in 100% OXYGEN position at the end of a flight to prevent dust and lint from entering the regulator.

Oxygen Supply Shutoff Lever

An ON--OFF oxygen supply shutoff lever (4, figure 4-25) is provided on each oxygen regulator. The lever located on the gunner's side panel is protected by a clear plastic guard to prevent inadvertent movement to OFF position. In ON position, oxygen is supplied to

OXYGEN DURATION—HOURS
BASED ON CREW OF SIX

CABIN ALTITUDE (feet)	REGULATOR DILUTOR POSITION	GAGE QUANTITY—SUM TOTAL OF THREE GAGES												
		60 LITERS	55 LITERS	50 LITERS	45 LITERS	40 LITERS	35 LITERS	30 LITERS	25 LITERS	20 LITERS	15 LITERS	10 LITERS	5 LITERS	BELOW 5 LITERS
40,000	100%	62.9	57.6	52.4	47.1	41.9	36.8	31.4	26.2	21.0	15.7	10.5	5.2	EMERGENCY DESCEND TO ALTITUDE NOT REQUIRING OXYGEN
	NORMAL	62.9	57.6	52.4	47.1	41.9	36.8	31.4	26.2	21.0	15.7	10.5	5.2	
35,000	100%	62.9	57.6	52.4	47.1	41.9	36.8	31.4	26.2	21.0	15.7	10.5	5.2	
	NORMAL	62.9	57.6	52.4	47.1	41.9	36.8	31.4	26.2	21.0	15.7	10.5	5.2	
30,000	100%	45.4	41.6	37.8	34.0	30.2	26.4	22.7	18.9	15.1	11.3	7.5	3.8	
	NORMAL	46.6	42.7	38.8	35.0	31.0	27.2	23.3	19.4	15.5	11.6	7.7	3.9	
25,000	100%	35.0	32.2	29.2	26.2	23.3	20.4	17.5	14.6	11.6	8.7	5.8	2.9	
	NORMAL	44.1	40.5	36.8	33.0	29.4	25.7	22.0	18.4	14.7	10.5	7.3	3.7	
20,000	100%	26.6	24.4	22.4	19.9	17.7	15.5	13.3	11.1	8.9	6.6	4.4	2.2	
	NORMAL	48.6	44.4	40.5	36.4	32.4	28.3	24.3	20.2	16.2	12.1	8.1	4.0	
15,000	100%	21.3	19.5	17.7	16.0	14.2	12.4	11.6	8.9	7.1	5.3	3.5	1.8	
	NORMAL	60.5	55.5	50.4	45.4	40.4	35.2	30.2	25.2	20.2	15.1	10.1	5.0	
10,000	100%	17.1	15.6	14.2	12.8	11.4	10.0	8.5	7.1	5.7	4.3	2.8	1.4	
	NORMAL	60.5	55.5	50.4	45.4	40.4	35.2	30.2	25.2	20.2	15.1	10.1	5.0	

oxygen duration

Figure 4-24.

the regulator. In OFF position, the oxygen supply to the regulator is shut off to prevent any flow of oxygen from the regulator when not in use.

NOTE

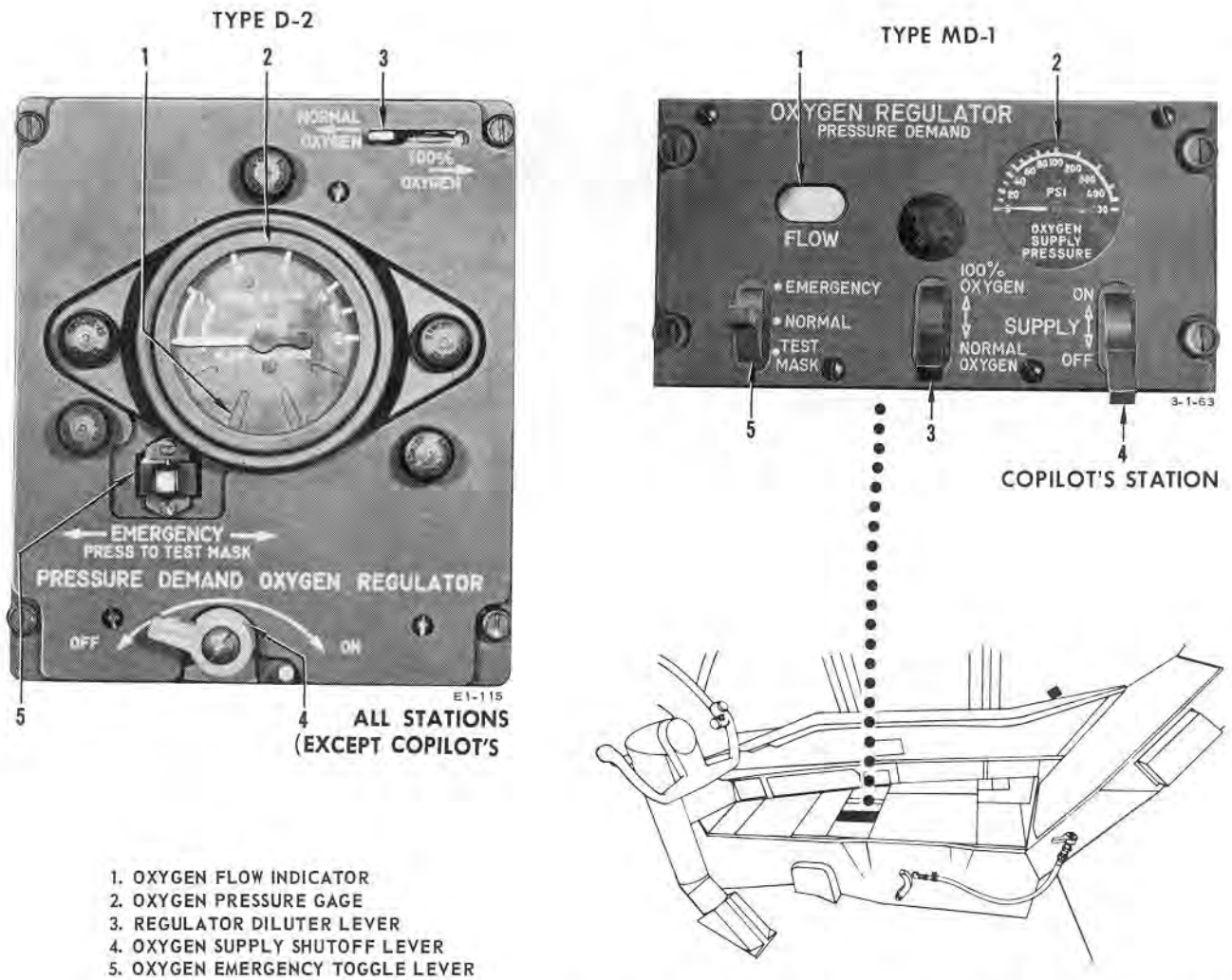
Due to the automatic pressure breathing feature of the oxygen regulator, a continuous flow of oxygen will result if the oxygen regulator is not being used and the oxygen supply shutoff lever is left in ON position above 30,000 feet cabin altitude. This condition will cause a rapid loss of oxygen.

Oxygen Emergency Toggle Lever

An emergency toggle lever (5, figure 4-25) is provided on each regulator for manually supplying a positive oxygen pressure to the mask for emergency use. On the Type D-2 regulator, the lever has EMERGENCY--OFF--EMERGENCY positions and may be depressed in OFF position to supply positive oxygen pressure for checking the oxygen mask. On the Type MD-1 regulator, the lever has EMERGENCY--NORMAL--TEST MASK positions. TEST MASK position supplies positive oxygen pressure for checking the oxygen mask. EMERGENCY position on both regulators supplies oxygen at a continuous positive pressure for emergency use. In OFF or NORMAL position, oxygen flow is controlled automatically by the regulator.

Buildup and Vent Valve Handle

A buildup and vent valve handle (figure 4-26) located on the underside of the aft equipment compartment controls a dual-purpose two-position three-port valve which is actuated to either a FILL or a SERVICE position. In FILL position, the converter is vented to the atmosphere when being filled from the oxygen service cart. Any



1. OXYGEN FLOW INDICATOR
2. OXYGEN PRESSURE GAGE
3. REGULATOR DILUTER LEVER
4. OXYGEN SUPPLY SHUTOFF LEVER
5. OXYGEN EMERGENCY TOGGLE LEVER

oxygen regulators (typical)

Figure 4-25.

excess liquid oxygen introduced during filling or excess oxygen pressure will escape through the vent. In SERVICE position, the vent line is blocked, the converter gas and liquid lines are connected, and system pressure builds up. The handle rotates through a 120° arc from one decaled position to the other. It is spring-loaded in such a manner that, as the midpoint of travel is approached, the handle will travel to the stop in the direction of travel.

NOTE

Oxygen system buildup requires approximately 30 minutes for system stabilization. Servicing should be accomplished at least 30 minutes prior to engine start.

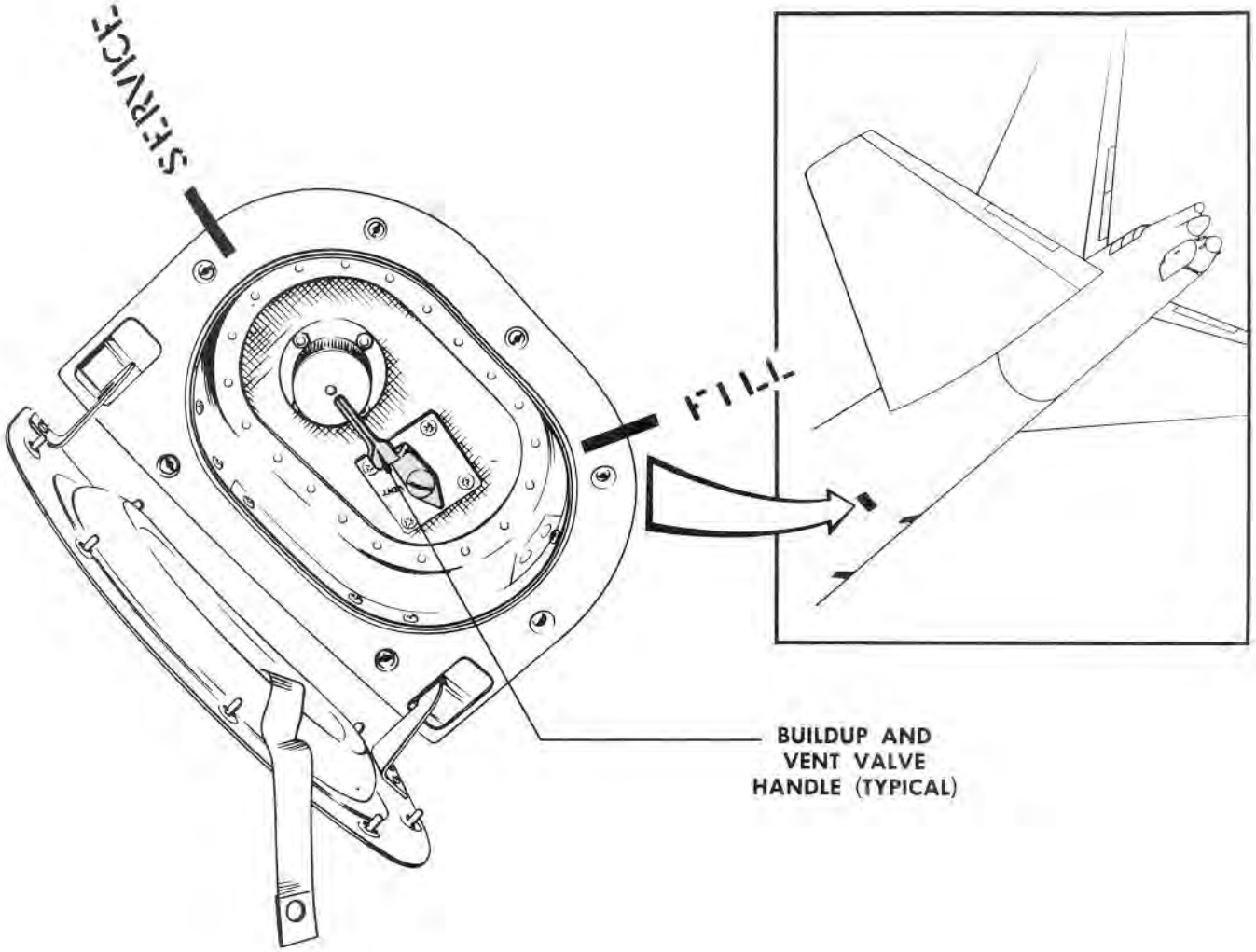
OXYGEN SYSTEM INDICATORS

Oxygen Converter Quantity Gages

Three oxygen converter quantity gages (figure 4-27) located on the forward end of the pilot's side panel are graduated from 0 to 20 liters in increments of 1 liter. The gages are operated by pressure caused from the head of liquid in the converter.

Oxygen Pressure Gage

An oxygen pressure gage (2, figure 4-25) on each regulator unit indicates oxygen system pressure in pounds per square inch when the oxygen supply shutoff lever is in ON position.



.....buildup and vent valve handles

Figure 4-26.

NOTE

Two manufacturers supply the Type MD-1 regulator installed at the copilot's station. Although both function alike, one manufacturer's regulator will indicate system pressure regardless of supply lever position, whereas on the other manufacturer's regulator, the supply lever must be in ON position in order for system pressure to be introduced to the pressure gage.

Oxygen Flow Indicator

A blinker-type oxygen flow indicator (1, figure 4-25) is provided on each regulator unit to show the crew member he is receiving oxygen. Luminescent segments indicate that oxygen is being dispensed.

OXYGEN SYSTEM NORMAL OPERATION

In Flight

The following procedure should be followed when oxygen is used during flight:

NOTE

Crew members must have mask in place and secured and be on oxygen during taxiing (if contamination is suspected), takeoff, climbout to first oxygen check, air refueling, jet penetration, approach, and landing. Pilots will insure that oxygen is used during critical phases of flight. Use of 100% oxygen will be as outlined in Sections II, III, IV, and VIII.

CAUTION

Crew members using upward ejection seats will insure that oxygen supply hose is under the seat armrest before hookup with the mask hose.

1. Check connection of oxygen mask hose to oxygen supply hose as shown in figure 4-28.
2. Place oxygen supply shutoff lever in ON.
3. Place oxygen regulator diluter lever in NORMAL OXYGEN.

NOTE

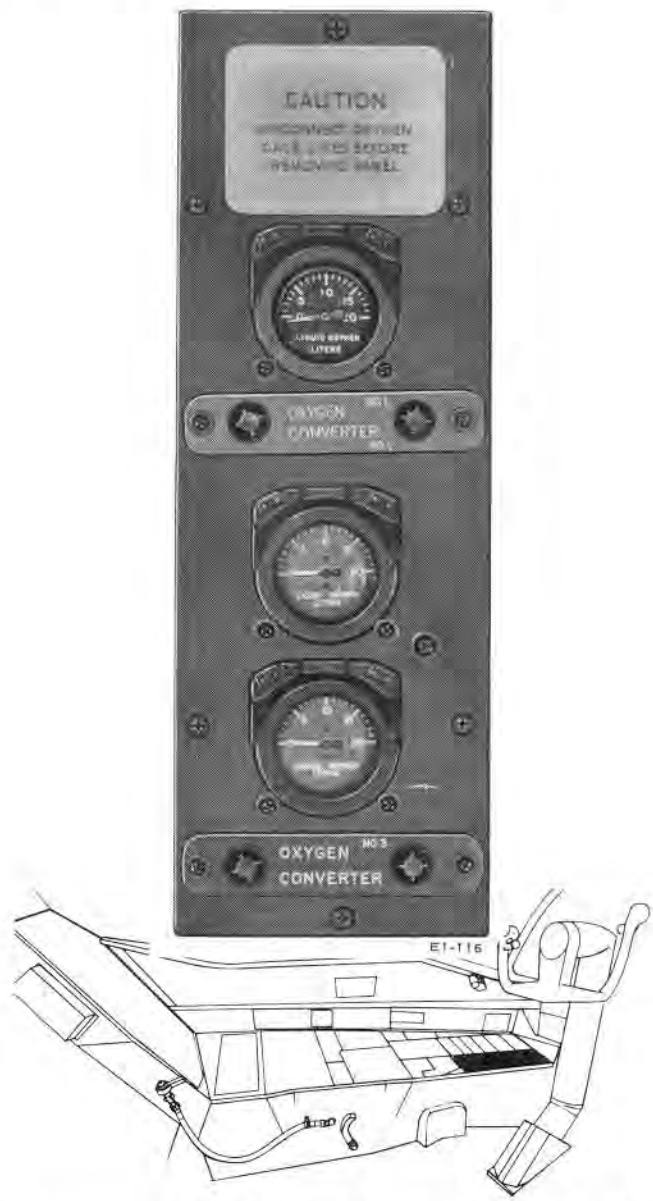
At cabin altitudes above 30,000 feet, the lever should be placed in 100% OXYGEN position as a safety precaution.

4. Frequently check the oxygen flow indicator.

NOTE

- Before any crew member goes off oxygen for a smoke, he should turn the oxygen supply shutoff lever OFF and push the regulator diluter lever to the 100% OXYGEN position. This will eliminate the possibility of accelerated combustion and will also prevent forgetting to turn the supply lever back ON when resuming use of the system.
- During turbulent flight conditions, liquid oxygen sloshes inside the converter. This cools the gas and allows part of it to return to the liquid state, resulting in a lowered gas pressure. Lowering of the gas pressure is not detrimental to crew consumption as long as pressure remains above 150 psi.
- Negative "g" loading during turbulence could cause temporary loss of quantity indication. Stabilization of flight conditions should result in reasonably rapid stabilization of the oxygen pressure and quantity indications.

5. When flight is completed, turn oxygen supply shutoff lever OFF and push the regulator diluter lever to 100% OXYGEN.



oxygen gages

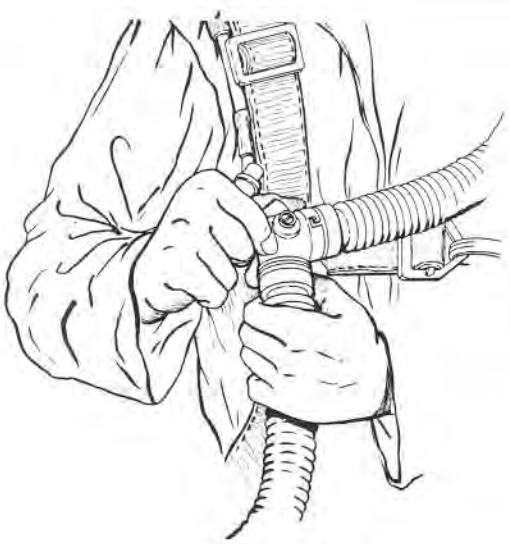
Figure 4-27.

1

Insert connector into the mounting plate attached to the parachute harness. Check that the connector is firmly attached and that the lockpin is locked.

2

Insert male bayonet connector, on the end of the oxygen mask hose, into the female receiving port of the CRU-8/P connector. Turn bayonet connector to lock prongs into the recess in the lip of receiving port.

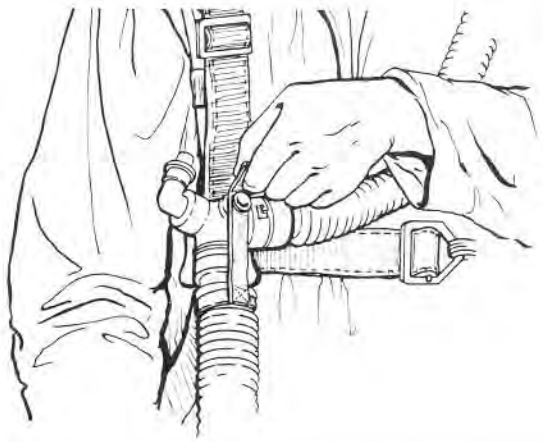


3

Couple the seat oxygen hose to the lower port of the connector.

CRU-8/P

Figure 4-28. (Sheet 1 of 2)

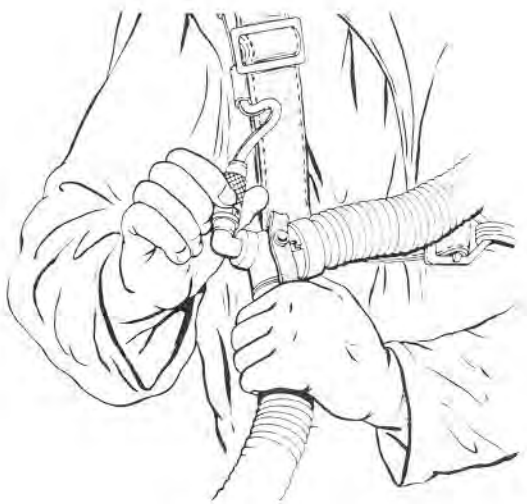


4

Snap the strap attached to the seat oxygen hose onto the CRU-8 P connector.

WARNING

The CRU-8 P system should not have an alligator clip on the seat hose. If one is installed, it shall not be used.



5

Attach the bailout bottle hose to the swiveling port of the connector by inserting the male coupling of the bailout bottle hose and turning it clockwise against the spring-loaded collar.

CRU-8/P

.....oxygen hose connection

Figure 4-28. (Sheet 2 of 2)

AUTOPILOT

WARNING

Less SZ

One or more of the switches on the autopilot command selector panel (servos engage, automatic localizer, approach glide slope, and altitude control) can fail to trip off when the autopilot is disengaged. As an example, if the servos engage switch fails to trip off when an emergency disconnect is initiated, the autopilot will reengage immediately upon release of the disconnect button. If the emergency which resulted in the original cause for disconnect persists, the autopilot is now in a non-overpowerable (non-steering) configuration. It is conceivable that there will be insufficient time to take secondary measures to assure disengagement. To prevent the possibility of the above situation occurring, the following precautions will be observed: 1) The autopilot will be used with caution during any critical phase of flight (i.e., instrument approach or combat breakaway maneuvers), 2) all disengagements of the autopilot (normal and emergency) will be accomplished by placing the autopilot master switch to the OFF position, thus assuring positive disengagement, and 3) the servos engage switch will be checked to the DISENGAGE position and all mode switches will be checked OFF prior to any subsequent actuation of the autopilot master switch.

NOTE

SZ

When the A/A42G-11 automatic flight control system is installed, the automatic pilot becomes a part of that system and the normal mode of the autopilot functions unchanged except the lateral axis can be overpowered by the pilots causing the autopilot to disengage. See "Automatic Flight Control System (A/A42G-11)," this section, for additional information.

The airplane is provided with an autopilot which is used to maintain a reference attitude, heading, and altitude; to provide a stable bombing platform; and to provide an accurate flight path control when used with the instrument landing system (ILS). During normal flight, the autopilot holds the airplane in a straight and level attitude at a constant heading provided by the N-1 compass system unless otherwise commanded by a crew member using the autopilot flight controller, the remote turn controller, the bombing navigational system, or the automatic approach system. Altitude control is provided to maintain constant barometric pressure altitude. Servo motors operate the rudder tab, elevator tab, aileron tab-spoiler control valves, and stabilizer jackscrew, which in turn control the rudder, elevator, ailerons-spoilers, and stabilizer respectively. The autopilot incorporates a protective system through the use of limit switches on the aileron and rudder axes and a safety monitor system on the pitch axis which automatically disengages the autopilot when the limit conditions for an axis have been exceeded. On airplanes NM, force switches are installed in control column linkage to disengage the autopilot if a certain elevator force is exceeded by either pilot. When the autopilot is ON but disengaged, the followup system continually aligns with the flight attitude and heading of the airplane so that smooth engagement may be made at any time. Pitch control is such that the airplane pitch attitude at the time the autopilot is engaged will be maintained. An interlock system is provided as protection against improper operation of the autopilot and to insure the pilot of primary control at all times. The autopilot operates on 24-volt d-c TR and 115-volt single-phase a-c power. The autopilot circuits are protected by circuit breakers on the pilots' overhead circuit breaker panel.

NOTE

If d-c or all a-c power to the N-1 compass is lost, the autopilot will disengage immediately. Loss of a single a-c phase will not degrade the heading information from the N-1 compass; therefore, the autopilot will not disengage. Loss of a single phase will not indicate on the protective fuses. The loss of a single phase may be detected only be removing and testing the fuses. If a fault occurs in the N-1 compass circuitry, two or all of the protective fuses will blow and may be detected by the blown fuse indicators lighting on the fuse holders. In the case of such a fault, the autopilot will disengage.

AUTOPILOT SAFETY FEATURES

Pitch Protection

A safety monitor system provides protection on the pitch axis against excessive angular accelerations. When such accelerations are encountered, this system disengages the autopilot. Protection against possible servo or accelerometer malfunctions is also provided by this system. As an additional safety feature, the pilot can overpower the stabilizer trim servo manually with the stabilizer trim wheels. On airplanes NM, a force switch will disengage the autopilot if the pilots apply a force to the control column opposing autopilot induced stabilizer trim actuation.

WARNING

Less NM

Do not attempt use of control column pressure to overpower the pitch axis of the autopilot while it is engaged. This will result in autopilot stabilizer trim operation in a direction opposite to the elevator input from the control column.

NOTE

The stabilizer trim function of the aileron and stabilizer trim buttons will be inoperative when the elevator servo cutout switch is positioned to IN and the servos engage switch is positioned to ENGAGE.

Roll Protection

Turns commanded by the BNS while in bomb mode are electrically limited in bank angle to approximately 39°. Turns commanded by the pilot's turn knob when rotated to the detent are also electrically limited in bank angle to approximately 39°. However, rotation of the turn knob past this detent will allow up to 50° of bank angle to facilitate a breakaway maneuver.

WARNING

See "Combat Breakaway Maneuvers," Section VI, for recommended bank angles applicable to existing gross weight, altitude, and Mach number.

Roll trim knobs are effective only in BOMB and ILS modes and unable to command additional bank angles. BNS controlled turns are electrically limited to 15° (±3°) when the search (mode) button or track (mode) button is depressed and the bomb control heading switch is on NAV. Diode limiters in the automatic approach amplifier limit the bank angle to 25° when the localizer switch is in ON, or 10° when the glide slope switch is in ON position. Aileron limit switches provide roll axis protection in case of an autopilot failure resulting in hard-over signals. These switches are effective in all flight conditions except when a bank angle in excess of approximately 4 1/2° is commanded by bombing computer, ILS coupler, or crew member.

Rudder Protection

Rudder limit switches provide protection in yaw movements by disengaging the autopilot within various airspeed ranges. The settings of the limit switches are based upon the structural limits of the vertical stabilizer.

AUTOPILOT CONTROLS

Autopilot Flight Controller

The autopilot flight controller (15, figure 4-29) is located on the aisle stand. When the autopilot is engaged, the flight controller provides a means for maneuvering the airplane from the pilot's or copilot's positions through the turn knob, pitch knobs, and roll trim knob.

TURN KNOB. A turn knob (16, figure 4-29) on top of the flight controller provides coordinated turns. Rotating the turn knob results in an airplane turn in the same direction as the knob is rotated. The rate of turn is proportional to the speed of the airplane and the amount of bank commanded with the turn knob. Moving the turn knob out of center detent puts turn control back to the pilot regardless of the setting of the autopilot turn control selector switch or the automatic approach localizer switch. Additional detents are located at points in the turn knob rotation corresponding with approximately 10° less than the maximum bank capability of 50°.

NOTE

When the turn knob is not in use, it should be in the detent at center position of total knob rotation.

PITCH KNOBS. Two large pitch knobs (6, figure 4-29) on either side of the flight controller are interconnected by a common shaft. The pitch knobs control the elevators for climb or glide. Forward rotation of the pitch knobs results in descent; aft rotation results in climb. The degree of airplane climb or dive is proportional to the amount of rotation of the pitch knobs. The pitch knob signal is always aligned to the existing airplane pitch attitude when the autopilot is engaged. With the altitude control or automatic approach glide slope switch in ON position, rotating the pitch knob will cause either of the above switches to drop to OFF position, disengaging either of these functions.

ROLL TRIM KNOB. A roll trim knob (14, figure 4-29) located on the front of the flight controller is used principally to correct localizer stand-off error when making an automatic ILS approach, but may be used during any of the autopilot tie-in modes of operation.

Autopilot and Air Refueling (IFR) Boom Release Buttons

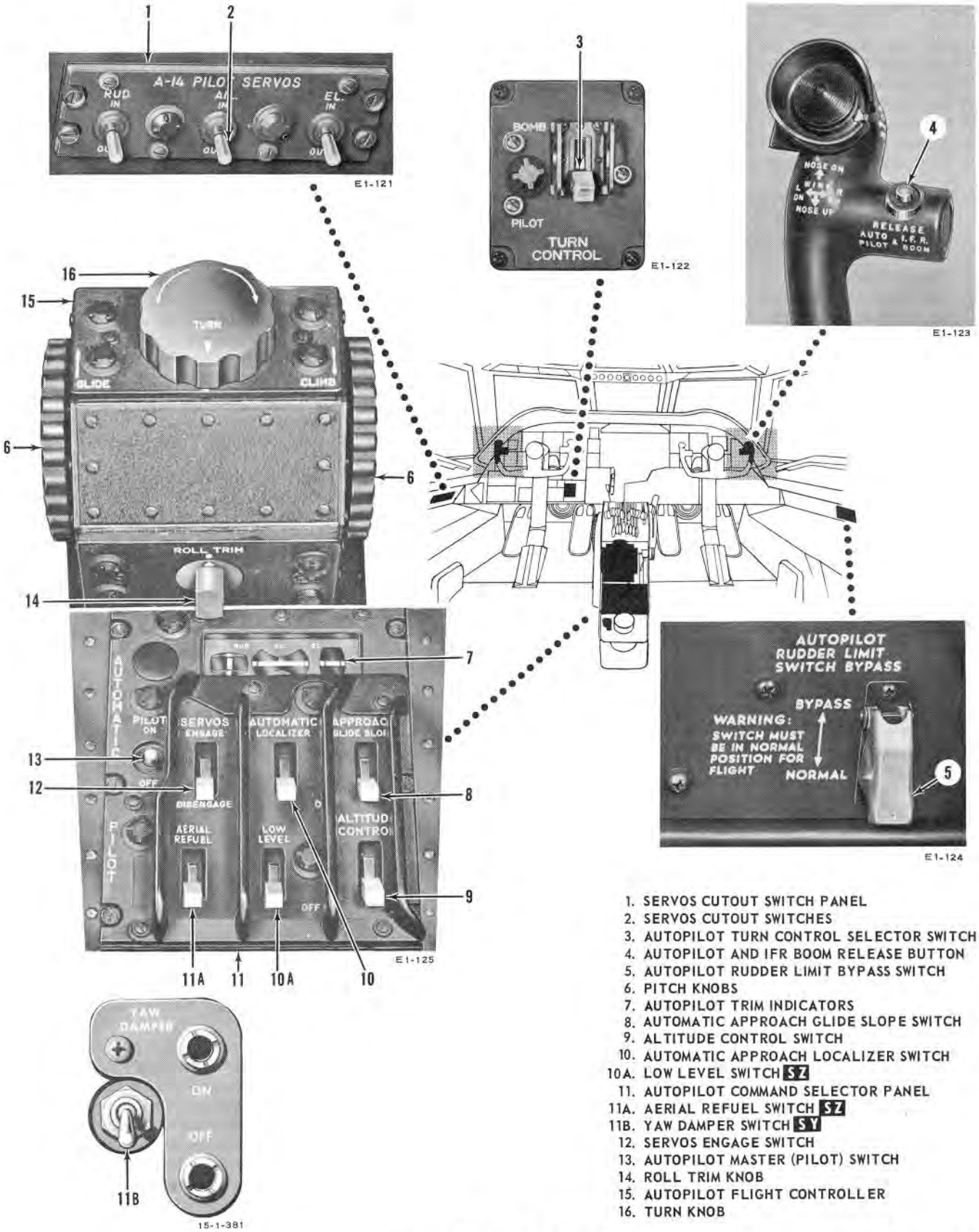
Autopilot release buttons (4, figure 4-29) are provided on both control wheels. Pressing either one of these pushbutton switches disengages all autopilot servo motors, thereby eliminating autopilot control. For further use of these release buttons, see "Air Refueling System," this section.

NOTE

The autopilot will be disengaged at all times when either the pilot's and/or copilot's autopilot and air refueling (IFR) boom release button is depressed. If the servos engage switch does not drop to DISENGAGE position because of a malfunction, the autopilot will be reengaged upon release of the button.

Autopilot Rudder Limit Bypass Switch

A two-position rudder limit bypass switch (5, figure 4-29) located on the copilot's auxiliary side panel has BYPASS--NORMAL positions and is guarded in NORMAL position. When the switch is held in BYPASS position, the low speed rudder limit switch is bypassed permitting engagement of the autopilot during the pilot's preflight check in the event of disengagement caused by a hard-over rudder from wind gusts. In NORMAL position, the low speed rudder limit switch will function normally.



1. SERVOS CUTOUT SWITCH PANEL
2. SERVOS CUTOUT SWITCHES
3. AUTOPILOT TURN CONTROL SELECTOR SWITCH
4. AUTOPILOT AND IFR BOOM RELEASE BUTTON
5. AUTOPILOT RUDDER LIMIT BYPASS SWITCH
6. PITCH KNOBS
7. AUTOPILOT TRIM INDICATORS
8. AUTOMATIC APPROACH GLIDE SLOPE SWITCH
9. ALTITUDE CONTROL SWITCH
10. AUTOMATIC APPROACH LOCALIZER SWITCH
10A. LOW LEVEL SWITCH SZ
11. AUTOPILOT COMMAND SELECTOR PANEL
11A. AERIAL REFUEL SWITCH SZ
11B. YAW DAMPER SWITCH SY
12. SERVOS ENGAGE SWITCH
13. AUTOPILOT MASTER (PILOT) SWITCH
14. ROLL TRIM KNOB
15. AUTOPILOT FLIGHT CONTROLLER
16. TURN KNOB

autopilot controls (typical)

Figure 4-29.

Autopilot Turn Control Selector Switch

The autopilot turn control selector switch (3, figure 4-29) is located on the pilots' instrument panel. This switch is of the solenoid locking type and has PILOT--BOMB positions for selecting either the autopilot flight controller (PILOT) or the BNS (BOMB) respectively for turn command of the autopilot. Interlocks will return the turn control selector switch from BOMB to the PILOT position without disengaging the autopilot when the pilots' turn knob is rotated out of detent or if any of the following changes occur during BNS operation of the autopilot:

1. Changing to memory point mode (track)
2. Changing to auto-fix mode (search or track)
3. Changing position of the bomb control heading switch (search or track)
4. Changing destination switch
5. Changing from search or track to bomb mode
6. Changing from bomb to search or track mode
7. In bomb mode when the bomb doors close.

Autopilot Command Selector Panel

The autopilot command selector panel (11, figure 4-29) is located on the aisle stand. It contains the autopilot trim indicators, autopilot master switch, servos engage switch, altitude control switch, and automatic approach switches. On aircraft SZ, the autopilot command selector panel also contains an aerial refuel switch and a low level switch.

AUTOPILOT MASTER (PILOT) SWITCH. An autopilot master (pilot) switch (13, figure 4-29) on the autopilot selector panel has ON--OFF positions. ON position connects power to the servo control drive motor and permits ready engagement of the servos. OFF position cuts off power to the servo control drive motor and disengages the autopilot.

NOTE

Power is applied to the autopilot system regardless of the position of the autopilot master (pilot) switch. Autopilot operation is prevented during the automatic warmup period of 3 to 5 minutes after power is on the airplane. After this initial warmup period, placing the autopilot master (pilot) switch to ON will permit immediate autopilot operation.

SERVOS ENGAGE SWITCH. A solenoid locking type servos engage switch (12, figure 4-29) on the autopilot command selector panel has ENGAGE--DISENGAGE positions. ENGAGE position engages all servos simultaneously. However, any axis whose servos cutout switch is in OUT position will not be engaged. DISENGAGE position will disengage all servos. The servos engage switch cannot be moved to ENGAGE if the autopilot master (pilot) switch is OFF or the roll trim knob or turn knob is out of detent. If engaged, interlocks will return this switch to DISENGAGE when 1) the autopilot release buttons are pressed, 2) the autopilot master switch is turned OFF, 3) the a-c power, filament, fields engage, interlock, or servo control circuit breakers are tripped, or 4) one of the protective systems is tripped.

ALTITUDE CONTROL SWITCH. An altitude control switch (9, figure 4-29) located on the autopilot selector panel has ON--OFF positions. In ON position, the elevator servo is controlled by a barometric pressure control unit. Rotating the pitch knob drops the altitude control switch to OFF and deactivates altitude control operation. Moving the glide slope switch to ON will drop the altitude control switch to OFF position. The altitude control switch will remain locked in OFF as long as the glide slope switch is in ON position. The altitude control switch cannot be turned to ON with the elevator servo cutout switch in OUT position. In OFF position, the constant altitude control is made inoperative. On aircraft SZ, the altitude control switch will drop to OFF position when the aerial refueling switch is placed to AERIAL REFUEL or the low level switch is placed to LOW LEVEL.

AUTOMATIC APPROACH LOCALIZER SWITCH. An automatic approach localizer switch (10, figure 4-29) on the autopilot selector panel has ON--OFF positions. The localizer switch is locked OFF unless the radio receivers are on and tuned to a localizer frequency. ON position allows the lateral controls of the autopilot to be controlled by the localizer beam after it has been intersected. In OFF position, no signal from the beam is received by the autopilot. The localizer switch will go to OFF if the turn knob is moved out of detent.

AUTOMATIC APPROACH GLIDE SLOPE SWITCH. An automatic approach glide slope switch (8, figure 4-29) on the autopilot selector panel has ON--OFF positions. ON position allows the pitch controls of the autopilot to be controlled by the glide slope beam after it has been intersected. In OFF position, no signal from the glide slope is received by the autopilot. The automatic approach glide slope switch cannot be turned ON unless the automatic approach localizer switch is in ON and will go to OFF position if the pitch knobs are rotated or when the localizer switch is turned off.

NOTE

Placing the automatic approach glide slope switch to ON position modifies the system response to localizer signals to compensate for the narrow localizer beam near the station. Attempting to continue the approach with the automatic approach localizer switch in ON and the automatic approach glide slope switch in OFF position after the glide slope has been intercepted will probably result in the airplane bracketing the localizer beam.

Servos Cutout Switches

A servos cutout switch (2, figure 4-29) is provided for each of the three control axes. Each switch located on the servos cutout switch panel has IN--OUT positions and must be in IN position before the individual servo can be engaged by the servos engage switch. OUT position is used to cut the servo out of operation.

NOTE

The servos engage switch will move to DISENGAGE, disengaging the autopilot, whenever any one of the servos cutout switches is placed in OUT position. However, the servos engage switch can be returned to ENGAGE position immediately with any of the servos cutout switches in OUT position. On aircraft SZ, either the aerial refuel or low level switch, if engaged, will drop to OFF if any of the servos cutoff switches are placed in OUT position. They may be reengaged if the elevator cutout switch is IN and the servos engage switch is reengaged.

Force Switches NM

The control rods between the pilot's and copilot's control columns and the forward elevator cable quadrants each include a force switch assembly which is actuated by a predetermined control column force initiated by either pilot in opposition to autopilot or unscheduled stabilizer trim movement. (See "Force Switches," Section I). Actuation of either force switch will completely disengage the autopilot and electrically interrupt the stabilizer trim circuit in the pitch direction opposing control column force.

AUTOPILOT INDICATORS

Autopilot Disengaged Light

A red autopilot disengaged warning light (13, figure 1-13 and 7, figure 1-13A) on the pilots' instrument panel flashes whenever the servos engage switch is disengaged after having once been engaged. The flashing may be stopped by reengaging the servos engage switch or by momentarily shutting off the autopilot master switch.

Autopilot Trim Indicators

Three autopilot trim indicators (7, figure 4-29) are located on the autopilot selector panel and are marked "Rud," "Ail," and "El," according to the autopilot servo it is used with. The trim indicators provide a visual indication of the electrical power input to the autopilot servos. The indicator bar will be displaced when the servo is exerting force on the control surface actuator and the bar will be displaced in proportion to the amount of force exerted. During flight the indicators will fluctuate constantly and their actual indication must be determined by interpreting their average displacement. The centered indicator bars indicate no electrical power input to the autopilot servos. Before autopilot engagement, a displaced trim indicator bar indicates incorrect power input to the autopilot servo and upon autopilot engagement the autopilot servos will deflect the airplane control surfaces to change airplane attitude in the direction of indicator bar displacement. After autopilot engagement, a displaced trim indicator bar indicates that the autopilot servo is exerting force on the control surface to compensate for an out-of-trim condition and upon autopilot disengagement, the servo will release the force allowing the control surface to return to the manual trimmed position and the airplane attitude will change in the opposite direction of indicator bar displacement.

CAUTION

An abrupt control surface displacement will occur if the autopilot is engaged or disengaged with a trim indicator steadily displaced more than one bar width.

BNS Steering Indicator

An ON--OFF tab indicator (16, figure 1-13 and 55, figure 1-13A) is located on the pilots' forward instrument panel. ON position indicates that the BNS system is controlling autopilot turns when the autopilot turn control selector switch has been placed in BOMB. OFF position indicates that the autopilot turn control selector switch is in PILOT.

BNS Steering (Autopilot) Light

A green BNS steering (autopilot) light (21, figure 4-38) on the radar navigator's panel, will illuminate when the autopilot turn control selector switch is placed in BOMB position.

AUTOPILOT NORMAL OPERATION

Preflight of the Autopilot

NOTE

This check will normally be made only after a reported malfunction has occured.

CAUTION

Hydraulic power is necessary at the stabilizer jackscrew to allow the mechanism to operate without slipping of the autopilot stabilizer trim servo override clutch.

1. Place turn knob and roll trim knob in detent and synchronize the N-1 compass.
1A. Check all servos cutout switches to IN.
2. Place autopilot master switch ON.
3. Note that autopilot trim indicators are centered and place servos engage switch in ENGAGE.

NOTE

If the autopilot cannot be initially engaged or if disengagement of the autopilot occurs during the checkout due to the rudder contacting the rudder limit switch, hold the autopilot rudder limit bypass switch in BYPASS position throughout the remainder of the checkout.

4. On airplanes NM, each pilot will push forward on the control column until the servos engage switch moves to DISENGAGE, reengage the autopilot and pull back on the control column until the servos engage switch moves to DISENGAGE, and again reengage the autopilot.
5. Place elevator servo cutout switch to OUT. Return servos engage switch to ENGAGE if it moved to DISENGAGE. Operate the pilot's or copilot's stabilizer trim button to NOSE UP and NOSE DN; the manual trim wheels should rotate in the direction of the commanded trim.
6. Place elevator servo cutout switch to IN. Return the servos engage switch to ENGAGE if it moved to DISENGAGE. Operate the pilot's or copilot's stabilizer trim button to NOSE UP and NOSE DN; the manual trim wheels should not rotate.
7. With the autopilot master switch ON, servos engage switch in ENGAGE, and ILS receiver inoperative, the automatic approach localizer switch should be locked OFF. With the ILS receiver on and tuned to an approach localizer frequency, turn the automatic approach localizer switch to ON.
8. With the automatic approach localizer switch ON, turn the automatic approach glide slope switch to ON.
9. Rotate the pitch knob; the automatic approach glide slope switch should drop to OFF.
10. Rotate the turn knob out of detent; the automatic approach localizer switch should drop to OFF. Return the turn knob to detent.
11. Place the altitude control switch in ON. Rotate the pitch knob; altitude control switch should drop to OFF.

NOTE

It should be considered normal, when engaging the altitude control on the ground, for the "engage error" of the altitude control to originate a signal to which the airplane at rest on the ground cannot respond, causing the elevator and stabilizer trim to be driven to their limits. The trim actuation may be stopped by exerting a force on the control column in the same direction as the trim is being driven.

12. Rotate the roll trim knob clockwise; the pilots' control wheels should rotate clockwise. Repeat for the counterclockwise direction, then return the roll trim knob to detent.
13. Rotate the turn knob clockwise; the pilots' control wheels should rotate clockwise. Repeat for the counterclockwise direction, then return the turn knob to detent.

NOTE

Rotating the turn knob rapidly may result in disengagement of the autopilot. This occurs because the servo will drive the control surface to the limit (opening the limit switch) before the roll followup amplifier can make the circuit that bypasses the limit switch.

14. Rotate the pitch knobs in the climb direction; the control columns should move aft and the manual trim wheel should rotate for nose up trim. Rotate the pitch knobs in the dive direction; the control columns should move forward and the manual trim wheel should rotate for nose down trim.
15. Place the autopilot turn control selector switch in BOMB. The BNS steering indicator should indicate ON, provided the BNS power switch is ON and the bomb control heading switch is on NAV or the bomb (mode) button is depressed.
16. Command a right turn with the bombing navigational system; the pilots' control wheels should rotate clockwise. Command a left turn with the bombing navigational system; the pilots' control wheels should move counterclockwise.
17. Return the autopilot turn control selector switch to PILOT.
18. Push forward and then pull back rapidly on the control column; the autopilot should disengage.
19. Place the aileron servos switch to OUT. Place servos engage switch to ENGAGE. Rotate control wheel clockwise. Autopilot should disengage at approximately 75° of control wheel rotation.
20. Place servos engage switch to ENGAGE. Rotate control wheel counterclockwise. Autopilot should disengage at approximately 75° of control wheel rotation.
21. Return all switches to OFF.
22. Check all servos cutout switches to IN.

Pilot's Operation of the Autopilot

Pilot's inflight operation of the autopilot may be accomplished by the following procedure:

1. Check autopilot master switch OFF.
2. Trim the aircraft wings level and ball centered.
   a. The aircraft should be trimmed by fuel management and thrust adjustments as much as possible since manual trim will create drag. (See "Fuel Management for Lateral Trim," under "Climb," Section II.)
   b. Use rudder trim as required to obtain straight and level flight; however, the autopilot should not be engaged if the rudder trim exceeds the following:

Knots IAS	Trim Units
Up to 155	12
155 to 235	6
Above 235	3

Nuisance autopilot disengagements may be encountered in mild turbulent air and during turn transient conditions when rudder trim is near or at the above values. Such disengagements are caused by the rudder actuating the autopilot rudder limit switches.

NOTE

Rudder trim should not be applied while the autopilot is engaged.

3. Check all servos cutout switches to IN.

NOTE

- With the aileron servo cutout switch in OUT position the airplane will not hold heading; however, the rudder servo will continue to provide Dutch roll damping.
- If the N-1 compass fails completely, the rudder servo cutout switch should be positioned to OUT to prevent erratic heading signals.
- With only the rudder servo cutout in OUT position:
  a. The airplane will not hold heading unless coupled to the BNS or automatic approach equipment.
  b. Turns can be made with the turn knob.
  c. A slight decrease in Dutch roll damping may be noted.

4. Check autopilot flight controller for:
   a. Turn knob in detent.
   b. Roll trim knob in detent.
5. Place autopilot master switch ON.
6. Check that autopilot trim indicator bars are in center reference positions.

NOTE

Steady displacement of one or more of the autopilot trim indicator bars on the autopilot selector panel indicates a lack of autopilot-airplane synchronization. The autopilot should not be engaged unless the malfunctioning axis is cut out, using the applicable servo cutout switch.

7. Place servos engage switch to ENGAGE.

WARNING

The pilot should be prepared to immediately disengage the autopilot in the event of a hard-over signal following engagement.

NOTE

- Upon engagement, there should be no engage transient in the control axes exceeding 1/2° of pitch or yaw and 1° of roll.
- Servos may be engaged in a normal climb or descent and the airplane will continue to fly that attitude until the pilot moves his pitch knob.
- If the autopilot is engaged when the airplane is banked for a turn, it will automatically roll the airplane to a near wings level attitude.
- The autopilot will not completely compensate for all lateral mistrim. If the airplane is not properly trimmed before autopilot engagement or becomes out of trim after engagement, the airplane may fly slightly wing low until the airplane is retrimmed by fuel management and thrust adjustments.

8. Place altitude control switch to ON if constant altitude control is desired. The airplane is now under autopilot control on all three axes.

NOTE

- The airplane should, with no more than two overshoots, stabilize out on a "reference" altitude within the following stated tolerances from "engage" altitude:

Bombing condition	±300 feet
Hi-Speed condition	±175 feet
Approach condition	±100 feet

  Then variation from "reference" altitude should not exceed ±50 feet during any 15-minute interval with no continuous oscillation after the engage transient has damped out. Long-term wander (slow steady change in altitude) may occur but shall not exceed 200 feet maximum altitude change. Gust response shall not exceed one overshoot in smoothly returning the airplane to controlled altitude. Recovery from a turn should be within ±70 feet of the altitude indicated before the turn.
- Pitch oscillations or erratic operation may occur while in altitude control near maximum level flight airspeeds between 40,000 and 45,000 feet altitude. In such cases, disengage the altitude control until airspeed is reduced.

9. Standard maneuvers may be executed with the pitch and turn knobs. Climb and descent are accomplished with the pitch knob; turns are made with the turn knob. A climbing or descending turn is made with a combination of the two knobs.

10. During flight, check that the autopilot trim indicator bars remain in the near centered position. Steady displacement of the "Ail" and/or "Rud" trim indicator bars and the control wheel indicate asymmetrical fuel load or engine thrust, requiring appropriate fuel management and/or thrust adjustment to center the control wheel and return the "Ail" and "Rud" trim indicator bars to near center. (See "Fuel Management for Lateral Trim" under "Climb," Section II.) Steady displacement of the "El" trim indicator bar appreciably more than a bar width indicates a malfunction. The elevator axis must be disengaged using the procedure under "Individual Servo Disengagement."

NOTE

- Do not attempt to change the pitch attitude of the airplane with the control column without first disengaging the autopilot. The elevator servo will sense any pressure on the control column as an out-of-trim condition and will cause the stabilizer to drive toward a position that will relieve this pressure. If the control column is pulled back (nose up), the stabilizer will drive toward a NOSE DOWN position and will continue to drive until the pressure on the control column is released, the limit stops are reached, or the autopilot is disengaged by the pitch axis safety monitors.

- During operation on autopilot, airbrake maneuvers should be performed with caution to avoid an excessive longitudinal out-of-trim condition and to prevent possible automatic pilot disengagement.

- During autopilot control with altitude control engaged, operation of the wing flaps is permissible. While operating flaps, a large but not dangerous indicated altitude change will result due to a change in airflow across the static source. Lowering flaps results in a gain in altitude; raising flaps will result in a loss of altitude.

Radar Navigator's Operation of the Autopilot

The bombing navigational system has no pitch control over the airplane. Turn control of the autopilot is transferred to the BNS when the autopilot turn control selector switch is placed in the BOMB position. The radar navigator can then command autopilot turns manually with the tracking handle or set up the BNS for automatic operation of the autopilot.

NOTE

On airplanes with autopilots modified to obtain up to 50° of bank with the turn knob for a break-away maneuver, intercardinal heading overcontrol will exist in the NAV mode from the AN/ASB-4 steering signal. This overcontrol is visible as a control wheel response and it will increase in severity until at approximately 45 miles from the target it may cause the autopilot to disconnect. To prevent intercardinal heading overcontrol and possible autopilot disconnect, the final 50 miles of the navigation leg should be flown manually or with the autopilot in first station in accordance with visual correction requirements from the flight command indicator (FCI).

Autopilot Disengagement

CAUTION

- Check elevator system for artificial feel after autopilot disengagement if flying in or leaving an icing condition. Icing of the Q-spring ram air duct may result in loss of artificial feel. If abnormally light rudder or elevator control forces are encountered, abrupt maneuvers should be avoided to prevent overstressing the aircraft. See "Elevator and Rudder Control Malfunction," Section III.

- If a constant large displacement of the elevator trim indicator bar indicates failure of the automatic stabilizer trim system during flight on autopilot, the airplane should be retrimmed longitudinally to center the elevator trim indicator bar before disengaging the autopilot to prevent excessive control column loads and pilot effort upon disengagement.

INDIVIDUAL SERVO DISENGAGEMENT. Individual servo disengagement is accomplished by the following procedure:

1. Disengage autopilot by means of the autopilot release button on the pilot's or copilot's control wheel.
2. Disengage desired individual servo by placing the proper servo cutout switch in OUT.
3. Reengage remaining servos by placing the servos engage switch in ENGAGE.

COMPLETE DISENGAGEMENT. Complete disengagement may be accomplished at any time by pressing the pilot's or copilot's autopilot release button on the respective control wheel, placing the servos engage switch in DISENGAGE, or placing the autopilot master switch in OFF position. On airplanes having force switches, the pilot or copilot may apply sufficient force on the control column to actuate the switches and completely disengage the autopilot.

AUTOPILOT EMERGENCY OPERATION

There are no special operating procedures to be used during an emergency. However, if the autopilot is engaged and manual flight control is desired, press the pilot's or copilot's autopilot release buttons for immediate autopilot disconnect. If the methods outlined under "Autopilot Disengagement" fail, pull the six autopilot circuit breakers located on the pilots' overhead circuit breaker panel.

AUTOMATIC FLIGHT CONTROL SYSTEM (A/A42G-11)

The A/A42G-11 automatic flight control system consists of the following major components:

- MA-2 Autopilot (modified) SZ
- Pitch and Roll Steering SZ
- "G" Limiter SZ
- Electromechanical Yaw Damper SY

NOTE

SY Less SZ

Provisions only for the A/A42G-11 automatic flight control system are installed. Aircraft-installed components are electrically connected in such a manner as to only allow normal operation of the autopilot as given in "Autopilot," this section.

The A/A42G-11 automatic flight control system (AFCS) has been incorporated on the aircraft to substantially reduce the loads imposed during air refueling and to reduce pilot fatigue during low level modes of flight. This system includes the installation of an electromechanical yaw damper which provides increased positive damping to lateral-directional (Dutch roll) oscillations for all flight conditions. Load and pilot fatigue reduction is accomplished by allowing the pilot to command the aircraft through the autopilot during the aerial refueling and low level modes of operation. The pilot flies the aircraft through the autopilot by control column and control wheel inputs in the same manner that he flies without the autopilot. Control column and wheel forces are considerably reduced because the autopilot is sensing the pilot's force on the controls and provides the necessary action to move the control surfaces. Autopilot control is provided by locating force transducers in and below the control columns which generate electrical signals to the autopilot proportional to pilot applied force. Dutch roll damping is increased by augmenting the existing mechanical (bob-weight) yaw damper with an electromechanical yaw damper that senses yaw rates of the aircraft through a rate gyro (see "Electromechanical Yaw Damper," this section). The maximum bank angle in the low level and aerial refueling modes is 33° and lateral control force stiffens when this bank angle is approached. Attempts to increase the bank angle beyond 33° will result in an autopilot disconnect.

AUTOPILOT

Functions of normal operation of the autopilot (aerial refueling and low level modes disengaged) have remained unchanged except that the lateral axis can be overcontrolled (disengaging the autopilot) by either pilot. See "Autopilot," this section, for description and operation of the normal autopilot.

PITCH AND ROLL STEERING

When using the aerial refueling and low level modes of the AFCS, the inputs of the pilot through the column and wheel generate electrical signals proportional to the force applied. These signals to the autopilot are used to command the aircraft in pitch and roll in lieu of signals from the autopilot pitch, turn, and roll trim knobs which now become inoperative. Aerial refueling and low level modes differ in that during aerial refueling mode the autopilot will maintain a constant attitude and will resist attempts to change that attitude even though stick forces are generally lighter in aerial refueling mode than during normal air refueling. The autopilot will return the aircraft to its original attitude unless the pilot holds a particular change to pitch or bank angle for a sufficient period of time to allow the autopilot to adjust (approximately 20 to 30 seconds). Once the autopilot adjusts, it will aid the pilot in maintaining the new attitude. During low level mode, any bank angle up to 8° initiated by the pilot, by turbulence, etc, will result in a "roll to level" action by the autopilot. The pilot will feel very little resistance in the lateral controls for bank angles up to 8°. Any bank angle between 8° and 33° established by the pilot will be held by the autopilot regardless of changes to power or airspeed. As the bank angle of the aircraft approaches the maximum of 33°, the pilot will feel increasingly stronger resistance to the lateral controls until the maximum bank angle is reached and the autopilot disconnects. Changes in pitch attitude will also be maintained by the autopilot in low level mode regardless of changes in thrust or airspeed. The rudder axis of the autopilot is automatically disengaged when selecting the aerial refueling or low level mode of operation but manual rudder requirements are greatly reduced when the electromechanical yaw damper is engaged. The pilot trims the aircraft laterally but need not apply any stabilizer trim. The autopilot will automatically trim the aircraft to assist the pilot in maintaining a pitch attitude and will trim to compensate for any gross weight or cg change.

Aerial Refueling Mode

The aerial refueling mode is placed in operation while in the observation position and will be engaged under the following conditions:

- Autopilot master switch is ON
- Elevator cutout switch is IN
- Aileron cutout switch is IN
- Servos engage switch is in ENGAGE
- Slipway doors are open
- No other autopilot mode is engaged (if altitude hold is engaged, it will drop out)

NOTE

When engaging the aerial refuel mode of the AFCS, transient voltages are frequently sufficient to cycle the signal amplifier. When this occurs, the blue ready-for-contact light will go out and the amber disconnect light will illuminate. To correct the situation, depress and release the signal amplifier reset button. The disconnect light will go out and the ready-for-contact light will illuminate.

Disengaging is accomplished in the normal manner by pressing either pilot's autopilot disconnect button. The autopilot will also be disengaged by abrupt pitch control inputs or by rapid reversals of force on the control column. During aerial refueling, boom disconnects caused by excessive pressure, exceeding the boom envelope limits, or boom operator initiated disconnects will not disengage the autopilot.

AERIAL REFUEL SWITCH. A solenoid locking aerial refuel switch (11A, figure 4-29) has AERIAL REFUEL --OFF positions. In AERIAL REFUEL position, power is supplied to the force transducers which allow the pilot to control the aircraft through the autopilot and the normal autopilot pitch and roll controls are rendered inoperative. In OFF position, power is removed from the automatic flight control portion of the autopilot and the normal autopilot mode of operation may be used if desired. The aerial refuel switch will automatically return to OFF position when the autopilot is disengaged for any reason.

Low Level Mode

The low level mode is used during a low altitude type of operation and the autopilot will hold heading and seek to maintain the aircraft attitude when no control forces are applied by the pilot. For bank angles of less than 8° established by the pilot, the autopilot will roll the aircraft back to level when the pilot relaxes wheel force. For bank angles between 8° and 33° established by the pilot, the autopilot will hold a constant bank angle when the pilot relaxes wheel force. Changes in pitch attitude will also be maintained by the autopilot in low level mode of operation regardless of changes in thrust or airspeed.

NOTE

Use of the low level mode is not recommended for holding patterns, penetrations, GCA's, or ILS approaches.

The low level mode may be engaged under the following conditions:

- Autopilot master switch is ON
- Elevator cutout switch is IN
- Aileron cutout switch is IN
- Servos engage switch is in ENGAGE
- No other autopilot mode is engaged (if altitude hold is engaged, it will drop out)
- Normal and alternate slipway door switches are CLOSED.

NOTE

In the event of a malfunction of the slipway door system, the low level switch may be engaged if the master refuel switch is OFF or is cycled from ON to OFF after the slipway door switches are in CLOSED position.

Disengaging is accomplished in the normal manner by pressing either pilots' autopilot disconnect button. The autopilot will also be disengaged by abrupt pitch control inputs or by rapid reversals on the control column.

LOW LEVEL SWITCH. A solenoid locking low level switch (10A, figure 4-29) has LOW LEVEL--OFF positions. In LOW LEVEL position, power is supplied to the force transducers which allow the pilot to control the aircraft through the autopilot and the normal autopilot pitch and roll controls are rendered inoperative. In OFF position, power is removed from the automatic flight control portion of the autopilot and the normal autopilot mode of operation may be used. The low level switch will automatically return to OFF position when the autopilot is disengaged for any reason.

"G" LIMITER

When using the low level steering function, control column force requirements are considerably reduced by servo assistance from the autopilot. Consequently, it would be possible for the pilot to inadvertently exceed the normal acceleration (load) limits of the aircraft in a pull-up, push-over, turn, or combination of pull-up and turn. To prevent this, a "g" limiter function has been incorporated in the system to limit the normal acceleration obtainable with the AFCS. The "g" limiter function is set to limit "g" loads from a minimum of 0.2 to a maximum of 1.8. As the pilot maneuvers the aircraft through any longitudinal attitude change, an accelerometer senses the variation in acceleration and causes the autopilot servo torque assistance to reduce, with a corresponding increase in pilot required force. If the pilot or copilot continues to increase the applied force, the AFCS will finally disengage. However, the disconnect will be smooth and the first indication to the pilot will be an illumination of the autopilot disengaged light. The smooth disconnect results from the logic that is built in the system. The logic requires that the following two conditions exist before the AFCS is disengaged: 1) The applied column force is greater than 30 (±6) pounds of push or pull force and 2) the elevator servo is opposing the applied column force by approximately 3 pounds. This requirement means that the pilot will be applying approximately 3 pounds more force than is required to hold the same column displacement

manually. Since these two conditions must be satisfied for all flight conditions, the transition from autopilot operation to manual operation is smooth.

NOTE

The "g" limiter does not affect the disconnect logic but is merely a method of increasing the pilot's applied force up to the manual force level.

An operational ground check of the disconnect logic circuit is made by applying a sharp push or pull force to the column and then rapidly reversing the direction of the applied force. Since the servo cannot reverse its direction of rotation as rapidly as the force is changed, both disconnect requirements will be met, assuming that the force applied exceeds 30 pounds.

ELECTROMECHANICAL YAW DAMPER

The electromechanical yaw damper operates in parallel with the existing magnetic yaw damper and senses the yaw rate of the aircraft through a rate gyro. The signal from the rate gyro drives a servo motor which in turn drives the bob-weight. The bob-weight is connected to the rudder stability tab in the normal manner. With the electromechanical yaw damper engaged, the autopilot on, and in either aerial refueling or low level mode of operation, the rudder axis of the autopilot is disengaged allowing the pilot to fly the aircraft by use of the rudder pedals. When the electromechanical yaw damper is disengaged, the magnetic yaw damper provides Dutch roll damping in its normal manner. The electromechanical yaw damper is designed to operate from unstick to touchdown and is automatically disengaged through a squat switch when the aircraft is on the ground. The yaw damper receives power continuously through circuit breakers marked "Yaw Damper AC" and "Yaw Damper Cont DC" on the "Control Surface" portion of the pilot's circuit breaker panel. A yaw damper switch (11B, figure 4-29) on the aisle stand has ON--OFF positions and can be placed to ON position at any time after unstick.

NOTE

SX Less SY

The yaw damper switch is inoperative.

AUTOMATIC FLIGHT CONTROL SYSTEM NORMAL OPERATION

Preflight — Low Level Mode

NOTE

- This check will normally be made only after a reported malfunction has occurred.
- During the following checks, do not allow the stabilizer trim to drive more than 1/2 unit at a time.

1. Place standby pump switches to ON.
2. Place hydraulic pack switches 9 and 10 to ON.
3. Place autopilot master switch ON.
4. Note that autopilot trim indicators are centered and place servos engage switch to ENGAGE.
5. Place low level mode switch to LOW LEVEL.

NOTE

The rudder axis of the autopilot will automatically disengage although the servo cutout switch will remain in.

6. Check autopilot disengage functions:
   a. Disengage autopilot by pressing pilot's release button; reengage autopilot and check by pressing copilot's release button.
   b. Apply approximately 40 pounds lateral force on the pilot's control wheel to the right; autopilot should disengage. Reengage autopilot and repeat to the left. Reengage autopilot and repeat lateral force disconnect both right and left for copilot's control wheel.

NOTE

It may be necessary to move the control wheel to the stops to apply sufficient force to disconnect the autopilot.

   c. Apply a sharp push-pull force to pilot's control column; autopilot should disconnect. Repeat using a sharp pull-push force. Repeat using copilot's control column.
7. Move control column forward. Control column should move easily and remain where displaced by the pilot. The stabilizer trim should not move while force is being applied to the control column. Within approximately 1 second after the control column is displaced, the stabilizer trim should drive in the nose down direction and may drive to the limit. Limit stabilizer trim movement to 1/2 unit of movement. While stabilizer trim is moving, apply a 5-pound push or pull force to control column in opposite direction of trim movement and note that stabilizer trim stops driving while force is held.

NOTE

Stabilizer trim may not necessarily start driving again after being stopped in this manner.

8. Repeat step "7" using an aft control column displacement.
9. Displace control wheel right using varying amounts of displacement up to full travel. Note that control wheel returns approximately to neutral when force is released. (The aileron limits are bypassed in low level mode.) Repeat using left control wheel displacement.
10. Place autopilot turn control selector switch to BOMB. The BNS steering indicator should indicate ON provided the BNS power switch is ON and the bomb control heading switch is in NAV or the bomb (mode) button is depressed.

11. Command a right turn with the BNS; pilots' control wheels should rotate clockwise. Command a left turn with the BNS; pilots' control wheels should rotate counterclockwise. During bomb mode of operation, the pilot will have the overpower feature on lateral control to disconnect the autopilot. The pilot will have pitch control through the control column. Switching between pilot and bomb modes of operation should not disconnect the autopilot.

NOTE

The roll trim knob may be used to reduce standoff error as observed on the PDI.

12. Return autopilot turn control selector switch to PILOT.

Preflight — Aerial Refueling Mode

NOTE

- This check will normally be made only after a reported malfunction has occurred.
- During the following checks, do not allow the stabilizer trim to drive more than 1/2 unit at a time.

1. Place standby pump switches to ON.
2. Place hydraulic pack switches 9 and 10 to ON.
3. Place master refuel switch ON.
4. Place normal slipway door switch to OPEN.
5. Place autopilot master switch ON.
6. Note that autopilot trim indicators are centered and place servos engage switch to ENGAGE.
7. Place aerial refuel mode switch to AERIAL REFUEL.

NOTE

The rudder axis of the autopilot will automatically disengage when placing aerial refuel switch to AERIAL REFUEL although the servo cutout switch will remain in.

8. Check autopilot disengage functions:
   a. Disengage autopilot by pressing pilot's release button; reengage autopilot and check by pressing copilot's release button.
   b. Apply approximately 40 pounds lateral force on the pilot's control wheel to the right; autopilot should disengage. Reengage autopilot and repeat to the left. Reengage autopilot and repeat lateral force disconnect both right and left for copilot's control wheel.

NOTE

It may be necessary to move the control wheel to the stops to apply sufficient force to disconnect the autopilot.

   c. Apply a sharp push-pull force to pilot's control column; autopilot should disconnect. Reengage and repeat using a sharp pull-push force. Repeat using copilot's control column.
9. Move pilot's control column forward and release; column should return to neutral. Move control column aft and release; column should return to neutral. Repeat using copilot's control column.
10. Move pilot's control column forward and hold in displaced position for 20 to 30 seconds. The control column should remain in displaced position. Repeat procedure by moving control column aft. Repeat using copilot's control column.

NOTE

- If stabilizer trim drives, limit movement to 1/2 unit by using approximately 5 pounds of push or pull force on the control column.
- Control column forces may appear higher when using aerial refueling mode than when using low level mode.

11. Rotate pilot's control wheel right and release; wheel should return to neutral. Rotate wheel left; wheel should return to neutral. Rotate control wheel right and hold in displaced position for 20 to 30 seconds; wheel should remain in displaced position when released by pilot. Rotate control wheel left and hold in displaced position for 20 to 30 seconds; wheel should remain in displaced position when released. Repeat using copilot's wheel.
12. Return all switches to OFF.

Inflight

Inflight operation of the automatic flight control system is accomplished by the following procedure:
1. Place yaw damper switch in ON position after takeoff.
2. Turn on and engage autopilot as given in "Autopilot Normal Operation," this section.
3. Prepare the aircraft for air refueling or low altitude tactic as applicable.
4. Engage the aerial refueling or low level switch as applicable.

NOTE

When engaging either the low level or aerial refuel mode switches, the pilot and copilot should not be exerting any force on the control column or wheel. If either pilot is exerting a force on their respective controls when the low level or aerial refuel mode switch is engaged, an engage transient will occur. The action will be observed as a short pulse action on the wheels or columns but will not drive the control to the limit.

INSTRUMENT LANDING SYSTEM (ILS) EQUIPMENT

The instrument landing system (ILS) provides the pilots with a straight line glide slope and a localizer or on-course guidance. The ILS system is used both as a means of navigation and as an aid to assist the pilots when landing in inclement weather. The ILS consists of the glide slope equipment (AN/ARN-18), omni-range radio (AN/ARN-14), pilots' control panel, and marker beacon receiver (AN/ARN-12). For further information on this equipment, see "Communication and Associated Electronic Equipment," this section.

INSTRUMENT LANDING SYSTEM CONTROLS

Omni Range Selector Switch

A selector switch (7, figure 4-12) on the pilots' control panel provides manual selection of the desired frequency. Tuning the receiver to the proper localizer channel will automatically tune the glide slope receiver to the proper glide slope channel frequency. The selector is calibrated from 108.0 to 135.9 megacycles.

Omni Range Power Switch

The receiver is turned on and off by a power switch (8, figure 4-12) on the pilots' control panel which has OFF--ON positions. ON position provides operation of the tone comparison glide slope and omni-range operation. OFF position turns off the equipment.

Omni Range Volume Knob

A volume knob (9, figure 4-12) on the pilots' control panel is used to adjust the receiver audio to the interphone system.

Course Set Knob

A course set knob (3, figure 4-12) on the omni-range radio course indicator is used to set the magnetic bearing of a desired course on three tab indicators.

INSTRUMENT LANDING SYSTEM INDICATORS

CAUTION

Some of these instruments have red warning flags which may be difficult to see at night.

Omni Range Radio Course Indicator

A course deviation indicator (1, figure 4-12) in the omni-range radio course indicator indicates relative position of the aircraft with respect to the localizer beam. Also a glide slope indicator (2A, figure 4-12) shows information from a glide slope receiver. A warning flag at one end of each needle will move from sight when localizer or glide slope signals, respectively, of dependable strength are being received. A course selector window at the top of the indicator provides magnetic bearing indication adjusted by the course set knob. When the desired magnetic bearing has been selected, the displacement of the course deviation indicator from center indicates the direction of turn necessary to position the aircraft on course. A heading pointer is provided to assist the pilot in keeping the course deviation indicator centered by showing the relation of the aircraft heading to the desired bearing. An amber light (2, figure 4-12) at the upper right corner shows information from a marker beacon receiver.

Radio Magnetic Indicator

The radio magnetic indicator (figure 4-12) is located on the pilots' instrument panel. It has a rotating dial and two indicator needles, numbered 1 and 2. The dial is slaved to the N-1 compass system and the heading read under the index mark at the top of the dial is the same as that shown by the heading pointer on the N-1 compass master indicator. Needle No. 1 indicates the bearing of the station to which the ARC-34 command receiver is tuned, as determined by the ARA-25 direction finder. Needle No. 2 indicates the bearing of the station to which the ARN-14 omni-receiver is tuned.

NOTE

Bearings indicated by needles 1 and 2 and airplane headings indicated by the dial will be related to magnetic north or gyro north depending on whether the N-1 compass system is in magnetic or gyro operation.

Marker Beacon Indicator Light

The marker beacon indicator light (2, figure 4-12) is used as a navigational and landing aid. This amber colored light is located on the omni-range radio course indicator.

AUTOMATIC APPROACH EQUIPMENT

The automatic approach equipment includes the instrument landing system equipment and the autopilot. The automatic approach equipment is the same as the ILS equipment except that the flight path of the airplane is controlled automatically rather than manually as in ILS. The localizer switch controls the on-course path, and the glide slope switch controls the angle of approach. For more information on this equipment, see "Communication and Associated Electronic Equipment" and "Autopilot," this section, and "Instrument Flight Procedures," Section IX.

NAVIGATION EQUIPMENT

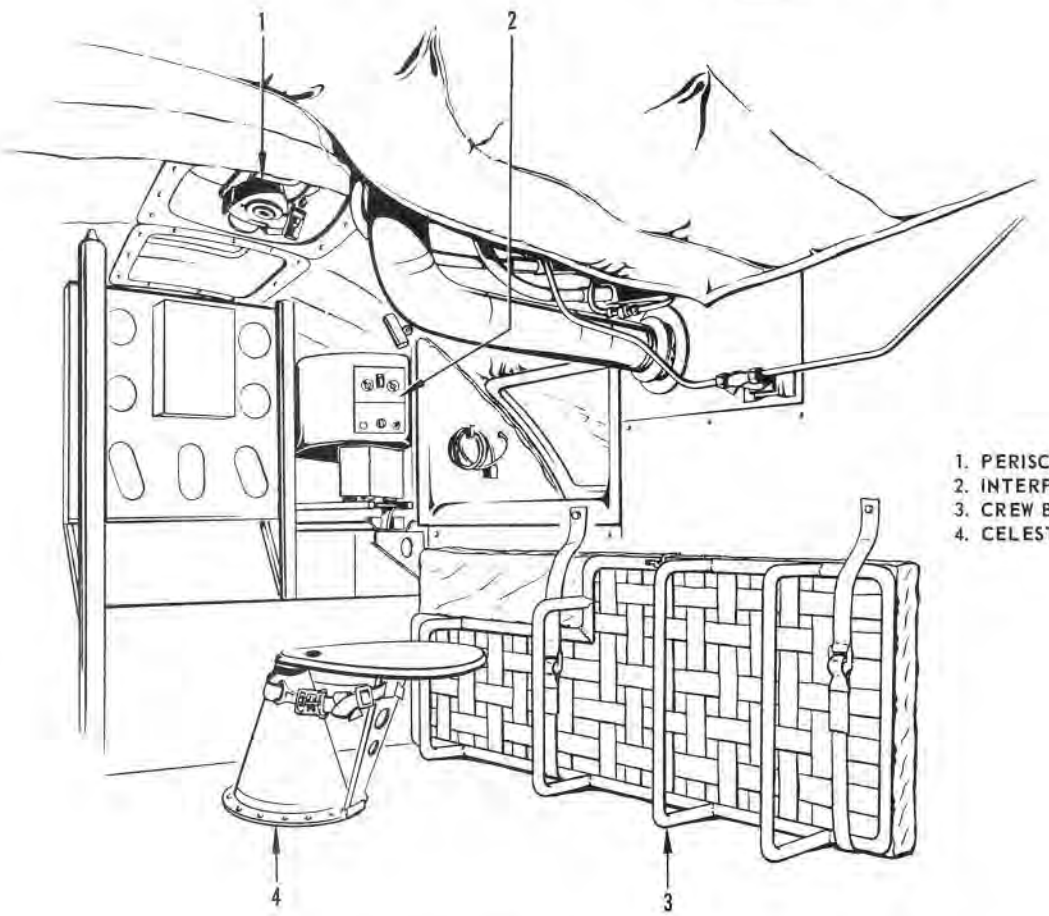
Although the bombing navigation system of the aircraft provides complete electronic navigation equipment, other equipment, which is used separately or can be used separately, is provided to aid in navigating. These items are the automatic astrocompass system, periscopic sextant, N-1 compass system, AJA-1 true heading computer system, doppler radar, true airspeed computer, altimeter, outside air temperature gage, and clock. A celestial navigation station (figure 4-30) is located on the upper deck of the control cabin forward of the EW officer's station.

AUTOMATIC ASTROCOMPASS SYSTEM (MD-1)

For description of this equipment, refer to T.O. 1B-52E-1-6-1.

PERISCOPIC SEXTANT

A periscopic sextant (figure 4-31) and periscopic sextant carrying case are located near the celestial navigation seat (4, figure 4-30) in the control cabin upper deck. On aircraft Less SP, they are located forward and to the left of the celestial navigation seat. On aircraft SP, they are located to the right of the celestial navigation seat and just aft of the entrance hatch (29, figure 1-2). This bubble-type periscopic sextant operates through a full 360° in azimuth and -10° to +92° in elevation. This sextant is provided with an automatic averager assembly which plots minor variations in altitude readings versus length of observations. Lighting is provided to read the counters and dials and illuminate the bubble during sightings. The 28-volt a-c power is provided through the "Periscopic Sextant" circuit breaker on the radar navigator's circuit breaker panel.



1. PERISCOPIC SEXTANT MOUNT
2. INTERPHONE AND LIGHT PANELS
3. CREW BUNK
4. CELESTIAL NAVIGATION SEAT

celestial navigation station (typical)

Figure 4-30.

Periscopic Sextant Mount

A periscopic sextant mount (figure 4-32) is provided to hold the periscopic sextant for celestial observations and to indicate the azimuth of the sighting. When the sextant is not in use, the mount may be sealed by a shutter which is flush with the airplane skin. When the sextant is to be used, the sealing shutter is drawn aside and the sextant extended so that the tip of the tube is exposed 1 1/2 inches. The shutter chamber drain plug permits the draining of water from the chamber to prevent the formation of ice at altitude. If lack of time prevents draining the chamber before takeoff, it is advisable to leave the drain plug open as it may be difficult or impossible to open the shutter after passing through freezing level. Provisions must be exercised to insure that excessive moisture does not enter cabin area if drain plug is left out.

CAUTION

- When the airplane is pressurized, do NOT open the shutter of mount until AFTER the sextant has been inserted to its "retracted" position.
- The provision of stops in the retracted position of the sextant is intended only to prevent its being dropped during insertion or removal. It is not advisable to leave the sextant in the retracted position for any extended period, particularly during rough weather, since damage may occur. When the sextant is removed from the mount, it should be returned to the carrying case.

An independently rotatable compass rose, engraved in increments of 1/2°, is provided. A lubber's line which may be aligned with the airplane longitudinal axis to establish a reference point provides indications of azimuth on the scale. For manual setting of true azimuth 0.1°, a counter is synchronized with the lubber's line indication. The direction of numbering the gradations is so arranged that relative bearing is subtracted. Thus, when the azimuth of an observed body is set against the lubber's line and the sighting mechanism is aligned on that body, the true heading of the airplane is indicated by the sextant vertical line of the reticle as read against the azimuth scale.

Optics

The optical system of the sextant is a two-power telescope with a true field of 15°. This wide field facilitates the location and identification of celestial bodies. Coating of optical elements serves to minimize light losses caused by reflections, although "ghost" images of the sun are inherent in the design of the optical system. These images usually occur when the sextant altitude is set several degrees above the true altitude of the sun. The image may be identified by tilting the sextant forward and back. If the body and the artificial horizon (bubble) move in opposite directions, it is an image. Images of the moon may be observed, but they will not be visible for stars. The eyepiece is adjustable for focusing. Filters of varying densities are provided for selective use in the optical system so that the intensity of the sun's light may be adequately reduced.

Bubble Horizon

The air bubble artificial horizon is formed from an air chamber located at the top of the body of the sextant. The bubble may be formed and adjusted in size, while in the field of view, by means of the "Increase Bubble" knob on the left side of the chamber. If a bubble is not present in the sextant, the knob must be rotated to the minimum position, the sextant tilted to the right, and the knob rotated toward maximum until the proper size bubble is formed. Bubble size is maintained by moving the sextant to the vertical position and positioning the "Increase Bubble" knob to the maximum position. If a bubble is already present, it may be adjusted by moving the knob in the desired direction while holding the sextant tilted to the right, keeping the bubble centered in the notch in the air chamber.

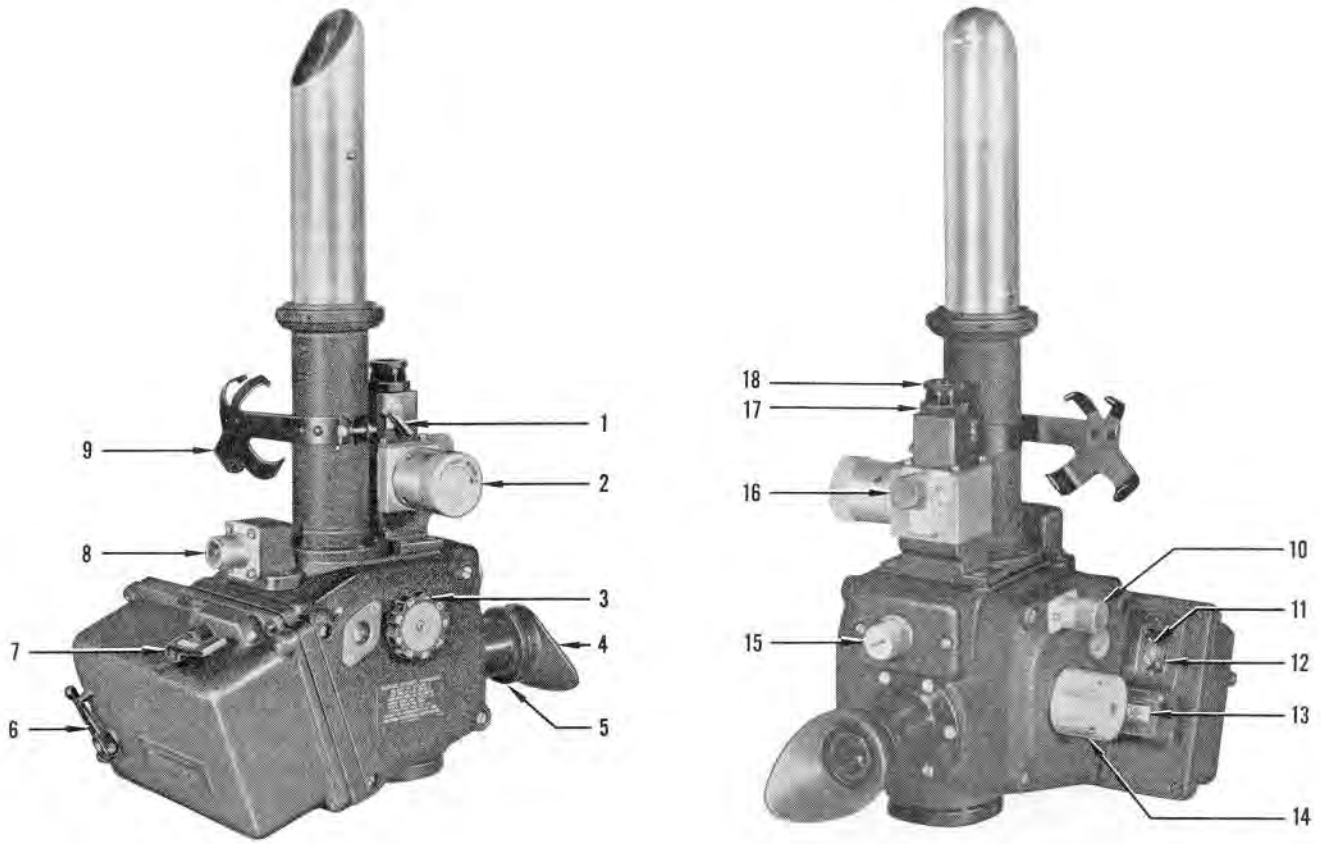
NOTE

Except when adjusting the bubble, the "Increase Bubble" knob is to be kept at full increase at all times.

The lens mounted above the bubble chamber may prevent the entrance of sufficient daylight for direct illumination; therefore, artificial illumination provided by a 28-volt lamp with controllable intensity is usually required.

Projection Lens

Supported on the bubble chamber is a small optical system which superposes the relevant portion of the true heading scale on the same plane as that of the bubble. The magnified scale is therefore visible in the eyepiece together with the bubble, celestial objective, and reticle. When the objective and bubble are collimated near the center of the field, the vertical line of the reticle acts as an index against the scale, so that when the true azimuth has been correctly set and the sextant aligned, true heading is immediately indicated. A diffuser may be inserted in the system to obstruct the image of the scale when true heading readings are not required. This, however, does not detract from the

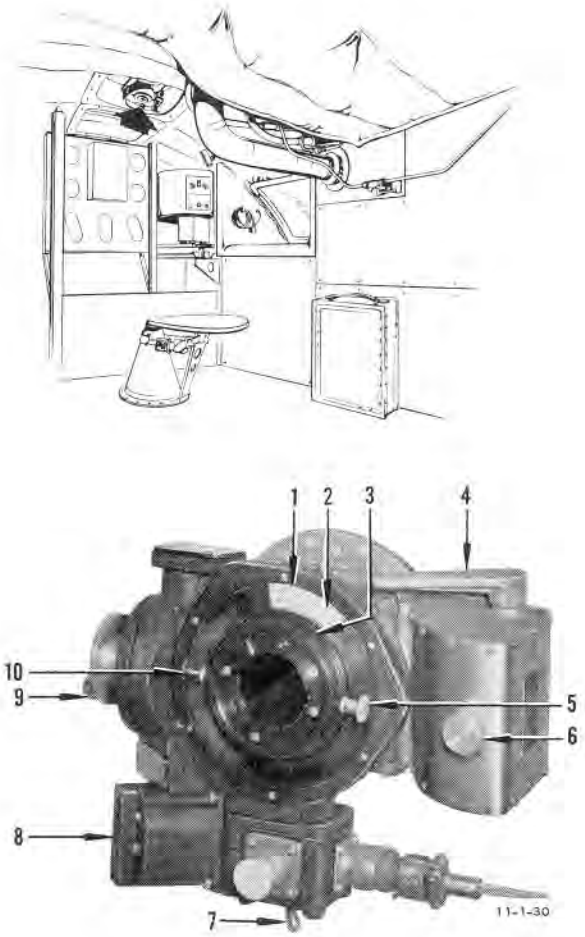


1. HEADING SCALE SHUTTER LEVER
2. BUBBLE ADJUSTMENT KNOB
3. FILTER CONTROL KNOB
4. EYEPIECE
5. EYEPIECE FOCUS ADJUSTMENT RING
6. AVERAGER REWIND LEVER
7. AVERAGER ACTUATING BUTTON (LEVER)
8. ELECTRICAL CONNECTOR
9. WATCH CLIP
10. DIAL LAMP
11. HALF TIME DIAL
12. AVERAGER INDICES
13. ALTITUDE COUNTER
14. ALTITUDE KNOB
15. RHEOSTAT KNOB
16. BUBBLE LIGHT
17. PROJECTION LENS LOCK RING
18. PROJECTION LENS ADJUSTMENT RING

periscopic sextant

Figure 4-31.

effective illumination of the mount scale. Provision is also made for adjusting the projection lens to remove parallax and allow for alignment of the sextant and mount. The lens is held stationary by a locking ring which may be loosened to allow the lens to be turned in order to position lubber's line, vertical line of the reticle, and the alignment objective in coincidence.



1. AZIMUTH INDEX (LUBBER'S LINE)
2. HEADING SCALE
3. LINE OF SIGHT LOCKING LEVER
4. SEXTANT PORT SHUTTER LEVER
5. RETRACT SEXTANT PULL KNOB
6. SHUTTER CHAMBER DRAIN PLUG
7. ILLUMINATION SWITCH
8. AZIMUTH COUNTER
9. AZIMUTH KNOB
10. INSERT-REMOVE SEXTANT PULL KNOB

....periscopic sextant mount

Figure 4-32.

NOTE

Rotation of the projection lens will cause the image of the azimuth scale and the lubber's line to appear to move in an elliptical path, giving two settings (high and low) where coincidence will occur. The higher of the settings should be selected.

Averager

In the periscopic sextant, the averaging is performed by a ball integrator which effects a continuous moving average over any observation period up to 2 minutes. A single lever sets and winds the averager. No other presetting of sextant, timing mechanism, or averager is necessary.

NOTE

At least 4 seconds should be allowed for the averager to "run" to its starting position after being wound.

Because it is continuously integrating altitude against elapsed time, after at least 30 seconds it may be stopped at any time up to 2 minutes as circumstances dictate. The average altitude angle is obtained at the end of an observation by recentering the averager indices by means of the altitude knob. The averager altitude may then be read directly from the counter. A time dial graduated in seconds indicates the half time of the observation, thus the maximum dial reading of 60 indicates 120 seconds of time. At the end of 2 minutes of observation, the averager actuates a lever which drops a shutter across the field of view, indicating that the observation has been concluded. The shutter (and filter assembly) is mounted on the left side plate which is removable in flight. The shutter is raised, clearing the field of view when the averager rewind lever is pressed.

CAUTION

The averager actuating lever (button) should always be depressed to allow the averager to run down when the sextant is not being used for an observation.

Lighting

An ON-OFF switch on the mount controls illumination. The illumination of the bubble and azimuth scale of the mount is adjustable by a rheostat. No adjustment is provided to control the illumination of the mount counter, sextant counter, averager indices, or the navigator's watch. Electrical connection is made from the airplane 28-volt a-c power supply to an AN receptacle on the mount.

N-1 COMPASS SYSTEM

The N-1 compass system is a remote indicating gyro stabilized compass system designed for use in all latitudes. It may be operated to provide gyro stabilized magnetic reference headings (magnetic mode) or latitude corrected directional gyro reference headings (gyro mode). Operation as a magnetic (slaved) compass may be used in any locality except near the poles or in areas where severe magnetic distortion occurs. Operation as a directional gyro (unslaved) may be used in any latitude but is especially useful where the magnetic field is weak or distorted or when used for grid navigation in the polar regions. The N-1 compass master indicator (figure 4-33) located on the navigator's front panel contains the controls and indicators for the system. The N-1 compass system provides gyro or magnetic reference signals for directional control directly to the autopilot. The direction displayed by the heading pointer on the N-1 compass master indicator is the heading supplied the true heading system, the pilot's directional indicator, the heading pointer on the pilot's omni-range radio course indicator, and the pilot's radio magnetic indicator, whether operating the system in magnetic or gyro mode. A latitude correction knob (2, figure 4-33) on the N-1 compass system panel allows selection of magnetic slaved or directional gyro operation. The latitude correction knob is mechanically connected to the latitude correction pointer (5, figure 4-33). When operating the system in the magnetic mode, the N-1 compass latitude correction pointer is positioned to OFF. When operating in the gyro mode, the N-1 compass latitude correction pointer is positioned to the local latitude or to AUTO. When the latitude correction pointer is in AUTO position, a correction for apparent drift of the gyro is provided automatically, based on the latitude displayed by the BNS present position latitude indicator. When the correction for apparent drift of the gyro is set manually, the latitude indicated by the correction pointer is the latitude for which correction is applied to the heading pointer. A synchronizer knob (4, figure 4-33) located on the lower right side of the N-1 compass system panel provides a manual means to rapidly synchronize the heading pointer to the correct magnetic heading when the system is in magnetic slaved operation, or to set the heading pointer to a desired gyro heading when in directional gyro operation. The heading pointer (1, figure 4-33) and scale indicate the correct magnetic heading of the airplane when the system is in slaved magnetic operation and gives the airplane heading reference to the preselected gyro heading datum when the system is in directional gyro operation. An annunciator scale and pointer (3, figure 4-33) indicate the direction in which to rotate the heading pointer to synchronize it while in magnetic slaved operation. The heading is synchronized when the annunciator is on the center index mark. A compass and true heading computer system cutoff switch (19, figure 4-38A) guarded to ON position is installed in the overhead panel at the radar navigator's station to facilitate removing power from N-1 and AJA-1 components during ground operations. Whenever power is on the aircraft, the N-1 compass system is supplied 118-volt three-phase a-c power through fuses marked "N-1 Compass Amplifier ØA, ØB, ØC," single-phase a-c power through a circuit breaker marked "N-1 Compass Amplifier AC" and TR power through a circuit breaker marked "N-1 Compass Amplifier DC." The fuses and circuit breakers are on the "N-1 Compass System" portion of the radar navigator's circuit breaker panel. The heading signal for the heading pointer of the pilot's omni-range radio course indicator and the pilot's radio magnetic indicator passes through the compass synchro signal amplifier (ME-1) which is supplied 118-volt single-phase a-c power through the circuit breaker marked "ME-1 Compass Amplifier" on the "N-1 Compass System" portion of the radar navigator's panel whenever power is on the aircraft.

NOTE

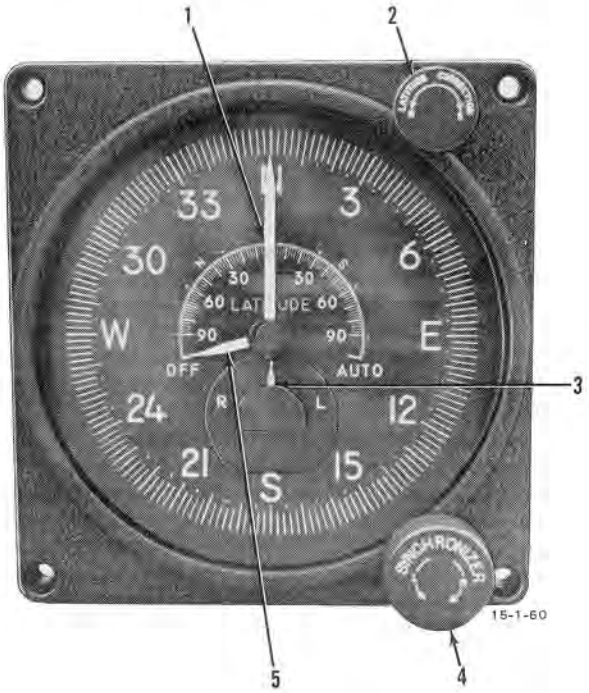
- The N-1 compass system becomes inoperative immediately upon failure of the d-c power or all a-c power and the autopilot will disengage. See "Autopilot," this section.
- When the autopilot is connected to the BNS, rapid changes in heading could result from varying the heading by means of the N-1 compass synchronizer knob. For this reason the autopilot should be disconnected from the BNS before actuating the N-1 compass synchronizer knob.

Directional Indicator (N-1 Repeater)

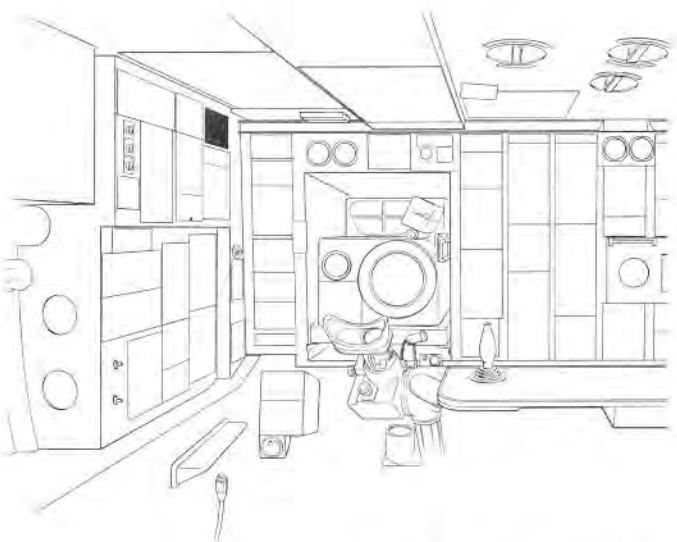
A directional indicator (N-1 repeater) (10, figure 1-13 and 6, figure 1-13A) is located on the pilots' instrument panel. The heading pointer is slaved to the N-1 compass heading pointer. By means of a dial knob on the indicator, the compass card and heading needle can be manually rotated together through 360° without changing the indication of the heading pointer.

AJA-1 TRUE HEADING COMPUTER SYSTEM

For description of this equipment, refer to T.O. 1B-52E-1-6-1.



1. HEADING POINTER
2. LATITUDE CORRECTION KNOB
3. ANNUNCIATOR POINTER
4. SYNCHRONIZER KNOB
5. LATITUDE CORRECTION POINTER



N-1 compass system panel

Figure 4-33.

DOPPLER RADAR

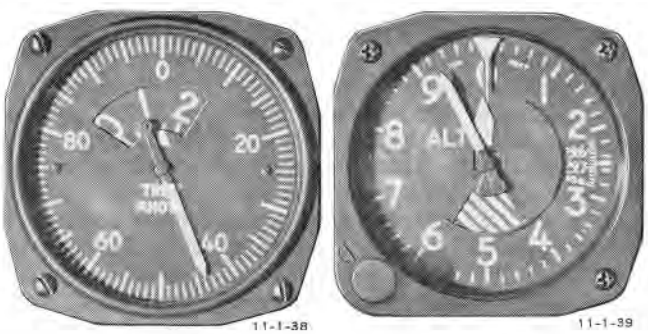
For description of this equipment, refer to T.O. 1B-52E-1-6-1.

TRUE AIRSPEED COMPUTER

The airplane is equipped with a true airspeed computer which uses static pressure, pitot pressure, and temperature to compute true airspeed and Mach information. True airspeed information is supplied to the gunnery system and to the true airspeed indicator on the radar navigator's front panel. Mach information is supplied to the ME-5 machmeter on the pilot's instrument panel. The 118-volt single-phase a-c power is supplied through the "Airspeed Computer" circuit breaker on the pilot's circuit breaker panel.

True Airspeed Indicator

The true airspeed indicator located on the radar navigator's front panel (figure 4-34) is a remote indicating unit. A main dial and subdial in the true airspeed indicator repeat airspeed information transmitted from the true airspeed computer. A cutout and reference mark on the main dial permit reading of the subdial. The power to operate this indicator is supplied by the true airspeed computer.



TRUE AIRSPEED INDICATOR

ALTIMETER (TYPICAL)

navigation instruments

Figure 4-34.

NAVIGATION INSTRUMENTS

Altimeter

The altimeter is located on the radar navigator's front instrument panel (figure 4-34) and is identical with the pilots' instruments. For further information, see "Instruments," Section I.

Outside Air Temperature Gage

The outside air temperature gage (17, figure 4-37) is located on the radar navigator's front panel. For further information, see "Instruments," Section I.

Clock

A clock (21, figure 4-37) is located on the radar navigator's front panel. For further information, see "Instruments," Section I.

Watch Holders VG

Two watch holders are provided at the navigators' station, one on the radar navigator's left side panel (6A, figure 4-37) and one on the navigator's front panel (44A, figure 4-38).

AIRCRAFT WEAPONS CONTROL SYSTEM MONITORING SET (AN/AJM-14(V)) QP

The monitoring set (AN/AJM-14(V)) provides a means for inflight recording of malfunctions which cannot be duplicated on the ground, detecting marginal circuits which do not present symptoms severe enough for operator or flight line personnel to discover, revealing the location of a malfunction thus decreasing maintenance manhours for trouble shooting, and for ground checkout for proper system operation. The monitoring set samples 200 voltages of the components of the AN/ASQ-38 bombing navigational and autopilot systems and records this information on a light-sensitive continuously moving paper tape. The 200 test voltages sampled include 50 test voltages of each BNS function (bomb, navigation, heading, and radar). Two modes of operation are available, manual and automatic. Manual mode provides manual selection of the BNS function to be monitored. Automatic mode provides continuous cycling of the monitoring system through all four functions of the BNS. Automatic mode provides a complete cycle every 12 minutes allowing a 3-minute monitoring period for each BNS function. On aircraft UL, in addition to the 200 BNS voltages sampled, approximately 50 test voltages of the AGM-28 can also be sampled. Only manual mode of operation is provided for monitoring the AGM-28 voltages. The monitoring set is composed of three basic components: the signal isolator which adjusts the sample voltages to the proper level for recording, the signal data recorder containing the recording paper, and the monitoring set control panel marked "Recorder Control" (figure 4-34A) located at the navigator's station. The system is supplied 118-volt single-phase a-c power through a circuit breaker marked "AN/AJM-14( )" located on the section 41 power distribution panel. The system is supplied TR power through a circuit breaker marked "AN/AJM-14( )" located on the section 41 power distribution panel.

NOTE QP

The supply of signal data recorders is limited; therefore, recorders may not be installed on all aircraft. Prior to each mission when monitoring set operation is planned, it will be necessary to ascertain that a signal data recorder is installed on the aircraft.

SIGNAL ISOLATOR QP

The signal isolator contains the circuits which process the sampled signals to a form usable by the recorder. The switching circuits which connect the recorder to the selected BNS function group are also contained in this unit.

SIGNAL DATA RECORDER QP

The signal data recorder unit contains the signal recording equipment, a blower for cooling, a power supply, and a 24-hour clock. The recorder provides a means of recording the signals being monitored. The record is made on a 12-inch wide photosensitive recording paper, exposed at a speed of 0.22 inch per second. The paper is exposed by high intensity light reflected from the mirrors of 50 galvanometers which are operated by the sampled signals. Timing lines occur every 10 seconds (2.2 inches on the paper) and extend the entire width of the paper. These lines, when used with galvanometer zeroing and clock image indications, enable the time of a trace indication to be determined to the nearest second. The galvanometers are "zeroed" (shorted out) every 60 seconds in coincidence with every sixth timing line for a period of 0.4 second. In addition, the galvanometers are zeroed for 1.5 seconds every 3 minutes when operating in automatic mode. The 24-hour clock image is also impressed on the recording paper automatically every 60 seconds. Each roll of recording paper (475 feet thin-base paper) provides approximately 7 hours 12 minutes of recorder operation.

MONITORING SET CONTROL PANEL QP

This unit contains all controls and indicators necessary for operation of the monitoring set.

MONITORING SET CONTROLS

System Select Switch

QP

A system select switch (2, figure 4-34A) located on the monitoring set control panel has OFF--STDBY--AUTO --BOMB--NAV--HDG--RADAR positions on aircraft Less UL and OFF--STDBY--AUTO--BOMB--NAV-- HDG--RADAR--AGM-28 positions on aircraft UL. STDBY position energizes the monitoring set warmup circuits. AUTO position energizes the timing and recording circuits which provide automatic mode of operation. NAV, BOMB, HDG, or RADAR position will select their respective BNS function for manual mode of operation. AGM-28 position selects the AGM-28 manual monitoring function. During the automatic mode of operation, the monitoring set cycles through the BOMB, NAV, HDG, and RADAR functions with each function being monitored for 3 minutes during each cycle. With the system select switch positioned to AUTO and BOMB mode of the BNS selected, the monitoring set will cycle to bomb function and remain in this function until the BNS changes modes.

Code Button

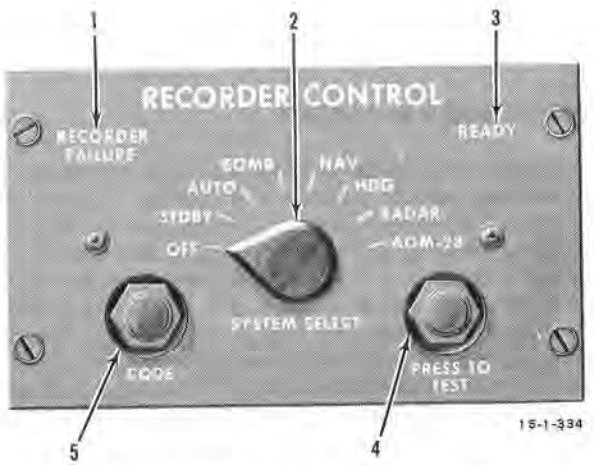
QP

A code button (5, figure 4-34A) located on the monitoring set control panel is provided so that the recording tape may be coded at any time that a special event is observed. Depressing the code button prints a picture of the recorder clock on the tape and zeroes the galvanometer (removes the signal from the tape for a short period of time).

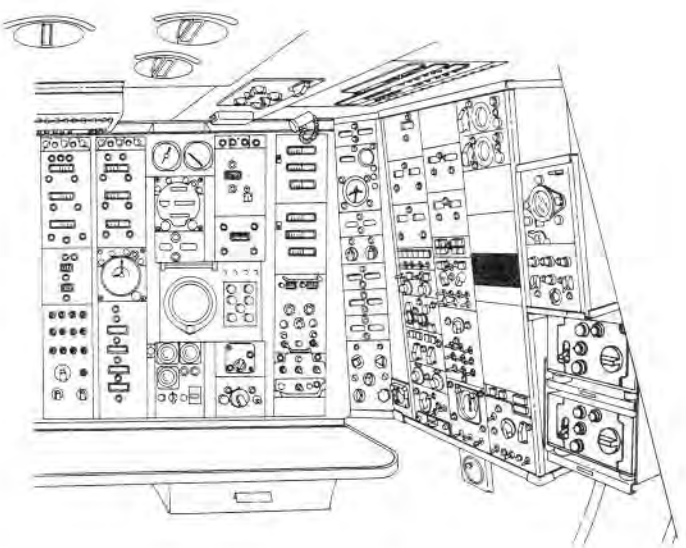
Press-to-Test Button

QP

A press-to-test button (4, figure 4-34A) located on the monitoring set control panel provides a means of testing the recorder failure and ready indicator lamps. Pressing the press-to-test button when the system select switch is in STDBY should cause the recorder failure and ready indicator lamps to illuminate.



1. RECORDER FAILURE INDICATOR
2. SYSTEM SELECT SWITCH
3. READY INDICATOR
4. PRESS-TO-TEST BUTTON
5. CODE BUTTON



..... monitoring set control panel QP

Figure 4-34A.

MONITORING SET INDICATORS OP

Ready Indicator

A ready indicator (3, figure 4-34A) is located on the monitoring set control panel. The word "Ready" will illuminate when the system has completed its warmup period and is ready for operation.

Recorder Failure Indicator OP

A recorder failure indicator (1, figure 4-34A) is located on the monitoring set control panel. The words "Recorder Failure" will illuminate whenever the tape magazine runs out of recording tape, the system blower motor is operating below normal speed, the automatic timing circuit malfunctions, or the recording light goes off.

Index Indicators OP

Index indicators are provided with each position of the system select switch (2, figure 4-34A). The STDBY, AUTO, BOMB, NAV, HDG, or RADAR index indicator will illuminate when the monitoring set is operating in that particular function.

MONITORING SET NORMAL OPERATION OP

1. Position system select switch to OFF.
2. Position system select switch to STDBY.
3. Test ready and recorder failure indicator lamps by pressing the press-to-test button.

NOTE OP

- The recorder failure indicator will normally illuminate momentarily immediately after applying power. It should extinguish when the blower is up to speed.
- A 90-second warmup period is required before selecting an operating mode. The ready indicator should illuminate at completion of the warmup period.

4. Position system select switch to the desired operating mode or function.

CAUTION OP

If the recorder failure indicator illuminates (other than momentarily) during system operation, the system select switch should be positioned to OFF. If the recorder failure indicator illumination is caused by a timing circuit malfunction, operation of the system may be continued using monitoring set emergency operation procedures.

NOTE OP

- During operation, should an event of special importance occur, pressing the code button will cause the recorder clock image to be impressed on the tape, thereby providing later identification of the event.
- During automatic mode operation (auto index indicator illuminated continuously), the index indicators should illuminate in the following sequence: BOMB, NAV, HDG, and RADAR with each indicator remaining illuminated for 3 minutes.

5. The system is turned off by placing the system select switch to OFF. All indicator lamps should extinguish.

MONITORING SET EMERGENCY OPERATION OP

During automatic mode, if the automatic system switching circuits fail (indicated by a BNS function index indicator remaining illuminated longer than 3 minutes and/or the recorder failure indicator illumination), the system should be operated in manual mode or turned off for 1 minute, then recycled to AUTO position. If the automatic mode is still not functioning properly, all operation should be limited to manual mode until the malfunction is found and corrected.

WEAPONS CONTROL SYSTEM — OFFENSIVE (AN/ASQ-38(V))

The aircraft is equipped with a Type AN/ASQ-38(V) Bombing Navigational Integrated System (BNIS). On this aircraft, the system is composed of the following auxiliary systems:

- BNS Radar System
- MD-1 Automatic Astrocompass System
- AN/AJA-1 True Heading Computer System
- AN/APN-89A Doppler Radar System
- AN/ASB-4A Bombing Navigation System
- Radar Recording Camera

The BNIS is designed to be highly automatic in operation by interconnection of the various auxiliary systems. The doppler radar system feeds ground speed and drift data to the bombing navigation system. The bombing navigation system in turn supplies data to the other components of the BNIS. Latitude and longitude data is supplied to the true heading computer system and to the automatic astrocompass system. Latitude data is supplied to the N-1 compass and roll-pitch stabilization is supplied to the doppler radar system. ECO signals are supplied to the automatic astrocompass system and triggering impulses are supplied to the radar recording camera. The bombing navigation system can be operated independently. For all except the terrain avoidance system which is a part of the BNS radar system, refer to T.O. 1B-52E-1-6-1.

Figures 4-35, 4-35A and 4-36 deleted

1. BOMB INDICATOR LIGHTS
2. INTERNAL BRIC (BOMB RELEASE INTERVAL CONTROL UNIT)
3. OXYGEN REGULATOR
4. ADM-20 EXERCISE CONTROL PANEL
5. SPECIAL WEAPONS AND LOCK INDICATOR PANEL
6. ADM-20 LAUNCH CONTROL PANEL OR EXTERNAL BRIC (BOMB RELEASE INTERVAL CONTROL UNIT)

6A. WATCH HOLDER

7. BNS CIRCUIT BREAKER PANEL
8. DISPLAY PANEL (GROUND RANGE AND AZIMUTH)
9. TERRAIN RADAR CONTROL PANEL
10. RADAR ANTENNA TILT PANEL
11. MIRROR
12. AIR OUTLET
13. TRUE AIRSPEED INDICATOR
14. ALTIMETER
15. RADAR NAVIGATOR'S CIRCUIT BREAKER PANEL
16. BDI (BOMBING DATA INDICATOR)
17. OUTSIDE AIR TEMPERATURE INDICATOR
18. BDI TG=0 (TIME TO GO ZERO) AND BNS STEERING (AUTOPILOT) LIGHTS
19. COMPASS AND TRUE HEADING COMPUTER CUTOFF SWITCH
20. SWESS CONTROL PANEL
21. CLOCK
22. WIND PANEL
23. BALLISTICS DERIVATIVES PANEL
24. RADAR RECORDING CAMERA
25. TOPOCOMP (TOPOGRAPHICAL COMPARATOR)
26. BNS DATA PRESET PANEL
27. INTERPHONE POWER SWITCH
28. STC PANEL
29. CROSSHAIR CONTROL
30. FLOOR INSPECTION LIGHT SWITCH
31. EMERGENCY ALARM LIGHT
32. OFFSET-IN LIGHT
33. SPOTLIGHT
34. PERISCOPE
35. RANGE SELECTOR PANEL
36. TARGET SCALE PANEL
37. FACEPLATE SWITCH
38. PRESENTATION GAIN PANEL
39. BOMB CONTROL PANEL
40. ASHTRAY
41. BOMB TONE SCORING PANEL
42. GROUND POWER SWITCH PANEL
43. D-2 BOMB RELEASE SWITCH
44. ARMREST
45. RADAR PRIMARY PANEL
46. PRESENTATION ADJUST PANEL
47. INTERPHONE PANEL
48. RADAR TEST PANEL
49. BOMB INDICATOR CARDS HOLDER
50. SIGHT (PERISCOPE ILLUMINATION CONTROL) PANEL
51. GROUND BLOWERS SWITCH
52. DESICCATOR SWITCH
53. TERRAIN TEST PANEL
54. ADM-20 TRAINING PANEL
55. SWK-2/A24T-1 SWITCH BOX (SWK BOX)
56. BNS POWER PANEL
57. SPECIAL WEAPON CONTROL PANEL
58. AIR OUTLET KNOBS AND AUXILIARY HEAT KNOB

58A. TERRAIN COMPUTER POWER PANEL

59. DOOR AND BOMB CONTROL PANEL
60. WALKWAY LIGHT SWITCH

60A. BOMB RELEASE MODE CONTROL PANEL

61. ADM-20 NO. 1 AND NO. 2 PROGRAM TURN PANEL
62. (BNS RADAR) EMERGENCY TIME DELAY BYPASS BUTTON
63. ADM-20 PROGRAM PANEL OR EXTERNAL BOMB RACK CONTROL PANEL
64. BOMB DOOR CONTROL VALVE LIGHTS

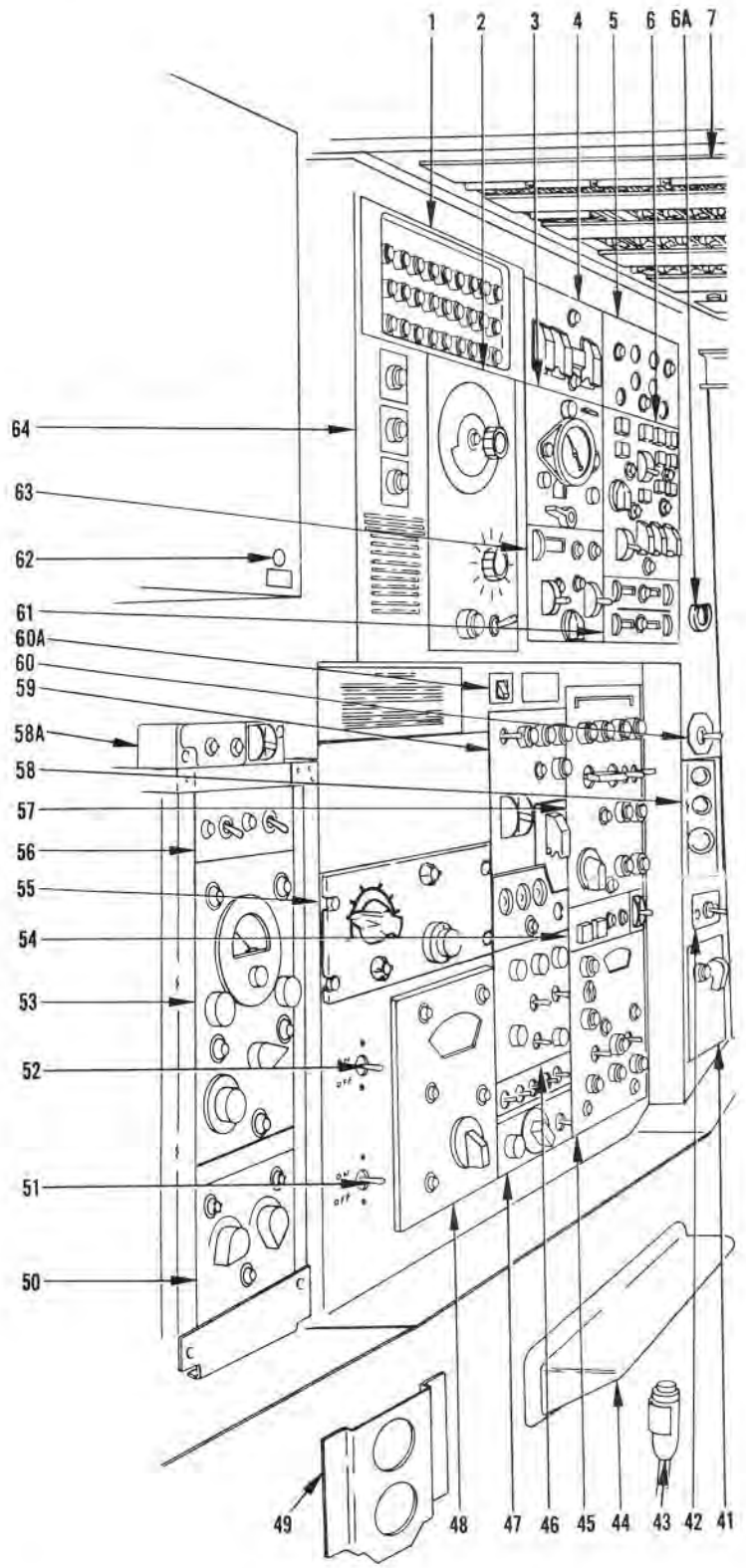
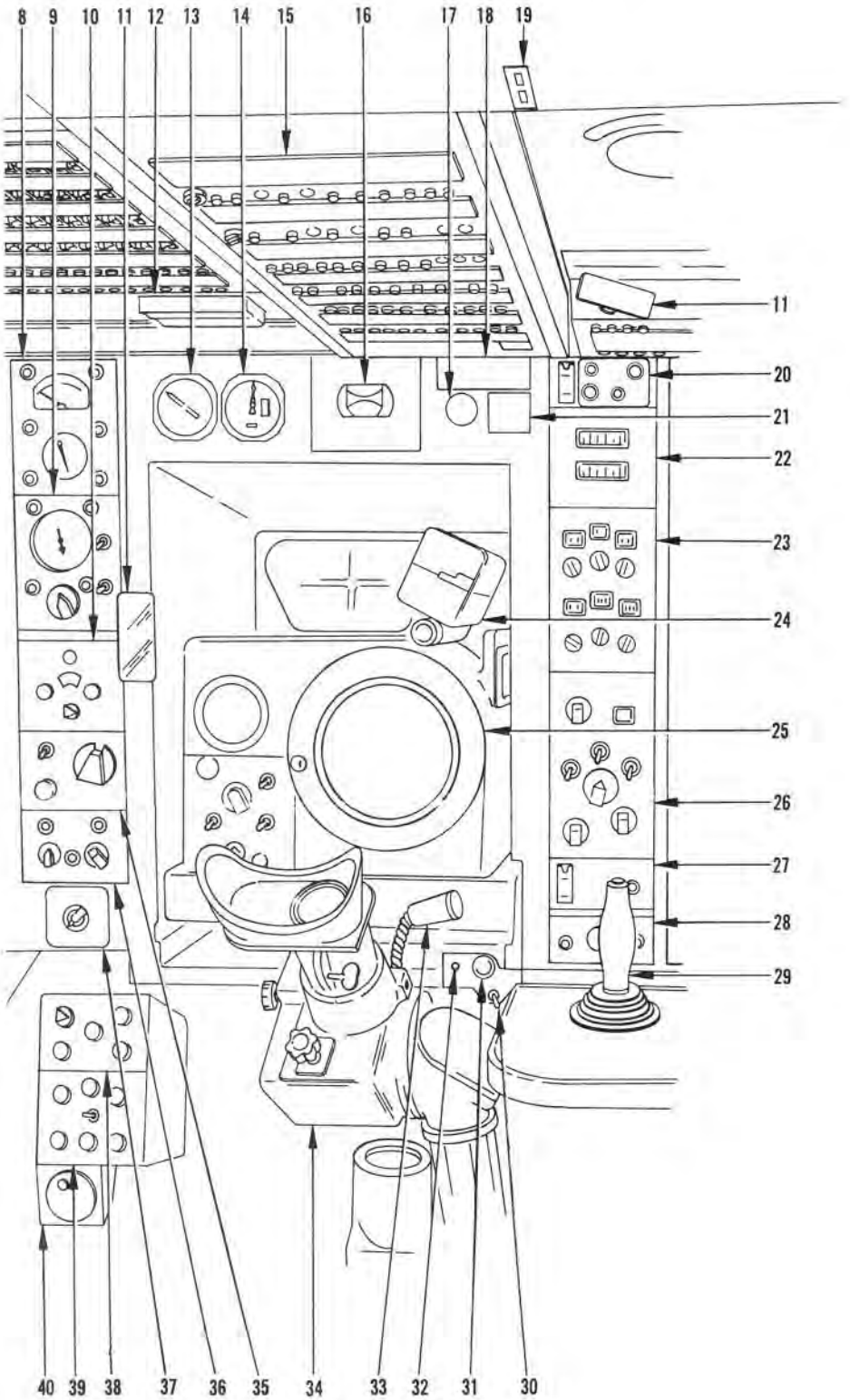


Figure 4-37 (Sheet 1 of 2).



.....radar navigator's station (typical)

Figure 4-37 (Sheet 2 of 2).

1. EXTERNAL MISSILE MANUAL RELEASE HANDLE
2. NAVIGATOR'S AUXILIARY CIRCUIT BREAKER PANEL
3. LONGITUDE PANEL
4. BNS COOLING INDICATOR LIGHTS
5. FORWARD SPECIAL WEAPON MANUAL RELEASE HANDLE
6. GROUND SPEED INDICATOR
7. REAR SPECIAL WEAPON MANUAL RELEASE HANDLE
8. DRIFT ANGLE INDICATOR
9. MIRROR
10. RADAR WARNING RECEIVER (AN/APS-54) INDICATOR
11. TIME-OF-FALL PANEL

11A. VGH RECORDER PANEL (INOPERATIVE)

12. LIGHT CONTROL PANEL
13. SPOTLIGHT
14. OFFSET PANELS
15. ASTROCOMPASS HEADING DISPLAY PANEL
16. ASTROCOMPASS INDICATOR DISPLAY PANEL
17. ASTROCOMPASS MANUAL PRESET POSITION DISPLAY PANEL
18. ASTROCOMPASS MANUAL SET PANEL
19. AGM-28 HEADING PANEL
20. AGM-28 TARGET DATA PANEL
21. AGM-28 POSITION DATA PANEL
22. AGM-28 ELECTRICAL POWER PANEL
23. AGM-28 TRACKING DATA PANEL
24. AGM-28 CELESTIAL DATA PANEL
25. ASM CIRCUIT BREAKER PANEL
26. RADAR PRESSURE CONTROL PANEL
27. AGM-28 INDICATOR LIGHTS PANEL
27A. RENDEZVOUS RADAR CONTROL PANEL
27B. RADAR AND HEADING DOPPLER DRIFT PANEL
28. OXYGEN REGULATOR
29. AUTO-NAV RADAR PANEL
29A. MONITORING SET CONTROL PANEL
30. AGM-28 FLIGHT CONTROL PANEL
31. AGM-28 GUIDANCE PANEL
32. AGM-28 GUIDANCE DATA PANEL
32A. AGM-28B RADAR ALTIMETER CHECK PANEL
33. DCU-9A CONTROL MONITOR UNITS
34. AGM-28 NONTACTICAL INSTRUMENTATION PANEL
35. AGM-28 LAUNCH SIMULATION PANEL
36. ASH TRAY
37. BNS HEADING SELECT SWITCH
38. IFF CONTROL PANEL
39. IFF CODER GROUP CONTROL PANEL
40. AGM-28 LAUNCH PANEL
41. AGM-28 ARMAMENT PANEL
42. DELETED
43. ASTROCOMPASS MASTER CONTROL PANEL
44. ASTROCOMPASS STAR DATA PANELS

44A. WATCH HOLDER

45. RADAR RECORDING CAMERA CONTROL PANEL
46. VERTICAL CAMERA CONTROL PANEL
47. INTERPHONE PANEL
48. TABLE LIGHT CONTROL SWITCH
49. FACEPLATE SWITCH
50. 5-INCH INDICATOR (NAVIGATOR'S RADAR INDICATOR)
51. VERTICAL CAMERA INTERVALOMETER
52. ALTITUDE PANEL
53. EMERGENCY CONTROLS PANEL
54. N-1 COMPASS MASTER INDICATOR
55. AIRSPEED PANEL
56. ASTROCOMPASS LINE OF POSITION DISPLAY PANEL
57. TRIAL PANEL
58. AJA-1 TRUE HEADING COMPUTER SYSTEM PANEL
59. LATITUDE PANEL
60. BNS OVERHEAT POWER SUPPLY AND RADAR PRESSURE LOW LIGHTS
61. RELEASE CIRCUITS DISCONNECT

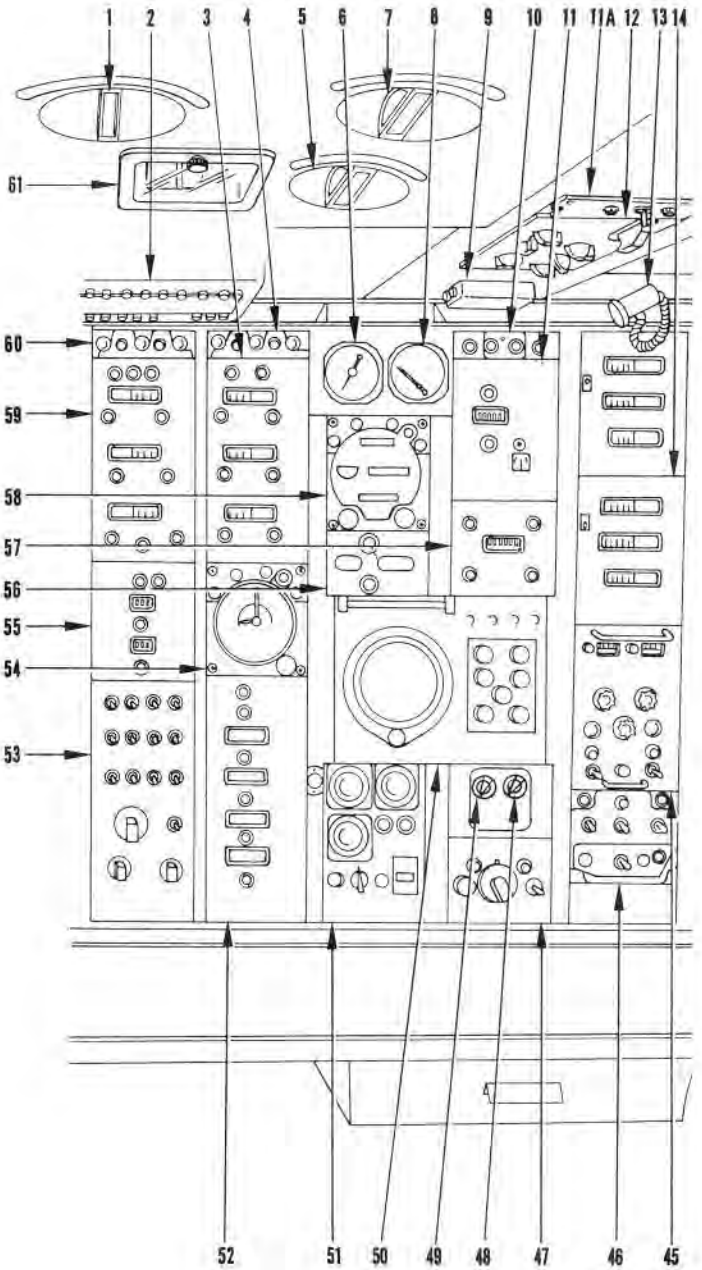
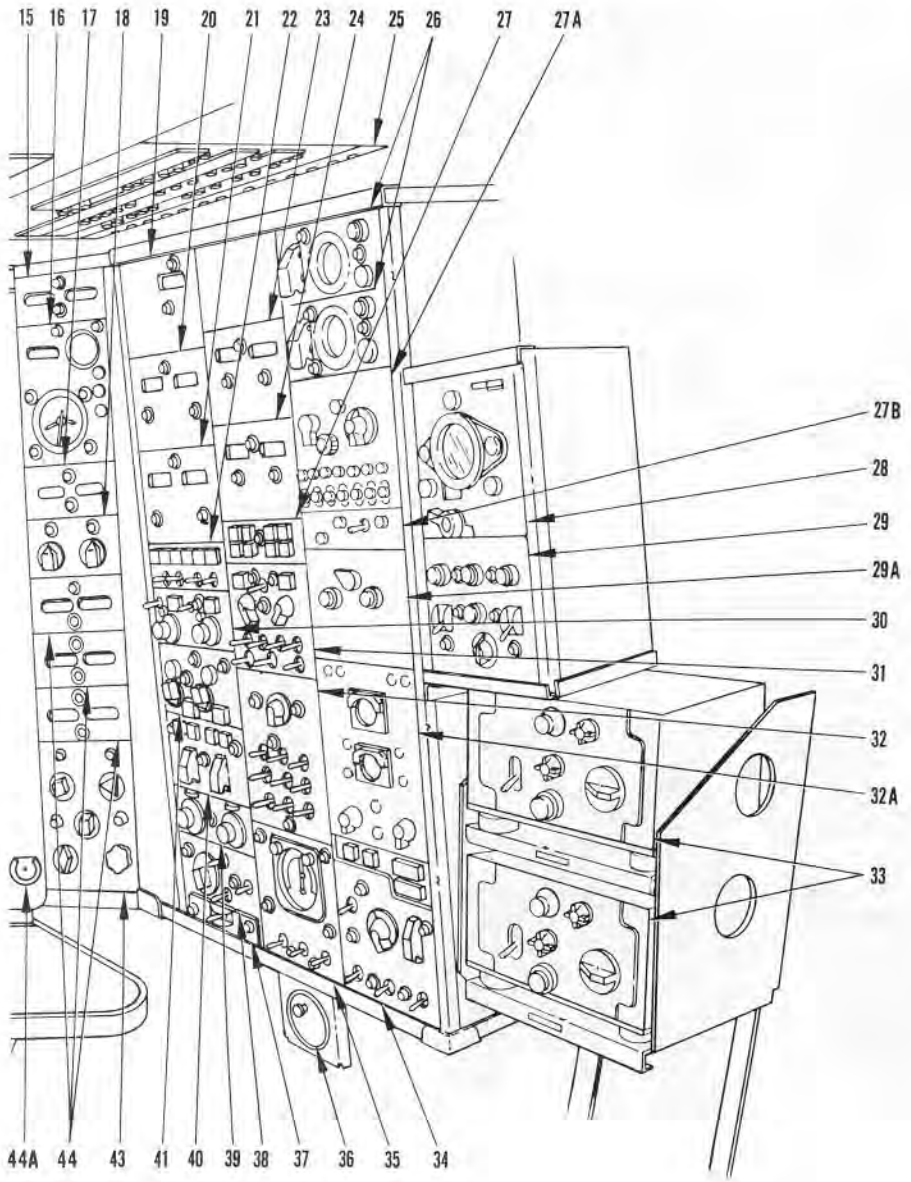
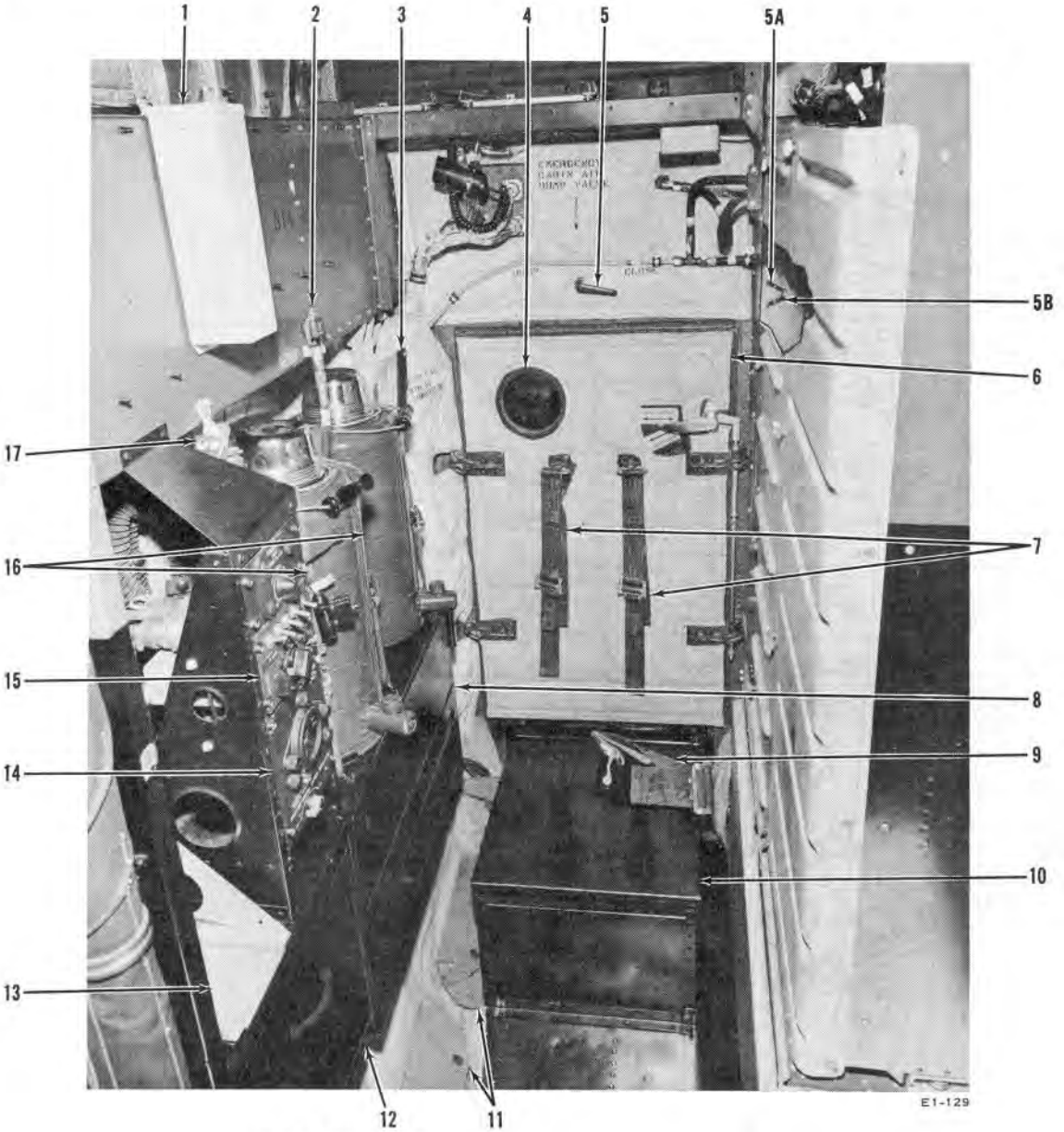


Figure 4-38 (Sheet 1 of 2).



.....navigator's station (typical)

Figure 4-38 (Sheet 2 of 2).



1. CUP DISPENSER
2. PORTABLE OXYGEN BOTTLE RECHARGER
3. MIRROR
4. ALTERNATOR DECK INSPECTION WINDOW B-52E
   FORWARD EQUIPMENT BAY INSPECTION WINDOW B-52F
5. EMERGENCY CABIN PRESSURE DUMP VALVE HANDLE

5A. FORWARD SPECIAL WEAPONS SAFEING CLIP REMOVAL HANDLE (NOT USED)
5B. AFT SPECIAL WEAPONS SAFEING CLIP REMOVAL HANDLE (NOT USED)

6. FORWARD COMPARTMENT PRESSURE BULKHEAD DOOR
7. SHOULDER HARNESS
8. FOOD STORAGE
9. SAFETY BELT
10. INSTRUCTOR NAVIGATOR'S SEAT (TOILET UNDER)
11. LANDING GEAR SAFETY PIN STOWAGE
12. TRASH CONTAINER
13. HOT CUP
14. OXYGEN REGULATOR
15. INTERPHONE PANEL
16. DRINKING WATER CONTAINERS
17. OXYGEN HOSE

.....instructor navigator's station

Figure 4-39.

TERRAIN AVOIDANCE SYSTEM

DESCRIPTION

The terrain avoidance (TA) system comprises a special mode of the BNS radar, an electronic terrain computer, and the pilot's and copilot's display indicators and their associated electronic components. The TA system provides a radar display of the terrain along the flight path of the aircraft. By interpreting the display and maneuvering the aircraft accordingly, the pilot is able to fly the aircraft at low absolute altitudes (aircraft to terrain separation distance).

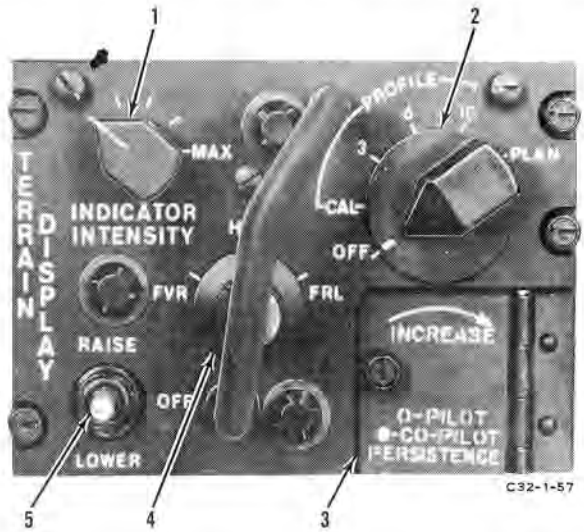
Power Source

Power is supplied to the TA system through circuit breakers located on the left forward BNS circuit breaker panel, right forward BNS circuit breaker panel, and the auxiliary BNS circuit breaker panel.

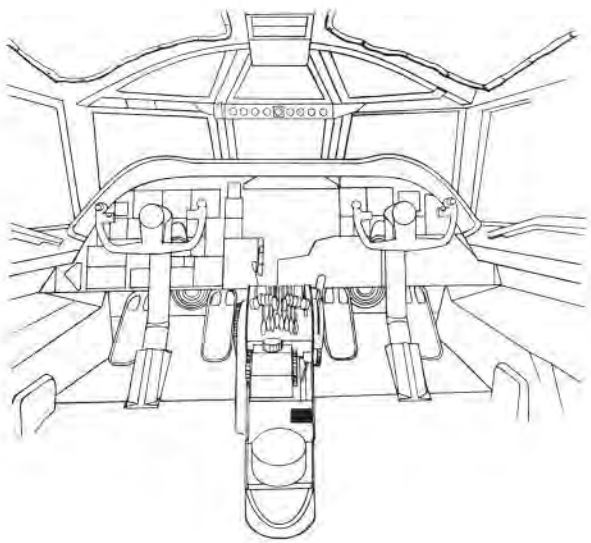
Pilots' Controls and Indicators

TERRAIN DISPLAY INDICATOR INTENSITY SWITCH. A terrain display indicator intensity switch (1, figure 4-40) is located on the pilot's and copilot's terrain display control panel. Low indicator intensity is provided when the switch is in the extreme counterclockwise position. Intensity or brightness is increased as the switch is moved clockwise toward MAX position.

TERRAIN DISPLAY MODE SELECTOR SWITCH. A terrain display mode selector switch (2, figure 4-40) located on the pilot's and copilot's terrain display control panel has OFF--PROFILE CAL--PROFILE 3--PROFILE 6--PROFILE 10--PLAN positions. The TA system is placed in operation when the selector switch is moved out of OFF position. PROFILE CAL is a test position used to determine if the system has been properly calibrated. PROFILE 3 position provides a silhouette outline display on the pilots' terrain display indicators of the highest terrain between minimum range and 3 nautical miles. PROFILE 6 position provides a silhouette outline display on the pilots' terrain display indicators of the highest terrain between minimum range and 6 nautical miles. PROFILE 10 position provides a silhouette outline display on the pilots' terrain display indicators of the highest terrain between minimum range and 10 nautical miles. PLAN position provides a plan display (azimuth and range) of the terrain protruding above a variable clearance plane between minimum range and 10 nautical miles.



1. TERRAIN DISPLAY INDICATOR INTENSITY SWITCH
2. TERRAIN DISPLAY MODE SELECTOR SWITCH
3. TERRAIN DISPLAY PERSISTENCE CONTROL ACCESS FLAP
4. STABILIZATION REFERENCE SELECTOR SWITCH
5. CLEARANCE PLANE CONTROL SWITCH



pilot's and copilot's terrain display control panel

Figure 4-40.

TERRAIN DISPLAY PERSISTENCE ADJUSTMENT. A terrain display persistence adjustment is located under a flap (3, figure 4-40) on the pilot's and copilot's terrain display control panel. The screwdriver adjustments are used to increase or decrease the persistence of the pilot's or copilot's terrain display indicator.

STABILIZATION REFERENCE SELECTOR SWITCH. A stabilization reference selector switch (4, figure 4-40) located on the pilot's and copilot's terrain display control panel has FVR--HOR--FRL positions. The clearance plane is oriented to the selected stabilization reference. FVR (flight vector reference) position is not used in this installation; however, FVR position is tied to the FRL mode circuits and placing the switch to FVR will select FRL mode. In HOR (horizontal) position, the clearance plane is maintained horizontal within the pitch and roll limits of the vertical gyro. In FRL (fuselage reference line) position, the clearance plane is maintained at a preset angle which is nearly parallel to the longitudinal axis of the aircraft.

CLEARANCE PLANE CONTROL SWITCH. A clearance plane control switch (5, figure 4-40) located on the pilot's and copilot's terrain display control panel is provided for use with plan mode of operation.

NOTE

In profile mode, the clearance plane is set during ground maintenance and cannot be changed during flight.

The switch has RAISE--OFF--LOWER positions, is spring-loaded to OFF position, and is independent of the radar navigator's clearance plane. Holding the switch to LOWER position lowers the clearance plane with respect to the aircraft and will be reflected on the clearance plane indicator. Holding the switch to RAISE position raises the clearance plane and will be reflected on the clearance plane indicator. The clearance plane can be set from 0 to 3000 feet below the aircraft.

WARNING

Under no circumstances will TA flight be conducted with clearance plane settings between 0 and 200 feet.

TERRAIN DISPLAY INDICATORS. The pilot and copilot each has a terrain display indicator (1, figure 4-41) located on the forward instrument panel. The terrain display indicators present the pilot and copilot a "profile display" or a "plan display" of the approaching terrain. There are six etched marks on the terrain display indicators. The etched marks are a ground track line (9, figure 4-41), a display center etch mark (10, figure 4-41), an aircraft mark (14, figure 4-41), a profile calibration etch mark (17, figure 4-41), a 6-mile range mark (11, figure 4-41), and a 3-mile range mark (12, figure 4-41). The upper edge of the terrain display indicator at the ground track line represents 10-mile range (8, figure 4-41). In addition, there are four electronically generated marks. During plan mode, the electronically generated mark is a failure warning cursor (13, figure 4-41). During profile mode, the electronically generated marks are a horizontal reference line (15, figure 4-41) and a terrain trace (16, figure 4-41). In addition, when PROFILE CAL is selected, an electronically generated profile calibration cursor (figure 4-46F) is displayed. In profile mode, the sector displayed is ±45° about the ground track line and the vertical limits of the pilots' terrain display indicators are ±1500 feet with respect to the horizontal reference line. In plan mode, the sector scanned is ±85° about the ground track line which is all the area in an arc of 170° ahead of the aircraft; however, the display presented on the terrain display indicators is approximately ±80° about the ground track line. The plan mode display shows only those terrain features which project above a variable clearance plane as set by the clearance plane control switch.

NOTE

The aircraft mark is correctly positioned relative to the horizontal reference line for a 200-foot profile clearance plane only.

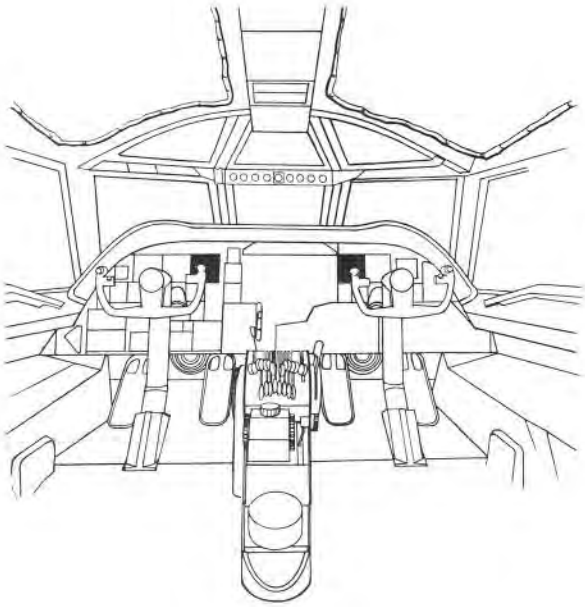
WARNING

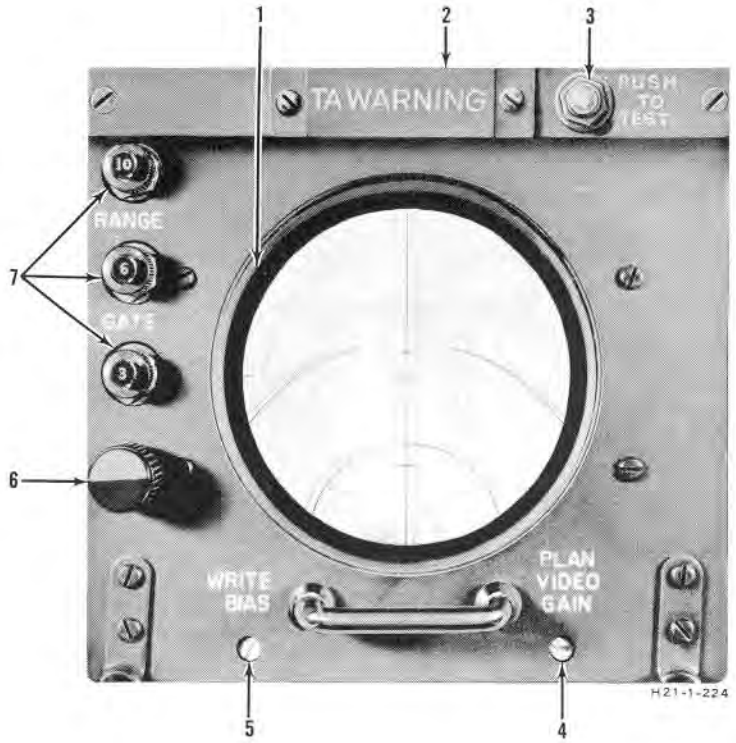
If the horizontal reference line is not present while using profile mode or if the failure warning cursor is not present while using plan mode, the TA system should be used with caution and only when visual contact with the ground can be maintained.

NOTE

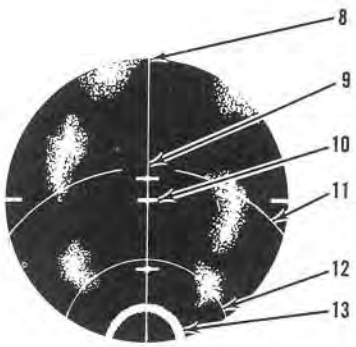
The pilot's and copilot's terrain display indicators require filters for night operation.

TERRAIN DISPLAY INDICATOR POLARIZING FILTERS. Each terrain display indicator is provided with a polaroid filter (18, figure 4-41) which fits over the indicator face. The filter consists of two pieces of polarized glass mounted so that one piece of glass can be rotated with respect to the other. The filter prevents glare by controlling the brightness of the indicator display and is required for night operation. When not in use, the filters are stowed at the pilots' stations.

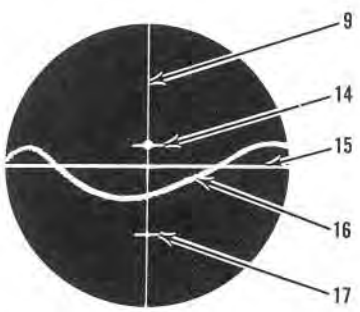




1. TERRAIN DISPLAY INDICATOR
2. TA WARNING LIGHT
3. PUSH-TO-TEST BUTTON
4. PLAN VIDEO GAIN CONTROL
5. WRITE BIAS CONTROL
6. RANGE GATE INDICATOR LIGHTS INTENSITY CONTROL
7. RANGE GATE INDICATOR LIGHTS
8. 10-MILE RANGE
9. GROUND TRACK LINE
10. DISPLAY CENTER ETCH MARK
11. 6-MILE RANGE MARK
12. 3-MILE RANGE MARK
13. FAILURE WARNING CURSOR
14. AIRCRAFT MARK
15. HORIZONTAL REFERENCE LINE
16. TERRAIN TRACE
17. PROFILE CALIBRATION ETCH MARK
18. TERRAIN DISPLAY INDICATOR POLARIZING FILTER



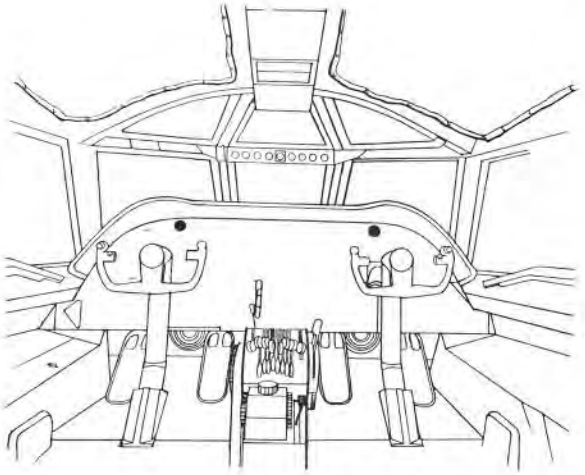
PLAN DISPLAY



PROFILE DISPLAY

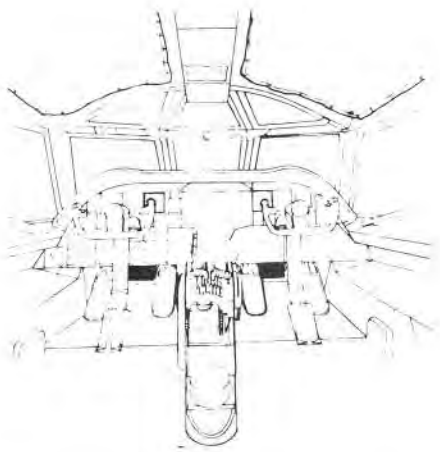
pilot's and copilot's terrain display indicators

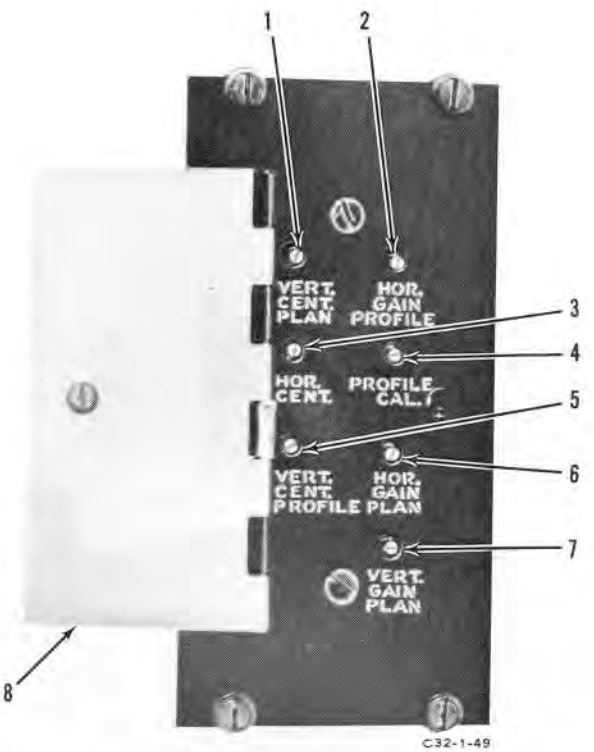
Figure 4-41.



pilot's and copilot's clearance plane position indicators

Figure 4-42.

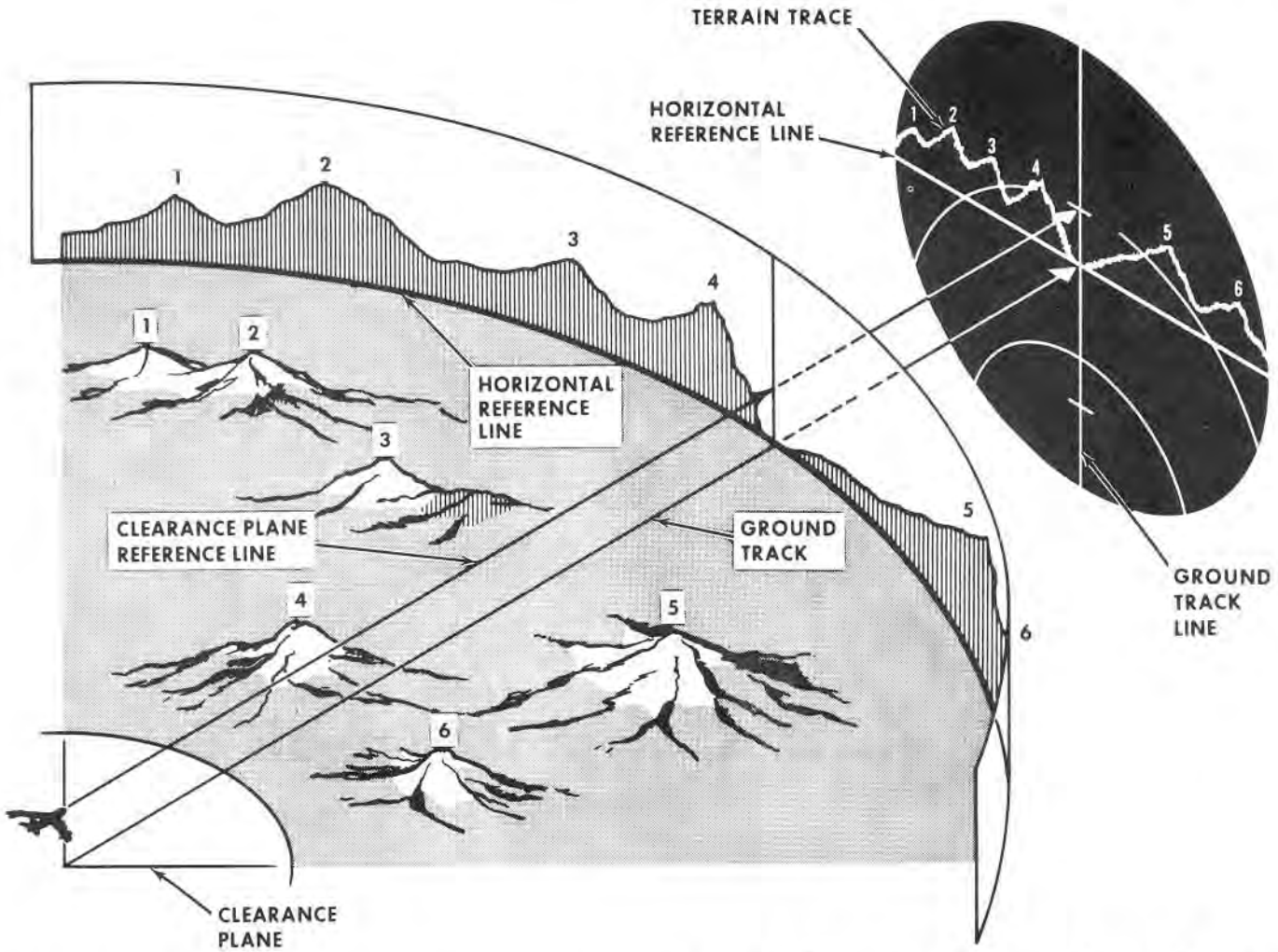




1. PLAN DISPLAY VERTICAL CENTERING CONTROL
2. PROFILE DISPLAY HORIZONTAL GAIN CONTROL
3. HORIZONTAL CENTERING CONTROL
4. PROFILE CALIBRATION CONTROL
5. PROFILE DISPLAY VERTICAL CENTERING CONTROL
6. PLAN DISPLAY HORIZONTAL GAIN CONTROL
7. VERTICAL GAIN CONTROL
8. PREFLIGHT ADJUSTMENTS PROTECTIVE COVER

preflight adjust control units

Figure 4-43.



profile mode display

Figure 4-46A.

Pilots' Display Modes

The TA system is equipped with two display modes, plan and profile, which can be used with either of the two modes of stabilization.

PLAN MODE. The plan mode display (figure 4-46) is a 10-mile PPI (plan position indicator) which displays range and azimuth of obstacles protruding through (above) the clearance plane. The bottom of the ground track line represents the position of the aircraft. The display resembles a contour map having 10 miles range. Valleys, river beds, ridge lines, etc may be discernible on the display. The radar shadow effect causes a large blank space to appear behind the display of a prominent obstacle. The position of the plan failure warning cursor (C, figure 4-44) varies with the clearance plane setting and indicates the range at which the lower limit of the primary area of the antenna intersects the clearance plane as explained above.

PROFILE MODE. The profile mode, operational only on TP TX aircraft, displays azimuth and height (figure 4-46A). The highest visible terrain obstacle between minimum range and the selected range gate (3, 6, or 10 miles) is sensed and retained in a peak detector module in the following manner. The profile mode peak detector senses the highest terrain computation within the range gate selected at each degree of azimuth and causes this terrain height to be displayed as illustrated in figure 4-46B. Notice that the peak detector value is

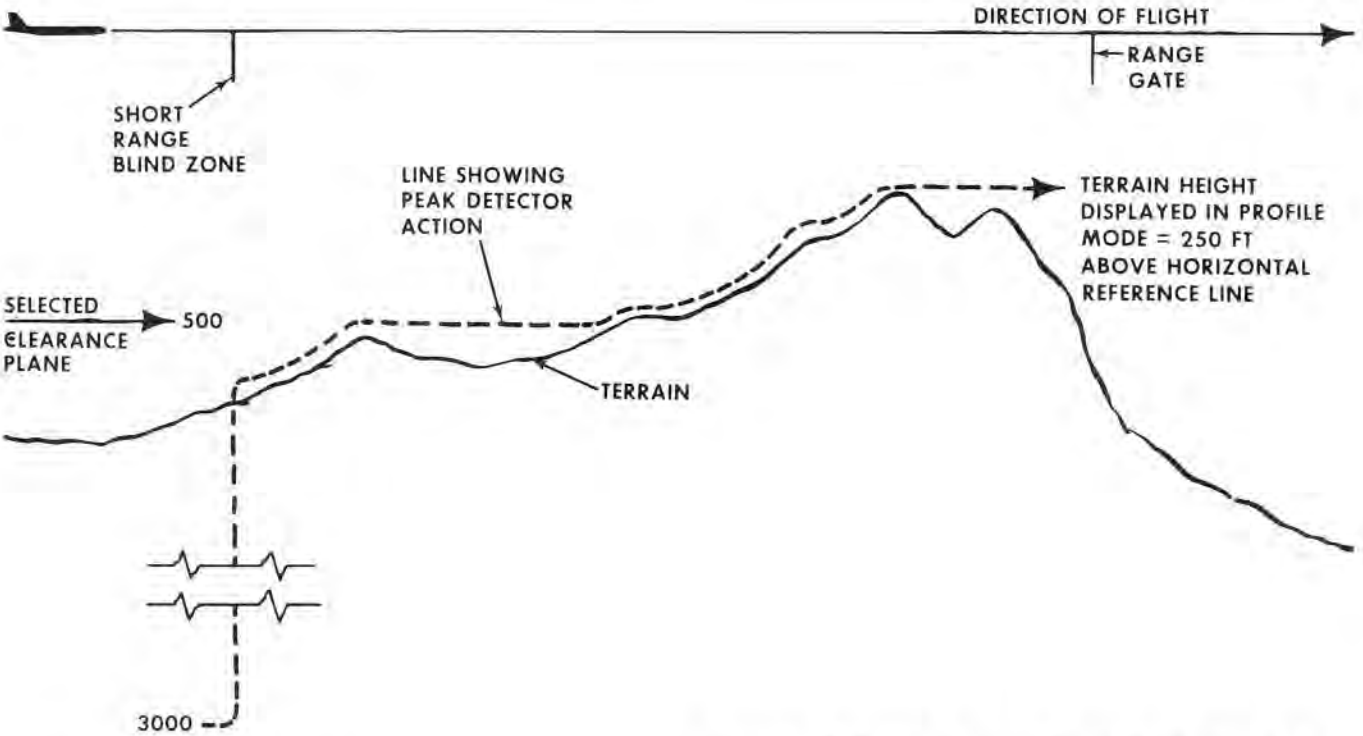


Figure 4-46B.

-3000 feet within the short range blind zone and that the peak detector senses and retains the highest terrain within the range gate, represented by the dashed line in figure 4-46B. (The peak detector is recycled to -3000 feed between radar cycles.) The peak detector output is smoothed and reproduced on the profile display; thus, only a silhouette of the highest obstacles is seen. Sweep circuits slaved to the antenna generate the left-right scan of the trace. In contrast to the forward and down view of plan mode, the profile mode display presents a view looking forward. The height of obstacles is displayed relative to the clearance plane which is represented by an electronically generated cursor known as the horizontal reference line. The term "horizontal" refers only to the cursor position of the line relative to the tube face. The profile mode is equipped with three selectable range gates; 3, 6, and 10 miles. Only radar echoes from targets within the range selected are accepted for processing or display.

Navigators' Displays

For information on the navigators' displays, refer to T. O. 1B-52E-1-6-1.

Failure Warning

The TA system is equipped with a self-test feature called "failure warning." A synthetic terrain obstacle is generated electronically and supplied to the radar receivers. This signal is processed through the computer and fed to a comparing circuit. The comparing circuit senses the accuracy of the computation. If the system accuracy deviates in a positive direction, no failure warning is given. However, if a negative error at short range is detected and the error exceeds 200 feet, the failure warning cursor in the plan mode display or the horizontal reference line in the profile mode display will disappear. Simultaneously the TA warning light will illuminate on TP TX aircraft. Although the failure warning circuit does not include every system component from the input to the output, it does check the accuracy of a majority of electronics involved.

The items not checked include the antenna, a portion of the receiver-transmitter unit, and a portion of the terrain computer. Furthermore, errors or malfunctions can exist in the components checked which may produce abnormal or erroneous displays but not cause a failure warning indication.

NORMAL OPERATION

System Characteristics

The following terrain display indicator characteristics are occasionally visible but do not degrade TA system performance significantly.

- A variation in persistence may exist between the pilot's and copilot's terrain display indicators.
- A dim halo may occur around the periphery of the terrain display indicators.

Less UC

- A dead band about 1/8 inch wide may appear on the terrain display indicators at about 9 miles in range.
- There may be a range error on either of the pilots' displays of ±0.75 mile at 6-mile range and decreasing to ±0.4 mile at 3-mile range.
- It may be that a return will be seen on the pilots' display but will not be seen on the navigators' display or vice versa; however, the two displays will not differ (in elevation) more than 250 feet plus 0.5% of the range. (In any event, the pilots' display is the reference for TA flying.)
- Dead and bright spots are permissible on the terrain display indicator from 1/2 inch either side of the ground track line to the edge of the indicator.

GROUND TRACK ERROR DUE TO DOPPLER. Drift angle signals are supplied to the TA system to orient the actual ground track under the ground track line (A, figure 4-46C). With the doppler drift switch OFF, the ground track line will represent the projected longitudinal axis of the aircraft and will not represent the actual ground track (B, figure 4-46C). If the doppler radar system is providing erroneous drift information, the actual ground track line will be displaced from the etched ground track line an amount equal to the drift error (C, figure 4-46C). This error may also shift back and forth in respect to the ground track line. The doppler radar is more likely to be unreliable in a descent.

TERRAIN VIDEO TRACE BREAKUP. The solidity or continuity of the terrain video trace is affected to some extent by antenna scan speed, PRF, drastic terrain profile slope changes (i.e., canyon walls, steep hills, etc), and the rate of TA solution and display. Abrupt changes in transverse slope of the terrain profile is the greatest cause of normal profile video trace breakup. Basically the magnitude of profile video trace breakup depends on the magnitude and duration of the terrain profile transverse slope changes. This condition will not prevent operational use of profile mode since it is possible to distinguish between normal trace breakup due to the above combination of factors and abnormal breakup due to system malfunction.

FALSE CLEARANCE PLANE INDICATION. When the profile modes are selected, the clearance plane indicator may not reflect the proper clearance plane setting. This condition occurs only in the event that the clearance plane was previously set exactly 180° away from the proper profile clearance plane indication when the system was in plan mode. This condition is not easily duplicated and does not occur frequently in normal operation.

Less TF TX

OBSCURED FAILURE WARNING CURSOR. At clearance plane settings most often used for operational flights, the failure warning cursor is very close to the vertex of the display and may not be seen because it is lost in the clutter.

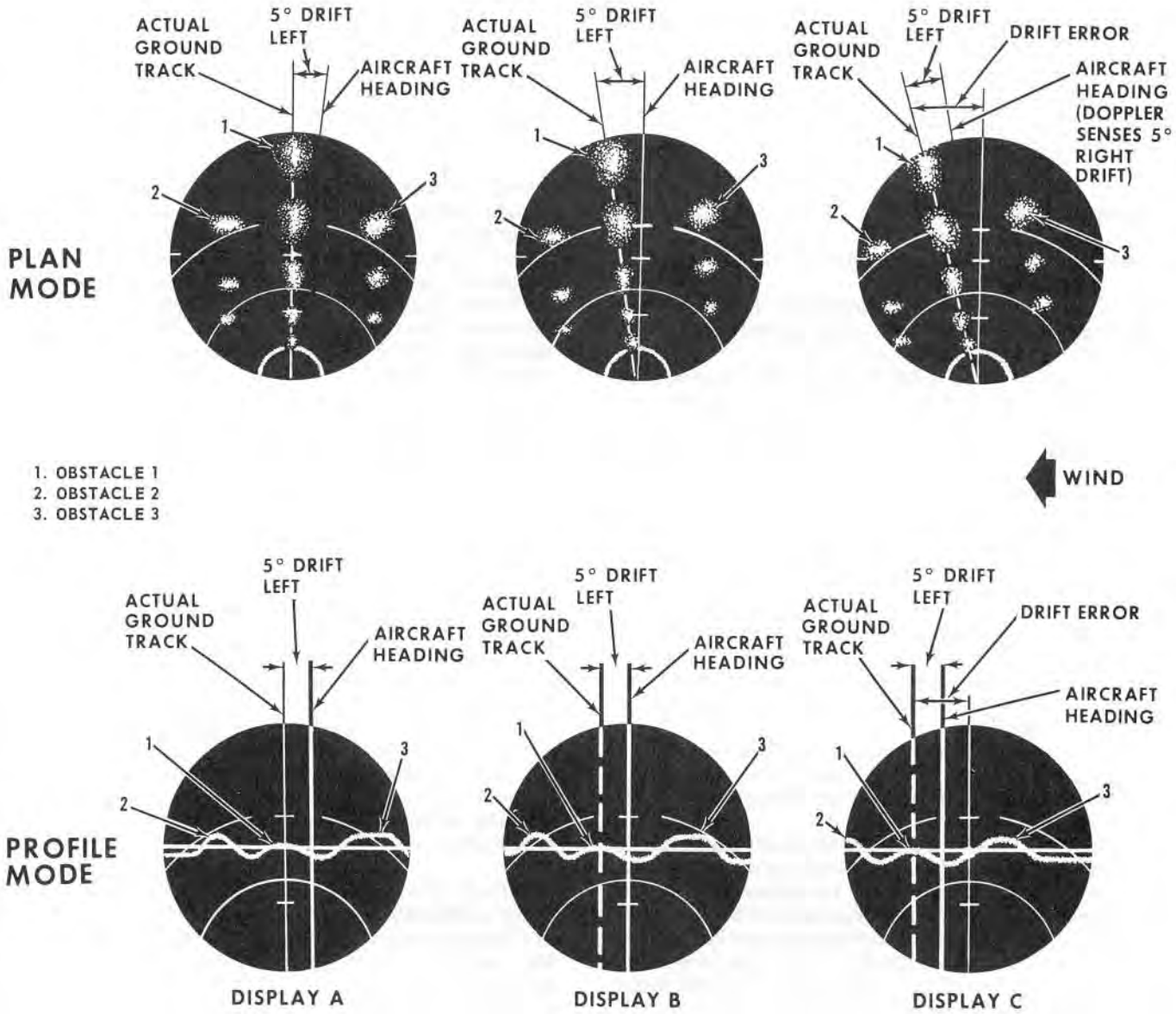
SCAN TO SCAN DISPARITY. Two types of TA presentation disparity may exist in the BNS:

1. Vertical disparity may occur when either plan or profile mode is being used. Plan mode video may appear on one scan and disappear on the reverse and/or successive scans if the "aircraft-to-terrain" height is close to the clearance plane setting. Profile mode video may appear higher on one scan than on the reverse and/or successive scans.
2. Azimuth disparity may occur when profile mode is being used. Profile mode video may appear at a slightly different azimuth on one scan than on the reverse scan.

TERRAIN DISPLAY INDICATOR STORAGE. Video which is displayed with the indicator intensity setting at a maximum may remain on the display for a short time after the intensity is reduced to minimum. At high levels of intensity, some video smearing may appear; this can be reduced by proper adjustment of the intensity controls.

FADE-IN FADE-OUT DIFFERENCE. In TA plan mode and horizontal stabilization, there may be as much as 200 feet difference between the fade-in and fade-out points of an obstacle. The fade-in of the obstacle must be taken at a range within 1/4 mile of that at which the fade-out was taken.

SHORT RANGE BLIND ZONE. The radar utilized in the TA system is blind at ranges closer than about 3/4 nautical mile (area A, figure 4-44). There is no indication of any target within the short range blind zone although a radar shadow may be observed occasionally from a target known to be within this zone.



NOTE

DRIFT REPRESENTATIONS NOT TO SCALE

ground track error

Figure 4-46C.

RADAR SHADOWS. Radar energy travels in line of sight. Only targets "visible" to the antenna are displayed; other targets which are hidden are located in the area known as the "radar shadow." As the aircraft progresses over the ground, the shadow areas are progressively illuminated provided the aircraft is above the terrain causing the shadow. The changing illumination and shadows can be observed on the plan mode displays.

POOR DISPLAY OF SHEER TARGETS. The system is not capable of consistently displaying or accurately computing the height of TV or radio antenna towers, power transmission lines, suspension bridges, very tall office buildings, straight-sided cliffs, etc. These obstacles may be displayed at partial height with improving accuracy as range decreases, producing a rapidly rising terrain trace on succeeding scans of the display. If the target is displayed close to ground track, the pilot should consider such a sequence as an emergency and immediately initiate a climbing steep turn.

POOR DISPLAY OF SMALL TARGETS. The returns from small objects (small buildings, boats, etc) are very weak and are not computed or displayed accurately, even though they may be discernible to the radar navigator.

WEATHER SENSITIVITY. The TA system will display returns from dense clouds, moderate rain or snow, etc. The total contrast feature of this display prevents the pilot from differentiating between weather returns and valid obstacles. Weather has been observed to make the profile terrain trace appear jagged (having an irregular sawtooth shape). Areas of precipitation should be avoided because these returns mask the ground returns and will cause the pilot to climb above the desired clearance altitude. The climb command in this case can exceed the climb performance of the aircraft. The radar navigator can often provide guidance through areas of scattered precipitation. When TA capability is degraded by weather effects, the pilot should climb to IFR altitude.

BANK ANGLE. The terrain display indicators will present a distorted display on the wing down side when the bank angle exceeds 12°. The short range blind zone affects the display of targets at close range off the wing tip as well as in front of the aircraft. These combined effects will prevent display of important targets during turns if the bank angle exceeds 12°.

DISPLAY IRREGULARITIES. Invalid spiking in profile 6 or profile 10 mode may appear. Evasive action should be initiated unless visual observation determines otherwise.

LIMITED AIRSPEED FLEXIBILITY. Operating in the FRL stabilization mode requires careful control of airspeed since an incorrect airspeed can cause errors in the TA system display. For a particular gross weight and FRL setting, only one IAS value will provide accurate FRL stabilization as shown in figure 4-46D. If a higher IAS is used, a positive TA system error will occur, resulting in the aircraft being flown at a higher absolute altitude than the clearance plane setting. If a lower IAS is used, a negative TA system error will result in the aircraft being flown at a lower absolute altitude than the clearance plane setting. These errors increase proportionately to the departure from the correct airspeed and as the range from the aircraft to the obstacle increases.

Planning Considerations

Careful planning to overcome certain characteristics of the TA system is essential for safety and effectiveness. Required planning falls into three categories: route selection, altitude planning, and airspeed planning. Select the route which makes the best compromise considering the following factors:

1. Avoid radio and TV tower areas. Provide 5-mile lateral clearance from towers. Any tower which rises to within one-half of clearance plane setting or higher is a threat. Alternately, an increased clearance plane can be used if circumnavigation is not feasible.
2. Avoid high wind in rough terrain. Turbulence usually increases proportionately to the terrain roughness. It is not necessary to increase the set clearance altitude to fly over mountains; the TA system is designed to provide adequate clearance over any type of terrain. However, turbulence in mountains may require use of higher than normal clearance plane settings. An increased clearance plane setting may be helpful but may also increase the severity of gust strikes.
3. Avoid weather. Select an alternate route or leg in case of inaccurate forecast. Do not rely on TA system displays for weather penetration.
4. Avoid extreme topography. Dogleg around the crest of excessively high mountains which require a protracted climb.
5. Check for sheer bluffs, dams, bridges across wide valleys, transmission lines, forest lookout towers, etc. Minimize the danger from these unseen or inaccurately computed obstacles by flying around rather than over them. Again, increasing the clearance plane setting may be a satisfactory alternate to circumnavigation.
6. Over-water operations.

WARNING

Do not depend on the TA displays for letdowns or low absolute altitude operations over water.

Use of the radar altimeter is recommended when over water. The BNS radar returns from liquid water depend on sea state and are usually such a low value that erroneously high clearance indications above lakes or oceans are displayed. The TA system is satisfactory for use over snow, ice, or dry lake beds unless the surface is very smooth.

7. Emergency altitude selection. A chart of emergency minimum safe altitudes should be prepared for each low level leg and alternate route. Pressure altimeter corrections for low barometric pressure or low temperature must be applied. The emergency minimum safe altitudes should provide terrain clearance of 1000 feet in nonmountainous terrain and 1500 feet in mountainous terrain for 10 nautical miles either side of track. Use of navigation charts with minimum altitudes indicated for each area is recommended.

8. Airspeed planning. Airspeed planning must consider factors of turbulence, required mission speed, endurance, and pilot factors (fatigue and proficiency). Operation over rough terrain at speeds below 260 knots IAS is not recommended due to airspeed tradeoff in protracted climbs (i.e., to clear peaks having a rise of 1000 feet/mile for 5 miles).

9. Altitude planning. Choice of the TA altitude depends on several factors: 1) type of terrain being crossed, 2) pilot's proficiency, 3) accuracy of the TA system, 4) visibility, and 5) weather. Clearance plane settings will be established by using commands.

WARNING

Under no circumstances will TA flight be conducted with clearance plane settings between 0 and 200 feet.

Preparations during preflight mission planning include selection of clearance altitudes for each low level leg. The profile mode clearance altitude will be used for basic mission planning; changes in clearance altitude in flight require switching to the plan display mode or flying an offset trace in profile mode. The profile trace should be maintained 1/8 inch below the horizontal reference line for each 100 feet additional clearance desired.

WARNING

Do not fly the terrain trace above the horizontal reference line.

10. FRL stabilization. Compute the FRL pot setting as follows:

NOTE

In cases of using commands designating an FRL pot setting (based on average conditions) to be used on training missions, there will be a corresponding error in actual terrain clearance altitude if variances in airspeed and/or airbrake configuration are prohibited.

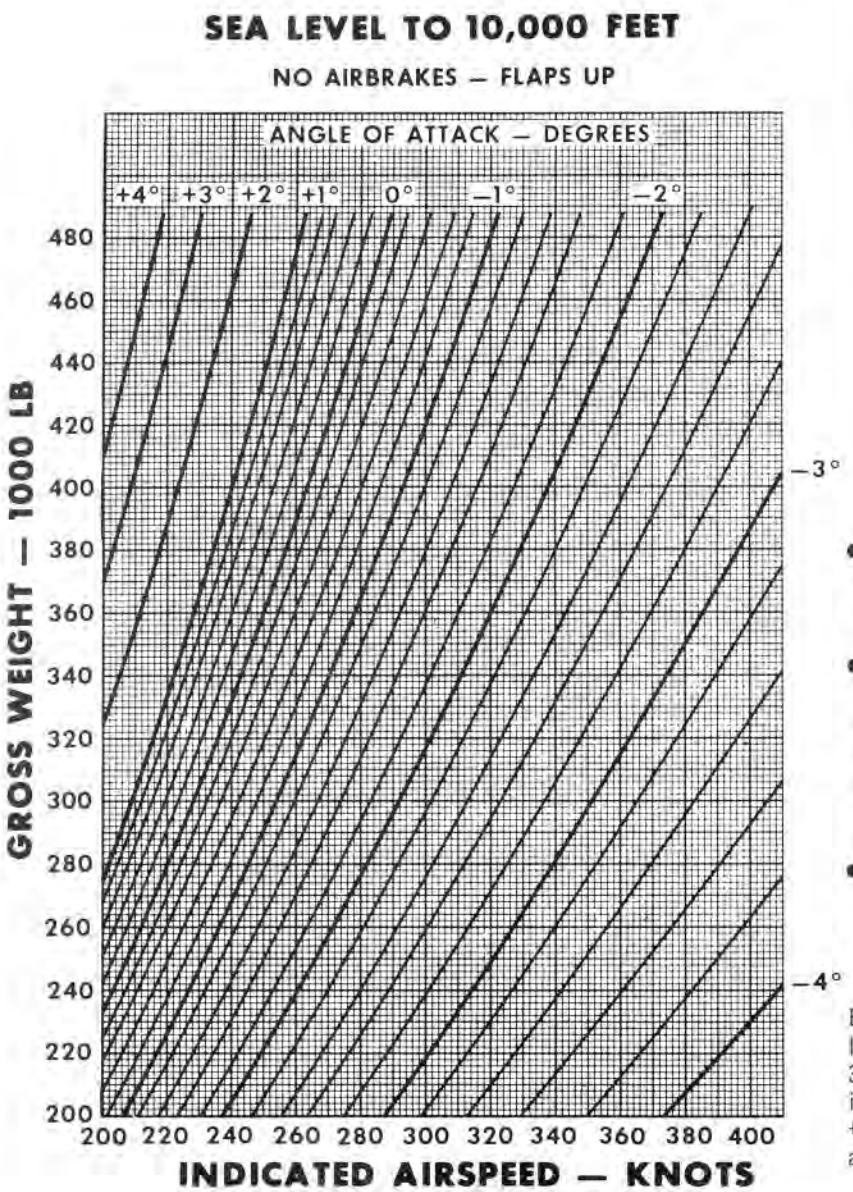
Determine the gross weight, indicated airspeed, airbrake positions, and TA system mode (profile or plan) schedule for the low absolute altitude portion of the mission. Using this information, determine the angle of attack values for the flight from the angle of attack chart in figure 4-46D.

EXAMPLE: At 270,000 pounds gross weight and 260 knots IAS, the computed FRL angle of attack is -1.6° without airbrakes, -1.3° with airbrake position 2 (or position 4 with inboard airbrake circuit breakers pulled), and -1.0° with airbrake position 4.

NOTE

When it is possible to select indicated airspeeds and airbrake positions, choose them to make the range of angle of attack values as narrow as possible to minimize FRL stabilization errors. Use of airbrakes changes the angle of attack as shown in figure 4-46D.

The altitude error due to changes in gross weight can be predicted using figure 4-46E. X is the gross weight determined from figure 4-46D for a particular airspeed and preset angle of attack. Assuming the FRL pot was set using X gross weight and 300 knots IAS, then X - 100,000 pounds would represent a reduction of 100,000 pounds in gross weight and would produce a 300-foot error (figure 4-46E) over flat terrain (aircraft would fly approximately 300 feet higher than the clearance plane setting using 3-mile range gate). Other values are shown for the error expected during peak crossings which differ because the short range TA system accuracy governs the peak crossing altitude. In flight, various deviations from the curves will result because of terrain irregularities. A low level leg involving two airspeeds requires compromise of the FRL pot setting and, if at all possible, should be programmed according to the particular mission requirements. To equalize the clearance error at the beginning and end of the leg, the FRL pot should be set to a value (figure 4-46D) using the expected gross weight



INDICATED AIRSPEED KNOTS	AIRBRAKE CORRECTION	
	ADD THIS CORRECTION TO THE ANGLE OF ATTACK FROM THE CHART	
	AIRBRAKE POSITION 2	AIRBRAKE POSITION 4
200	+0.4°	+0.8°
250	+0.3°	+0.6°
300	+0.3°	+0.6°
350	+0.3°	+0.5°
400	+0.3°	+0.3°

NOTE

- Use airbrake corrections in airbrake position 2 column when the inboard airbrake circuit breaker is pulled out and airbrake position 4 is selected per low altitude tactic in Section II.
- When flying with constant airspeed and a gross weight less than that used to compute the FRL potentiometer settings, the use of airbrakes will tend to improve the accuracy of the TA system display by providing a more nose-up angle of attack. At heavier gross weights, the use of airbrakes will tend to degrade the accuracy of the TA system display.
- One or two AGM-28 missiles installed on the aircraft changes the angle of attack 0.1° and 0.2° respectively in the positive direction when the weight of the AGM-28 missile(s) is included in the computation of the aircraft gross weight.

EXAMPLE:
If the aircraft gross weight (including two missiles) is 300,000 pounds, the angle of attack value at 260 knots indicated airspeed from the chart is −1.2° then add +0.2° correction for the missiles which results in an angle of attack setting of −1.0°.

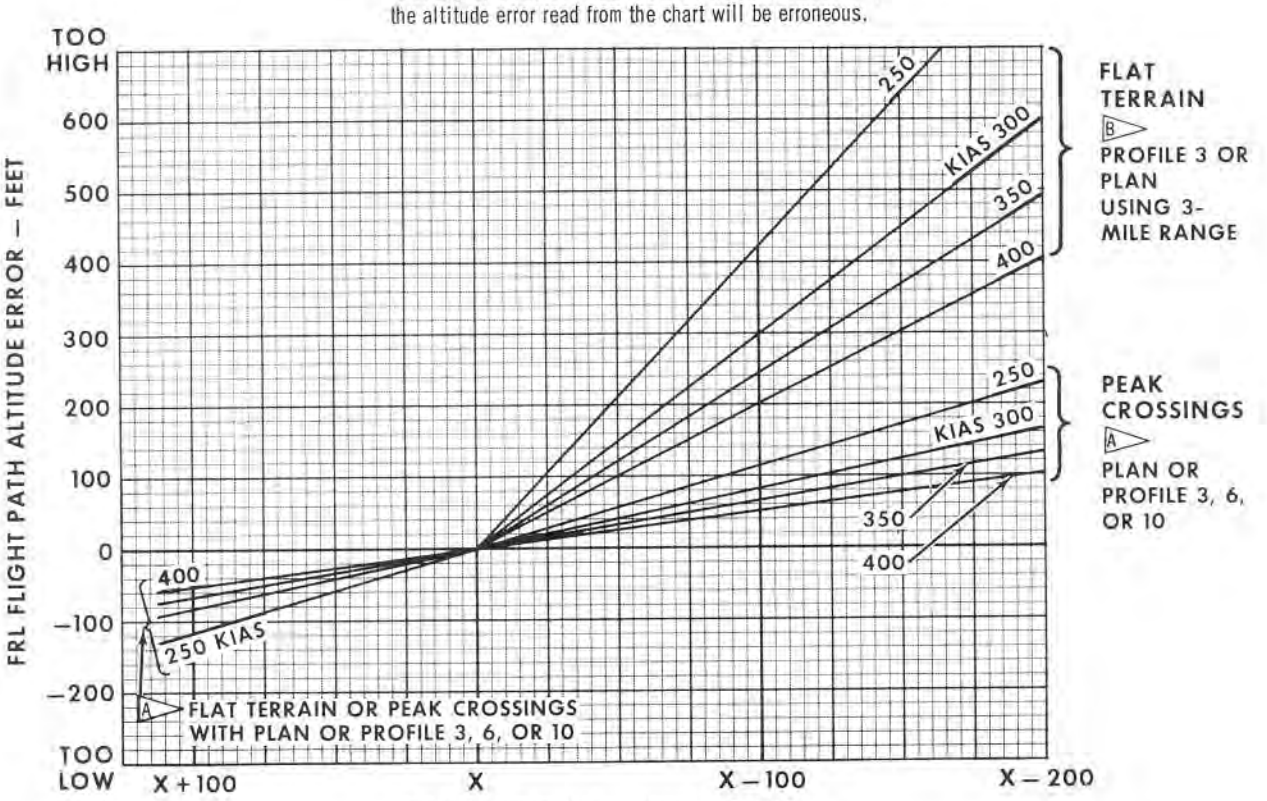
aircraft (body)

angle of attack - level flight

Figure 4-46D.

NOTE

Compute X value for the IAS used. When the IAS is changed, a new X value must be computed; otherwise, the altitude error read from the chart will be erroneous.



X is the gross weight obtained from the angle of attack chart using the IAS being flown and the angle of attack set into the FRL pot.

A Altitude error calculated using angular error and minimum radar range.

B Altitude error calculated using angular error and 3-mile radar range.

FRL flight path altitude error due to gross weight changes at constant indicated airspeed

Figure 4-46E.

at a point approximately four-fifths down the low level leg. The airspeed chosen should be as high as possible to minimize the error. Airspeeds above or gross weights below which the FRL pot is set tend to produce larger errors (these errors move the aircraft to higher clearance altitudes). Avoid negative error if plan mode is to be used. Figure 4-46E cannot be used to predict the effect of airspeed changes directly since the X value also changes with airspeed. However, the flight path altitude error can be obtained for the re-entered new airspeed using figure 4-46D. The corresponding gross weight obtained is used as the new point X. For example, a mission profile is established requiring airspeeds of 260 and 300 KIAS. The initial gross weight is 350,000 pounds. Entering figure 4-46D with 350,000 pounds gross weight and 260 KIAS results in a -0.55° FRL angle of attack trial setting. The X value on figure 4-46E for 260 KIAS would be 350,000 pounds. The X value for 300 KIAS is 465,000 pounds which is obtained from figure 4-46D using the trial value -0.55° FRL angle of attack. Assume that the mission profile calls for the 300 KIAS to be initiated when the gross weight equals approximately 325,000 pounds. The error when the KIAS is increased to 300 would be +418 feet as determined from figure 4-46E (465,000 - 325,000 = X - 140,000 pounds), using

X - 140,000 pounds and 300 KIAS (flat terrain) as entering values. If this error is considered excessive, the FRL pot setting must be compromised by choosing a lower gross weight in selecting the FRL angle of attack value and accepting a negative system error at the beginning of the low level leg. A more desirable FRL angle of attack value might be -1.92° (obtained from 325,000 pounds and 300 KIAS using figure 4-46D). The X value for 260 KIAS would then be about 245,000 pounds and the TA system error approximately a minus (negative) 100 feet at the beginning of the low level leg. The small change in gross weight would reduce the error as the flight progressed; increasing airspeed to 300 KIAS would remove the remainder of the FRL error and further gross weight reduction would produce a slowly increasing positive error. If the mission profile requires subsequent reduction of airspeed, the change can be predicted by following the same procedure; for example, if the airspeed is to be reduced to 280 KIAS with the existing FRL angle of attack value of -1.92°, the X value is 284,000 pounds. If the change in airspeed is to be accomplished at a gross weight of 275,000 pounds (X - 9000 pounds), the altitude error, determined from figure 4-46E, would be approximately +40 feet over flat terrain or +10 feet in peak crossings. The general rule in obtaining these X values is to move parallel to the diagonal lines on figure 4-46D reading the X values at the intersection of the existing FRL angle of attack setting and the intended IAS. The error is then determined from figure 4-46E using the difference between the X value and the actual gross weight in conjunction with the intended IAS.

Operating Techniques

NOTE

SQ

The radar altimeter is used for cross-checking the TA system and for observing peak passage before following a flydown command. A properly functioning radar altimeter is required for safe TA operation when visual contact with the ground cannot be maintained.

In flight, TA operation is essentially an extension of instrument flying with the TA system displays included in the cross-check. Neither TA display mode (plan or profile) provides any direct indication of pitch or roll, although an approximate indication of pitch changes can be obtained by noting the scan-to-scan changes in position of the profile terrain trace. It has been found helpful to assign airspeed (throttles) control to the safety pilot, who then maintains the desired airspeed without further direction. Frequent use of airbrakes for deceleration is not recommended. The climbing portions of TA operation require close monitoring of airspeed in rough terrain. Pilots should overshoot throttle settings by early advancement to higher settings than required, then retard throttles as required to maintain desired airspeed. It is especially important to maintain correct airspeed when in the FRL stabilization mode because airspeed reduction causes lower than desired crossing altitudes. Turns are possible during terrain following, provided good judgment is applied. Before turning toward blank, missing, or ragged (sawtoothed) areas of the terrain trace in profile mode or blank areas of the display in plan mode, clear the turn with the radar navigator. The blank may be caused by radar shadow from a large obstacle at very close range. Plan turns so that no more than 15° bank angle is used. Use slow rate of roll-in, not to exceed 3° per second. The copilot must monitor all the instruments and provide visual clearance of the aircraft. The radar navigator provides terrain assessments beyond the pilot's range. The radar navigator using LO ALT GM can normally see out as far as 35 NM ahead of the aircraft and provides information on large obstacles and weather beyond the range selected by the pilot. Using ranges greater than 75 miles may result in retraces and other interference effects. The radar navigator may recommend small course changes to utilize terrain cover or for weather. The navigator sets the destination indicators to the turn point coordinates which enable the pilot to use the flight command indicator (FCI) as the primary heading instrument. On aircraft SZ, BNS steering may be used to maintain correct aircraft heading while the pilot maintains pitch control. The navigator must also monitor the doppler radar and, in the event of a doppler malfunction, notify the pilot and place the doppler drift switch to OFF. If the doppler radar will not return to normal operation, the navigator may accomplish a memory point wind run and place the doppler radar silence switch to SILENT and the doppler drift switch back to ON. This will align the TA presentation about ground track derived from the BNS memory point winds. All subsequent wind runs will be made with the doppler drift switch in OFF position. Inform the pilot before making any changes in the doppler drift switch position. The navigator will monitor minimum safe altitudes for the low altitude leg.

HORIZONTAL STABILIZATION. In the horizontal stabilization mode, the terrain is displayed relative to its vertical distance below the aircraft. Horizontal stabilization is considered only a backup in TA operations.

WARNING

Use of horizontal stabilization will result in inconsistent peak crossings at very low clearance altitudes when peaks are crossed in a descending attitude. Confine descent rates to less than 1000 feet per minute. Insure active safety pilot monitoring. When horizontal stabilization is used with plan mode, do not use clearance plane settings less than 800 feet. A rapidly rising profile mode terrain trace, even though the trace may be well below the horizontal reference line, provides a visible indication of an impending low crossing or collision.

Failure Warning Indications TP TX

WARNING

- The failure warning circuits do not detect every failure of the TA system but do check the accuracy of the majority of the electronics involved.
- If the horizontal reference line is not present while using profile mode or if the failure warning cursor is not present while using plan mode, the TA system should be used with caution and only when visual contact with the ground can be maintained.

The general rule when observing a failure warning indication is to climb to a safe altitude and investigate. Switch to the other TA mode of display and, if failure warning indications disappear, TA flight may be continued in this mode of display after confirmation of TA system accuracy. A rough estimate of the TA system accuracy can be obtained by switching to PROFILE CAL. The failure warning problem is then displayed as a profile calibration cursor below the horizontal reference line. With an accurate system, the line will be coincident with the profile calibration etch mark. Failures of monitored components which influence short range accuracy may cause the profile calibration cursor (figure 4-46F) to shift above or below the etch mark providing a visual indication of the error. When the shift exceeds 200 feet downward (negative error), the failure warning cursor or horizontal reference line disappears and the TA warning light comes on. Upward shifts (positive error) will not cause failure warning indication but the shift is a rough estimate of the system error at short range. The failure warning circuits may also be actuated by excessive bank angle which is inconsequential unless it remains after reducing the bank angle.

Failure Warning Indications Less TP TX

WARNING

- The failure warning circuits do not detect every failure of the TA system but do check the majority of the electronics involved.
- If the failure warning cursor is not present while using plan mode, the TA system should be used with caution and only when visual contact with the ground can be maintained.

The general rule when observing a failure warning indication is to climb to a safe altitude and investigate. A TA system calibration run is recommended to determine system errors.

TA System Calibration

It is desirable to perform an accuracy run using an isolated mountain peak to verify TA system accuracy. The pilot will perform a fly-by at peak elevation and note the pressure altitude. This establishes a base altitude. Level terrain can be used as an alternate method when a peak is not available (see paragraph on plan mode error detection, this section).

PLAN MODE. The accuracy run should be made at base altitude +500 feet, using horizontal stabilization. Allow at least 10 miles of straight and level flight during the approach to the peak. As soon as the peak can be identified on the display, move the clearance plane to fade the peak noting range and clearance plane settings at which the display of the peak just disappears. Record as many clearance plane settings as possible between 6 miles and minimum range. The difference between each noted clearance plane setting and the 500-foot peak clearance altitude is the system error at the respective range. If the clearance plane setting is less than 500 feet, a positive error is present and, if the clearance plane setting is greater than 500 feet, a negative error is present.

TP TX

PROFILE MODE. A technique similar to the plan mode calibration run is used (with aircraft to peak separation equal to clearance plane setting) except that the peak trace position relative to the horizontal reference line is recorded. Range information is obtained from the radar navigator and the applicable profile range gate is selected as the peak is approached.

Pilots' Inflight Procedures

LETDOWN PROCEDURES

For terrain avoidance system letdown procedures, see "Descent Checklist" in Section II.

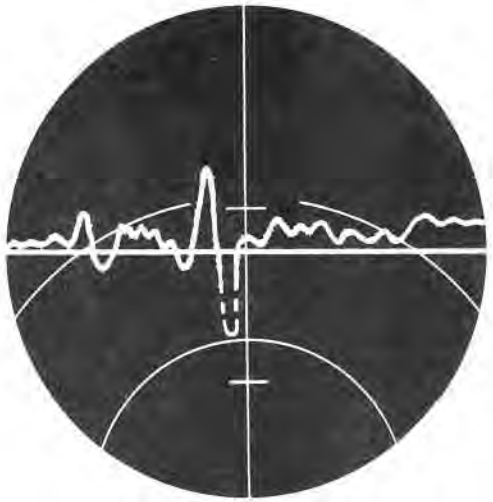
PLAN MODE OPERATION

Terrain video seen on the plan displays will differ due to the TP TX modification. On aircraft Less TP TX with absolute altitude above approximately 500 feet, the pilot will often observe a blooming vertex due to receipt of spurious returns from the nonlinear area of the antenna (area B, figure 4-44). The blooming increases directly with absolute altitude but the computational inaccuracy is most severe at short ranges. To fly TA satisfactorily, the pilot must recognize and ignore the spurious returns displayed inside the failure warning cursor. On TP TX aircraft, the electronic removal of these spurious returns yields a cleaner vertex and any return seen on the plan display, regardless of position, must be considered valid and necessary pitch corrections applied. This means that returns within the failure warning cursor (between the vertex and cursor) must not be ignored.

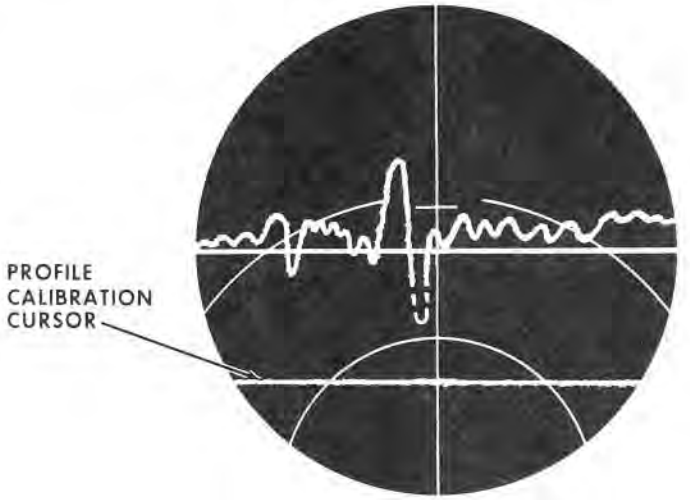
FLAT TERRAIN (terrain which does not vary more than 200 feet in elevation in 10 miles). Over flat terrain, many parts of the terrain display indicator may be flooded with video. The pilot should maintain the area between the vertex and the 3-mile range mark free of terrain returns within a corridor 1/8 inch each side of the ground track line. Slight pressures on the control column are usually sufficient to cause video to either appear or disappear.

ROLLING TERRAIN (terrain which does not vary more than 1000 feet in elevation in 10 miles). Over rolling terrain, a minimum of pitch maneuvering is required. When approaching an obstacle, the final maneuver is not performed until the obstacle is at the 3-mile range. The pitch attitude should be adjusted to maintain the obstacle display as a small dot, alternately appearing and disappearing until it enters the failure warning cursor. As a prominent obstacle presentation enters the area inside the failure warning cursor, the aircraft pitch attitude should be maintained until the obstacle is crossed. On TP TX aircraft, any video which appears inside the failure warning cursor should be treated as valid video and corrective action should be taken. A strong target displayed within the 3-mile range and within 1/8 inch left or right of ground track should never be permitted to remain longer than two consecutive scans. When flying over rolling terrain, it is good practice to check the long range area of the plan display frequently to ascertain the magnitude of approaching obstacles.

MOUNTAINOUS TERRAIN (terrain which varies more than 1000 feet in elevation in 10 miles). The display provides a ground map of terrain which is useful in determining the best flight course through the mountains. Azimuth maneuvering is recommended to avoid the highest obstacles. The size of radar shadow areas can be used to estimate the height of terrain obstacles. When approaching prominent terrain, the pitch change required to fade the obstacle enables early estimate of the climb performance necessary to clear the obstacle. When the obstacle within 1/8 inch of ground track appears inside the 3-mile range, it should be maintained as a small dot, alternately appearing and disappearing until it enters the failure warning cursor. As prominent obstacle presentation enters the area inside the failure warning cursor, the aircraft pitch attitude should be maintained until the obstacle is crossed. On TP TX aircraft, the object will usually disappear from the display as it enters the failure warning cursor but, if the aircraft is pitched downward, the object can be made to reappear within the minimum range area. In this situation, the -6° line performs the clearance plane function. If the usual plan technique of maintaining the obstacle display as a small dot is used, a 400- to 500-foot crossing will occur. The correct technique after the obstacle enters the minimum range cursor is to maintain pitch until peak passage occurs. On TP TX aircraft, any video which appears inside the failure warning cursor should be treated as valid video and corrective action should be taken. The plan display corridor 1/8 inch each side of the ground track line should be maintained free of returns within 3-mile range. On aircraft SQ, crossover can be determined by the radar altimeter (APN-150) when the aircraft has crossed over the highest terrain. On aircraft Less SQ (absolute altimeter not available), crossover can be estimated from the display or measured by timing. For example, a peak reaching the 3-mile range mark will have passed under the aircraft in 45 seconds when flying at 260 knots ground speed.



PROFILE 3, 6, OR 10



PROFILE CAL

.....typical profile display on the ground

Figure 4-46F.

PROFILE MODE OPERATION TP TX

WARNING

Profile mode is operationally usable only on TP TX aircraft.

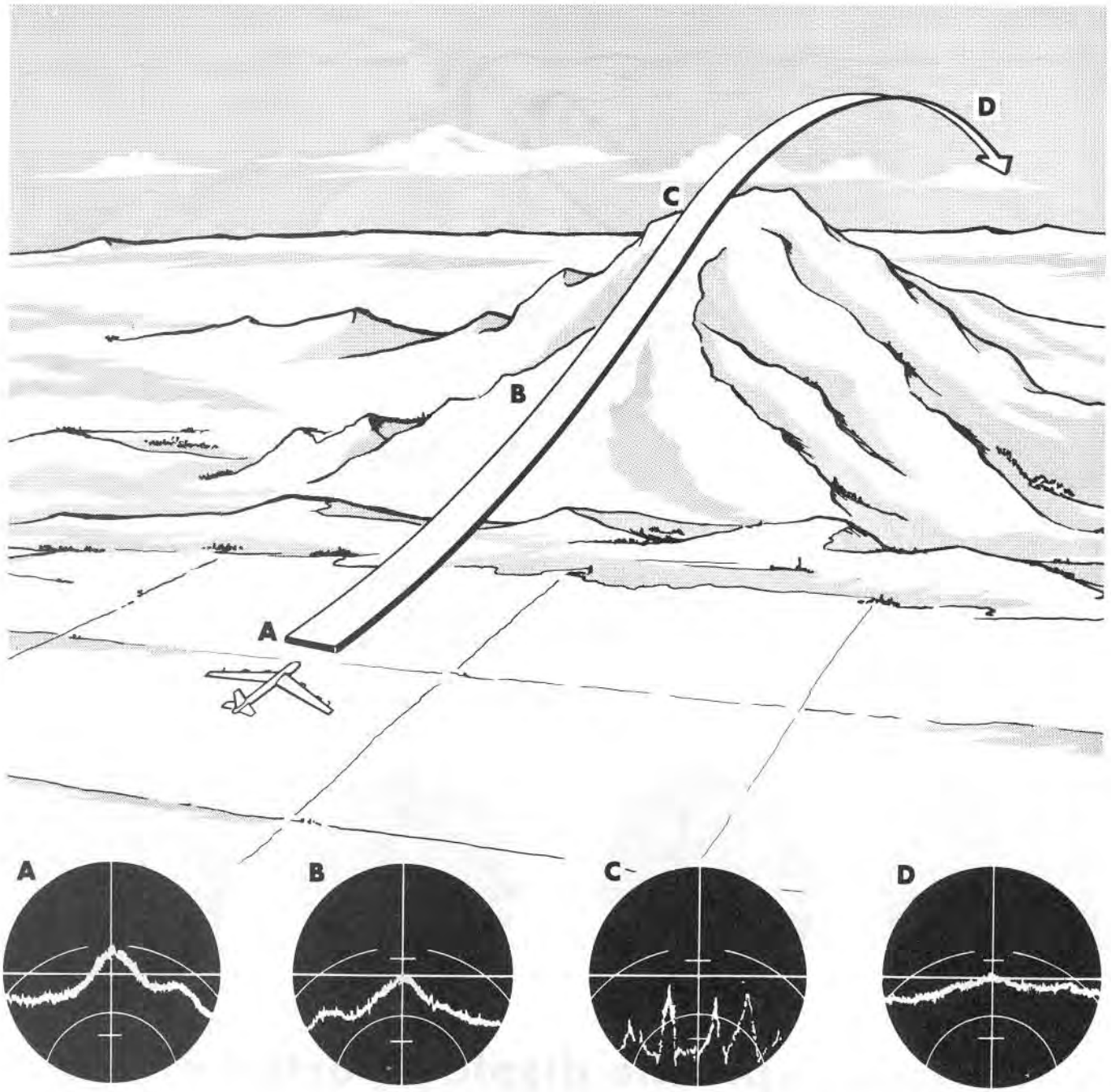
Three selectable range gates are provided for profile mode operation for different flight conditions and for pilot training. The longer range gates permit the pilot more time to adjust power and attitude during TA operations. Profile 3 mode is recommended for all normal conditions. When in extremely rough terrain at high gross weights and low airspeeds or partial power, the profile 6 mode may be more desirable. Flight operations in the profile mode are straight forward. If an obstacle is displayed above the horizontal reference line within 1/2 inch each side of ground track line, a climb is initiated. The climb attitude is then adjusted to maintain the terrain trace coincident with the horizontal reference line. This attitude is maintained until the obstacle is passed by utilizing the radar altimeter or dropout techniques. Profile mode is considered a command display using the rule "terrain up, fly up; terrain down, fly down." The technique is similar to that used in following ILS glide slope.

NOTE

Recheck TA system accuracy by switching momentarily to plan mode before proceeding from flat to mountainous terrain.

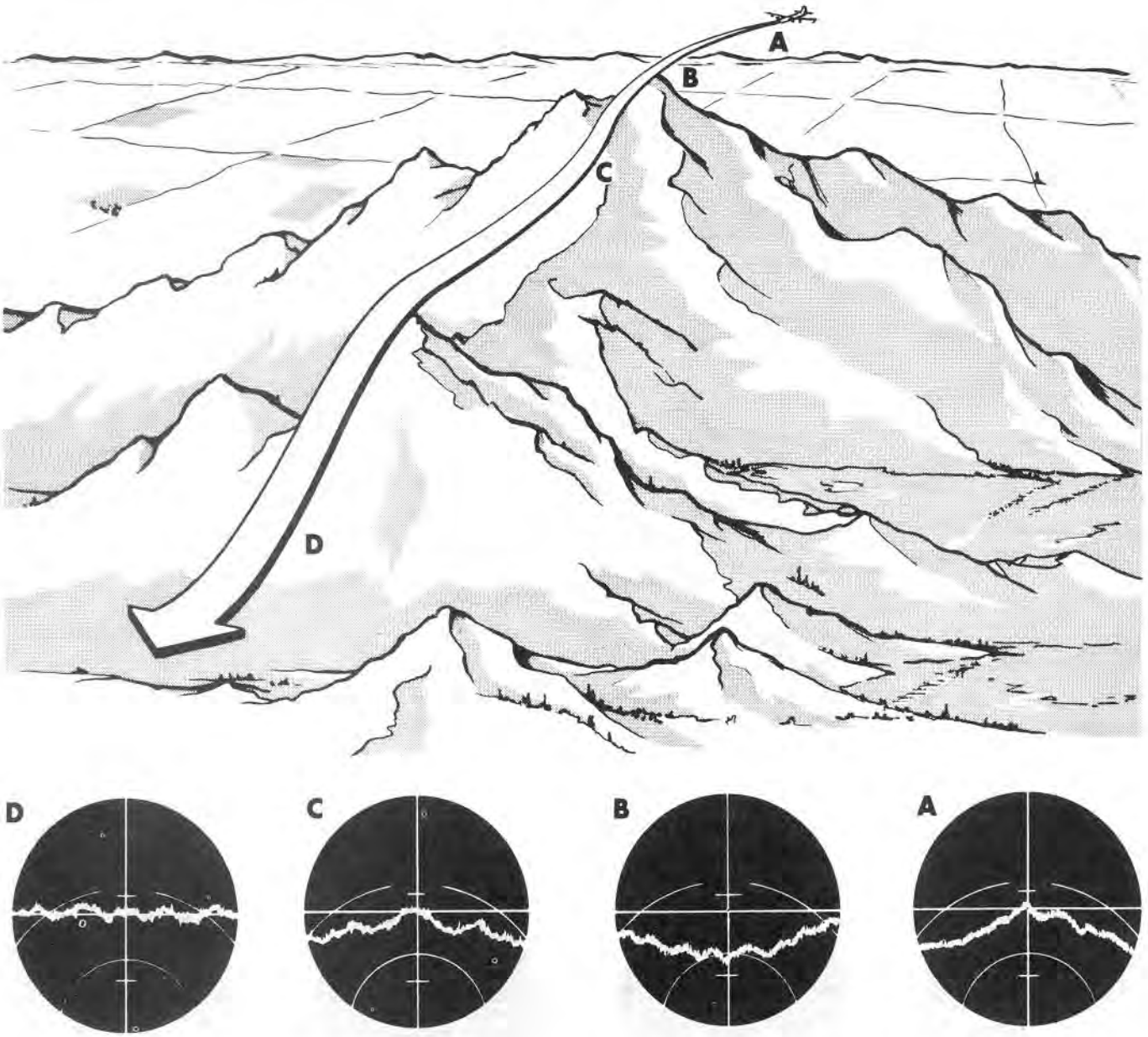
PREFLIGHT DISPLAYS. Two typical profile displays on the ground are shown in figure 4-46F. The terrain trace is noisy (ragged sawtooth shaped) and may be positioned above or below the horizontal reference line. The profile calibration cursor is shown aligned with the profile calibration etch mark. The profile calibration cursor should not exceed 1/8 inch in width and should coincide ±1/4 inch with the profile calibration etch mark. The profile calibration cursor may be ragged but not broken.

COMPLETE DROPOUT SEQUENCE. The TA system contains a short range blind zone. This is the area immediately adjacent to the aircraft extending in a horizontal arc of 3/4-mile radius across the nose. Obstacles within the short range blind zone are not displayed. This characteristic is very noticeable in profile mode as shown in the picture sequence of figure 4-46G. Note that the peak is displayed as solid video in displays A and B, drops down and becomes ragged and dotted (dropout) in display C, and returns to correct position after passing the peak in display D. If the pilot should fail to recognize this complete dropout, he would initiate descent in accordance with the display producing a low crossing. The proper technique is to note and maintain the aircraft pitch attitude until, about 10 seconds later, the peak passage is observed on the radar altimeter (the altitude indicator needle indicates a decrease in altitude, then stops and indicates an increase in altitude) and then resume following the profile terrain trace.



.....profile display complete dropout

Figure 4-46G.

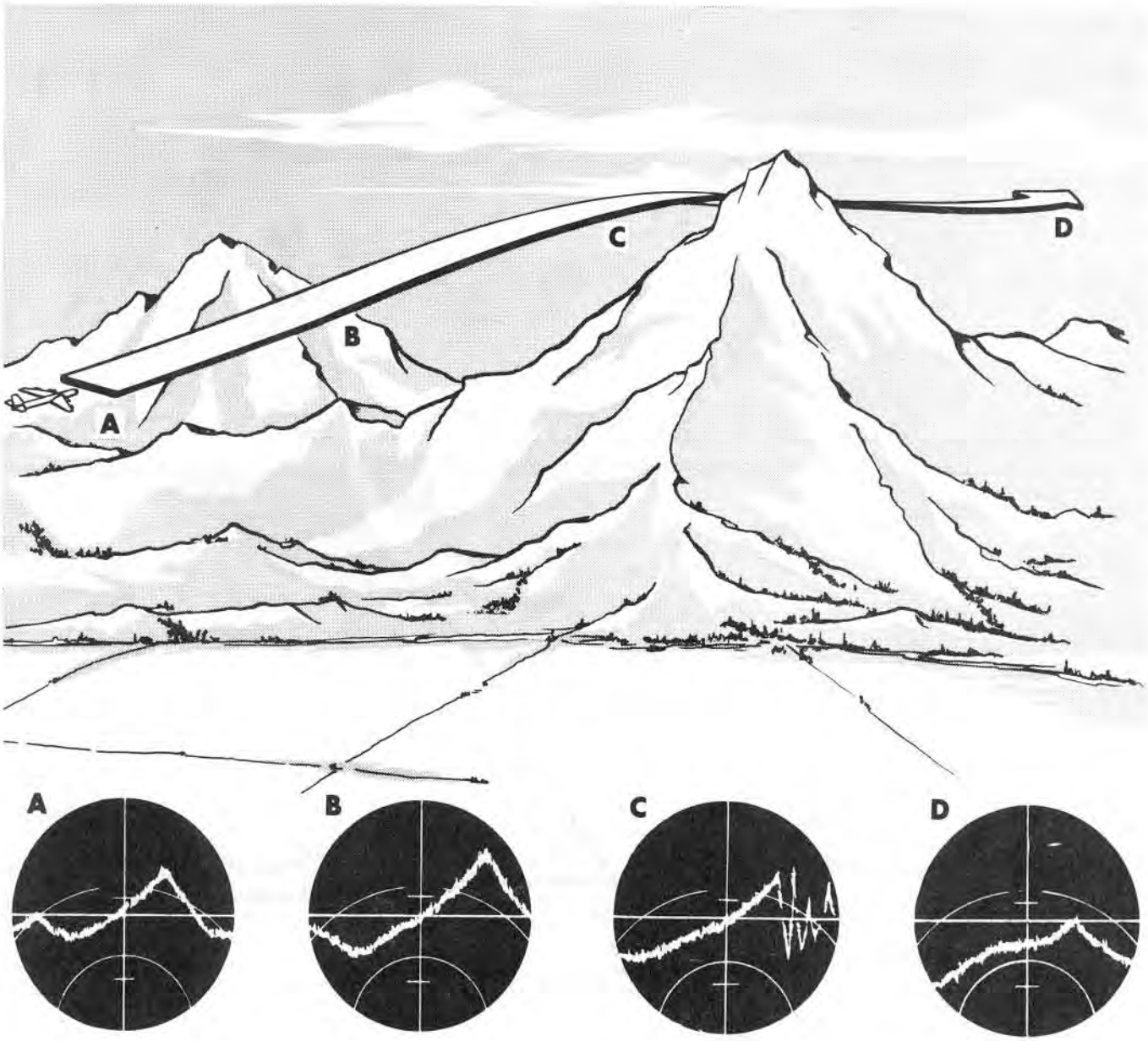


.....profile display partial dropout

Figure 4-46H.

PARTIAL DROPOUT SEQUENCE. Frequently a situation occurs in which the profile video drops an inch or so on the display without the ragged and dotted symptoms of a complete dropout. This characteristic is shown in figure 4-46H and indicates a minor ridge (mesa, peak behind peak, small peak, or ridge) is about to be crossed. The same peak crossing technique, as described under the complete dropout sequence, should be applied if the dropout is recognized, but if the pilot continues to follow the trace and uses gradual and gentle forward wheel pressure to ease into the descent, a satisfactory, although lower than planned, crossing will be observed in about 10 seconds.

SIDE DROPOUT SEQUENCE. The side dropout occurs as the aircraft passes across the shoulder of a ridge or



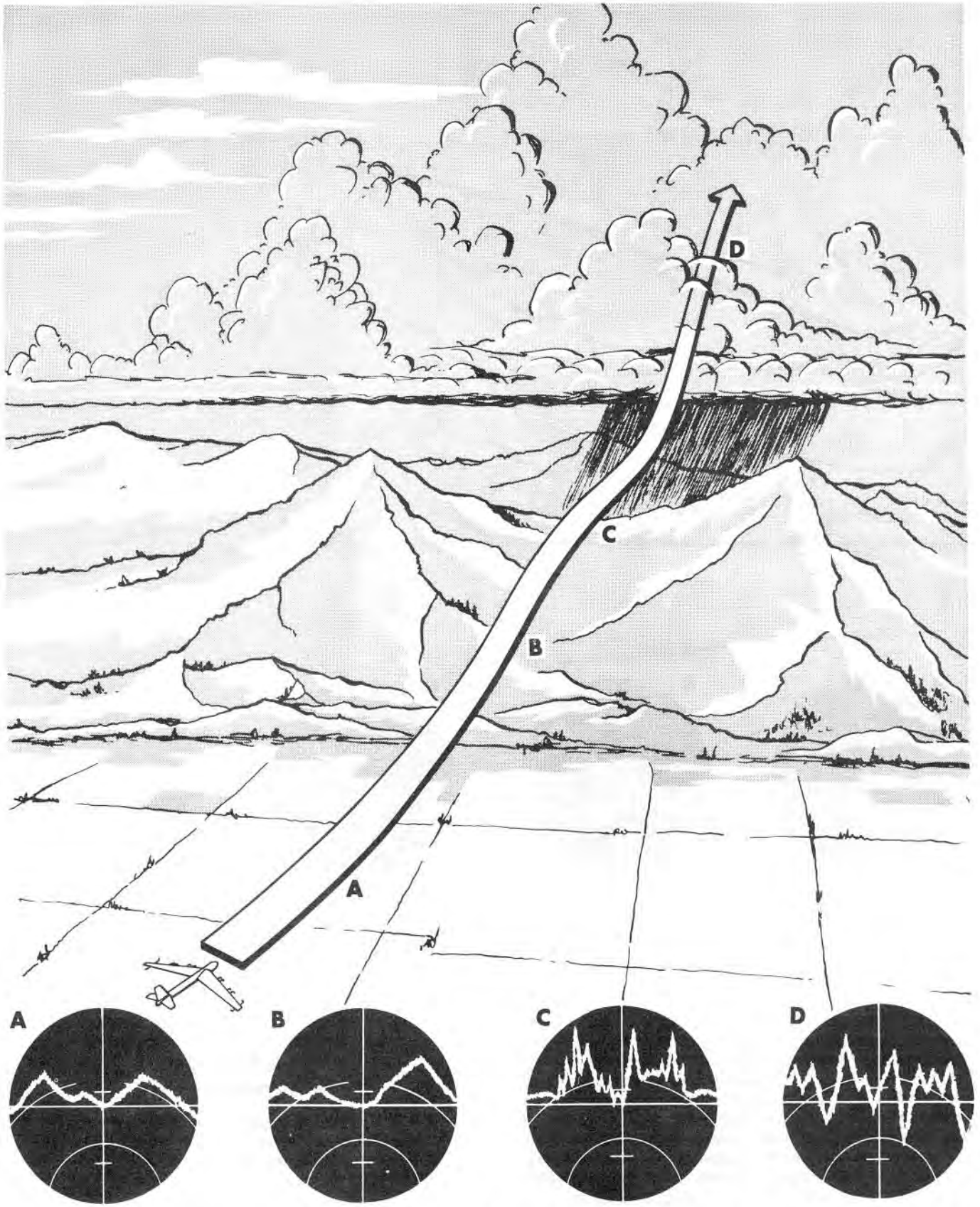
.....profile display side dropout

Figure 4-46J.

peak. This characteristic is shown in figure 4-46J. The dropout symptoms appear at the side because high terrain, right or left of ground track, is within the short range blind zone and the shadowing effect prevents reception of returns outside the blind zone. Therefore, the video on the peak side drops down or "out" until the aircraft passes beyond the obstacle. When the shadowing effect no longer blocks returns from other obstacles, the profile mode displays these obstacles as usual.

WARNING

Dropouts are important because they represent a circumstance in which the terrain display is inaccurate displaying obstacle height much lower than actual height.



.....profile display weather effects

Figure 4-46K.

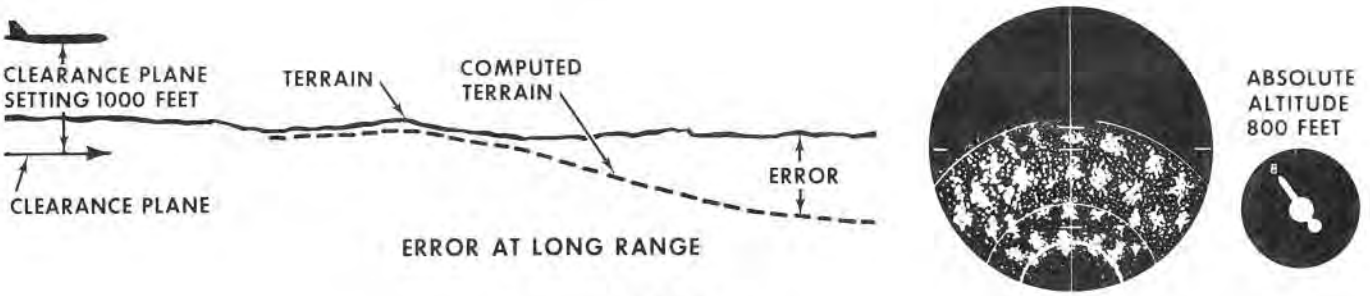
WEATHER EFFECTS SEQUENCE. The TA system may react unfavorably to certain types of clouds or rain in the flight path. This characteristic is shown in figure 4-46K. The profile terrain trace may provide some symptom indications if the trace becomes very ragged and gives a fly-up command. The only safe procedure is to climb to safe altitude and prepare for weather penetration. Weather effects not seen by the radar navigator have been observed to affect the pilots' terrain display.

System Errors

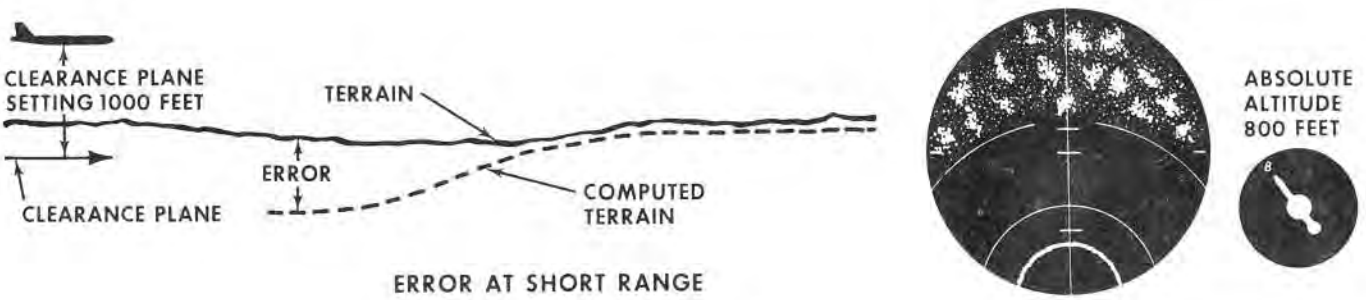
Errors in the TA system can result from several causes such as component aging or failure, poor ground alignment, temperature drift, etc. The resulting accuracy errors can be grouped into four basic types (plus combinations) as follows: Negative or positive error at minimum range (up to 1 1/2 miles); negative or positive error at range gate (the combinations would involve two basic types occurring simultaneously). Positive errors tend to force the aircraft higher because the terrain is computed higher than its actual position. Negative errors may allow the aircraft to descend below the desired altitude or they may prevent timely warning of approaching obstacles.

PLAN MODE ERROR DETECTION. Refer to figure 4-46L for plan mode error illustrations. When flying level over flat terrain with clearance plane set to absolute altitude if the plan mode display tends to appear blank toward the top of the indicator, a negative error at long range is present as shown in figure 4-46L detail A. If the situation is reversed (that is, the terrain display indicator tends to remain blank at short range (bottom of indicator)), a negative error at short range is present as shown in figure 4-46L detail B. If the terrain display indicator tends to display the terrain equally at all values of range but fails to display the terrain until the clearance plane setting is well below ground, the system contains a negative error at all ranges as shown in figure 4-46L detail C. The illustrated errors are based on operation in level flight over rolling terrain. Positive errors are detected in a similar manner. If the display remains filled with terrain returns when the clearance plane setting is less than absolute altitude, a positive error is present. If the returns are seen near the vertex, the error is at short range as shown in figure 4-46L detail D. If the returns are seen at the top of the display, the error is at long range as shown in figure 4-46L detail E. Similarly, if terrain returns are seen at all ranges with a clearance plane setting less than absolute altitude, a positive error at all ranges is present as shown in figure 4-46L detail F. As a rule of thumb, if the clearance plane setting corresponds to the absolute altitude, lack of terrain video indicates negative error; if the clearance plane setting is less than absolute altitude, presence of terrain video indicates positive error.

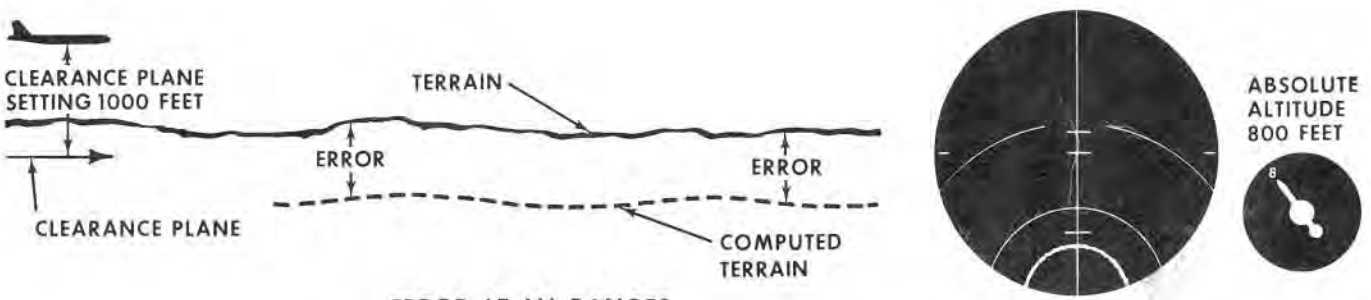
NEGATIVE ERRORS



DETAIL A



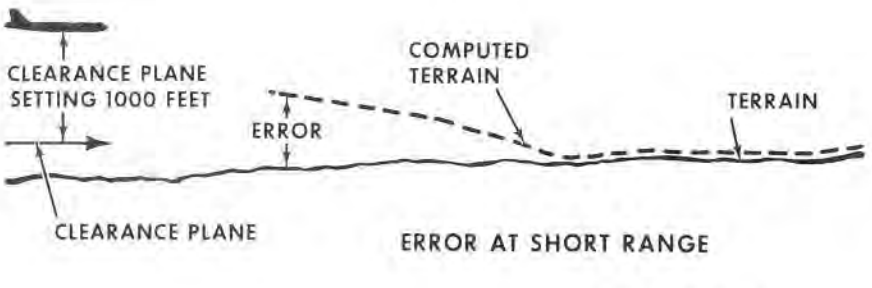
DETAIL B

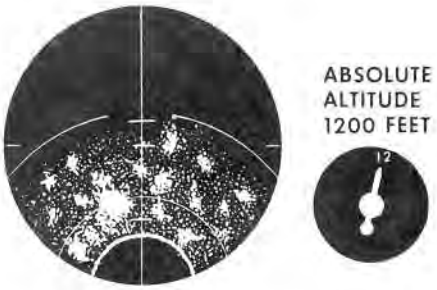


DETAIL C

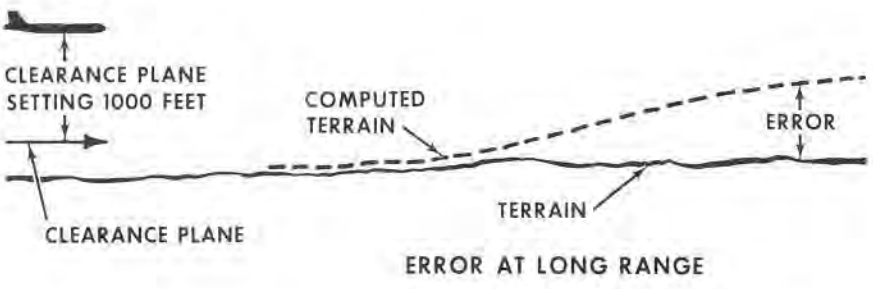
Figure 4-46L (Sheet 1 of 2).

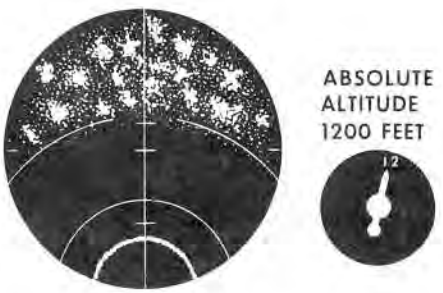
POSITIVE ERRORS



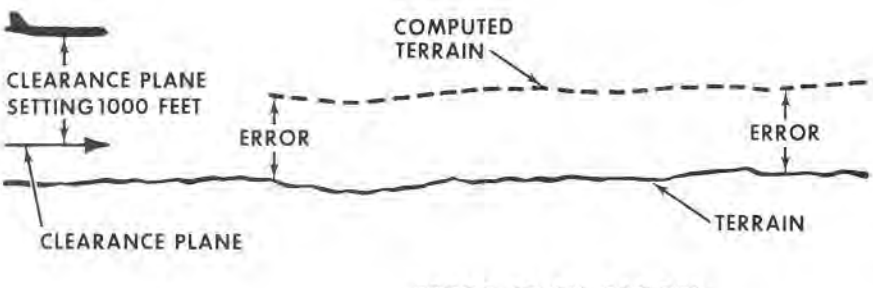


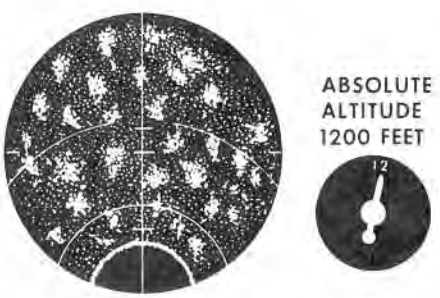
DETAIL D





DETAIL E

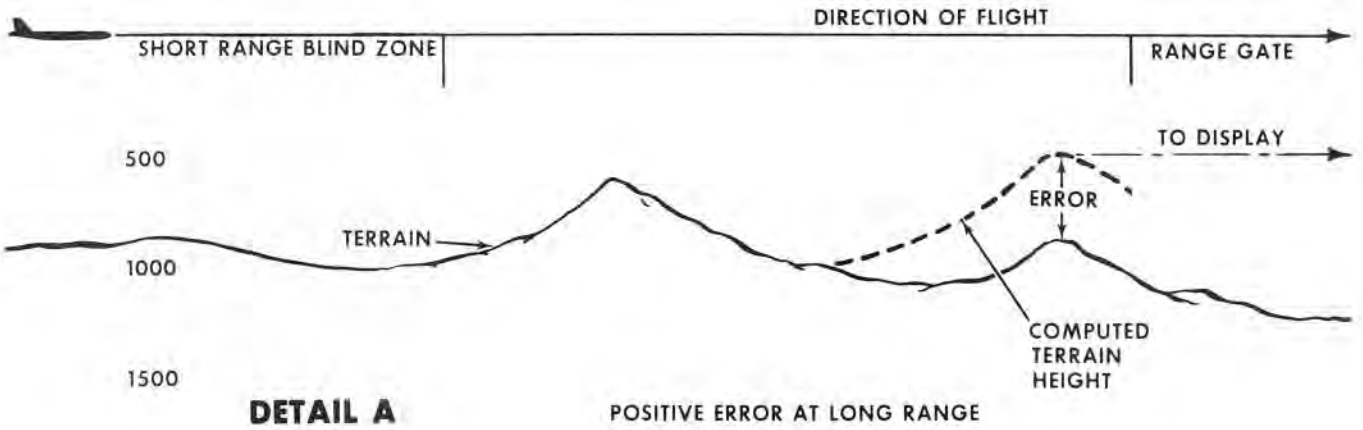




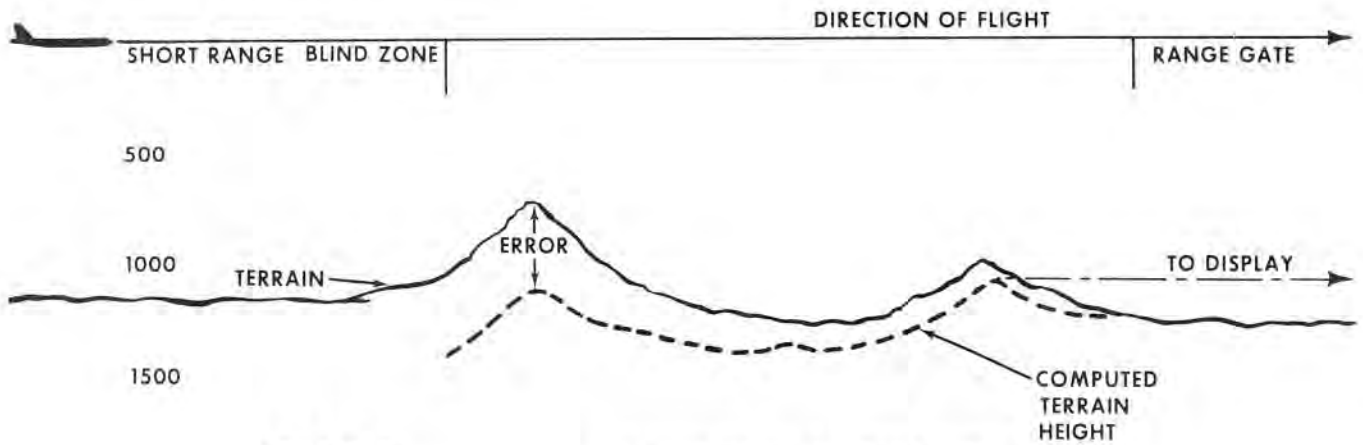
DETAIL F

plan mode errors

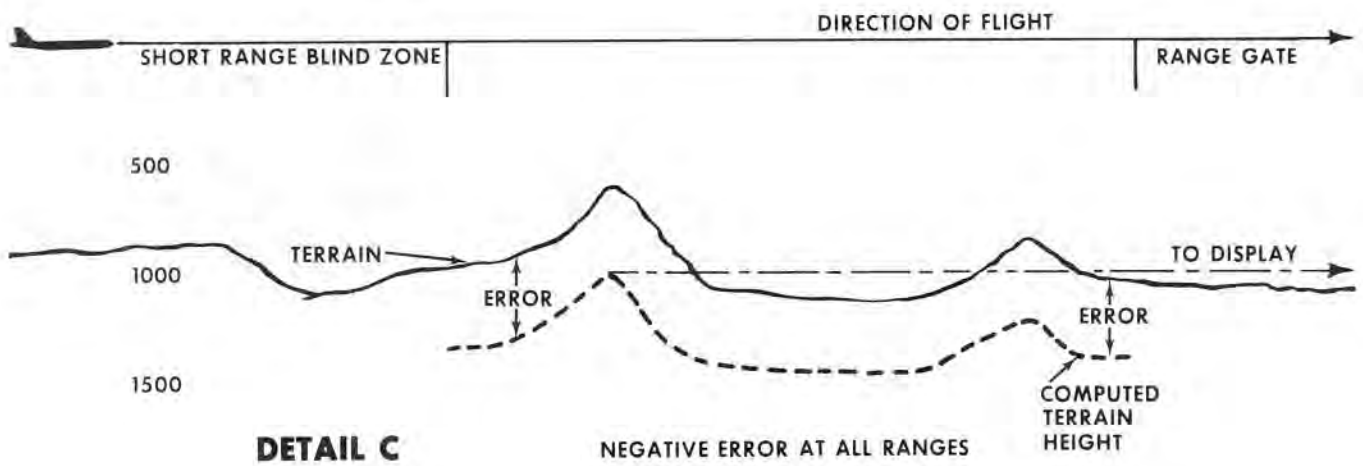
Figure 4-46L (Sheet 2 of 2).



DETAIL A POSITIVE ERROR AT LONG RANGE



DETAIL B NEGATIVE ERROR AT SHORT RANGE



DETAIL C NEGATIVE ERROR AT ALL RANGES

.....profile mode errors

Figure 4-46M.

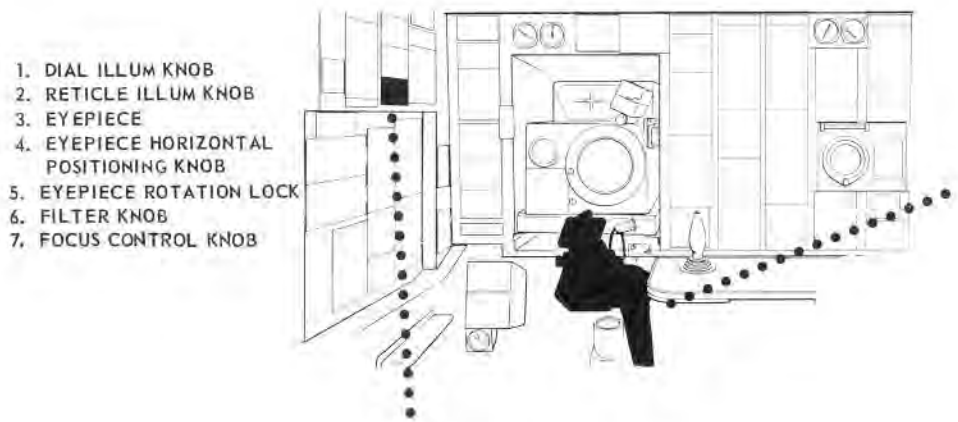


Figure 4-46.

the supply spool to the left. (Turn the takeup knobs (46, figure 4-44) slightly if necessary to engage the spindles in their drive shafts while inserting the film magazine.) Lock both magazine retainer clips.

NOTE

The following items will be accomplished with power on.

9. Turn the operation switch on the topocomp to S-S.
10. Adjust map light to desired intensity.
11. Turn right takeup knob counterclockwise to center a frame.
12. Engage the film drive claws (48, figure 4-44) by turning the film slide knob fully clockwise.

CAUTION

Extreme care must be exercised when engaging the drive claws. If they do not properly engage in the film advance holes, the film may be damaged. By centering a frame prior to engaging the film drive claws, damage to the film should not occur.

13. Turn the left takeup knob very slightly clockwise to increase film tension enough to insure that the film drive claws have seated properly and that the frame has not moved.
14. Pull out the interlock button by pulling down and out.
15. Check that the frame remained centered. If not, repeat steps "2" and "10" through "15."
16. Place the forward-reverse switch to FORWARD and depress the film advance button a series of times to check movement.
17. Place the switch to REVERSE and check movement. Return the switch to FORWARD.
18. Replace the projector cover door (4, figure 4-44) and lock it in place by turning the projector cover door handle all the way up. (Both the projector cover door and the coverplate must be securely fastened to prevent either from blowing off in the event of a decompression at altitude.) The coverplate should have all six screws in it.

5-Inch Indicator (Navigator's Radar Indicator)

A 5 inch navigator's BNS radar indicator (figure 4-44) is located on the navigator's front panel. The presentation on this indicator is the same as the radar presentation on the 10 inch screen of the topographical comparator. Screwdriver adjustment controls are provided to correct the circularity of the radar presentation. Control knobs are provided to adjust the radar presentation for vertical (vert) and horizontal (horiz) centering, focus (focus), the brilliance of the return in relation to scope background (video), intensity (intensity), azimuth and heading intensity (outside marker knob); range marks and range crosshair intensity (inside marker knob). A control is provided (ring lite) to

adjust the intensity of the azimuth scale and cursor line. A cursor knob is provided to rotate the cursor.

Display Panel (Ground Range and Azimuth)

A BNS radar ground range and azimuth display panel (figure 4-43) is located on the radar navigator's front panel. A ground range indicator displays the ground range of the position under the radar range crosshair. An azimuth indicator displays the relative bearing of the position under the radar azimuth crosshair.

Radar Test Panel

A BNS radar test panel (figure 4-43) is located on the radar navigator's side panel. A test meter selector switch, on this panel, is provided to check the amperage in certain circuits, in the BNS radar, by means of the test meter on this panel.

NOTE

QP

When the aircraft weapons control system monitoring set (AN/AJM-14(V)) is in operation and is monitoring radar parameters, it is not possible to test any of the circuits except the -300, +120, and + 300.

O-32 RADAR RECORDING CAMERA

An O-32 radar recording camera and O-32 camera control panel (Type M-2) (figure 4-45) are provided to record desired information from the radar scope in the topographical comparator. The camera is mounted on the topographical comparator. The camera control panel is mounted on the navigator's front panel.

The camera mounts a magazine underneath which is removed by means of the magazine locking lever. A film footage indicator is located on the back of the camera magazine. A camera "f" setting control is mounted on the topocomp (topographical comparator) immediately below the camera. A recording chamber in the camera contains a recording chamber data plate, recording chamber watch, exposure counter, and range lights. Access to the recording chamber is made by means of a recording chamber locking lever and cover on top of the camera.

The recording camera control panel has controls and indicators for an O-30 camera as well as the O-32 radar recording camera. The O-30 camera controls and indicators are inoperative. Power to operate the radar recording camera is supplied through the ON position of the O-32 camera power switch. An O-32 mode sel (selector) switch has operable T (thread) --OFF--R (radar) positions. When on T, film is run through the camera but no exposures made. When on R, exposures are made according to the setting of the scan selector switch or the IBDA power switch. A man opt switch is provided but should not be used with the KS-32A camera. If the switch is accidentally actuated during normal operation, it may result in jamming the M2 control. If jamming occurs, the camera power switch should be positioned to OFF momentarily and then repositioned ON. A rad pol (radar polarity) switch must be in the MINUS position. An exposure counter is provided which can be reset using the exposure counter reset knob. A red film out (camera operating) light illuminates each time the film advances. On aircraft Less KG, d-c power is supplied through the HSBR/RDPS excitation circuit breaker on the BNS circuit breaker panel. On aircraft KG, the O-32 camera has a separate circuit breaker marked "O-32 Cam Exc."

PERISCOPE

A periscope (figure 4-46) mounted at the radar navigator's station serves as an optical bombsight for the BNS. The crosshairs in the periscope are over the same position as the radar crosshairs and are positioned by means of the crosshair control and the computers. The periscope can be used to determine approximate ground speed and drift. Controls on the periscope are provided to focus the image and to adjust a polaroid-type filter. Indicators in the lower field of view display azimuth (AZ dial) and elevation (EL dial). The helmet-type eyepiece can be adjusted left to right horizontally by a lockable eyepiece horizontal positioning knob and adjusted forward and backward and rotated 180°, lockable by an eyepiece rotation lock. A foot pedal on the right side of the periscope is provided to open and close the periscope doors.

Sight (Periscope Illumination Control) Panel

A sight (periscope illumination control) panel (figure 4-46) located on the radar navigator's side panel provides controls to adjust the illumination of the periscope AZ dial and EL dial and the periscope crosshairs.

BOMBING SYSTEM

BOMB RELEASE METHODS

When bombs are carried, four methods of release are possible; normal, salvo/jettison, manual, and SWESS. The normal, salvo/jettison, and SWESS releases are electrically energized and the manual release is electromechanically actuated. The manual release system will not release conventional munitions. When one of the electrically energized means of release is used, safety switches in the bomb and cluster bomb release circuits prevent a bomb release until the bomb bay doors are fully open. The manual release system however will only unlatch the bomb bay doors before releasing a bomb. It is possible to release an aft bomb with the bomb bay doors closed and latched. When the ADM-20 launch gear is installed, only the forward area of the bomb bay is available for bombing functions.

TP TX

PROFILE MODE ERROR DETECTION. To understand the effect of these errors on the profile display, it is necessary to understand the profile mode peak detector function. If the TA system contains an error, this error will be reflected in the profile mode display in one of the following ways: If the error is positive, the terrain height displayed will reflect the error as shown in figure 4-46M detail A. The second peak is actually lower but is displayed higher than the peak at close range. A similar situation can be imagined for a positive error at minimum range. Over flat terrain, a positive error at any range will prevent the aircraft from descending and attaining the desired clearance altitude. Detail B of figure 4-46M shows a negative error at short range only. The comments below apply equally to a system with negative error at long range only. Either situation is undesirable because the action of the peak detector tends to conceal the error. The presence of negative error at either range cannot be detected as on the plan mode display when over flat terrain. In other words, the system can produce a level-off at the proper altitude and yet contain a negative error. Detail C of figure 4-46M shows the effect of a negative error at all values of ranges. This is obviously the most undesirable case because the terrain is computed low at all ranges and therefore is displayed low. The presence of this error is very easy to detect over flat terrain because the error causes a level-off which is lower than desired.

EMERGENCY OPERATION

It is conceivable that a situation may arise in which terrain following must be accomplished even though the TA system contains some error. It may be possible to continue TA operations if the crew understands TA system errors and uses emergency procedures. Either of the negative errors at short range described below, if of sufficient magnitude to be observed, will generally be accompanied by illumination of the TA warning lights on aircraft TP TX and disappearance of the plan mode failure warning cursor or profile mode horizontal reference line.

WARNING

Operations in the presence of a TA failure warning indication are hazardous without visual contact with the ground because of inaccurate TA displays and because no additional warning is given if a successive additional failure occurs. TA flight over mountainous terrain during IFR conditions in the presence of failure warning indication is prohibited.

System Error Compensation Procedures

WARNING

Profile offset trace operations should not be utilized unless plan mode is inoperative. Operating with the terrain trace below the horizontal reference line can result in close terrain clearance if the pilot inadvertently returns to operating with the terrain trace on the horizontal reference line.

NEGATIVE ERROR AT ALL RANGES. Use plan mode and increase the clearance plane setting by the amount of error observed. On TP TX aircraft, if plan mode is inoperative, select profile mode and maintain the terrain trace 1/8 inch below the horizontal reference line for each 100 feet of correction desired.

NEGATIVE ERROR AT SHORT RANGE ONLY. To compensate for this error over flat terrain, determine the range at which the video fades at the proper clearance altitude in plan mode. Maintain the scope free of all video inside the determined range. In profile over flat terrain, no compensation is required. If not over flat terrain, select plan mode, increase the clearance plane setting, and allow the terrain video to remain visible down to 1 1/2 to 2 miles range. This procedure will not remove more than about one-half the altitude penalty produced by the increased clearance plane setting. Peak crossings will be approximately correct. On TP TX aircraft, if plan mode is inoperative, select profile mode and maintain the trace offset 1/8 inch below the horizontal reference line for each 100 feet error observed if above rugged terrain.

NEGATIVE ERROR AT LONG RANGE ONLY. On TP TX aircraft, select profile mode and, if over flat terrain, no correction is required. On TP TX aircraft, when over rough terrain or in plan mode over any terrain, select the FRL mode and, if necessary, recheck the system accuracy; readjust FRL pot R08 on 6219500 terrain relay frame (located aft side of aft right BNS modules rack, lower deck) approximately 10° counterclockwise for each 100 feet of error measured at 3-mile range. Make an appropriate entry on the Form 781. When level over flat terrain in plan FRL mode, the pilot should observe an increase in the quantity of terrain returns at long range as the adjustment is made.

WARNING

Adjustment of the FRL pot R08 in the clockwise direction will result in a large negative error at long range accompanied by proportionately smaller errors at lesser ranges and will result in lower peak crossings and insufficient advance indication of approaching terrain obstacles.

POSITIVE ERROR AT SHORT RANGE ONLY. Use plan mode and decrease the clearance plane setting to remove approximately one-half the error (do not set the clearance plane to a value between 0 and -200 feet). If absolutely required, readjust the clearance plane setting further in small increments carefully judging the effect on ground clearance by radar altimeter indications or any available means. On TF TA aircraft, use the profile mode if plan mode is inoperative; the error must be accepted. When over rugged terrain, the pilot may safely initiate pushover after dropout prematurely if the error as noted on previous peak crossings has produced excessively high crossing clearance and large overshoot or ballooning immediately thereafter.

POSITIVE ERROR AT LONG RANGE ONLY. Select plan mode and allow the terrain video to remain visible down to 1 1/2 to 2 miles range, maintaining the area between the vertex and 1 1/2 to 2 miles free of ground returns.

POSITIVE ERROR AT ALL RANGES. Use plan mode and decrease the clearance plane setting to remove about one-half the error (do not set the clearance plane to a value between 0 and -200 feet). If absolutely required, readjust the clearance plane setting further in small increments carefully noting the effect on terrain clearance as indicated by radar altimeter or any available means.

Inflight Adjustments

The following inflight adjustment procedures may result in obtaining an operable TA system for certain terrain display indicator malfunctions.

TERRAIN DISPLAY INDICATOR ADJUSTMENTS.

1. Place terrain display selector switch to PLAN.
2. Turn plan video gain control fully counterclockwise.
3. Turn terrain indicator intensity switch to MAX.
4. Adjust write bias control counterclockwise until plan sweep traces just disappear.
5. Place terrain display selector switch to PROFILE 10 position.
6. If the horizontal reference line is visible, readjust write bias control counterclockwise until horizontal reference line just disappears.
7. Place terrain display selector switch to PLAN.
8. Turn plan video gain control fully clockwise.
9. Position the clearance plane control switch so that the failure warning cursor coincides with the 3-mile range mark.
10. Turn terrain indicator intensity control to the next to the highest intensity setting.
11. Adjust persistence controls (pilot's and copilot's) so that the failure warning cursor is completely faded at the ground track line just prior to new information being painted at the ground track line.

NOTE

The persistence controls are contained in the terrain display control panel. The larger outer shaft controls the pilot's display; the smaller inner shaft the copilot's.

12. Turn plan video gain control fully counterclockwise.
13. Slowly increase video gain by adjusting the plan video gain control clockwise. Note that when a saturation point is reached, further clockwise adjustment of the control will not increase brightness of the failure warning cursor but will degrade resolution.
14. Turn plan video gain control to the saturation point of the failure warning cursor as observed in step "13."
15. Readjust persistence as necessary per step "11" and repeat steps "13" and "14."

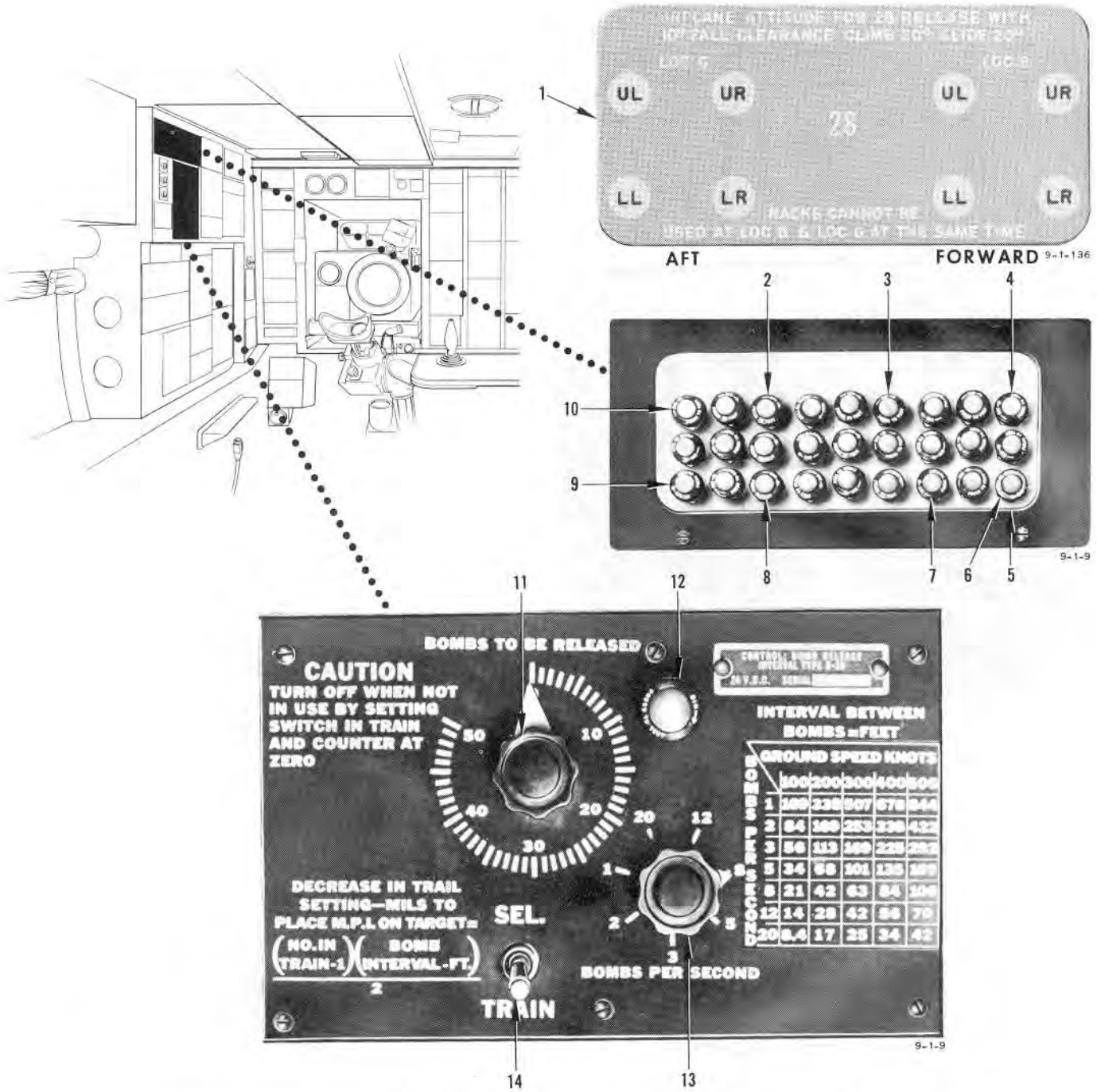
TERRAIN AVOIDANCE SYSTEM CHECKLIST

The TA system checklist is integrated in the pilot's and copilot's amplified checklist, Section II.

BOMBING SYSTEM

BOMB RELEASE METHODS

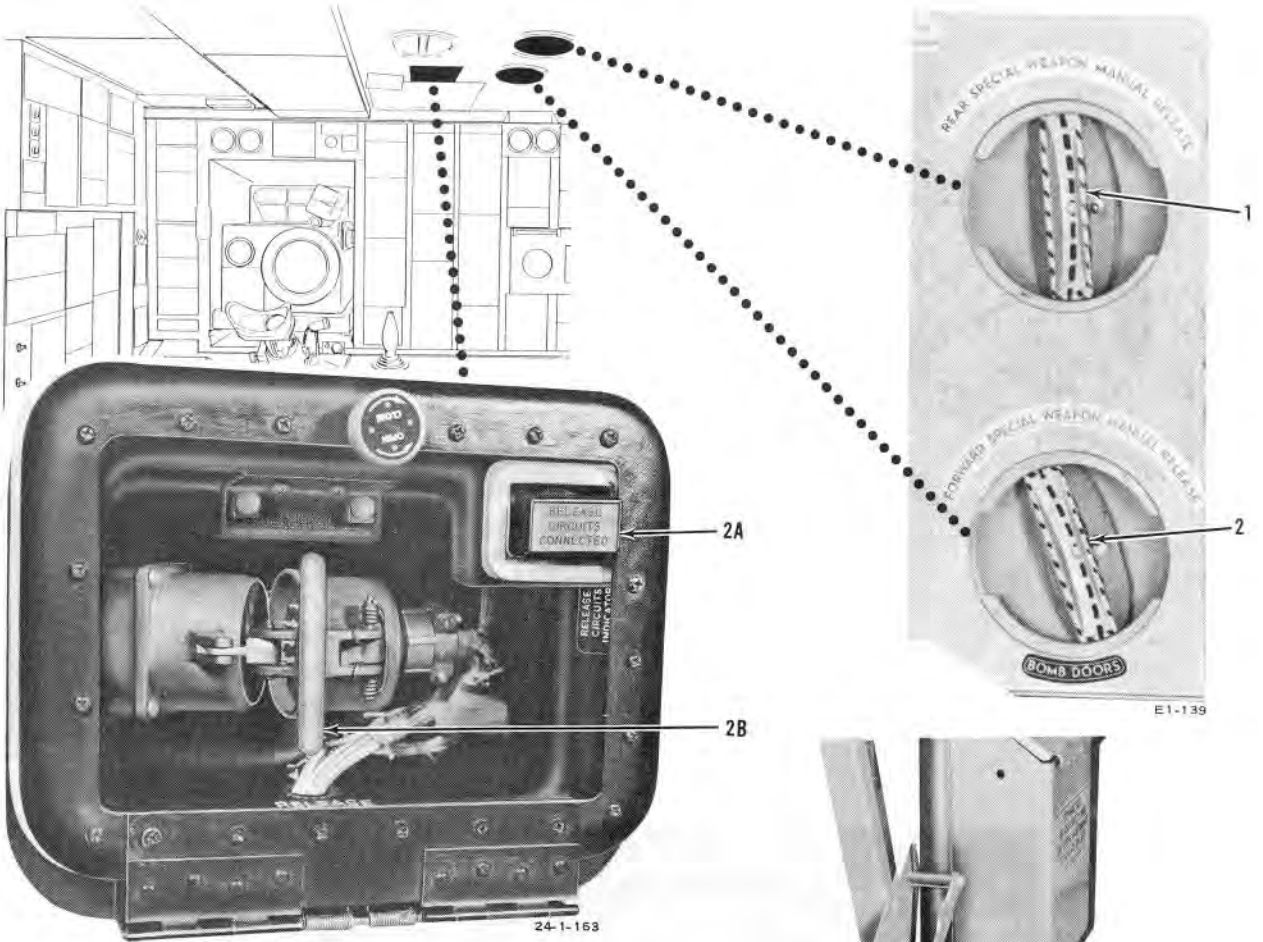
When bombs are carried, four methods of release are possible; normal, jettison, manual, and SWESS. The normal, jettison, and SWESS releases are electrically energized and the manual release is electromechanically actuated. The manual release system will not release conventional munitions. When one of the electrically energized means of release is used, safety switches in the bomb and cluster bomb release circuits prevent a bomb release until the bomb bay doors are fully open. The manual release system however will only unlatch the bomb bay doors before releasing a bomb. It is possible to release an aft bomb with the bomb bay doors closed and latched. When the ADM-20 launch gear is installed, only the forward area of the bomb bay is available for bombing functions.



1. MULTIPLE CARRIAGE INDICATOR CARD (TYPICAL)
2. LIGHT NO. 19 (AFT-UR-MULTIPLE CARRIAGE)
3. LIGHT NO. 24 (FWD-UL-MULTIPLE CARRIAGE)
4. LIGHT NO. 21 (FWD-UR-MULTIPLE CARRIAGE)
5. BOMB INDICATOR LIGHTS
6. LIGHT NO. 3 (FWD-LR-MULTIPLE CARRIAGE)
7. LIGHT NO. 6 (FWD-LL-MULTIPLE CARRIAGE)
8. LIGHT NO. 1 (AFT-LR-MULTIPLE CARRIAGE)
9. LIGHT NO. 4 (AFT-LL-MULTIPLE CARRIAGE)
10. LIGHT NO. 22 (AFT-UL-MULTIPLE CARRIAGE)
11. BRIC COUNTER
12. BRIC INDICATOR LIGHT
13. BOMB RELEASE INTERVAL CONTROL
14. BRIC SWITCH

internal BRIC (bomb release interval control unit) (typical)

Figure 4-47.



1. REAR SPECIAL WEAPON MANUAL RELEASE HANDLE
2. FORWARD SPECIAL WEAPON MANUAL RELEASE HANDLE
2A. RELEASE CIRCUITS CONNECTED LIGHT
2B. RELEASE CIRCUITS DISCONNECT
3. SPECIAL WEAPONS MANUAL LOCK HANDLE STOWAGE BRACKET
4. SPECIAL WEAPONS MANUAL LOCK HANDLE

special weapons manual controls (typical)

Figure 4-47A.

BOMB AND SPECIAL WEAPONS RACKS

Nuclear bombs are carried in the clip-in suspension system. The release mechanisms are electrically energized. Conventional munitions are carried in the bomb bay in cluster bomb racks equipped with A-5 releases.

UM

Conventional munitions are also carried externally on two multiple ejector racks suspended in tandem beneath each AGM-28 pylon. External munitions may be released separately or simultaneously with the conventional munitions carried on the cluster bomb racks in the bomb bay. The release mechanisms in the multiple ejector racks are electrically energized. Refer to T. O. 1B-52B-34-2-1 for detailed information on external munitions release.

BOMBING SYSTEM CONTROLS

Internal BRIC (Bomb Release Interval Control Unit)

An internal BRIC (bomb release interval control unit) (figure 4-47) located on the radar navigator's side panel can supply the release pulses for cluster bombs, bombs, and external missiles. A BRIC switch allows selection of single bomb release pulse (SEL) or a train of release pulses (TRAIN). When the BRIC switch is set to TRAIN the number of bombs to be dropped is controlled by the BRIC counter and the interval is controlled by the bomb release interval control. An amber BRIC indicator light illuminates when the BRIC is set to release either a single bomb (or cluster bomb) or a train of bombs. The bomb release pulse from the salvo circuits bypasses the bomb release interval control unit. The bomb release interval control unit is supplied TR power through the "Normal Release" circuit breaker on the "Bomb System" portion of the radar navigator's circuit breaker panel.

NOTE

UF

Three cluster bombs will be released simultaneously for each release pulse when the bomb release mode selector switch is positioned to RAPID.

Bomb Release Mode Selector Switch UF

A bomb release mode selector switch located on the bomb release mode control panel (figure 4-47B) has NORMAL--RAPID positions and is guarded to NORMAL. NORMAL position provides normal bomb release operations. The switch must be positioned in NORMAL to provide for release of nuclear bombs. RAPID position provides for simultaneous release of three cluster bombs for each bomb release pulse.

Master Bomb Control Switch

A master bomb control switch (10, figure 4-48) located on the door and bomb control panel at the radar navigator's station has ON--OFF positions. An open type guard discourages inadvertent actuation of this switch. When positioned to ON, TR power from the bomb indicator lights switch is supplied through a circuit breaker marked "Normal Release" on the "Bomb System" portion of the radar navigator's circuit breaker panel to the power on indicator light and the bomb release cir-

.....bomb release mode control panel UF

Figure 4-47B.

cuits. Switched battery power is supplied through a circuit breaker marked "Bomb Door Control Relays" on the "Miscellaneous" portion of the pilot's circuit breaker panel to turn on hydraulic packs 1, 2, and 4 and to the radar navigator's bomb door switch through the bombing system switch.

CAUTION

To prevent overheating and possible failure of the hydraulic packs, do not fly with the master bomb control switch in ON position for periods that exceed 30 minutes out of each hour. Therefore, the switch should be turned ON no longer than 10 minutes prior to bomb release and then turned OFF immediately after bomb release and door closure is completed.

Bomb Indicator Lights Switch

A bomb indicator lights switch (6, figure 4-48) located on the door and bomb control panel has ON--OFF positions. When in the ON position, TR power is supplied through a circuit breaker marked "Normal Release" on the "Bomb System" portion of the radar navigator's circuit breaker panel to the bomb release circuit and the power on indicator light through the master bomb control switch. Power is also supplied to the rack locked indicators, weapon released lights, missile released lights, parachute static line retain lights, release circuits connected light, and bomb indicator light panel circuits. If this switch is OFF, the bombs and external missiles (AGM-28) can be released by the salvo/jettison switches or the manual system. The bombs can also be released by SWESS.

External BRIC (Bomb Release Interval Control Unit) UM

An external BRIC (bomb release interval control unit) (figure 4-47C) located on the radar navigator's side panel can supply the release pulses for conventional munitions carried on the externally mounted multiple ejector racks. A BRIC switch allows selection of a single release pulse (SEL) or a train of release pulses (TRAIN). When the BRIC switch is set to TRAIN, the number of release pulses is controlled by the BRIC counter and the interval is controlled by the bomb release interval control. Each release pulse transmitted from the BRIC to the multiple ejector racks releases one conventional munition from each rack. The BRIC is turned on by setting the BRIC switch to either SEL or TRAIN and the bombs to be released control (BRIC counter) to a single pulse or a train of pulses. An amber BRIC indicator light illuminates when the BRIC is turned on. The bomb release pulse from the jettison circuits bypasses the BRIC. The BRIC is supplied TR power through the "External Rel" circuit breaker on the "Bomb System" portion of the radar navigator's circuit breaker panel.

External Bomb Rack Control Panel UM

An external bomb rack control panel (figure 4-47C) located on the radar navigator's side panel provides controls for arming and releasing conventional munitions from externally mounted multiple ejector racks. The panel contains an arming switch, a release power switch, a racks loaded lights switch, and four racks loaded indicator lights.

UM

ARMING SWITCH. An arming switch (1, figure 4-47C) located on the external bomb rack control panel has ARMED--SAFE positions. The two-position toggle switch is guarded to SAFE position. When the arming switch is placed in ARMED position, TR power is supplied through a circuit breaker marked "External Arm" on the "Bomb System" portion of the radar navigator's circuit breaker panel to arm the conventional munitions. A jettison interlock relay in the jettison circuits insures that the conventional munitions are released SAFE any time the jettison circuits are energized, regardless of the position of the arming switch.

UM

RELEASE POWER SWITCH. A release power switch (4, figure 4-47C) located on the external bomb rack control panel has ON--OFF positions. When positioned to ON, the switch transmits a signal from the BNS or the D-2 bomb release switch to the external BRIC.

UM

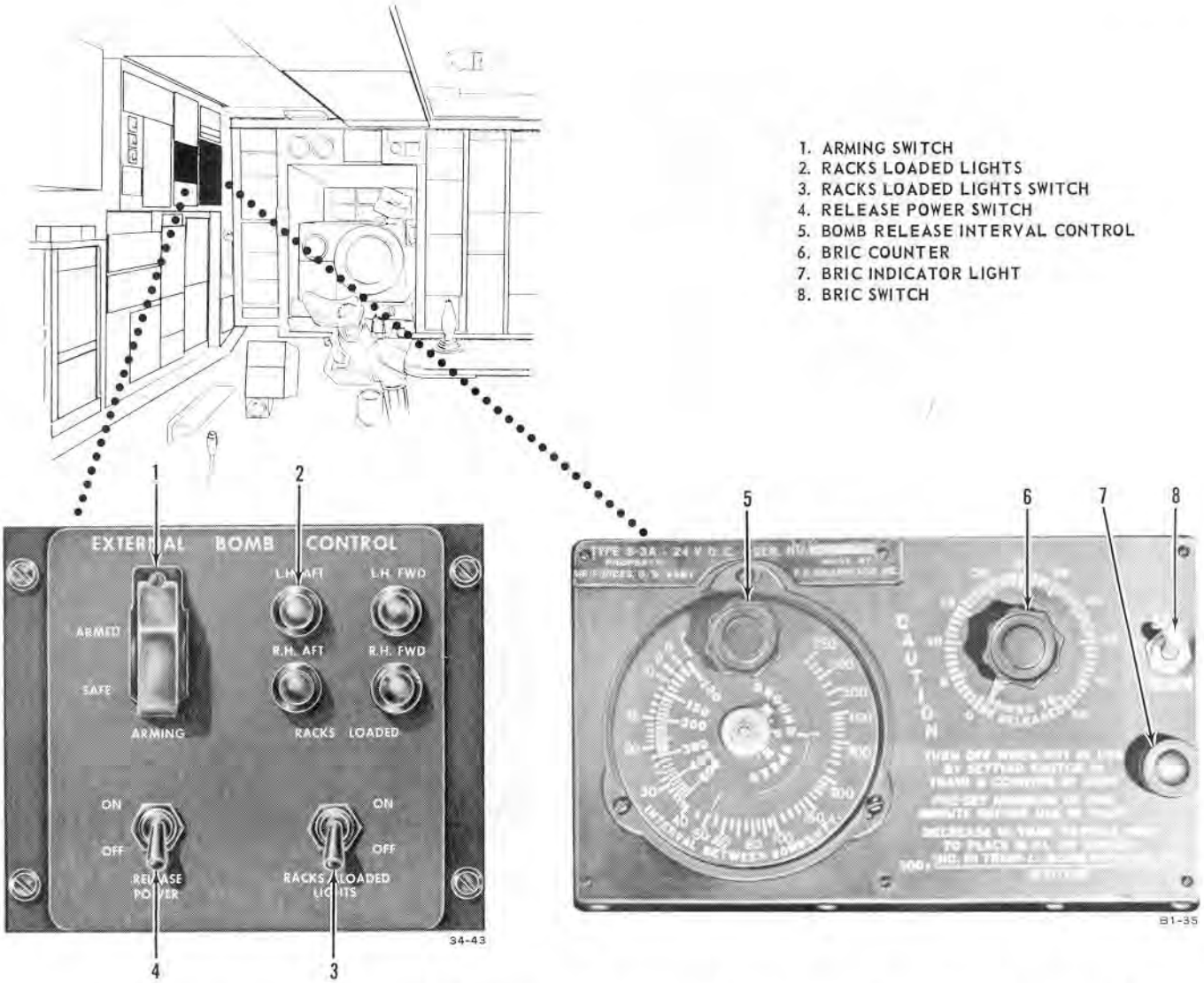
RACKS LOADED LIGHTS SWITCH. A racks loaded lights switch (3, figure 4-47C) located on the external bomb rack control panel has ON--OFF positions. When positioned to ON, the switch controls release power from the external BRIC to the multiple ejector racks and provides power to the four racks loaded lights.

Bomb Salvo/Jettison Switches

Bomb salvo or jettison switches are located on the door and bomb control panel at the radar navigator's station (9, figure 4-48) and on the pilot's overhead panel. The pilots' salvo/jettison switch and the radar navigator's salvo/jettison switch are button type with unmarked RELEASE--OFF positions, the depressed position being the RELEASE position. The salvo/jettison switches are spring-loaded to the OFF position and recessed within the panel to discourage inadvertent actuation. Momentary actuation of either or both switches to the RELEASE position will energize the salvo/jettison circuits by means of direct battery power. Direct battery power is provided through two circuit breakers marked "Salvo Cont" and "Salvo Power" on aircraft Less KR and "Jettison Cont" and "Jettison Power" on aircraft KR located on the radar navigator's circuit breaker panel. When the salvo/jettison circuits are energized, the bomb door open circuits will be energized; if the hydraulic pack switches are ON, hydraulic packs 1, 2, and 4 will be energized; the camera intervalometer will be initiated and will take pictures if the camera master switch is ON and the camera intervalometer is set; and the bomb bay stores will be released.

NOTE

On aircraft PR, the release circuits disconnect located on the radar navigator's overhead panel interrupts the jettison control circuits when disconnected. Therefore, it must be connected to salvo/jettison bombs.



.....external bomb rack control panels UM

Figure 4-47C.

The bomb doors will be held open while the salvo/jettison circuits are energized. See "Bomb Door Emergency Operation with the Salvo/Jettison Switches," this section.

UM

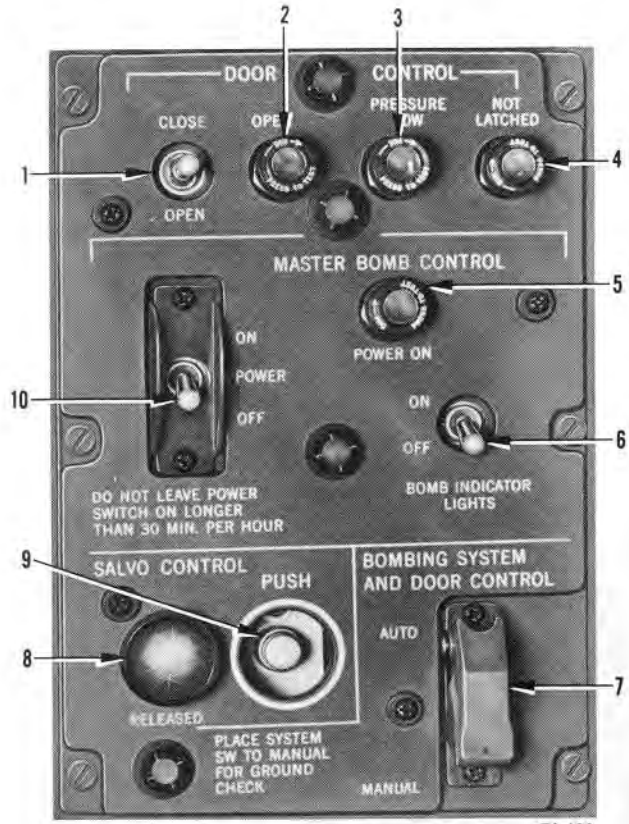
The bomb bay jettison circuits are extended to provide for jettisoning the conventional munitions carried on the externally mounted multiple ejector racks when the bomb bay stores are jettisoned. A jettison interlock relay prevents munitions being released from the multiple ejector racks in the armed configuration regardless of the position of the arming switch on the external bomb rack control panel any time the jettison circuits are energized.

D-2 Bomb Release Switch

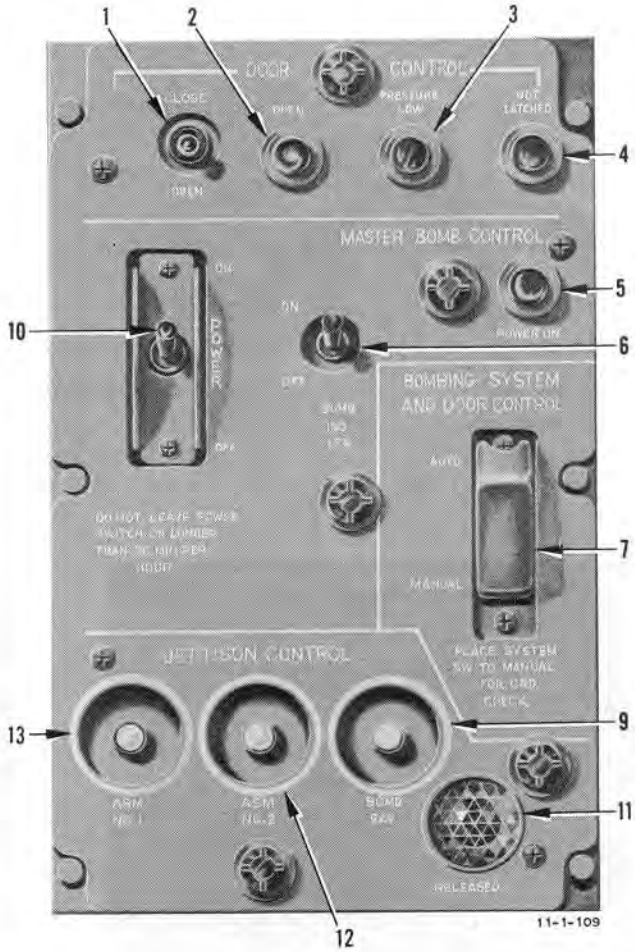
A D-2 bomb release switch (43, figure 4-38 and 43, figure 4-38A) stowed on the radar navigator's side panel is a button-type switch with unmarked RELEASE --OFF positions, spring-loaded to OFF position. The depressed position is RELEASE position. Actuating the switch to RELEASE position will initiate the intervalometer (internal) by means of TR power supplied through a circuit breaker marked "Normal Release" on the "Bomb System" portion of the radar navigator's circuit breaker panel which in turn supplies the preselected number of release pulses.

UM

On these aircraft, the D-2 bomb release switch will also initiate the external bomb release interval control (BRIC) when the release power switch on the external bomb rack control panel (figure 4-47C) is positioned ON. TR power is supplied through a circuit breaker marked "Normal Release" on the "Bomb System" portion of the radar navigator's circuit breaker panel.



Less KR

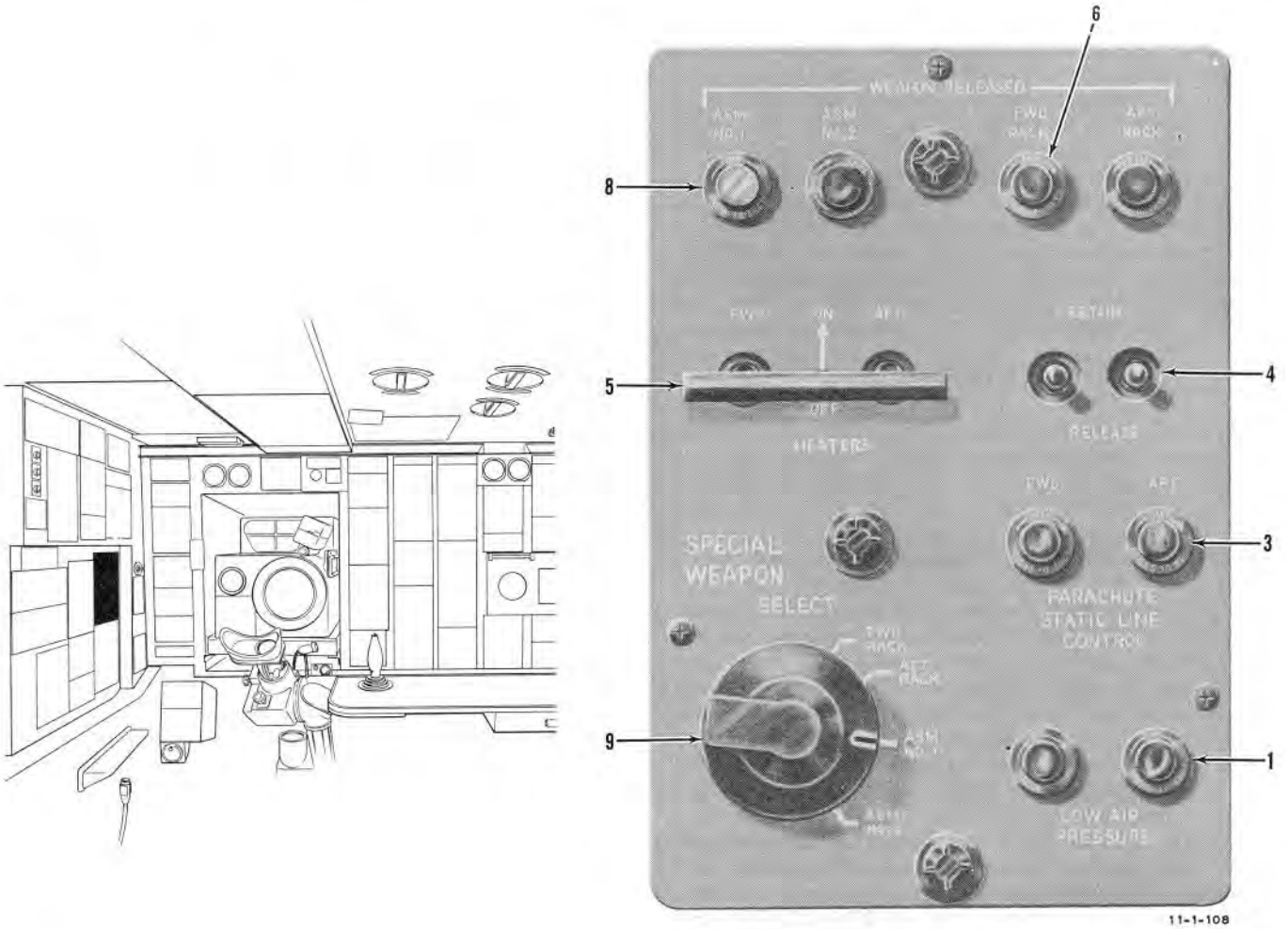


KR

1. BOMB DOOR SWITCH
2. BOMB DOORS OPEN LIGHT
3. BOMB DOOR PRESSURE LOW LIGHT
4. BOMB DOORS NOT LATCHED LIGHT
5. POWER ON INDICATOR LIGHT
6. BOMB INDICATOR LIGHTS SWITCH
7. BOMBING SYSTEM SWITCH
8. BOMB SALVO LIGHT
9. BOMB SALVO SWITCH
10. MASTER BOMB CONTROL SWITCH
11. JETTISON CONTROL RELEASED LIGHT
12. ASM NO. 2 JETTISON CONTROL SWITCH
13. ASM NO. 1 JETTISON CONTROL SWITCH

.....door and bomb control panel

Figure 4-48.



1. LOW AIR PRESSURE LIGHTS (NOT USED)
2. (DELETED)
3. PARACHUTE STATIC LINE RETAIN LIGHTS
4. PARACHUTE STATIC LINE CONTROL SWITCHES
5. HEATER SWITCHES (NOT USED)
6. WEAPON RELEASED INDICATOR LIGHTS
7. DELETED
8. MISSILE RELEASED INDICATOR LIGHTS
9. SPECIAL WEAPONS SELECT SWITCH

special weapon control panel

Figure 4-49.

Special Weapons Select Switch

A special weapons select switch (9, figure 4-49) located on the special weapons control panel on the radar navigator's side panel has FWD RACK--AFT RACK--ASM NO. 1--ASM NO. 2 positions. When positioned to FWD RACK or AFT RACK, a bomb can be dropped from the respective bomb bay rack. When positioned to ASM NO. 1 or ASM NO. 2, a missile may be released from the respective external mount by means of the BNS or D-2 bomb release switch. TR power is supplied through a circuit breaker marked "Alt Weapon Rack Select" located on the radar navigator's circuit breaker panel.

NOTE

The bomb doors cannot be opened with the BNS (bombing system switch in AUTO) when the special weapons select switch is positioned to ASM NO. 1 or ASM NO. 2.

AN-1A Bomb Group Rack Selectors

An AN-1A bomb group rack selector is provided in each bomb bay. In the multiple carriage configuration, the release signal applies power to the AN-1A bomb group rack selector. The first pulse from the bomb group rack selector will energize the right MB-3A release solenoid. When the bomb is released, the right release solenoid will deenergize and set up the bomb group rack selector to send power to the left MB-3A release solenoid when pulsed by a second release signal. With the bomb bay doors remaining open until all bombs are released, the bomb group rack selector will alternate release pulses between the right and left side. The release sequence would then be LR, LL, UR, and UL. When the bomb doors are closed or the master bomb control switch is turned OFF and then ON after each release, power is removed from the bomb group rack selector causing it to restart the release sequence. The release sequence is then LR, UR, LL, and UL. Three seconds after a pulse from the BRIC, a door close signal is generated to close the bomb bay doors.

Bomb Release Pulse Indicator System 5A

Provisions are on the aircraft for installation of a bomb release pulse indicator system. This system is used only as a training device and provides a means of indicating a bomb release when bombs are not loaded on the aircraft. The system consists of A-5 release units installed in the bomb bay and connected to the bomb release circuits (automatic, D-2, salvo/jettison, special weapon manual release handles, and SWESS). When a release circuit is energized, a release pulse is sent to the applicable A-5 release unit. This release pulse actuates the A-5 release unit which in turn energizes the applicable weapon-released indicator light (single carriage configuration) or bomb indicator light (multiple carriage configuration). Power for the system is provided through a microswitch which is actuated by the special weapons manual lock handle bellcrank. This necessitates the special weapons manual lock handle being in the unlock position for the system to be operational.

NOTE

The bomb release pulse indicator system will not be installed on aircraft carrying internal or external stores.

Parachute Static Line Control Switches

Two special weapon parachute static line control switches (4, figure 4-49) are located on the special weapons control panel at the radar navigator's station. Each switch has RETAIN--NORMAL--RELEASE positions and is spring-loaded to the unmarked NORMAL position. When actuated to the RETAIN position, TR power is supplied to actuate the corresponding parachute static line retain mechanism so it will retain the parachute static

line, causing the parachute to open when the bomb falls from the aircraft. When actuated to the RELEASE position, the pin securing the static line is withdrawn and the static line is allowed to fall with the bomb allowing a free fall bomb. When operating the switch from NORMAL to RELEASE or RETAIN, it must be held in the RELEASE or RETAIN position for a minimum of 15 seconds to allow the static line retain pin to be inserted or withdrawn. These switches can be effectively repositioned at any time prior to bomb release. The parachute static line control mechanism will remain in the last selected position until the corresponding switch is actuated to the opposite position. An illuminated parachute static line retain light indicates the corresponding mechanism will retain the parachute static line. TR power is supplied through circuit breakers marked "Alt Weapon Para Static Line Fwd Cont" and "Alt Weapon Para Static Line Aft Cont" on the "Bomb System" portion of the radar navigator's circuit breaker panel.

Forward and Rear Special Weapon Manual Release Handles

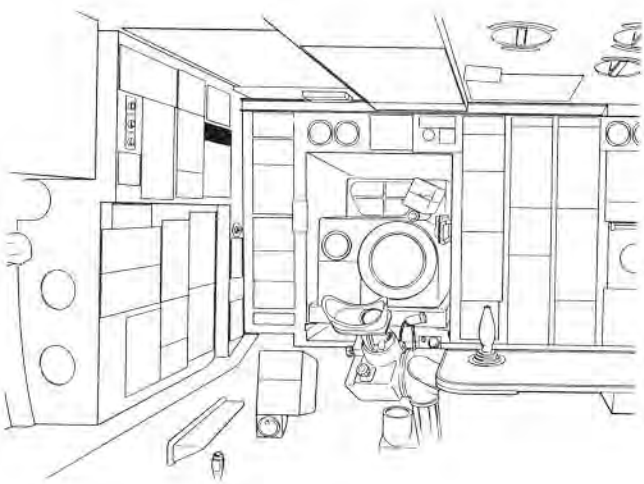
An emergency electro-mechanical method of releasing bombs is provided through operation of the forward special weapon manual release handle (2, figure 4-47A) and the rear special weapon manual release handle (1, figure 4-47A) located above the navigator's station. The forward special weapon manual release handle is part of the forward special weapon manual release system which consists of the handle, an interlock with the manual lock system, a coordinating unit, cable linkage to the bomb bay door latches, a release quadrant, and a rotary electrical switch in the forward bomb bay. The rear special weapon manual release handle is part of the aft special weapon manual release system which consists of the handle, a release quadrant, and a rotary electrical switch in the aft bomb bay. Power to the rotary switch on the release quadrant is supplied by the SWESS battery through the "Emergency Release Fwd" and "Emergency Release Aft" circuit breakers on the SWESS equipment panel (if the airplane has SWESS provisions) or by direct airplane battery power through the salvo power circuit breaker on the radar navigator's circuit breaker panel (on airplanes not equipped with SWESS). When the rotary switch is closed, power is applied to the release mechanism(s). The special weapons manual lock handle must first be pulled and stowed to disengage the interlock before the forward special weapon manual release handle can be pulled.

SINGLE CARRIAGE. For single carriage application, pulling the forward release handle approximately 9 inches will unlatch the bomb bay doors through the coordinating unit. Pulling the handle to its limit (approximately 18 inches) will close the rotary switch on the forward release quadrant, allowing SWESS battery power or airplane battery power to fire the forward release unit explosive cartridge (figure 4-50A). Pulling the rear release handle approximately 6 inches will close the rotary switch on the aft release quadrant allowing SWESS battery power or airplane battery power to fire the aft release unit explosive cartridge (figure 4-50A). There is no connection between the aft manual release system and the bomb bay doors so that an aft bomb would be dropped on closed and latched doors if they were not first unlatched by other means. If an emergency situation requires release of the aft bomb first and the doors cannot be opened by other means, the forward handle must be pulled approximately 9 inches to unlatch the bomb bay doors prior to pulling the rear handle.

MULTIPLE CARRIAGE. With the multiple carriage unit installed in the forward bomb bay, the forward special weapon manual release handle will release the right bombs and the rear special weapon manual release handle will release the left bombs. Pulling the forward handle approximately 9 inches will unlatch the bomb doors through the coordinating unit. Pulling the handle to its limit (approximately 18 inches) will close the rotary switch, allowing SWESS battery power or airplane battery power to energize the lower right MB-3A release solenoid. When the handle is permitted to return to the stowed position, the release solenoid will deenergize, causing the transfer switch to close. When the transfer switch closes, the lower right bomb released light on the bomb indicator lights panel will illuminate and the upper MB-3A release solenoid will be connected to the release system. Do not hold the handle down as this may cause the lower right release solenoid to fail. Failure of the lower right release solenoid will cause it to deenergize, transfering power to the upper right MB-3A release solenoid, releasing the upper right bomb. Pulling the forward release handle a second time will energize the upper right MB-3A release solenoid, releasing the upper right bomb. Pulling the rear manual release handle approximately 6 inches will release the left bombs in the same manner as described for the right bombs. If the unit is installed in the aft bomb bay, the operation of the manual release handles is reversed, the forward handle releasing the left bombs and the rear handle releasing the right bombs. If an emergency situation requires manual unlatching of the bomb doors, the forward handle must be pulled approximately 9 inches to unlatch the doors before pulling the rear handle regardless of the multiple carriage unit location.

CAUTION

Do not hold either handle in bomb release position as this could damage the bomb rack release solenoid and cause a second bomb to be released.



special weapons lock and indicator panel

Figure 4-49A.

NOTE

- If the BNS is in BOMB, the bombing system switch must be in MANUAL position before releasing a bomb with the special weapon manual release handles. This is to prevent the BNS bomb door close signal from holding the bomb doors closed and a bomb being dropped on closed bomb doors.

- When a bomb is released from the multiple carriage rack with either handle, the applicable bomb release light will not illuminate until the handle is released.

WARNING

Before manually releasing a bomb with the rear special weapon manual release handle, the bomb doors must be opened, or at least unlatched, so the bomb will not damage the airplane.

Release Circuits Disconnect PR

A release circuits disconnect (2B, figure 4-47A) is installed on the navigator's overhead panel and permits connection and disconnection of the bomb and AGM-28 release circuits. The normal bomb release (D-2 and BNS), bomb jettison release, SWESS release, and the AGM-28 missile release power (jettison, launch, and gravity releases) circuits are all routed through the release circuits disconnect. In addition, the BNS bomb door open circuit and the release circuits connected light circuit are also routed through the release circuits disconnect. When the release circuits disconnect is disconnected, the release circuits connected light (2A, figure 4-47A) will be off, the BNS bomb door open circuits will be disabled, and all means of releasing bombs or AGM-28 missiles will be disabled, except bombs may be released with the forward and rear special weapons manual release handles. When the release circuits disconnect is connected, the release circuits connected light will be illuminated, the BNS bomb door open circuits will function normally, and all bomb and AGM-28 release systems will provide normal operation.

Special Weapons Manual Lock Handle

A special weapons manual lock handle is located on the EW officer's floor (4, figure 4-47A). Pulling the han-

dle until the swaged ball on the cable appears (about 1 1/2 feet) will unlock the special weapons racks and AGM-28 separation systems. The racks may be held in the unlocked position by inserting the swaged ball in the slotted detent. The handle should then be stowed on the special weapons manual lock handle stowage bracket (3, figure 4-47A). To lock the racks again, remove the swaged ball from the detent slot and allow the cable to retract all the way.

NOTE

- The bombs cannot be released by any method until the racks are unlocked by means of the special weapons manual lock handle.
- If bomb release has been attempted with the racks locked, unlock the racks by means of the special weapons manual lock handle and initiate release again.
- A mechanical lockout prohibits simultaneous actuation of the forward special weapon manual release handle and the special weapons manual lock handle.

BOMBING SYSTEM INDICATORS

Power On Indicator Light

A green power on indicator light (5, figure 4-48) is located on the door and bomb control panel at the radar navigator's station. When illuminated, this light indicates that the master bomb control switch and the bomb indicator lights switch are both ON. The light is supplied TR power through a circuit breaker marked "Ind Lights" on the "Bomb System" portion of the radar navigator's circuit breaker panel.

Bomb Indicator Lights (Cluster Bombs)

Amber bomb indicator lights (1, figure 4-47) on the radar navigator's side panel are used with the cluster bomb release system. These lights will illuminate if the bomb indicator lights switch is ON and the bomb at the corresponding station is armed. Each illuminated light will go out when the bomb at the corresponding station is released or the bomb indicator lights switch is positioned to OFF. The lights are supplied TR power through a circuit breaker marked "Ind Lights" on the "Bomb System" portion of the radar navigator's circuit breaker panel.

Bomb Indicator Lights (Multiple Carriage)

The bomb indicator lights panel (figure 4-47) is above the BRIC on the radar navigator's side panel. These amber bomb indicator lights, in multiple carriage bomb application, illuminate to show which bomb has been released. An indicator card (1, figure 4-47) showing bomb configuration is placed over the panel. The indicator lights used in multiple bomb application are (forward bomb bay) No. 3 (LR), 6 (LL), 21 (UR), and 24 (UL) and (aft bomb bay) No. 1 (LR), 4 (LL), 19 (UR), and 22 (UL). When bombs are carried in the multiple carriage racks, the applicable indicator light will be off when the corresponding MB-3A rack is latched. The lights are supplied TR power through a circuit breaker marked "Ind Lights" on the "Bomb System" portion of the radar navigator's circuit breaker panel.

NOTE

When a bomb is released from a multiple carriage rack (MB-3A) with a special weapon manual release handle, the applicable bomb release light will not illuminate until the handle is released and returned to the stowed position.

Racks Loaded Lights UM

Four amber racks loaded lights (2, figure 4-47C) located on the external bomb rack control panel will illuminate if the racks loaded lights switch is ON and a munition is loaded on the corresponding multiple ejector rack. Each illuminated light will go out when all the munitions on the corresponding multiple ejector rack are released or the racks loaded lights switch is positioned OFF. The lights are supplied TR power through a circuit breaker marked "Ind Lights" on the "Bomb System" portion of the radar navigator's circuit breaker panel.

Pilot's Bombs Released Light

An amber bombs released light (5, figure 1-13 and 43, figure 1-13A) is located on the pilots' instrument panel. The light will flash once for each bomb release pulse by the bomb intervalometer. The light is supplied TR power through the bomb intervalometer from a circuit breaker marked "Ind Lights" on the "Bomb System" portion of the radar navigator's circuit breaker panel.

Weapon Released Lights

Amber forward and aft weapon release lights (6, figure 4-49) on the special weapons control panel at the radar navigator's station illuminate when a bomb is released from the corresponding single carriage rack. Each light is supplied TR power through the bomb indicator light switch and a weapon release indicator switch located on the corresponding bomb rack. Light power is provided through a circuit breaker marked "Ind Lights" on the "Bomb System" portion of the radar navigator's circuit breaker panel.

Rack Locked and Rack Unlocked Indicators

Rack locked and rack unlocked indicators (figure 4-49A) are located on the special weapons lock and indicator panel at the radar navigator's side panel. Each indicator has three indicating positions; lock, unlock, and slanting stripe markings. Each indicator will register LOCK when the corresponding rack is locked and UNLOCK when the corresponding rack is unlocked. The indicators will register slanting stripe markings when deenergized. Each indicator is supplied TR power through the bomb indicator lights switch and a bomb release mechanism locked indicator switch located on the corresponding bomb rack. Light power is provided through a circuit breaker marked "Ind Lights" on the "Bomb System" portion of the radar navigator's circuit breaker panel.

Parachute Static Line Retain Lights

Amber forward and aft parachute static line retain lights (3, figure 4-49) are located on the special weapons control panel at the radar navigator's station. When illuminated, the lights indicate the corresponding special weapon parachute static line will be retained when the bomb is released. These lights are not used with multiple carriage racks. Each light is supplied TR power through the bomb indicator lights switch and a position indicator switch on the corresponding parachute static line control mechanism. Light power is provided through a circuit breaker marked "Ind Lights" on the "Bomb System" portion of the radar navigator's circuit breaker panel.

Bomb Salvo Lights Less KR

Red bomb salvo lights are located on the pilots' instrument panel (43, figure 1-13) and on the door and bomb control panel (8, figure 4-48) at the radar navigator's station. When illuminated, the lights indicate the salvo circuits are energized. The lights are supplied direct battery power through circuit breakers marked "Jettison Cont" and "Jettison Power" on the "Bomb System" portion of the radar navigator's circuit breaker panel.

Store Jettisoned Lights KR

Red store jettisoned lights are located on the pilots' instrument panel (33, figure 1-13A) and on the door and bomb control panel (11, figure 4-48) at the radar navigator's station. The light on the pilots' instrument panel is marked "Store Jettisoned" and the light on the door and bomb control panel is marked "Released." Both lights illuminate while a jettison circuit is energized. The jettison circuits are bomb bay (which includes external bomb racks UM), No. 1 external missile, and No. 2 external missile. The lights are supplied direct battery power through two circuit breakers marked "Jettison Cont" and "Jettison Power" on the "Bomb System" portion of the radar navigator's circuit breaker panel.

PR

Release Circuits Connected Light

An amber release circuits connected light (2A, figure 4-47A) is located adjacent to the release circuits disconnect. The light has a press-to-test circuit for testing the lamp. When illuminated, the light indicates the release circuits disconnect is connected. The light is supplied TR power through the bomb indicator lights switch and the release circuits disconnect. Light power is provided through a circuit breaker marked "Ind Lights" on the "Bomb System" portion of the radar navigator's circuit breaker panel.

SPECIAL WEAPONS EMERGENCY SEPARATION SYSTEM (SWESS)

The special weapons emergency separation system provides for an automatic release of bomb(s). It is actuated by baroswitches and is provided with its own power supply to open the bomb bay doors and release the bomb(s) in the event airplane power is lost. The special weapons emergency separation system consists of two SWESS control panels, a SWESS equipment panel, a baroswitch assembly, a stepping switch, a manual safeing handle, and a SWESS battery. The SWESS battery is a nickel-cadmium battery located in the left forward portion of the bomb bay. If airplane power is lost and the SWESS is armed, the battery will supply emergency power for SWESS operation. The SWESS battery also supplies power for operation of the forward and rear emergency bomb release systems through the "Forward and Aft Emergency Release" circuit breakers on the SWESS equipment panel. Airplane power is supplied to the SWESS through circuit breakers marked "SWESS" and "SWESS Batt Htr" on the radar navigator's circuit breaker panel.

SWESS Controls

SWESS ARM-SAFE SWITCHES. A SWESS arm-safe switch (3, figure 4-50) is provided on the pilot's and radar navigator's SWESS control panels. Each switch is a two-position guarded toggle switch with ARM--SAFE positions. ARM position of the radar navigator's switch provides power to the pilot's arm-safe switch and press-to-test power to the armed lights. Placing the pilot's arm-safe switch to ARM, provided the radar navigator's arm-safe switch is positioned to ARM, will supply power to position the stepping switch to A illuminating the armed lights and arming the SWESS. Placing either or both the pilot's and radar navigator's arm-safe switches to SAFE will safe the SWESS.

NOTE

Both the pilot's and radar navigator's arm-safe switches must be positioned to ARM to arm the SWESS.

SWESS AUTO-OFF SWITCH. A SWESS auto-off switch on the SWESS equipment panel, which is located in the left forward portion of the bomb bay, is a two-position guarded switch with AUTO--OFF positions and can be sealed in either position. AUTO position connects the SWESS baroswitches to the SWESS allowing the baroswitches to provide a SWESS release when the airplane descends through the release altitude if the stepping switch is at A position. OFF position disconnects the baroswitches from the SWESS removing the SWESS release capability. With the baroswitches disconnected, the warning light will not come on under any circumstances.

SWESS BAROSWITCHES. Four baroswitches, a safeing baroswitch, a warning baroswitch, and two release baroswitches, are provided in the baroswitch assembly located in the left forward portion of the bomb bay. The warning baroswitch is set to energize the warning light circuits at 25,000 feet. The two release baroswitches are set to energize the SWESS release circuits at 20,000 feet. The safeing baroswitch is set at 17,000 feet and prevents a SWESS release below that altitude.

the SWESS manual safeing handle. There are no provisions for manually arming the stepping switch. A window type indicator is provided on the stepping switch and will display an A when the stepping switch is positioned to ARM and an S when the stepping switch is positioned to SAFE.

SWESS MANUAL SAFEING HANDLE. The SWESS manual safeing handle (2, figure 4-50) is located above the bomb bay forward bulkhead door. The handle is used to manually position the stepping switch to S and SAFE the SWESS in the event of an airplane electrical power failure or a SWESS malfunction. A quick release safeing pin (1, figure 4-50) is provided to prevent inadvertent operation.

SWESS Indicators

SWESS ARMED LIGHTS. An amber armed light (4, figure 4-50) on each SWESS control panel illuminates when the stepping switch is positioned to A indicating the SWESS is armed. The armed lights will illuminate when pressed-to-test at any altitude, provided the auto-off switch is positioned to OFF and the radar navigator's arm-safe switch is positioned to ARM. The armed lights will also illuminate when pressed-to-test, with the auto-off switch positioned to AUTO, provided the airplane is above SWESS release altitude and the radar navigator's arm-safe switch is positioned to ARM. Power is supplied to the armed lights through a circuit breaker marked "Armed Lights" on the SWESS equipment panel.

NOTE

The pilot's arm-safe switch must be positioned to SAFE during press-to-test of the armed lights.

WARNING LIGHT. A red warning light (5, figure 4-50) on each SWESS control panel will illuminate, provided the SWESS is armed, when the airplane descends below 25,000 feet. The illuminated warning lights indicate a SWESS release will result at 20,000 feet if the SWESS is not safed. Each warning light has a press-to-test circuit for checking the lamps. Power is supplied to the warning light through a circuit breaker marked "Warning Light" on the SWESS equipment panel.

SWESS Operation (auto-off switch positioned to AUTO)

Operation of SWESS (airplane above 25,000 feet while arming SWESS) is as follows:

1. Place the master bomb control switch to ON. The master bomb control switch must be positioned to ON to energize the hydraulic packs.
2. Place radar navigator's arm-safe switch to ARM. Power is applied to the pilot's arm-safe switch and to the armed lights press-to-test circuit.
3. Press to test the armed lights. The armed lights should illuminate when pressed indicating the release baroswitches are in the proper position and it is safe to position the pilot's arm-safe switch to ARM.

NOTE PR

The release circuits disconnect must be connected before SWESS can be armed.

WARNING

If armed lights do not illuminate when pressed, do not position pilot's arm-safe switch to ARM.

4. Place the pilot's arm-safe switch to ARM. The stepping switch will move to A and the armed lights will illuminate, indicating an armed SWESS. After the airplane is armed, if airplane SWESS control power is lost, the arming relay will deenergize connecting the SWESS battery to the SWESS release system and the armed lights will remain illuminated. After the SWESS is armed, a SWESS release will be the same whether on airplane power or SWESS battery power. When the airplane descends through 25,000 feet the SWESS warning light will illuminate. As the airplane descends through 20,000 feet, power from the SWESS will be applied to open the bomb doors and release the bombs if the release units are unlocked. The bomb doors will remain open until the aircraft descends below 17,000 feet.

CAUTION

Do not attempt to close bomb doors until aircraft descends below 17,000 feet as damage to the bomb doors could result.

SWESS Operation (auto-off switch positioned to OFF)

Operation of SWESS (baroswitches are disconnected) is as follows:

1. Position radar navigator's arm-safe switch to ARM. Power is applied to the pilot's arm-safe switch and the armed lights press-to-test circuit.
2. Press to test the armed lights. The armed lights should illuminate when pressed indicating that it is safe to position the pilot's arm-safe switch to ARM.

NOTE PR

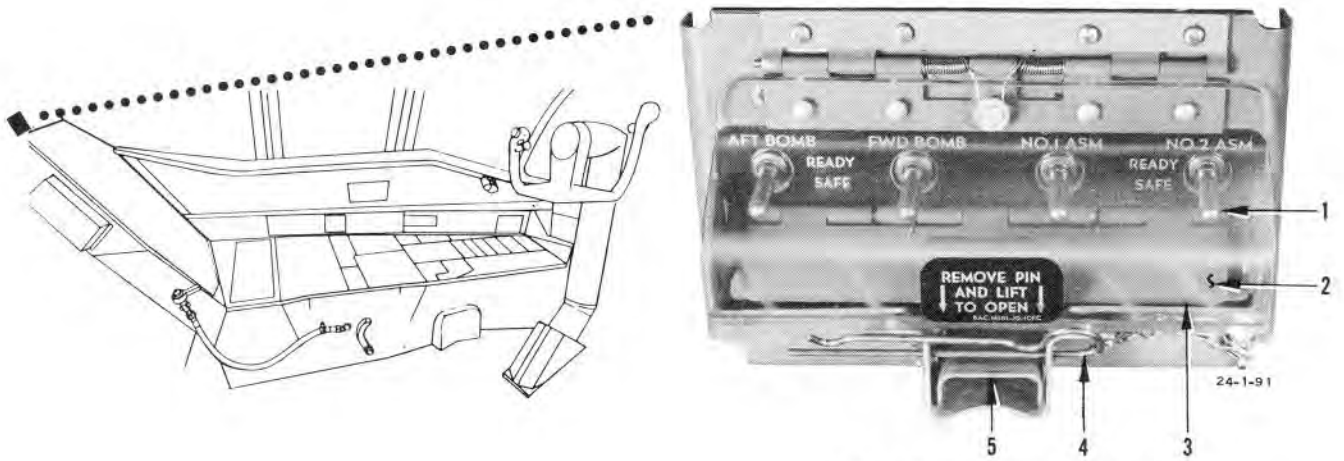
The release circuits disconnect must be connected before SWESS can be armed.

WARNING

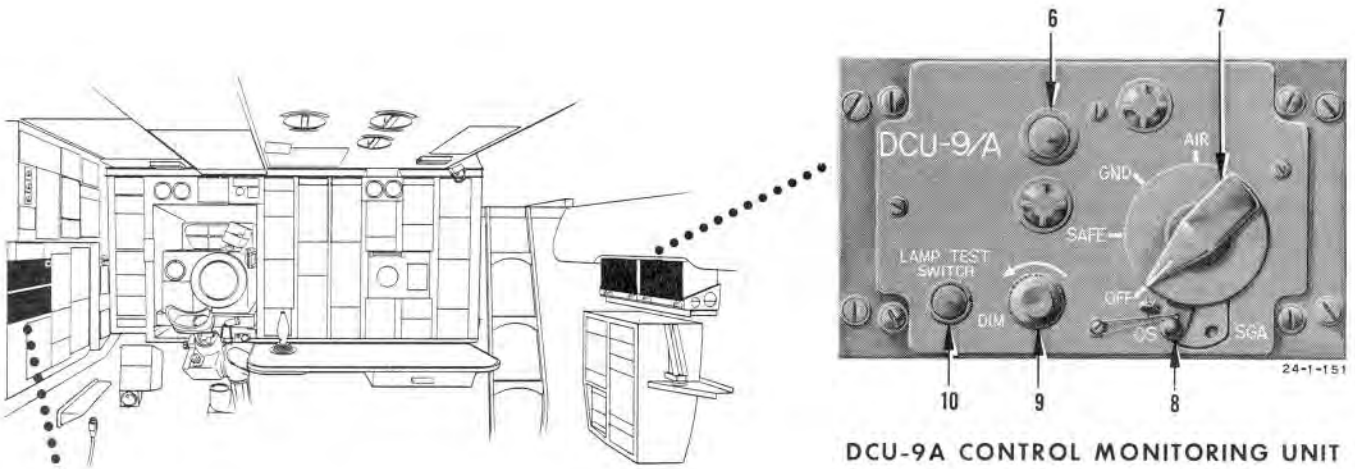
If armed lights do not illuminate when pressed, do not position pilot's arm-safe switch to ARM.

3. Place the pilot's arm-safe switch to ARM. The stepping switch will move to A and the armed lights will illuminate. The SWESS will not open the bomb doors or release the bomb(s) and the SWESS warning lights will not illuminate at any altitude.

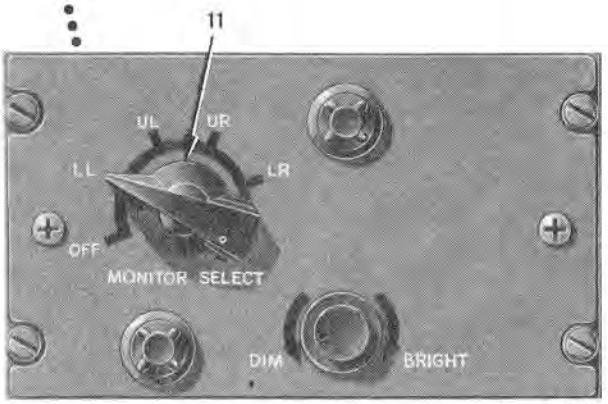
REVERSE SIDE INTENTIONALLY LEFT BLANK



READINESS SWITCH ASSEMBLY



DCU-9A CONTROL MONITORING UNIT



SWK(SWK-2/A24T-1 SWITCH BOX)

1. READINESS SWITCHES
2. PLEXI-GLASS COVER GUARD
3. GANG BAR
4. SAFETY PIN
5. COVER LATCH
6. DCU-9A WARNING LIGHT
7. DCU-9A SELECTOR SWITCH
8. DCU-9A CONTROL LEVER
9. DCU-9A DIMMING KNOB
10. DCU-9A LAMP TEST SWITCH
11. SWK MONITOR SELECT SWITCH

.....special weapons inflight control panels

Figure 4-49B.

Emergency Operation of SWESS

WARNING

Do not arm SWESS if a malfunction exists in the system.

If a SWESS release is not desired after arming the SWESS or when any malfunction develops in the system, attempt to safe the SWESS with the pilot's and radar navigator's arm-safe switches. If SWESS cannot be safed in this manner, or if the armed lights illuminate prior to arming SWESS, manual safeing is required.

WARNING

The SWESS stepping switch should be safed before the airplane descends to a pressure altitude of 25,000 feet, since a release would occur at 20,000 feet.

Manual safeing of SWESS is not required when no bomb(s) are remaining in the bomb bay. However, the bomb doors will open at 20,000 feet and cannot be closed until the airplane descends through 17,000 feet. In the event manual safeing of SWESS is desired, perform the following:

NOTE

Manual safeing of SWESS does not constitute entry into the bomb bay.

1. Check that pilot's and radar navigator's arm-safe switches are positioned to SAFE.
2. Pull SWESS circuit breaker out.
3. Remove SWESS safeing pin from the SWESS manual safeing handle.
4. Rotate handle as far as it will go then allow to retract slowly and reinstall SWESS safeing pin.
5. Check SWESS stepping switch to determine that the letter S appears in the indicator window.

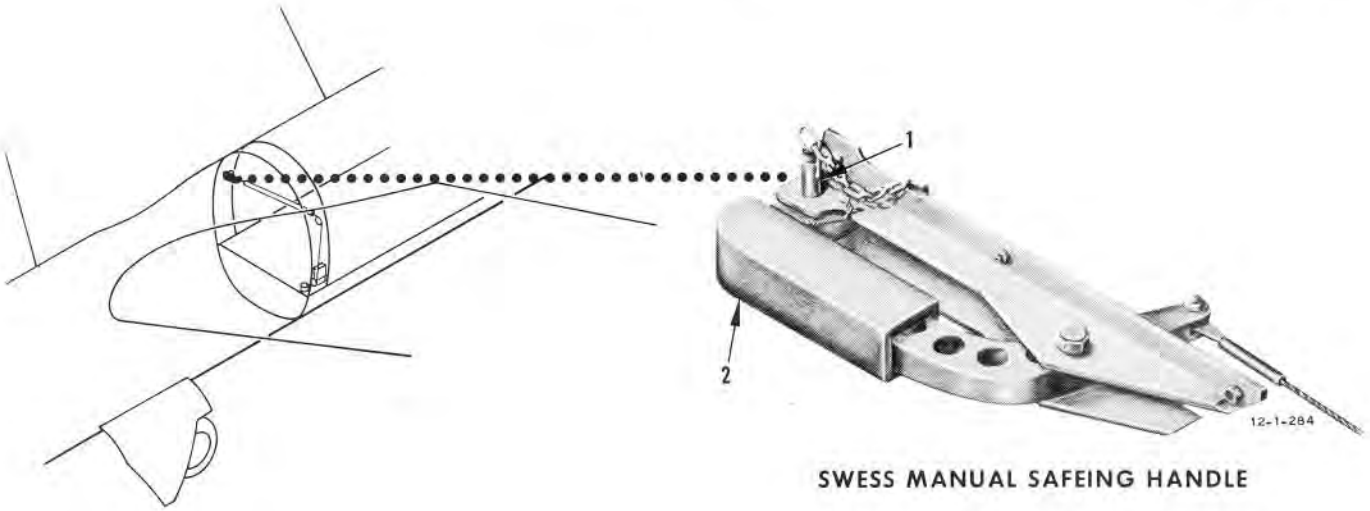
SPECIAL WEAPONS INFLIGHT CONTROL AND MONITORING

DCU-9A Control Monitor Unit

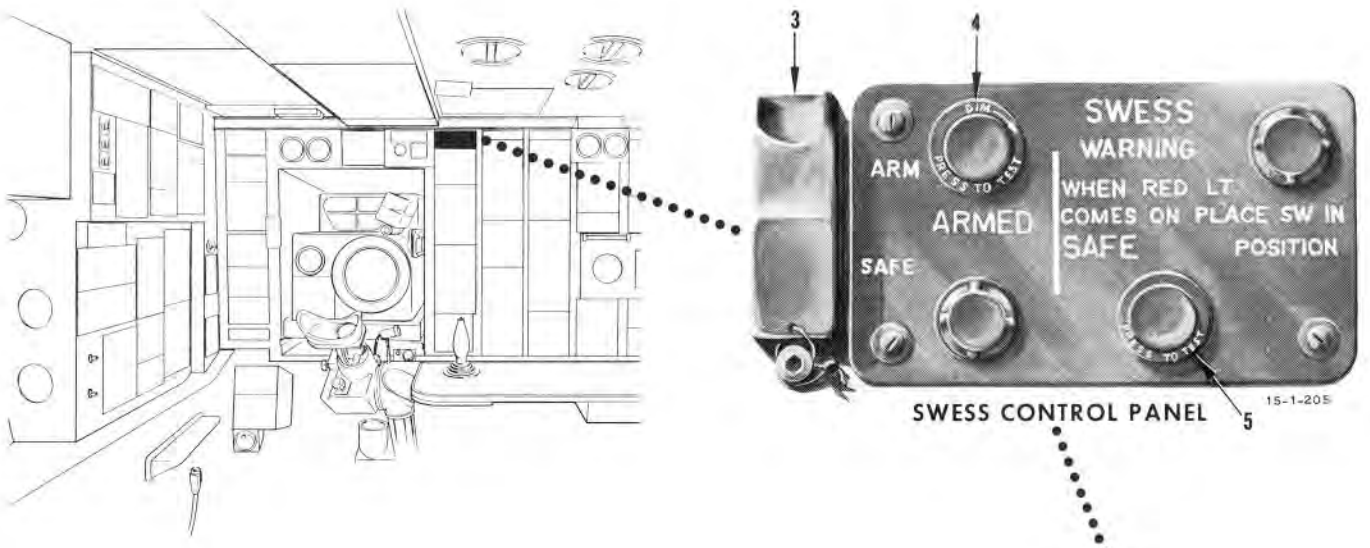
Two DCU-9A control monitor units (figure 4-48C) are installed in the forward and aft panel recesses on the radar navigator's side panel. Each unit has a four-position selector switch (7, figure 4-48C) with OFF--SAFE--GND--AIR positions. Each unit has a control lever (8, figure 4-48C) with OS (OFF, SAFE)--SGA (SAFE, GROUND, AIR) positions, which prevents inadvertent operation of the selector switch. Each unit has a warning light (6, figure 4-48C). Each unit has a lamp test switch (10, figure 4-48C) which provides a means of determining the condition of the warning light bulb. A dimming knob (9, figure 4-48C) is also provided and is used to adjust the panel light intensity.

Readiness Switch Assembly

A readiness switch assembly (figure 4-49B) located above the pilot's aft circuit breaker panel contains four readiness switches (1, figure 4-49B) marked "Aft Bomb," "Fwd Bomb," "No. 1 ASM," and "No. 2 ASM" with READY--SAFE positions. READY position of the aft bomb or forward bomb readiness switch permits normal operation of the corresponding DCU-9A panel. SAFE position breaks the pre-arming circuits of the corresponding DCU-9A panel and supplies continuous power to the safeing circuits. SAFE position allows normal operation of DCU-9A warning light press-to-test circuits. For operation of the No. 1 ASM and No. 2 ASM readiness switches, refer to T.O. 1B-52C-30-1. A gang bar (3, figure 4-49B) is provided for simulta-



SWESS MANUAL SAFEING HANDLE



SWESS CONTROL PANEL

1. SAFEING PIN
2. SWESS MANUAL SAFEING HANDLE
3. SWESS ARM-SAFE SWITCH
4. SWESS ARMED LIGHT
5. SWESS WARNING LIGHT

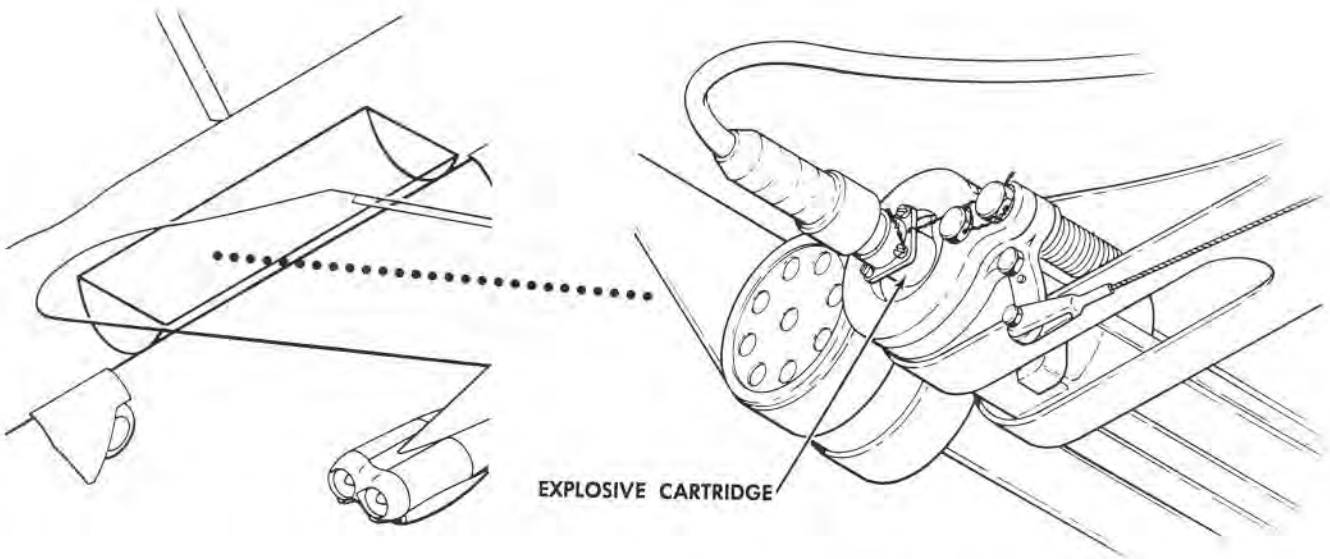
SWESS controls

Figure 4-50.

neously positioning all switches to READY. A hinged (spring-loaded open) plexiglas cover guard (2, figure 4-49B) is mounted on the face of the readiness switch assembly. Closing the cover moves all switches to SAFE position. A cover latch (5, figure 4-49B) and a safety pin (4, figure 4-49B) are provided and have provisions for sealing the cover in the closed position. To open the cover, remove the safety pin and lift the latch.

SWK (SWK-2/A24T-1 Switch Box)

The SWK box (figure 4-49B) has a rotary switch with OFF--LL--UL--UR--LR marked positions and is used to select the bomb to be monitored by the DCU-9A. The only function of the SWK box is to complete the monitor circuit between the bomb selected and the DCU -9A warning light. It does not select any component within the bomb or select the bomb to be released.



single carriage (clip-in) explosive release unit

Figure 4-50A.

LAST RESORT BOMBING

Last Resort Bombsight JW

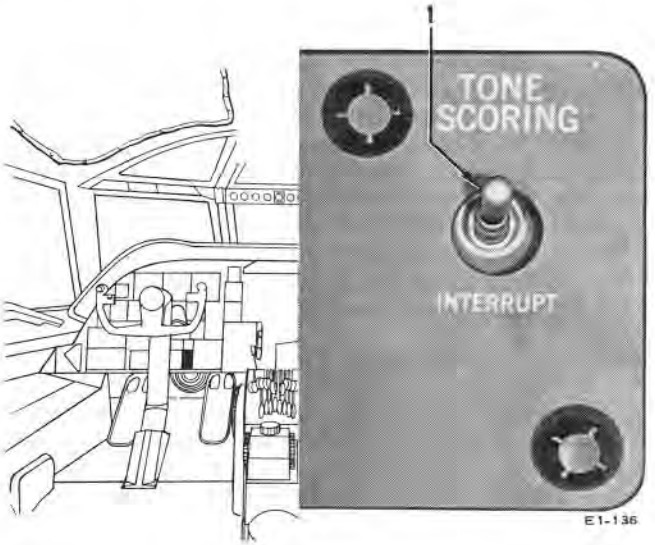
The pilot's last resort bombsight (4A, figure 1-8) and copilot's last resort bombsight (3A, figure 1-8) are located on the instrument panel hood and provide for bomb sighting under last resort conditions. Each bombsight consists of a forward sighting post and a rear sighting assembly. The rear sighting assembly has an upper and lower sighting ring and is mounted on a bar that allows lateral movement of the sighting rings to compensate for drift. Each sighting ring has vertical and horizontal crosshairs. There are 11 detents on each mounting bar that allow drift corrections of 2° increments on aircraft Less UW and 3°15' increments on aircraft UW. The zero drift position for the pilot's sighting ring is the fifth detent from the left. The zero drift position for the copilot's sighting ring is the fifth detent from the right. The line of sight from the pilot or copilot through the vertical crosshair, over the sighting post, and to the aiming point represents 0° of drift when the above specified detents are being used. Once the drift is killed, the airplane is on a course that will permit it to pass directly over the target. Crosstrail is not compensated for. As the airplane moves toward the target, the aiming point will appear to be moving toward the airplane. When the aiming point approaches the nose of the airplane, the stopwatch or airplane clock to be used during the timing phase should be readied. While using the lower sighting ring, the aiming point continues to move in toward the airplane nose and first intersects the vertical crosshair on the lower ring. The aiming point continues to move in toward the airplane nose until it intersects the lower portion of the upper ring. When the upper ring horizontal crosshair intersects the top of the forward sighting post and the aiming point, the timing device will be started. At time of release, bomb release will be accomplished by manual release if possible. However, electrical salvo or special weapon manual release handles may be utilized if the situation warrants.

NOTE

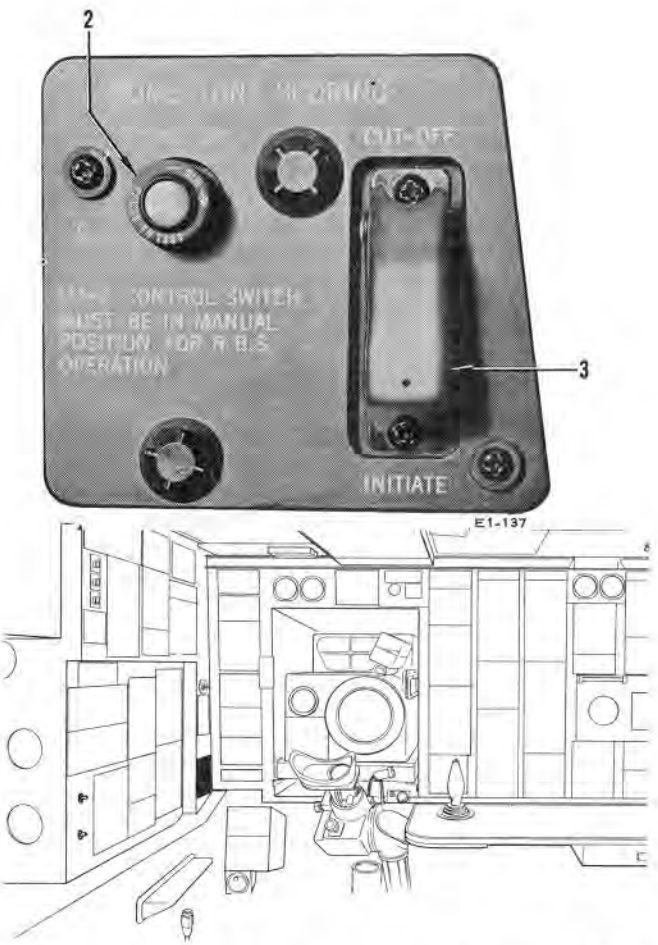
Actuating electrical salvo will result in the release of all bombs.

BOMB TONE SCORING SYSTEM

A bomb tone scoring system is installed in this airplane to provide a means of simulated bomb drops whereby the accuracy of the bomb run can be determined using



1. TONE SCORING INTERRUPT SWITCH
2. TONE ON LIGHT
3. BOMB TONE SCORING SWITCH



bomb tone scoring system controls

Figure 4-51.

a radio signal. When initiated, the bomb tone scoring system causes a continuous tone to be transmitted by the UHF radio set(s) on the selected frequency(ies). A bomb release pulse from either the BNS or the bomb release switch (but not the salvo system) stops the tone, simulating bomb release. The bomb tone scoring system must be reinitiated in order to simulate another bomb run. Voice communications cannot be transmitted by means of either UHF radio set when the bomb tone scoring system is energized. A bomb tone scoring panel (42, figure 4-38 and 41, figure 4-38A) is provided at the radar navigator's station.

Bomb Tone Scoring System Controls

BOMB TONE SCORING SWITCH. A guarded bomb tone scoring switch (3, figure 4-51) on the bomb tone scoring panel at the radar navigator's station, provides a means of energizing the bomb tone scoring system. The switch has INITIATE--NORMAL--CUT-OFF positions and is spring-loaded to the unmarked NORMAL position. Actuating this switch momentarily to INITIATE will energize the circuit causing the tone on indicator light to illuminate and both UHF radio sets to transmit a steady tone provided both UHF radio sets are turned on. Actuating this switch momentarily to CUT-OFF will de-energize the circuit causing the bomb tone indicator light to go out and the tone transmission to stop.

BOMB TONE SCORING INTERRUPT SWITCH. A bomb tone scoring interrupt switch (1, figure 4-51) on the pilot's instrument panel provides the pilot with a means of de-energizing the bomb tone scoring system. The switch has NORMAL--INTERRUPT positions, spring-loaded to the unmarked NORMAL position. Actuating this switch momentarily to INTERRUPT will de-energize the bomb tone scoring system causing the bomb tone indicator light to go out and the tone transmission to stop.

Bomb Tone Scoring System Indicators

TONE ON INDICATOR LIGHT. A tone on indicator light (2, figure 4-51) located on the bomb tone scoring panel is illuminated when the bomb tone scoring system has been energized. This light is supplied TR power through the bomb tone scoring switch and the bomb tone scoring interrupt switch from a circuit breaker marked "Normal Release" on the "Bomb System" portion of the radar navigator's circuit breaker panel.

Bomb Tone Scoring System Normal Operation

The bomb tone scoring system operates whenever the command or standby UHF transmitter is on and the bomb tone scoring master switch has been positioned momentarily to INITIATE. The tone is stopped by a bomb release pulse from the BNS or bomb release switch, through the bomb intervalometer, or by momentary actuation of the pilot's bomb tone scoring interrupt switch to INTERRUPT, or the bomb tone scoring switch to CUTOFF.

NOTE

The bomb tone scoring system will cause the No. 1 and 2 UHF radios to transmit a tone if both are turned on. A garbled transmission will result if both UHF radios are tuned to the same frequency; therefore, it is recommended that one UHF radio be tuned to an unused frequency during tone operation.

VERTICAL (STRIKE) CAMERA SYSTEM

The vertical camera photographic system provides a photographic record of the bombing run. A compartment at the forward end of the aft unpressurized section houses the strike and orientation camera. An automatic vacuum system supplies vacuum for camera operation made by venting air from the airbleed system to the atmosphere through an ejector; a line connects the low pressure side of the throat of the ejector to a spring balanced vacuum regulator which is connected to the camera magazine. An automatic camera heating system heats the camera compartment. For further information on camera compartment heating see AIR CONDITIONING SYSTEMS, this Section. The camera can be operated by manual operation of switches or automatically by means of the bomb intervalometer or camera intervalometer. The camera door can be operated by manually positioning the camera door switch, or by means of a handcrank, or opened automatically when the bomb doors open. Controls for the photographic system are located on the front panel of the navigator's station. Salvo release of the bombs causes the camera door to open and the camera to operate in accordance with intervalometer settings, provided the camera master switch and camera intervalometer power switch are ON.

Vertical Camera System Controls

VERTICAL CAMERA MASTER SWITCH. A vertical camera master switch (16, figure 4-52) on the vertical camera control panel has ON--OFF positions. Actuating the switch to ON supplies 118-volt single-phase a-c power to operate the camera doors and TR power to the camera door indicating lights, camera operating light, camera intervalometer, and the camera compartment heat system. Turning this switch OFF then ON will allow the camera intervalometer to reset itself. Single-phase 118-volt a-c power is supplied to the vertical camera master switch through a circuit breaker marked "Camera Control" - "Doors." TR power is supplied to the switch through circuit breakers marked "Camera Control" - "Master," "Ind," "Auto," and "Heater." All circuit breakers are on the "Miscellaneous" portion of the radar navigator's circuit breaker panel.

NOTE

No camera or camera door operation is possible, or camera heat available, when the camera master switch is OFF.

VERTICAL CAMERA DOOR SWITCH. A vertical camera door switch (12, figure 4-52) on the vertical camera control panel has OPEN--AUTO--CLOSED positions and is spring loaded to the AUTO position. Actuating this switch to the OPEN position will open the camera door; actuating this switch to the CLOSED position will close the camera door. This switch supplies 118-volt single-phase a-c power from the camera master switch to operate the camera door except when the bomb doors are unlatched. Single-phase 118-volt a-c power is supplied to the switch through a circuit breaker marked "Camera Control Doors" on the "Miscellaneous" portion of the radar navigator's circuit breaker panel.

VERTICAL CAMERA DOOR HAND CRANK. A hand crank, stowed on the forward side of the vertical camera compartment cover, is provided for emergency operation of the camera door. The socket for the camera door is located on the door motor mechanism, on the left side of the walkway forward of the camera.

WARNING

To prevent injury to personnel resulting from the hand crank being driven by the motor, remove electrical power from the circuit while the crank is in the mechanism.

VERTICAL CAMERA INTERVALOMETER SWITCH. A vertical camera intervalometer switch (13, figure 4-52) on the vertical camera control panel has MANUAL--AUTO positions and is spring loaded to the AUTO position. This switch provides TR power from the camera master switch to operate the camera intervalometer. In the AUTO position, the camera intervalometer controls operation of the camera. When this switch is held in the MANUAL position, the camera intervalometer is inoperative, the camera takes pictures at the maximum rate, and the camera operating light will flash for each exposure. Turning this switch to MANUAL then AUTO will allow the camera intervalometer to reset itself. TR power is supplied to the vertical camera intervalometer switch through a circuit breaker marked "Camera Control Auto" on the "Miscellaneous" portion of the radar navigator's circuit breaker panel.

VERTICAL CAMERA INTERVALOMETER. A vertical camera intervalometer (84, figure 4-38) located on the radar navigator's front panel controls the initial delay, exposure interval and number of exposures which may be taken automatically. Automatic operation of the camera by the camera intervalometer can be initiated by means of a bomb release pulse from the bomb intervalometer, the camera intervalometer manual initiation switch, or the bomb salvo switches. Initiation of the camera intervalometer will cause it to operate as preset if the camera master switch is ON, the camera intervalometer switch is AUTO and the camera intervalometer power switch is on BOMB SPOTTING. The initiation pulse will cause the camera to take one exposure which will not affect the camera exposure limiter; the pulse will register on the camera exposure counter. At the completion of a set sequence the intervalometer will reset itself and the camera intervalometer ready light will illuminate. When the camera intervalometer has reset it must be initiated before it will transmit camera trip pulses. The camera intervalometer will also reset itself whenever power is removed from the intervalometer as when the camera master switch is positioned to OFF or the camera intervalometer switch is positioned to MANUAL, or the camera intervalometer power switch is positioned to OFF.

VERTICAL CAMERA INTERVALOMETER POWER SWITCH. A vertical camera intervalometer power switch (7, figure 4-52) on the camera intervalometer has RUNAWAY--OFF--BOMB SPOTTING positions. When positioned to BOMB SPOTTING the camera intervalometer will, when initiated, operate the camera as set. When positioned to RUNAWAY the camera intervalometer will, when initiated, cause the camera to make exposures at the maximum rate for the length of time set on the camera exposure interval control knob. When positioned to OFF the camera can be operated only with the camera intervalometer switch or the camera trip switch. The camera intervalometer will reset at the conclusion of each automatic operation; it can also be reset by turning the camera intervalometer power switch to OFF, then to BOMB SPOTTING or RUNAWAY.

VERTICAL CAMERA TRIP SWITCH. The vertical camera trip switch (6, figure 4-52) on the vertical camera intervalometer is a spring loaded push to actuate type switch. While this switch is depressed, power to operate the camera bypasses the intervalometer circuits and the camera operates at maximum rate, camera operating lights will flash at each exposure. The camera exposures remaining counter will also operate but will have no effect on the exposure limiter control. When this switch is released, the camera intervalometer resumes operation as it was set or initiated prior to actuation of the camera trip switch. This switch supplies TR power from the camera master switch and the camera intervalometer switch to the camera. TR power is supplied to the switch through a circuit breaker marked "Camera Control Master" on the "Miscellaneous" portion of the navigator's circuit breaker panel.

VERTICAL CAMERA INTERVALOMETER MANUAL INITIATION SWITCH. The vertical camera manual initiation switch (8, figure 4-52) on the vertical camera intervalometer is a spring loaded, push to actuate type switch. Depressing and releasing this switch will initiate camera operation by the camera intervalometer just as a bomb release pulse would.

VERTICAL CAMERA EXPOSURE DELAY CONTROL KNOB. A vertical camera exposure delay control knob (1, figure 4-52) on the vertical camera intervalometer has OFF and 1 through 120 second interval positions marked in 2 second intervals but with 1 second interval detents. The position selected by this knob controls the amount of delay between the camera intervalometer initiation pulse and operation of the camera by the camera exposure interval control. Once the camera intervalometer has been initiated the only effective repositioning of this control is to decrease the amount of delay set. If this control knob is positioned to OFF, automatic camera operation is not possible even though the camera intervalometer ready light is illuminated.

VERTICAL CAMERA EXPOSURE INTERVAL CONTROL KNOB. A vertical camera exposure interval control knob (2, figure 4-52) on the vertical camera intervalometer panel has OFF and 1 through 120 second interval positions marked in 2 second intervals but with 1 second interval detents. The camera exposure control spaces the impulses to operate the camera as selected on the dial when the intervalometer power switch is on BOMB SPOTTING. When the intervalometer power switch is on RUNAWAY this control limits the length of time the camera will make exposures. The setting can be changed at any time. When the camera exposure interval control knob is positioned OFF no impulses will be sent to the camera thus preventing normal automatic operation, and the camera intervalometer ready light will not illuminate.

VERTICAL CAMERA EXPOSURE LIMITER CONTROL KNOB. A vertical camera exposure limiter control knob (9, figure 4-52) on the vertical camera intervalometer panel has OFF and 1 through 120 exposure positions marked in 2 exposure intervals but with 1 exposure detents. The desired number of camera exposures to be taken is selected with this knob. Once the camera intervalometer has been initiated, the only effective repositioning of this control is to decrease the number of exposures set. The camera exposure limiter counts the number of camera trip impulses from the camera trip mechanism. When the preset number of exposures have been taken this control will allow the intervalometer to reset itself. When the camera exposure limiter control knob is in the OFF position, the number of exposures is not limited by this control.

Vertical Camera Indicators

VERTICAL CAMERA DOOR OPEN LIGHT. An amber vertical camera door open light (11, figure 4-52) on the vertical camera control panel will illuminate while the camera door is fully open. The light is supplied TR power through the camera master switch. TR power is supplied to the light through circuit breakers marked "Camera Control Master" and "Camera Control Ind" on the "Miscellaneous" portion of the radar navigator's circuit breaker panel.

VERTICAL CAMERA OPERATING LIGHT. A green vertical camera operating light (10, figure 4-52) on the vertical camera control panel will flash each time the camera mechanism is actuated to take an exposure. The light is supplied TR power through the camera master switch. TR power is supplied to the light through circuit breakers marked "Camera Control Master" and "Camera Control Ind" on the "Miscellaneous" portion of the radar navigator's circuit breaker panel.

VERTICAL CAMERA INTERVALOMETER READY LIGHT. An amber vertical camera intervalometer ready light (3, figure 4-52) on the vertical camera intervalometer will be illuminated when the camera intervalometer is receiving power and is ready to be initiated. This light will be out when the camera intervalometer is not receiving power or has been initiated.

NOTE

If the camera exposure delay control knob is positioned to OFF the camera intervalometer is not ready to be initiated even though the camera intervalometer ready light is illuminated.

VERTICAL CAMERA OPERATION INDICATOR LIGHT. A green vertical camera operation indicator light (4, figure 4-52) is located on the vertical camera intervalometer panel. This light will flash each time the camera mechanism is actuated to take an exposure, provided the camera intervalometer is receiving power; that is, camera master switch ON, camera intervalometer switch AUTO.

VERTICAL CAMERA EXPOSURES REMAINING COUNTER. The vertical camera exposures remaining counter (5, figure 4-52) on the vertical camera intervalometer panel will indicate one less exposure remaining each time a picture is taken, provided the camera intervalometer is receiving power.

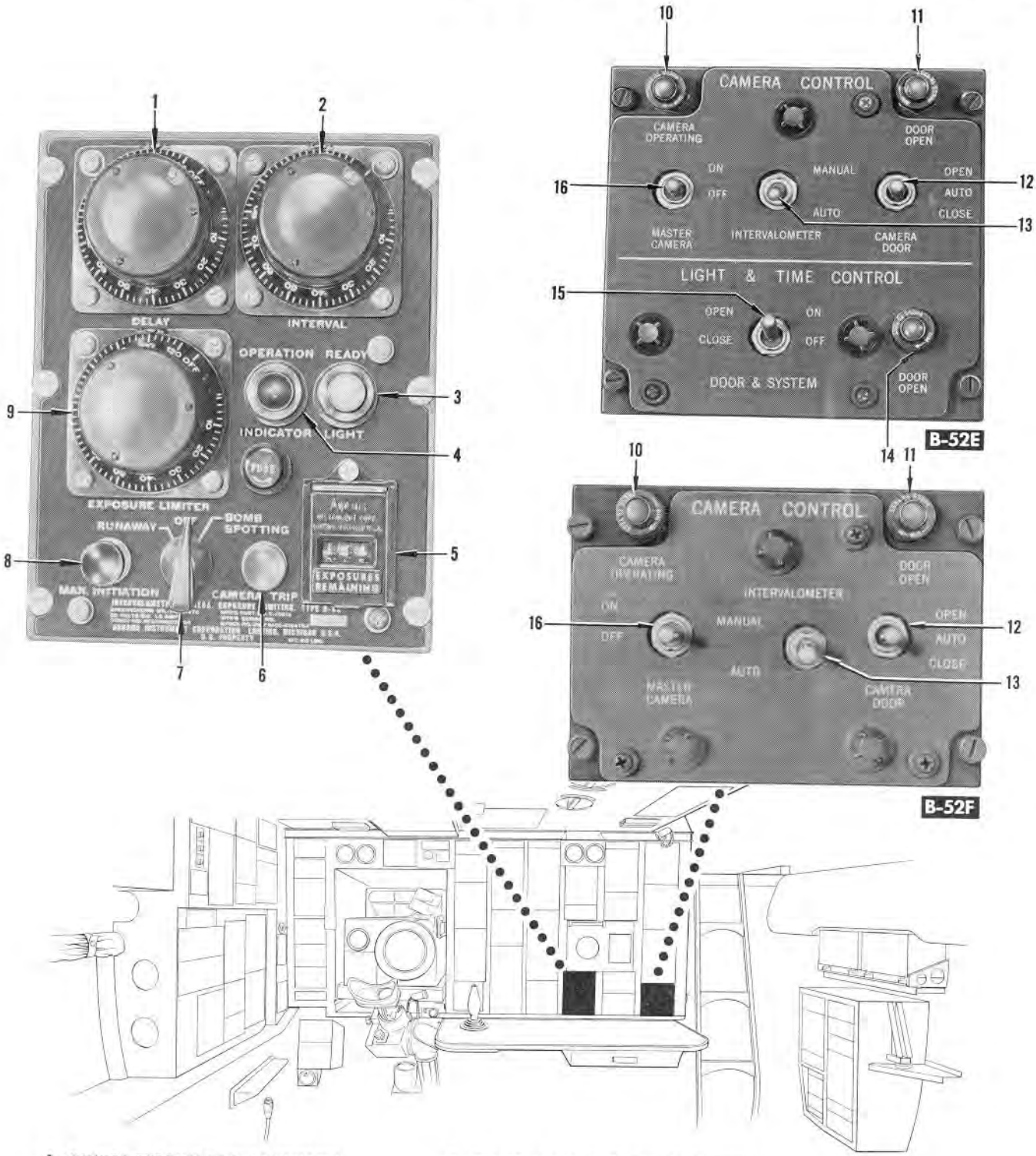
Vertical Camera System Normal Operation

The following steps are recommended for the normal operation of the vertical camera system:

1. Vertical Camera Master Switch - ON

No camera or camera door operation is possible unless this switch is ON. It is recommended that this switch be turned ON prior to takeoff as it turns on the camera compartment heat. When this switch is ON the camera door will open when the bomb doors open.

2. Vertical Camera Intervalometer Power Switch - BOMB SPOTTING or RUNAWAY



1. CAMERA EXPOSURE DELAY CONTROL
2. CAMERA EXPOSURE INTERVAL CONTROL
3. CAMERA INTERVALOMETER READY LIGHT
4. CAMERA OPERATION INDICATOR LIGHT
5. CAMERA EXPOSURES REMAINING COUNTER
6. CAMERA TRIP SWITCH
7. CAMERA INTERVALOMETER POWER SWITCH
8. CAMERA INTERVALOMETER MANUAL INITIATION SWITCH
9. CAMERA EXPOSURE LIMITER CONTROL
10. CAMERA OPERATING LIGHT
11. CAMERA DOOR OPEN LIGHT
12. CAMERA DOOR SWITCH
13. CAMERA INTERVALOMETER SWITCH
14. LIGHT AND TIME RECORDER DOOR OPEN LIGHT (INOPERATIVE) B-52E
15. LIGHT AND TIME RECORDER DOOR AND SYSTEM CONTROL SWITCH (INOPERATIVE) B-52E
16. CAMERA MASTER SWITCH

.....vertical camera system controls

Figure 4-52.

3. Vertical Camera Intervalometer - Set
   a. Vertical Camera Exposure Delay Control Knob - Set at any desired position but OFF

If this knob is set at OFF, automatic camera operation is not possible, even though the camera intervalometer ready light is illuminated.

   b. Vertical Camera Exposure Interval Control Knob - Set at any desired position but OFF

If this knob is set at OFF, automatic camera operation is not possible.

   c. Vertical Camera Exposure Limiter Control Knob - Set as desired

4. Vertical Camera Door Open Light - Illuminated

If camera door open light is not illuminated, open the camera door by means of the camera door switch. Hold the camera door switch in the OPEN position until the camera door open light illuminates.

NOTE

The camera will expose film whether the camera door is open or not.

The camera system is now ready to take pictures. The camera intervalometer can be initiated by a bomb release pulse from the bomb intervalometer, the bomb salvo system, or the manual initiation switch on the camera intervalometer. The camera can be operated by depressing the camera trip switch on the camera intervalometer. The camera can also be operated by positioning the camera intervalometer switch to MANUAL, but this is inadvisable unless the camera intervalometer is inoperative because the exposures remaining counter will not register.

NOTE

If the camera operating light stops flashing, the camera exposures remaining counter stops working, and the camera intervalometer ready light does not illuminate, it is an indication that the camera is no longer taking pictures because: (1) It has run out of film, (2) the film has broken, or (3) the camera is not receiving the impulses from the intervalometer. If it is desired to take more pictures, move the camera intervalometer switch to MANUAL. If the camera operating light on the camera control panel does not flash, the camera probably is not making exposures; shut down the photographic system.

To shut down the photographic system, proceed as follows:

5. Vertical Camera Door Switch - CLOSED

When the bomb doors are fully closed the camera doors can be closed by holding the camera door switch in the CLOSED position.

6. Vertical Camera Intervalometer Power Switch - OFF

7. Vertical Camera Master Switch - OFF

It is recommended that this switch remain ON until after landing to provide heat for the camera compartment.

BOMB DOOR SYSTEM

The bomb door system (figure 4-53) comprises doors, latches and the systems which control them. Six double-panel doors cover the bomb bay opening. All actuation by the bomb door system affects the lower panels only. The upper panels are hinged to provide a larger opening for ground service. The doors are latched at the forward and aft bulkheads of the bomb bay. To secure simultaneous action of all doors, the center doors are mechanically linked to the forward and aft doors.

The doors can be operated with the bomb door switch on either the pilot's or the radar navigator's control panel. The BNS can operate the doors automatically. The bomb salvo/jettison, GAM-72 launch gear jettison, and SWESS systems will open the doors but will not close them. The bomb doors are held closed by means of mechanical latches and held open by hydraulic pressure. Hydraulic system No. 2 provides normal pressure and No. 1 provides alternate pressure to operate the forward bomb doors actuator. In the event the normal hydraulic system does not supply enough pressure, the alternate hydraulic system operates the actuator. Hydraulic system No. 4 provides pressure to operate the aft bomb door actuator. The control circuits operate on switched battery power. A forward special weapon manual release handle is connected to the latch actuator cable to provide an emergency means of unlatching the bomb doors, after which they will be positioned by airstream loads.

BOMB DOOR SYSTEM CONTROLS

NOTE

See BOMBING SYSTEM CONTROLS, this Section, for additional controls which operate or affect the operation of the bomb doors.

CAUTION

To avoid bomb door damage in the event of a hydraulic system malfunction, see "Bombing System Switch in the Manual Position," this section.

Bomb Door Switches

PILOT'S BOMB DOOR SWITCH. A pilot's bomb door switch (3, figure 1-13 and 1, figure 1-13A) on the pilots' instrument panel provides a means of controlling

the bomb doors. The switch has OPEN--OFF--CLOSED positions and is spring-loaded to the OFF position. Actuating this switch to OPEN or CLOSED will turn on hydraulic packs 1, 2, and 4 (if hydraulic packs switches 1, 2, and 4 are positioned to ON) and energize the bomb doors open circuit or the bomb doors close circuit, respectively. Actuating this switch to CLOSED will deenergize the salvo/jettison circuits if the salvo/jettison circuits are energized and close the bomb doors. This switch provides the bomb door circuits with switched battery power through a circuit breaker marked "Bomb Door Control Relays" on the "Miscellaneous" portion of the pilot's circuit breaker panel.

RADAR NAVIGATOR'S BOMB DOOR SWITCH. A radar navigator's bomb door switch (1, figure 4-48) on the radar navigator door and bomb control panel provides a means of controlling the bomb doors. This switch has OPEN--OFF--CLOSE positions and is spring-loaded to the unmarked OFF position. Actuating this switch to OPEN, if the bombing system switch is in MANUAL and the master bomb control switch ON, will energize the bomb doors open circuit. Actuating this switch to CLOSE, if the bombing system switch is in MANUAL, will deenergize the salvo/jettison circuits if the salvo/jettison circuits are energized and cause the bomb doors to be closed even though the master bomb control switch is OFF. Power is supplied to this switch through relay contacts when the bomb doors are open and the bombing system switch is in MANUAL. This switch provides the bomb door circuits with switched battery power through a circuit breaker marked "Bomb Door Control Relays" on the "Miscellaneous" portion of the pilot's circuit breaker panel.

Bombing System Switch

A bombing system switch (7, figure 4-48) located on the radar navigator's door and bomb control panel provides a means of transferring control of the bomb doors from the BNS to the radar navigator's bomb door switch. The switch has AUTO--MANUAL positions. Actuating the switch to AUTO allows the BNS control of the bomb doors. Actuating the switch to MANUAL transfers control of the bomb doors to the radar navigator's bomb door switch. With this switch in MANUAL, the BNS is prevented from dropping bombs if the bomb doors are not full open.

NOTE

The bomb doors cannot be opened with the BNS (bombing system switch in AUTO) when the special weapons select switch is positioned to ASM NO. 1 or ASM NO. 2.

Bomb Door Close Timer

A bomb door close timer is provided to supply a bomb door close signal when the BNS is operating the bomb doors. The BNS does not actually supply a bomb door close signal following bomb release. The BNS does supply power to close the bomb doors when operating in the bomb mode (and the bombing system switch is in AUTO) and a bomb door open signal at the preset time to go. The bomb door close timer starts to work upon receiving the first bomb release pulse from the bomb release interval control and approximately 3 seconds after receiving the last bomb release pulse it causes a continuous door close signal to be sent. The bomb door close timer is supplied TR power through the "Bomb Door MA-2 Timer" circuit breaker on the "Bomb System" portion of the radar navigator's circuit breaker panel.

BOMB DOOR SYSTEM INDICATORS

Bomb Doors Open Lights

A red bomb doors open light (2, figure 1-13 and 42, figure 1-13A) is located on the pilot's instrument panel. An amber bomb doors open light (2, figure 4-48) is on the radar navigator's door and bomb control panel. When the bomb doors open lights are illuminated they indicate the bomb doors are fully open, that the bomb doors will be held open until the bomb doors close circuit is energized, and that the bomb door safety switches are positioned so that bomb release may be made by either the normal or the salvo/jettison systems. The bomb doors open lights will remain illuminated as long as the bomb doors are fully open. The bomb doors open lights receive TR power through the bomb door indicator and valve open limit switch actuated by the aft bomb door radius rod. The bomb doors open lights are supplied TR power through a circuit breaker marked "Bomb Door Control Hold Open" on the "Miscellaneous" portion of the pilot's circuit breaker panel.

Bomb Doors Not Latched Lights

A red bomb doors not latched light (1, figure 1-13 and 41, figure 1-13A) is located on the pilot's instrument panel. An amber bomb doors not latched light (4, figure 4-48) is on the door and bomb control panel. The bomb doors not latched lights, when illuminated, indicate the forward bomb door latch is unlatched. The bomb doors not latched lights will remain illuminated until the bomb doors are closed and the forward bomb door latch is latched. The bomb doors not latched lights are supplied TR power through a limit switch actuated by the forward bomb doors latch. The bomb door not latched lights are supplied TR power through circuit breakers marked "Bomb Door Control Pos Ind" on the "Miscellaneous" portion of the pilot's circuit breaker panel and marked "Bomb Door Pos Ind" on the "Bomb System" portion of the radar navigator's circuit breaker panel.

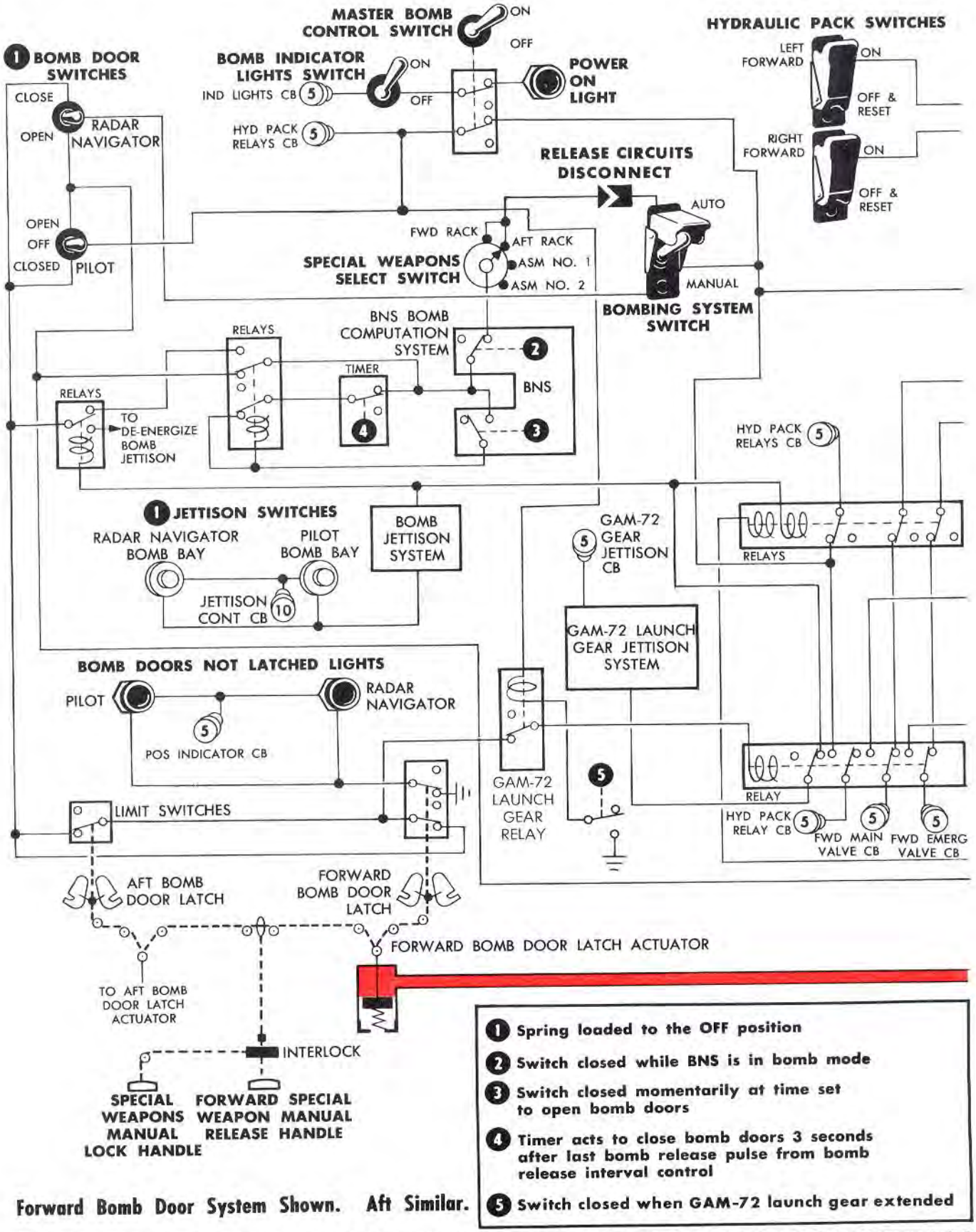
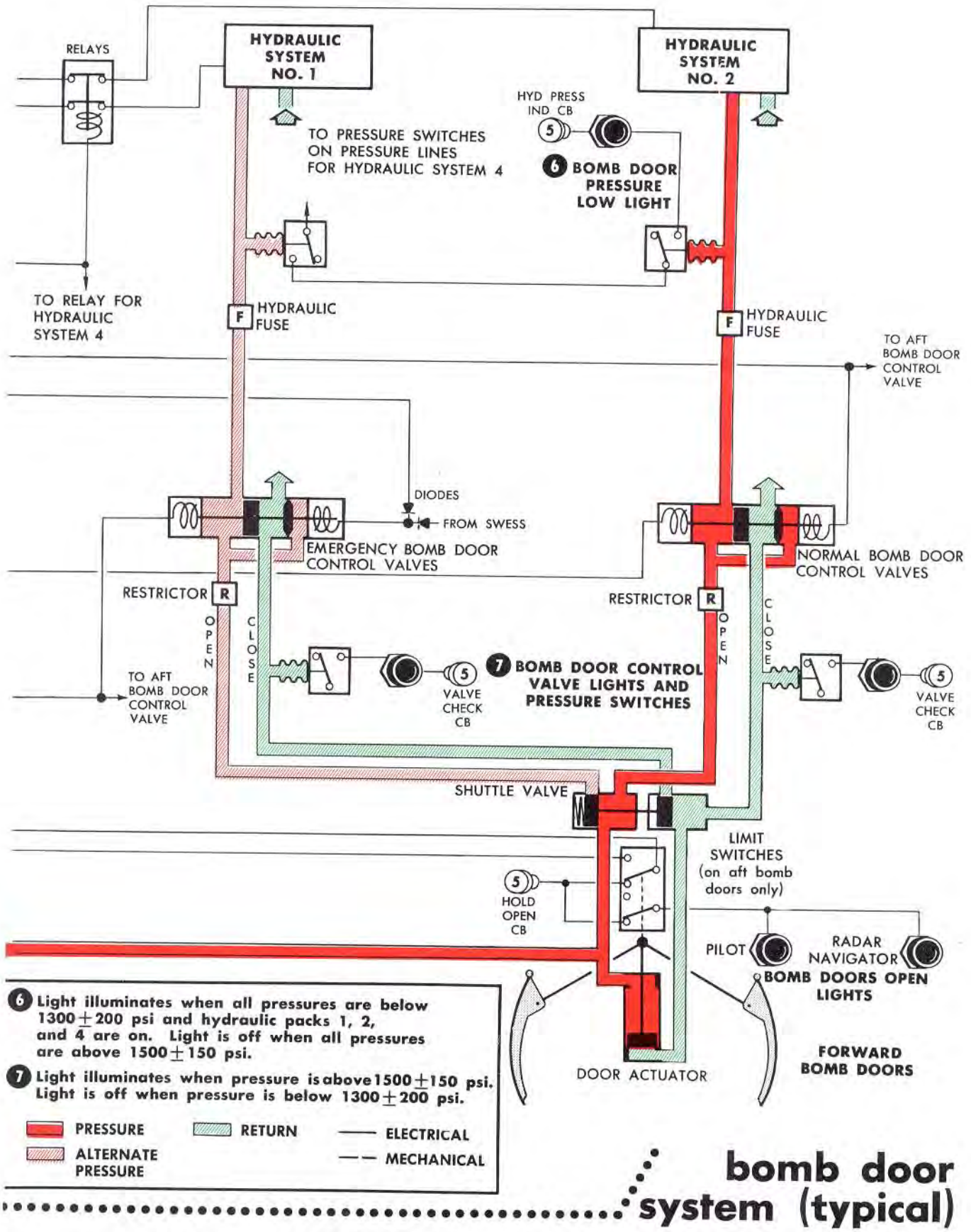


Figure 4-53 (Sheet 1 of 2).



bomb door system (typical)

Figure 4-53 (Sheet 2 of 2).

Bomb Door Pressure Low Light

An amber bomb door pressure low light (3, figure 4-48) is located on the door and bomb control panel. The bomb door pressure low light, when illuminated, indicates that hydraulic pressure from hydraulic packs 1, 2, and 4 are all below 1300 ± 200 psi and the landing gear is not up and locked or the master bomb control switch is ON. The light goes out when the hydraulic pressure from any of these hydraulic packs is above 1500 ± 150 psi. The light is supplied TR power through a series circuit with the pressure switches on the hydraulic pressure lines from these hydraulic packs. The bomb door pressure low light is supplied TR power through a circuit breaker marked "Bomb Door Hyd Press Ind" on the "Bomb System" portion of the radar navigator's circuit breaker panel.

Bomb Door Control Valve Lights

Three amber bomb door control valve lights (64, figure 4-38A) are on the radar navigator's side panel. Each light receives TR power through a pressure switch on the bomb door close line located between the respective control valve and the shuttle valve (packs 1 and 2) or the hydraulic door actuator (pack 4). The bomb door control valve lights are supplied TR power through a circuit breaker marked "Bomb Door Valve Check" on the "Bomb System" portion of the radar navigator's circuit breaker panel. Each light, when illuminated, indicates the corresponding bomb door control (4 way) valve is directing hydraulic pressure to the respective bomb door close line. If opening is attempted with a bomb door control valve light illuminated, trapped door closing pressure may be indicated and bomb door damage may occur. If a bomb door control valve light is illuminated when there is no pressure on the corresponding hydraulic system, it indicates the corresponding bomb door control valve light pressure switch is malfunctioning. This, of course, does not indicate whether or not the bomb door control valve (4 way) is operating correctly. Each light will illuminate when the hydraulic pressure in the close line is approximately 1500 psi and go off when the hydraulic pressure in the close line is approximately 1300 psi. Operation of the lights is as follows:

1. During Opening - All lights off
2. During Closing - Emergency light on, main lights off.

It is possible that one or both of the main light(s) may momentarily blink and/or remain on during closing.

3. Doors Closed and Properly Latched - All lights off
4. If the forward main hydraulic pack (pack 2) fails, all lights will be off during closing (blinking or steady illumination of the operating lights may still occur).

CAUTION

If a bomb door control valve light remains illuminated after the doors are closed and properly latched, door damage may occur if the doors are opened. See "Bomb Door Control Valve Lights Illuminated with Bombing System Switch in the MANUAL Position," this section.

BOMB DOOR SYSTEM NORMAL OPERATION

The BNS and the bomb door switches at the pilot's and radar navigator's station are used for normal operation of the bomb doors. For normal operation of the bomb doors, hydraulic pack switches 1, 2, and 4 should be positioned ON, even though it is possible for one hydraulic pack to open the bomb doors. The standby pumps are not available to open the bomb doors when the landing gear is retracted. The bomb door pressure low light at the radar navigator's station will illuminate only if the pressures from the applicable hydraulic packs are all low when the landing gear is not up and locked or the master bomb control switch is ON. The bomb door control valve lights on the radar navigator's side panel will illuminate if there is pressure in the bomb door close lines. The bomb doors not latched lights will illuminate when the forward bomb door latch is unlatched and they remain illuminated until the forward bomb door latch is latched again. When illuminated, the bomb doors open lights indicate the bomb doors are fully open and the bomb door system will now hold the bomb doors open until closing action is initiated.

CAUTION

Do not operate the bomb doors with either the standby pumps or the accumulators as equipment may be damaged. The hydraulic packs must be used to operate the bomb doors.

Bomb Door Operation With BNS

The BNS will automatically open and close the bomb doors at the proper time according to a predetermined setting. When the BNS is operating in the bomb mode and the bombing system switch is in AUTO, the BNS sends a continual door close signal to the bomb door system. This door close signal is interrupted only when the BNS sends a door open signal or the salvo/jettison circuits are energized. When the bomb door close timer does not receive a bomb release pulse from the bomb intervalometer for approximately 3 seconds following the first bomb release pulse the bomb door close timer provides a continuous door close signal, closing the bomb doors. To operate the bomb doors and obtain a release with the BNS:

1. BNS Bomb Mode Button - Depress
2. Hydraulic Pack Switches 1, 2, and 4 - ON
3. Master Bomb Control Switch - ON
4. Bomb Indicator Lights Switch - ON
5. Bombing System Switch - AUTO
6. Special Weapons Select Switch - FWD or AFT RACK
7. Release Circuits Disconnect PR - Connected
8. BRIC - Set

Bomb Door Operation With Radar Navigator's Bomb Door Switch

To open the bomb doors with the radar navigator's bomb door switch:

1. Hydraulic Pack Switches 1, 2, and 4 - ON
2. Master Bomb Control Switch - ON

3. Bombing System Switch - MANUAL
4. Radar Navigator's Bomb Door Switch - OPEN

Hold the switch in the OPEN position until the bomb doors open lights are illuminated, then release the switch. The bomb doors will remain open and the hydraulic packs will remain in operation. Loss of hydraulic pressure will allow the bomb doors to be positioned by the airstream loads.

To close the bomb doors with the radar navigator's bomb door switch:

1. Hydraulic Pack Switches 1, 2, and 4 - ON
2. Master Bomb Control Switch - ON
3. Bombing System Switch - MANUAL
4. Radar Navigator's Bomb Door Switch - CLOSE

Hold the switch in the CLOSE position until the bomb doors not latched lights are out, then release the switch. The bomb doors will remain closed. The hydraulic packs will remain in operation until the master bomb control switch is positioned to OFF or the hydraulic pack switches are positioned to OFF & RESET.

Bomb Door Operation With Pilot's Bomb Door Switch

To open the bomb doors with the pilot's bomb door switch:

1. Hydraulic Pack Switches 1, 2, and 4 - ON
2. Pilot's Bomb Door Switch - OPEN

Hold the switch in the OPEN position until the bomb doors open lights illuminate, then release the switch. The bomb doors will remain open and the hydraulic packs will remain in operation. Loss of hydraulic pressure will allow the bomb doors to be positioned by the airstream loads.

CAUTION

Do not attempt to open the bomb doors with the pilot's bomb door switch when the bombing system switch is in the AUTO position and the BNS is operating in the bomb mode, as the bomb doors will keep cycling (opening partly and then slamming closed) until either the pilot's bomb door switch is positioned OFF or the bombing system switch is positioned to MANUAL.

To close the bomb doors with the pilot's bomb door switch:

1. Hydraulic Pack Switches 1, 2, and 4 - ON
2. Pilot's Bomb Door Switch - CLOSED

Hold the switch in the CLOSED position until the bomb doors not latched lights are out, then release the switch. The bomb doors will remain closed, and the hydraulic packs will be shut down, provided the master bomb control switch is OFF.

BOMB DOOR SYSTEM EMERGENCY OPERATION

Bomb Door Emergency Operation With Jettison Switches

When the jettison circuits are energized, hydraulic packs 1, 2, and 4 are energized, the bomb doors close signal from the BNS is interrupted, and the bomb doors are opened. The jettison circuits can be deenergized by actuation of the pilot's bomb door switch to the CLOSED position. The pilot's bomb door switch not only deenergizes the jettison circuits but also closes the doors. The radar navigator's bomb door switch performs the same function as the pilot's bomb door switch when the bombing system switch is in MANUAL.

Bomb Door Emergency Operation With Forward Special Weapon Manual Release Handle

Pulling the forward special weapon manual release handle through the first 9 inches of travel will manually unlatch the bomb doors. Air loads will position the bomb doors after they are unlatched, provided none of the hydraulic systems 1, 2, and 4 are pressurized and the bomb door system is not receiving a door close signal from the bomb door switches or the BNS. When the bomb doors are unlatched, the bomb doors unlatched lights will illuminate provided TR power is available. To close the bomb doors, use a procedure described under "Bomb Door System Normal Operation" in this section.

NOTE

Due to a mechanical interlock incorporated in the forward special weapon manual release system, the bomb doors cannot be unlatched with this system without first pulling the special weapons manual lock handle. All special weapon racks and the AGM-28 missile separation systems are unlocked when the special weapons manual lock handle is actuated.

Bomb Door Control Valve Lights Illuminated with Bombing System Switch in the AUTO Position

If all the bomb door control valve lights are illuminated when the bomb doors are closed and latched and the bombing system switch is in AUTO, the BNS, when operating in the bomb mode, may be sending a door close signal through a defective door close limit switch which is actuating the door close system. The following steps are recommended to check this condition:

1. Place the bombing system switch to MANUAL. Positioning the bombing system switch to MANUAL stops BNS control of the doors.

2. Check that the master bomb control switch is ON. Check the master bomb control switch ON so the hydraulic system will remain pressurized when the door close signal is stopped.
3. If the bomb door control valve light(s) goes off after accomplishing steps "1" and "2," the bomb door system is safe for operation provided the respective hydraulic systems are pressurized.
4. If the bomb door control valve light(s) remains illuminated after accomplishing steps "1" and "2," refer to the procedure under "Bomb Door Control Valve Lights Illuminated with Bombing System Switch in the MANUAL Position," this section.

Bomb Door Control Valve Lights Illuminated with Bombing System Switch in the MANUAL Position

If the bomb door switches are both out of the CLOSE(D) position and the bombing system switch is in MANUAL with the respective hydraulic system pressurized, an illuminated bomb door control valve light may indicate the corresponding bomb door control (4 way) valve is stuck in a position to direct hydraulic pressure to the corresponding bomb door close line. Opening the bomb doors in this condition may cause them to be damaged. The following steps are recommended to check the system:

1. Master Bomb Control Switch - ON

NOTE

Hydraulic pack 1 or 2 must be in operation in order to bleed hydraulic pressure from hydraulic pack 3 or 4.

2. Affected Hydraulic Pack Switch - OFF

CAUTION

Do not attempt to free a bomb door control (4 way) valve or bleed hydraulic pressure by means of the bomb door switches as this procedure may damage the bomb door system.

3. Brake Pedals - Actuate

Pump brake pedals to deplete the system hydraulic pressure to zero.

a. Bomb door control valve light remains illuminated.

(1) A malfunctioning bomb door control valve light pressure switch is indicated if the light remains illuminated when the affected hydraulic system pressure is zero. This, of course, does not indicate whether or not the control valve (4 way) is operating properly.

(2) If hydraulic packs 1 or 2 are affected, the system is safe for bomb door operation since an alternate system is available; however, the affected hydraulic pack switch will remain positioned in OFF & RESET for subsequent bomb door operation only.

(3) If hydraulic pack 4 is affected, there is no alternate source of pressure. Further, the position of the control valve (4 way) is unknown. It the control valve (4 way) is stuck in the close position, the bomb doors would be damaged if opened.

CAUTION

Do not operate the bomb doors with the aft main bomb door control valve light illuminated unless imperative to do so since this may result in damage to the bomb doors.

b. Bomb door control valve light not illuminated.

(1) A bomb door control (4 way) valve stuck in the CLOSE position is indicated.

(2) If hydraulic pack 1 or 2 is affected, the system is safe for bomb door operation since an alternate system is available; however, the affected hydraulic pack switch will remain positioned in OFF & RESET for subsequent bomb door operation only.

(3) If hydraulic pack 4 is affected, it is not safe to open the doors. Since there is no alternate source of hydraulic pressure for this pack (bomb door operation) and the control valve (4 way) is stuck in the CLOSE position, the bomb doors would be damaged if opened because of a hydraulic lock in the aft actuator.

CAUTION

- When bomb doors are operated with power to only the forward bomb door actuator, aircraft speed should not exceed 325 knots IAS, if practical, as a precaution against buffeting and structural damage to the doors.
- Do not operate bomb doors in flight with power to only the rear bomb door actuator except when imperative to do so since this may result in loss of portions of the bomb doors and possible damage to the aft body structure and empennage.

MISSILE SYSTEM (ADM-20)

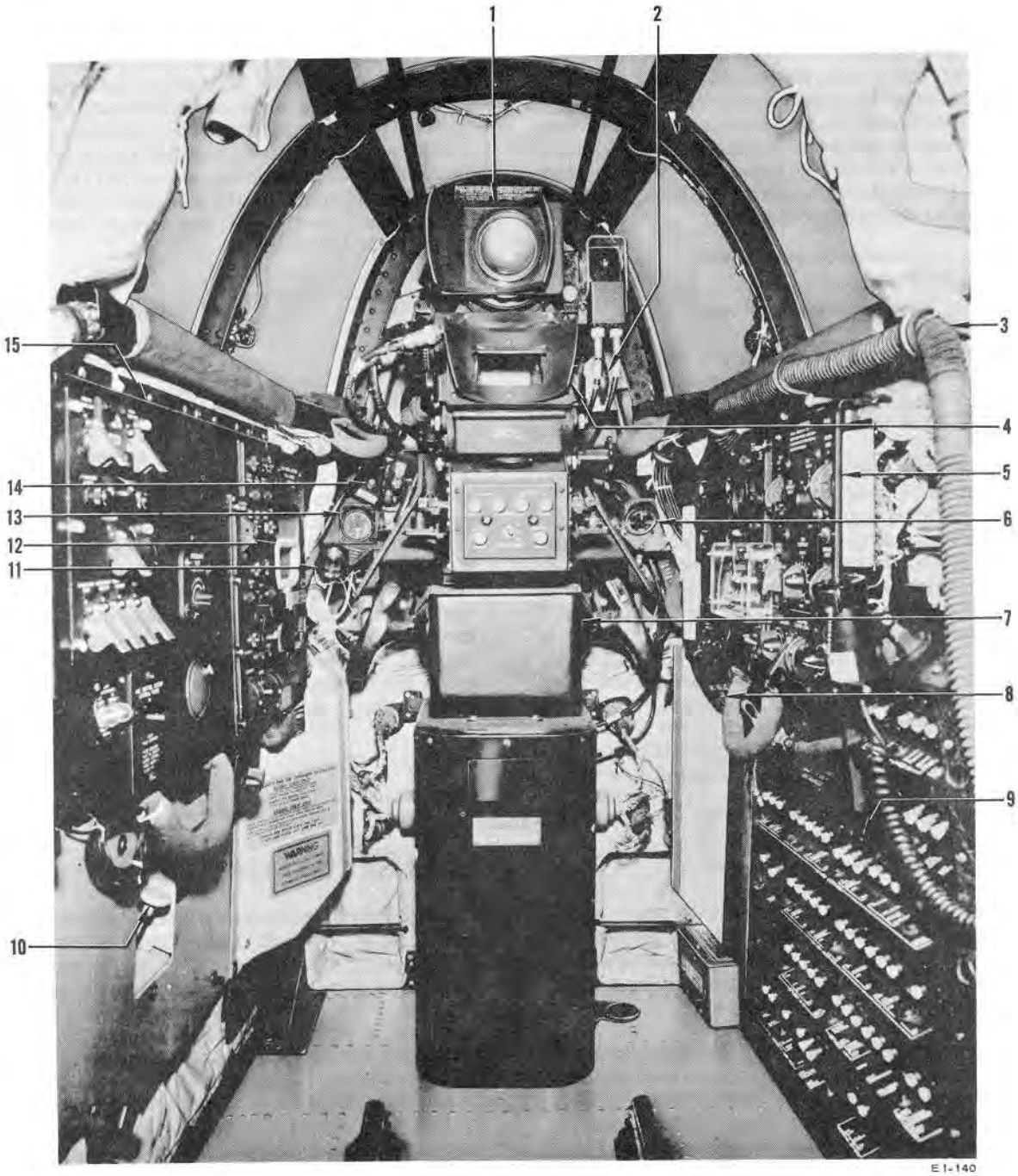
The aircraft has provisions for mounting, launching, and controlling four ADM-20 missiles located in the aft portion of the bomb bay. The radar navigator has the controls and indicators for missile guidance and launching. Both pilots and the radar navigator have jettison capability and the copilot has the switches and indicators for missile fire detection. (See "Fire Warning System," Section I.) For further information, refer to T.O. 1B-52E-1-4.

MISSILE SYSTEM (AGM-28)

The airplane has provisions for mounting and controlling two AGM-28 (Hound Dog) missiles. The missiles are mounted on pylons attached to the left and right wings between the fuselage and the inboard engine nacelles. The copilot has the controls and indicators for missile engine operation and the missile fire detection system switches and indicators. The navigator has the controls and indicators for missile guidance, arming, and launch. The pilots and the radar navigator have jettison switches. The radar navigator can also release the missile by means of the BNS. For further information, refer to T.O. 1B-52C-30-1.

GUNNERY SYSTEM (MD-9)

The MD-9 fire control system has the ability to search, detect, acquire, track, and compute correct lead angle for attacking enemy aircraft. At the same time the system automatically and continuously positions the turret and then provides accurate gunfire against the targets. A hemispheric sight is provided to permit visual search and manual tracking if the radar mode is inoperative. The gunner has the controls and indicators for operation of the system. For inflight operating procedures and general overall technical information, refer to T.O. 1B-52B-1-5.



1. HEMISPHERIC SIGHT
2. HEMISPHERIC SIGHT COVER HANDLE
3. OXYGEN SUPPLY HOSE
4. RADAR INDICATOR
5. GUNNER'S SIDE PANEL
6. GUN CHARGER AIR PRESSURE GAGE
7. CONTROL COLUMN
8. HEATED AIR OUTLET
9. GUNNER'S CIRCUIT BREAKER PANEL
10. TURRET-DRAG CHUTE INTERCONNECT CONTROL KNOB
11. EMERGENCY ALARM LIGHT
12. TAIL CONE JETTISON HANDLE
13. CABIN ALTIMETER
14. INTERPHONE CALL LIGHT
15. GUNNER'S SIDE PANEL

gunner's station

Figure 4-54.

GUNNERY SYSTEM MD-9

The MD-9 fire control system has the ability to search, detect, acquire, track, and compute correct lead angle for attacking enemy aircraft. At the same time the system automatically and continuously positions the turret and then provides accurate gunfire against the targets. A hemispheric sight is provided to permit visual search and manual tracking if the radar mode is inoperative. An N-9 16mm camera on the right side of the hemispheric sight photographs the central portion of the sight as seen by the gunner. A hemispheric sight cover is provided to protect the optical sight from the effects of the special weapon. The cover is mechanically operated and covers the lower half of the external sight head when extended. When open (retracted), the cover segments may be seen in the lower field of view of the gunsight. Controls for operation of the FCS are located on the control panel and the control handles located on the control column. A radar indicator is located above the control column. The indicator scope is a dual gun cathode ray tube. Two-thirds of the screen area is used for B-type display (azimuth and range). The lower third of the scope area is used for C-type display (azimuth and elevation). There are three basic modes of operation in using the fire control system; namely search, acquisition, and track. Each of these modes have several variations in its operational sequences. A combination of these various sequences allows the system to operate even when partially disabled. Although the firing zone covers 60° right or left and 40° above and 50° below the centerline of the airplane, targets may be detected in an area covering essentially the rear hemisphere. The search radar will detect targets out to 8000 yards and automatic tracking using the track radar can begin at 6000 yards. For targets with higher reflectivity, these ranges may be increased up to 20,000 yards and 7,500 yards respectively. Depending on the mode of operation, radar or manual controls supply commands for the servo system which drives the hydraulically operated turret. The turret armament consists of four M-3 .50 calibre machine guns, each supplied with 600 rounds of ammunition, together with the ammunition feed, pneumatic gun chargers, boosters, and ejection chutes. A 1500 psi pneumatic system is reduced to 800 pounds for gun charging and 15 to 18 psia for pressurizing the search and track radar units. Primary 118/205-volt a-c power is supplied to the fire control system through circuit breakers marked "Track Radar ØA, ØB, and ØC," "Search Radar ØA, ØB, and ØC," "Turret ØA, ØB, and ØC," "Air Compr ØA, ØB, and ØC," "Cont Col ØA, ØB, and ØC," "Power Central ØA, ØB, and ØC," and "Ammo Bstrs ØA, ØB, and ØC." TR power is supplied through circuit breakers marked "DC Pwr," "Track," "Search," "Htrs," "Compr," and "Cont Panel." All circuit breakers are on the "Fire Control" portion of the gunner's circuit breaker panel. High voltage d-c power, two-phase a-c power, and 400-cycle precision voltages are supplied by system components.

GUNNERY SYSTEM CONTROLS

Control Panel

The control panel (2, figure 4-55) is located on the gunner's side panel. Two optional configurations of this panel are used. Since they can be interchanged readily, it is not possible to code them. They are therefore called out as panel A and panel B for reference purposes.

Power Switch

A power switch on the control panel (8, figure 4-56) has OFF--WARMUP--ON positions and the main power switch for the system. When in OFF position, the fire control system is inoperative. The WARMUP position prepares the system for operation allowing time for the gyros to reach their proper operating temperatures. In this position search radar may be used. When the power switch is positioned to ON and the gyros ready lamp illuminates, the fire control system is fully operational. At this point, the gunner can begin his normal operating procedure for the system.

NOTE

- On airplanes equipped with control panel A (figure 4-56), the gyros ready light will remain illuminated when the power switch is placed in ON position. On airplanes equipped with control panel B (figure 4-56), the gyros ready light will go out when the power switch is placed in ON position.

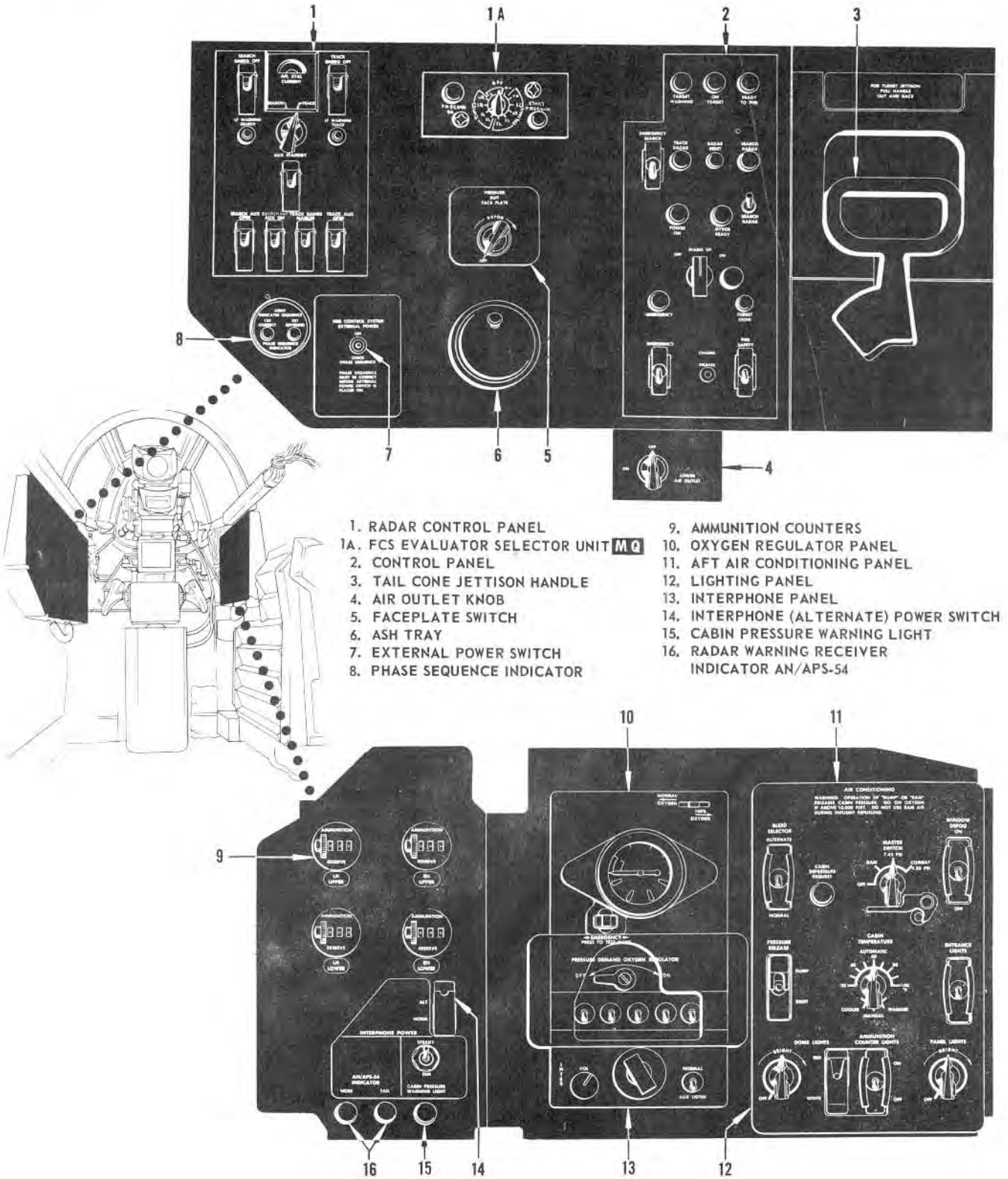
- On airplanes equipped with control panel A, the power switch is provided with a detent which prevents moving it inadvertently to ON position without proper warmup of the system. On airplanes equipped with control panel B, the power switch has no detent.

Fire Safety Switch

The fire safety switch on the control panel (10, figure 4-56) has READY (up)--SAFE (down) positions. READY (up) position energizes the gun firing circuits to permit firing of the guns when the action switches and triggers are depressed. The SAFE (down) position deenergizes the gun firing circuits.

Hemispheric Sight Cover Handle

A sight cover handle (2, figure 4-54) just below and to the right (facing aft) of the hemispheric sight is provided to actuate the hemispheric sight cover. To extend the cover, rotate the handle counterclockwise to unlock it, push it in to the stop, and rotate the handle clockwise to lock it in CLOSED (cover extended) position. To retract the cover, rotate the handle counterclockwise, pull to the stop, and rotate the handle clockwise to lock it in OPEN (cover retracted) position.



1. RADAR CONTROL PANEL
1A. FCS EVALUATOR SELECTOR UNIT MQ
2. CONTROL PANEL
3. TAIL CONE JETTISON HANDLE
4. AIR OUTLET KNOB
5. FACEPLATE SWITCH
6. ASH TRAY
7. EXTERNAL POWER SWITCH
8. PHASE SEQUENCE INDICATOR
9. AMMUNITION COUNTERS
10. OXYGEN REGULATOR PANEL
11. AFT AIR CONDITIONING PANEL
12. LIGHTING PANEL
13. INTERPHONE PANEL
14. INTERPHONE (ALTERNATE) POWER SWITCH
15. CABIN PRESSURE WARNING LIGHT
16. RADAR WARNING RECEIVER INDICATOR AN/APS-54

gunner's side panels

Figure 4-55.

Search Radar Switch

A search radar switch on the control panel (7, figure 4-56) has ON (up)--OFF (down) positions. ON (up) position places the search radar in operation when the power switch is in WARMUP or ON position after approximately a 3 1/2-minute warmup period.

Control Handles

Control handles (6, figure 4-57) on the control column pedestal control the line-of-sight pointer, optics of the hemispheric sight, circle cursor on the C-scope, and the turret in azimuth and elevation. The intensified sweep on the B-scope is controlled in azimuth. They are used for search, target acquisition, and manual tracking of the target. Switches are mounted on the control handles, right and left referring to gunner's right and left facing aft, to establish the mode of operation of the system.

ACTION SWITCH. An ON--OFF action switch (11, figure 4-57) spring-loaded to OFF position is located on each control handle. In ON position, either switch allows azimuth and elevation control of the line-of-sight pointer, gunsight optics, and the circle cursor on the C-scope.

TRACK PRESS BUTTON. A track press button (8, figure 4-57) spring-loaded to OFF position is on the left control handle. LIGHT PRESS position causes the turret to come out of stow and align itself according to signals received from the control handles provided the action switches are depressed. At the same time the range gate sweeps to 7500 yards and the radar lock-on circuitry is energized. HARD PRESS position places the track radar in short sweep condition, reducing the sweep range from 7500 to 2500 yards.

SECOND TARGET BUTTON. The second target button (12, figure 4-57) spring-loaded to OFF position is on the right control handle. ON position enables the operator to position the circle cursor and optics on a second target. When the track press button is pressed, the turret will reject the first target and slew to the position indicated by the circle cursor. When the range gate locks on, the system is in automatic tracking.

TRACK SELECT SWITCH. A track select switch (13, figure 4-57) located on the right control handle is a two-position slide switch with RADAR--MANUAL positions. This switch provides a means of selecting the type of angular tracking desired by the operator. RADAR position is the normal operating position. MANUAL position allows the operator to manually control the tracking movement of the optics and turret by use of the control handles.

TRIGGER SWITCH. Either of two trigger switches (7, figure 4-57) on the control handles will fire all the guns in the turret simultaneously. An action switch must be depressed and the fire safety switch placed in READY (up) position. The trigger switches also control the operation of the N-9 camera.

Ranging Wheels and Wing Span Control

The ranging wheels (9, figure 4-57) on the control handle unit are rotary thumbwheel switches with RANGE IN--RANGE OUT directions of rotation and are used during manual ranging to provide ranging information for the computer. With the estimated target wing span set on the wing span control knob (2, figure 4-57), the ranging wheels are rotated to maintain the circumference of the sight reticle to just encircle the wing tips of the target. The corresponding range of the target will appear on the range scale visible in the sight and corrections of the computed range will be fed to the prediction computer. When ranging by radar, the ranging wheels in conjunction with second target and track press button may be used to unlock in-range from one target and lock on in-range to the next available target.

Range Select Switch

A range select switch (14, figure 4-57) having RADAR--MANUAL positions located below the right control handle controls the radar ranging of the track radar. RADAR position places the system in automatic range tracking. MANUAL position permits range tracking with the hemispheric sight through use of the ranging wheels when the radar ranging circuits fail.

Course Switch

A course switch (10, figure 4-57) below the left control handle with PURSUIT COURSE--STRAIGHT LINE COURSE positions permits changing of the computer feed to accommodate the type of maneuver of the target airplane.

Search Emergency Off Switch

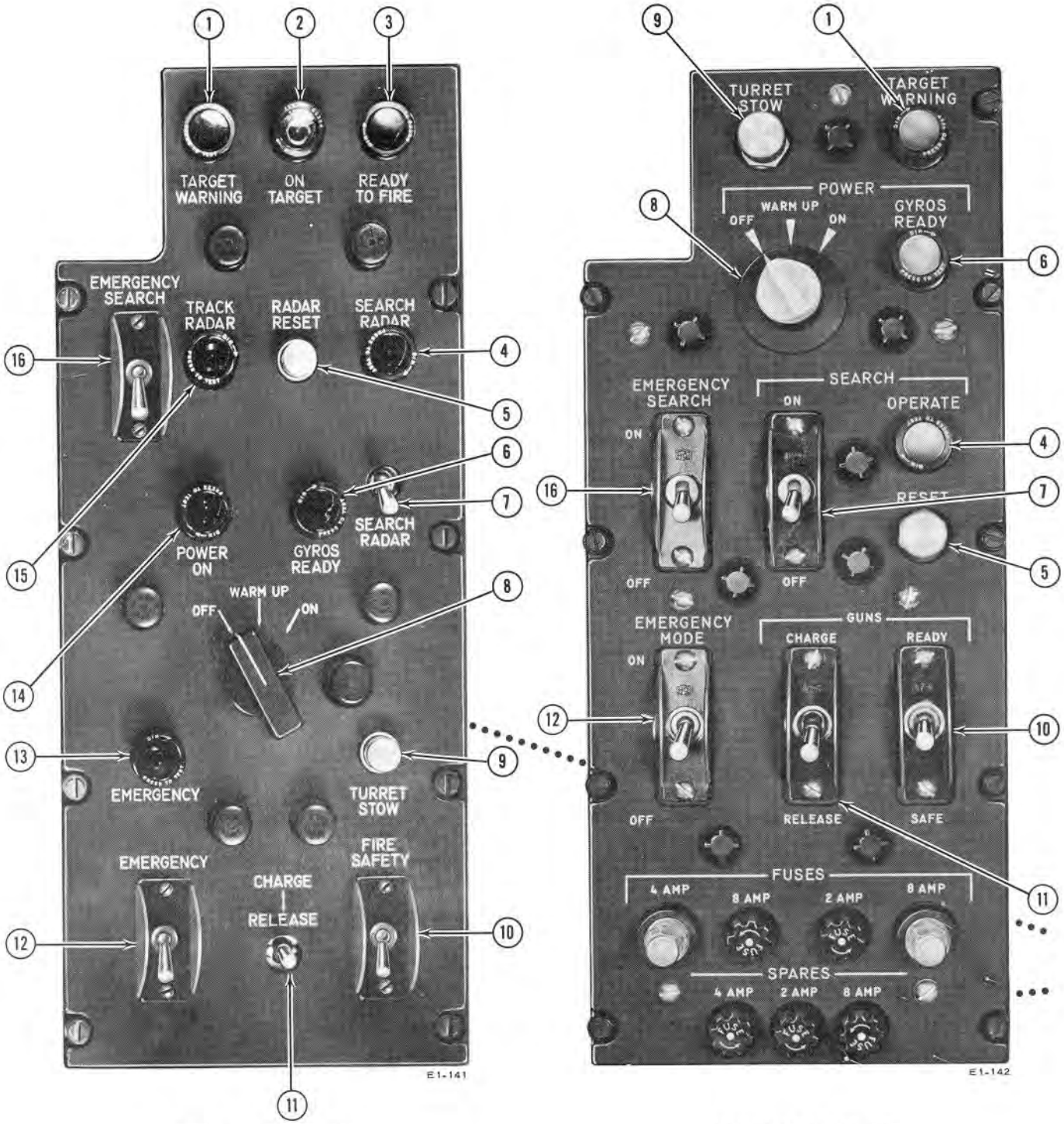
A search emergency off switch (17, figure 4-56) on the radar control panel has ON--OFF positions and is guarded to ON position. OFF position removes all power from the search radar including the search radar indicator.

Track Emergency Off Switch

A track emergency off switch (19, figure 4-56) on the radar control panel has ON--OFF positions and is guarded to ON position. OFF position removes all power from the track radar.

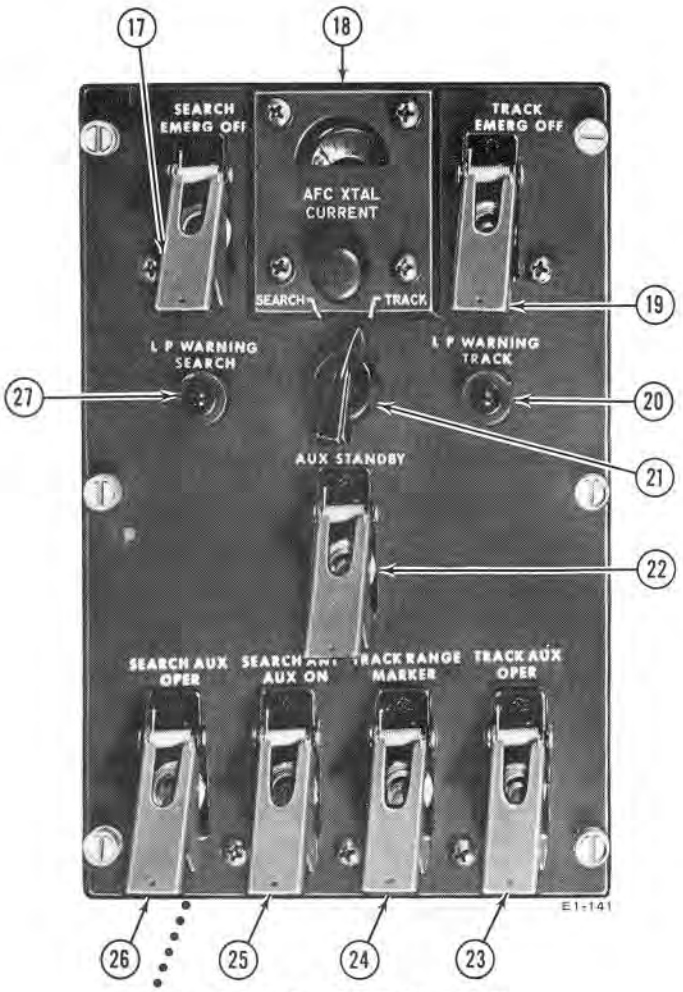
AFC Crystal Current Selector Switch

An AFC crystal current rotary selector switch (21, figure 4-56) on the radar control panel has SEARCH--TRACK positions. SEARCH position permits the search radar crystal current to be read on the AFC crystal current meter. TRACK position permits the track radar crystal current to be read on the meter.



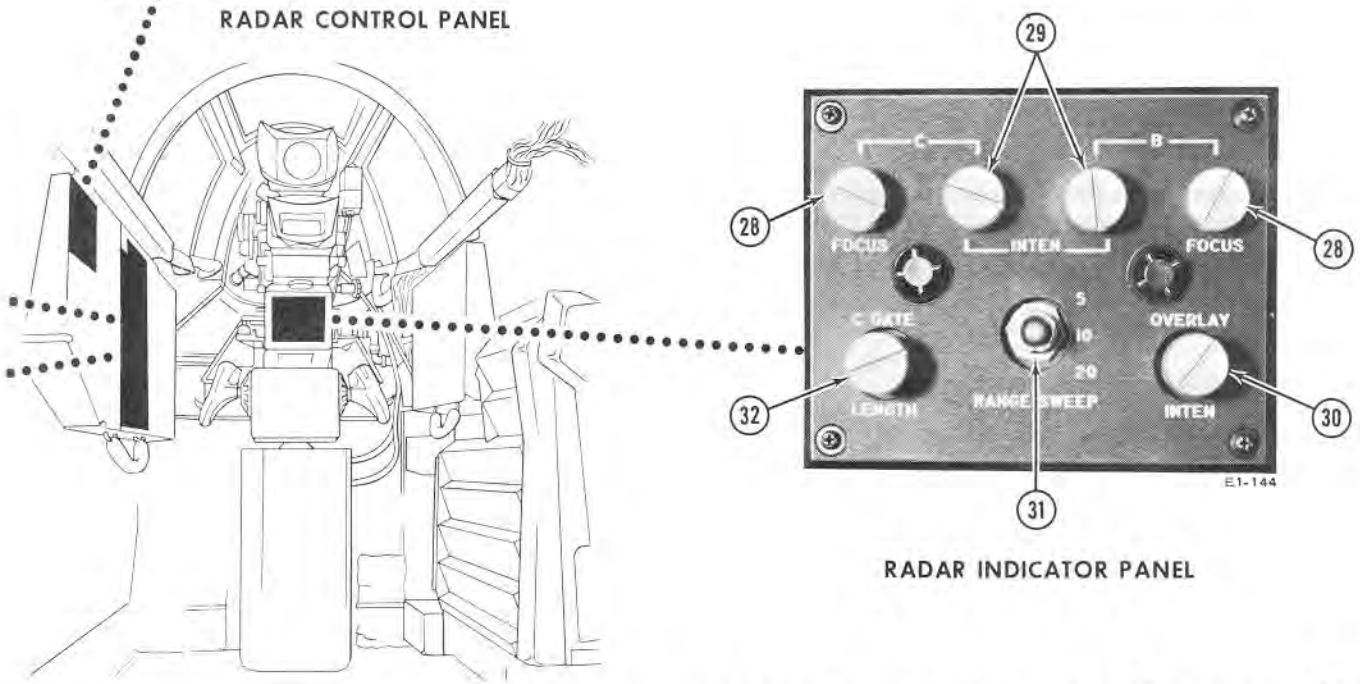
CONTROL PANEL (A) CONTROL PANEL (B)

Figure 4-56. (Sheet 1 of 2).



RADAR CONTROL PANEL

1. TARGET WARNING LIGHT
2. ON TARGET LIGHT
3. READY TO FIRE LIGHT
4. SEARCH RADAR OPERATE LIGHT
5. RADAR RESET BUTTON
6. GYROS READY LIGHT
7. SEARCH RADAR SWITCH
8. POWER SWITCH
9. TURRET STOW BUTTON
10. FIRE SAFETY SWITCH
11. GUN CHARGER SWITCH
12. EMERGENCY MODE SWITCH
13. EMERGENCY MODE LIGHT
14. POWER ON LIGHT
15. TRACK RADAR LIGHT
16. EMERGENCY SEARCH SWITCH
17. SEARCH EMERGENCY OFF SWITCH
18. AFC CRYSTAL CURRENT METER
19. TRACK EMERGENCY OFF SWITCH.
20. TRACK LOW PRESSURE WARNING LIGHT
21. AFC CRYSTAL CURRENT SELECTOR SWITCH
22. AUXILIARY STANDBY SWITCH
23. TRACK AUXILIARY OPERATE SWITCH
24. TRACK RANGE MARKER SWITCH
25. SEARCH ANTENNA AUXILIARY ON SWITCH
26. SEARCH AUXILIARY OPERATE SWITCH
27. SEARCH LOW PRESSURE WARNING LIGHT
28. FOCUS CONTROL
29. INTENSITY CONTROL
30. OVERLAY CONTROL
31. RANGE SWEEP SELECT SWITCH
32. C-GATE CONTROL



RADAR INDICATOR PANEL

gunnery system control panels

Figure 4-56. (Sheet 2 of 2).

Auxiliary Standby Switch

An auxiliary standby switch (22, figure 4-56) on the radar control panel has ON--OFF positions and is guarded to OFF (down) position. ON (up) position applies standby power to the search and track radars only.

Track Auxiliary Operate Switch

A track auxiliary operate switch (23, figure 4-56) on the radar control panel has ON--OFF positions and is guarded to OFF (down) position. ON (up) position places the track radar in the operate condition independent of the remainder of the system provided the auxiliary standby switch is on STANDBY.

Track Range Marker Switch

A track range marker switch (24, figure 4-56) on the radar control panel has ON--OFF positions and is guarded to OFF (down) position. ON (up) position provides internal 500- and 2000-yard range marks for testing track radar lock-on.

Search Antenna Auxiliary On Switch

A search antenna auxiliary on switch (25, figure 4-56) on the radar control panel has ON--OFF positions and is guarded in OFF (down) position. ON (up) position permits the search antenna to be rotated independent of the remainder of the system provided the auxiliary standby switch is on STANDBY.

Search Auxiliary Operate Switch

A search auxiliary operate switch (25, figure 4-56) on the radar control panel has ON--OFF positions and is guarded in OFF (down) position. ON (up) position places the search radar in the operate condition independent of the remainder of the system provided the auxiliary standby switch is on STANDBY.

Cursor Intensity Control MT

A cursor intensity control knob (5A, figure 4-57) on the left side of the radar indicator panel controls the brightness of the circle cursor displayed on the radar indicator scope from a "no-circle" cursor presentation in counterclockwise position to a full intensity cursor in extreme clockwise position.

Automatic Noise Level Control MT

An automatic noise level control knob (19, figure 4-57) located on the right side of the radar indicator panel enables the operator to compensate for differences between ambient noise conditions on the ground and in flight, for changes due to deterioration occurring in automatic noise level circuitry due to ambient temperatures, and for differences in indicator presentations desired by various operators. Range of adjustment available with use of this control is minimum noise level amplitude in full counterclockwise (detent) position to maximum noise level in the extreme clockwise direction of rotation.

Radar Reset Button

A radar reset button (5, figure 4-56) on the control panel is pressed and released to reset the overload relays in the search radar.

Turret Stow Button

A turret stow button (9, figure 4-56) on the control panel returns the turret to stow position when pressed.

Gun Charger Switch

A gun charger switch (11, figure 4-56), spring-loaded to RELEASE, on the control panel has CHARGE--RELEASE positions. CHARGE position draws the bolt to the rear and holds it back until released. RELEASE position releases the bolt thus charging the guns.

Emergency Switch (Emergency Mode Switch, "B" Panel)

An emergency (mode) switch (12, figure 4-56) on the control panel has ON (up)--OFF (down) positions. ON (up) position places the system in the emergency mode.

Emergency Search Switch

An emergency search switch (16, figure 4-56) with ON (up)--OFF (down) positions is on the control panel. ON (up) position places the track radar in emergency search condition and places the track radar return on the radar indicator scope.

GUNNERY SYSTEM INDICATORS

Power On Light

The red power on light (14, figure 4-56) on the control panel A serves to indicate that power is applied to the system.

Gyros Ready Light

The red gyros ready light (5, figure 4-56) on the control panel indicates that the gyros are ready for operation. This light should, under normal conditions, illuminate in less than 20 minutes after the power switch has been placed in WARMUP position. Cold weather operation may extend the warmup period. The power switch can then be placed in ON position and the system will be fully energized. On airplanes equipped with control panel A, the gyros ready light will remain illuminated when the power switch is placed in ON position. On airplanes equipped with control panel B, the gyros ready light will go out when the power switch is placed in ON position.

CAUTION

No tracking operation should be attempted until the gyro ready lights indicate gyros are timed out.

Search Radar Operate Light

A red search radar operate light (4, figure 4-56) on the control panel illuminates if the search radar is in the operate condition. To enter the operate condition, the search radar system must warm up approximately 3 1/2 minutes and the search radar switch must be in ON (up) position.

NOTE

If the light should go out subsequently, press the radar reset button to reinstate overload protection. If the search radar light should blink on and off, turn the search radar switch to OFF (down) for approximately 1 minute and then back to ON (up) position. This is to correct reverse current relay action.

Track Radar Light

A red track radar light (15, figure 4-56) on control panel A illuminates when the track radar is operating.

Target Warning Lights

Red target warning lights on the control panel (1, figure 4-56) and on the radar indicator (15, figure 4-57) are normally on and will start flashing when a target approaches within the area covered by the radar C-scope.

On Target Lights

Amber on target lights (2, figure 4-56) on control panel A and on the radar indicator (15, figure 4-57) will illuminate when the track radar has locked on a target.

Ready To Fire Lights

Green ready to fire lights (3, figure 4-56) are on control panel A and on the radar indicator (15, figure 4-57). When tracking in range and the turret is not in limits, these lights illuminate when the target approaches within 1500 yards, indicating that defensive fire can begin.

Line-of-Sight Pointer

A line-of-sight pointer (17, figure 4-57) on the right side of the hemispheric sight provides a line-of-sight reference for the optics in azimuth and elevation at all times.

Radar Indicator

The radar indicator (15, figure 4-57) provides a visual reference of target range, azimuth, and elevation. The upper two-thirds of the screen area is called the B-scope and the lower third the C-scope. The B-scope displays range and azimuth for targets out to the maximum range of the search radar. The C-scope displays azimuth and elevation for targets within range limits selected by the gunner. A bright vertical line on the B-scope and a small circle on the C-scope provide line-of-sight cursors for bringing the hemispheric sight and the track radar antenna to bear on the target by means of control handles. Indicator scales are calibrated in yards of range and degrees of azimuth and elevation.

Ammunition Reserve Counter

Four ammunition counters (9, figure 4-55) are on the gunner's side panel. When set to the initial number of rounds loaded for the respective gun, the indicator will indicate the number of rounds remaining as ammunition is expended. A thumbwheel is provided in the face of the indicator for setting in the desired number of rounds.

AFC Crystal Current Meter

A crystal current meter (18, figure 4-56) on the radar control panel is used to read crystal current of either the search radar or track radar depending on the position of the selector switch.

Track Low Pressure Warning Light

A red track low pressure warning light (20, figure 4-56) on the radar control panel indicates low air pressure in the track frequency converter transmitter unit.

Search Low Pressure Warning Light

A red search low pressure warning light (27, figure 4-56) on the radar control panel indicates low air pressure in the search frequency converter transmitter unit.

Emergency Light

A red emergency light (13, figure 4-56) on control panel A indicates that the emergency switch is in ON (up) position.

FLIGHT OPERATOR EVALUATOR (FEO) MC

An FCS operator evaluator system consisting of a selector unit and an analyzer set is installed in the aircraft with the selector unit located on the gunner's side panel at the gunner's station (1A, figure 4-55). The system (hereinafter called FEO) is interconnected with the fire control system for the purpose of training and to determine performance of operators in acquiring and firing on phantom or real targets of attacking aircraft. The analyzer is comprised of four functional assemblies; a frame assembly containing all electronic circuitry necessary for operation of the FEO, a programmer, recorder, and a target line servo unit. Operational modes of the evaluator system are controlled by the gunner at his station through the selector unit switch having four positions; OFF--WARMUP--PHANTOM TARGET--REAL TARGET. In OFF position, the evaluator system is rendered inoperative and the aircraft fire control system functions in the normal manner. In WARMUP position, the components of the analyzer set are permitted to warm up for a period of 5 minutes, at which time an evaluator on indicator light on the selector unit panel illuminates, indicating readiness of

the evaluator system. In PHANTOM TARGET position, the fire control system and the FEO work in conjunction to simulate attacking targets by presenting test patterns in the form of two phantom target courses which appear on the FCS radar display. The gunner proceeds to acquire, track, and accordingly dispose of the targets. During one sequence of programmed operation, 18 separate attacks with one or two targets are simulated. By changing the programmer cam magazine assembly, additional sequences of different attacks may be presented. Simulated targets are generated in the video generators of the evaluator analyzer set by search, track, and acquisition simulators which are controlled by the programmer and the radar beam position input from the fire control system. The programmer utilizes cam action with predetermined settings to create the phantom targets represented in azimuth, elevation, and range which are displayed on the gunner's radar indicator B and C scope. As the phantom targets are displayed, the gunner's action signals (voltages corresponding to closing and opening the fire control system action switches, acquiring and losing lock-on, and pressing and releasing the firing button) are fed to the recorder together with the signal solutions of the programmer to be recorded on a moving strip of photosensitive paper. Upon development of the paper strip, a comparison of the gunner's action and the programmer's solution may be evaluated to determine the gunner's response to targets during the acquisition and firing phases. In REAL TARGET position, the programmer and phantom target signal generating circuits are inoperative. The actions of the gunner during acquisition and actual firing phases are recorded as the real targets are detected by the radar and displayed on the B and C scope. The recordings made on the photosensitive paper by the recorder galvanometer are the same as that for phantom target operation except that no target identification data in the form of phantom targets is fed to the recorder. Control power is supplied to evaluator system through a circuit breaker marked "FCS Evaluator-Sel" on the gunner's circuit breaker panel.

Normal Operation of Flight Operator Evaluator

MC

Normal operation of the FCS operator evaluator in conjunction with the fire control system may be accomplished as follows:

To operate the FEO system in the phantom target mode:

1. Place fire control system in normal operation.
2. Place range select switch in RADAR.
3. Place track select switch on right control handle in RADAR (down).
4. Place fire safety switch in SAFE and insert safety pin.

CAUTION

The fire safety switch will remain in SAFE and pinned during the entire FEO operation.

5. Place FEO selector switch in WARMUP.

NOTE

The FEO selector switch should be allowed to remain in WARMUP until the evaluator on indicator light on the selector unit illuminates before proceeding with evaluator operation.

6. Place FEO selector switch in PHANTOM TARGET.

NOTE

At this time, the FEO will begin to generate test patterns for a period of 3 minutes, followed immediately by an approximate 20-second blanking of the radar display, and then the series of 16 phantom target problems will appear. The 3-minute test patterns are distinguished by an irregular/unrealistic type of target movement on the B and C scope; the gunner is not required to evaluate these test patterns.

7. Upon appearance of the phantom target problems, the gunner evaluates the displayed target course and operates the fire control system to dispose of the simulated threat in the most effective manner.

NOTE

To interrupt FEO operation for the return of fire control system to tactical use, place the FEO selector switch in OFF. Interrupted programming of phantom targets will resume with no delay when the selector switch is returned to PHANTOM TARGET.

8. The end of programmed phantom target operation is indicated by blankout of the radar display for approximately 70 seconds.
9. Place FEO selector switch in OFF.
10. Place FCS power switch in OFF.

To operate the FEO system in the real target mode:

1. Place fire control system in normal operation.
2. Place FEO selector switch in WARMUP.

NOTE

The FEO selector switch should remain in WARMUP until the evaluator on indicator light illuminates.

3. Place FEO selector switch in REAL TARGET. The FEO system is now ready to record gunner actions when operating the fire control system against actual targets.

NOTE

Optimum results are obtained in operation of the FEO system in "real target" mode when the fire control system is operated in manual track/radar range or manual track/manual range.

4. Place FEO selector switch in OFF.
5. Place FCS power switch in OFF.

FIRE CONTROL SYSTEM EVALUATOR (FEA) MQ

A fire control system evaluator system consisting of a selector unit, programmer, recorder, and analyzer set is installed in the aircraft with the selector unit (1A, figure 4-55) located on the gunner's side panel at the gunner's station. The system (hereinafter called FEA) is interconnected with the fire control system for the purpose of evaluating the inflight performance of the overall system. The system is capable of performing the following functions: 1) a boresight check to determine that the fire control system radar and guns are zeroed electrically and mechanically, 2) a radar gradient calibration check, 3) a system track check to determine that the FCS can follow an actual target in all four quadrants for either a straight line or a pursuit course, and 4) a system prediction check to determine that the prediction circuits of the FCS respond properly to programmed prediction signals. TR control power is supplied to the system through circuit breakers marked "DC" and "Sel." Three-phase 118-volt a-c power is supplied through circuit breakers marked "ØA," "ØB," and "ØC." All circuit breakers are on the "FCS Evaluator" portion of the gunner's circuit breaker panel.

FEA Selector Switch MQ

A 12-position rotary selector switch on the FEA selector unit has two positions for OFF, one WU position, five CALIBRATE positions (0, 0 -- +AZ -- -AZ +EL -- -EL), and four COURSE positions (UL--LL--LR--UR). In either of the two OFF positions, the evaluator system is completely inoperative and the fire control system functions in the normal manner. In WU position, components of the analyzer set and the recorder unit are supplied standby power for warm-up purposes. In the CALIBRATE positions of the selector switch, a selection of azimuth and elevation signals is provided as reference signals to be used to check the static characteristics of the fire control system and determine actual track radar error. In the COURSE section of the selector switch, certain specified combinations of elevation and azimuth signals, simulating straight line or pursuit target courses, compare the dynamic performance of the fire control system with the expected performance.

Start Program Pushbutton Switch MQ

This pushbutton switch located on the FEA selector unit, when depressed, starts the programmer unit of the evaluator on a test timing cycle of approximately 26 seconds duration; circuits within the analyzer set are controlled to permit performance of the specified functions of signal application, recording, and comparison in the proper sequence. Normally the start program switch is depressed for approximately 2 seconds, then released; the 26-second timing cycle is initiated and will continue after the switch is released until the completion of the cycle. The switch must be depressed again momentarily to start another test time cycle.

Program On Indicator Light MQ

This indicator light located on the FEA selector unit illuminates when the 26-second timing cycle of the evaluator programmer is initiated by depressing the start program switch and remains illuminated until the time cycle is completed.

Normal Operation of Fire Control System Evaluator MQ

Normal operation of the FCS evaluator in conjunction with the fire control system may be accomplished as follows:

1. Place FCS power switch on FCS control panel in WARMUP.
2. Upon illumination of gyros ready indicator light, place FCS power switch in ON.
3. Place range select switch on right side of control handle unit in RADAR.
4. Place track select switch on right control handle in RADAR (down).
5. Place FEA selector switch in WU and allow the evaluator system to warm up for 5 minutes.
6. Place guns fire safety switch on FCS control panel in READY.

CAUTION

Do not proceed with this test or place the guns fire safety switch in READY until over the firing area and clearance has been obtained from the pilot.

7. Place FEA selector switch in 0, 0.
8. Depress track button on left control handle to HARD PRESS. When the range gate on the radar indicator stops sweeping and locks at a range of approximately 400 yards, release track button.
9. Depress start program pushbutton on FEA selector unit for 2 seconds, then release. The program on indicator light should illuminate and remain illuminated for the period of the test cycle (approximately 26 seconds).
10. After a period of 10 or 15 seconds after the program on indicator light illuminates, depress one or both action switches and squeeze and hold trigger button switches until the program is completed.
11. Place guns fire safety switch in SAFE and insert safety pin.
12. Place FCS power switch in OFF.
13. Place FEA selector switch in one of the OFF positions.

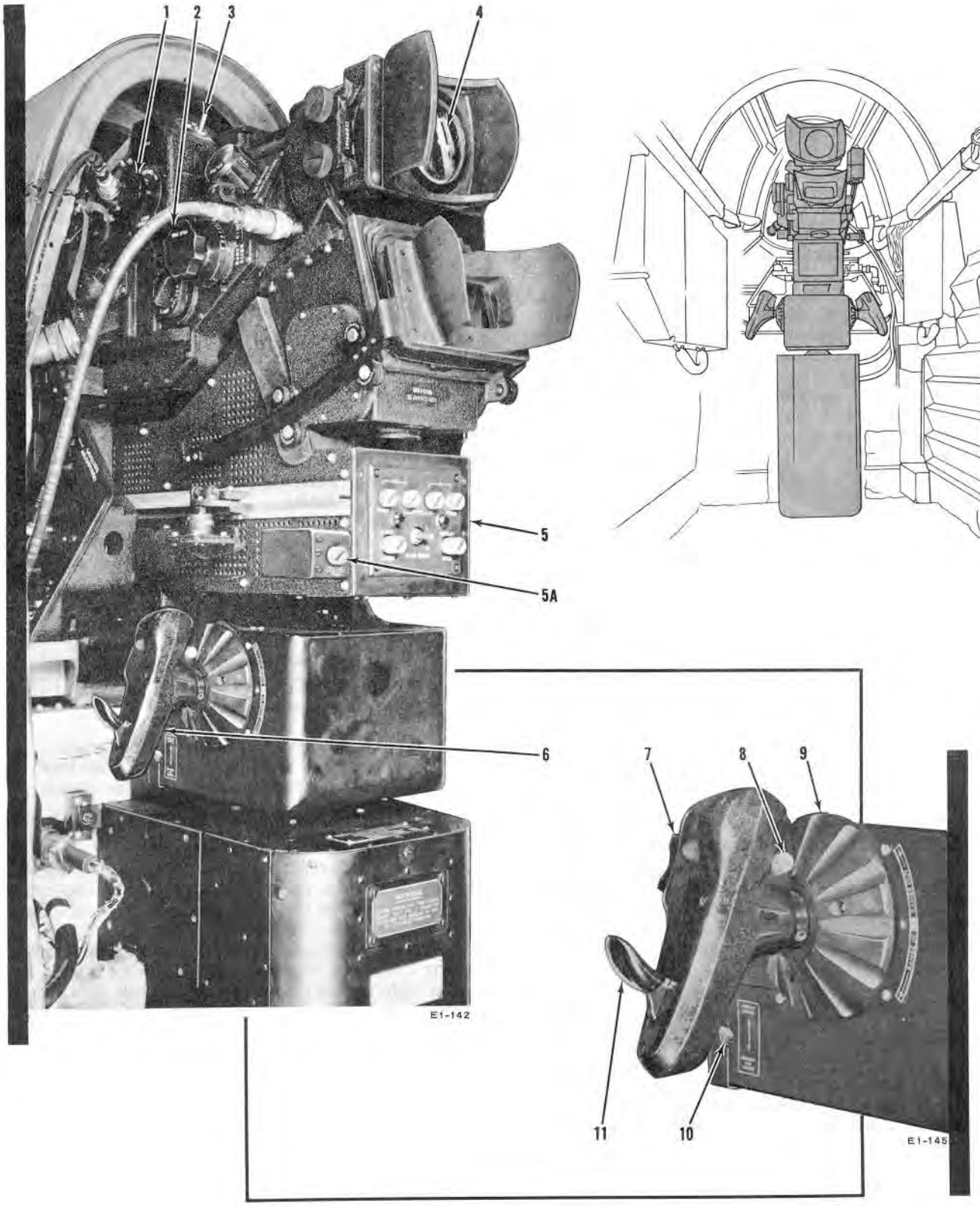
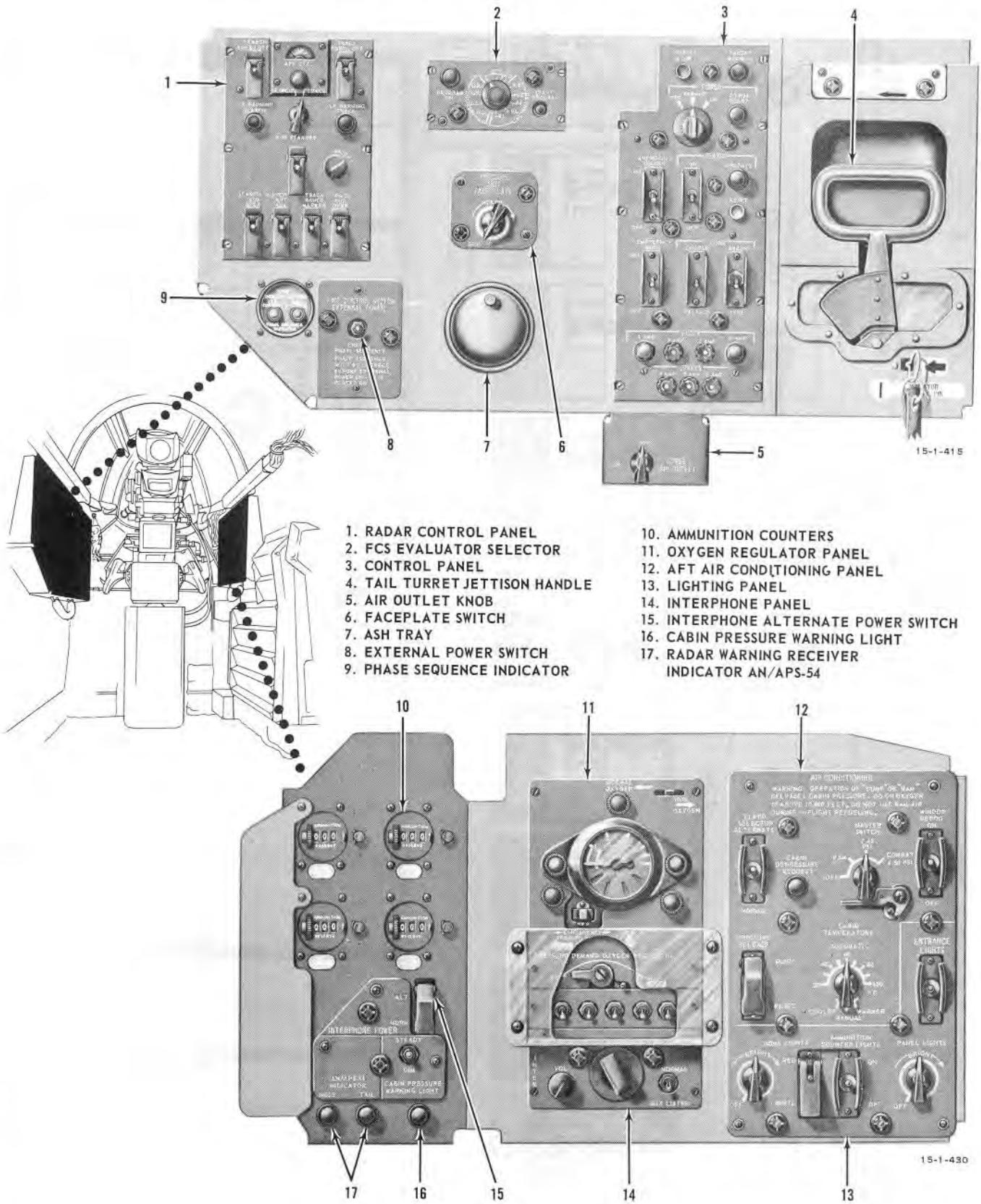


Figure 4-57 (Sheet 1 of 2).



gunner's side panels (MD-9)

Figure 4-55.

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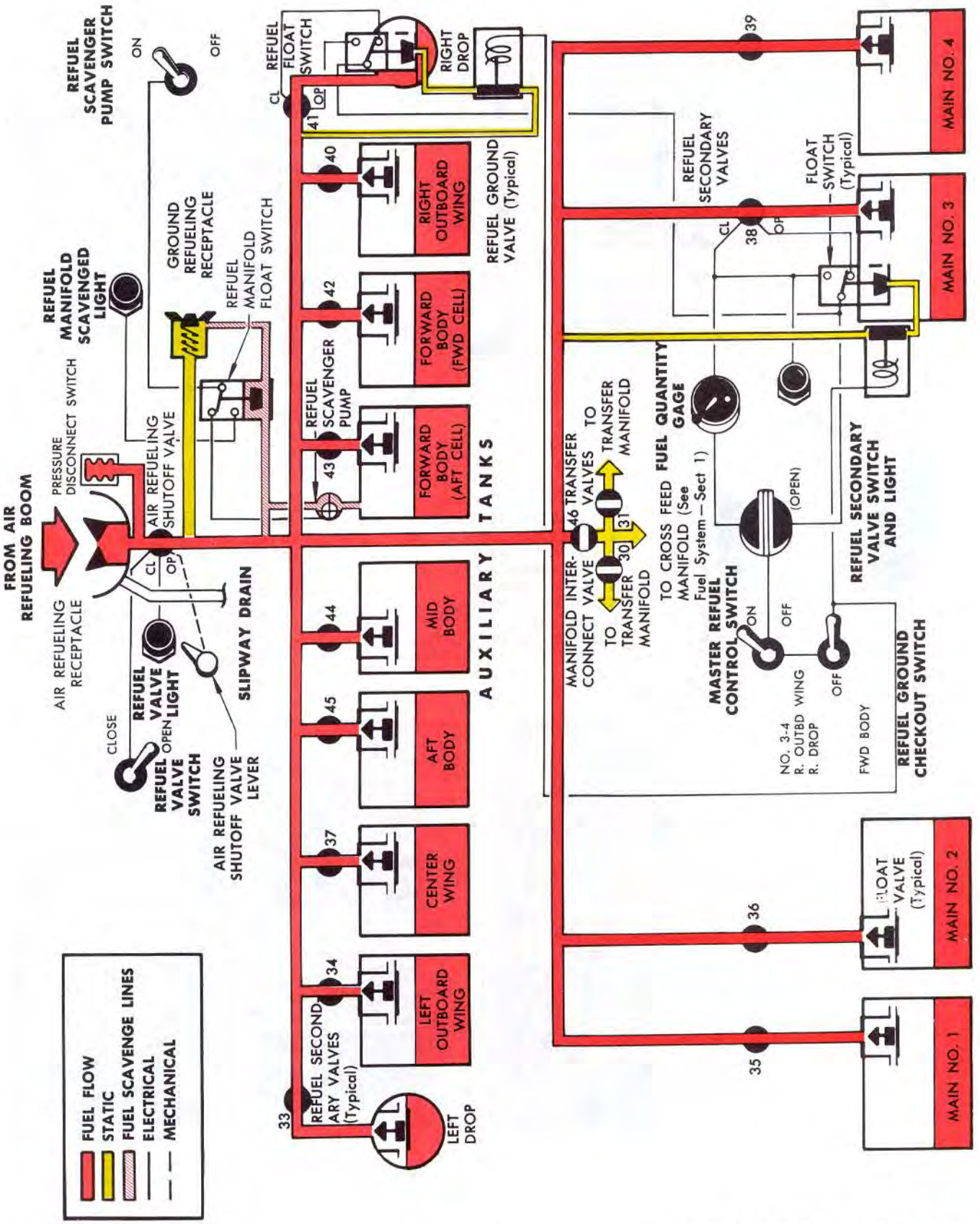


refuel system

Figure 4-58.

AIR REFUELING SYSTEM

An air refueling (IFR, aerial refueling) system makes it possible to refuel the airplane in flight from a boom-type tanker aircraft. An air refueling slipway and receptacle, which can be covered by hydraulically operated slipway doors when not in use, is located on top of the fuselage slightly aft of the pilots' stations. A refuel system (figure 4-58) makes it possible to fill all the airplane fuel tanks from the air refueling receptacle or a single point ground refueling receptacle. The refuel system is normally independent of either the fuel feed system or fuel transfer system ("Fuel Supply System," Section I). A refuel shutoff valve, downstream from the receptacle, connects the receptacle to the refuel manifold and is designed to keep fuel out of the refuel manifold in the pilots' compartment during ground refueling. The refuel manifold distributes fuel to each tank through refuel secondary valves which are controlled from the refuel panel on the copilot's side panel. The refuel manifold has thermal relief provisions around the refuel shutoff valve to eliminate trapped fuel between the air refueling receptacle and the refuel valve. This provision decreases pressure in the manifold and prevents fuel leakage into the control cabin. An air refueling panel (figure 4-60) on the pilots' overhead panel contains the controls necessary to operate the air refueling hydraulic system and refuel shutoff valve, and to control an electronic signal amplifier system. The signal amplifier serves to indicate when the air refueling system is ready for contact, to control power supplied to lock the hydraulic latching toggles when contact is made, and to indicate when a disconnect occurs.

AIR REFUELING HYDRAULIC PRESSURE

Hydraulic pressure used to operate the slipway door system (figure 4-59) is normally supplied by hydraulic system No. 1. Hydraulic system No. 2 serves as an alternate source of pressure for this purpose. This pressure is controlled by normal and alternate slipway door control valves which are electrically controlled by slipway door switches. A shuttle valve, positioned by the pressure source, allows hydraulic pressure to operate the slipway doors actuator and to position the toggle actuator to unlock the toggles. Pressure is also supplied to an electrically operated toggle actuator valve which is controlled automatically by the signal amplifier or manually by a manual toggle latching switch. Opening the toggle actuator valve allows hydraulic pressure to lock the latching toggles which hold the air refueling boom in the receptacle.

AIR REFUELING FUEL FLOW

When the air refueling boom nozzle is seated in the air receptacle and held by hydraulically operated latching toggles, fuel is pumped from the tanker to the receiver refuel manifold. Rate of flow is controlled by the tanker crew and number of receiver tanks open. In the receiver, fuel flows from the refuel manifold into fuel tanks as directed by refuel secondary valves which are operated by switches located on the refuel panel. When a fuel tank is full by weight, the full by weight switches connected to the fuel quantity indicating system will close the secondary valves. When a fuel tank is full by volume, a float valve hydraulically closes a refuel primary valve. A float switch is also provided which will close the refuel secondary valve when the fuel tank is full if the primary valve should fail. When refuel shutoff valves for all tanks are closed, pressure builds up in the refuel manifold and a disconnect is effected if the fuel pressure in the refuel manifold exceeds a disconnect pressure switch setting of 69 (±3) psi. A disconnect is also caused by the boom exceeding its envelope limits (figures 4-67 and 4-71). A voluntary disconnect may be initiated by either pilot of the receiver or by the tanker boom operator.

AIR REFUELING SYSTEM CONTROLS

Air Refueling (IFR or Refuel) System Master Switch

A guarded air refueling system master switch (1, figure 4-60) on the air refueling panel has ON--OFF positions. In ON position, this switch supplies TR power through circuit breakers marked "Slipway Door" - "Normal" and "Alternate" to the slipway door switches and to the signal amplifier power switch through a circuit breaker marked "Sig Ampl." All circuit breakers are on the "IFR" portion of the pilots' overhead circuit breaker panel. In OFF position, no power is supplied to these units.

240 ▶ WI 20 ▶

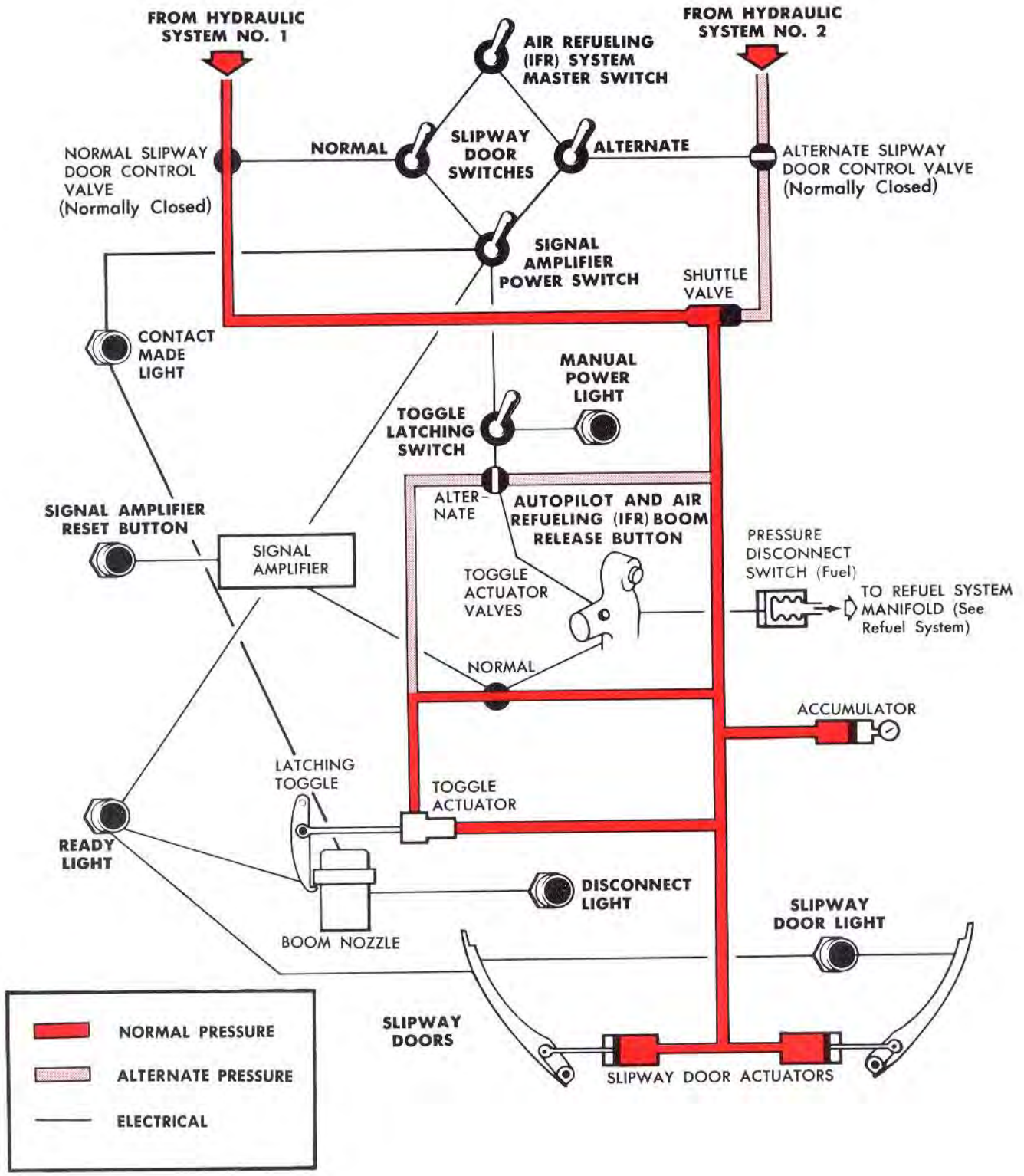
The air refueling system master switch also controls an air refueling slipway drain valve. In the ON position, TR power through a circuit breaker marked "Sig Ampl" in the "IFR" portion of the pilots' overhead circuit breaker panel closes the motor-driven drain valve. Placing the switch in the OFF position opens the drain valve.

Signal Amplifier Power Switch

A guarded signal amplifier power switch (6, figure 4-60) located on the refueling panel has MANUAL--NORMAL positions. This switch controls power supplied to the signal amplifier and the actuation of the latching toggles which hold the boom in the air refueling receptacle. NORMAL position supplies TR power from a circuit breaker marked "Sig Ampl" through the master refuel switch to the signal amplifier which automatically controls operation of the latching toggles. MANUAL position deenergizes the signal amplifier and supplies TR power from a circuit breaker marked "Manual Control" on the "IFR" portion of the pilots' circuit breaker panel to the manual power light and the toggle latching switch for manual operation of the latching toggles.

Toggle Latching Switch

A guarded toggle latching switch (5, figure 4-60) located on the air refueling panel has RELEASE--HOLD positions. This switch is supplied with TR power only when the signal amplifier power switch is in MANUAL



slipway door system

Figure 4-59.

position, and controls the latching toggles (normally controlled by the signal amplifier). In HOLD position, power is supplied to the manual toggle latching valve allowing the latching toggles to hold the boom in the air refueling receptacle. In RELEASE position, the toggles are released and allow the air refueling boom nozzle to be withdrawn from the receptacle. The latching toggles may also be released by pressing the air refueling disconnect button on the pilot's control wheel, copilot's control wheel, by high fuel pressure, or by brute force pull-outs. TR power is supplied to the toggle latching switch through a circuit breaker marked "Manual Control" on the "IFR" portion of the pilots' overhead circuit breaker panel.

Refuel Valve Switch

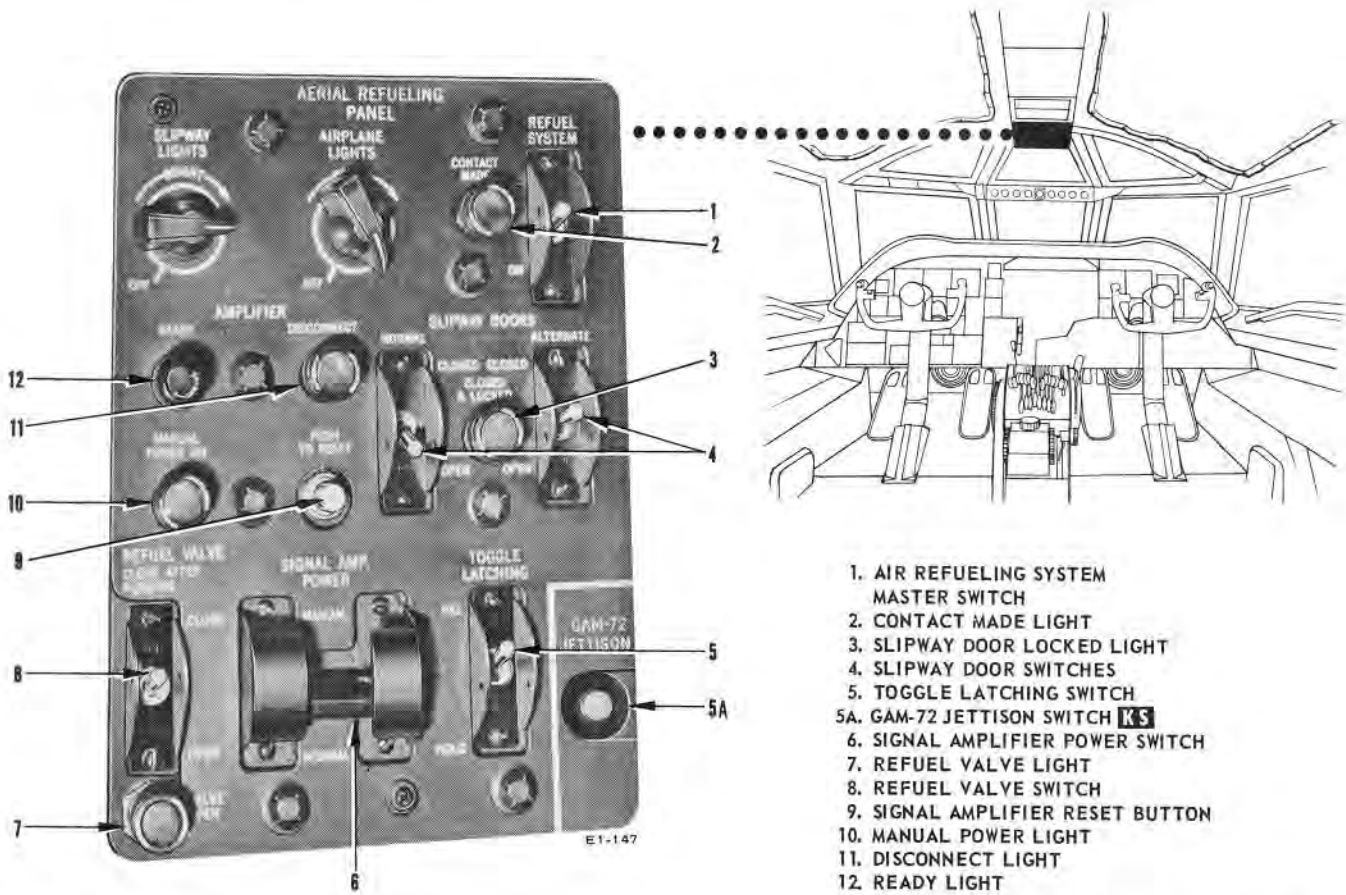
A guarded refuel valve switch (8, figure 4-60) located on the air refueling panel has OPEN--CLOSE positions. This switch controls an air refueling shutoff valve located immediately downstream from the air refueling receptacle. In CLOSE position, TR power is supplied to close the air refueling shutoff valve. In OPEN position, power is supplied to open the air refueling shutoff valve and to illuminate the refuel valve light. Power is supplied to the refuel valve switch at all times, regardless of the position of the air refueling system master switch. TR power is supplied to the refuel valve switch through a circuit breaker marked "Fuel Valve & Hyd Pks Shutoff" on the "IFR" portion of the pilots' overhead circuit breaker panel.

Air Refueling Shutoff Valve Lever

An air refueling shutoff valve lever (2, figure 4-63), having OPEN--CLOSE positions, is provided for manual operation of the air refueling shutoff valve which is normally operated by the refuel valve switch. The lever is mounted directly on the valve which is located aft of a removable panel in the left side of the aft pressure bulkhead of the forward pressurized compartment. It is accessible from the lower deck of the control cabin. If the lever is operated manually to either the OPEN (inboard movement of handle) or CLOSED (outboard movement of handle) position, electrical operation may be resumed by running the valve motor to the position corresponding to the valve position using the refuel valve switch.

Slipway Door Switches

Guarded alternate and normal slipway door switches (4, figure 4-60) with OPEN--CLOSED positions are



1. AIR REFUELING SYSTEM MASTER SWITCH
2. CONTACT MADE LIGHT
3. SLIPWAY DOOR LOCKED LIGHT
4. SLIPWAY DOOR SWITCHES
5. TOGGLE LATCHING SWITCH
5A. GAM-72 JETTISON SWITCH KS
6. SIGNAL AMPLIFIER POWER SWITCH
7. REFUEL VALVE LIGHT
8. REFUEL VALVE SWITCH
9. SIGNAL AMPLIFIER RESET BUTTON
10. MANUAL POWER LIGHT
11. DISCONNECT LIGHT
12. READY LIGHT

air refueling panel

Figure 4-60.

provided on the air refueling panel. Power is supplied to these switches when the air refueling system master switch is in ON position. When the normal slipway door switch is in OPEN position, hydraulic pack No. 1 is started and TR power is supplied to the normal slipway door control valve which allows hydraulic pressure from system No. 1 to open the doors. When the normal slipway door switch is placed in CLOSE position, power is supplied to the normal slipway door control valve to close the doors. When the normal slipway door switch remains in CLOSE position, the hydraulic pack is shut down, no power is supplied to the valve, and the valve closes. The alternate slipway door switch functions similarly except that hydraulic system No. 2 and the alternate slipway door control valve are utilized. TR power is supplied to the slipway door switches through circuit breakers marked "Slipway Door" - "Normal" and "Alternate" on the "IFR" portion of the pilots' overhead circuit breaker panel.

CAUTION

To prevent overheating and possible failure of the hydraulic packs, do not fly with either slipway door switch in OPEN position for periods in excess of 30 minutes out of each hour unless the landing gear is extended. Adequate cooling for continuous operation of the packs is available only when the landing gear is extended.

NOTE

The alternate slipway door switch must be in CLOSE position for the normal slipway door switch to operate the doors properly.

Signal Amplifier Reset Button

A push-to-reset signal amplifier reset button (9, figure 4-60) is located on the air refueling panel. When depressed after a disconnect has been accomplished, this button resets the automatic control circuit of the signal amplifier. After resetting, the air refueling system is ready for another contact.

NOTE

Upon occasion, the signal amplifier reset button will either fall out of or be pushed inside the air refueling panel when attempting to reset after a disconnect has occurred. Placing the air refueling system switch to OFF, then back to ON will accomplish the same thing as pressing the reset button and the signal power amplifier will be in the "ready for contact" position.

Master Refuel (Fuel) Control Switch

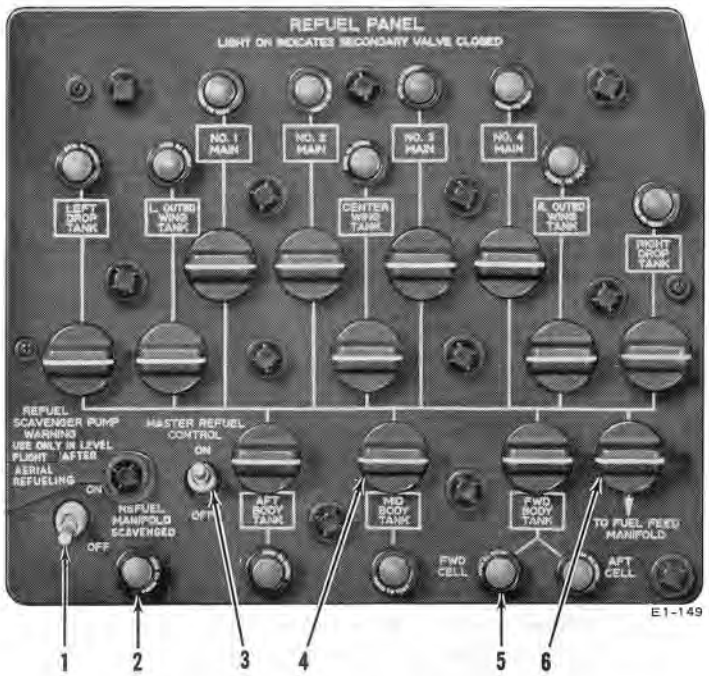
A master refuel control switch (3, figure 4-61) on the refuel panel has ON--OFF positions. In ON position, switched battery power is supplied to the refuel secondary valve switches, the fuel weight control relay, the fuel gage full by weight switch, and the refuel ground checkout switches. In OFF position, switched battery power is supplied through float switches to the main tank fuel level valves. See "Fuel Supply System," Section I, for additional information about this switch. Switched battery power is supplied to the master refuel control switch through circuit breakers marked "Master" - "Left" and "Right" on the "Fuel Level Control" portion of the copilot's circuit breaker panel.

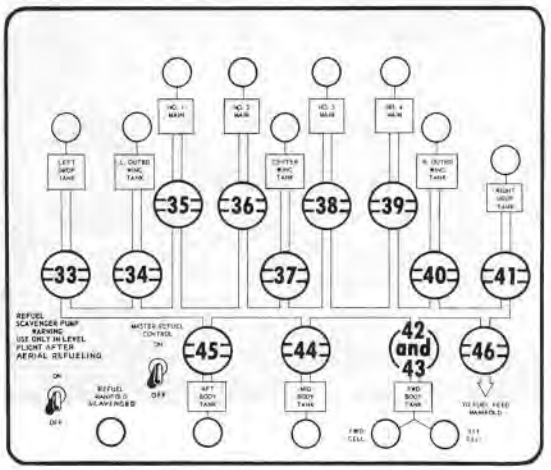
NOTE

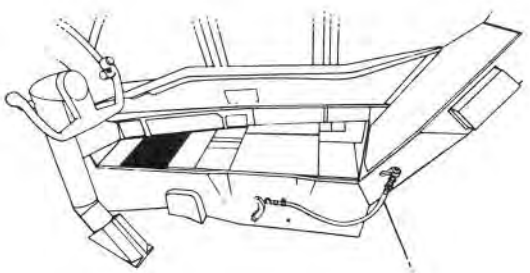
Turning the master refuel control switch to ON position transfers float switch control of main tank fuel level to the refuel secondary valves in the refuel system. This will cause the main tank fuel level valves to remain in their last position. If these valves are closed at the time, no replenishing of the main tanks from the fuel transfer system will occur until the master refuel control switch is returned to OFF position.

Refuel Secondary Valve Switches

Twelve refuel secondary valve switches (4, figure 4-61) are on the refuel panel. The refuel secondary valve switch is in the VALVE OPEN position when the white line on the refuel secondary valve switch is aligned with the flow lines on the refuel panel. When turned 90° to







1. REFUEL SCAVENGER PUMP SWITCH
2. REFUEL MANIFOLD SCAVENGED LIGHT
3. MASTER REFUEL CONTROL SWITCH
4. REFUEL SECONDARY VALVE SWITCHES
5. REFUEL SECONDARY VALVE LIGHTS
6. MANIFOLD INTERCONNECT VALVE SWITCH

refuel panel

Figure 4-61.

the line of flow, the switch is in VALVE CLOSED position and supplies TR power to close the refuel secondary valve which illuminates the corresponding refuel secondary valve light. Power is supplied to these switches only when master refuel control switch is in ON position. TR power is supplied to the refuel secondary valve switch through circuit breakers marked "Master" - "Left" and "Right" on the "Fuel Level Control" portion of the copilot's circuit breaker panel.

Autopilot and Air Refueling (IFR) Boom Release Buttons

An autopilot and air refueling (IFR) boom release button (2, figure 4-29) is located on the pilots' control wheels. Depressing this button during air refueling operations will supply TR power to the signal amplifier which in turn deenergizes the toggle latching valve thus releasing the latching toggles. TR power is sup-

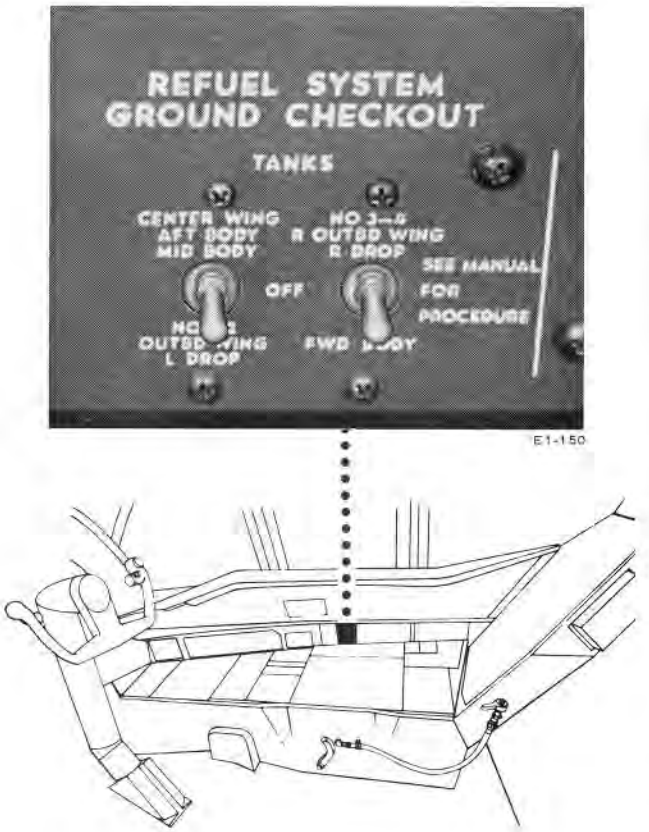


Figure 4-62.

plied to the release buttons through a circuit breaker marked "Disc" on the "IFR" portion of the pilots' overhead circuit breaker panel. Additional functions of this switch are covered under "Autopilot," this section.

Refuel Ground Checkout Switches

Two refuel ground checkout switches (figure 4-62) are provided on the copilot's auxiliary side panel. Power is supplied to these switches when the master refuel control switch is in the ON position. When operated, these checkout switches supply TR power to open refuel ground checkout valves which permit fuel from the refuel manifold to actuate the tank float switch, testing the operation of the refuel secondary valves. Each refuel ground checkout switch has three positions. In the center or OFF position, the refuel ground checkout valves are closed. In the CENTER WING, AFT BODY, MID BODY position, the refuel ground checkout valves of these tanks are opened provided the master refuel control switch is in ON position. This action floods the chamber of the float switch in each tank, simulating a full tank condition when refueling. In CENTER WING, AFT BODY, MID BODY position, the center wing, aft body, and mid body fuel tanks are checked. In No. 1-2, OUTBD WING, L DROP position, the No. 1 and 2 main fuel tanks, the outboard wing fuel tank, and left drop tank are checked. In FWD BODY position, the forward and aft cells of the forward body fuel tank are checked. In No. 3-4, R OUTBD WING, R DROP position, the No. 3 and 4 main fuel tanks, the right outboard wing fuel tanks, and the right drop tank are checked. TR power is supplied to the refuel ground checkout switches through circuit breakers marked "Ground Checkout" - "Fuel System" and "Refuel System" on the pilot's auxiliary circuit breaker panel.

NOTE

The refuel ground checkout switches can be used during air refueling to check operation of the refuel secondary valves if absolutely necessary; however, their use in flight is not recommended. Use of these switches at such a time might cause a pressure disconnect or might, as a remote possibility, result in a refuel secondary valve failing closed. It is recommended therefore that refuel secondary valve operation be checked before flight while fueling through the single point ground refueling receptacle.

Refuel Scavenger Pump Switch

A refuel scavenger pump switch (1, figure 4-61) on the refuel panel has ON--OFF positions. In ON position, 118-volt single-phase a-c power is supplied to the refuel scavenger pump motor through the float switch in the refuel manifold and the fuel scavenge control relay. The refuel scavenger pump will automatically shut off when fuel has been exhausted from the refuel manifold; however, residual fuel may actuate the refuel manifold float switch and turn off the refuel manifold scavenged light during brief intermittent (5 to 10 seconds) intervals if the refuel scavenger pump switch is left in ON position. TR power is supplied to the refuel scavenger pump switch through a circuit breaker marked "Scavenge" on the "Fuel Level Control" portion of the copilot's circuit breaker panel.

NOTE

- The refuel scavenger pump switch should be turned to OFF position after the amber refuel manifold scavenged light is illuminated.
- To ensure optimum scavenging after air refueling and when the airplane is in level flight, fuel should be removed from the refuel manifold by the refuel scavenger pump

Manifold Interconnect Valve Switch

A rotary manifold interconnect valve switch (6, figure 4-61) on the refuel panel controls switched battery power to the fuel manifold interconnect valve (No. 46). The switch is in valve OPEN position when the white

line on the switch is aligned with flow lines on the refuel panel. In valve OPEN position, power is supplied to open the manifold interconnect valve which connects the refuel manifold with the crossfeed manifold and fuel feed system. When turned 90° to the line of flow, the switch is in valve CLOSED position and the valve prevents flow of fuel from the refuel manifold to the fuel feed system. Switched battery power is supplied to the manifold interconnect valve switch through a circuit breaker marked "Body 46" on the "Fuel Transfer Valve Control" portion of the copilot's circuit breaker panel. For further information on the fuel feed system, see "Fuel Supply System," Section I.

AIR REFUELING SYSTEM INDICATORS

Slipway Door Locked Light

An amber slipway door locked light (3, figure 4-60) on the air refueling panel is supplied TR power when the slipway doors are closed and locked and is off when the doors are either open or not locked. TR power is supplied to the slipway doors locked light through a circuit breaker marked "Fuel Valve & Hyd Pks Shutoff" on the "IFR" portion of the pilots' overhead circuit breaker panel.

Refuel Valve Light

A green refuel valve light (7, figure 4-60) is on the air refueling panel. When the air refueling shutoff valve is open, TR power is supplied to illuminate the refuel valve light. When the air refueling shutoff valve is closed, the light is out. TR power is supplied to the refuel valve light through a circuit breaker marked "Fuel Valve & Hyd Pks Shutoff" on the "IFR" portion of the pilots' overhead circuit breaker panel.

Ready Light

A blue ready light (12, figure 4-60) on the air refueling panel is supplied TR power when the air refueling system is ready for contact. The air refueling system master switch must be in ON, the slipway doors open, the signal amplifier power switch in ON, and the toggle latching switch in RELEASE position (if manual toggle latching is used) for power to be supplied to this light. Pressing the signal amplifier reset button or closing the slipway doors will cause the light to go out. TR power is supplied to the ready light through a circuit breaker marked "Sig Ampl" on the "IFR" portion of the pilots' overhead circuit breaker panel.

Contact Made Light

A green contact made light (2, figure 4-60) on the air refueling panel indicates when the boom is locked into the receptacle. It is supplied TR power from the signal amplifier power switch during a normal contact, and from the IFR circuit breaker during a manual contact. When the air refueling boom nozzle is seated in the receptacle and the signal amplifier power switch is in MANUAL position, as the toggles are locked in place over the nozzle, the ready light will go out and the contact made light will illuminate. TR power is supplied to the contact made light through a circuit breaker marked "Sig Ampl" on the "IFR" portion of the pilots' overhead circuit breaker panel.

Disconnect Light

An amber disconnect light (11, figure 4-60) on the air refueling panel is supplied TR power when the air refueling boom has been disconnected from the receptacle after a contact has been made. TR power is supplied to the disconnect light through a circuit breaker marked "Disc" on the "IFR" portion of the pilots' overhead circuit breaker panel.

Manual Power Light

An amber manual power light (10, figure 4-60) on the air refueling panel is illuminated when the signal amplifier power switch is in MANUAL position, provided the air refueling system master switch is ON. The manual power light is out when the signal amplifier power switch is in NORMAL position. TR power is supplied to the manual power light through a circuit breaker marked "Manual Control" on the "IFR" portion of the pilots' overhead circuit breaker panel.

Refuel Secondary Valve Lights

Thirteen amber refuel secondary valve lights (5, figure 4-61) are on the refuel panel. These switched battery powered lights are illuminated when the corresponding refuel secondary valve is closed. The refuel secondary valve light is out when the refuel secondary valve is open. Switched battery power is supplied to the refuel secondary valve lights through a circuit breaker marked "Master" - "Left" and "Right" on the "Fuel Level Control" portion of the copilot's circuit breaker panel.

Refuel Manifold Scavenged Light

An amber refuel manifold scavenged light (2, figure 4-61) on the refuel panel is supplied TR power when the float switch in the refuel scavenger line indicates the refuel manifold is free of fuel. TR power is supplied to the refuel manifold scavenged light through a circuit breaker marked "Scavenge" on the "Fuel Level Control" portion of the copilot's circuit breaker panel.

AIR REFUELING SYSTEM NORMAL OPERATION

CAUTION

Do not open the manifold interconnect valve switch (valve 46) on the refuel panel while refueling.

NOTE

Aviation gasoline and JP-4 fuel mixed in any proportion are suitable for continuous operation from an engine performance standpoint. However, the use of aviation gasoline must be restricted to air refueling operations and to emergency evacuation ferry-type missions to minimize undesirable lead deposits in the engines. "Rate of Climb Limitations with Emergency Fuel (Aviation Gasoline)" under "Fuel Grade Properties and Limits," Section V, must be observed when applicable.

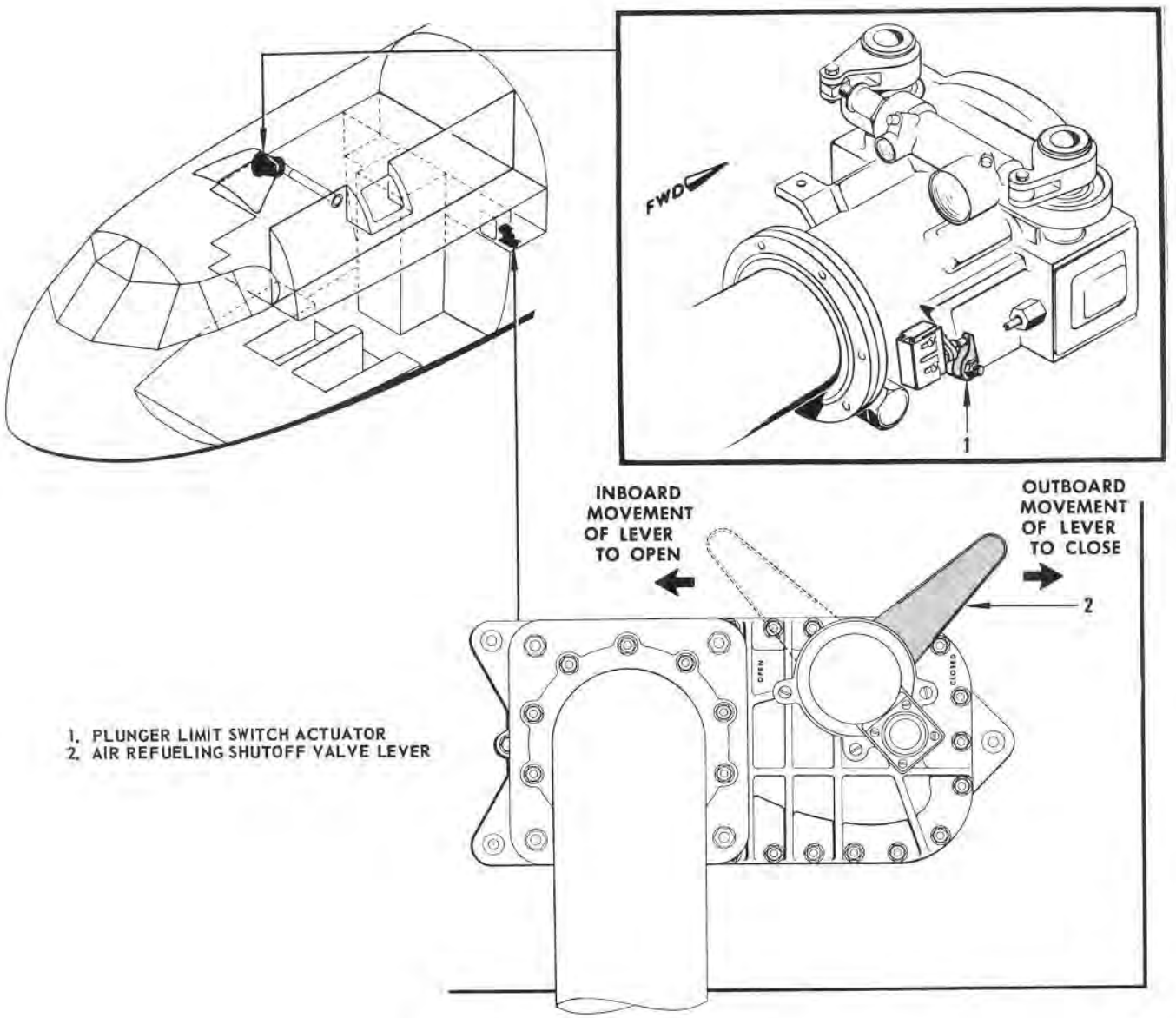
Air Refueling System Check (Pilot Reads)

INTERIOR CHECK. The following preflight will be accomplished after external power is connected to the airplane, the landing gear standby pumps are on, and the bypass keys are removed. This check will normally be made only after maintenance or reported malfunction has occurred.

1. Air Refueling System Master Switch - ON (CP)
2. Refuel Valve Switch - OPEN, light on (CP)

Check that refuel valve green indicator light illuminates.

3. Signal Amplifier Power Switch - NORMAL (CP)



....air refueling system miscellaneous controls

Figure 4-63.

4. Normal Slipway Door Switch - OPEN, ready light on (CP)
When slipway doors are open, the amber slipway door locked light will be out and the blue ready light will illuminate when the slipway doors are fully open.

NOTE

The pilot must wait 30 seconds after the blue ready light is illuminated to allow sufficient warmup time for the signal amplifier before proceeding with the next steps.

5. Plunger Limit Switch - Depressed, toggles engaged (EW)
The EW officer depresses the plunger limit switch on pilot's request and observes toggle actuator operation. Blue ready light will go out and the green contact made light will illuminate, indicating contact made and toggles engaged.

NOTE

When operating the plunger limit switch, the EW officer should check the actuator and spring for operation by pulling down on the actuator arm. For the remaining checks, the EW officer need only push the limit switch.

6. Plunger Limit Switch - Released, toggles disengaged (EW)
EW officer releases signal switch plunger and toggle actuator will return to the release position. Amber disconnect light will illuminate and the green contact made light will go out (if installed).
7. Signal Amplifier Reset Button - Depressed (CP)
Push and release signal amplifier reset button and check ready light illuminated.
8. Plunger Limit Switch - Depressed, toggles engaged (EW)
EW officer holds plunger limit switch in depressed position and observes toggle actuator operation. Blue ready light will go out and the green contact made light will illuminate, indicating contact made and toggles engaged.
9. Pilot's Boom Release Button - Depressed (P); Toggles disengaged (EW)
Pilot depresses boom release button on control wheel. The amber disconnect light will illuminate and the green contact made light will go out, indicating the toggles are in the released position. EW officer checks toggle release action and continues to hold the plunger limit switch depressed.
10. Signal Amplifier Reset Button - Depressed (CP); Toggles engaged (EW)
Copilot depresses and then releases the amplifier reset button. The blue ready light will blink on then will go out and the green contact made light will illuminate, indicating contact made and toggles engaged. EW officer observes toggle actuator operation.

NOTE

The toggles will engage as soon as the copilot releases the signal amplifier reset button because the EW officer is still holding the plunger limit switch depressed.

11. Copilot's Boom Release Button - Depressed (CP); Toggles disengaged (EW)
Copilot depresses boom release button on control wheel. The amber disconnect light will illuminate and the green contact made light will go out, indicating the toggles are in the released position. EW officer checks toggle release action.
12. Plunger Limit Switch - Released (EW)
13. Normal Slipway Door Switch - CLOSE(D), slipway door locked light on (CP)
Amber slipway door locked light will illuminate when doors are fully closed.
14. Alternate Slipway Door Switch - OPEN, ready light on (CP)
Amber slipway door locked light will go out and blue ready light will illuminate when the doors are fully open.
15. Signal Amplifier Power Switch - MANUAL (CP)
The amber manual power light will illuminate and the blue ready light will illuminate when the toggle latching switch is in the release position.
16. Toggle Latching Switch - HOLD (CP); Toggles engaged (EW)
The blue ready light will go out. EW officer checks toggle engage action.
17. Pilot's Boom Release Button - Depressed (P); Toggles disengaged (EW)
Pilot depresses boom release button on control wheel; amber disconnect light will illuminate. EW officer checks toggle release action.

NOTE

If the pilot's and copilot's boom release buttons function properly when the signal amplifier switch is in NORMAL position, it is unnecessary to check the copilot's boom release button with the signal amplifier switch in MANUAL.

18. Toggle Latching Switch - RELEASE (CP)
19. Signal Amplifier Power Switch - NORMAL (CP)
20. Refuel Valve Switch - CLOSE (CP)
When the switch is in CLOSE position, green refuel valve light will go out.
21. Alternate Slipway Door Switch - CLOSED, slipway door locked light on (CP)
The amber slipway door locked light will illuminate when the doors are fully closed.
22. Air Refueling System Master Switch - OFF (CP)

CAUTION

If the air refueling system master switch is turned OFF before the slipway doors locked light illuminates, the doors will remain in an unlocked or intermediate position.

23. Air Refueling Accumulator Preload - Checked (EW)
EW officer checks air refueling accumulator located on sidewall of upper deck above ladder.
24. Hydraulic Leaks - Checked (EW)
EW officer checks for possible hydraulics leaks aft of slipway area. Report to pilot.

AIR REFUELING FUEL MANAGEMENT

Fuel Distribution Prior to Air Refueling

The distribution of fuel prior to air refueling will affect the wing structural life and also affect the time required for contact. The primary consideration for improved wing fatigue life is to maintain or fill the wing tanks prior to refueling the body and center wing tanks. The recommended procedure provides for refueling the main wing and body tanks prior to using fuel from the slower filling outboard wing or drop tanks. Seven tanks will be open to admit fuel during most of the refueling period, providing a capacity of up to 140, 000 pounds. In general, the body tank refueling should be made in the reverse order of use so that the applicable steps of the normal fuel usage sequence can be followed after refueling.

WARNING

To avoid flutter, all outboard wing tank fuel must be used prior to using fuel from full drop tanks in accordance with normal fuel usage sequence. If normal fuel sequence cannot be followed, do not exceed the lower airspeed and Mach number flutter limitation given in Section V. If the EWO fuel sequence is used, the lower airspeed flutter limitation must be observed until all drop tank fuel is used.

Recommended Air Refueling Procedure

A. In order to accomplish air refueling with a minimum reduction in wing fatigue life, the following procedure is recommended for gross weight down to approximately 340, 000 pounds or through step 4 in the normal fuel sequence.

1. Prior to refueling contact, determination of fuel quantity distribution should be based on the following:

a. Determine the net transfer by subtracting fuel to be used during contact from the gross tanker offload.

b. Approximately 5000 pounds of fuel will be required to refuel the main tanks from the transfer level to the 100% full level. In addition, fuel burned during refueling will be used from the main wing tanks and automatically replenished.

c. The maximum body tank capacity available for refueling may be determined by subtracting the aircraft gross weight with forward, mid, and aft body tanks empty and all other tanks full from the desired gross weight after refueling. The fuel distribution in the body tanks during refueling must be planned to maintain the aircraft cg within structural limits.

d. In the event net transfer is in excess of 5, 000 pounds plus the body tank capacity determined above, additional capacity of up to 20, 000 pounds may be attained by using main tank fuel equally until main tanks 1 and 4 are at the 9, 500-pound level. This fuel is used after step 4 and just prior to contact.

NOTE

- Main tanks 1 and 4 should not be used to less than 9, 500 pounds in each tank. At this time, main tanks 2 and 3 will be at approximately 12, 000 pounds each.

Less SS

- Even though the outboard wing tanks may be less than full, it may not be possible to refuel these tanks in flight. During some inflight attitudes of the wing, the inboard float switches may be covered with fuel making it impossible to open the refuel secondary valves. To determine if the tanks can be refueled, place the refuel secondary valve switch in VALVE OPEN position and if the corresponding refuel secondary valve light goes out, the outboard wing tanks can be refueled.

SS

- Air refueling capability is provided for the outboard wing tanks at any fuel level less than full.

2. Use fuel prior to refueling in the following order:

a. 8% main tanks.

b. Aft body, until equalized to forward body, to main tanks 1, 2, 3, and 4.

c. Aft body to main tanks 1 and 2; forward body to main tanks 3 and 4.

d. Mid body to main tanks 1, 2, 3, and 4.

e. Main tanks equally to no less than 9500 pounds in each of main tanks 1 and 4.

3. The following sequence should be observed during refueling:

a. Refuel the main wing tanks simultaneously until near full. To avoid a pressure disconnect, the necessary body tank valves should be opened for refueling when any main tank is full and the other main tanks are still receiving fuel. Leave the main tanks open until refueling is completed to replenish fuel used during contact.

b. Simultaneously refuel the forward, mid, and aft body tanks. Refuel these tanks as required, maintaining cg within acceptable structural limits.

NOTE

Due to armament load or deactivated tanks, it may be necessary to maintain a specific fuel quantity differential between the forward and aft body tanks.

During refueling, do not transfer fuel to the main tanks through the fuel transfer system. Monitor all fuel quantities on tanks which are not to be completely filled. Turn the secondary valve switch to VALVE CLOSED position when the required fuel quantity is reached. The engines will receive fuel directly from the main tanks during refueling.

CAUTION

- The forward body tank should be monitored and manually controlled during air refueling to maintain a filling rate equal to or less than the aft body tank in order to maintain the cg within limits.
- The copilot must monitor the fuel quantity indicators during air refueling to insure lateral and cg control. The filling rate and location of the forward body tanks makes it possible to exceed the forward cg limits if the copilot fails to open and close valves as necessary to control rate of transfer. The fuel loading and structural limits are found in Section V.

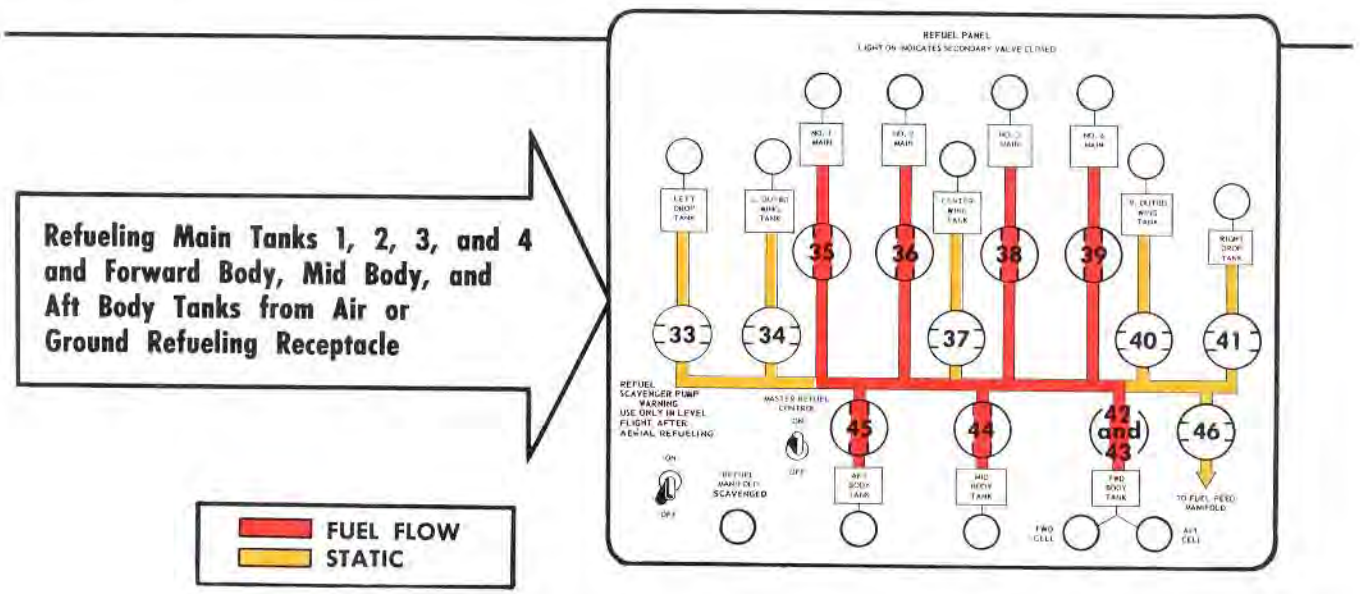
B. The following procedure is recommended for gross weights between approximately 230,000 pounds and 340,000 pounds or through step 7 in the normal fuel sequence:

1. Fuel use prior to refueling:
   a. Normal sequence through step 7.
   b. Main tanks equally to no less than 6000 pounds in each of main tanks 1 and 4. At this time, mains 2 and 3 will be at approximately 8500 pounds each.
2. The following sequence should be observed for a single refueling:
   a. Refuel simultaneously the mains, outboards, and drop tanks. If the planned on-load is not sufficient to fill the mains and drop tanks, do not refuel the outboard wing tanks because of flutter speed restrictions incurred with partial outboard and drop tank fuel.
   b. When mains are full, open the center wing tank and continue simultaneous refueling of center wing, outboards, and drop tanks or the center wing and drop tanks as applicable. Outboards should be refueled to no less than 5000 pounds each for use during step 6. Center wing and drop tanks should be filled to capacity prior to refueling body tanks.
   c. In the event additional fuel is required when center wing and drop tanks are full and the outboard wing tanks have not filled, open the body tanks and continue simultaneous refuel of the outboard wing and body tanks. If the outboards are not full when contact has been completed, complete filling of these tanks by transfer of fuel from the body tanks through valve 46.

NOTE

If the gross weight after refueling will exceed 395,000 pounds, the outboard wing tank fuel quantity should be in accord with the structural limitations outlined in Section V.

3. In event a double refueling is to be accomplished, the following sequence should be observed:
   a. Refuel simultaneously the mains, outboard wing, and drop tanks.
   b. When the mains are near full, open the center wing and mid body tanks. Continue simultaneous refuel of these tanks with the outboard wing and drop tanks until the first tanker contact has been completed.
   c. Prior to the second contact, transfer mid body fuel to fill the outboard wing tanks. Use main tank fuel to the engines. Do not use main tank fuel to less than 6000 pounds in each of mains 1 and 4.



air refueling fuel management

Figure 4-64.

d. During the second contact, refuel the mains, center wing, and body tanks as recommended in the above procedure for refueling with outboard wing tanks full.

4. After refueling, return to the normal fuel usage sequence or to the EWO fuel usage sequence if drop tanks are to be jettisoned. See "Fuel System Management," Section VII.

C. The air refueling of aircraft carrying two AGM-28 missiles should be accomplished using the same general procedures outlined in the preceding paragraphs. There are, however, some additional restrictions on body tank fuel quantities and tank filling combinations which must be observed in order to preclude the possibility of exceeding the forward structural cg limits during fuel usage after refueling.

1. The following should be accomplished when refueling prior to using outboard and center wing fuel:

a. When all body fuel has been consumed, use main tank fuel equally to no less than 6000 pounds in each of mains 1 and 4.

b. Refuel the main tanks simultaneously until near full; open the mid and aft body tank valves and continue refuel until the aft body tank fuel level is at 15,000 pounds, then open the forward body tank valve.

c. Refuel the forward, mid, and aft body tanks until the forward body is at 10,000 pounds. Close forward body tank valve and continue refuel of mid and aft body tanks to desired gross weight.

CAUTION

- The aft body tank must be refueled to 15,000 pounds prior to refueling the empty forward body tank.
- The forward body tank fuel quantity must be limited to 10,000 pounds.

2. The following is recommended for refueling after use of center wing, outboard, and drop tank fuel.

a. Refuel simultaneously the main, outboards, and drop tanks. When mains are full, open the center wing tank and continue simultaneous refuel of center wing, outboard, and drop tanks or center wing and drops as applicable.

b. When center wing and drop tanks are full, open body tanks and continue refuel as required observing the restrictions specified above for the aft and forward body tanks.

AIR REFUELING SYSTEM EMERGENCY OPERATION

Emergency Operation of Slipway Doors

Failure of hydraulic system No. 1 will prevent actuation of the slipway doors from the normal system. In such an emergency, place the alternate slipway door switch in OPEN position to operate the slipway doors. Hydraulic pressure is supplied from hydraulic system No. 2 with the alternate slipway door switch in OPEN position. If both hydraulic packs No. 1 and 2 fail and the landing gear is up and locked, hydraulic pressure for the air refueling system can be obtained from either No. 1 or 2 standby pump. With the standby pumps switch for the landing gear in ON position, pressure is supplied from the No. 1 standby pump by pulling the left forward landing gear normal control circuit breaker on the pilot's circuit breaker panel and placing the normal slipway door switch to OPEN position. Pressure from the No. 2 standby pump, if needed, can be obtained by pulling the right forward landing gear normal control circuit breaker and placing the alternate slipway door switch to OPEN position.

NOTE

Upon completion of the air refueling operation, reset the landing gear normal control circuit breaker and return the landing gear standby pumps switch to OFF position.

Emergency Operation of Air Refueling Shutoff Valve

The air refueling shutoff valve (figure 4-63) on the pressure bulkhead aft of the radar navigator's station is operated by a 24-volt d-c motor. If this motor should fail in the closed position, it would be impossible to receive fuel from a tanker until the valve was manually placed in OPEN position. If the air refueling shutoff valve is to be manually operated, pull the "Fuel Valve & Hyd Pks Shutoff" circuit breaker located on the "IFR" portion of the pilots' overhead circuit breaker panel since the valve motor may tend to resist valve movement when the air refueling shutoff valve lever is actuated. To manually place the valve in OPEN, the control lever must be moved in a counterclockwise position (inboard). To close the valve, move the control lever in a clockwise direction (outboard).

AIR REFUELING OPERATION

For further air refueling information and checklists, refer to T.O. 1-1C-1 and T.O. 1-1C-1-5.

All data on pages 4-131 thru 4-144, figures 4-64A thru 4-72 deleted

22. EMERGENCY REVERSE FLOW AIR REFUELING - The transfer of fuel from receiver to tanker airplane.
23. FORMATING AIRSPEED - An airspeed or Mach number at which air refueling will be initiated.
24. SEPARATION DISTANCE - The slant range distance used in conjunction with the 180° head-on rendezvous to determine the tanker "start turn" point.
25. MANDATORY DROPOFF POINT (BINGO) - That point in space and time where the receiver must proceed to the alternate airport in the event hookup and fuel transfer have not been effected.
26. MANUAL BOOM LATCHING (MBL) - Both tanker and receiver air refueling systems in manual operation.
27. MASS RENDEZVOUS AND AIR REFUELING - The procedure employed for rendezvous and air refueling between tanker and receiver forces using one or more air refueling control points simultaneously in the same air refueling area.
28. MULTIPLE AIR REFUELING CONTROL POINT PATTERN - That pattern of air refueling control points used for mass rendezvous air refueling when more than one air refueling control point is required.
29. OBSERVATION POSITION - Receiver's stabilized position (approximately 100 feet) behind and slightly below assigned tanker.
30. OFFLOAD/ONLOAD - That amount of fuel transferred between tanker and receiver airplanes.
31. ORBIT DEPARTURE TIME - That time at which the tanker will depart the orbit point to effect the planned rendezvous.
32. RADIO SILENCE - Use of visual signals to accomplish air refueling without the aid of verbal commands.
33. RECEIVER-TANKER DEPARTURE POINT - Two points approximately 300 nautical miles apart on or near the planned A/R track from which the receiver and tanker depart to effect a head-on rendezvous.
34. STATIC REFUELING - Refueling performed as the tankers maintain a prescribed pattern which is anchored to a geographical point or fix.
35. TANKER MANUAL OPERATION - Receiver air refueling system in normal; tanker air refueling system in manual operation.
36. TANKER ORBIT PATTERN - The pattern flown by the tanker near the orbit point when performing a point rendezvous.
37. TANKER ORBIT POINT - A geographical point along the planned air refueling track where the tanker will orbit.
38. TOBOGGAN - The word announced by a receiver to indicate to the tanker to commence a predetermined rate of descent or to increase rate of descent.
39. AIR REFUELING POSITION - The position maintained by the receiver pilot after contact has been made.

Formating Airspeed

The formating speed must be increased as the gross weight increases in order to maintain a stable margin of maneuvering airspeed above the stalling speed of the receiver. To accomplish this, the tanker speed should increase as fuel is off-loaded. Performance characteristics of the receiver airplane are such that the tanker and receiver are more compatible at the end of refueling than at the start provided tanker power is not changed. For an illustration of air refueling formating, see figures 4-66 and 4-69.

Level-Flight Refueling

Level flight refueling is recommended whenever possible. Normally, flaps are not required for refueling since the flaps up flight characteristics are good at refueling airspeeds. Airbrakes position 1, marked AR, is used primarily for air refueling and gives increased roll rate authority.

NOTE

In the event the receiver becomes power limited while using airbrakes position 1, retract the airbrakes.

B-52	KC-97	KC-135
ASQ-38 Search Radar	APN-69 Racon Beacon	APN-69 Racon Beacon
APN-69 Racon Beacon	APS-42 Search Radar	APN-59 Search Radar
ARC-34 UHF Command	ARA-25 Homing	ARA-25 Homing
ARN-14 Omni (Rc)	ARC-3 VHF (Tx)	
ARA-25 Homing	ARC-27 UHF (Tx)	ARC-34 UHF (Tx)
Visual	Rotating Beacon Pyrotechnics	Rotating Beacon

.....rendezvous equipment

Figure 4-64A.

Airbrakes at high positions may be used at light receiver weights to increase the amount of required engine power in order that the throttles may be used in a more responsive engine range. The receiver will tend to drop back as tanker downwash is encountered and it will be necessary to increase the rpm to maintain the proper position behind the tanker. It may also be necessary to retrim the stabilizer to an angle of attack sufficient to overcome the effects of the downwash. The refueling formation is best initiated by the receiver closing in from below, behind, and directly in train, being careful to maintain a safe altitude separation until it is certain that overrunning will not occur. When formation has been established, the receiver should be in an observation position approximately 100 feet aft, 50 feet below, and in train from the tanker. In the event there is a tendency to overshoot, speed can best be decreased by using airbrakes and retarding the throttles to idle rpm. The advantage of initiating a formation in this manner is that the tanker can be seen clearly at all times. After formating aft of the tanker, the pilot will proceed toward the contact position. Since the rate of deceleration of this airplane is low, the receiver pilot should use a slow rate of closure to prevent overrunning the tanker. The tanker has manual switches incorporated on the boom operator's panel to use in coaching the receiver into contact position. Coaching is done by pilot director lights during radio silence and begins when receiver is in the observation position. (A steady red light will indicate a large correction and a flashing red light will indicate a small correction in the direction indicated by the red director lights.) As the tanker is approached, it will be necessary for the pilot to lower his seat below the normal position so that he may have a better view of the tanker. When the seat is in the normal position, the pilot's view is obstructed by structural members over the top of the windshield. The boom operator will trail the boom at 34° and 8 feet extended and will advise the receiver pilot "Tanker ready for contact." The receiver will move forward and up to a point approximately 20 feet aft and level with the boom nozzle. From this point, the receiver will proceed slowly ahead to the contact position. As the receiver approaches the boom nozzle, the boom operator will raise the boom to approximately 30° in elevation, keeping the nozzle clear of the receiver windshield. The boom operator will give instructions to the receiver pilot during the approach and while in contact, first by giving the direction in which to move and then the desired distance. (Example: "Forward five, up two.") Distances are always given in feet. When the boom operator advises "Stand by for contact," the receiver pilot should hold a steady position until the boom is in the slipway and the boom operator calls "Tanker contact." The landing gear should not be extended during any refueling except in an emergency. If the landing gear were extended during any refueling except in an emergency and failed to retract, the missions would be compromised and, under certain conditions, the safe return of the airplanes to a landing base might be precluded.

Receiver Pilot Technique

Receiver pilot technique during transfer is not difficult if basic formation rules are observed. Control changes in the contact envelope should be made early in order to remain at the desired position and to avoid automatic disconnects. Position corrections must be made early and at the proper time to prevent tanker and receiver motions from getting out of phase with each other. Turns and banks may be made during contact without disconnects provided no abrupt motions are made by either tanker or receiver and if the proper speed margin is maintained. The lateral control spoilers introduce an "up" pitching moment but, during normal refueling operations, this characteristic is not objectionable. During refueling in rough air, it may be necessary to apply a small amount of elevator to offset the pitch tendency if a large amount of aileron correction is made rapidly. While approaching the tanker and during contact, the pilot should make his visual observations on the forward section of the tanker fuselage and cross-check with the pilot director lights to maintain a nominal position. Sufficient rudder control should be used to maintain the receiver fuselage in alignment with the tanker fuselage. Good azimuth control can be maintained by observing the center stripe painted on the bottom of the tanker fuselage. Elevation control is best maintained by small well-anticipated corrections on the elevator while making a visual cross-check between movement of the tanker nose section and corrections obtained from the pilot director lights. Lateral control is best accomplished by maintaining a parallel wing condition with that of the tanker. Small banks with aileron control is used to center the receiver airplane behind the tanker and then maintain a parallel wing condition.

SZ

An automatic flight control system has been incorporated to substantially reduce the loads imposed during air refueling and to reduce pilot fatigue. Pilot techniques as described in the above paragraph will still apply when using the aerial refuel mode of the automatic flight control system but these techniques should be easier to implement since control forces are reduced by flying the aircraft through the autopilot. Smoother refueling is possible in the aerial refuel mode since pilot inputs are damped out by the autopilot and added lateral stability helps to hold the aircraft in position by eliminating wallowing or rolling from side to side. Pitch oscillations are also damped out by the autopilot. With the electromechanical yaw damper engaged, the rudder controls may be used but rudder requirements are greatly reduced because the yaw damper is sensing and correcting any lateral-directional oscillations of the aircraft. The autopilot will assist the pilot in maintaining an attitude and will trim the aircraft automatically in the refueling envelope and during fuel transfer as cg and gross weight change. The aerial refuel mode of the automatic flight control system should be engaged while in the observation position. For additional information, see "Automatic Flight Control System," this section.

With Two or More Tankers

Under many conditions, one tanker may be unable to supply the required amount of transfer fuel. Under these conditions, the required additional tankers will fly formation on the lead tanker during the orbit, rendezvous, and refueling. After leaving the orbit point, the tankers should form a right echelon, stacked up, and flying well forward. This will afford the receiver pilot the best visual check of all tankers. The receiver will close on the right tanker for KC-97, lead tanker for KC-135 during initial contact. After completing its fuel transfer, the first tanker will make a right turn, clearing the formation. The receiver, after establishing visual contact with the second tanker, will move left and down into the observation position. It is very important that the second tanker maintain a forward position to prevent a loss of time and fuel by the receiver when moving from No. 1 tanker to No. 2 tanker. Additional tankers can be utilized in a similar manner.

During Contact

When the boom is in the slipway and the nozzle seats in the receptacle, the receptacle toggles will secure the nozzle in place and the airplane is ready for refueling. The air space known as the "contact envelope" (figure 4-67) is defined by limit switches connected to the boom. As long as the receiver is positioned inside these limits, contact can be maintained despite rolling, pitching, or yawing. The envelope limits are set well within the mechanical limits of the boom so that a disconnect will take place soon enough to allow ample time for a separation. This is true even though the envelope limits are approached at a relatively high velocity. Extreme azimuth disconnects should be avoided at all times. If the boom is released at this azimuth limit, slipstream forces attempt to streamline the boom to the trail position. This results in the boom striking the slipway doors before the operator can elevate the boom, causing damage to the doors and slipway lights located in the doors.

Receiver Director Lights

The KC-97 pilot director lights are provided on the lower side of the tanker to aid the receiver pilot in maintaining correct formation while in contact. The pilot director lights are actuated by movements of the boom and therefore provide assistance to the receiver pilot only when the receiver is in contact. The center light has a plain green lens and remains illuminated as long as the boom remains in the nominal position. The other four lights have red lenses and read as follows from forward to aft: UP--AFT--FWD--DWN. These lights indicate the correction necessary to restore the receiver airplane to the nominal position. In addition to these lights, some KC-97 airplanes have been modified in the field by the installation of pilot director lights which are of the same configuration as those used on the KC-135 tanker. These lights (figure 4-70) are located on the bottom of the fuselage between the nose gear and the main landing gear. The red pilot director lights may be actuated by the boom operator to aid in positioning the receiver airplane prior to contact. A steady red light will indicate a large correction and a flashing red light will indicate a small correction in the direction indicated by pilot director lights. The lights assist the receiver pilot in maintaining the nominal position while in contact and will automatically reflect the correction the receiver pilot should make to attain the nominal contact position. They are separated in two strips consisting of individual colored panels. The left row, as seen by the receiver pilot, is for elevation movement and the right row is for telescoping movement. The elevation group consists of four triangular shaped and one rectangular shaped colored panels: Strip green, green and red, with two illuminated letters, D and U, for down and up respectively. Background lights are provided behind the panels to accentuate the panel outlines and the individual colored panels are illuminated by lights that are controlled by boom elevation during the contact made condition. The telescoping group, consisting of rectangular shaped colored panels, is not illuminated by background lights but contains an illuminated white panel between each colored panel to serve as a reference point. The letters A for aft and F for forward augment the telescoping group. The strip green panels (so called because of a black strip painted down the center of each center panel) are illuminated when the boom nozzle is within approximately ±3 feet of the nominal extension (11.75 feet) and ±5° of the nominal elevation (30°). See figure 4-71 for refueling boom envelope limits, KC-135.

Night Refueling

Under night or low visibility conditions, the night refueling lights will be turned on by the tanker airplane when in positive radar contact with the receiver and when the range has closed to 30 nautical miles. If no radar contact is made, the refueling lights will be turned on 20 minutes prior to the receiver's orbit control time. The tanker navigation lights, rotating beacon, boom lights, and underwing and overwing lights will all be on during rendezvous. If rotating beacons are not installed, the boom operators will be equipped with aldis lamps, complete with colored slides, to shine out of the pod in the direction of the receiver. Flares will be available upon call by the receiver. Proper colored flares will be fired from the tanker upon requests of the receiver to assist in identifying the assigned tanker. When the receiver arrives in the observation position, the tanker navigation lights will be placed on DIM, rotating beacons and aldis lamps will be turned off, and pilot director, boom illumination, overwing, and body lights will be dimmed to low intensity. During rendezvous and descent, the receiver's navigation light switches will be in the BRIGHT and STEADY positions and the anticollision light will be ON. As the receiver approaches the observation position, the cockpit lights will be dimmed as required, navigation light switches in FLASH and BRIGHT positions, and the anticollision light switch OFF. While approaching the contact position, the receiver pilot can adjust the intensity of the slipway and wing lights as required by boom operator.

Fuel Transfer Rate

Receivers should open all possible tank valves so that the tanker can transfer fuel at a maximum rate. The fuel transfer rate normally will be as follows:

KC-97 - 5,000 pounds per minute.
KC-135 - 6,500 pounds per minute.
(All four air refueling pumps operating).

Visual Signals

1. In the event of radio communication failure or radio silence contacts, the following visual signals will be used:

a. Up-and-down movement of the boom ending in trail position with the boom extended to 10 feet means that the tanker is ready for contact.

b. Boom retracted, up-and-down movement of the boom ending in stowed position indicates that there is a malfunction in the tanker that will be fixed shortly. The receiver should remain in the observation position until the malfunction is corrected or until the receiver deems it necessary to depart.

c. Side-to-side movement of the boom ending in trail position with the boom extended 10 feet indicates that the tanker is fully operative and requests that the receiver check his air refueling system.

d. Side-to-side movement of the boom with the boom retracted and ending in trail indicates that prescribed fuel load has been transferred.

e. Side-to-side movement of the boom ending with the boom in stowed position indicates that the tanker's air refueling system is completely inoperative.

f. The need for a disconnect, when the situation does not warrant a breakaway, will be indicated by receiver director lights being turned OFF. Receiver pilot observing that all receiver director lights go out will immediately initiate a disconnect and return to the observation position.

g. The need for emergency breakaway by tanker will be indicated by receiver director lights being turned off and on rapidly. Receiver pilot will immediately initiate disconnect and institute breakaway procedure.

h. Should the receiver pilot desire breakaway, he will institute breakaway procedure and close slipway doors.

i. To indicate termination of refueling, the receiver will turn upper anticollision light on or off as applicable.

j. A steady light from receiver indicates that an actual fuel shortage exists and refueling operations must continue on an emergency basis. Applicable lights are aldis lamp or flashlight.

2. If necessary to use manual operation in the event of communication failure, the following visual signals will be used.

CAUTION

Refueling operations will be discontinued in the event of communications failure or tanker boom position instrument failure except in case of an emergency.

a. Boom operator will indicate use of tanker manual operation by trailing fully extended boom. The receiver pilot will acknowledge by flashing A/R overwing lights (night) or aldis lamp/flashlight (day). Boom operator will then retract boom into ready position and stand by for contact.

b. Should the receiver pilot desire to initiate manual boom latching, he will pull into observation position and signal by flashing A/R overwing lights (night) or aldis lamp/flashlight (day). Receiver will remain in the observation position until his signal has been acknowledged by the boom operator, which will be one up-and-down movement of the boom fully extended ending with the boom in the ready position.

Oral Communications

Communications during rendezvous should be held to an absolute minimum. The actual air refueling operation should be performed whenever possible under complete radio silence. Occasionally situations will arise, such as refueling under adverse conditions or with an inexperienced receiver pilot, when it will become necessary for the boom operator to give the receiver oral corrections. The following voice procedure is to be used as a guide when oral communications are necessary and it is not to be construed as the exact words the boom operator will use in all instances. When the receiver reaches the observation position, the boom operator, when directed by the tanker pilot, will establish radio contact with the receiver.

1. Establish radio contact.

"(Receiver call sign) this is (tanker call sign) boom operator, radio check." After call from receiver pilot, state "Tanker ready." Receiver pilot acknowledges by stating "Receiver ready."

2. Voice procedure for normal contacts:

a. Prior to contact:

Boom operator will begin communications when receiver reaches approximately 50 feet. Direction will precede distance for receiver to move and will be given in 10-foot increments

until receiver reaches approximately 10 feet from end of boom. Example: Fwd 50, Fwd 40, Fwd 30, Fwd 20, Fwd 10. When receiver reaches approximately 10 feet from end of nozzle, all the corrections will be given in (feet) smaller increments for the receiver to move. Example: Up 4, Fwd 8, Up 2, Fwd 6, Fwd 4, Fwd 2. When contact is established, state "Tanker contact." Receiver pilot acknowledges by stating "Receiver contact." With boom nozzle in receiver receptacle and tanker and/or receiver air refueling system does not advance to contact, the boom operator or receiver pilot will call "Disconnect."

b. During contact:

Communications during air refueling operation will be held to an absolute minimum.

3. Voice procedure for tanker manual operation and manual boom latching:

a. KC-97 receiver briefings:

(1) Tanker Manual Operation Briefing. "(Receiver call sign) the following contacts will be made in tanker manual operation. Receiver A/R system will remain in NORMAL. All boom limit switches and boom operator's disconnect switch are inoperative and receiver pilot must initiate all disconnects. Inform boom operator when receiver A/R system is in CONTACT MADE. Tanker ready." Receiver pilot will acknowledge transmission by stating "Receiver ready."

(2) Manual Boom Latching Briefing. "(Receiver call sign) the following contacts will be made in manual boom latching. Tanker and receiver A/R systems will both be in MANUAL. All boom limit switches and boom operator's disconnect switch are inoperative and receiver pilot must initiate all disconnects. Inform boom operator when receiver A/R system is in CONTACT MADE. Tanker ready." Receiver pilot will acknowledge transmission by stating "Receiver ready."

b. KC-135 receiver briefings:

(1) Tanker Manual Operation Briefing. "(Receiver call sign) the following contacts will be made in tanker manual operation. Receiver A/R system will remain in NORMAL. Tanker ready." Receiver pilot will acknowledge transmission by stating "Receiver ready."

(2) Manual Boom Latching:

"(Receiver call sign) the following contacts will be made in manual boom latching. All boom limit switches inoperative and receiver pilot must initiate all disconnects." Receiver will acknowledge transmission by stating "Receiver ready."

c. For voice procedure prior to contact, see step "2a" above.

d. During contact:

Communication during air refueling operation will be held to an absolute minimum.

e. Disconnect:

Use command words "Disconnect" or "Breakaway" as the case warrants before receiver reaches normal envelope limits.

4. Breakaway:

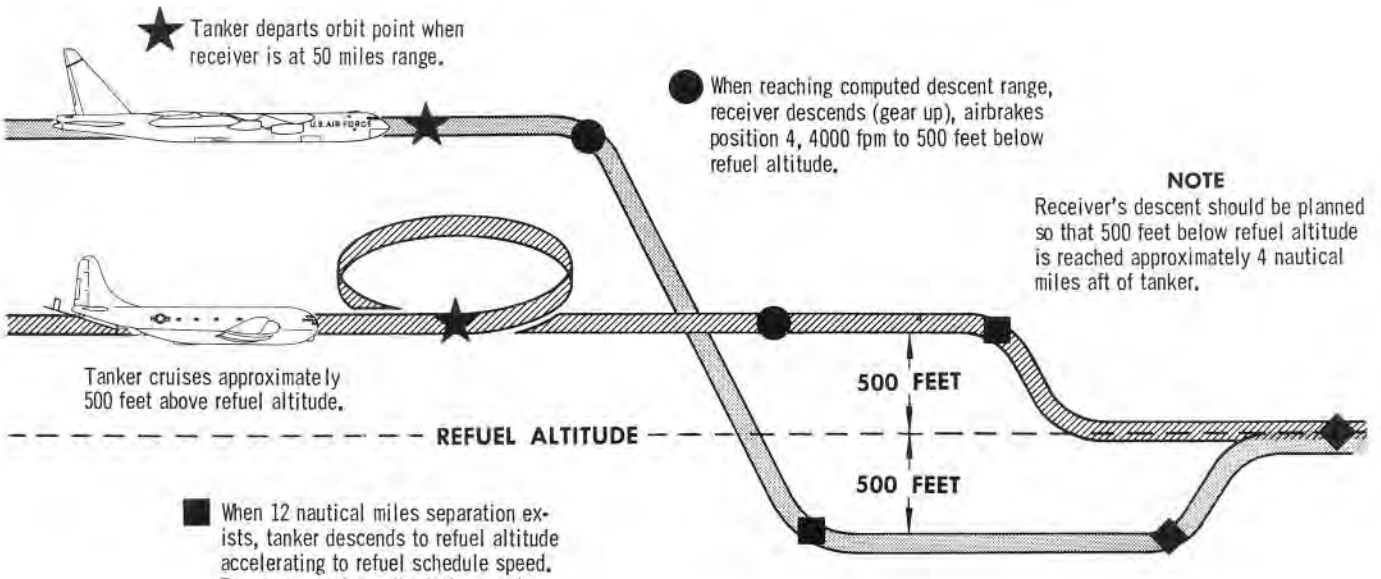
When a crew member aboard either the tanker or receiver determines that an emergency exists, the crew member will transmit on air refueling frequency (the other airplane tactical call sign) followed by "Breakaway, Breakaway, Breakaway." (During mass refuelings, the cell position call sign will be used.)

Operational Technique (KC-97)

WARNING

To preclude the possibility of inadvertent actuation of the stabilizer trim switch, the pilot should rest his thumb between the horizontal spur and the upright position of the control wheel grip during all normal operation. Special care should be taken during takeoff, landing, and air refueling operations.

RENDEZVOUS. Both tanker and receiver crews will monitor the designated radio frequency at least 40 minutes before planned air refueling control time. Receiver airplane rendezvous equipment will be on at



NAUTICAL MILES SEPARATION	IAS (KNOTS)
4	280
3	275
2	250
1	225
1/2	Formating speed (contact) plus 15

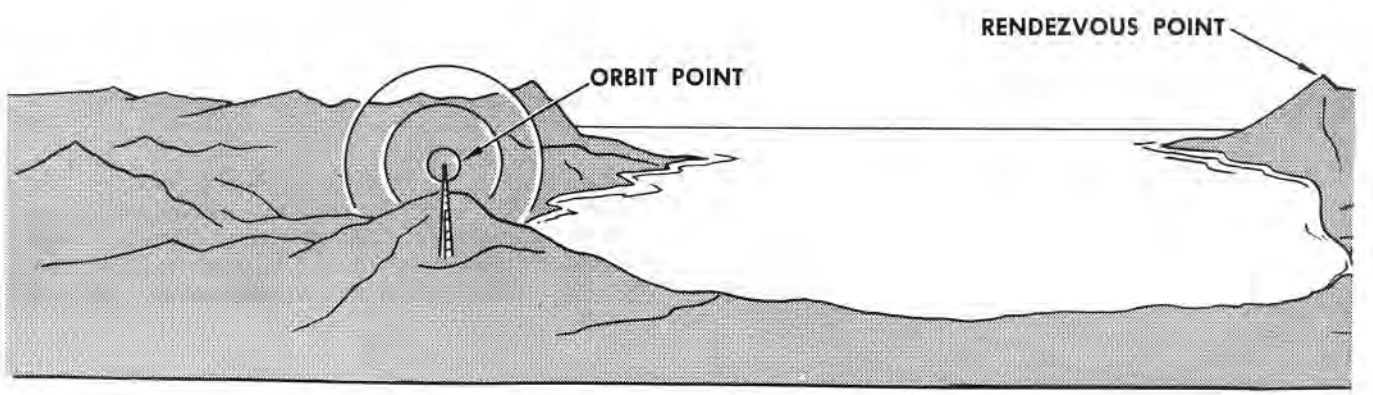
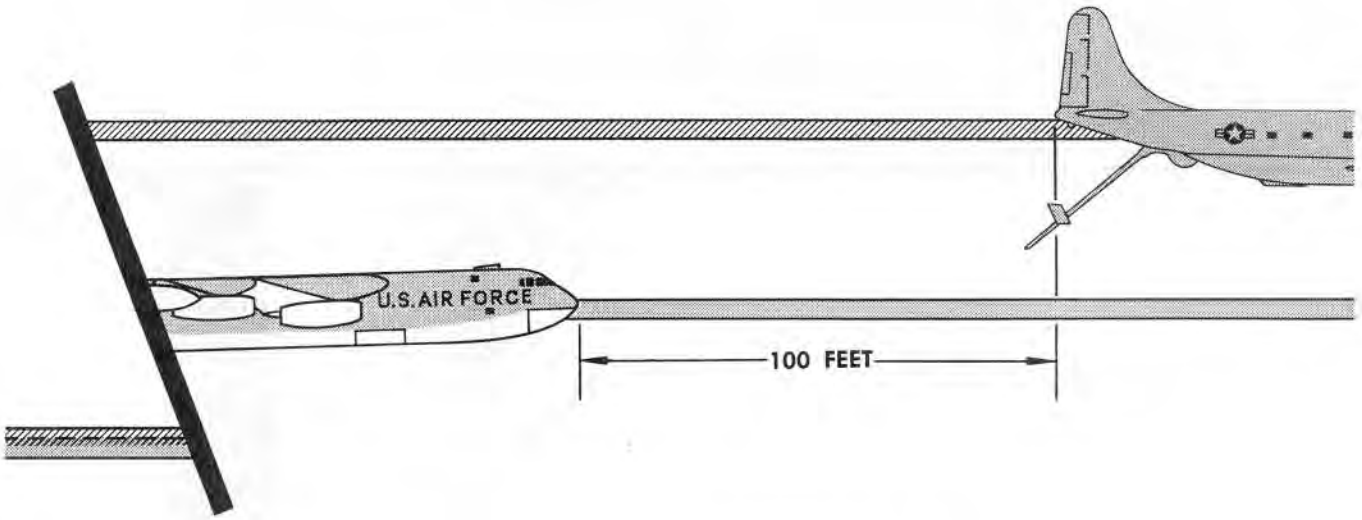
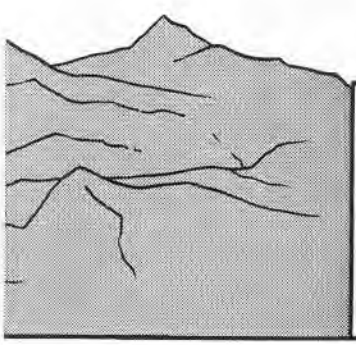


Figure 4-65 (Sheet 1 of 2).



CAUTION

- Pilots must exercise particular care when closing on the tanker to prevent overrunning. Should it become apparent that overrunning may occur, the pilot must maintain positive vertical clearance preferably staying below, and lateral clearance if the tactical situation permits.
- The recommended procedure for decelerating is as follows:
  1. Reduce power.
  2. Vary airbrake setting to obtain desired speed schedule.



$$\text{DESCENT RANGE} = \frac{\text{DIFFERENTIAL ALTITUDE}}{\text{RATE OF DESCENT}} \times \frac{\text{CLOSING SPEED}}{60} + 4 \text{ MILES}$$

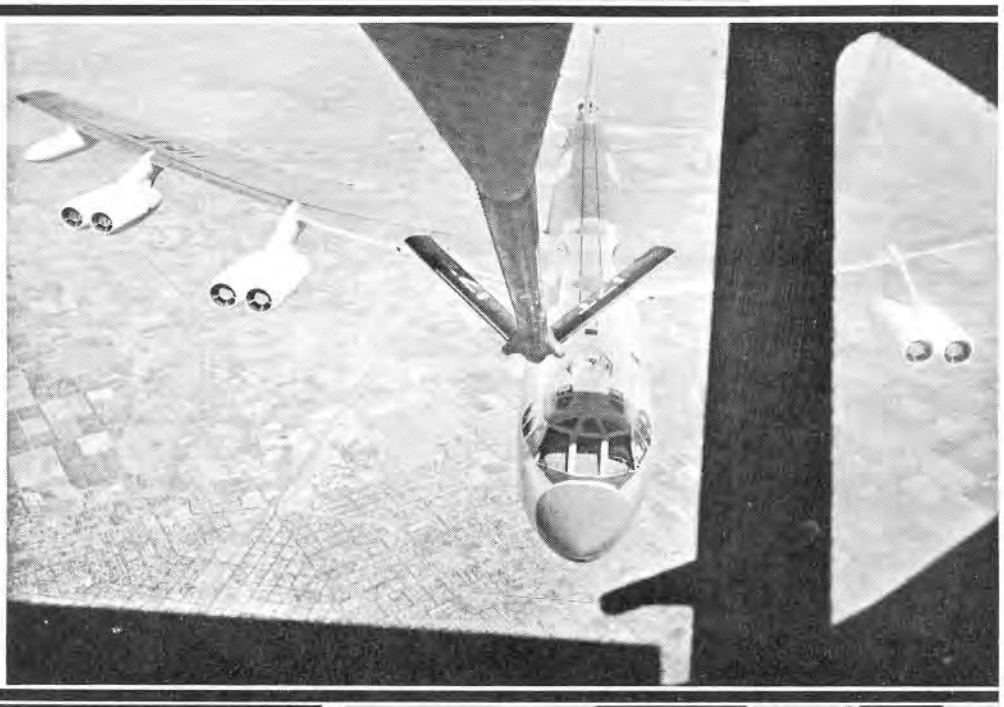
RENDEZVOUS ASB-4 OR APN-69 (RECEIVER)

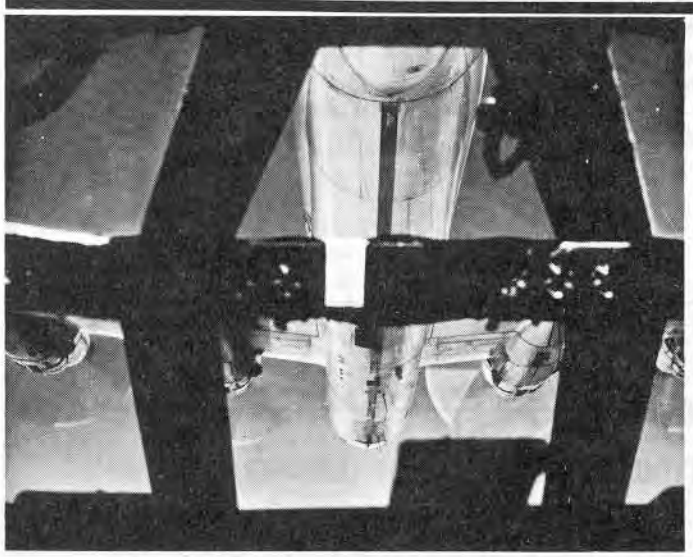
.....typical air refueling rendezvous - KC-97

Figure 4-65. (Sheet 2 of 2).

OBSERVATION POSITION

BEFORE CONTACT





CONTACT—Seen from bomber

CONTACT—Seen from tanker

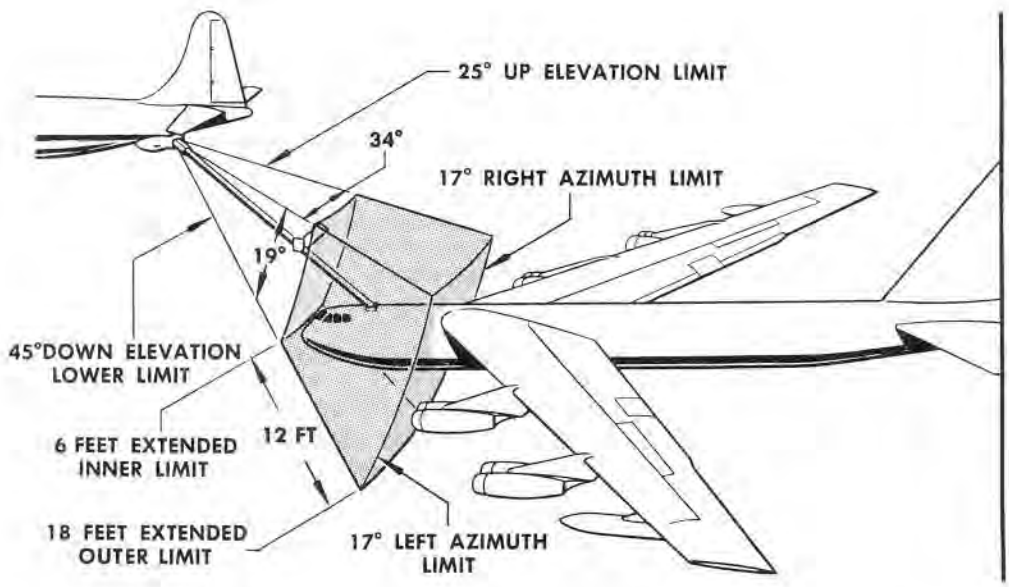
.....air refueling formating - KC-97

Figure 4-66.

least 40 minutes prior to the planned air refueling control time. The tanker navigator will insure that the tanker rendezvous equipment is turned on a minimum of 40 minutes prior to the receiver's ETA for the ARCP. The tanker APN-69 radar beacon will be used as the primary method of electronic rendezvous. The receiver pilot will communicate with the tanker pilot as far from the ARCP as possible, giving ETA to ARCP, APN-69 beacon reception, range if in electronic contact, descent range, and contact speed. To prevent erroneous electronic indications being used, it is imperative that tanker and receiver crews attempt to identify and confirm each other's electronic signal as soon as possible. Turning the equipment off momentarily, based on prearranged agreements, is an effective method of insuring positive identification of rendezvous signal. In no case should this identification be completed later than the receiver's arrival at the refueling IP. The tanker will orbit in the prescribed orbit pattern and will depart the orbit point when the receiver is at 50-mile range. When effecting the rendezvous utilizing electronic signals from the tanker's APN-69 radar beacon, the tanker must be advised of the range separation. Ranges normally will be called in 10 nautical mile increments from the 50-mile range to the 20-mile range, then a call at the 15-mile range and the 12-mile range. After this, calls will be continued in 1-mile increments until visual contact is established. The AN/ARA-25 UHF/DF, if installed, can be used as a reference to the receiver/tanker position during electronic rendezvous. For an illustration of a typical air refueling rendezvous, see figure 4-60.

ALTERNATE RENDEZVOUS. The procedure as outlined in this paragraph can be utilized when equipment malfunctions prevent an electronic rendezvous. The receiver will transmit to the tanker an ETA for the ARCP based on the latest known information. The tanker will depart the orbit point to make good the receiver's ETA at the ARCP. Action must be taken to assure the arrival of both the tanker and the receiver at the ARCP on the same ETA. The receiver will start descent on course, on ETA for the ARCP, minus the time required for descent, and minus 1 additional minute to insure arrival at the desired altitude for final closure prior to reaching the ARCP. This procedure will allow approximately 7 nautical miles for final phase of visual rendezvous. At least 10 minutes prior to ETA for the ARCP, the tanker will key an identifier followed by a 20-second tone on his UHF transmitter to provide a homing facility for the receiver utilizing the AN/ARA-25 UHF/DF. After visual contact is established, the remainder of the operation will follow normal procedures.

DESCENT. The radar navigator will notify the pilot when approaching and upon reaching the descent range point. At this point, receiver pilot will reduce power



.... air refueling boom envelope limits - KC-97

Figure 4-67.

to idle, extend airbrakes to position 4, and descend at 4000 feet per minute until reaching Mach .80 or 280 knots IAS, whichever is slower. The landing gear will not be extended for normal refueling descents. If the descent range was computed correctly, the receiver should reach a point 4 miles aft and 500 feet below refueling altitude at the end of descent. At this point, the airbrakes normally will be retracted and throttles and airbrakes will be used to maintain the following deceleration schedule:

4 nautical miles	280 knots IAS
3 nautical miles	275 knots IAS
2 nautical miles	250 knots IAS
1 nautical mile	225 knots IAS
1/2 nautical mile	Formating speed (contact) plus 15 knots IAS

During the deceleration schedule, it is imperative that the speed schedule be maintained. When the rendezvous is made using the tanker APN-69 radar beacon, the receiver radar navigator will pass the range calls to the receiver pilot at 3, 2, 1, and 1/2 nautical miles. The receiver pilot will transmit range and indicated airspeed to the tanker at each of the above ranges. During cell formation, only the cell leader will make the above calls.

NOTE

Level-off altitude will be maintained until it is ascertained that overrunning will not occur.

CAUTION

- Receiver airplane will stabilize in the observation position to insure that a zero rate of closure exists prior to closing for contact.
- If it becomes apparent that overrunning will occur after the receiver has left the observation position, breakaway procedure will be used.
- Lower landing gear as a last resort; consider that failure to retract would jeopardize the mission.

When the receiver is close enough to pick up the tanker in the "altitude hole," the radar navigator will adjust his radar set to receive this return and will call the tanker's range to the pilot as required to assist the pilot in adjusting the rate of closure. The tanker radar navigator also will give the receiver's range at 1-mile intervals. Level-off altitude will be maintained until 1/2 mile from the tanker and visual contact has been established. If final stages of closure are made with radar contact only, the receiver pilot will maintain at least a 500-foot altitude differential until visual contact has been established with the tanker. As soon as visual contact is made with the tanker, the receiver pilot should pull up into observation position. The airspeed will drop off rapidly during the last mile of closing and power must be added as tanker downwash is encountered.

WARNING

If the control cabin is not pressurized, all unnecessary electrical equipment should be turned off.

NOTE

If the crew compartment is pressurized, the radar navigator should operate all equipment as desired and maintain definitely known positions during refueling in order to give the pilot the desired heading upon completion of refueling.

DESCENT REFUELING. Descent refueling offers a negligible amount of range increase, even if successfully accomplished. For this reason, level flight refueling is recommended whenever possible. Since weather may sometimes necessitate a higher starting altitude, a descent refueling procedure may be desired. When a descent refueling is to be made, formate as previously discussed and, when airspeeds are stabilized, the tanker should initiate the descent on a predetermined heading and establish the desired descent rate. The receiver follows and slowly moves into contact position, keeping a low rate of closure to prevent overrunning the tanker. The use of airbrakes will tend to prevent an overrunning tendency and, in an emergency, the use of full airbrakes will prevent overrunning the tanker. The maximum recommended rate of descent is 400 feet per minute. Level off at the level flight refuel altitude or slightly above this level and refuel in the normal manner.

WARNING

The use of more than airbrakes position 2 is hazardous because the resultant pitchup cannot be controlled with the stick alone at refueling altitudes and speeds.

Operational Technique (KC-135)

MISSION PLANNING. The air refueling rendezvous will be normally planned to permit the receiver airplane to maintain course and cruising altitude as long as possible. If a last minute change has been made in the air refueling control point of refueling altitude, the tanker will so inform the receiver as soon as radio contact has been established. All rendezvous will be planned with an established altitude differential of at least 2000 feet but not more than 9000 feet; receiver at the higher alti-

tude. Receiver descent point will be planned 80 nautical miles prior to the ARCP. The receiver level-off altitude will be 1000 feet below the assigned tanker base altitude. This level-off altitude will be maintained until 1 nautical mile from the tanker and visual contact is established.

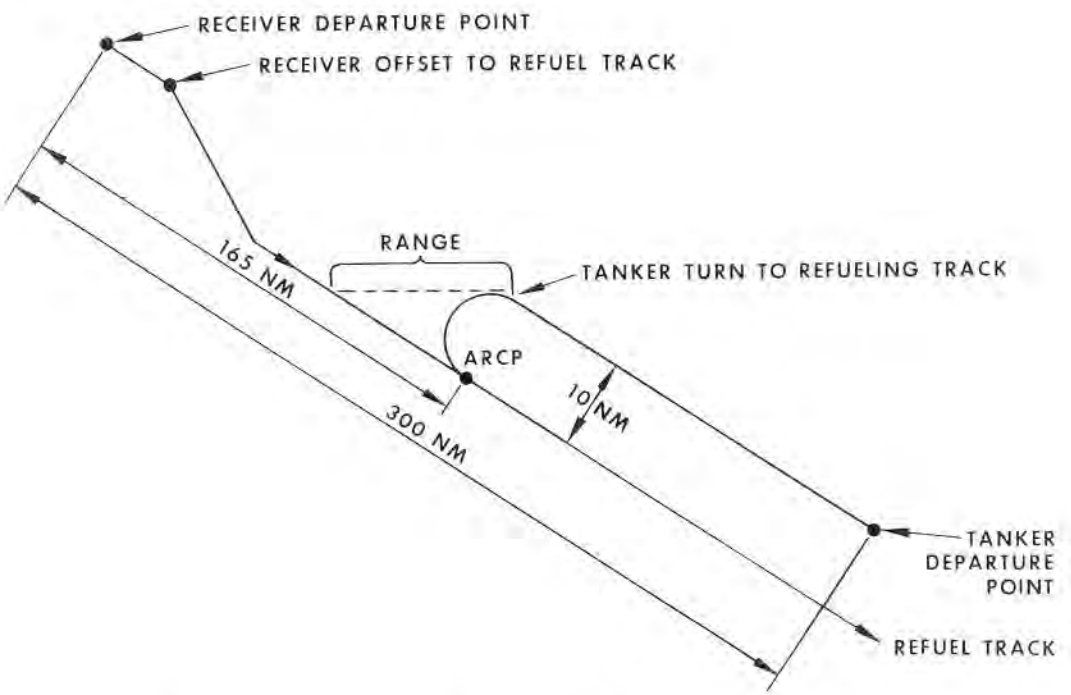
NOTE

See "Mission Planning," Part 12 of the Appendix for proper fuel log procedure.

RENDEZVOUS. Both tanker and receiver crews will monitor the designated radio frequency at least 40 minutes before planned air refueling control time. Receiver airplane rendezvous equipment will be on at least 40 minutes prior to the planned air refueling control time. The tanker navigator will insure that the tanker rendezvous equipment is turned on a minimum of 40 minutes prior to the receiver's ETA for the ARCP. The tanker APN-69 radar beacon will be used as the primary method of electronic rendezvous, with the receiver APN-69 rendezvous beacon being monitored for a backup when installed. The receiver pilot will communicate with the tanker pilot as far from the ARCP as possible, giving ETA to ARCP, APN-69 beacon reception, and range if in electronic contact. To prevent erroneous electronic indications being used, it is imperative that tanker crews attempt to identify and confirm each other's electronic signal as soon as possible. Turning the equipment off momentarily, based on prearranged agreements, is an effective method of insuring positive identification of rendezvous signal. In no case should this identification be completed later than the receiver's arrival at the refueling IP.

HEAD-ON RENDEZVOUS. When accomplishing a head-on rendezvous, the receiver and tanker departure points will be separated approximately 300 nautical miles with the receiver flying at an altitude of 2000 feet above the tanker. The ARCP will be located on the refueling track 165 miles downstream from the receiver departure point. Departure points and controlled departure times will be used for both the tanker and receiver. The tanker will establish a track from the assigned departure point toward the receiver departure point. Radio and electronic contact will be established as soon as possible, with range transmitted to the tanker airplane. The receiver radar navigator will monitor range and establish the receiver on an offset track to the right (figures 4-68B and 4-68C); he will also transmit a countdown in 20-mile increments from the 150-mile range to the 50-mile range and then in 10-mile increments to the 30-mile range. At the 25-mile range, he will transmit the countdown in 1-mile increments until reaching the tanker turn range. The range and speed schedule will be the same as the point/parallel orbit type rendezvous.

POINT/PARALLEL ORBIT RENDEZVOUS. When accomplishing a point/parallel orbit type rendezvous, the tanker will orbit over the designated orbit point in a racetrack pattern to the left, parallel to the planned



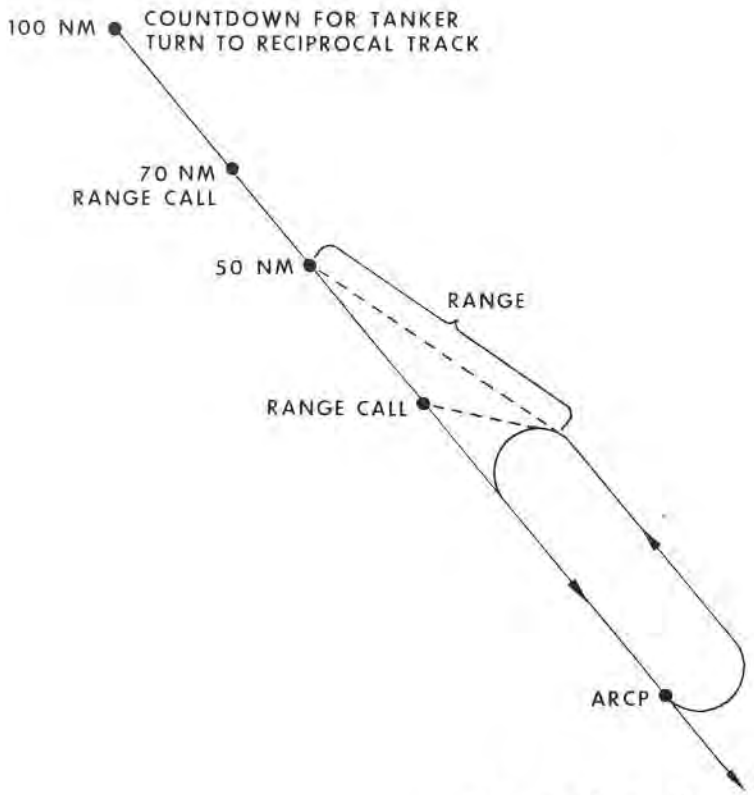
.....head-on rendezvous — KC-135

Figure 4-68.

refueling track at Mach . 74 or 255 knots IAS, whichever is lower. The orbit pattern will be established to fly 2-minute legs with 2-minute turns with the orbit point at the downstream end of the leg that coincides with the planned refueling track. The tanker orbit will be at the same altitude that refueling is to be initiated and/or maintained when receiver capability permits. Normally, the base refueling altitude for the tanker will be at least 2000 feet below assigned receiver optimum altitude. To perform an effective rendezvous, receiver airplane must plan for and pass over the refueling initial point (IP). Receivers will home on the tanker when the closure rate is at a minimum (tanker is on the refueling track leg of his orbit) to establish a basic heading for the rendezvous. After the tanker has departed his orbit on the reciprocal of the refueling track, proper lateral separation must be maintained by the receiver. The receiver radar navigator will monitor the range and begin a countdown, on command radio, in 10-nautical mile increments from the 100-mile range to the 70-mile range to prepare the tanker for the turn to the reciprocal of the refueling track at the 70-mile range. The receiver radar navigator will continue countdown in 10-mile increments to the 30-mile range, then call in 1-mile increments from the 25-mile range to the tanker turn range. The radar navigator will continue range calls on interphone in 1-mile increments with a final call at 1/2 mile. The AN/ARA-25 UHF/DF, if installed, can be used as a reference to the receiver/tanker position during electronic rendezvous.

NOTE

The exact turn distances and lateral separations for crosswinds and off normal altitude rendezvous will be determined from the applicable turn range and crosswind correction charts. See figures 4-68B and 4-68C.



point/parallel orbit rendezvous — KC-135

Figure 4-68A.

ALTERNATE RENDEZVOUS. The procedure as outlined in this paragraph can be utilized when equipment malfunctions prevent an electronic rendezvous. If the APN-69 is not received and identified before reaching a point 40 nautical miles upstream of the ARCP, the tanker pilot will be advised that an ARA-25 rendezvous can be initiated. At this time, the tanker will turn to the upstream heading while the receiver continues to the ARCP, maintaining level-off altitude, and slows the airplane to 40 knots above initial stall speed. The receiver will transmit on the refueling frequency 5 seconds of every 10-second period, ending with the receiver call sign. As the receiver shows wing tip passage, the tanker will turn behind the receiver and accelerate to Mach .78 or 310 KIAS, whichever is lower. The tanker will notify the receiver that he is turning to refueling heading. The receiver will continue to transmit the homing signal until visual sighting is made. Upon passing the receiver, the tanker will decelerate to refueling airspeed and the receiver will accelerate and close visually.

BUDDY REFUELING - KC-135. Receiver(s) and tanker(s) will join into enroute cell formation on the tanker leader utilizing the APN-69 signal. All aircraft will climb on course at 280 knots IAS or Mach .765 as required. Upon reaching assigned altitude, the lead aircraft will level off and adjust his speed to Mach .70. The following aircraft, upon reaching their assigned level-off altitude, will adjust to Mach .81 to close the formation. Route cell formation procedures will be maintained utilizing station keeping techniques until a minimum of 100 nautical miles prior to ARCP. The tanker and receiver cell will then adjust to refueling formation. The receiver formation will start a descent to prepare for refueling at 80 nautical miles prior to ARCP. The receiver level-off altitudes will be planned to provide for 1000-foot altitude separation between the highest receiver altitude and the tanker leader base altitude. After the receiver leader reaches level-off altitude, he will inform the tanker leader at which time tanker formation will adjust to refueling airspeed. Normal refueling formation procedures will then apply for the remainder of refueling and departure.

DESCENT. The receiver will begin descent to an altitude 1000 feet below the assigned refueling altitude either 80 nautical miles prior to the tanker beacon signal (if tanker is in orbit) or 80 nautical miles prior to

TANKER ALTITUDE	TANKER TURN RADIUS & TURN TIME		RECEIVER TAS	RECEIVER DISTANCE	RECOMMENDED TRACK OFFSET	TURN RANGE
	NM	MIN		NM	NM	NM
34,000'	4.5	2'	460	15.3	10	23
30,000'	4.0	1' 53"	435	13.6	9	21
25,000'	3.5	1' 45"	405	12.0	8	18
20,000'	3.0	1' 38"	375	10.3	7	16
15,000'	2.5	1' 30"	350	8.7	6	14
10,000'	2.25	1' 26"	325	7.7	5	12

Assumed:
Standard Day
B-52 Mach .80 or 280 KIAS, whichever is lower
KC-135 Mach .74 or 255 KIAS, whichever is lower
B-52 1000 feet below Tanker
Tanker used 30° bank for turn

"Rule of Thumb": For each 5000 feet below 35M: Decrease Track Offset by 1 NM and Turn Range by 2 NM.

off normal altitude turn range chart B-52/KC-135 point rendezvous

Figure 4-68B.

the ARCP (if tanker is late arriving at ARCP). In the event electronic contact has not been established, receiver will descend at 80 nautical miles prior to ARCP. The receiver will descend at 2500 feet per minute at Mach .80 until reaching 280 knots IAS, then maintain 280 knots IAS through level-off to a point 2 miles from the tanker. This level-off altitude will be maintained until 1 mile from the tanker and visual contact has been established at which time a gradual climb to observation position will be initiated, arriving at 1/2 nautical mile with a minimum altitude separation of 500 feet. The receiver will maintain 280 knots IAS until the following ranges vs speed schedules apply:

3 nautical miles - Mach .80 or 280 knots IAS, whichever is less
2 nautical miles - Mach .80 or 280 knots IAS, whichever is less
1 nautical mile - Mach .78 or 270 knots IAS, whichever is less
1/2 nautical mile - Mach .76 or 265 knots IAS, whichever is less
Contact - Mach .74 or 255 knots IAS, whichever is less.

During the deceleration schedule, it is imperative that the speed schedule be maintained. When the rendezvous is made using the tanker APN-69 radar beacon, the receiver radar navigator will pass the range calls to the receiver pilot at 3, 2, 1, and 1/2 nautical miles. The receiver pilot will transmit range and indicated airspeed to the tanker at each of the above ranges. During cell formation, only the cell leader will make the above calls.

NOTE

Level-off altitude will be maintained until it is ascertained overrunning will not occur.

DEGREES DRIFT	RANGE ADJUSTMENT	DISPLACEMENT ADJUSTMENT
	NM	NM
0	0	0
4	1/2	1
8	1	2
10	1 1/2	2 3/4
14	2	3 3/4
18	2 1/2	5
20	3	5 1/2

- Receiver with left drift correction (wind from left): ADD to turn distance and lateral separation
- Receiver with right drift correction (wind from right): SUBTRACT from turn distance and lateral separation

crosswind corrections for KC-135 point rendezvous

Figure 4-68C.

WARNING

A nose high attitude must be assumed by the receiver to maintain level flight as it is flown into the downwash of a tanker airplane. A sudden gain in altitude will result if the receiver moves forward and out of the tanker downwash. This will require instantaneous and positive forward control pressure with a simultaneous decrease of engine power to avoid a midair collision.

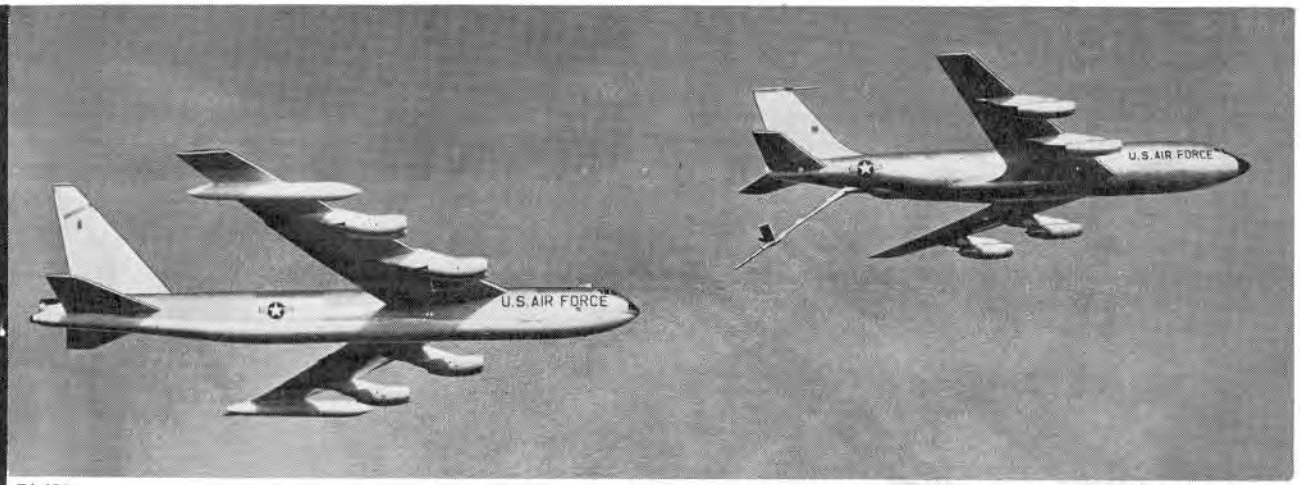
CAUTION

- Receiver airplane will stabilize in the observation position to insure that a zero rate of closure exists prior to closing for contact.
- If it becomes apparent that overrunning will occur after the receiver has left the observation position, breakaway procedure will be used.
- Lower landing gear as a last resort; consider that failure to retract would jeopardize the mission.

RECEIVER OVERRUN. The following procedures will be utilized in the event of the receiver overrunning the tanker. After the airplanes are separated, the receiver will reduce airspeed to 255 knots IAS and maintain track and altitude. The tanker will increase the airspeed to 280 knots IAS, maintain altitude, adjust track as required, and overtake the receiver. After overtaking the receiver, the tanker will reduce the airspeed to 255 knots IAS for final receiver closure.

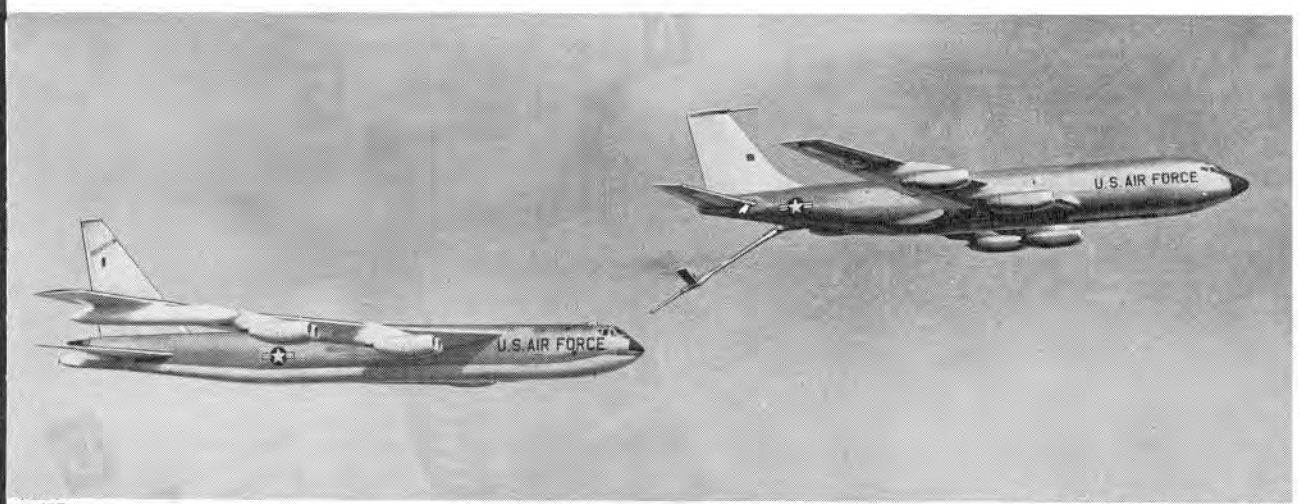
AIR REFUELING FORMATION. Closure for contact from the observation position should be made very slowly to enable both the tanker and receiver pilots to compensate for the required trim changes. In addition, with slow closure rates, the power adjustments required to finally stabilize in the refueling position will be smaller. The basis of good refueling is to fly formation on the tanker. The director lights and the boom operator's directions should be utilized as information on the exact location of the receiver in the envelope but basically the technique is to fly formation on the tanker. Rough usage of the controls on the part of either the receiver or tanker pilot will cause a chain reaction with progressively larger corrections required to maintain position; therefore, development of a smooth technique is necessary. Minute throttle changes can be accomplished by squeezing the throttle together and "walking" them forward or back in a gradual motion.

DIRECTOR LIGHTS. The director lights do not give true vertical and horizontal information. The up and down lights change because of angular movement of the boom and the fore and aft lights change because of in and out movements of the boom. The axis of the director light system is inclined at a 30° angle to the tanker fuselage. This angle causes an interaction in both lights when a true vertical or horizontal movement is made by the receiver. For example, flying straight



E1-156

OBSERVATION POSITION



E1-157

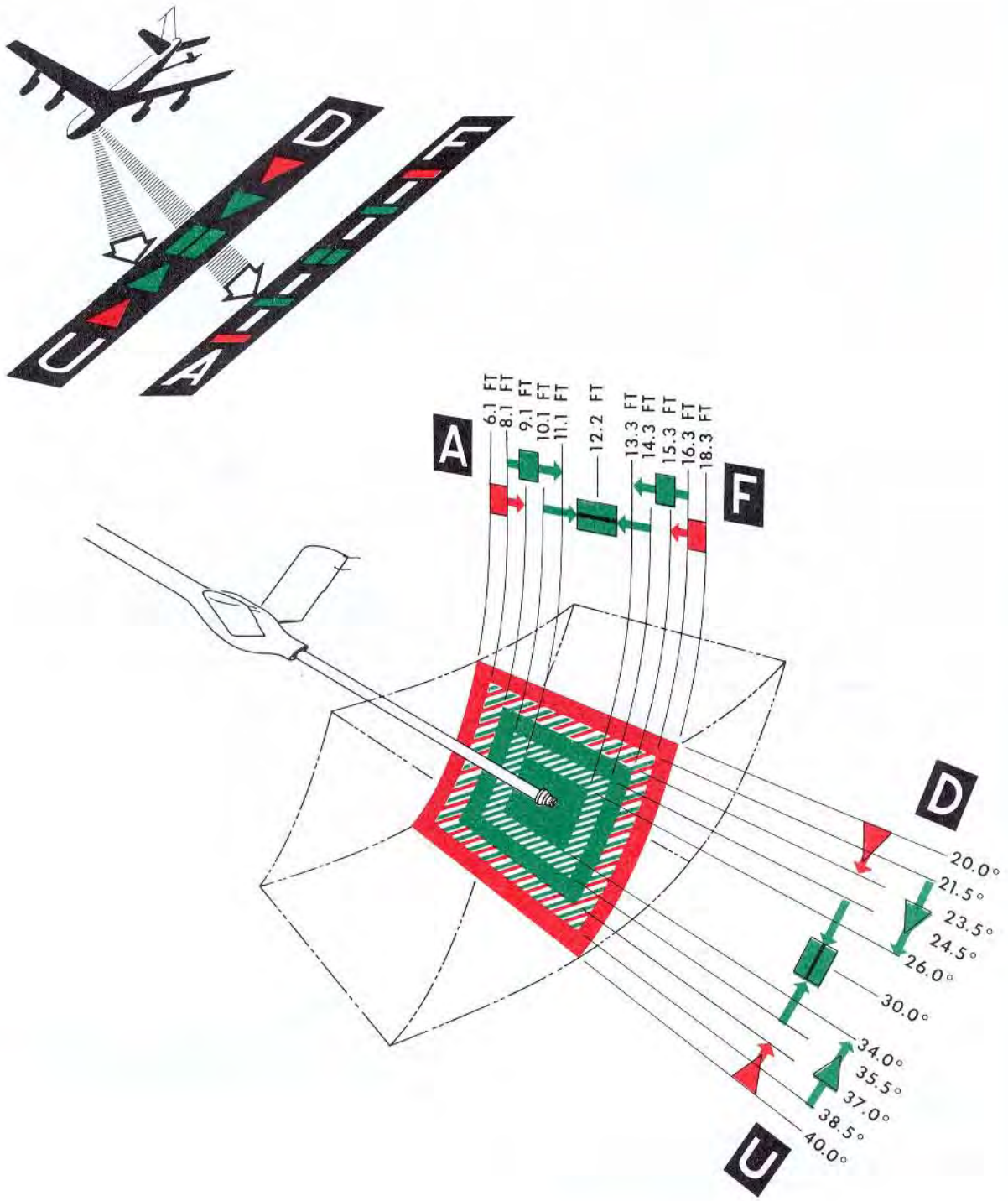
BEFORE CONTACT

E1-158

CONTACT

.....air refueling formating - KC-135

Figure 4-69.



.....receiver director lights - KC-135

Figure 4-70.

forward while in contact will cause the boom to compress and also increase its angle with the tanker fuselage. The lights will show that the airplane is flying forward and down. If a true up movement is made, the boom will compress and also lessen its angle with the tanker fuselage giving a combined up and forward indication from the lights. When this interaction between the lights is understood, it can be used to advantage in keeping position. Small fore and aft corrections can be made with little or no power change by moving vertically.

UNDERRUNNING THE TANKER. Since the air refueling contact position is behind and below the tanker, the danger is in underrunning the tanker during an attempt to formate. Normally the rate of closure is determined by a cross-check of airspeeds between the two airplanes. When closing on the lead airplane, the rate of closure is reduced by retarding the throttles. If closure rate remains too rapid with throttles at idle, put up not more than No. 2 airbrakes. Using more than No. 2 airbrakes is hazardous because the resultant pitchup cannot be controlled with the stick alone. If normal procedures do not adequately control the closure and underrunning the lead airplane appears imminent, extend the gear. This has the advantage of adding drag and pitching the airplane nose down. If visual contact with the lead airplane is lost, establish a rate of descent of approximately 1000 fpm. See "Breakaway Procedure," this section.

WARNING

If extremely close formation is encountered inadvertently, be on guard for large and rapidly varying aerodynamic interference forces. See "Formation Flying," Section VI, for a discussion of these forces.

PILOT FATIGUE. One of the greatest potential hazards during refueling is fatigue. On becoming fatigued or if for any reason large oscillations develop which require increasing amounts of control displacement, break contact and let the other pilot fly the airplane in the observation position for a few minutes. The time spent in stabilizing and resting will result in better refueling in a shorter time since fewer disconnects will be experienced. On aircraft [SY], pilot fatigue is reduced by using the aerial refuel mode of the automatic flight control system. See "Receiver Pilot Technique" and "Automatic Flight Control System," this section.

AIR REFUELING SYSTEM EMERGENCY OPERATION

NOTE

[SY]

When using the aerial refuel mode of the automatic flight control system, the autopilot will disengage in the normal manner by pressing either the pilot's or copilot's autopilot disconnect button on their respective control wheels. The autopilot will also be disengaged by abrupt pitch control inputs or rapid reversals of force on the control column. Boom disconnects caused by excessive pressure, exceeding boom envelope limits, or boom operator's command will not disengage the autopilot.

Engine Failure

A tanker engine failure is more serious than a receiver engine failure. A receiver engine failure will result in extension of the boom and probable separation. However, a tanker engine failure will probably cause the receiver to overrun the tanker. In the event of tanker engine failure, the formation accomplishes the "breakaway" procedure.

Tanker Cannot Release Receiver

It is possible, though improbable, that the tanker signal system may change to disconnect while the receiver signal system stays in contact made. In this case, the retraction limit switch on the tanker will not free the receiver from the tanker. For this remote possibility and other emergencies which might arise, the receiver pilot must be prepared at all times to press his autopilot and air refueling (IFR) boom release button instantly.

Air Refueling System Failure

FAILURE TO DISCONNECT. At any time if either the boom operator or the receiver pilot is unable to accomplish disconnect, the receiver pilot must place the signal amplifier power switch in the manual position and press the autopilot and air refueling (IFR) boom release button.

FAILURE AFTER CONTACT HAS BEEN MADE. If the blue ready for contact light stays on or comes back on after contact has been established, the receiver pilot must place the signal amplifier power switch in the manual position and press the autopilot and air refueling (IFR) boom release button.

NOTE

An air refueling system malfunction is indicated by the blue ready-for-contact light staying on or coming back on. In certain cases however a malfunction may occur and not be indicated in this manner.

ESTABLISHING SUBSEQUENT CONTACT. Manual contact may be accomplished through established procedures.

Manual Boom Latching

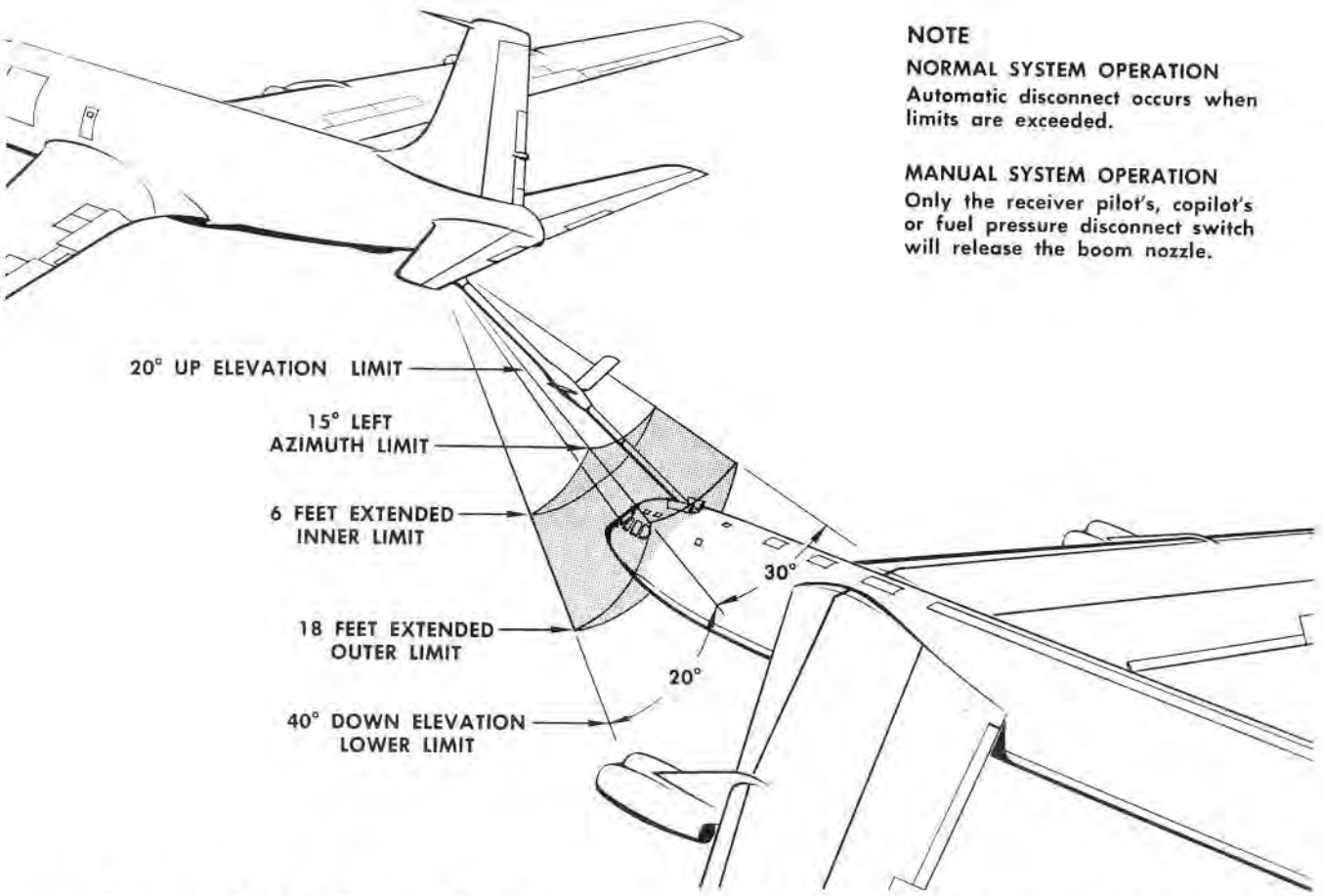
If failure of the signal amplifier system should occur, the boom may be latched in the receptacle by placing the signal amplifier power switch in MANUAL and the toggle latching switch in HOLD position. There is no visual means of knowing when the boom is in the bottom of the receptacle except when the green contact made light illuminates. When visual means are lacking and the manual toggle latching system is in use, the following procedure should be used:

1. Fly the receiver into the contact position with the signal amplifier power switch in MANUAL and the toggle latching switch in RELEASE position.
   a. Manual power light on.
   b. Ready (blue) light on.
2. Boom operator will place nozzle in bottom of receptacle and advise receiver pilot "nozzle contact."
3. With the contact made (green) light on, receiver pilot will then place toggle latching switch in HOLD position.
   a. Ready (blue) light off.
   b. Contact made (green) light on.

CAUTION

If the toggle latching switch is placed in HOLD position before the boom is in the bottom of the receptacle, it is possible for the boom nozzle to damage or break the extended toggles, preventing any further refueling.

4. Receiver pilot will advise tanker boom operator, "Receiver contact made."
5. Tanker boom operator will actuate emergency contact trigger switch and advise receiver pilot, "Tanker contact made."
6. Proceed with normal air refueling methods. Tanker boom operator will advise receiver pilot of corrective action to be used to remain within air refueling envelope.
7. When fuel transfer has been completed, tanker boom operator will call for "Disconnect."
8. Receiver pilot will disconnect by depressing the boom release button to release toggles and inform the



...air refueling boom envelope limits - KC-135

Figure 4-71.

tanker boom operator, "Receiver disconnect." Receiver pilot must hold the boom release button until the boom nozzle leaves the receptacle and visual inspection reveals the boom nozzle clear of receptacle.

CAUTION

It is possible to cause structural damage to the air refueling boom and slipway by severe relative movement between the two airplanes when operating with manual latching of the boom as the limit switches are deactivated. The receiver pilot must initiate all disconnects before exceeding any of the limits.

NOTE

The boom operator is unable to release the boom toggles during manual boom latching.

9. Boom operator will actuate his disconnect switch and when nozzle is free in receptacle, he will retract the boom. If no additional refueling contacts are to be made, he may then stow the boom.

Emergency Operation of Slipway Doors

Failure of hydraulic system No. 1 will prevent actuation of the slipway doors from the normal system. In such an emergency, place the alternate slipway door switch in OPEN position to operate the slipway doors. Hydraulic pressure is supplied from hydraulic system No. 2 with the alternate slipway door switch in OPEN position. If both hydraulic packs No. 1 and 2 fail and the landing gear is up and locked, hydraulic pressure for the air refueling system can be obtained from either No. 1 or 2 standby pump. With the standby pumps switch for the landing gear in ON position, pressure is supplied from the No. 1 standby pump by pulling the left forward landing gear normal control circuit breaker on the pilot's circuit breaker panel and placing the normal slipway door switch to OPEN position. Pressure from the No. 2 standby pump, if needed, can be obtained by pulling the right forward landing gear normal control circuit breaker and placing the alternate slipway door switch to OPEN position.

NOTE

Upon completion of the air refueling operation, reset the landing gear normal control circuit breaker and return the landing gear standby pumps switch to OFF position.

Emergency Operation of Air Refueling Shutoff Valve

The air refueling shutoff valve (figure 4-63) on the pressure bulkhead aft of the radar navigator's station is operated by a 24-volt d-c motor. If this motor should fail in the closed position, it would be impossible to receive fuel from a tanker until the valve was manually placed in OPEN position. To manually place the valve in OPEN, the control lever must be moved in a counterclockwise position (inboard). To close the valve, move the control lever in a clockwise direction (outboard).

Emergency Disconnect

To disconnect in an emergency, the receiver pilot must be prepared at all times while flying in formation to press the boom release button. Unless a serious emergency arises, every effort should be made to stay in contact position until certain the nozzle is clear of the receptacle.

Breakaway Procedure

When a crew member aboard either the tanker or receiver determines that an emergency exists, he will transmit on air refueling frequency the other airplane tactical call sign followed by "Breakaway, Breakaway, Breakaway." During mass refueling, the cell position call sign will be used. This call is used to notify tanker and receiver that an emergency condition exists such as excessive rate-of-closure, receiver underrunning, etc. The airplanes do not necessarily have to be in contact to call a breakaway. Relative position of both airplanes must be monitored closely by tanker and receiver crew members during all phases of air refueling. If the tanker desires a breakaway while operating with loss of interplane communications, the crew member will state on interphone "Breakaway" three times and the boom operator will turn the receiver director lights off and on rapidly. Should the receiver desire a breakaway during loss of interplane communications, the crew member will state on interphone "Breakaway" three times and the pilot will institute breakaway procedure. The following action will be taken simultaneously by the indicated crew members:

1. Tanker Pilot. Increase power if available to obtain forward separation and, when clear of the receiver airplane, climb straight ahead with wings level.
2. Boom Operator. Actuate disconnect switch, move boom away from receiver, notify tanker pilot when clear to climb, and stow boom if desired or deemed necessary.
3. Receiver Pilot. Immediately actuate the boom release, retard throttles to IDLE, and drop down and aft of tanker until entire tanker airplane is in sight (add drag if necessary to avoid collision).

WARNING

The receiver pilot should use caution not to overrun the tanker. If overrunning does occur, under no conditions should a turn, either right or left, be made until breakaway has been completed.

4. Receiver Copilot. Actuate boom release, maintain visual contact with the tanker until clear, and stand by for instructions from the pilot.

AIR REFUELING CHECKLIST (Copilot Reads)

NOTE

All asterisk (*) items will be read by the copilot and response given over interphone. All other items may be completed silently by the appropriate crew member.

Rendezvous and Predescent

All refueling preparations and precontact checks will be made before descent to refuel altitude is started. This will permit the pilot to concentrate on formating with the tanker. The copilot will initiate the following checklist procedures:

*1. Rendezvous Equipment - On at briefed time (if applicable) (EW/N)

At least 40 minutes from planned air refueling control time, EW officer (or navigator NF) turns on rendezvous equipment. Prior to reaching the 200 nautical mile point, the EW officer (or navigator NF) will turn on the APN-69 equipment.

The radar navigator completes the following procedures:

a. Radar Set - On

The radar navigator will tune radar set for beacon operation when approximately 200 nautical miles or less from the tanker orbit point.

b. Beacon Signal of Assigned Tanker - Identify

Identify beacon signal of assigned tanker per code given during briefing.

c. Range & Azimuth of Tanker - Determine

Radar navigator directs pilot to home in on the predetermined point after determining the range and azimuth.

*2. Descent Range - _____ Miles (if applicable) (CP)

Compute descent range for chase or point type rendezvous when final cruise altitude is determined using the following formula or descent range chart in the Appendix.

$$\text{Descent Range} = \frac{\text{Differential altitude}}{\text{Rate of descent}} \times \frac{\text{Closing Speed}}{60} + 4$$

NOTE

Normally the differential TAS can be used instead of differential ground speed (GS) since the average wind effect on the receiver during descent should not differ appreciably from the effect on the tanker at refueling altitude.

*3. Contact Speed - _____ Knots (CP)

The receiver copilot will compute receiver gross weight and will enter the appropriate chart in the Appendix to determine minimum refueling speed. If the speed is different from the one computed during flight planning, the receiver pilot will advise the tanker pilot of the new required speed. Use briefed Mach or IAS for KC-135 refueling.

*4. Air Conditioning System - Checked, cabin pressurized, no smoking (CP)

During air refueling operations, it is desirable that the cabin and tail compartments be pressurized. If forward compartment pressurization is lost and air refueling is necessary, place air conditioning master switch to RAM. This will tend to prevent fuel spillage that may occur from entering cabin. Pressurize as outlined in "Air Conditioning Systems," this section.

AIR REFUELING CHECKLIST (Copilot Reads) (Cont)

WARNING

- Do not use ram air for tail compartment ventilation during air refueling operations. This will prevent the possibility of fuel vapors entering the compartment through the air conditioning ducts.
- There will be no smoking by any crew member during the refueling operation since combustible fuel fumes may be present.

5. Transfer Valve Switches - OFF (CP)

CAUTION

All fuel transferring should be discontinued before air refueling is started since there is no secondary valve control in the transfer system when the master refuel control switch is in ON position.

6. Master Refuel Control Switch - ON (CP)

All amber-colored valve closed indicator lights should illuminate when the valve switches are in the closed position.

*7. Refuel Secondary Valve Switches - VALVE OPEN as required (CP)

Open fuel tank valves as required to maintain cg. Normally, the four main wing tanks and the forward, mid, and aft body tanks will be refueled.

CAUTION

Fuel can be pumped in a reverse direction from the receiver through the air refueling boom to the aft tanks of the tanker. This can occur if valve 46 is open and pressure is delivered to it from either the crossfeed manifold or the transfer manifold. Therefore, valve switches 10, 11, 30, and 31 on the fuel system control panel and valve switch 46 (labeled TO FUEL FEED MANIFOLD) on the refuel panel should be checked in OFF (valve closed) position during all air refueling contacts, wet or dry. Conversely, if certain crossfeed valves (valves 9, 10, 11, and 12) are ON (valve open), engine fuel pressure could be increased by pressure from the refueling boom. See figure 1-15, "Fuel System," and figure 4-58, "Refuel System," for an understanding of these possibilities.

8. Air Refueling System Master Switch - ON (CP)

When the switch is in ON position, power is supplied to additional controls on the overhead air refueling panel and, on airplanes 240▶ WI20▶, the slipway drain valve closes.

9. Refuel Valve Switch - OPEN, refuel valve light on (CP)

When refueling valve is open, green refuel valve light will illuminate.

10. Signal Amplifier Power Switch - NORMAL (CP)

11. Manual Toggle Latch Switch - RELEASE (CP)

*12. Periscopic Sextant - Stowed, port closed (EW)

AIR REFUELING CHECKLIST (Copilot Reads) (Cont)

*13. Ranges & Bearings - Report to pilot (RN)

The radar navigator will report ranges and bearings to the pilot and/or tanker.

NOTE

To eliminate trapped fuel from the refuel manifold when the refueling system is not in use:
1. Do not open the manifold interconnect (valve 46) switch on the refuel panel while refueling. This valve should be opened only as a ground operation or an emergency flight condition.
2. Do not open the drop tank refuel secondary valves within 15 minutes after having completed transfer operation from the tanks and having closed transfer valves 17 and 21.
3. Scavenge refuel manifold after each refueling operation and after each transfer operation through the refuel system. Close the air refueling shutoff valve after scavenging. The air refueling manifold in the forward crew compartment should be scavenged at all times when not in use.

*14. Engine & Nacelle Anti-Icing - Climatic (P)

Descent (KC-97 Refueling Only)

*1. Throttles - IDLE (P)

*2. Airbrake Lever - Position 4 (P)

The airbrake lever should be moved to position 4 cautiously to avoid pitchup as airbrakes are extended.

*3. Descent - 4000 feet per minute (P)

As the airplane approaches refueling altitude, the airbrakes may be raised or lowered to arrive at the proper point to establish correct deceleration to constant speed.

*4. Altimeters - Reset (or as briefed) (P-CP-N)

Altimeters will be reset to local altimeter setting if descending through flight level 240 unless otherwise dictated by tactical operation requirements.

*5. Airbrake Lever - OFF (P)

Preparation For Contact

*1. Radio Contact - Established (P)

Pilot will establish radio contact at the 3 nautical mile range with the tanker pilot.

2. Slipway & Aircraft (Wing) Light Switches - Set (night only) (CP)

Rotate each rheostat approximately 180° clockwise and adjust later if requested by boom operator.

*3. Anticollision Lights - OFF (night only) (P)

*4. Navigation Lights - FLASH (night only) (P)

*5. FCS Switches - Positioned (G)

*6. Rendezvous Radar - STDBY (N/EW)

SINGLE POINT GROUND REFUELING SYSTEM

A single point ground refueling receptacle (20, figure 1-60) is provided to allow filling of all airplane fuel tanks from a single point. Single point servicing of the fuel system reduces the time and amount of equipment required during fuel servicing of the airplane. The receptacle in the right forward wheel well baffle is accessible through a filler cap. The nozzle adapter of the receptacle contains a spring-loaded poppet which is opened by the fuel nozzle and seals the filler opening when the nozzle is withdrawn. The single point refueling receptacle is connected directly to the refuel manifold and fuel flows in the same manner as in air refueling (figure 4-58). The refuel panel (figure 4-61) on the copilot's side panel includes the controls necessary for operation of the refuel system valves. See "Air Refueling System," this section, for information on these controls.

EW OFFICER'S EJECTION SEAT

The EW officer is provided with an upward ejection seat the same as the pilot's upward ejection seat (figure 1-55). The controls are operated in the same manner as the pilot's seat controls and the sequence of operation of the seat ejection system is the same as the pilot's with the exception of not having a control column stowage thruster. For a detailed description of the upward ejection seats, see "Upward Ejection Seats," Section I.

DOWNWARD EJECTION SEATS

The navigator and radar navigator are provided with downward ejection seats (figure 4-72A). The radar navigator's seat is positioned over an escape hatch and the navigator's seat is positioned over the main entry hatch. Both seats position automatically for ejection. The ejection control trigger ring located on the front of the seat initiates the ejection cycle. One continuous pull on the ejection control ring will sequence a series of ballistic devices and mechanical linkages incorporated in the seat to rotate the leg guards, lock the inertia reel, position the seat, jettison the hatch, and fire the catapult to eject the seat from the airplane. Ankle restraints are provided to keep the legs in position during ejection. The ankle restraints are spring-loaded and may be kicked free any time after they are closed. In the event they are accidentally triggered, they may be reset by pushing downward and outward on either restraint until pivot arms and restraints are locked. Each seat can be positioned electrically up and down, fore and aft, and tilted by seat positioning switches during normal use. The fore and aft adjustment is accomplished by two electric actuators, one at the top and one at the bottom of the seat. The back is tilted by

operation of the upper actuator only. Electrical, oxygen, and ballistics lines are provided with disconnects to permit separation of the lines when the seat is ejected. The seat is equipped with a headrest and an inertia reel which assist the occupant in maintaining position during ejection. The downward ejection seat accommodates a survival kit and a modified B-5 parachute.

WARNING

Do not use any form of shock absorbing device other than the survival kit and/or seat cushion designated as standard equipment for the ejection seat. Utilizing the wrong seat cushions and/or survival kit or too much cushioning material does not provide comfort, but actually creates a definite injury hazard and may position the seat occupant where it is difficult to reach the controls. Chance of vertebral injury upon impact of crash landing or ditching is increased considerably by sitting on too thick a compressible mass. The added cushioning may also permit the seat occupant to sink far enough down to loosen the shoulder straps, allowing the seat occupant to slump forward, possibly incurring severe back injury. It may raise the seat occupant to such a height that the leg restraints will not restrain his legs, thus exposing them to possible injury from flailing in the windblast following ejection.

An integrated harness release mechanism provides a means for separating the safety belt and parachute harness from the seat automatically after ejection of the seat. Manual operation of the integrated harness release will disengage the safety belt and, in addition, will disengage the parachute arming lanyard. A modified B-5 parachute and a specially designed safety belt is installed in the harness release fittings. See "Integrated Harness System," this section, for additional information. For a detailed discussion of seat ejection sequences, see "Escape Systems Operation," Section VII.

WARNING

Should a downward ejection hatch be inadvertently dropped, the ejection seat at that station will be armed and can be fired.

The seats are equipped with a man-seat separator that insures positive controlled separation of crew members from the downward seats during ejection. Two nylon straps are installed in the seat under the survival kit and parachute. A reel-type ballistic actuator and jackshaft is installed on the back of the seat. The nylon straps are attached to the jackshaft driven by the reel-type ballistic actuator. The actuator is connected by ballistic hose to the integrated harness ballistic actuation system. After the integrated harness is released, the straps are pulled tight, forming one side of a triangle the other two sides of which form the seat back and bottom. As the straps are pulled tight, they throw the man clear of the seat automatically.

WARNING

Do not connect zero delay lanyard to parachute ripcord T-handle when using a downward ejection seat since it is equipped with a man-seat separator.

DOWNWARD EJECTION SEAT CONTROLS

Leg Guards

The leg guards (5, figure 4-72A) are positioned automatically during the ejection cycle. Pulling the ejection control trigger ring fires the arming initiator which

in turn fires the leg guard thruster which turns the leg guard torque tube and rotates the leg guards into position to protect the legs during ejection.

Safety Pins and Streamers

Each downward ejection seat is provided with a safety pin (15, figure 4-72A) numbered 1, to be used by the flight crew member to prevent inadvertent initiation of the seat ejection sequence. This pin (lockpin) safeties the ejection control firing trigger located at the front of the seat. The pin should be in place in the firing trigger ring at all times on the ground including preflight and postflight inspections and whenever the crew member leaves his seat during flight. The ejection control firing trigger safety pin is stowed in a pouch on the right side of the seat when the pin is removed. In addition, each downward ejection seat is provided with five maintenance pins (numbered 2, 3, 4, 5, and 6) to be used for maintenance operations only (figure 4-72A). Three of the pins are attached to a single red streamer and the remaining two pins attached to another red streamer. When the seat is in flight status, these pins are stowed in the box provided on the back of the seat.

Ejection Control Trigger Ring — Less VD

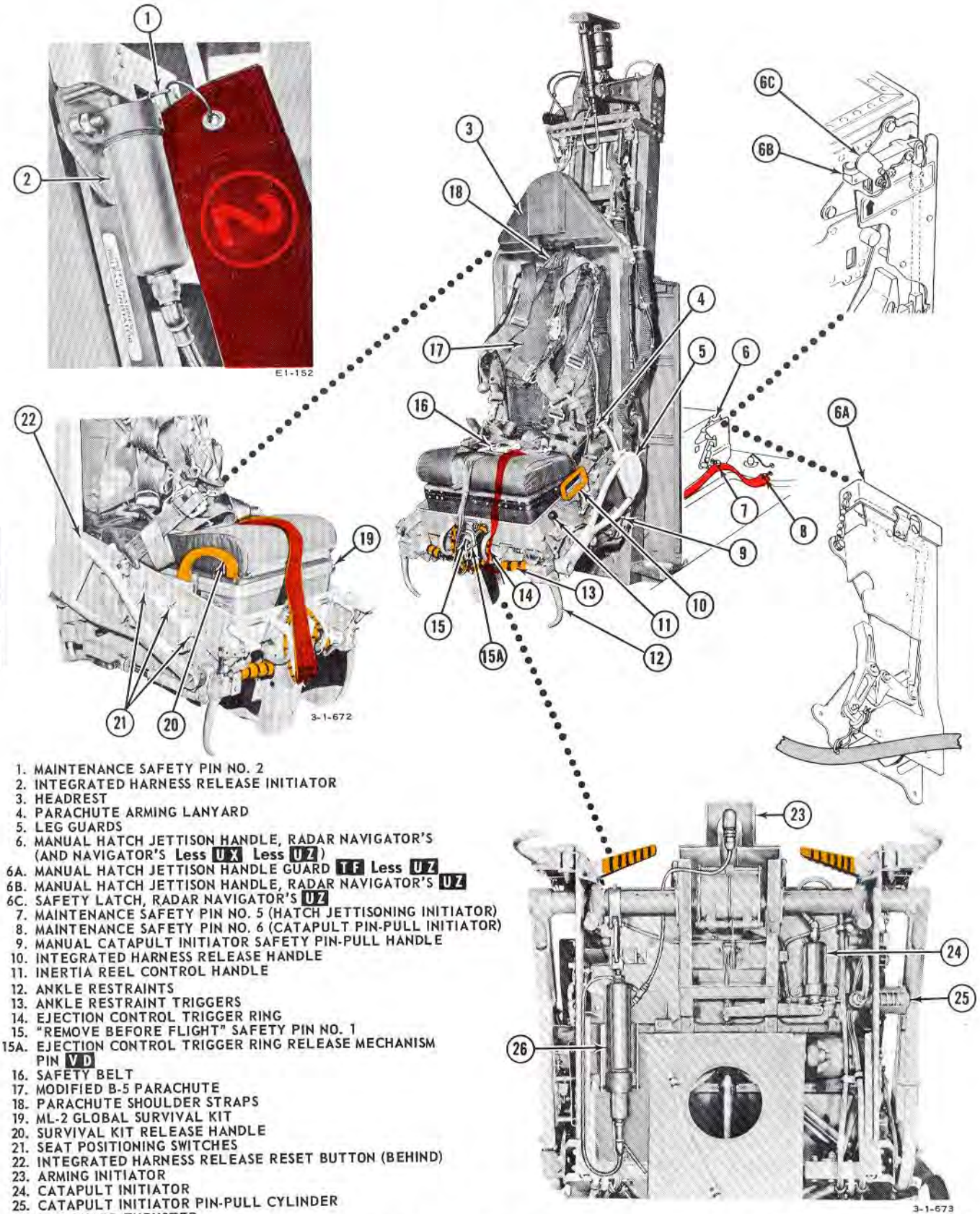
An ejection control trigger ring (14, figure 4-72A) is stowed on the front center of the seat. Prior to flight, the trigger ring is safetied by the No. 1 "Remove Before Flight" safety pin. When the pin is removed, the spring-loaded trigger ring will rotate 180° upward, thus providing the seat occupant ready access to the ring. The seat occupant is required only to grasp the ring and pull continuously to accomplish both the arming and ejection sequences. A pull of approximately 35 pounds is required to remove the trigger ring from its retaining detent. After release from the detent, a pull of approximately 40 pounds and a cable travel of approximately 1 inch fire the arming initiator, which locks the inertia reel, positions the seat, rotates the leg guards, and jettisons the escape hatch. Continued pull on the ejection trigger ring (exerting approximately the same 40 pounds for approximately 4 more inches of cable travel) fires the catapult initiator which fires the catapult to eject the seat.

Ejection Control Trigger Ring — VD

An ejection control trigger ring (14, figure 4-72A) is stowed on the front center of the seat. Prior to flight, the trigger ring is safetied by the ejection control trigger ring release mechanism pin (15A, figure 4-27A), which in turn is safetied by the No. 1 "Remove Before Flight" safety pin. In order to unstow the ejection control trigger ring, remove the No. 1 "Remove Before Flight" safety pin from the stowage clip on the ejection control trigger ring release mechanism pin; then pull upward on the spring-loaded release mechanism pin. When the release mechanism pin is lifted, the spring-loaded trigger ring will rotate 180° upward, thus providing the seat occupant ready access to grasp the ring. A pull of approximately 35 pounds is required to remove the trigger ring from its retaining detent. After release from the detent, a pull of approximately 40 pounds and a cable travel of approximately 1 inch fire the arming initiator, which locks the inertia reel, positions the seat, rotates the leg guards, and jettisons the escape hatch. Continued pull on the ejection trigger ring (exerting approximately the same 40 pounds for approximately 4 more inches of cable travel) fires the catapult initiator which fires the catapult to eject the seat.

Ejection Control Trigger Ring Release Mechanism Pin — VD

An ejection control trigger ring release mechanism pin (15A, figure 4-72A) is installed on the front center of the seat. The release mechanism pin provides a means of stowing and unstowing the ejection control trigger ring with the parachute and safety belt fastened. In addition, the release mechanism pin provides a stowage clip for the No. 1 "Remove Before Flight" safety pin. The release mechanism pin cannot be operated until the No. 1 safety pin is removed. After removal of pin No. 1, pull upward on the spring-loaded release mechanism pin to release the ejection control trigger ring from the stowed position. To restow the trigger ring, reverse the sequence.



1. MAINTENANCE SAFETY PIN NO. 2
2. INTEGRATED HARNESS RELEASE INITIATOR
3. HEADREST
4. PARACHUTE ARMING LANYARD
5. LEG GUARDS
6. MANUAL HATCH JETTISON HANDLE, RADAR NAVIGATOR'S (AND NAVIGATOR'S Less UX Less UZ)

6A. MANUAL HATCH JETTISON HANDLE GUARD TF Less UZ

6B. MANUAL HATCH JETTISON HANDLE, RADAR NAVIGATOR'S UZ

6C. SAFETY LATCH, RADAR NAVIGATOR'S UZ

7. MAINTENANCE SAFETY PIN NO. 5 (HATCH JETTISONING INITIATOR)
8. MAINTENANCE SAFETY PIN NO. 6 (CATAPULT PIN-PULL INITIATOR)
9. MANUAL CATAPULT INITIATOR SAFETY PIN-PULL HANDLE
10. INTEGRATED HARNESS RELEASE HANDLE
11. INERTIA REEL CONTROL HANDLE
12. ANKLE RESTRAINTS
13. ANKLE RESTRAINT TRIGGERS
14. EJECTION CONTROL TRIGGER RING
15. "REMOVE BEFORE FLIGHT" SAFETY PIN NO. 1

15A. EJECTION CONTROL TRIGGER RING RELEASE MECHANISM PIN VD

16. SAFETY BELT
17. MODIFIED B-5 PARACHUTE
18. PARACHUTE SHOULDER STRAPS
19. ML-2 GLOBAL SURVIVAL KIT
20. SURVIVAL KIT RELEASE HANDLE
21. SEAT POSITIONING SWITCHES
22. INTEGRATED HARNESS RELEASE RESET BUTTON (BEHIND)
23. ARMING INITIATOR
24. CATAPULT INITIATOR
25. CATAPULT INITIATOR PIN-PULL CYLINDER
26. LEG GUARD THRUSTER

..... downward ejection seat (typical)

Figure 4-72A.

Ankle Restraint Triggers

A trigger (13, figure 4-72A) is located on each side of the seat front. Pressing the triggers causes the ankle restraints (12) to rotate upward and inward to clasp the ankles securely. Normally, the legs should be pressed against the triggers prior to grasping the ejection trigger ring. The ankle restraints will then hold the legs in position during ejection. The ankle restraint triggers are cocked until triggered. If accidentally triggered, they may be reset by pushing downward and outward on either ankle restraint until the pivot arms and restraints are restowed and locked.

Seat Positioning Switches

Three seat positioning switches (21, figure 4-72A) are located on the right side of the seat. The up and down switch is mounted vertically, the fore and aft switch horizontally, and the tilt switch on a 45° slant. The appropriate switch is pushed in the direction movement is desired to electrically position the seat.

Manual Catapult Initiator Safety Pin-Pull Handle

A handle (9, figure 4-72A) on the left side of the seat is provided to manually disengage the catapult pin-pull cylinder and thus pull the safety pin from the catapult initiator. If the seat will not fire after pulling the trigger ring, pulling upward on the manual pin-pull handle will allow a spring to force the pin-pull cylinder outward, withdrawing the safety pin from the initiator.

INTEGRATED HARNESS SYSTEM

The integrated harness system provided in the aircraft consists of the integrated harness release mechanism located on the seat, the safety belt, and the modified B-5 automatic parachute (figure 4-73B). The integrated harness release mechanism includes a trigger, integrated harness release initiator with necessary ballistic tubing, integrated release handle, and inertia control handle. Firing the ejection seat catapult triggers the integrated harness release initiator which fires after a 1-second delay to open the integrated harness release fittings on the seat and allow seat occupant, parachute, and safety belt (along with survival kit) to separate from the seat as an integral unit. (Separation from the seat arms the automatic parachute since the parachute arming lanyard is anchored to the seat.) Pulling the integrated harness release handle on the seat provides for separation of man, parachute (and arming lanyard), and safety belt from the seat following crash landings or ditching.

INTEGRATED HARNESS SYSTEM CONTROLS

Integrated Harness Release Handle

An integrated harness release handle (10, figure 4-72A and 7, figure 4-75) painted yellow with black stripes is located on the left side of each seat to enable the parachute harness and safety belt to be detached from the seat. Pulling the release handle upward disengages the two safety belt fittings, the parachute harness shoulder straps, and the parachute arming lanyard, thus completely freeing the occupant from the seat. The gunner's release handle disengages the two safety belt fittings and the parachute shoulder harness. The release mechanism is reset by pushing the handle down.

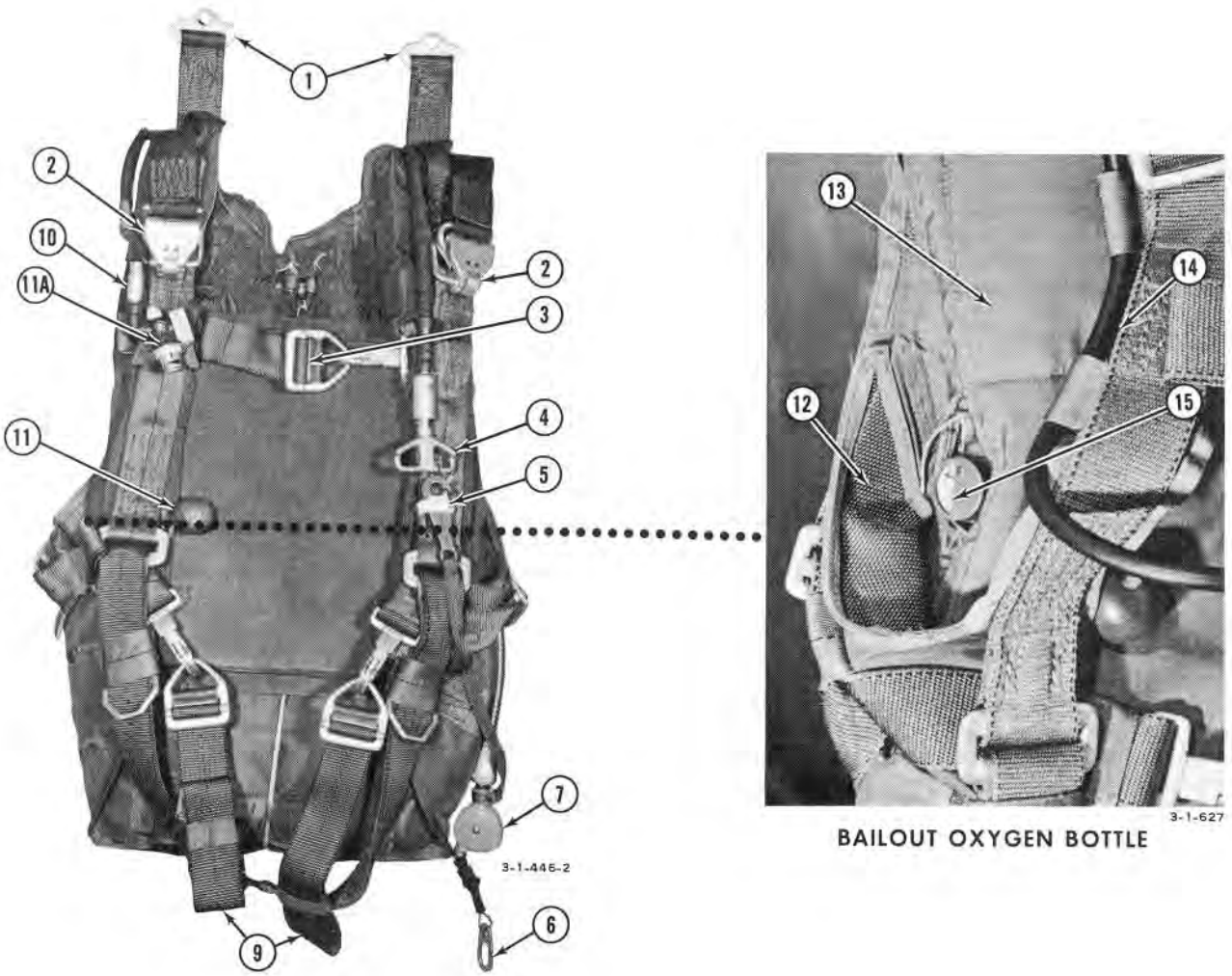
WARNING

Lock the inertia reel before actuating the integrated harness release handle to assure complete release of the integrated harness before leaving the seat.

NOTE

- The integrated harness release handle should not be used to free the occupant from the seat for normal inflight or postflight movement. If the release is pulled and the parachute and survival kit are worn during such movement, the parachute will have to be removed to reinstall the shoulder straps in the inertia reel fitting without assistance.
- The integrated harness release handle should be pulled directly upward since any fore, aft, or side loads can cause the handle to bind resulting in excessive force required to pull the handle.

Figures 4-73 and 4-73A deleted

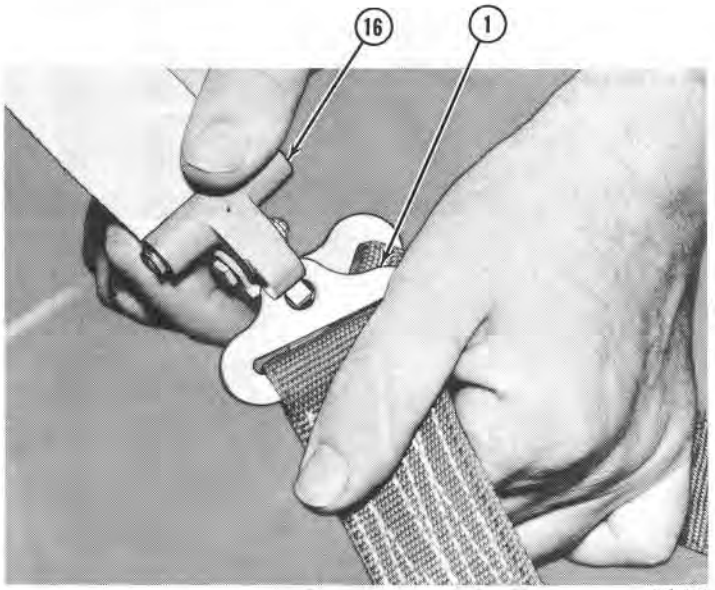


BAILOUT OXYGEN BOTTLE

MODIFIED B-5 AUTOMATIC PARACHUTE

1. SHOULDER STRAPS
2. QUICK-RELEASES
3. CHEST STRAPS
4. RIPCORD T-HANDLE
5. ZERO DELAY LANYARD (STOWED)
6. ARMING LANYARD
7. ARMING KNOB
8. DELETED
9. LEG STRAPS
10. BAILOUT OXYGEN HOSE CONNECTOR
11. BAILOUT BOTTLE RELEASE KNOB
11A. CRU-8/P OXYGEN HOSE CONNECTION
12. BAILOUT BOTTLE INSPECTION FLAP
13. PARACHUTE BACKPAD
14. BAILOUT OXYGEN HOSE
15. BAILOUT BOTTLE PRESSURE GAGE
16. INTEGRATED HARNESS RELEASE FITTING
17. SAFETY BELT ATTACHMENT FITTING
18. DOWNWARD EJECTION SEAT PARACHUTE ATTACHMENT LOOPS

Figure 4-73B (Sheet 1 of 5).

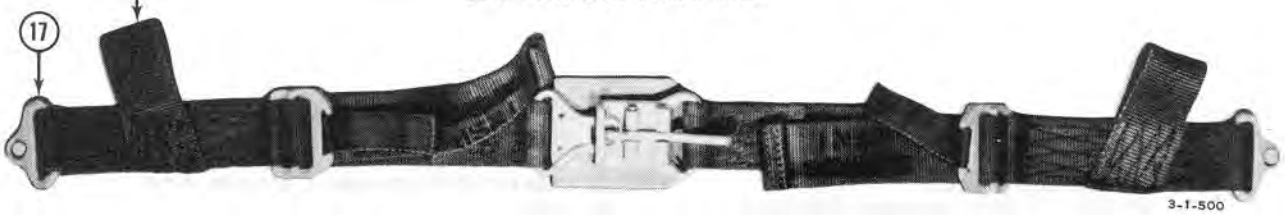


3-1-120

ATTACHING PARACHUTE SHOULDER HARNESS TO INTEGRATED HARNESS RELEASE FITTING

3-1-498

BELT FOR GUNNER'S SEAT

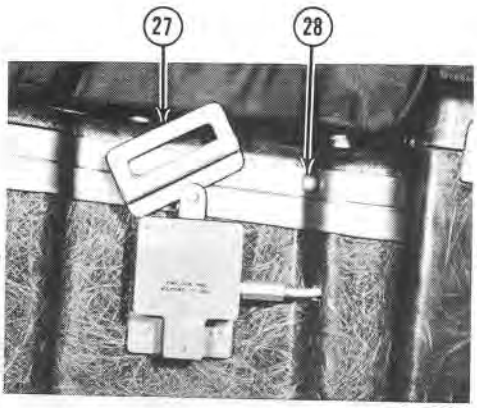


3-1-500

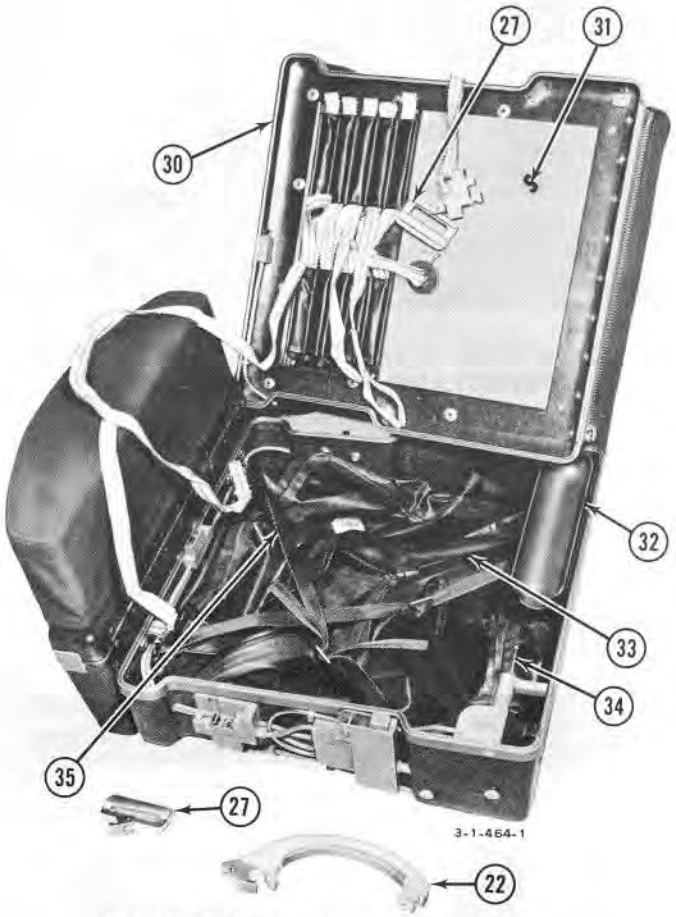
BELT FOR DOWNWARD EJECTION SEATS

.....bailout equipment (typical)

Figure 4-73B (Sheet 2 of 5).



SEAT CUSHION REMOVED



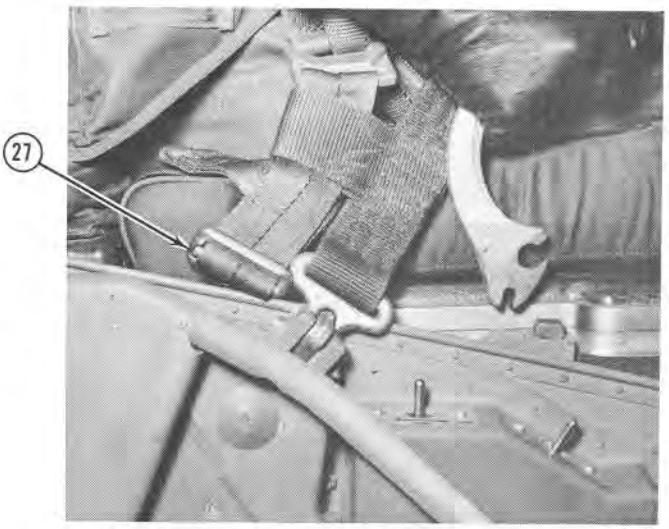
MAIN COMPARTMENT LID OPEN

GLOBAL SURVIVAL KIT

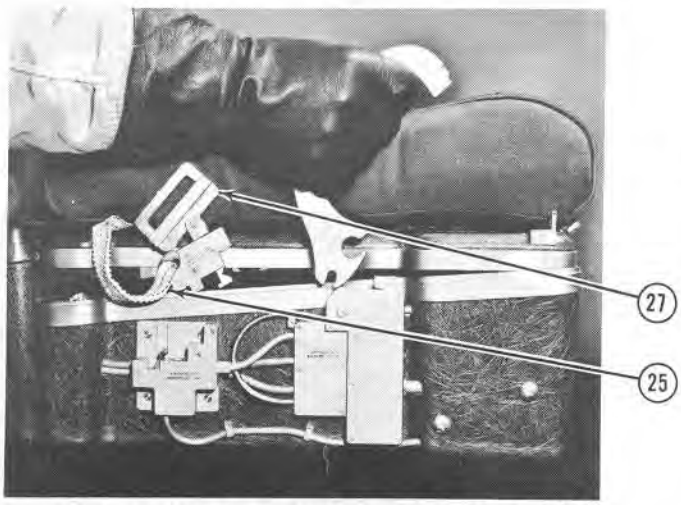
19. COMPRESSIBLE SPACER
20. SURVIVAL KIT QUICK-DISCONNECT FITTING AND STRAP
21. SEAT CUSHION
22. KIT RELEASE HANDLE
23. ARMING PLUNGER
24. MAIN COMPARTMENT
25. DROP LINE
26. AFT COMPARTMENT
27. SURVIVAL KIT STRAP ADJUSTER
28. COMPARTMENT LID MANUAL RELEASE KNOB
29. ZIPPER
30. COMPARTMENT LID
31. REFLECTIVE SURFACE
32. HOLDER FOR CO_2 BOTTLE
33. WATERPROOF CONTAINER
34. CO_2 RELEASE CABLE
35. WATERPROOF CONTAINER TIE-DOWN STRAPS
36. AFT COMPARTMENT LID MANUAL RELEASE LATCH
37. SAFETY BELT RELEASE FITTING

Figure 4-73B (Sheet 3 of 5).

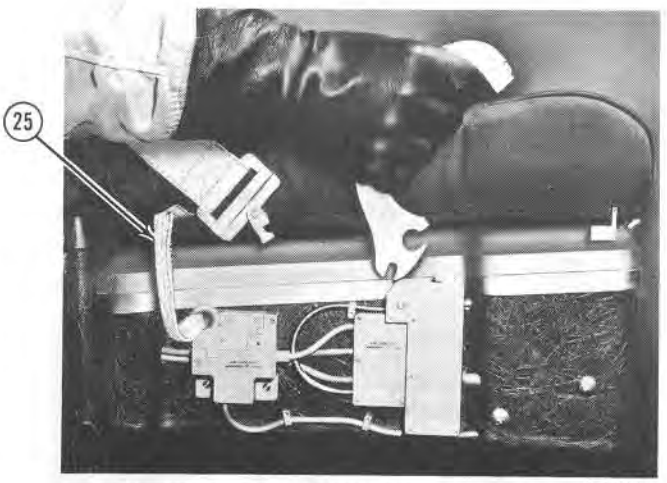
KIT IN SEAT 3-1-732



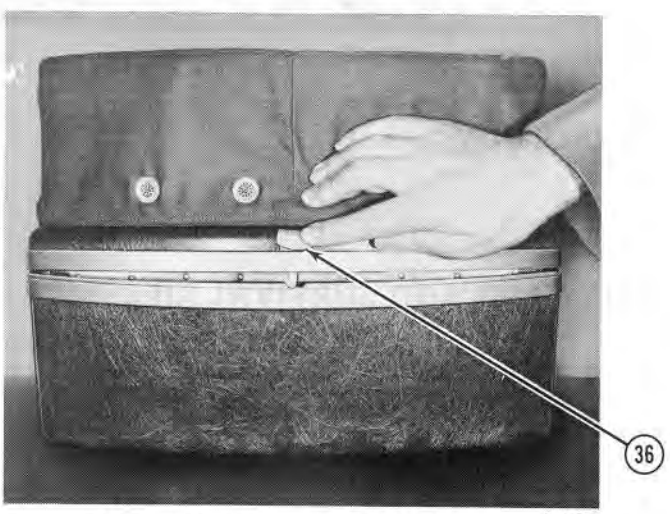
SURVIVAL KIT STRAP ADJUSTER RELEASE 3-1-733



KIT SUSPENDED — PLUNGER EXTENDED 3-1-512



KIT IN SEAT — PLUNGER DEPRESSED 3-1-463-1

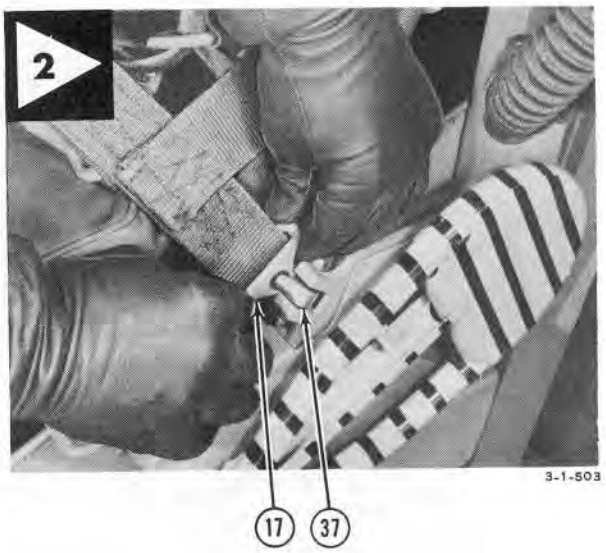


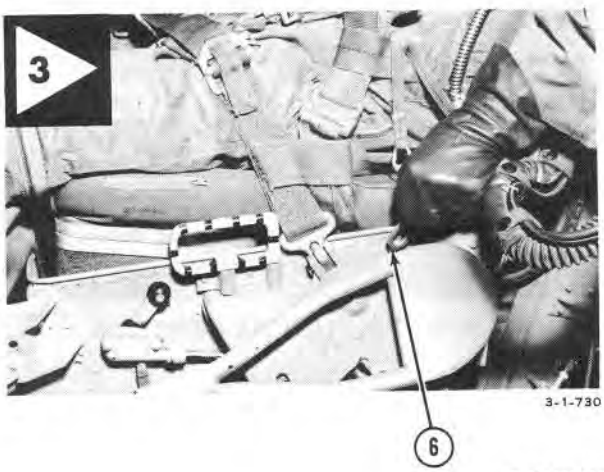
OPENING AFT COMPARTMENT 3-1-513

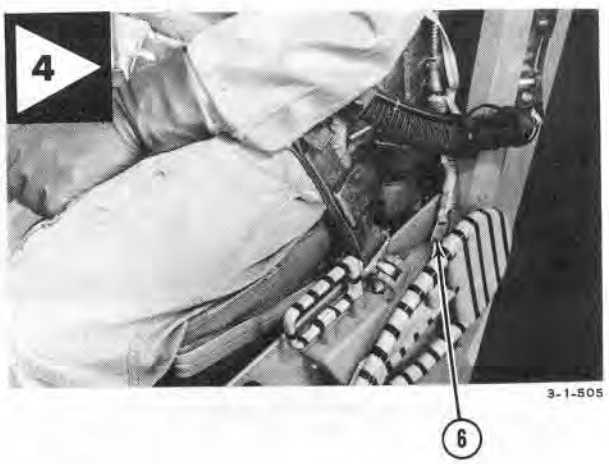
GLOBAL SURVIVAL KIT OPERATION

.....bailout equipment (typical)

Figure 4-73B (Sheet 4 of 5).





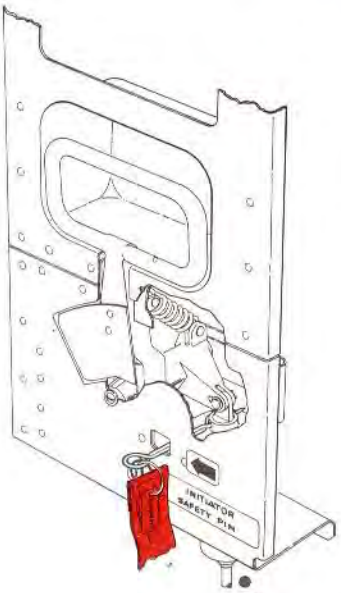


DOWNWARD SEAT EJECTION

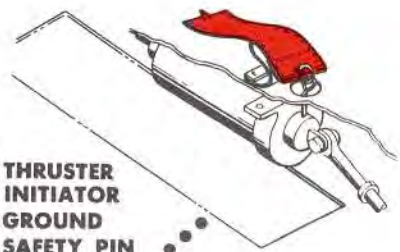
INSTALLATION OF PARACHUTE SAFETY BELT AND SURVIVAL KIT

.....bailout equipment (typical)

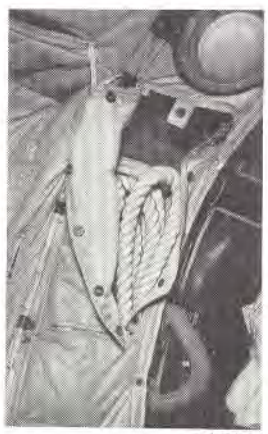
Figure 4-73B (Sheet 5 of 5).



INSIDE TURRET JETTISON HANDLE AND SAFETY PIN (Handle in Stowed Position and Safety Pin Installed in Inner Emergency Release Handle Initiator)

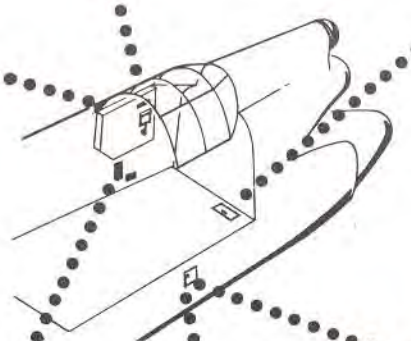


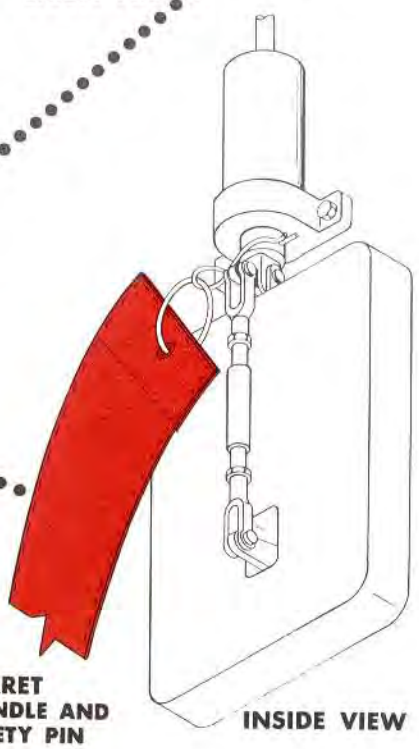
THRUSTER INITIATOR GROUND SAFETY PIN



E1-152-1

GUNNER'S ESCAPE ROPE





INSIDE VIEW

E1-152-2

TURRET DRAG CHUTE INTERCONNECT CONTROL

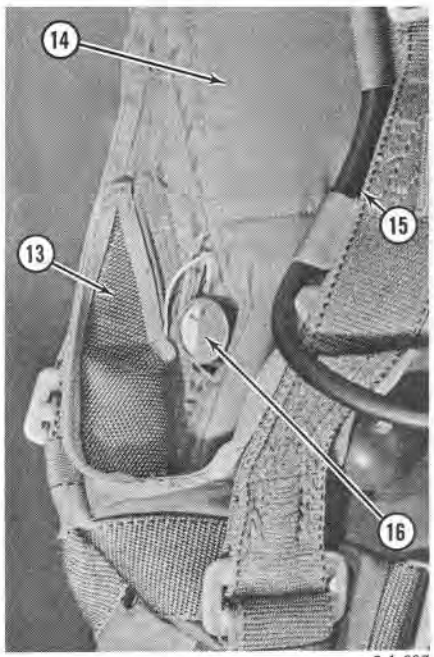
OUTSIDE TURRET JETTISON HANDLE AND GROUND SAFETY PIN

E1-152-3

OUTSIDE VIEW

gunner's emergency escape controls

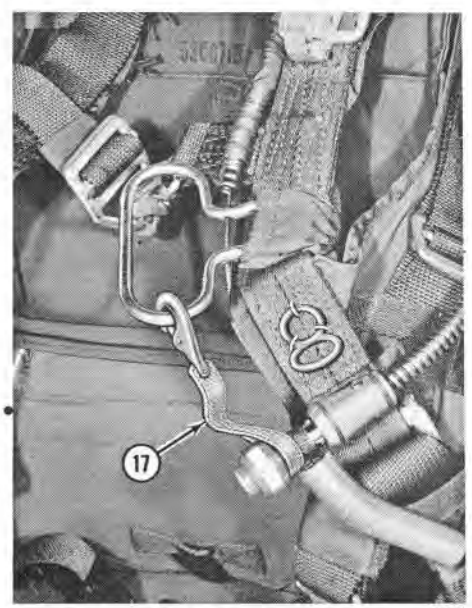
Figure 4-74.



BAILOUT OXYGEN BOTTLE

MD-1 SURVIVAL KIT

B-5 AUTOMATIC OPENING PARACHUTE



ZERO DELAY LANYARD ATTACHED TO D-RING

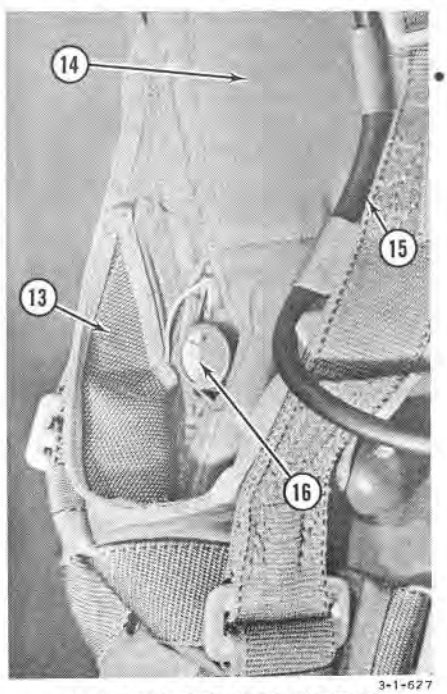
190▶237 Less HP
W70▶W119

bailout equipment (typical)

Figure 4-73B (Sheet 2 of 7).

ZERO DELAY LANYARD STOWED

ZERO DELAY LANYARD ATTACHED TO D-RING

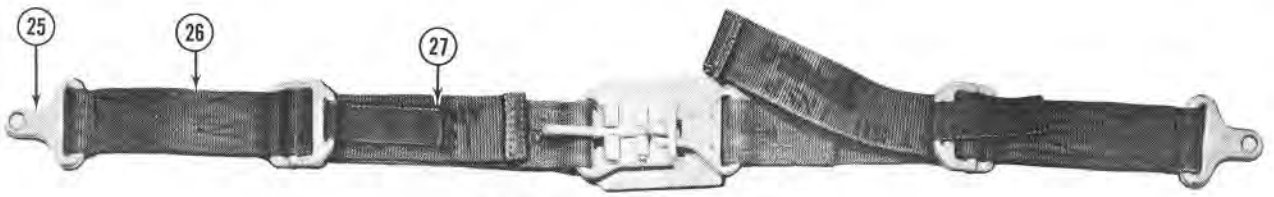


BAILOUT OXYGEN BOTTLE

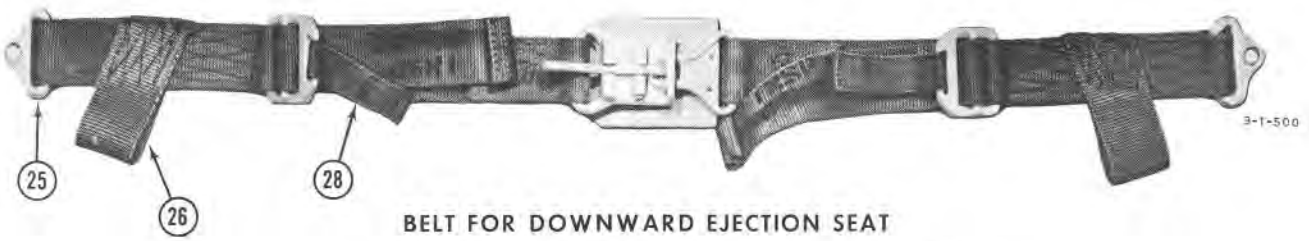
MODIFIED B-5 PARACHUTE

238 ▶ W120 ▶ Plus HP

Figure 4-73B (Sheet 3 of 7).

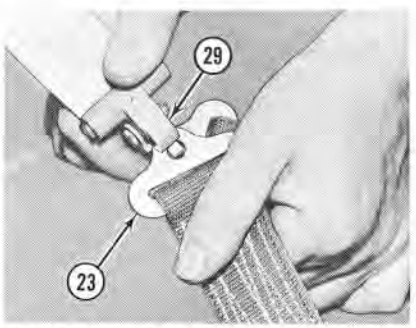


BELT FOR GUNNER'S SEAT

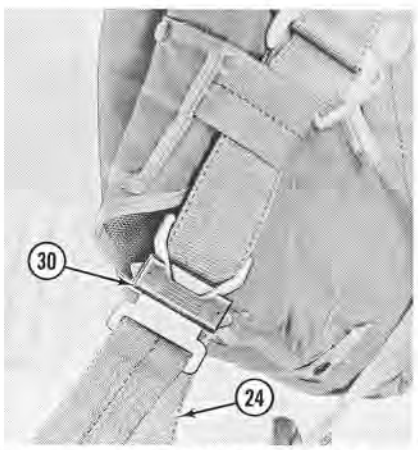


BELT FOR DOWNWARD EJECTION SEAT

MODIFIED SAFETY BELT 238▶ W120▶Plus HP



ATTACHING PARACHUTE SHOULDER STRAPS TO INTEGRATED HARNESS RELEASE FITTING 238▶ W120▶Plus HP

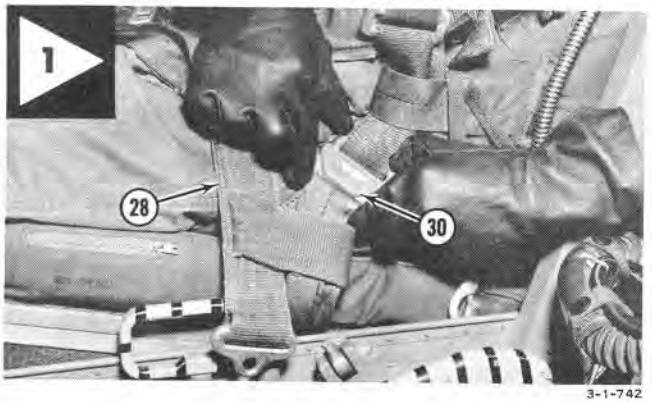


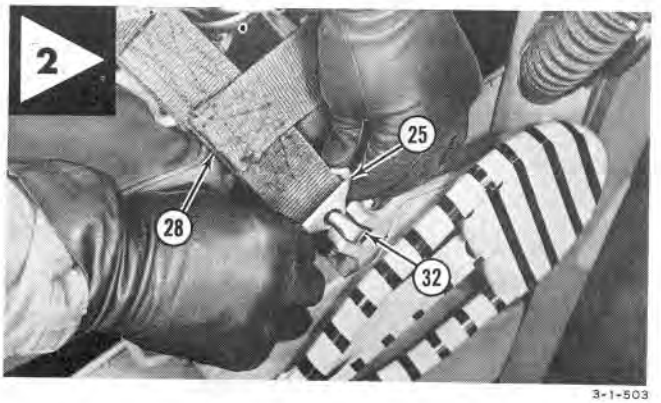
USE OF QUICK-DISCONNECT FITTING TO ATTACH SURVIVAL KIT TO PARACHUTE

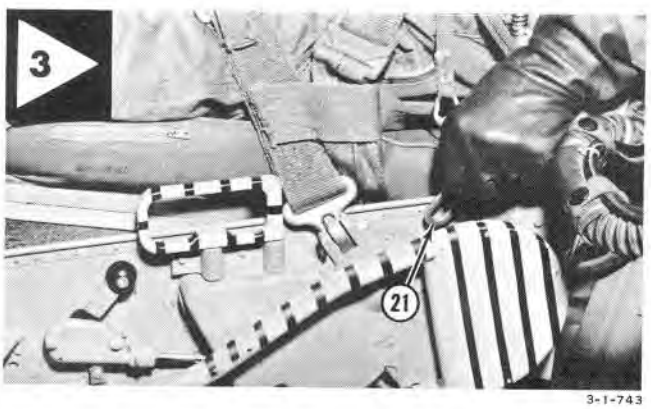
22. INTEGRATED HARNESS MANUAL RELEASE HANDLE
23. PARACHUTE SHOULDER STRAPS
24. PARACHUTE-SURVIVAL KIT ATTACHMENT STRAPS (NOT USED WHEN KIT QUICK-DISCONNECT INSTALLED)
25. SAFETY BELT ATTACHMENT FITTING
26. SAFETY BELT LOOPS
27. SAFETY BELT FOR UPWARD EJECTION SEATS AND GUNNER'S SEAT
28. SAFETY BELT FOR DOWNWARD EJECTION SEATS
29. SHOULDER STRAP RELEASE FITTING
30. SURVIVAL KIT QUICK-DISCONNECT FITTING AND STRAP
31. SURVIVAL KIT STRAP ADJUSTER
32. SAFETY BELT RELEASE FITTING
33. COMPRESSIBLE SPACER
34. SEAT CUSHION
35. KIT RELEASE HANDLE
36. PLUNGER
37. MAIN COMPARTMENT
38. AFT COMPARTMENT
39. DROP LINE
40. COMPARTMENT LID MANUAL RELEASE KNOB
41. ZIPPER
42. COMPARTMENT LID
43. REFLECTIVE SURFACE
44. HOLDER FOR CO_2 BOTTLE
45. WATERPROOF CONTAINER
46. CO_2 RELEASE CABLE
47. WATERPROOF CONTAINER TIE DOWN STRAPS

.....bailout equipment (typical) (cont)

Figure 4-73B (Sheet 4 of 7).



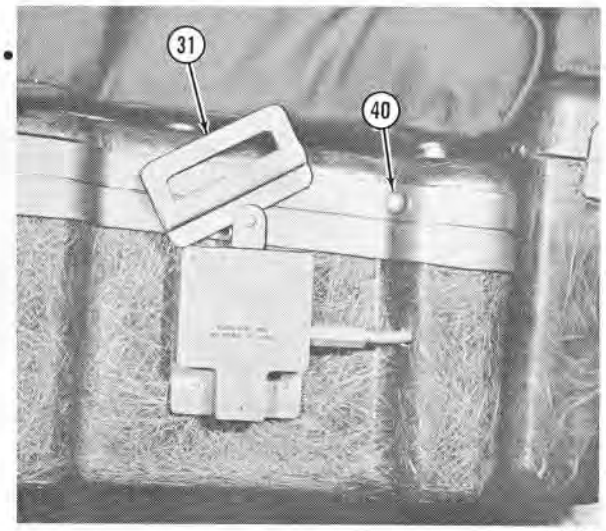


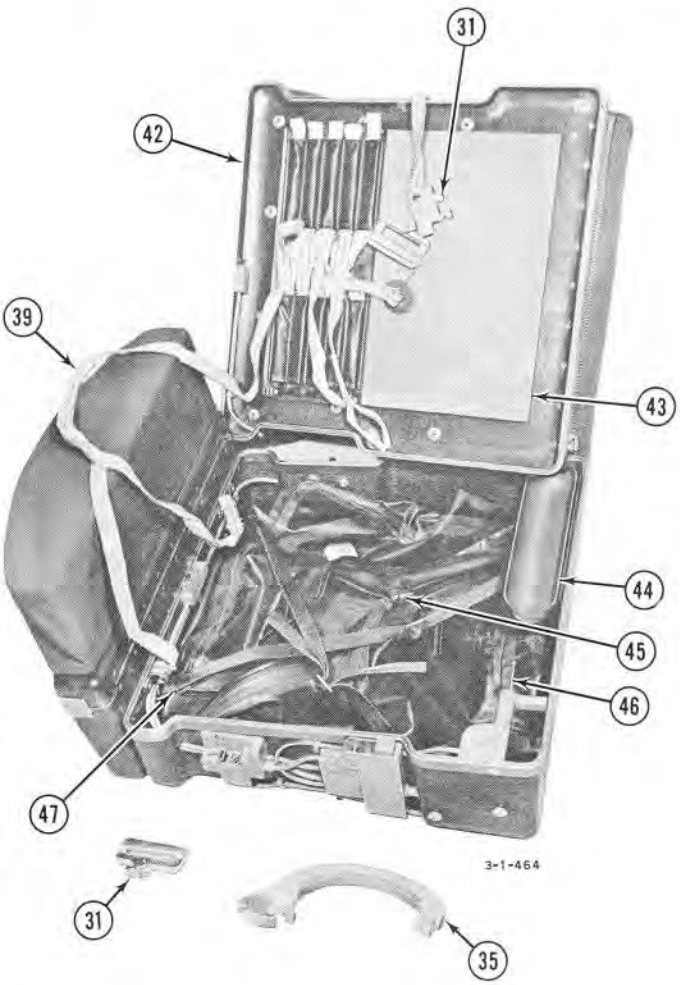


DOWNWARD EJECTION SEAT

INSTALLATION OF PARACHUTE AND ML-2 GLOBAL SURVIVAL KIT (TYPICAL) 238▶ W120▶ Plus H-P

Figure 4-73 B (Sheet 5 of 7).





ML-2 GLOBAL SURVIVAL KIT 238 ▶ W120 ▶ Plus HP

.....bailout equipment (typical) (cont)

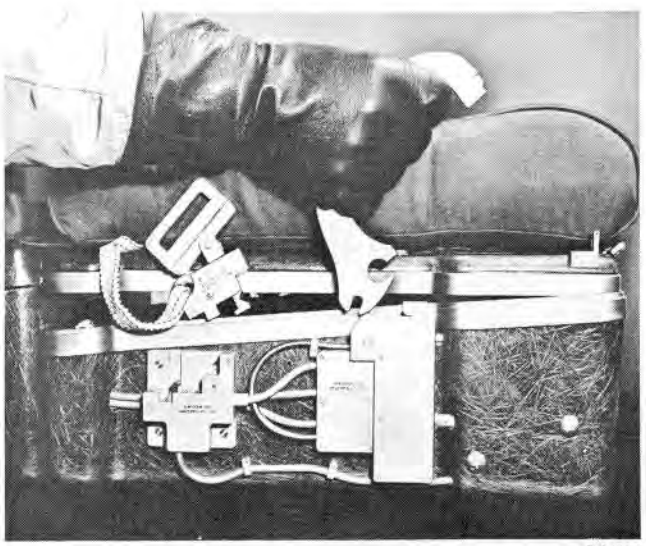
Figure 4-73B (Sheet 6 of 7).

3-1-741

KIT IN SEAT

3-1-740

SURVIVAL KIT STRAP ADJUSTER RELEASE



3-1-512

KIT SUSPENDED (PLUNGER DOWN) — LID OPENS, LIFE RAFT INFLATES. LANYARD REMAINS ATTACHED TO PARACHUTE

3-1-513

OPENING AFT COMPARTMENT

ML-2 GLOBAL SURVIVAL KIT OPERATION (TYPICAL)

.....bailout equipment (typical) (cont)

Figure 4-73B (Sheet 7 of 7).

Inertia Reel Control Handle

A handle (11, figure 4-72A) with LOCKED--RELEASED positions is located on the left side of each seat. A detent is provided for retaining the handle at either position of the quadrant. In RELEASED position, the shoulder harness will extend to allow the crew member to lean forward; however, the inertia reel will automatically lock when an impact force of 2 to 3 "g's" is encountered. When the reel is locked in this manner, it will remain locked until the handle is moved to the LOCKED and then returned to the RELEASED position. When the handle is in LOCKED position, the inertia reel is manually locked so the crew member is prevented from bending forward. LOCKED position may be used as an additional safety feature over the automatic operation of the reel.

MODIFIED B-5 AUTOMATIC PARACHUTES

A B-5 automatic parachute, developed specifically for use in B-52 aircraft upward and downward ejection seats, modified to utilize the integrated harness release mechanism in the seat is provided in the ejection seats. The B-5 automatic parachute is equipped with a faster opening Type C-9 canopy for improved low level escape capability. Modifications include shoulder straps (1, figure 4-73B) which are sewn into the parachute harness for attachment to the inertia reel fitting. Additional straps (8, figure 4-73B) are sewn into the lower harness to provide for attachment of the global survival kit. These straps are not used when the quick-disconnect fittings and straps (20, figure 4-73B) are installed on the survival kit. A bailout oxygen bottle and gage are contained in the parachute and may be inspected by opening the flap located under the right side of the parachute lining. Normal bailout bottle pressure is 1800 psi based on 80° F. A reduction in temperature causes reduction in cylinder pressure of 3.5 psi for each degree of F. The bailout bottle (figure 4-73B) is operated by pulling the green knob (9, figure 4-73B) on the right front of the harness. A Type F-1B automatic release device which can be preset by opening the zipper under the left side of the parachute lining contains an aneroid opening device and timer. The F-1B timer is set for the number of seconds delay recorded in the parachute log book. The automatic release device is activated when the arming lanyard (6, figure 4-73B) is pulled either manually or automatically by separation from the seat. When activated, the automatic release device opens the parachute after a preset delay of 1 second when the preset altitude is reached, or if activated below the preset altitude, the automatic release opens the parachute 1 second after separation from the seat. A ripcord T-handle (4, figure 4-73B), when pulled, manually releases the parachute. The ripcord T-handle bypasses the automatic release device. A canopy quick-release fitting (2, figure 4-73B) on the upper left of the harness permits release of the left set of risers for spilling the canopy after landing. Two canopy quick-release fittings on the upper left and right of the harness may be fixed to allow complete release of the canopy after landing.

The parachute is installed in the seat as follows:

1. The shoulder strap attaching hardware is inserted into the inertia reel fitting of the seat.
2. The survival kit attachment straps (8, figure 4-73B) are connected to the survival kit strap adjusters. Thread these straps through the loops (18, figure 4-73B) in between the webbing of the safety belt and attach to the parachute accessory rings with the quick-disconnect at the opposite end.
3. Safety belt attachment fittings are inserted into integrated harness release fittings on the seat.
4. The parachute arming lanyard anchor is inserted into the integrated harness release fitting at the left rear corner of the seat.

NOTE

The modified B-5 automatic parachute, safety belt, and survival kit should first be installed in the seat, then buckled to the crew member.

Since the parachute must be removed by the wearer in order to attach the shoulder straps to the inertia reel fittings unassisted, it is recommended that the parachute and survival kit be left in the seat when the crew member desires to make routine movements about in the aircraft. It is then only necessary to buckle the chest strap, leg straps, and safety belt and to connect the oxygen mask to prepare for ejection in an emergency.

NOTE

Do not open the safety belt to permit unrestrained hip movement. Since the parachute arming lanyard is anchored to the seat, this could spill the parachute in the seat.

ZERO DELAY LANYARD

WARNING LW

Do not hook the zero delay lanyard to the parachute ripcord T-handle when using a downward seat since it is equipped with man-seat separator.

A detachable ripcord T-handle lanyard (zero delay lanyard) hook provides for improved low altitude escape capability when using an upward ejection seat. The lanyard is attached to the automatic release device arming knob. When the hook on the other end of the lanyard is hooked to the ripcord T-handle, the automatic release device is bypassed and the manual ripcord release is pulled simultaneously as separation from the seat occurs. (In effect, this is zero second delay in deployment of the automatic parachute following separation from the seat.) The zero delay lanyard should never be hooked to the ripcord T-handle at the downward ejection seat stations. During all flight above minimum altitudes, the hook must be detached from the ripcord T-handle and stowed on the stowage ring provided on the parachute harness. "Hooking" and

"stowing" are manually accomplished by each crew member.

WARNING

Zero second delay parachute configuration should never be used at speeds in excess of approximately 400 knots since opening shock will be excessive.

SAFETY BELT

A safety belt (figure 4-73B) with standard manual release and lock lever fittings is provided with each seat. The belt is installed by inserting the attachment fittings in the integrated harness release fittings on each side of the seat. The survival kit is then secured to the parachute by threading the parachute attachment fittings through the straps on the safety belt and fastening them to the kit. Thus, the seat occupant, parachute, safety belt, and survival kit are released from the seat as an integral unit whenever the integrated harness release fittings are opened. For routine movement in the airplane, it is recommended that the crew member unlock and open the safety belt, then disconnect the parachute chest and leg straps, leaving the parachute with survival kit attached to the seat.

TURRET JETTISON SYSTEM

The aft portion of the tail compartment can be jettisoned for emergency escape or rescue of the gunner. The tail turret can be jettisoned from the inside of the airplane by pulling the jettison handle (figure 4-74) out of its recess and back (forward in the airplane) toward the operator. The tail turret may be jettisoned from outside the airplane by opening the door (figure 4-74) and pulling the jettison handle out and away from its recess. Power for the jettison system is self-contained pneumatic pressure, and the turret is pushed away through the action of the initiators and the two thrusters. For an illustration of the system mechanism and schematic diagram, see "Escape Systems Operation," Section VII.

WARNING

The possibility exists that shipping pins may be inadvertently left in the initiators on initial delivery of the airplane and following major inspections and depot overhaul. In such instances, the gunner must take every precaution possible to assure that these shipping pins have been removed.

TURRET JETTISON SAFETY PINS

There are three turret jettison safety pins, one for the inside turret jettison handle initiator, one for the outside turret jettison handle initiator, and one for the pushoff thruster initiator (figure 4-74). The safety pins in the pushoff thruster initiator and the outside turret jettison handle initiator must be removed before the ground crew can jettison the tail turret. All safety pins are removed immediately prior to flight and the inside turret jettison handle initiator safety pin is reinstalled immediately after landing.

TURRET-DRAG CHUTE INTERCONNECT CONTROL KNOB

A turret drag chute interconnect control knob (figure 4-74) below the turret jettison handle provides a means by which the gunner may deactivate or retain activation of the drag chute prior to jettisoning the turret. If the turret is jettisoned with the knob in the up position, the drag chute remains active. If the knob is in the down (normal) position and the turret is jettisoned, the drag chute is deactivated.

NOTE

If the turret is jettisoned with the drag chute interconnect control knob up, it will be possible to position the knob down and deactivate the drag chute or jettison a deployed drag chute.

GUNNER'S ESCAPE ASSIST HANDLES

Canvas-covered escape assist handles are located throughout the tail compartment from the aft entry door to the escape opening primarily to aid the gunner in abandoning the airplane after the turret has been jettisoned. They also assist him in moving about the compartment.

MISCELLANEOUS EQUIPMENT

GUNNER'S SEAT

The gunner's seat (figure 4-75) is located in the tail compartment facing aft. The seat is a bucket type with a spring-loaded reclining back. The seat may be raised and lowered, and moved fore and aft on tracks. An adjustable headrest spring-loaded to the forward position, an inertia reel, and an integrated harness release mechanism are installed. The seat will accommodate a back-type automatic opening parachute and a survival kit. A modified B-5 parachute and manual safety belt are installed. See "Integrated Harness System," this section, for additional information.

WARNING

Lock the inertia reel before actuating the integrated harness release handle to assure complete release of the integrated harness before leaving the seat.

On airplanes modified in accordance with [9], a parachute static line (8A, figure 4-75) and parachute static line reel assembly (8B, figure 4-75) is provided for the gunner. The static line should be attached to the gunner's parachute arming lanyard prior to flight for bailout above 2000 feet. During low altitude flights up to 2000 feet the zero delay lanyard should be attached to the D-ring. The reel assembly contains 6 feet of cable which will allow the gunner to move freely about the seat without arming the parachute, yet will automatically arm the parachute following bailout.

Gunner's Seat Controls

SEAT POSITIONING HANDLES. A handle (5, figure 4-75) on the left forward side of the seat near the floor is provided to release the seat for fore and aft movement. A handle (3, figure 4-75) on the right front corner of the seat controls up and down movement of the seat. To control the tilting back, a handle (2, figure 4-75) is installed on the center of the right side of the seat. Pulling the reclining handle to the first detent allows the seat back to be tilted to seven different positions through 45°. Pulling the reclining handle past the detent will permit the seat back to fold flat, permitting greater accessibility to the forward end of the compartment. A handle (4, figure 4-75) on the left side of the headrest permits positioning of the headrest.

CELESTIAL NAVIGATION SEAT

The celestial navigation seat (4, figure 4-30) is located in the center of the control cabin upper deck. When actuated, a release lever near the forward end of the seat permits the seat to be turned through 360°. The seat is equipped with a standard safety belt and is used with the periscopic sextant.

NOTE

On NF aircraft, the ALR-20 rack located at the EW officer's station must be moved aft to the extended position to permit freedom of movement when occupying the celestial navigation seat. For a description of the rack, see "ALR -20 Rack," this section.

INSTRUCTOR PILOT'S SEAT

The instructor pilot's seat (30, figure 1-2) behind and between the pilot's and copilot's seats is not adjustable. The seat is equipped with a standard safety belt but no shoulder harness is provided. When not in use, the seat may be folded to the stowed position. The seat may be converted to a ditching seat and consists essentially of a seat back and two seat bottoms. The back is suspended from overhead structure and is locked in either the normal or ditching position at the floor. The two seat bottoms, one on the forward side and one on the aft side of the seat back, are hinged so they may be folded up against the back when not in use. A release cord under the forward seat bottom will unlock the back so it may be swung aft for ditching or forward for normal use. The aft seat bottom is designed for ditching and should be used since the floor is not adequately stressed. The safety belt is fastened on swivels at the bottom of the seat back so it may be used on either the forward or aft side.

INSTRUCTOR NAVIGATOR'S SEAT

An instructor navigator's seat (10, figure 4-39) is located behind the navigator's seat in the control cabin lower deck. Through the use of a hinged lid, this seat also serves as a toilet. The seat is equipped with a standard safety belt and a shoulder harness without the inertia reel. The seat is not stressed for high "g" loads.

INSTRUCTOR EW OFFICER'S SEAT UH

On aircraft UH, an instructor EW officer's seat is located adjacent to the right side of the EW officer's seat. The seat is not stressed for takeoff and landings or use in turbulent air. No safety belt is provided.

CAUTION UH

Do not occupy seat for takeoff and landing or in turbulent air.

RELIEF EQUIPMENT

Two chemical toilets (55, figure 1-2) are provided, one forward of the gunner's seat in the tail compartment and one behind the navigator's seat in the control cabin lower deck. By use of a hinged cover, the toilet in the control cabin lower deck is also used as the instructor navigator's seat. A toilet paper bracket (71, figure 1-2) is provided near each chemical toilet. Relief tanks and tubes are also provided in the airplane. One relief tank and tube is located at the side of the gunner's seat. One relief tank is located on the left side behind the radar navigator's seat.

WINDSHIELD WIPERS

Electrically operated windshield wipers clear the windows in front of the pilot and copilot. On airplanes 190 ▶ 249 W70 ▶ W145, they are driven by a single motor while on airplanes 250 ▶ W146, they are driven by two motors. The wipers are controlled by a rotary type switch (54, figure 1-13 and 56, figure 1-13A) on the pilot's instrument panel. The switch has PARK--OFF --FULL--3/4--1/2--LOW positions giving a choice of wiper speeds. The switch is spring-loaded from PARK to the OFF position. After use, the pointer is held to PARK until the blades move to the stowed position and stop. The switch is then released to OFF. The motors are provided TR power through circuit breakers on the pilot's circuit breaker panel.

CAUTION

Do not operate windshield wipers on dry or dirty glass as this can scratch or damage the windshield glass.

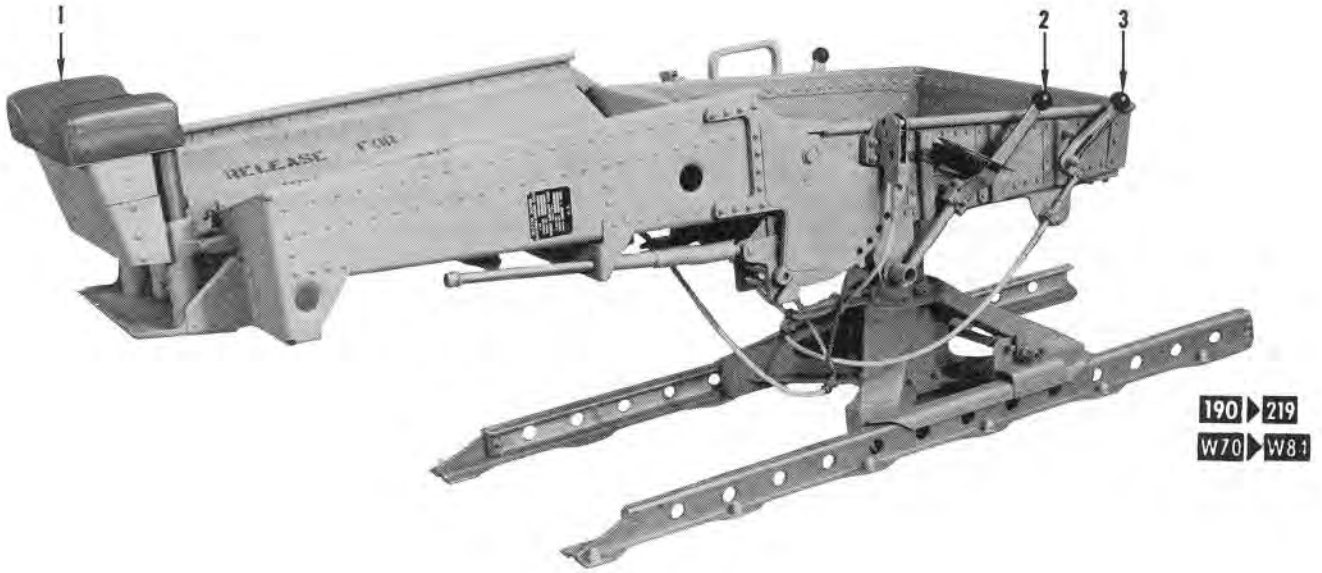
NOTE

If rain repellent has been applied to the windshield, hold windshield wiper operation to an absolute minimum as approximately 30 minutes of wiper operation will remove the rain repellent.

CREW BUNK

Less ML

A crew bunk on the aft right side of the control cabin upper deck is equipped with a safety belt.



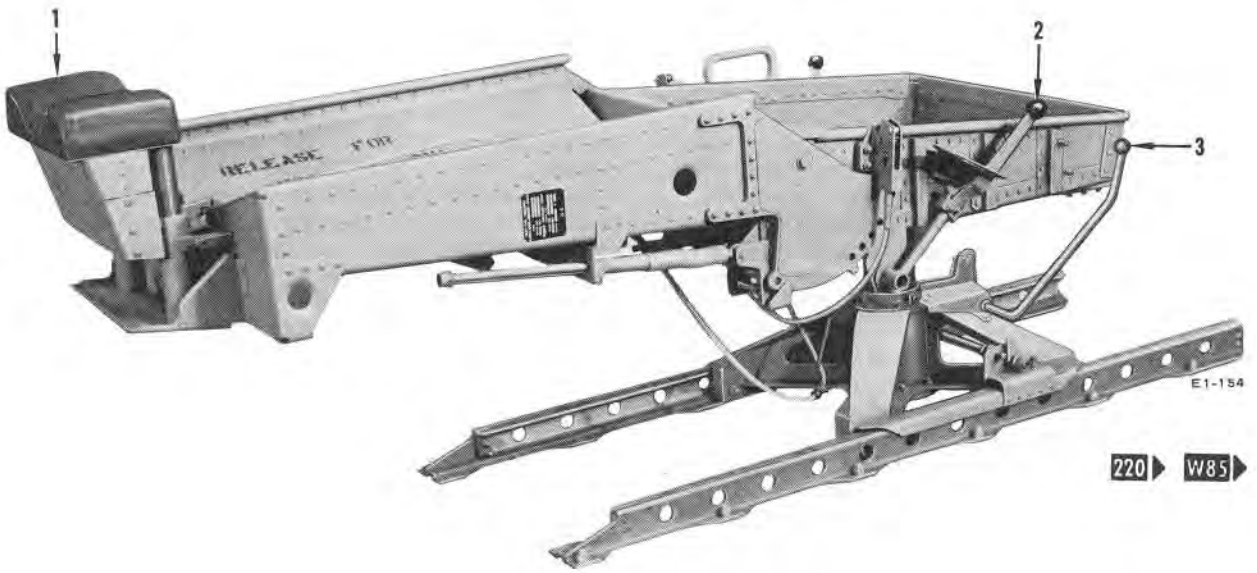
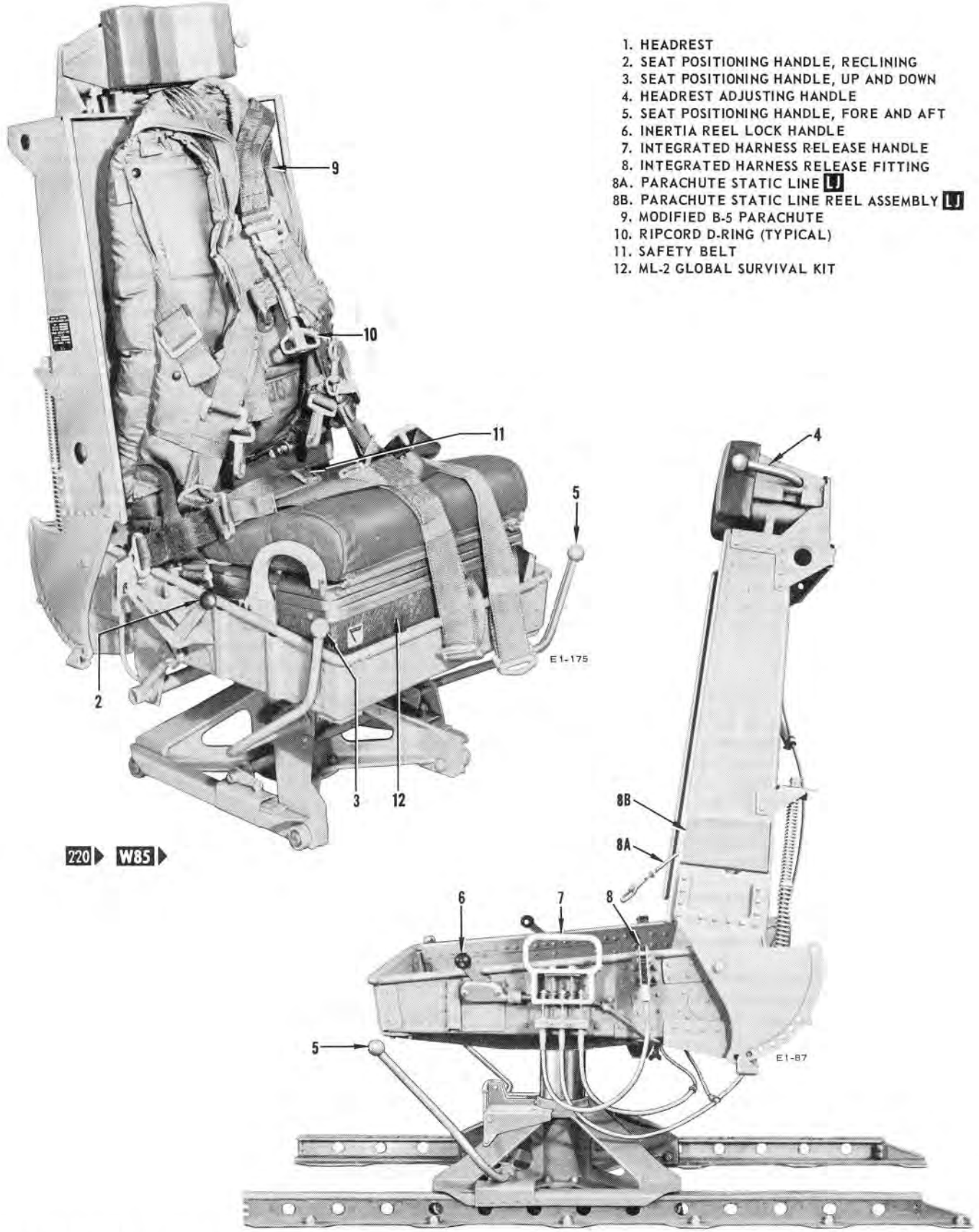


Figure 4-75 (Sheet 1 of 2).

1. HEADREST
2. SEAT POSITIONING HANDLE, RECLINING
3. SEAT POSITIONING HANDLE, UP AND DOWN
4. HEADREST ADJUSTING HANDLE
5. SEAT POSITIONING HANDLE, FORE AND AFT
6. INERTIA REEL LOCK HANDLE
7. INTEGRATED HARNESS RELEASE HANDLE
8. INTEGRATED HARNESS RELEASE FITTING
8A. PARACHUTE STATIC LINE LJ
8B. PARACHUTE STATIC LINE REEL ASSEMBLY LJ
9. MODIFIED B-5 PARACHUTE
10. RIPCORD D-RING (TYPICAL)
11. SAFETY BELT
12. ML-2 GLOBAL SURVIVAL KIT



220 ▶ W85 ▶

gunner's seat (typical)

Figure 4-75 (Sheet 2 of 2).

SP

A crew bunk (3, figure 4-30) is located in the control cabin upper deck along the bulkhead left of the celestial navigation seat. When not in use, the bunk may be stowed against the bulkhead and held by retaining straps that are provided. On aircraft Less NF, it is necessary to slide the bunk approximately 6 inches forward before it can be stowed.

STOWAGE HAMMOCKS

The airplane is equipped with fishnet-type stowage hammocks. Two stowage hammocks (65, figure 1-2) are located in the control cabin lower deck, and one in the tail compartment.

EW OFFICER'S TABLE

An EW officer's table (50, figure 1-2) is on the right side of the seat and hinged at the aft edge. The table can be raised to a stowed position and fastened by a strap when not in use.

ALR-20 RACK NF

A sliding rack which houses the APR-14 receiver is located on the EW officer's console. The rack is normally stowed and locked in the full forward position. When unrestricted use of the celestial navigation seat and equipment is desired, the rack can be unlocked and moved aft to extended position. The rack will latch in the extended position and will latch and lock in the stowed position.

Locking Lever

A locking lever located on the aft side of the ALR-20 rack has three detent positions. Holding the lever full down unlocks the rack allowing it to slide aft. When the lever is released, it will automatically reposition itself to an intermediate position. In this position, the rack will latch when moved to stowed position. Placing the lever to the full up position (stowed) will lock the rack in the stowed position.

CAUTION

- To prevent damage to the latching mechanism, the locking lever should be in the intermediate position when the rack is moved into the stowed position.
- After stowing and locking the rack, it can be checked for security by applying a pull force on the rack (not on the APR-14 handles) of not over 100 pounds.

Latch Release Button and T-Handle

A latch release button on the aft face of the ALR-20 rack and a T-handle on the forward end of the rack unlatch the rack when in the extended position. The release button must be pressed or the T-handle pulled before the rack can be moved forward from extended position.

PERISCOPIC SEXTANT CARRYING CASE

A removable periscopic sextant carrying case is provided in the aircraft. On aircraft Less SP, it is located in the control cabin upper deck forward and to the left of the celestial navigation seat. On aircraft SP, it is located in the control cabin upper deck on the right side of the aircraft just aft of the entrance hatch (29, figure 1-2). It is held in place by a strap fastened to the floor.

LADDER

A ladder (61, figure 1-2) on the right side of the control cabin lower deck provides access between the upper and lower decks of the control cabin. On airplanes Less ML, a four-step ladder has hinged pins on the left leg and a snap catch on the top of the right leg so that it can be swung back and to the left when it is desired to gain access to equipment in the forward end of the control cabin lower deck. On airplanes ML, a five-step ladder is installed against the fuselage on the right side of the control cabin lower deck to provide access between the upper and lower decks of the control cabin. In addition, two hand rails are installed against the fuselage on the right side of the upper deck control cabin immediately above the ladder.

ALTIMETER CORRECTION CARD

An altimeter correction card and holder (15A, figure 1-8) is located on the pilot's left glare shield. For information concerning the use of the altimeter correction card, refer to Part 1 of the Appendix.

FLIGHT REPORT HOLDERS

An aircraft flight report holder is mounted on the back of both the pilot's and copilot's seats.

DATA CASE

A data case (37, figure 1-2) on the floor behind the pilot's seat in the control cabin upper deck is used for stowage of miscellaneous data.

CLIPBOARD

A clipboard (69, figure 1-2) is provided at the copilot's station for his use in flight.

NIGHT FLYING CURTAIN

A night flying curtain (45, figure 1-2) is provided to shut out light between the EW officer's and pilot's stations. When not in use, it is rolled up and stowed aft of the pilot's seat.

ALTERNATOR DECK OR FORWARD EQUIPMENT BAY INSPECTION MIRRORS AND WINDOWS

Three mirrors (11, figure 3-1) are provided to permit the navigator and radar navigator to monitor the forward equipment bay without turning around. One mirror is mounted at the navigator's forward upper left and permits him to view the equipment bay through the inspection window in the bulkhead aft of the radar navigator.

Another mirror is mounted on the right of the control cabin pressure bulkhead door. It is used in conjunction with a mirror mounted on the radar navigator's forward upper right. These two mirrors enable the radar navigator to view the equipment bay through the window in the pressure bulkhead door. On B-52E airplanes, the right and left forward alternators are located in the equipment bay.

GALLEY EQUIPMENT

The airplane is equipped with a galley located forward of the pressure bulkhead in the control cabin lower deck. The galley equipment consists of hot cups, paper cup dispensers, trash containers, water containers, and shelf and food stowage provisions.

Shelf and Food Stowage

The airplane has a shelf and food stowage (8, figure 4-39) space in the lower right side of the galley. The top of the shelf provides the framework for the trash container. The aft section of the shelf is provided with a hinged door and is used for food stowage.

Trash Container

A trash container (59, figure 1-2) is provided in the galley in the forward end of the shelf and food stowage unit.

Food Warming Oven

RD

A food warming oven (29A, figure 1-2) is located forward and left of the celestial navigator's station. The oven is mounted by the use of two hooks and a strap. A-C power is supplied for the oven through a circuit breaker marked "Food Oven" in the section 41 power distribution panel.

Hot Cups

Hot cups (60, figure 1-2) are provided in the airplane, one on the left side of the forward end of the tail compartment with an alternate location immediately aft at the left window and one in the forward end of the shelf and food stowage unit in the galley.

Drinking Water Containers

The airplane is equipped with drinking water containers. Two 2-gallon drinking water containers (58, figure 1-2) are mounted on the top of the shelf and food stowage unit in the galley. A 2-quart thermos bottle (70, figure 1-2) is mounted on the right side of the tail compartment.

Cup Dispensers

Cup dispensers (51, figure 1-2) are provided in the airplane, one on the wall in the middle of the galley and one at the gunner's left on the wall of the tail compartment.

ASHTRAYS

An ashtray is conveniently located at each crew member's position.

SCANNING LAMP AND FILTER

A scanning lamp (28, figure 1-2) is provided on the window shelf to the left of the celestial navigation seat. A 28-volt a-c power receptacle is located near the light and is supplied power through a circuit breaker marked "Scan Light Recp" on the Section 41 Power Distribution Panel.

SIGNAL LIGHT

A signal light (72, figure 1-2) is provided on the bulkhead forward of the gunner's seat on the left side of the aircraft. A 28-volt a-c power receptacle is located near the light. Another receptacle is located near the aft end of the left side of the compartment. A 28-volt a-c circuit breaker marked "Signal" on the gunner's circuit breaker panel supplies power to the signal light receptacles.

SPARE LAMPS

Spare lamps are located at the forward end of the bunk in the upper pressurized compartment and to the left of the gunner's seat.

ACCESSORY EQUIPMENT

Each airplane is provided with stowage facilities for the following accessory equipment for ground use: pitot tube covers, landing gear ground locks, engine tailpipe shields, air intake shields, bomb bay door lock struts, body jacking fittings, wing jacking pads, tail closure cover, and miscellaneous external opening plugs.

VGH RECORDER

Less SN

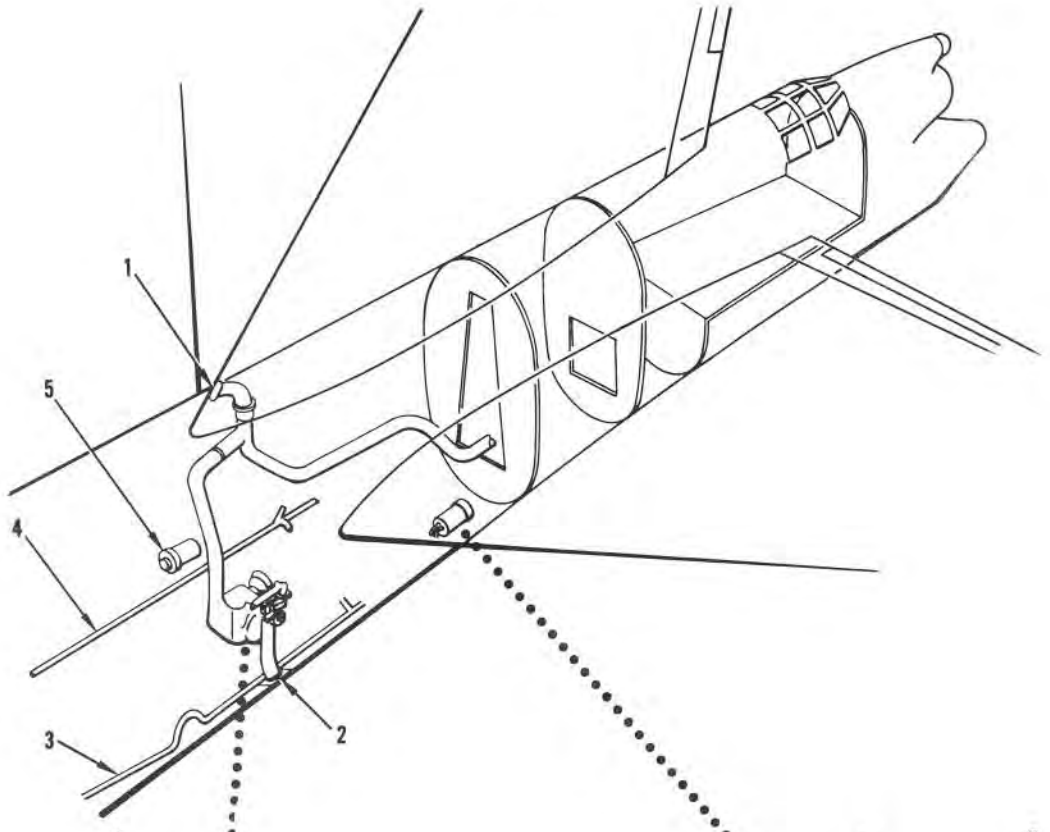
A basic recorder, connected to the pitot-static system and a remote accelerometer, provides gust recording capabilities. The recorder is supplied 24-volt TR power and 205/118-volt three-phase a-c power through four circuit breakers on the pilot's circuit breaker panel marked "VGH Recorder." The circuit breakers are individually marked "ØA," "ØB," "ØC," and "DC." An ON--OFF VGH recorder switch (11A, figure 4-38) is on the VGH recorder panel located aft of the navigator's light control panel.

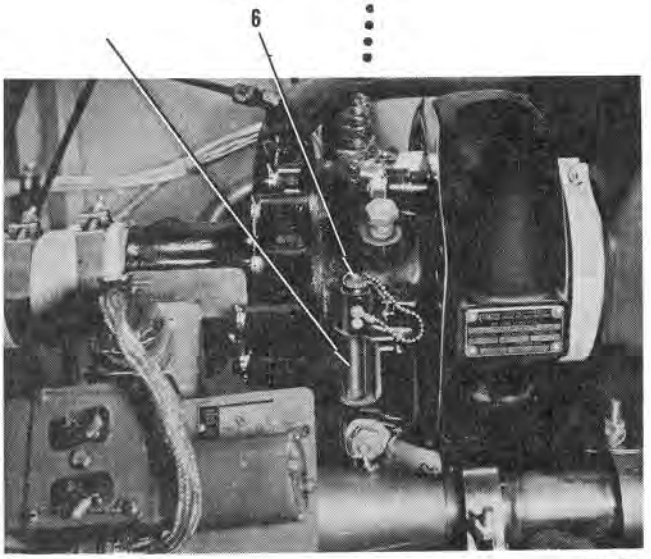
ACCESSORY RADAR EQUIPMENT

Each airplane is provided with stowage facilities for the following radar accessory equipment:

BNS Spare Modules

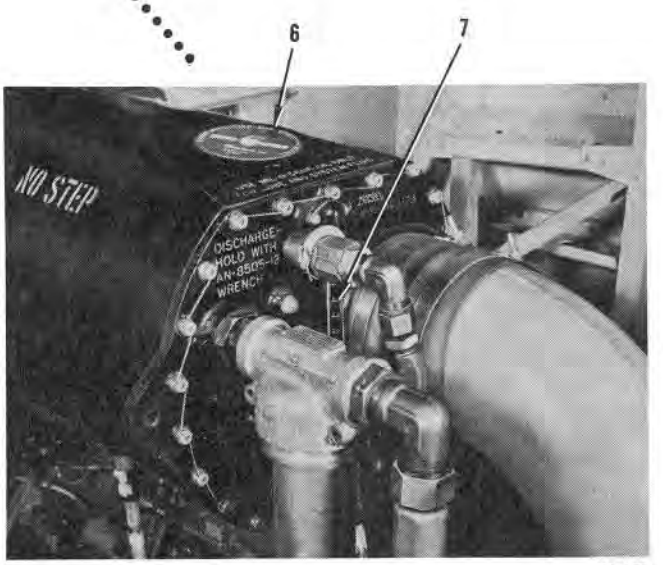
Provisions for carrying BNS spare modules are provided in the lower left side of the center module rack.





E1-176

AFT AIR CONDITIONING PACK



E1-177

HYDRAULIC PACK NO. 9 (Typical)

1. RAM AIRSCOOP
2. RAM COOLING AIR EXHAUST
3. AIR BLEED SYSTEM LEFT BODY MANIFOLD
4. AIR BLEED SYSTEM RIGHT BODY MANIFOLD
5. HYDRAULIC PACK NO. 10
6. FILLER CAP
7. SIGHT GAGE

.....aft air conditioning and hydraulic packs

Figure 4-76.

STARTER CARTRIDGE STOWAGE

A stowage rack with clamps (16B, figure 1-2) for four pneumatic engine starter cartridges is located in the aft wheel well on aircraft [D] [N]. On aircraft [F] [G], provisions have been made for the installation of an additional four spare cartridges.

CREW HOODS (THERMAL CURTAINS)

Crew hoods (33, figure 1-2) and aluminized curtains are provided for each window to increase the weapon delivery capability of the aircraft. The hoods are designed so that crew members can cover the windows without leaving their seats and are stowed on slides, rollers, or snaps attached to the structure surrounding the window. The gunner's sunshades must be removed before the hoods can be used.

[UN]

Two 5-inch square peepholes, one for each pilot, are provided for forward visibility with the thermal curtains in place. Covers are provided to cover the peepholes when not in use. Two dividers, one for each pilot, are provided to shield the pilot when the opposite peephole is being used. The covers and dividers are held in place by the use of felt tape and hook tape. The dividers may be removed when not in use.

NOTE

Crew hoods must be replaced after each flight in which they are exposed to radiation.

INSTRUMENT FLYING HOODS

[PU]

Instrument flying hoods are installed for instrument and low altitude training flights. They consist of roller-type curtains which can be extended by pulling inboard. To hold in extended position, insert lower end of curtain rod into hole in top of instrument panel, then place upper end of curtain rod into wire retainer located on lower surface of the eyebrow panel. To stow the curtain, reverse the steps.

BLACKOUT CURTAIN

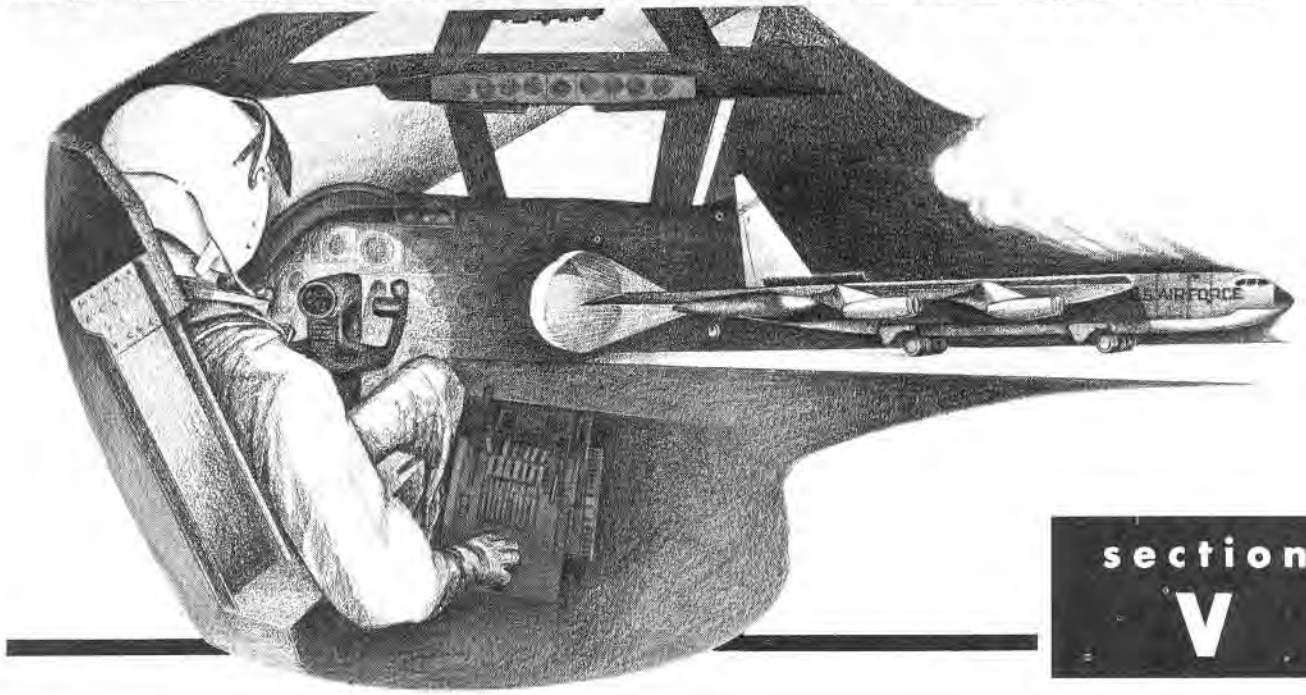
A blackout curtain (46, figure 1-2) is provided to enclose the opening and ladder area between the radar navigator-navigator station and the pilots' and EW officer's stations. This curtain serves the double function of a blackout curtain and a heat retainer to help keep heat in the lower compartment. The curtain has a zippered opening to allow passage between the upper and lower compartments. The section of the curtain forward of the ladder is attached with buttons to provide access to the area forward of the radar navigator-navigator panel. Straps are provided to stow the aft and/or the forward parts of the curtain in the open position.

SUNSHADES

Sunshades (26, figure 1-2) are installed on the overhead windows. The roller-type sunshades are closed by pulling the tab and snapping it to structure. The sliding-type sunshade at the gunner's station uses the same fasteners and tracks as the crew hood and may be removed easily by the gunner during flight so that it will not interfere with operation of the crew hood.

REVERSE SIDE INTENTIONALLY LEFT BLANK

OPERATING LIMITATIONS



section V

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This section covers the operating limitations of the airplane that must be observed during normal conditions. Special attention should be given to the instrument markings (figure 5-1) since these limitations are not necessarily repeated under their respective sections. When necessary, an additional explanation of instrument markings is covered under appropriate headings in this section.

NOTE

- All aircraft instruments will be marked in accordance with the limitations reflected in figure 5-1.
- The term "within limits," as used herein, pertains to the operating range between minimum and maximum red line markings on the applicable gage.

FUEL QUANTITY

FULL BY WEIGHT SWITCH SETTING
(Value for No. 1 and No. 4 main tanks shown
For other tanks see table below)

TANK	WEIGHT IN POUNDS *
No. 1 and No. 4 MAIN	15,300 ± 150
No. 2 and No. 3 MAIN	17,900 + 100 - 300
MID BODY	33,100 ± 400
FORWARD BODY	28,450 ± 400
AFT BODY	38,450 ± 400
OUTBOARD WING	14,550 ± 150
CENTER WING	35,600 ± 400
DROP	19,500 + 100 - 300

*Based on a fuel density of 6.5 pounds per gallon

TACHOMETER

APPLICABLE TO ANY GRADE OF FUEL

	58% RPM	MINIMUM IDLE
	58-65% RPM	IDLE RANGE
	85-97% RPM	RANGE OF BEST CRUISE
	105% RPM	MAXIMUM ALLOWABLE

EXHAUST GAS TEMPERATURE

	300° to 560°C	CONTINUOUS OPERATION 0-30,000 ft *(590°C at 55,000 ft)
	560° to 650° C	RANGE OF LIMITED OPERATION Military Rated Thrust (30 Minutes) 620° C from 0-30,000 ft *650°C at 55,000 ft Normal Rated Thrust and Below (continuous) 560° C from 0-30,000 ft * 580° C at 55,000 ft
	610° C	MAXIMUM FOR STARTING
	660°C	MAXIMUM DURING ACCELERATION (2 Minutes Maximum Duration)

*Temperature limit increases directly between 30,000 and 55,000 feet altitude

Figure 5-1 (Sheet 1 of 6).

EXHAUST GAS TEMPERATURE

J-57-P-43W AND -43WA ENGINES

- 300° to 560° C — CONTINUOUS OPERATION
  0-30,000 ft *(580° C at 55,000 ft)
- 560° to 640° C — RANGE OF LIMITED OPERATION
  Military Rated Thrust (30 Minutes)
  610° C from 0-30,000 ft
  *640° C at 55,000 ft
  Normal Rated Thrust and Below (continuous)
  560° C from 0-30,000 ft
  *580° C at 55,000 ft
- 450° C — MAXIMUM FOR STARTING (GROUND)
- 650° C — MAXIMUM DURING ACCELERATION
  (2 Minutes Maximum Duration)

*Temperature limit increases directly between 30,000 and 55,000 feet altitude

J-57-P-43WB ENGINES

- 300° - 560° C — CONTINUOUS OPERATION
  (Normal Rated Thrust and Below)
  560° C 0 – 30,000 ft.
  *570° C at 45,000 ft.
  *580° C at 55,000 ft.
- 560° - 660° C — RANGE OF LIMITED OPERATION
  Takeoff Rated Thrust (Wet)
  620° C at 60° F to 660° C at 100° F
  Maximum For Takeoff, 5 Minutes Wet
  Military Rated Thrust (30 minutes)
  610° C from 0 – 30,000 ft.
  *630° C at 45,000 ft.
  *640° C at 55,000 ft.
- 450° C MAXIMUM FOR STARTING (GROUND)
- 680° C MAXIMUM DURING ACCELERATION
  (2 Minutes Maximum Duration from 0 – 30,000 feet.)
- 660° C MAXIMUM DURING ACCELERATION
  (2 Minutes Maximum Duration at 45,000 feet)
- 650° C MAXIMUM DURING ACCELERATION
  (2 Minutes Maximum Duration at 55,000 feet and above.)

*Temperature limit increases directly from 30,000 to 45,000 feet and from 45,000 to 55,000 feet altitude.

CAUTION

If the engine installation combines J-57-P-43WB engines with -43W or -43WA engines, the -43WB's will be trimmed to -43W and -43WA performance and only -43W and -43WA markings will apply.

TACHOMETER

- 58% RPM — MINIMUM IDLE
- 58-65% RPM — IDLE RANGE
- 85-97% RPM — RANGE OF BEST CRUISE
- 102% RPM — MAXIMUM ALLOWABLE

APPLICABLE TO ANY GRADE OF FUEL

instrument markings

Figure 5-1 (Sheet 2 of 6).

OIL PRESSURE

	35 PSI	MINIMUM (for idle)
	40-50 PSI	NORMAL
	50 PSI	MAXIMUM

NOTE

- Although the minimum oil pressure required for idle is 35 psi, actual pressure may be greater than 50 psi immediately following engine start when the oil is cold.

B-52F

- Fluctuations up to 5 psi may be observed. These fluctuations are generated in the pressure indicating system and do not indicate abnormal engine operation.

AIR BLEED MANIFOLD PRESSURE

	200 PSI	MAXIMUM

HYDRAULIC SYSTEMS PRESSURE

	2400 PSI	MINIMUM
	2700-3000 PSI	NORMAL
	3600 PSI	MAXIMUM

PARKING BRAKE HYDRAULIC PRESSURE

	1700 PSI	ONE BRAKE APPLICATION REMAINING
	2700-3000 PSI	NORMAL
	3900 PSI	MAXIMUM

Figure 5-1. (Sheet 3 of 6).

AIRSPEED

WARNING

For additional airspeed limitations see AIRSPEED LIMITATIONS and figure 5-3, this Section.

190 KNOTS IAS FULL FLAPS

280 KNOTS IAS MAXIMUM UNDER CERTAIN FUEL USAGE AND DISTRIBUTION CONDITIONS. SEE FIGURE 5-3.

305 KNOTS IAS MAXIMUM WITH LANDING GEAR EXTENDED

390 KNOTS IAS MAXIMUM WITHOUT DROP TANKS

NOTE

- The instrument setting is such that the striped pointer will move to indicate the limiting structural airspeed with drop tanks of 350 knots IAS or the airspeed representing Mach .90, whichever is less.
- Maximum airspeed without drop tanks is 390 knots IAS. At altitudes above 20,000 feet, speed is generally restricted by tolerable buffeting. At Mach .87, a "tuck under" tendency develops and increases with Mach; however, it is easily controllable with stabilizer or elevator.

MACHMETER

MACH .90 INDICATED MAXIMUM SEE FIGURE 5-3

216 W84

190 215 W70 W83

instrument markings

Figure 5-1 (Sheet 4 of 6).

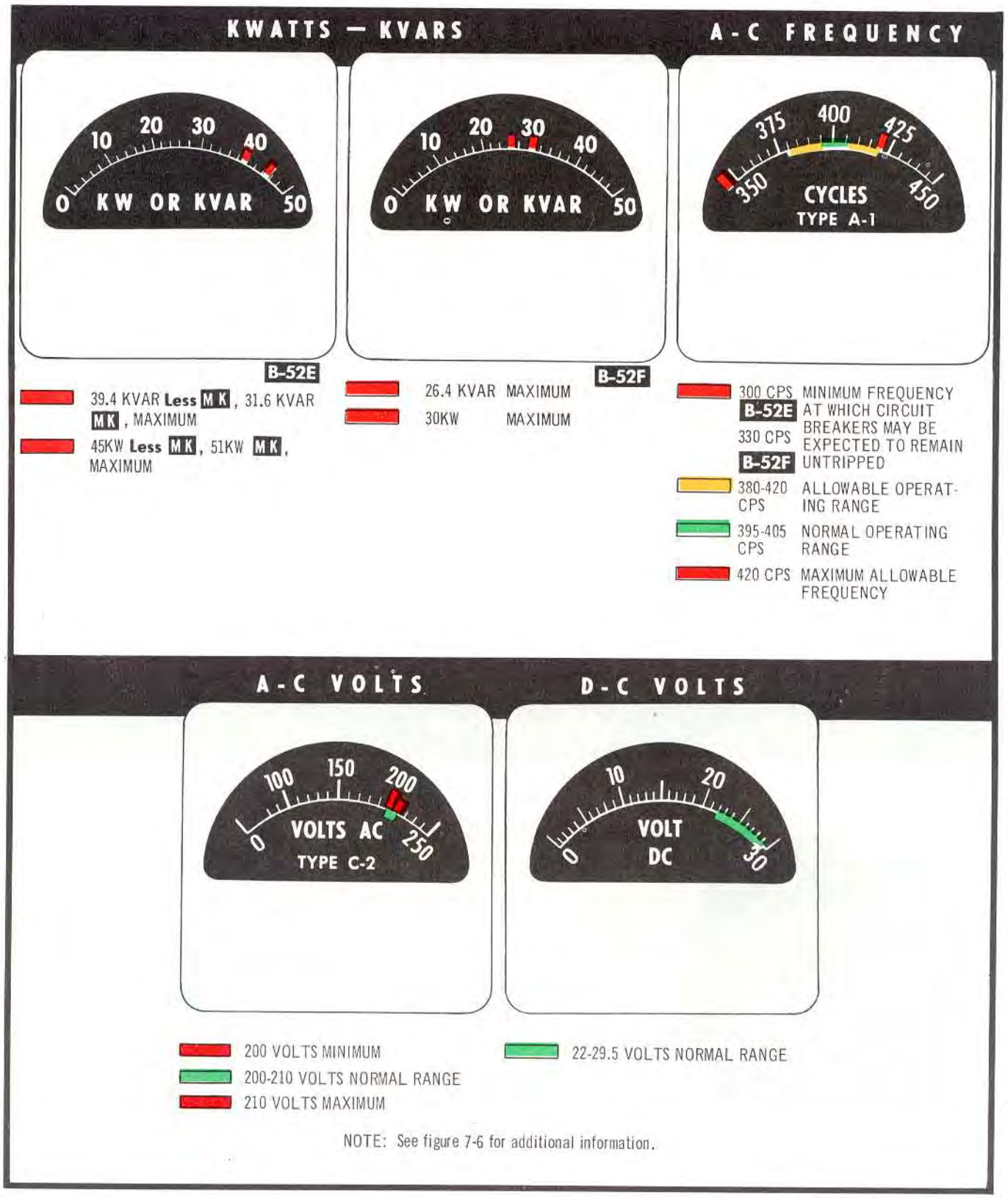


Figure 5-1 (Sheet 5 of 6).

MINIMUM CREW REQUIREMENTS

A pilot and a copilot constitute the minimum crew required for a normal nontactical flight in this airplane. Additional crew members as required will be added at the discretion of the commanding officer.

ENGINE LIMITATIONS

ENGINE RATING DEFINITIONS

The following terms are used to define engine thrust ratings and limitations associated with the ratings:

NOTE

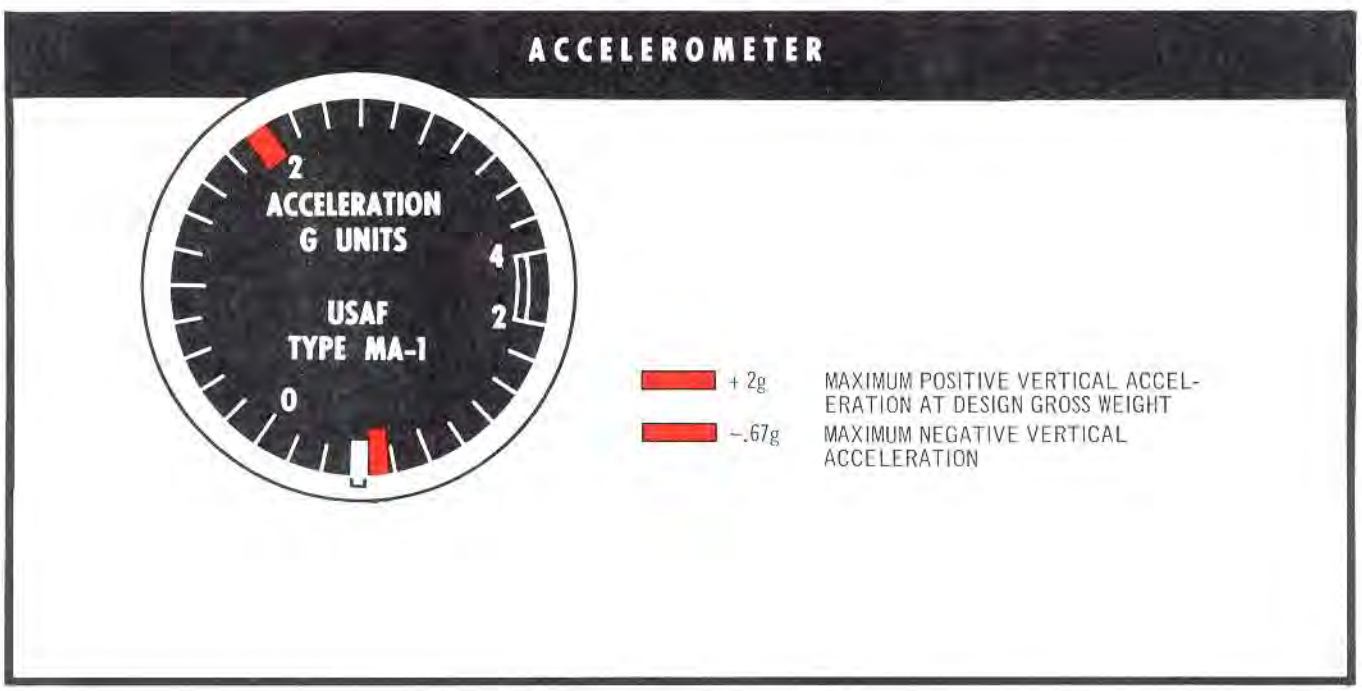
Thrust ratings as defined are subject to the applicable EGT limitations specified in figure 5-2.

CAUTION

Thrust ratings are not established by setting EGT.

1. Takeoff Rated Thrust (TRT) is the highest value of thrust which the engine will consistently deliver at specific ground or flight conditions with water injection. This rating is restricted to 5 minutes of operation on takeoff. On B-52F airplanes with J57-P-43W or -43WA engines installed and B-52E airplanes, this thrust rating is obtained by positioning the throttle in the full forward position and actuating the water injection system. On B-52F airplanes with J57-P-43WB engines installed, the thrust rating is obtained by actuating the water injection system after positioning the throttle to obtain a predetermined EPR reading on the EPR gages. This value is calculated for prevailing conditions of field barometric pressure and runway temperature and is obtained from the "EPR for Takeoff Rated Thrust" chart in Part 2 of the Appendix.

2. Military Rated Thrust (MRT) is the highest value of thrust which the engine will consistently deliver at specified ground or flight conditions without water injection. This rating is restricted to 30 minutes of operation. On B-52F airplanes with J57-P-43W or -43WA engines installed and all B-52E airplanes, this thrust rating is obtained by positioning the throttle in the full forward position or to the EGT limit, whichever comes first. On B-52F airplanes with J57-P-43WB engines installed, the thrust rating is obtained by positioning the throttle to obtain a predetermined value of EPR for specific ground or flight conditions. The information is obtained from the "Thrust Setting" charts in Parts 4 and 5 of the Appendix.



instrument markings

Figure 5-1 (Sheet 6 of 6).

3. Normal Rated Thrust (NRT) is the highest value of thrust at which the engine may be operated continuously with the prevailing ground or flight conditions. Throttle position is selected with reference to a predetermined EPR which is obtained from the "Thrust Setting" charts in Parts 4 and 5 of the Appendix.
4. Idle Thrust is not an engine rating, but rather a throttle position suitable for minimum thrust operation on the ground or in flight; it is obtained by placing the throttle in IDLE detent on the throttle quadrant. See figure 1-3 for thrust ratings.

ENGINE AND STARTER LIMITATIONS

Engine

Each engine is trimmed for takeoff percent rpm when installed. The takeoff rpm on a standard day varies for each engine and when other than standard temperatures are encountered, engine rpm will increase as temperature increases and decrease as temperature decreases. Takeoff rpm at any temperature should never exceed the operating limit which can damage an engine. In the event of overspeed, the engine should be shut down as soon as possible. All instances of overspeed or overtemperature will be recorded on Form 781 in order that the engine may be inspected for possible damage before being released for further operation.

B-52E

The takeoff rpm for each engine may be expected to vary from 95% to 102% on a standard day. The operating limit is 105% (10,200 rpm).

B-52F

The takeoff rpm for each engine may be expected to vary from 92% to 98% on a standard day. The operating limit is 102% (10,200 rpm).

CAUTION

B-52F

When engine cowlings are installed and latched, ground operation of engines at 90% rpm or higher is limited to a maximum of 5 minutes. If operation at 90% rpm or higher reaches the time limit of 5 minutes, a cooling period of 20 minutes at idle power is required before again advancing rpm to 90% or higher.

NOTE

- Aviation gasoline and JP-4 fuel mixed in any proportion are suitable for continuous operation from an engine performance standpoint. However, the use of aviation gasoline must be restricted to air refueling operations and to emergency evacuation ferry-type missions to minimize undesirable lead deposits in the engines. Furthermore, "Rate of Climb Limitations with Emergency Fuel (Aviation Gasoline)" under "Fuel Grade Properties and Limits," this section, must be observed when applicable.

- The engine operating limits are the same for all fuel grades; however, with the use of aviation gasoline, the charted EPR values may not be obtained at takeoff rated thrust.

- On B-52E aircraft, the engine pressure ratio should not exceed the minimum EPR by more than 0.20 for wet or dry power checks prior to takeoff. On B-52F aircraft, the engine pressure ratio of J57-P-43W and -43WA engines during both wet and dry power checks, and for J57-P-43WB engines during dry power checks only, should not exceed the minimum EPR by more than 0.10 prior to takeoff. For wet takeoff on B-52F aircraft with J57-P-43WB engines, refer to Part 2 of the Appendix. If these values are exceeded, a Form 781 entry must be made and the engine retrimmed.

Starter

The pneumatic starters have the following limitations:

1. Maximum continuous operation	2 minutes
2. Minimum rest after 2-minute continuous operation	3 minutes
3. Minimum rest after two 2-minute cycles	10 minutes

The cartridge-pneumatic starters installed on engines 2 and 8 QN have the following limitations:
1. Not more than two cartridge starts shall be made in any period of 60 minutes.
2. After a normal cartridge firing, misfire, or hangfire, at least 5 minutes shall elapse before removing the breech cap, inserting another cartridge, and initiating another cartridge start.

WARNING

Do not remove a cartridge that has fired normally, hangfired, or misfired until there is no evidence of exhaust smoke at the starter exhaust duct and at least 5 minutes have elapsed since start of initiation. Wear asbestos gloves when removing cartridge. Do not point the screened end of the cartridge at personnel or equipment.

3. Not more than three pneumatic starts shall be made in any period of 15 minutes.
4. If cartridge starts and pneumatic starts are interspersed, no more than three starts shall be made within a 15-minute period. Two of these starts may be cartridge starts provided that limitations noted previously are not exceeded.

WARNING

- Except in an emergency, engine operation is prohibited when a live (unfired) cartridge is installed in the starter. Abnormal cartridge conditions of explosive nature could be generated due to the combination of vibration and high temperatures that can exist in the engine nacelle.
- The service life of a cartridge after removal from its container is approximately 15 days. A live (unfired) cartridge should not remain in the starter for more than 15 days. At the end of 15-day period, the cartridge must be replaced before engine start is attempted.

In the event an unfired cartridge has remained in the breech during engine operation, the cartridge will not be used for a subsequent start.

IGNITION SYSTEM LIMITATIONS

For the purpose of engine starting on the ground, operation of the engine ignition system is limited to 2 minutes followed by a 3-minute cooling period. The system may be energized for another 2 minutes following the 3-minute cooling period. To assist in prevention of multiple engine flameout, this limit may be exceeded when flying through cumulus clouds or areas of severe turbulence at altitudes of 40,000 feet or above. (See "Engine Operation," Section VII, and "Turbulence and Thunderstorms," Section IX.) Under such circumstances, continuous use of the ignition system for a period of time not in excess of 10 minutes is permissible. For B-52F airplanes, ignition may be energized longer than 10 minutes during emergency. After 10 minutes (or more on B-52F airplanes) of continuous operation, the ignition system must be turned off for a cooling period of at least 10 minutes.

CAUTION

B-52E

Continuous use of the ignition system for a period in excess of 10 minutes or continuous use without 10-minute interim cooling periods may damage the ignition system and render it inoperable for subsequent engine restarts.

NOTE

If the ignition system is energized continuously for more than 2 minutes, record the period of continuous operation on Form 781. Prior to the next flight, the ignition system will be inspected in accordance with applicable maintenance publications.

WATER LIMITATIONS

Normally, water with less than 10 parts solid per million parts will be used in the water injection system. Tap water rarely meets these specifications. Use of water with impurities greater than specified must be restricted to EMERGENCY USE ONLY. Water with impurities exceeding specified limits will coat the compressor blades with deposits which can result in lowering thrust and stall margins of the engine to a dangerous point. This is especially true if the engine is subsequently operated under dry takeoff conditions. When impure water is used this fact will be entered in Form 781 so the engine can be trim checked, internally cleaned if out of limits, and the water system flushed if necessary.

FUEL GRADE PROPERTIES AND LIMITS

RECOMMENDED FUEL

Recommended fuel is a fuel which has been proven to operate satisfactorily under all conditions. The recommended fuel for the B-52 type aircraft shall conform to Specification MIL-J-5624 Grade JP-4.

ALTERNATE FUEL

Alternate fuel is a fuel which can be used continuously with a possible loss of efficiency and may result in increased maintenance or overhaul costs. The alternate fuel for this aircraft shall conform to Specification MIL-J-5624 Grade JP-5. Use of alternate fuels may require engine retrimming if takeoff is critical. To determine if trim is required, use the EPR to check rated thrust; i.e., if rated EPR cannot be obtained, retrim the engines. It is recommended that if a landing is made at a base having only alternate grade fuels and no facilities for engine retrimming, only enough fuel be loaded to accomplish a one-time flight to a base where JP-4 is available. Engine thrust settings below takeoff thrust will not be limited. Engines opera-

USE	FUEL TYPE	GRADE (In order of preference)	NATO SYMBOL	U.S. MILITARY SPECIFICATION	SPECIFIC GRAVITY (Max-Min at 60°F)	FREEZE POINT °F	LIMITS
RECOMMENDED FUEL	WIDE CUT GASOLINE	JP-4 [5]	F-40	MIL-J-5624	.802-.721	-76	
		JP-4B	F-40	NONE	.802-.751	-76	
		COMMERCIAL JET B [5]	NONE	NONE	.802-.751	-60	[2] [3]
ALTERNATE FUEL	KEROSENE	JP-5	F-44	MIL-J-5624	.845-.788	-55	[2]
		JP-5B	F-42	NONE	.845-.788	-40	[2]
		COMMERCIAL JET A-1 [5]	NONE	NONE	.829-.775	-58	[2] [3]
		COMMERCIAL JET A [5]	NONE	NONE	.829-.775	-40	[2] [3]
EMERGENCY FUEL	AVIATION GASOLINE (AVGAS) PLUS 3% GRADE 1100 OIL	80/87	F-12	MIL-G-5572	.706 [4]	-76	[1]
		91/96	F-15	MIL-G-5572	.709 [4]	-76	[1]
		100/130	F-18	MIL-G-5572	.702 [4]	-76	[1]
		108/135	NONE	NONE	.707 [4]	-76	[1]
		115/145	F-22	MIL-G-5572	.706 [4]	-76	[1]

[1] Follow climb restrictions.

[2] Avoid flying at altitudes where indicated OAT is below the freeze point of the fuel.

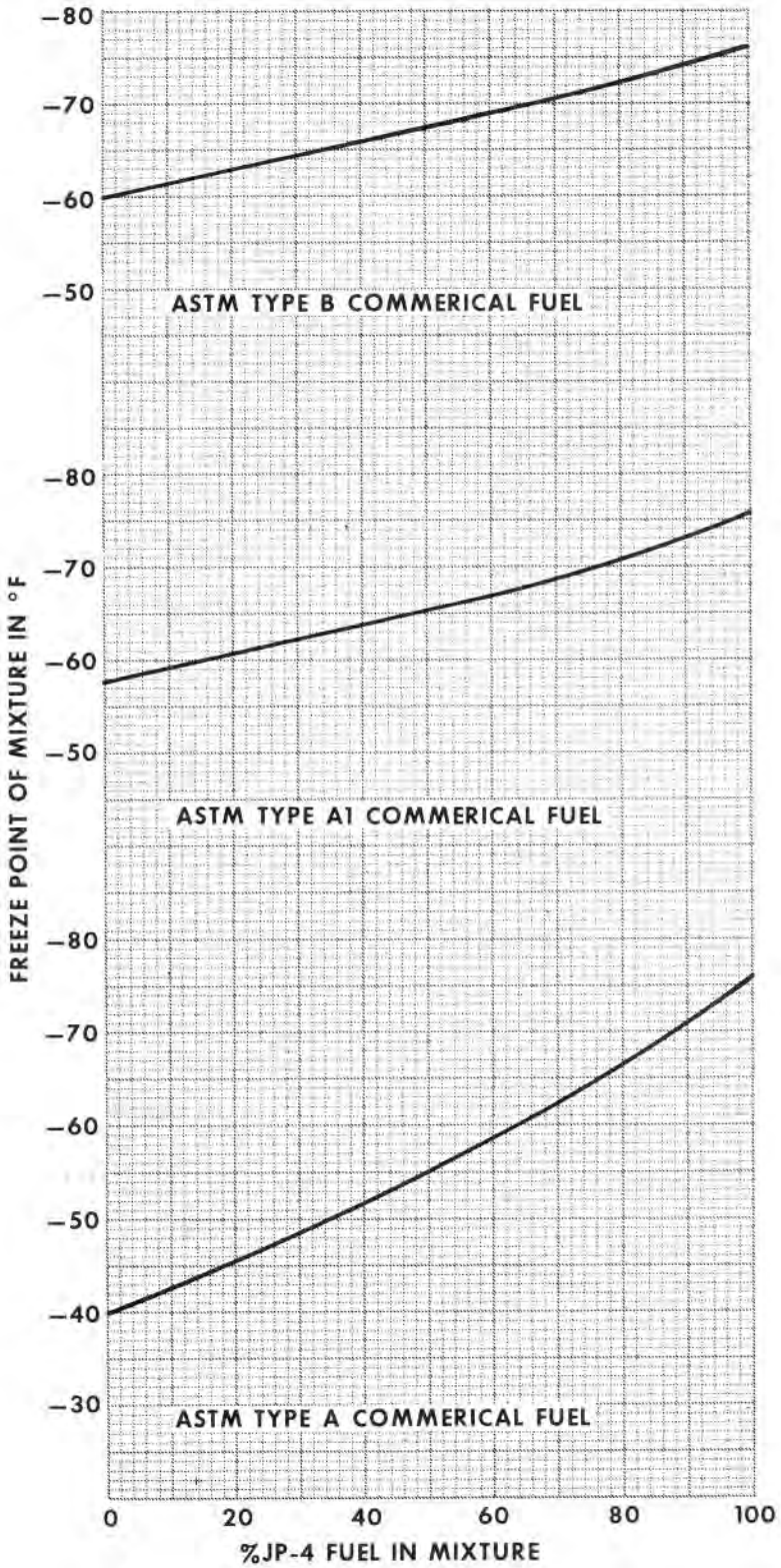
[3] Prior to using commercial fuel, obtain freeze point from vendor or airline supplying the fuel, then follow limit 2 above. The pilot should exercise caution if he suspects or observes improper fuel handling procedures. If there is any indication that cleanliness is not up to standard, a fuel sample should be taken in a glass container and observed for fogginess, presence of water or rust.

[4] Average value-limits are not controlled by specification.

[5] See figure 5-1B, "Jet Fuel Mixture Freeze Point Charts."

.....fuel grade properties and limits

Figure 5-1A.



.....jet fuel mixture freeze point charts

Figure 5-1B.

ting on alternate fuels can be trimmed to produce the same thrust as obtained with JP-4. The engine operating limits discussed under "Engine Limitations," this section, also apply to alternate fuels.

EMERGENCY FUEL

Emergency fuel is a fuel which may cause significant damage to the engines or other systems. Emergency fuel for this aircraft must conform to Specification MIL -G-5572, the lowest grade aviation gasoline available. This fuel is limited to a one-time flight and should be used only if recommended or alternate fuels are unavailable. When using aviation gasoline, the engine-driven fuel pump life becomes critical because of the poor lubricating properties of the gasoline. In addition, the use of aviation gasoline will leave lead deposits in the burners, turbine section, and tailpipe. For these reasons the use of aviation gasoline is to be avoided.

NOTE

Aviation gasoline and JP-4 fuel mixed in any proportion are suitable for continuous operation from an engine performance standpoint. However, the use of aviation gasoline must be restricted to emergency evacuation or ferry-type missions to minimize undesirable lead deposits in the engines.

RATE OF CLIMB LIMITATIONS WITH EMERGENCY FUEL (AVIATION GASOLINE)

The fuel tank vent system is designed for JP-4 fuel which has a Reid vapor pressure of 3 psi. Aviation gasoline has a Reid vapor pressure of 7 psi. If any tanks are refueled with aviation gasoline and a rapid rate of climb is established at altitudes above the boiling altitude of the fuel, the flow of vapor will exceed the capacity of the tank vent system. This will result in hazardous excess pressures in the tanks and vent system. When aviation gasoline is used, the rate of climb at altitudes above the boiling altitude of the fuel must be reduced. This is required as approximately 0.5% of the tank fuel quantity will be evaporated overboard per 1000 feet of tank altitude above the boiling point altitude of the fuel. The kerosene-type fuels will not limit aircraft climb rate.

NOTE

Gasoline and JP-4 fuel mixtures that contain less than 10% gasoline in all fueled tanks have no climb rate limitations.

GROUND REFUELING

When the aircraft is serviced on the ground with aviation gasoline and subsequently is flown above the limiting altitudes for the initial fuel temperatures shown in the table below, the rate of climb shall be restricted to not more than 200 feet per minute. Initial fuel temperature is the temperature of the aviation gasoline in the tanks shortly before takeoff time.

Initial Fuel Temperature	Limiting Altitude (Feet)
60° F	53,000
70° F	44,000
80° F	36,000
90° F	30,000
100° F	25,000
110° F	20,000

AIR REFUELING

If the fuel received from the tanker includes a portion of aviation gasoline, no accurate fuel temperature data will be available. The rate of climb restrictions will be determined by altitude and by the percent of aviation gasoline in any of the receiver tanks after refueling. If the aircraft is flown above the limiting altitudes for the percent of aviation gasoline shown in the following table, the rate of climb shall be restricted to not more than 200 feet per minute.

% Aviation Gasoline	Limiting Altitude (Feet)
50	45,000
75	35,000
100	Transfer Altitude

AIRSPEED LIMITATIONS

Mach number limitations shown in this section are indicated unless otherwise noted. The airspeed limitations, other than those shown in figure 5-1, are listed herein and are summarized in figure 5-4A.

NOTE

If proper calibration is made, the aircraft may be flown to 400 knots calibrated airspeed and .93 Mach true under conditions allowing 390 knots IAS and .90 Mach indicated.

ENGINE OPERATING LIMITS B-52E

Operating Condition	Exhaust Gas Temperature Limit*			Time Limit
	SL to 30,000 Ft	45,000 Ft	55,000 Ft	
Takeoff Rated Thrust (TRT) (Wet)	630°C	——	——	5 minutes
Takeoff Rated Thrust (TRT) (Dry)	620°C	——	——	30 minutes****
Military Rated Thrust (MRT) (Dry)	620°C	640°C	650°C	30 minutes
Normal Rated Thrust (NRT)	560°C	570°C	580°C	Continuous
90% NRT**	530°C	540°C	550°C	Continuous
80% NRT**	490°C	500°C	510°C	Continuous
70% NRT**	460°C	470°C	480°C	Continuous
Idle	340°C	——	——	——
Starting	610°C	610°C	610°C	15 seconds
Acceleration (Engine)***	660°C	660°C	660°C	2 minutes

Engine operating limit speed is 105% rpm; Engine takeoff speed nominal spread is 95% to 102% rpm.
When a tendency to overtemperature is observed, the throttle should be retarded in an attempt to maintain the EGT within limits.

NOTE

In flight, if temperature or rpm cannot be controlled, the engine should be shut down as soon as possible if the EGT exceeds 730°C for any length of time, or the rpm exceeds 107.2%.

*Limits from 30,000 to 55,000 feet vary between the end points in a straight-line relation with altitude. The 45,000 feet altitude table is included for convenience.

**Values shown are not limits, but are indicative of expected temperatures. At thrust settings less than NRT, the NRT temperature limit applies.

***The following information is applicable to engine acceleration time and temperature limits:

- Acceleration temperature time limit is defined as the period between advancing the throttle and the time that the EGT is first observed to start falling after reaching its peak.
- Three additional minutes are allowed following an engine acceleration for the EGT to decrease to a stabilized temperature at or below the applicable limit.
- For accelerations from idle to MRT or TRT, the acceleration temperature limit applies.
- For accelerations to a thrust setting below MRT or from an intermediate thrust setting to MRT, use the temperature limit for the desired thrust setting as the acceleration temperature limit.

****The 30-minute time limit at MRT includes acceleration time and the 3 minutes allowed for the EGT to stabilize.

NOTE

Each time a limit as outlined above is exceeded it must be recorded accurately on Form 781. Record the maximum temperature or rpm observed and the length of time the temperature limit was exceeded.

Figure 5-2 (Sheet 1 of 2).

ENGINE OPERATING LIMITS B-52F

Operating Condition	Exhaust Gas Temperature Limit* SL to 30,000 Ft	45,000 Ft	55,000 Ft	Time Limit
Takeoff Rated Thrust (TRT) (Wet) (-43WB)	620° –660° C***	——	——	5 minutes
Takeoff Rated Thrust (TRT) (Wet) (-43WA)	620° C	——	——	5 minutes
Takeoff Rated Thrust (TRT) (Dry) (-43WA)	610° C	——	——	30 minutes*****
Military Rated Thrust (MRT) (Dry)	610° C	630° C	640° C	30 minutes*****
Normal Rated Thrust (NRT)	560° C	570° C	580° C	Continuous
90% NRT**	530° C	540° C	550° C	Continuous
80% NRT**	490° C	500° C	510° C	Continuous
70% NRT**	460° C	470° C	480° C	Continuous
Idle	340° C	——	——	——
Air Starting	500° C	500° C	500° C	15 seconds
Ground Starting	450° C	——	——	15 seconds
Acceleration (-43WA) (Engine)****	650° C	650° C	650° C	2 minutes
Acceleration (-43WB) (Engine)****	680° C	660° C	650° C	2 minutes

Engine operating limit speed is 102% rpm; Engine takeoff speed nominal spread is 92% to 98% rpm.
When a tendency to overtemperature is observed, the throttle should be retarded in an attempt to maintain the EGT within limits.

NOTE

In flight, if temperature or rpm cannot be controlled, the engine should be shut down as soon as possible if the EGT exceeds 730°C for any length of time, or the rpm exceeds 104.2%.

*-43WA; Limits from 30,000 to 55,000 feet vary between the end points in a straight-line relation with altitude.

*-43WB; Limits from 30,000 to 45,000 feet and from 45,000 to 55,000 feet vary between those indicated for the end points in a straight-line relation with altitude.

**Values shown are not limits, but are indicative of expected temperatures. At thrust settings less than NRT, the NRT temperature limit applies.

***-43WB; 620° C at an OAT of 60° F varying linearly to 660° C at an OAT of 100° F.

****The following information is applicable to engine acceleration time and temperature limits:

- Acceleration temperature time limit is defined as the period between advancing the throttle and the time that the EGT is first observed to start falling after reaching its peak.
- Three additional minutes are allowed following an engine acceleration for the EGT to decrease to a stabilized temperature at or below the applicable limit.
- For accelerations from idle to MRT or TRT, the acceleration temperature limit applies.
- For accelerations to a thrust setting below MRT or from an intermediate thrust setting to MRT, use the temperature limit for the desired thrust setting as the acceleration temperature limit.

*****The 30-minute time limit at MRT includes acceleration time and the 3 minutes allowed for the EGT to stabilize.

NOTE

Each time a limit as outlined above is exceeded, it must be recorded accurately on Form 781.
Record the maximum temperature or rpm observed and the length of time the temperature limit was exceeded.

.....engine operating limitations

Figure 5-2 (Sheet 2 of 2).

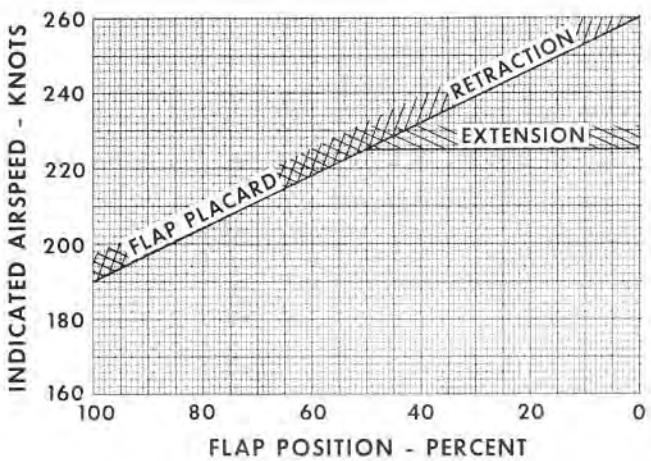
WING TANK FUEL LOADING		AIRSPEED LIMITATION		
OUTBOARD WING	EXTERNAL TANKS	KNOTS IAS	INDICATED MACH NUMBER	
			WITHOUT AGM-28	WITH AGM-28
Full or less than full but not empty	Less than full but not empty	280	.90	.86
Any	Full or empty	350	.90	.86
Empty	Any			
Any	Off	390	.90	.86

NOTE

- It is recommended that the body fuel and center wing fuel be used in accordance with the normal fuel usage sequence given in Section VII.
- Wing tanks considered full { Outboard within 1000 lb of maximum capacity; External within 2000 lb of maximum capacity }

..... flutter airspeed limitations

Figure 5-3.



... wing flap airspeed limits

Figure 5-3A.

WING FLUTTER

To avoid flutter when equipped with drop tanks, the maximum speed to be observed is 350 knots IAS or Mach .90 indicated, whichever is less. To avoid flutter, all outboard wing tank fuel must be used prior to using fuel from full drop tanks in accordance with normal fuel usage sequence. If normal fuel sequence is initiated with drop tanks less than 2000 pounds of full or if the normal fuel sequence cannot be followed, do not exceed 280 knots IAS or Mach .90 indicated. If the EWO fuel sequence is used, do not exceed 280 knots IAS or Mach .90 indicated until all drop tank fuel is used. For tabular presentation of wing flutter airspeed limitations, see figure 5-3.

PRIMARY STRUCTURAL DAMAGE

Less UR and Less VL

To avoid primary structural damage, do not exceed 270 knots IAS or .77 Mach, whichever is less.

skin. The damage is believed to be caused by a combination of turbulence at low level and local airflow disturbance caused by high indicated airspeed and by exhaust of bleed and cooling air from outlets in the nacelles. The existing Mach number limits are not affected by this 325 knot IAS limit.

WING FLUTTER

To avoid flutter when equipped with drop tanks, the maximum speed to be observed is 350 knots IAS or Mach .90 indicated, whichever is less. To avoid flutter, all outboard wing tank fuel must be used prior to using fuel from full drop tanks in accordance with normal fuel usage sequence. If normal fuel sequence is initiated with drop tanks less than 2000 pounds of full or if the normal fuel sequence cannot be followed, do not exceed 280 knots IAS or Mach .90 indicated. If the EWO fuel sequence is used, do not exceed 280 knots IAS or Mach .90 indicated until all drop tank fuel is used. For tabular presentation of wing flutter airspeed limitations, see figure 5-3.

ECM EQUIPMENT

NF

The airplane should not exceed 300 knots IAS unless one of the following is accomplished:

1. ECM transmitters and heat exchangers are installed in systems 5 through 8, ALT-16 transmitters and amplifiers are installed in systems 11 and 12 or ALT-6B transmitter only in system 12, ALT-15 transmitters and power supplies in systems 13 and 14, and transmitter in system 16.
2. Dummy boxes or blank adapter plates are installed in lieu of any of the above equipment.

Possible ram air duct, radome, or ECM shroud failures may occur if the airplane exceeds 300 knots IAS without one of the above installations due to the flow of the unrestricted ram air. Systems 1, 2, 3, 4, 9, 10, and 15 are not included in the above since systems 1, 2, 3, 4, and 15 are not ram air cooled and systems 9 and 10 have blank adapter plates permanently installed.

DROP TANK JETTISONING

The following speed limitation must be observed when jettisoning the drop tanks:

1. Maximum: 300 knots IAS or Mach .83 indicated, whichever is less
2. Minimum:
   - Flaps Up - 150 knots IAS or minimum recommended speed from figure 2-17, whichever is greater
   - Flaps Down - 150 knots

CAUTION

Since the airplane cg will move forward considerably when full drop tanks are jettisoned, adjust stabilizer trim 2 to 3 units nose up in combination with nose down elevator prior to release.

NOTE

Jettisoning at airspeeds above 300 knots IAS may result in a partially opened drop tank parachute having a streamlined configuration.

WING FLAPS

The wing flap airspeed limitations are as follows:

1. Maximum airspeed with flaps full down - 190 knots IAS
2. Maximum airspeed with flaps 50% - 225 knots IAS.

LANDING GEAR

The landing gear airspeed limitations are as follows:

1. Maximum speed for retraction	220 knots IAS
2. Maximum speed for extension	305 knots IAS at 30,000 feet and below Mach .82 indicated at 35,000 feet Mach .83 indicated at 40,000 feet Mach .85 indicated at 45,000 feet Mach .88 indicated at 50,000 feet

NOTE

Maximum speed at which all gears will lock down is 305 knots IAS.

3. Maximum speed while extended	305 knots IAS or airplane strong buffet

AIRBRAKES

- Do not use airbrake positions 3 through 6 above Mach .80 indicated.
- Do not use airbrake positions 5 and 6 above 20,000 feet.
- Positions 1 and 2 have no restrictions.
- Neither of the above restrictions apply if a 30- to 40-pound push force is maintained on the control column.

AIR REFUELING SLIPWAY DOORS

Maximum speed while slipway doors are open - 300 knots IAS.

BOMB DOORS

Operation of the bomb doors at high indicated airspeeds can cause cracks in the skin and loosening of the rivets on the bomb doors. This damage can be expected if either of the following occurs at speeds of 390 knots IAS:

- The bomb doors remain open a total of 5 minutes.
- The bomb doors remain open 30 seconds for each of approximately 8 to 10 operations.

UPPER NOSE RADOME

After inflight loss of upper nose radome, maximum flaps up airspeed limits are 270 knots IAS or Mach .80 indicated, whichever is less.

CLUSTER BOMB DROP

If bombs are dropped from the outboard stations 22, 13, 4, 19, 10, and 1 of the aft cluster bomb rack at an airspeed in excess of that indicated in figure 5-4 the bomb doors will be damaged. If the mission is planned to make the bomb run at a higher airspeed, the bomb load is limited to 21 bombs as bombs should not be loaded in the above-mentioned outboard stations of the aft cluster bomb rack.

TERRAIN CLEARANCE LIGHT

Maximum speed for terrain clearance light extended - 305 knots IAS.

AIRSPEED UNRESTRICTED

Camera door operation

RUDDER TRIM LIMITATIONS

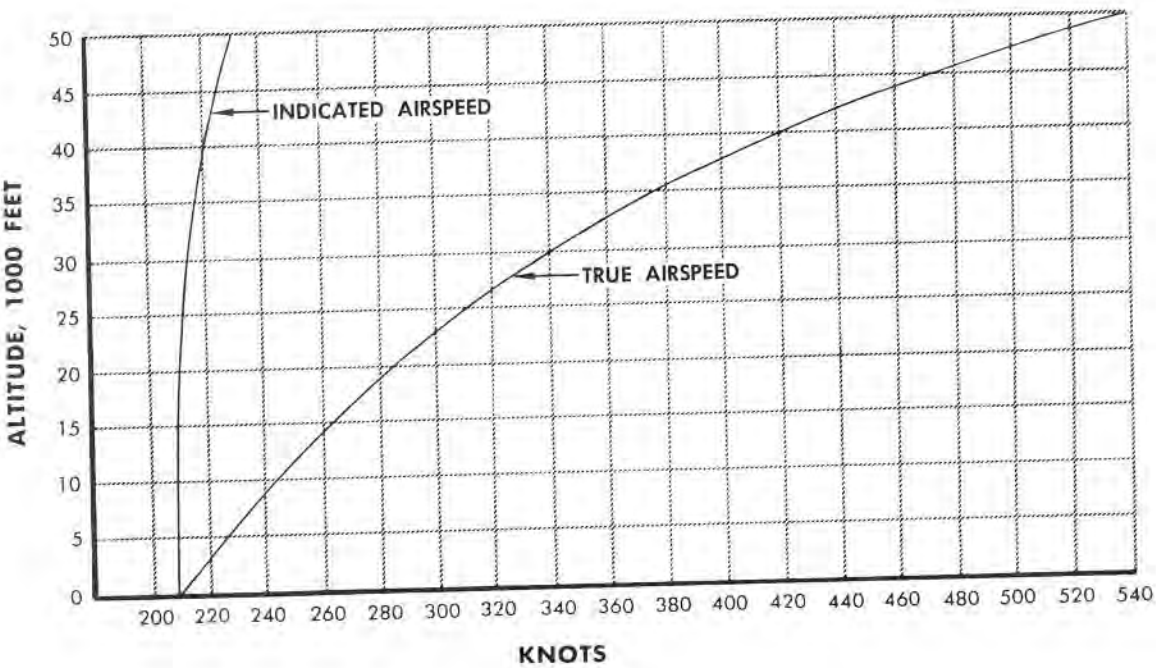
In order to stay within the structural limits of the fin, the rudder trim limits tabulated below should be observed. These limits will protect the airplane structure during normal maneuvering with pedal forces up to 200 pounds and will also allow trimming of single outboard engine failures throughout the normal speed range in the clean configuration. Double outboard engine failures can be trimmed in cruising flight.

KNOTS IAS	TRIM SETTING
Under 320	12 units (full trim)
Over 320	8 units

EXTERNAL BOMB RACKS

UM

Refer to T. O. 1B-52E-1A for airspeed limitations.



NOTE

- The lines represent the maximum indicated or true airspeed at which bombs may be dropped from the outboard stations of the aft cluster bomb rack without damaging the bomb doors.
- This chart is based on estimated data.

..... cluster bomb drop airspeed limitations

Figure 5-4.

AIRSPEED LIMITATIONS

INDICATED KNOTS	INDICATED MACH	CONDITION
135	–	Drag chute deployed
190	–	Full flaps
217	–	Maximum tire speed
220	–	Gear retraction
225	–	Half flaps
270	.77	Primary structure **Less** UR and **Less** VL
280	.90	Wing flutter (Abnormal fuel sequence)
300	.83	Drop Tank Jettison
300	–	Air refueling slipway doors open
300	–	ECM transmitters and heat exchangers, or dummy boxes or blank adapter plates not installed
	.80	Airbrakes greater than position 2 with no push force
305	–	Airbrakes greater than position 4
305	–	Terrain clearance light extended
305	–	Gear extension 30,000 feet and below
	.82	Gear extension at 35,000 feet
	.83	Gear extension at 40,000 feet
	.85	Gear extension at 45,000 feet
	.88	Gear extension at 50,000 feet
305	–	Landing gear extended
350	.90	When equipped with drop tanks
390	.86	AGM-28 installed
390	.90	Maximum airspeed (clean aircraft)

NOTE

When equipped with external bomb racks UM, refer to T.O. 1B-52E-1A.

.....airspeed limitations

Figure 5-4A.

REVERSE SIDE INTENTIONALLY LEFT BLANK

NOTE

It should be observed that these limits are not identical to those listed on the rudder trim placard. The placard limits, being more conservative, should be adhered to operationally whenever possible. In any event, the above-listed structural limits shall not be exceeded.

DRAG CHUTE LIMITATIONS

During the deceleration of a landing or refused take-off, the drag chute may be deployed at 135 knots IAS. Deployment at higher speeds may result in failure of the chute or the shear pin.

BUFFET BOUNDARY LIMITATIONS

Flight Speed Envelope

Figure 5-5 represents the flight speed envelope of the airplane at high altitude. It is possible to fly fast enough to cause a progressive airflow separation over the wing which results in airplane buffet. Buffet is also encountered at low speeds prior to stalling. The airplane can be flown safely through the first indication of buffet to the speed for maximum recommended buffet (maximum recommended buffet is defined as a buffet or vibration amplitude of ±0.1 "g" at the pilots' stations). The MRT lines on figure 5-5 define the level flight speed range at high altitude. See "Wing Buffeting," Section VI.

PROHIBITED MANEUVERS

Acrobatics of any kind are strictly prohibited. This includes intentional spins, vertical stalls, and steep dives, as well as any other maneuver resulting in abrupt accelerations. Normal stalls, accidental spins, and shallow dives are discussed in Section VI.

ACCELERATION LIMITATIONS

LIMIT LOAD FACTOR

On figure 5-6, a plot is shown which illustrates the limitations imposed on the maneuvering "g's" by the structural design of the airplane. To obtain gross weights above 375,000 pounds fuel must be added to the drop tanks before adding to any other tank in order to avoid exceeding the inflight maximum allowable wing bending moment (figure 5-10).

ALTITUDE AND TEMPERATURE LIMITATIONS

Although there is no unqualified altitude restriction on the airplane, the table below lists limitations on equipment which is not designed for operation above the noted altitude or which must be shut down under specific conditions.

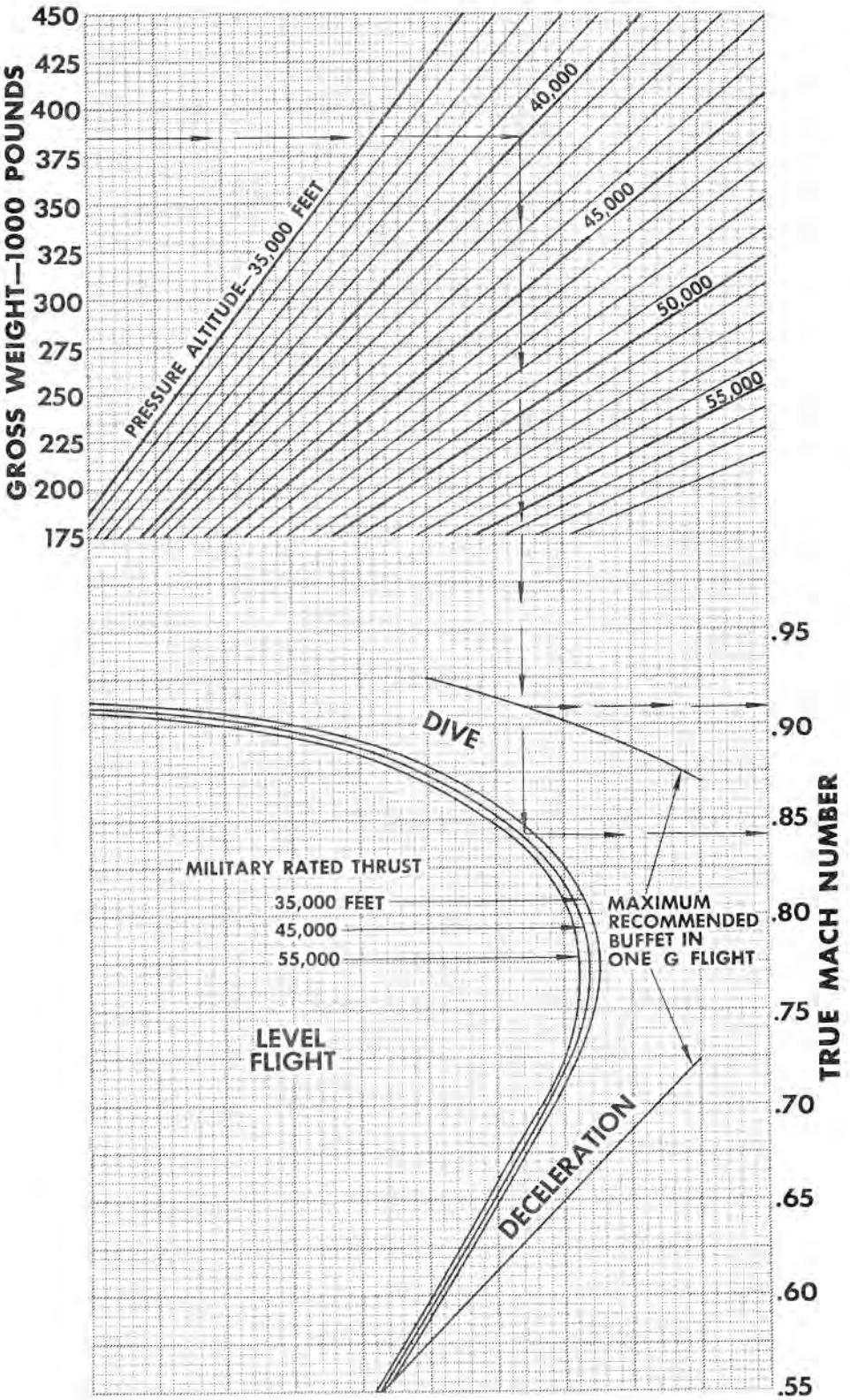
Water Injection System	40° F OAT or 8000 feet
Oxygen Regulators	45,000 feet (cabin altitude)
MD-9 Gunnery System	50,000 feet (airplane altitude)

If ECM equipment is to be operated on the ground without ground cooling equipment, definite time limitations must be observed to prevent the equipment from reaching critical temperatures. Operation within the prescribed time limits must be accomplished with ram air inlets open and no more than one transmitter at a time operated in any one cooling shroud area. Operation above the temperature given is prohibited. Time and temperature limitations for ECM equipment are as follows:

• ALT-15	3 minutes at 100° F or below
• ALT-16	5 minutes at 100° F or below
• ALT-13	8 minutes at 100° F or below
• ALT-6B	8 minutes at 100° F or below
• ALT-18/ALT-6B	9 minutes at 100° F or below

NOTE

After operation, ECM equipment must cool for at least 60 minutes before operation can be resumed.



AIRPLANE: B-52E

ENGINES: J57-P-19W & -29WA

CONDITIONS:

NACA STANDARD DAY
CLEAN CONFIGURATION
WITH DROP TANKS

EXAMPLE:

GIVEN:
Gross weight = 385,000
Altitude = 40,000 feet

FIND:
Maximum speed in level flight and maximum permissible dive speed

SOLUTION:
Maximum level flight Mach No. = .829
Maximum dive speed Mach No. = .909

DATA BASIS: FLIGHT TEST

DATE: JULY 1956

Figure 5-5. (Sheet 1 of 2).

AIRPLANE: B-52F

ENGINES: J57-P-43W

CONDITIONS:

CLEAN CONFIGURATION
NACA STANDARD DAY
WITH DROP TANKS
8 ENGINES AT MRT

EXAMPLE:

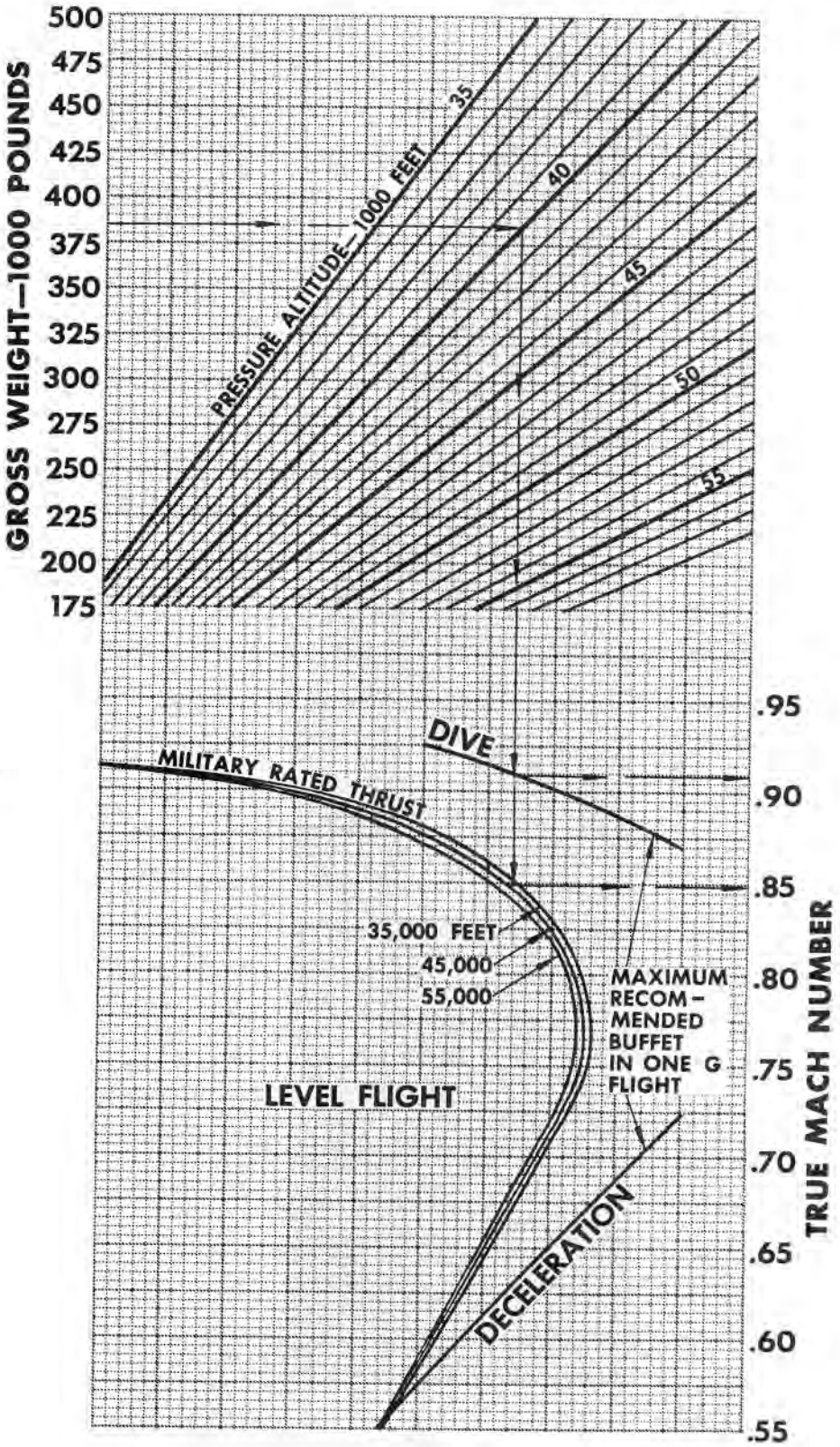
GIVEN:
Gross weight = 385,000 lb
Altitude = 40,000 ft

FIND:
Maximum speed in level flight
and maximum permissible dive speed

SOLUTION:
Maximum level flight
Mach No. = .849
Maximum dive speed
Mach No. = .909

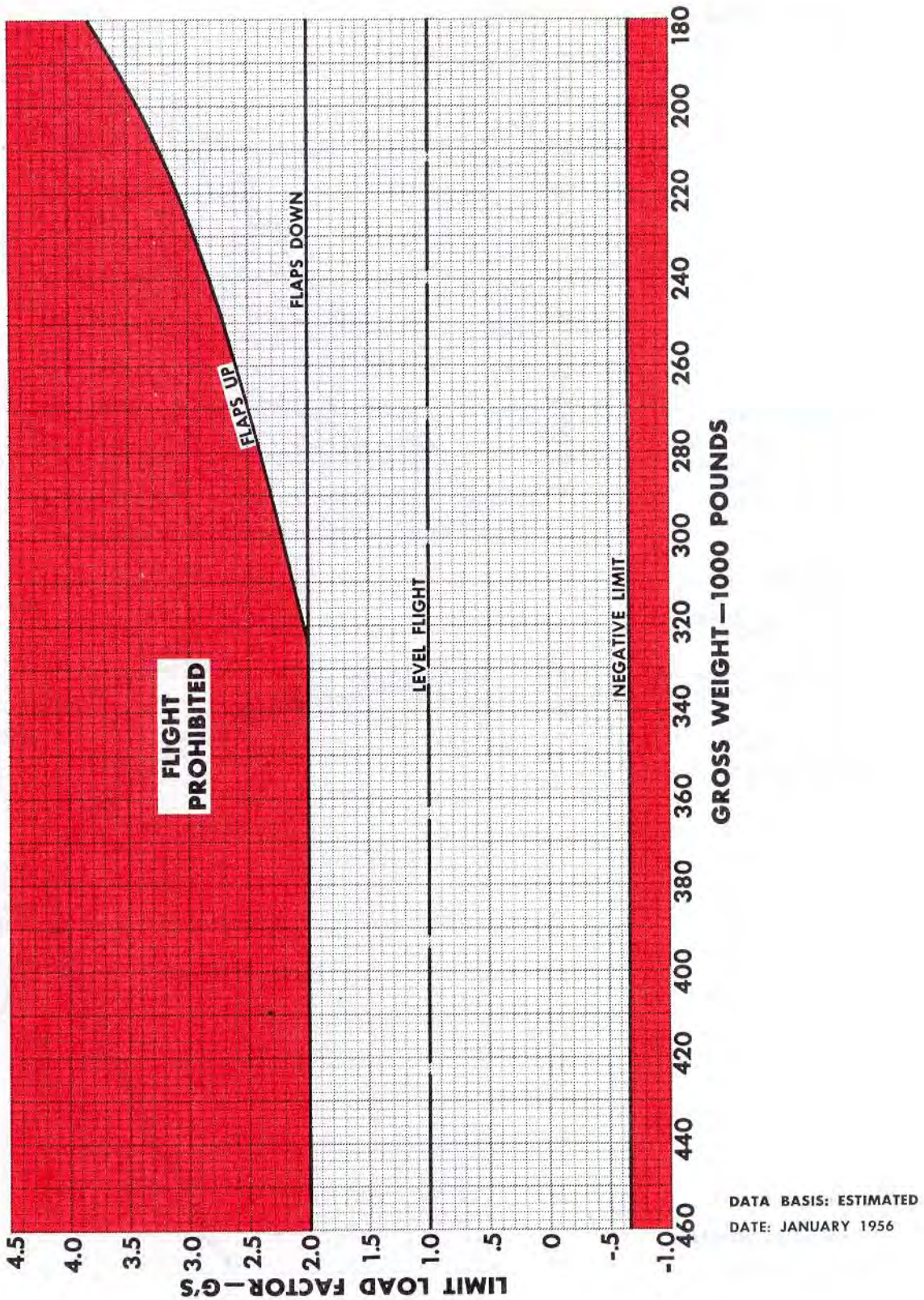
DATA BASIS: ESTIMATED

DATE: MAY 1958



flight speed envelope

Figure 5-5. (Sheet 2 of 2).



..... structural limitations—limit load factor

Figure 5-6.

RATE OF DESCENT LIMITATIONS

The maximum rate of descent is 25,000 fpm.

MANEUVER LIMITS — FLAPS DOWN

Figure 5-7 provides curves which may be used to determine the allowable flaps down maneuver limits to avoid stall buffeting, stalls, or exceeding the structural placard limits. This chart is useful in planning the approach.

SYSTEMS LIMITATIONS

STABILIZER TRIM MECHANISM LIMITATIONS

There are no restrictions on the use of the manual stabilizer trim system; however, when using the electrical portion of the system, observe the following limitations:

1. Do not operate the electrical trim mechanism on the ground more than 5 seconds after either pack 9 or 10 hydraulic low pressure warning light illuminates. At this time, hydraulic pack 9 or 10 accumulator pressure will have become depleted and clutch slippage will occur.
2. Do not operate the electrical trim mechanism on standby hydraulic pressure except during inflight emergencies.
3. Do not actuate one trim switch in NOSE UP position while applying nose down trim with the other trim switch (an exception to this is a runaway trim condition).
4. Electrical actuation of the followup screws into either the nose up or nose down limit stops should be avoided to prevent stalling the output shaft of the actuator motor and overheating the clutch, as this shortens clutch service life. Extreme nose up or nose down positions may be obtained manually after approaching the extremes electrically.
5. During flight, the stabilizer trim should be operated only in short bursts. This will serve as an aid in recognizing a malfunctioning electrical trim system before an extreme out-of-trim condition is reached.

HYDRAULIC PACK LIMITATIONS

To prevent overheating and possible failure of hydraulic packs 1, 2, or 4, do not fly with any one of the following conditions existing for a period in excess of 30 minutes out of each hour unless the landing gear is extended:

1. Either slipway door switch in OPEN position.
2. Master bomb control switch in ON position.
3. Bomb doors open.

For continuous operation of a utility pack, see procedures in Section II$_L$, "Failure of a Utility Pack to Shut Down."

WING FLAP LIMITATIONS

Actuation of the wing flaps is limited as follows:

1. Three complete duty cycles (extension and retraction) allowed in a 30-minute period.
2. Eight starts allowed in a 30-minute period.

Wing flap operation, either normal or emergency, shall be discontinued within 10 seconds if the flaps fail to start moving. Slippage of the power unit clutch or malfunction of the wing flap system can be detected by monitoring the wing flap indicator while using the system. Any additional attempt to start the flaps shall be limited to 10-second intervals of actuation. Do not use either flap motor for more than eight attempted starts in any 30-minute period.

NOTE

If slippage of the wing flap power unit clutch is known or suspected to have occurred, an entry must be made in Form 781 stating the circumstances and the approximate duration of the malfunction.

ELECTRICAL LOAD LIMITATIONS

For electrical load limitations other than those indicated in figure 5-1, see "D-C Power System Failure," Section III.

CONDITIONS:

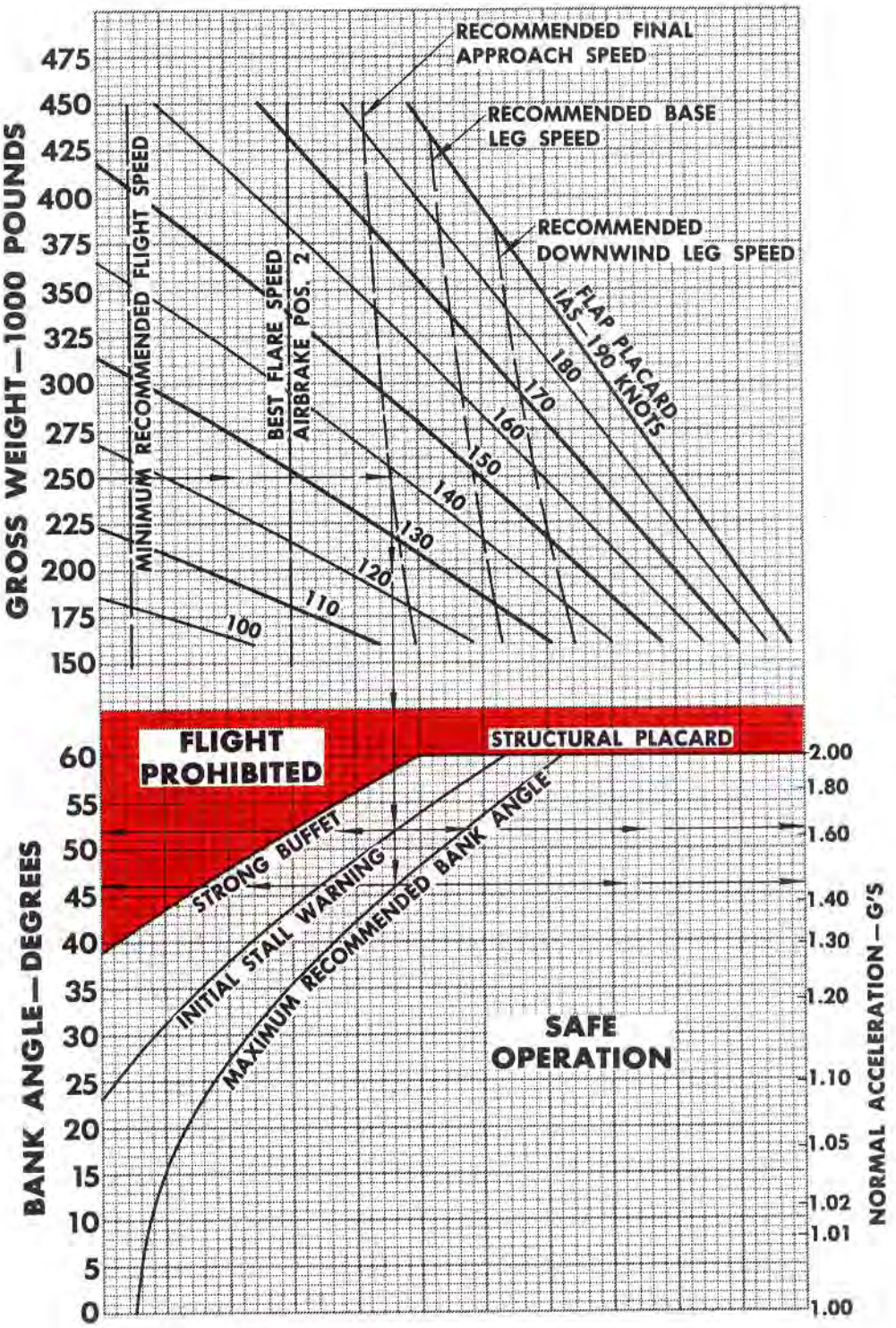
FLAPS DOWN
SEA LEVEL TO 10,000 FEET

EXAMPLE:

GIVEN:
Gross weight = 250,000 lb

FIND:
Maneuver limit at recommended final approach speed

SOLUTION:
46° bank angle or 1.45 g = Maximum recommended
52° bank angle or 1.62 g = Initial stall warning



DATA BASIS: FLIGHT TEST
DATE: JANUARY 1956

maneuver limits—flaps down

Figure 5-7.

CONDITIONS:

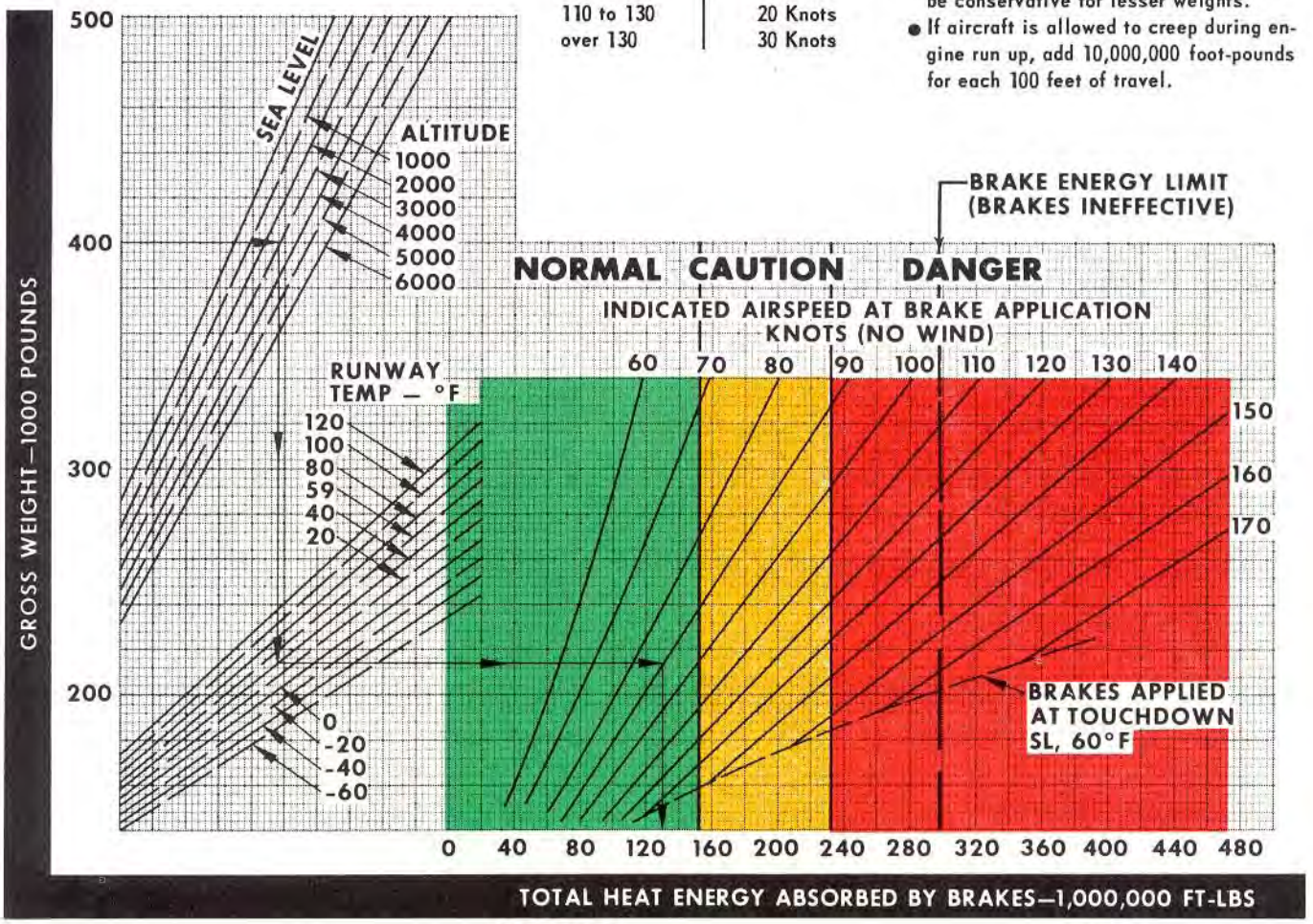
- Eight engines assumed at idle when brakes are applied.
- Equal braking is assumed.
- Full flaps, airbrakes, and drag chute are assumed for all conditions.
- No wind conditions.

REMARKS:

- If airbrakes and drag chute are not used, the chart IAS should be increased as follows:

IAS	AMOUNT INCREASES
0 to 70	0 Knots
80 to 100	10 Knots
110 to 130	20 Knots
over 130	30 Knots

- One-half the HEADWIND component measured by the tower should be subtracted from the IAS at brake application.
- A TAILWIND component must be added to the IAS.
- The table is based on maximum ground handling weight of the aircraft and will be conservative for lesser weights.
- If aircraft is allowed to creep during engine run up, add 10,000,000 foot-pounds for each 100 feet of travel.



TAXI SPEED AT BRAKE APPLICATION — KNOTS

	FINAL TAXI SPEED — KNOTS						
–	50	40	30	20	10	5	0
60	25	45	60	70	77	79	80
50	–	20	35	45	52	54	55
40	–	–	15	25	32	34	35
30	–	–	–	10	17	19	20
20	–	–	–	–	7	9	10
10	–	–	–	–	–	2	3
5	–	–	–	–	–	–	1

HEAT ENERGY ABSORBED
1,000,000 FT-LBS

EXAMPLE:

GIVEN:

- Gross weight = 400,000 pounds.
- Pressure altitude = 3000 feet.
- Runway temperature = 40° F.
- Initial brake application = 90 KIAS.
- Four brake applications during taxi to parking area, decelerating from 20 to 5 knots.
- One brake application from 5 knots to 0.

FIND:

Heat energy absorbed by brakes for a complete stop after landing and taxi to parking area.

NOTE

To determine the total heat energy absorbed, ground maneuvering must be added. For stops and decelerations, use the table to determine the additional heat energy absorbed.

SOLUTION:

- From the chart:
  Initial heat energy absorbed to stop after landing = 130,000,000 foot-pounds.
- From the table:
  Four brake applications at 9,000,000 foot-pounds each = 36,000,000 foot-pounds.
  One brake application at 1,000,000 foot-pounds.
- Total heat energy absorbed = 167,000,000 foot-pounds.

FLAPS DOWN WITH AIR BRAKES & DRAG CHUTE

brake energy limits

Figure 5-7A.

BOMB DOOR OPERATION LIMITATIONS

CAUTION

- When bomb doors are operated with power to only the forward bomb door actuator, airplane speed should not exceed 325 knots IAS, if practical, as a precaution against buffeting and structural damage to the doors.
- Do not operate bomb doors in flight with power to only the rear bomb door actuator except when imperative to do so, since this may result in loss of portions of the bomb doors and possible damage to the aft body structure and empennage.

AILERON TRIM MECHANISM LIMITATIONS

Continuous actuation of the aileron trim mechanism shall be limited to two complete duty cycles followed by a 10-minute cooling period. One duty cycle includes actuation from the neutral, or 0° position, to either the extreme left wing down or right wing down position, back through neutral to the opposite extreme position, then finally returned to neutral.

GROUND OPERATION LIMITATIONS

GROUND TURNING LIMITATIONS

Maximum ground turning speeds with full rudder travel are 5 knots with steering ratio selector lever in TAXI or 27 knots with the lever in TAKEOFF LAND.

WHEEL BRAKE LIMITATIONS

Brake Energy Limits

The brakes are limited in the amount of work they can perform and still function properly because this work must be dissipated in the form of heat. A measure of the amount of heat absorbed or work performed by the brakes is the kinetic energy expended, measured in millions of foot-pounds. The heat generated from the brakes can cause the tire pressure to increase to dangerous values. The combination of increased tire pressure and deterioration of the tire strength, due to heat, could cause the tire to explode. In some extreme cases, the brake and wheel assembly may get hot enough to ignite the hydraulic fluid and start a fire before the tire explodes. The amount of heat added to the brakes for each braking effort during a landing rollout, taxiing, or ground maneuver is cumulative and is determined by the speed of the aircraft and its gross weight at the time the brakes are applied. To preclude the possibility of injury to personnel and damage to equipment from an overheated brake and wheel assembly and tire due to the brake energy limit being exceeded, figure 5-7A is provided.

NOTE

- The effect of aerodynamic braking has been considered in the "Brake Energy Limits" chart (figure 5-7A). This aerodynamic braking will slow the aircraft the same amount whether the brakes are applied steadily or in short applications.
- The same amount of heat is generated bythe brakes in stopping the aircraft within a given stopping distance or in deceleration of the aircraft during taxiing or ground maneuvers, regardless of whether the brakes are applied in one steady application or in a series of short applications. The internal heat generated by brakes does not reach the outer surface of the wheel-brake assembly for several minutes whereas the ground roll requires only a few seconds; therefore, all but an insignificant amount of the heat generated by the brakes will remain in the brake assembly for the duration of the ground roll.

Figure 5-7A should be used whenever a takeoff is aborted, for all landings at gross weights over 300,000 pounds, for planned lengthy ground maneuvers, and

when the pilot suspects that the combination of gross weight, runway altitude, temperature, IAS, and the number of stops and decelerations will result in exceeding the brake energy limits. To determine the heat energy absorbed during landings and aborted takeoffs, enter the chart with gross weight, runway pressure altitude, runway temperature, and the IAS at brake application. For stops and decelerations, determine the heat energy absorbed during each brake application by entering the table with the taxi speed at brake application and the final taxi speed. The total heat absorbed is found by summing the heat energy absorbed from each maneuver. See example, figure 5-7A. The following operating procedures and restrictions are necessary to preclude the possibility of injury to personnel and damage to equipment from overheated brakes and tires in accordance with the applicable brake energy limit zones of figure 5-7A.

DANGER ZONE - OVER 230 MILLION FOOT-POUNDS

1. Taxi aircraft clear of runway, other aircraft, and personnel. Taxi distance and braking shall be an absolute minimum. Stop aircraft and release brakes as soon as possible.
2. Approach from front or rear only for fire fighting. Crew evacuation shall be in the same direction. Tire explosion and hydraulic fluid fire are imminent.
3. Extinguisher agents shall be applied as fog or foam on tires. Do not spray liquid directly on wheels.
4. After wheels and brakes have cooled, remove and replace per T.O. 1B-52B-2-10.
5. Remove and replace tires per T.O. 4T-1-3.

CAUTION ZONE - 150 TO 230 MILLION FOOT-POUNDS

1. Park aircraft.
2. Inspect tires per T.O. 4T-1-3.
3. Inspect brakes per T.O. 1B-52B-2-10 for brake wear and hydraulic fluid leaks.
4. Delay subsequent takeoff until hand can be held on brake assembly (approximately 135° F).

NORMAL ZONE - UP TO 150 MILLION FOOT-POUNDS

1. No special inspection is required.
2. If gross weight is not above 300,000 pounds, no brake cooling is required prior to takeoff. If the gross weight is above 300,000 pounds, delay subsequent takeoff until hand can be held on brake assembly.
3. If stop exceeds 100 million foot-pounds and an immediate takeoff is made:
   a. Make a normal takeoff.
   b. After cleanup altitude is reached, extend gear and leave down 2 minutes for each 8 million foot-pounds in excess of 100 million foot-pounds.
   c. Some loss in rate of climb can be expected.

Landing Gear Oscillation

If landing gear oscillation is experienced, brakes shall be fully released immediately. Brakes may be reapplied as soon as body and landing gear oscillations have ceased.

TIRE LIMITATIONS

Maximum Ground Speed

To prevent main landing gear tire casing failures, all takeoffs and landings will be limited to a maximum ground speed of 217 knots. Refer to Part 9 of the applicable Appendix for tire limit speed chart used to convert IAS to ground speed.

ARC-65 LIAISON RADIO LIMITATIONS

WARNING

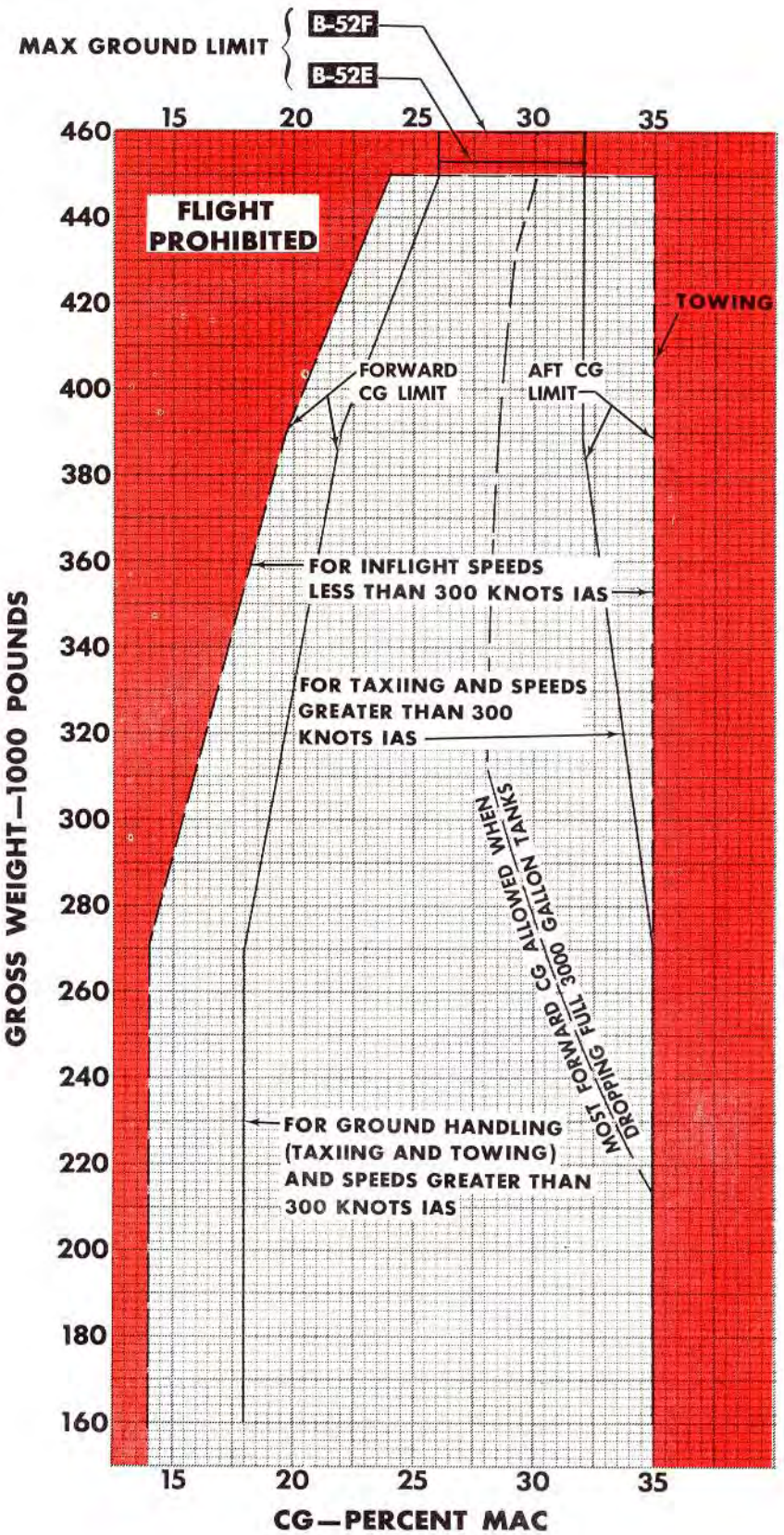
Ground operation of the AN/ARC-65 transmitter (interphone selector switch positioned to LIA and mike switch actuated) is prohibited on any tactical aircraft under the following conditions:
1. Nuclear weapons loaded and bomb bay doors open.

NOTE

This restriction applies only to AN/ARC-65 installed on the tactical aircraft having nuclear weapons aboard and does not apply to adjacent aircraft regardless of separation distance. This does not prohibit AN/ARC-65 receiver operation on the ground.

CAUTION

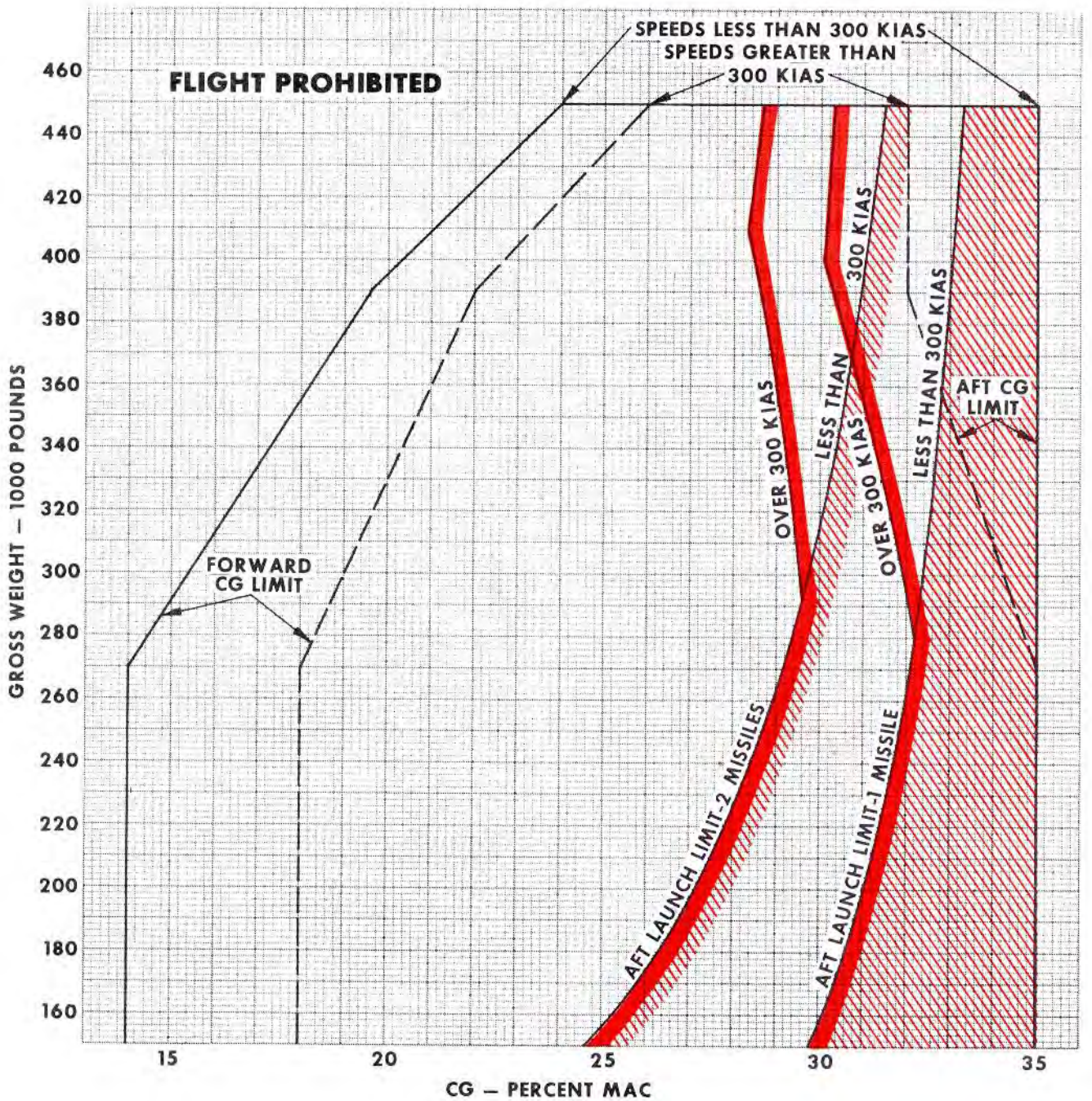
The aircraft will not be moved with its own power with the cg aft of the taxiing limit.



DATA BASIS: ESTIMATED
DATE: FEBRUARY 1962

structural cg limits

Figure 5-8.



NOTE

THE FUEL SEQUENCES (FIGURES 7-4, 7-4A, AND 7-4B) ARE DESIGNED TO KEEP THE AIRCRAFT FORWARD OF THE GAM-77 LAUNCH CG LIMITS.

GAM-77 launch cg limits

Figure 5-8 A.

CENTER OF GRAVITY LIMITATIONS

The allowable cg limits are shown in the chart on figure 5-8. Maintaining the center of gravity within these limits is required by structural rather than aerodynamic considerations. The cg may easily be maintained within these limits by following the prescribed normal fuel scheduling. A considerable margin is also available for other than normal scheduling to allow for battle damage.

WEIGHT LIMITATIONS

MAXIMUM GROSS WEIGHT

The aircraft may be loaded to a maximum gross weight under certain configurations as follows:

CONDITION	MAXIMUM GROUND HANDLING WEIGHT INCLUDING WATER	MAXIMUM INFLIGHT WEIGHT
With external tanks on and full	B-52E 453,000 pounds B-52F 460,000 pounds	450,000 pounds
No external tanks	376,500 pounds	370,000 pounds
External tanks on but empty	379,100 pounds	375,000 pounds
Maximum weight to drop empty external tanks		372,600 pounds

LANDING GEAR LIMITATIONS

The main landing gear is basically critical for the braked-roll condition. The drag strength is sufficient to allow application of the brakes for airplane gross weights up to 460,000 pounds. The hydraulic pressure of the brake system has been limited to preclude gear failure up to 460,000 pounds gross weight. The normal landing gross weight at 470 fpm limit contact sinking speed is 270,000 pounds. However, it is possible to land the airplane up to the maximum weight limit if the sinking speed is limited as shown in figure 5-9. Landings above 400,000 pounds will be quite difficult because of the shallow approach angles necessary and also because there will be little power margin for maneuvering or go-around. These sinking speeds are dictated by a combination of vertical and spring-back loads. The strength of the body bulkheads supporting the landing gear permits ground turns which produce a maneuver side load of .27 "g's" limit at a gross weight of 460,000 pounds.

FUEL LOADING

The fuel valving system is designed so that the engines receive fuel from the nearest main tank only. For emergencies, fuel can be routed from any tank to any or all of the engines through the fuel transfer and crossfeed manifolds. Fuel from the auxiliary tanks is normally routed through the main tanks to the engines. Auxiliary tank fuel then maintains the main tanks at or near 92% full until auxiliary tank fuel is used. At various gross weights, wing strength is based upon the fuel loading in the wing tanks. The maximum allowable gross weights for different fuel loadings are shown in figure 5-10. The "Maximum Flight Weight vs Fuel Weight in Wing Tanks" chart (figure 5-10) is presented in a form that is independent of fuel usage sequence in order to provide information that is applicable to unusual fuel loading conditions. This chart shows, in incremental form, the maximum flight gross weight corresponding to any given combination of wing fuel loading. This chart may be used for symmetrical or asymmetrical fuel loading and for any fuel usage sequence, provided the flutter placards are not exceeded. As the aircraft weight is supported by the airload on the wings, the more load that is carried in the fuselage the greater will be the bending moment in the wings. To prevent overloading the wings as the gross weight increases, it is necessary to provide relieving dead weight in the wings to relieve the effects of increased airloads. Since the center wing tank fuel does not provide relieving dead weight, it is considered to be the same as body fuel.

Example of Chart Usage

PROBLEM 1: An aircraft is to be loaded with the following quantities of wing fuel: Full fuel (39,000 pounds) in the two drop tanks, 25,000 pounds total in the two outboard tanks, 20,000 pounds in main tanks 1 and 4, and 30,000 pounds in main tanks 2 and 3. What is the maximum flight gross weight allowable under this wing fuel loading condition?

SOLUTION: Referring to figure 5-10, proceed along the fuel line to 39,000 pounds and project a vertical line to the drop tank line. From this intersection, draw a horizontal line and read 80,000 pounds additional flight gross weight. Similarly, read 47,000 pounds additional flight gross weight corresponding to 25,000 pounds in the outboard tanks, 13,500 pounds additional flight gross weight for a combined fuel weight of 20,000 pounds in main tanks 1 and 4, and 7,000 pounds additional flight

gross weight corresponding to a combined fuel weight of 30,000 pounds in main tanks 2 and 3. The maximum allowable flight gross weight is equal to the 286,000-pound basic aircraft weight plus the combined sum of the individual additional allowable gross weights corresponding to the fuel weights in each wing tank. In this example the maximum allowable flight gross weight is 286,000 + 80,000 + 47,000 + 13,500 + 7,000 = 433,500 pounds.

NOTE

Flutter placards and cg limitations must be observed at all times.

FUEL USAGE

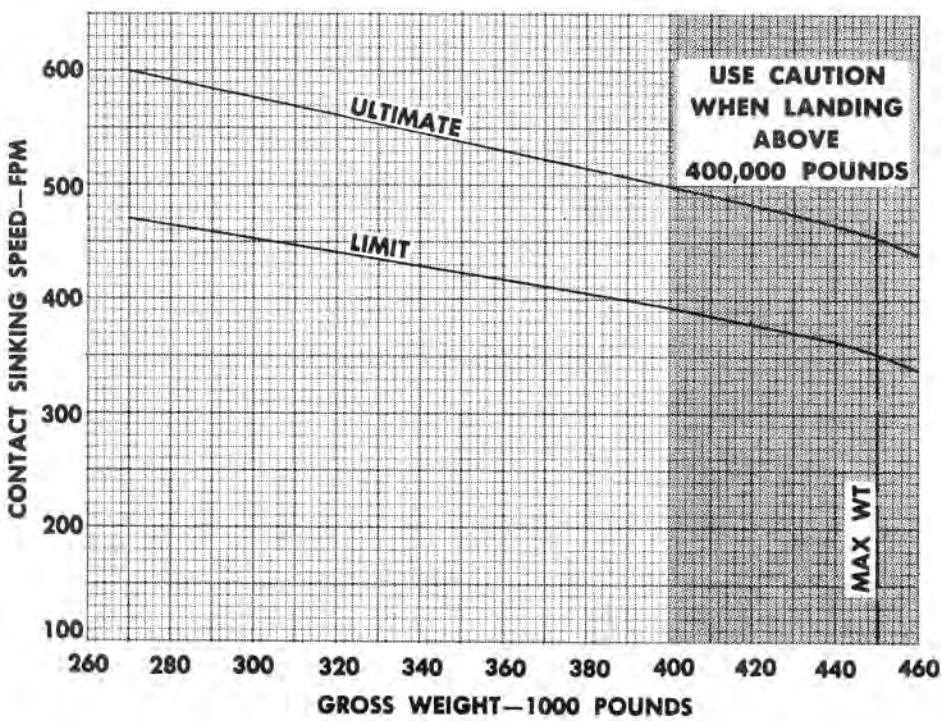
The aircraft is designed primarily as a 2.0 "g" load factor aircraft. A lighter gross weight with the noted wing fuel limits will increase the margin of safety for critical wing bending. The advantages of carrying more wing fuel than necessary are counteracted by consideration of protecting over-target fuel and jettisoning the drop tanks as early as possible for maximum range. The EWO fuel sequence ("Air Refueling System," Section IV) is designed to utilize the fuel so as to allow jettisoning of the empty drop tanks at the maximum permissible gross weight. The aircraft is designed for tanks full of 6.5 pounds-per-gallon fuel, but standard fuel variations may be from 6.0 to 6.8 pounds per gallon. Weight switches prevent overfilling the tanks with the heavier fuels. Volume switches prevent overfilling of tanks with light weight fuel; however, the aircraft will be underweight. The underweight condition in the wing will reduce the relieving dead weight and lower the allowable gross weight (figure 5-10).

NOTE

To avoid overweight and center of gravity complications, the tanks should be filled by the fuel quantity gages and not to the filler neck or vent limits.

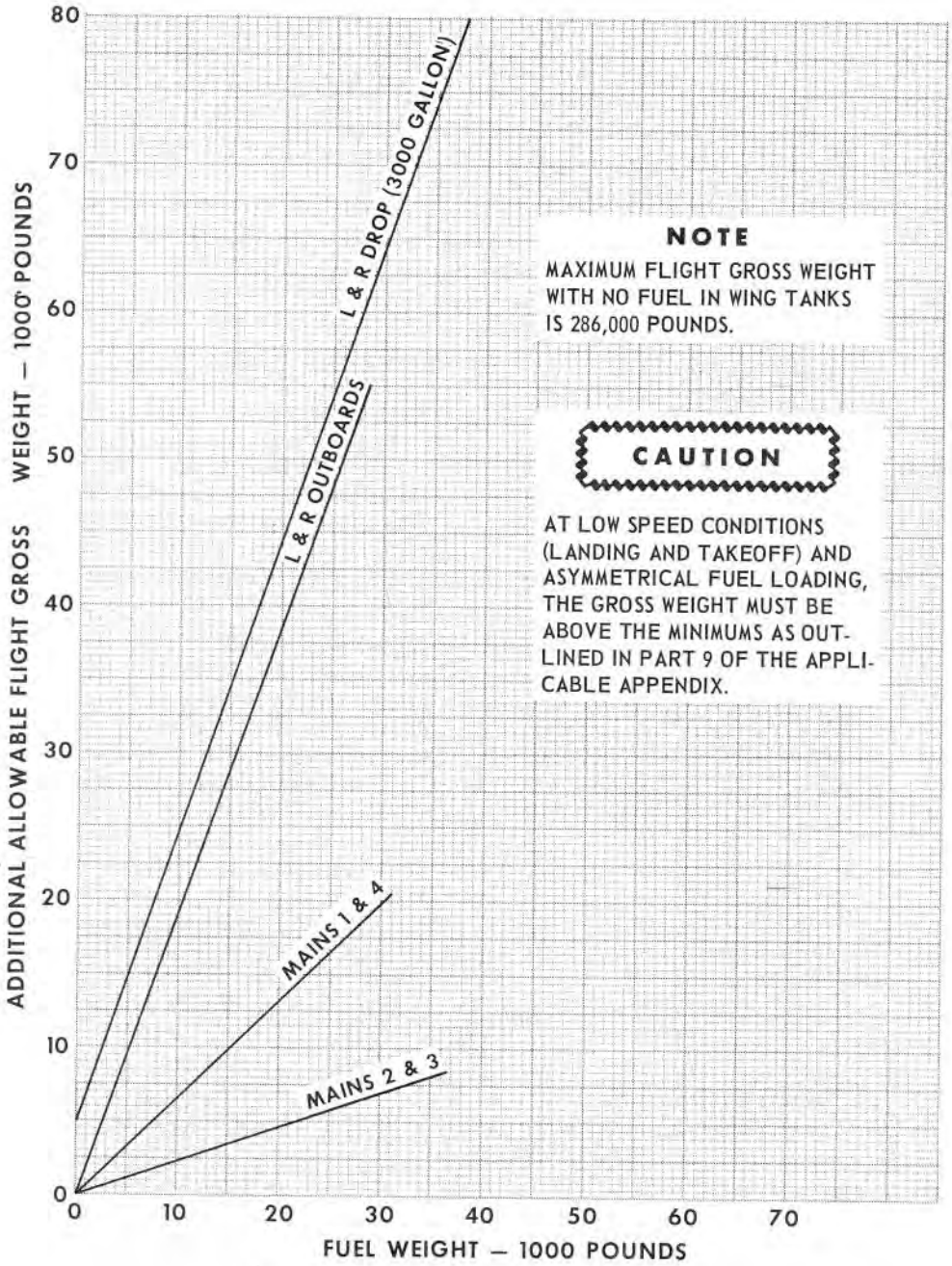
REFUELING OPERATIONS

To prevent exceeding the structural limits during refueling operations, any wing tank fuel that has been used should be replaced first. In using fuel prior to air refueling, it is advantageous to use body fuel first. This method shortens air transfer time by keeping the slow filling wing tanks full. After using body fuel prior to air refueling, the recommended refueling sequence is to fill main tanks first, then distribute the remaining fuel required between the forward body, mid body, and aft body tanks as necessary to stay within the structural limits of the aircraft. The normal fuel usage sequence should be followed after air refueling is completed. Any deviations from the standard fuel sequence procedures set forth in Section VII must be thoroughly investigated to determine their effect on the aircraft center of gravity.



contact sinking speed limitations

Figure 5-9.



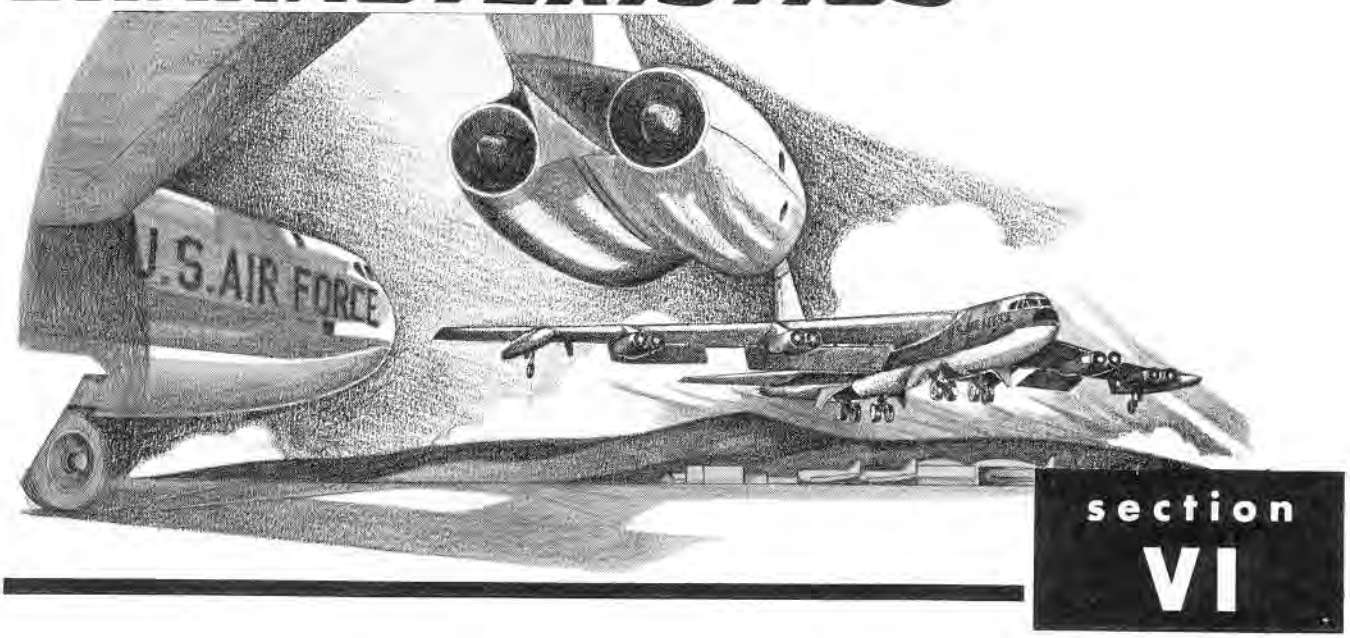
INSTRUCTIONS

To obtain maximum flight gross weight, read the additional allowable weight corresponding to the actual fuel weight in each wing tank and add these additional weights to the basic 286,000 pounds.

maximum flight weight vs fuel weight in wing tanks

Figure 5-10.

FLIGHT CHARACTERISTICS



section VI

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DESIGN CONSIDERATIONS

AERODYNAMIC DESIGN

The following discussions are intended to give some of the aerodynamic design background of the airplane in order to aid in understanding the airplane flight characteristics.

Wing Selection

The effects of compressibility are the primary limiting factors on the performance of high speed airplanes. In order that a wing may produce lift, the air must pass over the top surfaces of the wing at a higher speed than that over the lower surfaces. As the airplane speed is increased, the air velocity over the top surface of the wing reaches the speed of sound much sooner than that

over the lower surfaces. When the air over the top surface of the wing exceeds the speed of sound, a shock wave is produced resulting in a sharp pressure rise. This in turn causes an increase in drag and a decrease in lift because of the airflow separation induced behind the shock wave. Since the air velocity over the top of the wing is greater than the airplane speed, this condition always occurs at airplane speeds less than the speed of sound (Mach 1.0). The speed where this effect becomes great enough to be noticeable is termed the critical Mach number.

Elevator and Stabilizer Selection

Because of the large spread between stalling speed and top speed and the overall airplane aerodynamic characteristics, the longitudinal trim requirements of this airplane are much greater than would be required for a comparable airplane of lower performance. An adjustable horizontal stabilizer is utilized for longitudinal trim rather than elevator surfaces for the following reasons:

1. An elevator surface to be used both for primary longitudinal control and for longitudinal trim would be so large that its aerodynamic balancing would present extreme difficulties.
2. The large size of the elevators would necessitate a power boost system which in turn would create structural problems and reduce reliability of the primary control system.
3. The drag of such a control surface held in a displaced position for trim purposes would adversely affect performance.

At airspeeds up to 235 knots IAS, to compensate for 1° of stabilizer trim, approximately 3° of elevator are required; therefore, to provide the maximum elevator possible for maneuvering at low airspeeds, especially during flap retraction, the airplane should be kept trimmed to a zero stick force condition at all times.

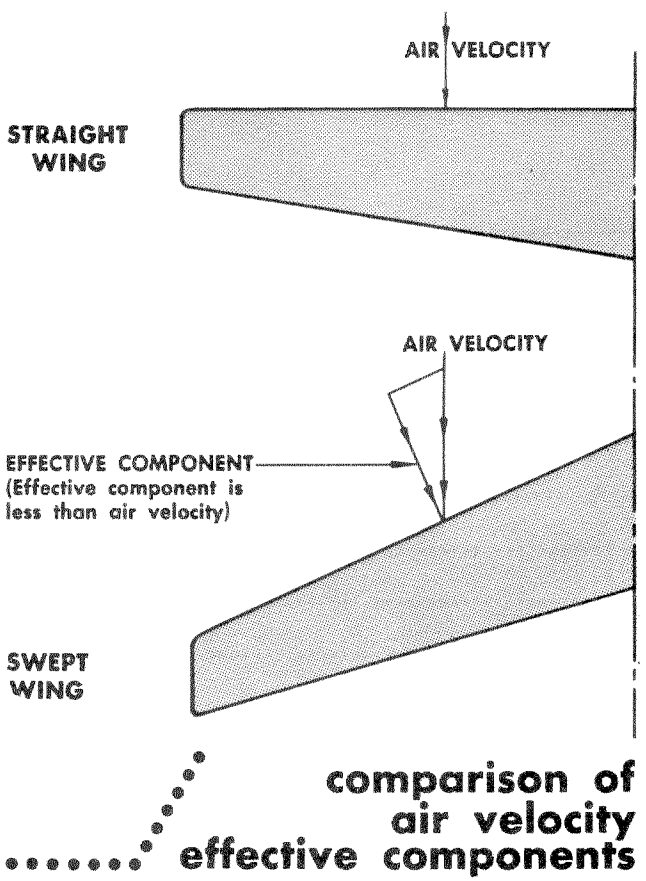


Figure 6-1.

HIGH SPEED DESIGN FEATURES

Every presently known means for increasing the critical Mach number of this airplane has been employed in the design. The more important features employed to attain a high critical Mach number are wing and tail surface sweepback, choice of thin high speed airfoil sections, careful selection of wing loading, and smooth and clean surfaces with a minimum of protuberances.

Sweepback

Sweeping back the wing and tail surfaces is one of the most effective methods of increasing the critical Mach number. The lift of a wing is produced from the component of air velocity traveling at right angles to the leading edge of the wing. A swept wing has a smaller effective component as shown in figure 6-1. Since the velocity of the effective air passing over the top of the wing is less on a swept wing than on a straight wing, the airplane can fly at a higher speed before reaching the critical Mach number. Swept forward wings would be just as effective as swept back wings in producing high critical Mach numbers; however, swept forward wings are seldom used because of stability, control, and structural problems which are more severe than those for swept back wings. The maximum lift of a swept wing is also less than a comparable straight wing. The decreased lift is not detrimental at high speed but it must be offset by the use of efficient flaps in order to have moderate takeoff and landing speeds. This is one of the main reasons why the airplane is equipped with large area fowler-type flaps. The swept wing, in conjunction with its flexibility, also helps to reduce the loads imposed on the wing and body structure at high speeds and gusty conditions. Swept back wings however have the disadvantage that sweepback tends to cause a stall progression from the wing tips to the root. This often results in a reduction of lateral control effectiveness due to separated flow over the ailerons. Adequate lateral control has been provided by using spoilers as well as ailerons.

Airfoil Section

The thickness ratio of a wing has an important bearing on its critical Mach number. When the thickness ratio of an airfoil section is decreased, the critical Mach number increases since the air flowing over the top of the wing travels relatively slower, thereby permitting higher airplane speeds before the wing critical speed is reached. Wind tunnel tests conducted on models show that the airfoil section at the root of the wing could be quite thick without reducing the critical Mach number. The airplane has a relatively thick airfoil section near the root of the wing and tapers down to a very thin section at the tips. The outstanding disadvantages of a thin airfoil section as compared to one with more thickness are that there is less space in the wing to house fuel and equipment, a heavier structure is required because of the decreased beam depth of the spars, and the maximum lift is lower.

Wing Loading

The critical Mach number of a wing generally increases as the angle of attack is decreased. This follows from the fact that the increase in air velocity over the upper surface is proportionately less at low angles of attack than at high angles of attack, thus the airflow reaches sonic velocity at a higher airplane speed. The load carrying ability of a wing varies almost directly with both the angle of attack and the wing area at a given speed and altitude. If a decrease is made in the angle of attack for a given combination of speed, altitude, and weight (for purposes of decreasing the compressibility drag), a corresponding increase must be made in the wing area (decreased wing loading). Increased wing area however will cause additional friction drag as well as require a heavier structure. Therefore, a compromise was necessary in order to achieve the optimum configuration from all considerations.

STALLS

The stall characteristics of the airplane will vary with wing flap extension and drop tank installation. The following stall characteristics can be expected:

1. With flaps extended and no drop tanks installed, there is little or no stall warning speed margin. Buffet of the flaps when the stall is approached will mask airplane buffet. At stall, the airplane will tend to fall off on one wing. This fall-off can be stopped by applying forward pressure on the control column and full lateral control.
2. With flaps extended and drop tanks installed, a fair amount of stall warning will exist. The stall is preceded by a mild buffet approximately 5 to 10 knots above the stall, increasing to strong buffeting at the stall.
3. With flaps retracted and with or without drop tanks installed, the initial buffet occurs at approximately 10 to 15 knots above the stall.
4. There is approximately 30 knots difference in the stalling airspeed depending upon whether the flaps are extended or retracted. The use of airbrakes has a negligible effect on the stalling speed but full airbrakes will cause the initial buffet to occur at an airspeed approximately 2 to 4 knots higher than if no airbrakes are used.

PRACTICE STALLS

Practice stalls may be executed without difficulty provided the following procedures are observed:

1. Gross weight does not exceed 300,000 pounds.
2. A minimum altitude of 20,000 feet above terrain. If clouds exist between the airplane and the terrain, the airplane will be at least 10,000 feet above the tops of the clouds and a minimum of 20,000 feet above the terrain.
3. Extend flaps and reduce thrust to slightly above idle. Allow the airplane to slow down while holding approximately a constant altitude. Engine thrust has no effect on the stall characteristics or stall speed but if high thrust settings are carried in the stall approach, fairly large rates of climb will occur as the airplane is decelerated and the stall will occur at a large nose up attitude.

WARNING

As the airplane is decelerated in the stall approach, it is essential that it not be trimmed to speeds below best flare speed. The stall and recovery should be made using elevator control only. Trimming the airplane to speeds below best flare speed may make recovery more difficult and the use of stabilizer trim in the stall recovery may result in overcontrolling with resultant steep nose down attitudes, excessive speed buildup, and altitude loss.

4. Below best flare speed, continue to decelerate the airplane using back pressure on the wheel. The amount of wheel force and column movement needed to stall the airplane will vary with cg position. More force and column deflection is required for more forward cg positions. Maintain a wings level attitude with lateral control. Fairly large and rapid lateral corrections will be required as the stall is approached. It is not recommended that rudder be used to hold wings level

since the airplane response to rudder is quite slow and it is almost impossible to avoid getting out of phase with the airplane and exciting rather than correcting the motion.

5. With flaps down and no drop tanks installed, there is only 1 or 2 knots stall warning and this can easily be masked by the flap buffeting if the engines are above idle thrust. The stall is characterized by a mild pitch-up and a strong but not violent roll-off. The roll can be stopped by use of full aileron and rudder but the wing usually cannot be raised until the stall is broken. The stall should be terminated by rapid full forward wheel which should be held until the nose drops through the horizon.

6. With flaps down and drop tanks installed, there will be approximately 10 knots stall warning in the form of buffeting which increases as speed is reduced. At the stall there will be fairly heavy buffeting and the pitchup and roll-off tendencies will be much less than without tanks. The stall recovery is performed in the same manner as in the stalls without drop tanks.

WARNING

Under no conditions should an attempt be made to carry a stall to completion by holding the wheel back until the nose falls through the horizon. Any such attempt will result in severe buffeting and could easily result in roll-off to airplane attitudes from which recovery would be difficult or impossible.

7. If practice stalls are performed in the flaps up configuration, the procedure is the same as for flaps down stalls. About 10 knots stall warning will occur if drop tanks are not installed and about 15 knots with drop tanks installed. The buffet intensity will increase as speed is reduced below initial stall warning. There may be a mild roll-off without tanks but there is generally no tendency for a wing to drop with the tanks installed. The stall should be terminated when the wing drops or before heavy buffet is reached.

WARNING

No attempt should be made to carry a flaps up stall to completion by holding the wheel back until the nose falls through the horizon. Any such attempt will result in violent buffeting and can result in damage to the airplane equipment or structure, particularly any components of the bombing navigational system which are installed.

8. Accelerated stalls can occur at any speed as a result of pulling excessive "g's" in turns or pull-ups. Generally they are similar to unaccelerated stalls except that speed and altitude changes occur much faster. An accelerated stall will occur if the airplane is placed in a stalling angle of attack during a pull-up or turn at any speed higher than 1 "g" stalling speed. As a rule at normal cg's, if the airplane is trimmed for 1 "g" flight, sufficient elevator control is available at high altitudes to produce an accelerated stall at any speed. At low altitudes, the elevators must be augmented by stabilizer trim and, in some cases, the wing structural limits are exceeded to obtain an accelerated stall. Approaches to accelerated stalls requiring flight in the strong buffet region can be safely executed and may be necessary in escape maneuvers at high altitudes. Complete stalls while pulling "g's" are not recommended for the following reasons:

a. The drag associated with accelerated stalls will result in rapid speed and altitude changes.

b. Loss of accurate orientation due to the extreme attitudes which can occur during and following an accelerated stall may delay recovery or jeopardize control of the airplane so that considerable altitude will be lost in the maneuver.

c. The strong buffeting encountered will have adverse effects on the airplane structure and equipment.

d. If the accelerated stall occurs at Mach numbers well above the low speed stall, the airplane can accelerate beyond the flight placards during recovery. Close monitoring of airplane attitudes in turns should be observed to avoid pitchup into inadvertent accelerated stalls.

STALL OR CONTROLLABILITY CHECKS

Under some unusual airplane configurations or conditions, it may be desirable to conduct a stall check or controllability check of the airplane prior to landing. A check of the stalling speed should be made if the accuracy of the pitot-static system is seriously in doubt or if the fuel quantity indicating system becomes inoperative resulting in an unknown landing gross weight. If the airplane sustains damage or has a control system malfunction which makes controllability doubtful, control characteristics should be determined at a safe altitude prior to descent for landing. It is recommended that a minimum altitude of 10, 000 feet above the terrain or cloud cover be used for these checks. At these altitudes, the initial buffet speed will be increased, compared with those shown in figure 2-17, by a factor of 1% per 5000 feet for altitudes above 10, 000 feet pressure altitude.

WARNING

When any controllability check is made due to doubtful control characteristics of the airplane, the airspeed should not be reduced below the best flare speed for the airplane configuration in which the check is to be made. Under these conditions, the check should be discontinued immediately if any buffet or control problem is encountered.

Determination of Stalling Speed

If the airspeed indicators are suspected of giving inaccurate readings or if the fuel quantity gages are inoperative, a check of the initial buffet speed should be made at an altitude of 10,000 feet above the terrain or cloud cover and the resulting speed compared with the appropriate (flaps up or down; drop tanks on or off) initial buffet curve on figure 2-17. In this manner the increment in stalling speed can be found and applied to the landing speeds data. If the gross weight is unknown, comparing the initial buffet speed found with that shown on the charts will give the approximate gross weight directly. If the landing is to be made in a short period of time, this weight should be used to compute the landing data; otherwise, the anticipated fuel consumption between the stall check time and the landing time can be subtracted from the weight found by the check.

Determination of Airplane Controllability

REDUCED LATERAL CONTROL OR LATERAL UNBALANCE. In case of reduced lateral control or of lateral unbalance, a control check may be made at an altitude of 10,000 feet above the terrain or cloud cover by putting the airplane in the landing configuration and slowing it to the best flare speed shown on the "Landing Speeds" charts in Part 9 of the applicable Appendix. As the best flare speed is approached, care must be taken to avoid slowing the airplane to a speed at which full lateral control is required to keep the wings level. If control problems are encountered at a speed higher than best flare speed, the speed at which control is considered adequate should be noted. The landing approach should be made at 20 knots higher than the noted speed. This speed will allow the same maneuvering capabilities as the speed for a normal approach provides under normal conditions.

REDUCED LONGITUDINAL CONTROL OR LONGITUDINAL UNBALANCE. In cases of reduced elevator and/or stabilizer trim control or of longitudinal unbalance, a control check may be made at 10,000 feet by putting the airplane in the landing configuration including airbrakes at position 2 and cautiously slowing the airplane to best flare speed. If the lowest speed at which the available stabilizer trim will hold the airplane level without aid of the elevators is above best flare speed, the trim speed should be noted. The landing approach should be made at 10 knots above this noted speed. The margin will allow sufficient elevator control for the flare but the landing approach should be made as shallow as possible in order to minimize the amount of flare required for landing. Power should not be reduced until after completion of the flare.

AIRPLANE DAMAGE. In cases where the airplane has been damaged (such as damage to the wing leading edge, to the control surfaces, or with asymmetrical wing flaps) so that both controllability and stalling speed could be affected, a controllability check should be made prior to landing. The altitude for this check will depend on the extent of damage sustained. In any case, an altitude below 10,000 feet above the terrain or cloud cover is not recommended. The airplane should be slowed to the minimum speed at which the pilot feels he has adequate control. This speed should not be lower than the speed at which the first indications of buffet are felt. If a pressure altitude above 10,000 feet is used, the airspeeds (for landing) found during the check may be reduced by 1% for each 5,000 feet above 10,000 feet that the check is made. The landing approach should be made at 20 knots above this speed.

SPINS

WARNING

- Intentional spins are prohibited.
- The B-52 is critical in body side loading at high sideslip angles and the possibility of aft fuselage and empennage failure is almost certain for the fully developed spin condition. In the event of structural failure, emergency egress must be accomplished immediately.

The ability of an airplane to spin is dependent upon cg location, distribution of mass, basic aerodynamic configuration, and control deflections. Forward cg's tend to make spinning more difficult while aft cg's promote spinning. Extended gear and/or flaps have no appreciable effect on spin recovery; however, extended gear will reduce speed buildup during dive recovery after spin rotation stops. In a developed spin, an indicated airspeed of approximately 200 to 220 knots can be expected. The pilot should not interpret this as sufficient flying speed but should make certain that angle of attack is reduced to less than stall angle during recovery.

STANDARD SPINS

In case an inadvertent yaw or roll is encountered at low indicated speed, corrective rudder and lateral control plus nose down elevator should be immediately applied. In case a spin is entered accidentally, apply full opposite rudder immediately followed by forward stick to reduce angle of attack with neutral lateral control. Apply nose down trim and close the airbrakes if they are extended. Reduce throttles to idle. Extend the gear. To augment the rudder, apply throttles asymmetrically to develop thrust against the spin. As spin rotation stops, set all throttles in idle and neutralize rudder. Recover from dive attitude by retrimming. If excessive nose down trim was introduced during the spin re-

covery, airbrakes may be extended as required to effect recovery from the dive attitude.

NOTE

The airbrakes will give the fastest pitch control possible but should be used judiciously and in conjunction with the elevators and elevator trim so that design limit "g" forces are not exceeded and buffeting is not reencountered. The airbrakes in the up position produce maximum drag to reduce speed buildup in the steep nose down attitude required to reestablish airflow across the wing. Recommended dive recovery procedures apply following spin stop.

INVERTED SPINS

Recovery from an inverted spin must be accomplished by the least structurally hazardous method. Full rudder and lateral control against the spin must be applied and held until rotation stops and a zero "g" roll made to "right side up." Airbrake throttle and gear utilization should be accomplished as noted above. A dive recovery then must be made following recommended procedures.

FLIGHT CONTROLS

FLIGHT CONTROL SYSTEM COMPONENTS

The flight controls on this airplane have been designed to provide a system that will give the airplane good flying qualities at all speeds, altitudes, and airplane weights, as well as small control forces for these same conditions. Weight has been saved and safety of operation has been increased by the elimination of power boost on all of the primary controls, except the lateral control spoilers. The flight controls are quite unique in that the rudder and elevator are only 10% chord surfaces (in other words, the chord of the control surface from hinge line to trailing edge is 10% of the chord of the horizontal or vertical stabilizer). On high speed aircraft, weights must be added to properly balance the control surfaces. By using short chord empennage control surfaces, less weight is required for balancing purposes. It is possible to use a short chord elevator because an adjustable stabilizer is used to provide longitudinal trim. The short chord rudder will adequately handle the yawing moment due to asymmetrical thrust which results from the failure of an outboard engine. The inboard location for the ailerons was dictated by the wing flexibility. With the aileron located out near the wing tip on a flexible wing, the controls reverse at the higher speeds.

Tab Characteristics

The elevator, ailerons, and rudder are positioned by tabs rather than by direct push-pull rods or cable systems. Tabs have been used primarily because they make it possible to obtain good control force characteristics at all speeds. The tab system also results in a weight saving for such a large airplane as compared to other systems involving power boost. Basically, the tab is used to vary the pressure distribution on a control surface so that the surface will float in a deflected position, thus changing the lift on a wing or empennage. Actuation of a small tab, with very little effort from the pilot, produces sufficient lift in the opposite direction to balance out the lift produced by the control surface. For instance, for one particular control position and one airspeed and altitude, the control surface and tab will balance out and become free-floating at one unique setting.

Tab Followup Ratio

Tab followup ratio is used on the elevators and rudder. The elevators have a followup ratio of 1:1, while the followup ratio between the rudder stability tab and the rudder is -1/2:1. Followup ratio is defined as the ratio of the tab deflection angle to the control surface deflection angle where the tab deflection is caused by the surface deflection with the pilot's controls held fixed. Using the elevators as an example, by holding the control column in a fixed position, movement of the elevator trailing edge upward 10° will also cause the elevator tab to move upward 10° relative to the elevator. Or, if the elevator is moved upward 15°, the tab will also move 15° upward relative to the elevator. If the followup ratio were 2:1, then a 5° movement of the elevator would result in a 10° movement of the tab relative to the elevator. During flight, the pilot moves the control column which causes the tab to deflect. This results in a corresponding movement of the control surface until the tab deflection and control surface deflection balance out aerodynamically. Again considering the elevator with a 1:1 followup ratio, assume the pilot pulls back on the control column to one fixed position such that the elevator tab is deflected downward to an angle of 10°. (This actually would not occur since the elevator would start to move before the tab would get to the 10° position.) This tab movement would cause the elevator to start moving upward. When the elevator reaches 2°, the tab would back off to an angle of 8° relative to the elevator. At a 4° elevator deflection, the tab relative angle would be 6°. At increasing elevator deflections, the tab relative angle decreases to a point where the hinge moments balance out and no further deflection of either surface will occur for one set of conditions. This relative position is variable for airplane altitude, airspeed, and gross weight.

Tab Systems and Functions

ELEVATOR AND RUDDER CONTROL TABS. The control tab used on the elevator and rudder is positioned relative to the control surface by a direct cable system from the pilot's controls. Normally the pilot can only move the control surface through the hinge moments developed by the tab. On the elevator however, the pilot can move the control surface directly if the tab reaches its limit of travel before the elevator reaches its limit. This will occur, for example, on the ground when the tab has no aerodynamic effect.

AILERON TABS. The type of control tab used on the ailerons is similar to the one described above except that no followup ratio is used. Aileron centering is accomplished by a torsion rod which is connected to the control cable system in the pilot's compartment. The purpose of this torsion rod is to center the pilot's control wheel which in turn centers the aileron control surfaces. Additional control forces over and above those produced by aerodynamic forces on the control tab result from deflection of the torsion spring as the control wheel is turned to deflect the control tab. The aileron trim and balance tab is connected by a link between the tab and the airplane structure. The tab deflection relative to the aileron is thus determined by the aileron deflection relative to the wing structure. The linkage is so adjusted that the tab aids the aileron deflection.

RUDDER STABILITY TAB. The rudder stability tab is basically a control tab which is primarily controlled by a bob-weight for small deflections and by the pilot for large deflections. The purpose of this installation is to damp out airplane lateral oscillations (Dutch roll) that might be caused by gusts or other disturbances. A damping device is required on this airplane because the combination of swept wings and the low indicated airspeeds encountered at high altitudes provides much less natural aerodynamic damping than that of more conventional straight wing airplanes operating at lower altitudes.

Yaw Damper

OPERATION OF YAW DAMPER. The yaw damper consists of a bob-weight that is free to rotate about a nearly vertical axis. A bob-weight is linked to the stability tab so that the tab will drive the trailing edge of the rudder in the opposite lateral direction from that of the bob-weight; that is, a left displacement of the bob-weight would cause a right rudder deflection. Thus, the mass of the bob-weight acts like additional mass overbalance on the rudder. Some centering of the stability tab is accomplished as a result of the bob-weight axis being canted 15° from vertical so that the bob-weight exhibits pendulum stability in coordinated flight. Damping is introduced into the bob-weight motion by an eddy current device consisting of magnets on the bob-weight which traverse a copper or aluminum plate attached to the airplane structure. Damping is produced by this device because the moving magnetic flux lines induce electrical currents (eddy currents) in the copper or aluminum plate which in turn develop a magnetic field tending to oppose the motion of the magnetic field associated with the magnets on the bob-weight. The eddy currents and their magnetic fields are proportional to the velocity of the bob-weight magnets so that the device produces velocity or viscous damping. This same principle is used to operate the common watt-hour meters which are used to measure electrical energy in homes. On aircraft SY, an electromechanical yaw damper has been installed to provide increased positive damping to lateral-directional (Dutch roll) oscillations for all flight conditions. It works in parallel with the magnetic yaw damper and senses the yaw rate of the aircraft through a rate gyro. A signal from the rate gyro drives a servo motor which in turn drives the bob-weight. The bob-weight is connected to the stability tab in the normal manner.

NOTE

With the electromechanical yaw damper engaged, aggravated dutch roll may be encountered if the signal from this subsystem is lost. Loss of this signal locks the yaw damper and it will remain inoperative until the yaw damper switch is placed in OFF position. With the yaw damper switch in OFF position, the existing magnetic yaw damper will function normally. When an electromechanical yaw damper malfunction is suspected, place yaw damper switch to OFF position and note results. If dutch roll conditions improve, leave yaw damper switch OFF until the cause can be isolated and corrected. If dutch roll conditions worsen, indicating that the system is functioning, turn yaw damper switch ON.

For additional information, see "Electromechanical Yaw Damper" under "Automatic Flight Control System," Section IV.

EFFECT OF YAW DAMPER. The effect of the yaw damper on the motion of the airplane is most easily understood by considering a simplified installation that would produce the same results. The magnetic bob-weight damper could be replaced by a heavily massed

overbalanced rudder (nose heavy). It should be pointed out that this type of rudder would not be practical for two reasons: 1) a great weight penalty would be incurred in order to obtain the required overbalance and 2) the damping would interfere with the normal use of the rudder. The damper is designed to be effective in coupled oscillations consisting of yaw, roll, and sideslip, all of which are present in the airplane response to a disturbance but, for simplicity, only a yawing oscillation of the airplane will be considered. The inertia force on the undamped rudder causes the rudder to be deflected in such a manner that it will force the yawing motion during one half of a cycle and oppose the motion during the other half. The addition of damping causes the rudder motion to be out of phase with the airplane motion so that the rudder will oppose the airplane motion for more than one-half of each cycle. The damping and overbalance could be adjusted to an optimum so that this rudder action would effectively stop all airplane oscillation in a very short time and also limit the peak amplitude. This is the same result that is actually produced by the bob-weight damper acting on the rudder through the stability tab.

Aerodynamic Balance

SIMPLE AND COMPOUND BALANCES. Sealed gap aerodynamic balances are used on the elevator, ailerons, and rudder. These balances are of two types: One consists of a simple nose overhang area and the other has a compound balance area consisting of hinged plates to augment the nose overhang. Aerodynamic balance is used to reduce the normal control surface hinge moments that result from a surface deflection and thereby, through this action, assist the pilot in making maneuvers with less control force. This action is accomplished by venting each side of the balance area to the free airstream on opposite sides of the control surface. The pressure differential on the balance area which exists when a control surface is deflected then causes a moment that reduces the normal control surface hinge moment.

HINGE MOMENT REGULATORS. A slight modification to the compound aerodynamic balance is used on part or all of the aerodynamic balance panels on the airplane. Such additions, called hinge moment regulators, are used for varying the effectiveness of the compound aerodynamic balance at various deflections so that a near linear hinge moment curve can be obtained. This is done by controlling the airflow between the two sides of the balance area which controls the pressure differential and thus the load developed on the balance panel. Weights are added to the nose section of the

Figures 6-2 through 6-8 deleted

balance panels and a slight amount of static overbalance is used on all of the control surfaces in order to avoid any surface instability such as flutter or buzzing.

FAILURE OF AERODYNAMIC BALANCE SYSTEM. All aerodynamic balance panels are sealed by a rubberized fabric. In case this sealing material becomes ruptured, wears out, or is damaged in such a way that a good seal is not maintained, the aerodynamic balance becomes ineffective. If such a condition occurs, it will be readily apparent to an experienced pilot in the form of increased control forces. A larger tab deflection angle will also be required to produce the same amount of response since a smaller boost will be obtained from the aerodynamic balance panel. Any change in control forces or control system operation which are noted should be reported on Form 781 so that a thorough inspection can be made of the balance panels and seals.

Gust Damper

Built-in gust dampers are used to protect the control surfaces rather than mechanical gust locks. The gust dampers are used because the controls cannot be inadvertently locked, damage cannot result from a failure to use gust locks, and the dampers are more practical because the surfaces are tab controlled with no direct link to the control cabin. The gust dampers are similar to automobile shock absorbers in their action. They are effective in gusts up to 65 knots and allow 10° of free control surface travel in both directions before acting so that there is no appreciable interference with a normal control operation.

Q-Springs

Any high speed airplane which had very light control forces at high speeds would be very dangerous since it would be relatively easy for the pilot to make such large and rapid control surface deflections that the control surface mounting structure would be overstressed. The direct use of control surface and tab hinge moments as the only source of pilot's control feel is unsatisfactory because this requires that the control surfaces be very closely balanced at all speeds and control surface deflections to obtain reasonable control forces and gradients. Since this approach is not satisfactory from a design and weight consideration, an artificial feel system using a ram air pressure bellows (commonly called a Q-spring) has been added to the rudder and elevator control system to give the pilot the desired control forces for the specific conditions needed throughout the speed range. This Q-spring is essentially a bellows under pressure from the ram air taken from a pressure source at the leading edge of the fin. Use of ram air as the pressure source provides part of the increase in control forces required to aid the pilot in limiting flight maneuvers at high speeds and to stay within the structural limits of the airplane. The desired feel characteristics (pilot force with respect to control deflection) have been obtained by proper design of the linkage between the Q-spring and the control system. As with any airplane, there is a practical limit to the control force which can be added without causing excessive control forces for normal operations. For this reason, no violent reversal of control should be made at high indicated airspeeds since it is still possible under these conditions to overstress the airplane structure even with the Q-spring installed. The rudder system makes use of two Q-springs while the elevator control system makes use of one Q-spring plus a tension spring. The tension spring was added to the elevator control system to assist in centering the elevator at low indicated airspeeds. No Q-spring is installed in the aileron control system since feel and centering characteristics are introduced by the tab hinge moments and by the installation of a torsion bar in the control system as explained under "Tab Systems and Functions," this section.

CAUTION

- Malfunction of the Q-spring system, either due to the inlet being plugged by icing or loss of ram pressure for other reasons, can result in loss of control forces. At any time abnormally light control forces are encountered in the elevators or in the rudder, abrupt maneuvers should be avoided so as not to structurally overload the airplane.
- If, at any time, abnormally stiff controls are encountered and icing is suspected, descend to a warmer altitude. Icing or other blockage of the ram air duct can result in a pneumatic lock of the artificial feel system.
- If a landing must be made with stiff controls, see "Elevator Control Malfunction" under "Flight Control System Emergency Operation," Section III.
- After disengagement of the autopilot, either automatically or manually, while operating in or after leaving an icing condition, check the elevator and rudder systems for artificial feel.

NOTE

On airplanes RG, the installation of an additional tension spring will provide partial elevator feel in the event Q-spring pressure is lost.

Control Column Balance

Under certain flight conditions, unstable oscillations of the longitudinal (pitch) control system can be induced. These oscillations are divergent and if allowed to continue could result in undue stress and/or loss of control of the airplane. If such oscillations are encountered, a slight pull force on the control column with a reduction in airspeed will stop these oscillations. On airplanes QE balance weights are installed on each control column below the pivot point which automatically dampen such oscillations. In addition, some improved centering results from the pendulum action of the balance weights.

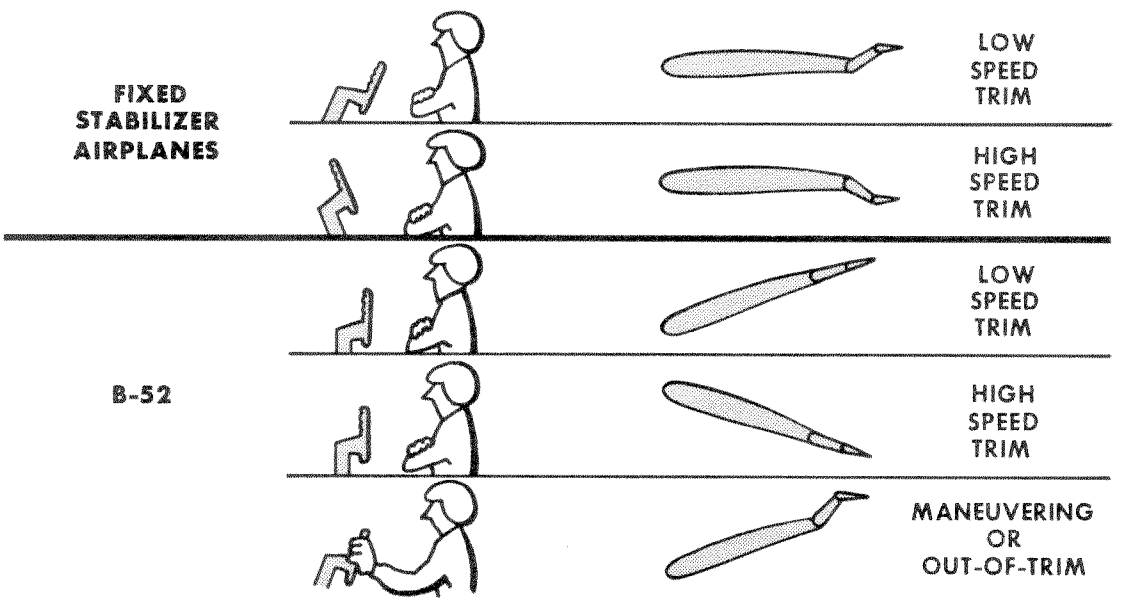
FLIGHT CONTROL SYSTEM CHARACTERISTICS

Pitch Control

Longitudinal control is provided by a 10% chord elevator located on the trailing edge of the stabilizer. The elevator is positioned by a control tab which is manually controlled by the pilot. Longitudinal trim is provided by an adjustable stabilizer. Actuation of the trim switch causes the stabilizer to move at the rate of 0.60° per second. The stabilizer may also be actuated by a manual trim wheel which results in 1° or 1 unit of stabilizer deflection for each revolution of the trim wheel. In either case, operation of the stabilizer trim system is accompanied by rotation of the manual trim wheel. Basically, the stabilizer is intended as a trimming device while the elevators are intended for maneuvering at a given speed and control for small speed changes. The elevators are adequate for maneuvering purposes and should be used whenever possible. In cases when the elevators cannot counter all of the trim changes occurring, such as when using gear, flaps, and airbrakes, the stabilizer may be used to augment the elevator control. In general, use of the stabilizer as the primary control is not considered desirable. More specifically, use of the stabilizer as the primary control in steep turns is undesirable because in turn recoveries, the elevators cannot counter the combined pitchup used to establish the turn and the pitchup moment produced from the lateral control spoilers.

Pitch Control Systems

To better understand the difference in trim technique between a fixed stabilizer airplane and this airplane, it is first necessary to establish one fact: When any airplane is flying in trim, it is maintaining a desired attitude or flight path. This does not necessarily mean that the airplane is trimmed out and flying hands off, but that the control surfaces are positioned so as to obtain the desired results. This does imply however that attitude must first be known to properly place any airplane in trim. An airplane having a fixed horizontal stabilizer is placed in trim by the pilot positioning the elevator with the control column to maintain the desired attitude as shown in figure 6-9. Any forces the pilot might be holding on the control column can be eliminated by means of the trim system but the control column and elevator remain in their original position. The pilot can detect the operation of the trim system by a lightening of forces as control column position is held

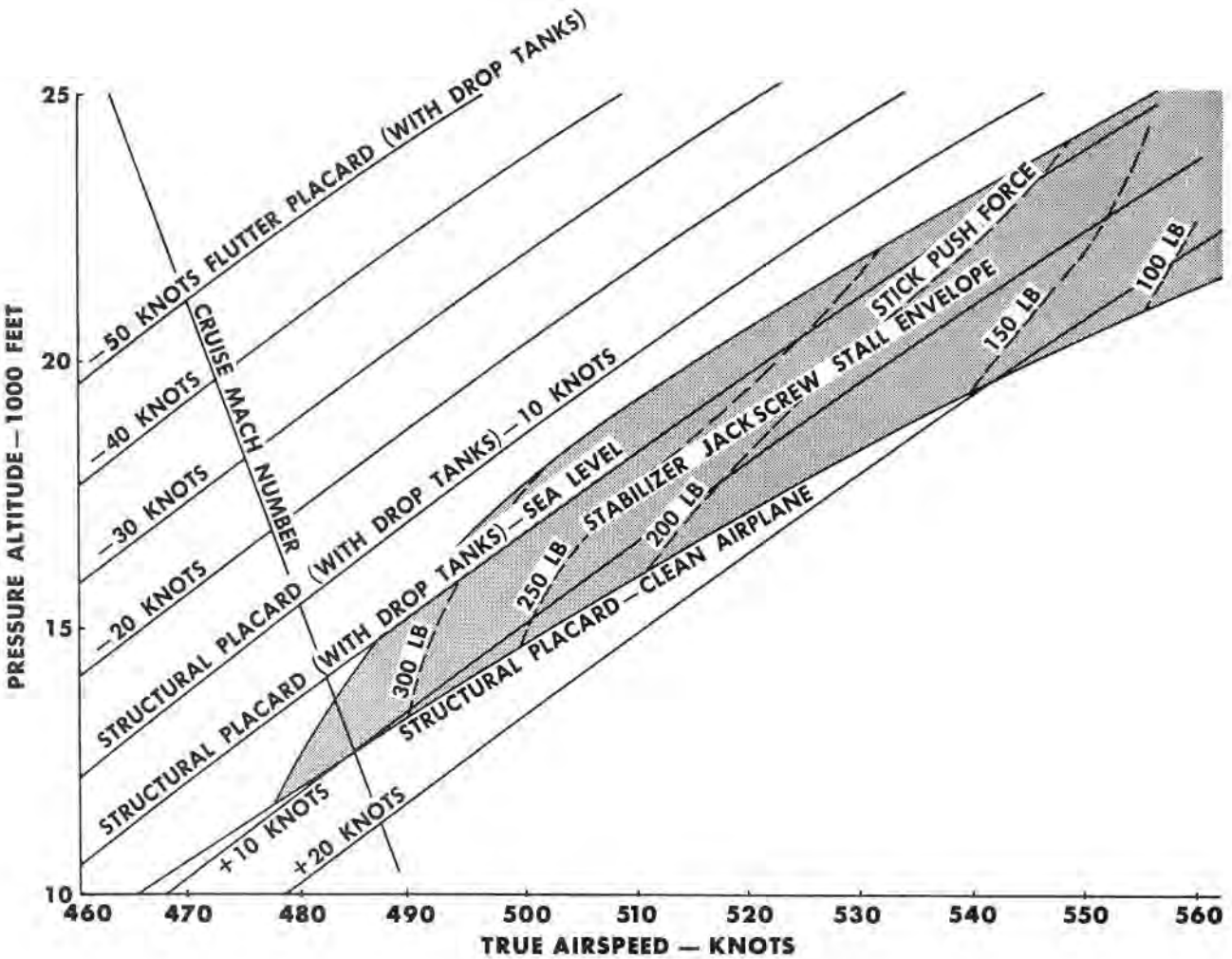


pitch control systems

Figure 6-9.

constant. This airplane is placed in trim by the pilot positioning the elevator through the control column and control tabs. When the stabilizer is moved to relieve the force being held, the pilot detects the movement by a change in attitude rather than a reduction of force and must allow the column to return to neutral to prevent an attitude change and realize a force reduction. This airplane can only be in hands-off trimmed flight when the control columns are neutral and the elevators are faired with the horizontal stabilizer as shown in figure 6-9. To sum it up, holding a constant control column position while trimming results in a change in attitude with no change in force; but in a fixed horizontal stabilizer airplane this results in a change of force with no change in attitude. This difference in trimming must be thoroughly understood for safe operation of this airplane.

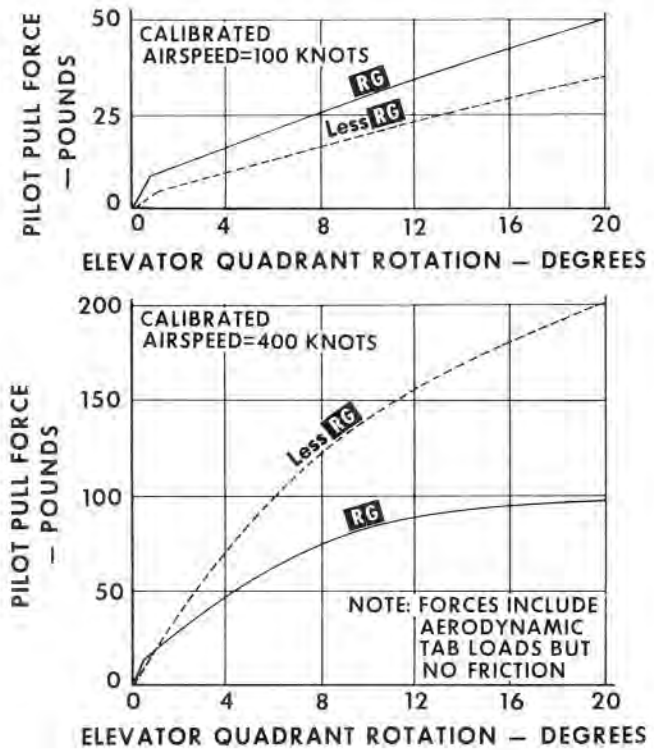
STABILIZER JACKSCREW CAPABILITY. The structural limits of the horizontal tail and its components will not be exceeded when operating within the flight placards of the airplane; however, it is possible to exceed the operating capability of the jackscrew hydraulic mechanism within the small area shown in figure 6-10 if abnormal trim procedures are used. The stabilizer jackscrew mechanism is stalled because of the high



stabilizer jackscrew stall limits

Figure 6-10.

forces imposed on it due to abnormal trimming. This takes place only at speeds very near the structural placard speed when large push forces are held on the stick by the pilot. The push forces that need to be held are abnormally large, from 100 to 300 pounds, as shown on figure 6-10. The jackscrew cannot be stalled by a pull force under any circumstances. In case the airplane is in this very unusual condition (near the placard airspeed with large push stick forces), the pilot can do one of two things to free the stabilizer hydraulic trim mechanism. One is to momentarily reduce elevator deflection while operating the trim button which reduces the force on the jackscrew and allows the mechanism to start. The other is to momentarily reverse the trim mechanism by operating the button in the wrong direction before pushing it in the correct direction which relieves friction and allows starting against a higher load. If placard speeds are inadvertently exceeded, the airplane must be kept trimmed as closely as possible with the stabilizer, thereby keeping the required elevator deflections to a minimum.



comparison of elevator control forces

Figure 6-10A.

ELEVATOR FEEL CHARACTERISTICS. The elevator feel force required to accomplish a maneuver varies with control column deflection, airspeed being flown, and the control tab hinge moments produced. The major contribution to stick forces is produced by the Q-spring with secondary forces being contributed by a mechanical spring and tab hinge moments. On aircraft QE, some centering force results from the pendulum action of balance weights on the control columns. On aircraft RG, an additional mechanical spring is installed to produce a more positive centering of the elevator controls. As a result of this change, pilot effort required to maneuver the aircraft is increased at low airspeeds and decreased at high airspeeds with improved centering at all airspeeds (figure 6-10A). During the landing flare on aircraft RG, a mistrim condition will become apparent sooner, requiring more use of stabilizer trim to maintain stick forces near zero. The outboard sections of elevators have a simple type of aerodynamic balance while the inboard sections have the compound type of balance. The compound balance area is equipped with hinge moment regulators. This type of regulator contains holes in the balance area that are open at low elevator angles and are closed off by plugs at large angles. The purpose of these regulators is to make certain that there is no reversal of elevator hinge moments throughout the elevator deflection range. At the same time, the regulators maintain a desirable relationship between control column and control surface deflection in order that the Q-spring can provide proper feel characteristics. The elevator control force necessary to pull a maximum "g" loading, by performing some normally executed maneuver, is approximately 20 to 40 pounds. Elevator control forces as high as 80 to 100 pounds may be encountered either at heavy weights with forward cg locations or at light weights where higher "g" loading is permitted. At low airspeeds, the pilot can obtain full nose up elevator without encountering excessive stick

forces. Under this condition, the use of stabilizer trim is necessary to maintain a safe airplane attitude since high stick forces are not present to warn the pilot of loss of elevator authority. On aircraft RG, increased trim stimulus is provided at low airspeeds through higher stick forces. In the event Q-spring pressure is lost, the increased tension provided by this added mechanical spring will provide partial feel.

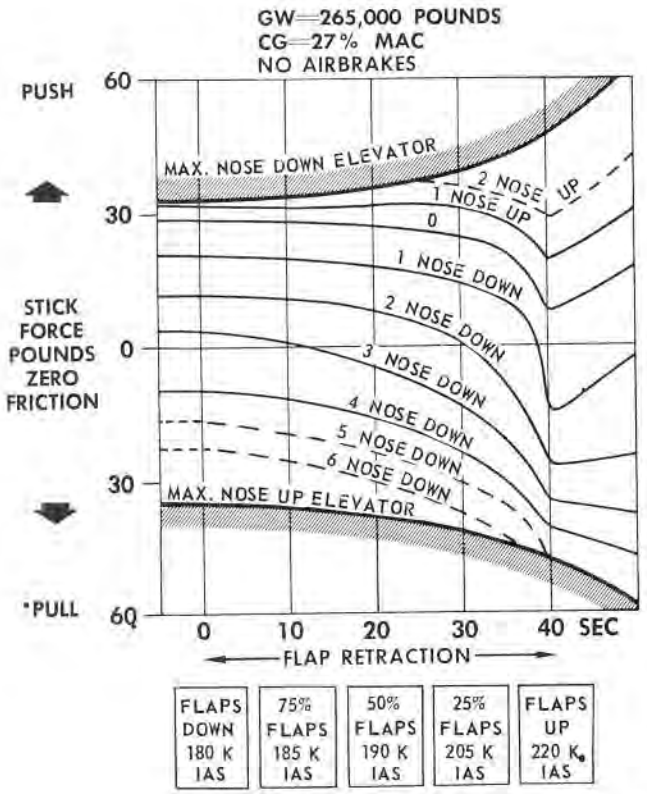


Figure 6-11.

CAUTION

RG

More trim action will be required to maintain stick force levels comparable with an unmodified feel system. The increase in force level is especially noticeable in the landing flare condition when the flare is attempted by use of control column only. The significant difference between this system and the unmodified system during low speed operation is that the forces required to maneuver the aircraft in a mistrim condition are higher than those previously experienced. While becoming familiar with the modified feel system, it will be necessary to maintain closer attention to trim requirements during the takeoff and landing phases of operation.

ELEVATOR EFFECTIVENESS. The elevator effectiveness is sufficient to adequately maneuver the airplane under all conditions for which trim is established by the stabilizer. The elevator is also sufficiently effective to permit the airplane to be landed by means of the elevator system alone should the stabilizer actuating system become inoperative within its normal operating range. In case the stabilizer trim becomes inoperative while set at a large airplane nose down position, a full flare landing probably could not be made, but adequate control could be maintained to accomplish a safe landing. If the airplane is not kept in proper trim during the last 20% of flap retraction, the elevator may lose its authority. Simultaneous application of nose up trim and full up elevator will make recovery smooth and immediate. See figure 6-11 for an illustration of stick force at various conditions of trim versus flap position for a typical airplane. The elevator authority limit is also shown.

NP

A row of vortex generators on the upper and lower surface of the stabilizer increases the energy of the air in the boundary layer which passes over the elevators. This change increases the maximum elevator authority especially in low speed flaps down flight. With the vortex generators installed, the elevator authority is equivalent to 6.6 units nose up trim and 4.0 units nose down trim, flaps down. This is an improvement in elevator authority due to the vortex generators of 3% nose up and 25% nose down.

WARNING

When holding full nose up elevator, the pilot must be certain that he is engaging the trim button in the nose up position. Due to the position of the control column, he may be pushing in on the trim button or down on the trim button guard.

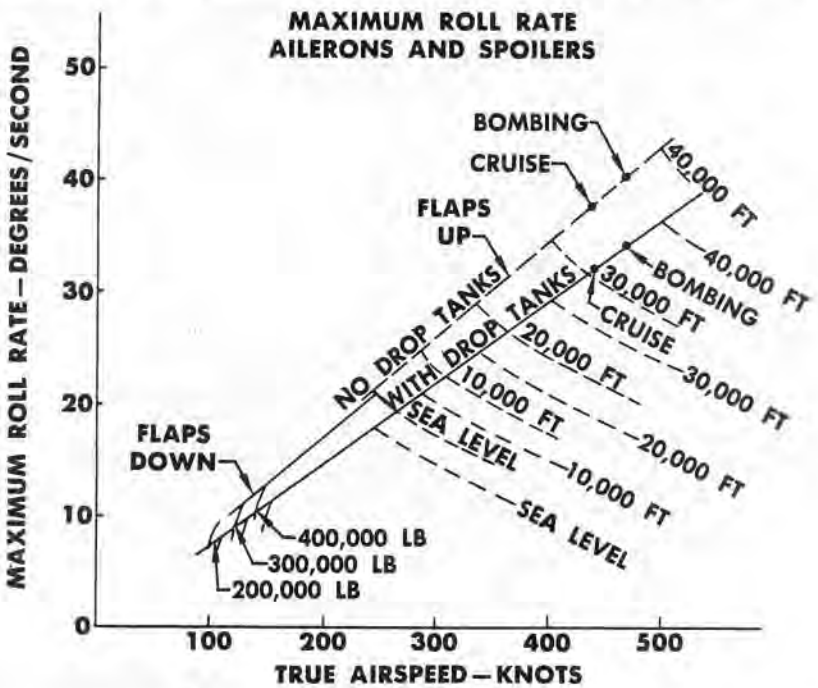
STABILIZER TRIM FAILURE. See "Flight Control System Emergency Operation," Section III, for detailed instructions pertaining to stabilizer trim failure.

Lateral Control

Lateral control is provided by one aileron and seven spoiler segments on each wing. The maximum roll rates that can be generated at various true airspeeds and altitudes are given in figure 6-12. At normal operating speeds and altitudes, roll rates are quite high. Care should be exercised that roll corrections during instrument flying under these conditions are not excessively applied nor in the wrong direction. The highest roll rates at any altitude will occur at approximately 250 knots IAS. Beyond this speed, hydraulic pressure is insufficient to obtain full deflection of the spoilers so that roll rates will decrease. However, because of the midspan location of the ailerons and spoilers, roll rates will not decrease to zero. (Aileron reversal will not occur, at any speed.)

LATERAL UNBALANCE. During the landing operation, roll control can be marginal in at least one direction when large amounts of lateral unbalance exist. Figure 6-13 shows percent lateral control required to trim out lateral unbalance due to an asymmetric external tank condition where one tank has been jettisoned and the remaining tank is full. There is a minimum speed at which roll control can be maintained. As speed decreases below the point where more than 50% lateral control is required, the lateral control is used up rapidly. Lateral control can be augmented during such conditions through use of the rudder which will provide a sizeable rolling moment from the sideslip induced. It is not desirable during normal operations to deliberately enter regions where more than 50% of lateral control is required for lateral balance. Part 9 of the applicable Appendix shows minimum landing weight for various amounts of unbalance. This data is based on the use of not more than 50% lateral control and illustrates the advantage of higher touchdown speeds obtained by flaps up landings. Additional advantage can be gained through the use of airbrakes which will allow simultaneous contact of the landing gear at higher than normal touchdown speeds.

AILERON SYSTEM. The ailerons are positioned by control tabs which are manually actuated by the pilot. The ailerons are bussed together by a cable system in order to prevent a symmetrical up-float in level flight. The hinge moments developed on the tab as a result of tab and aileron deflections through rotation of the pilot's control wheel provide most of the pilot's control



.....maximum roll rates

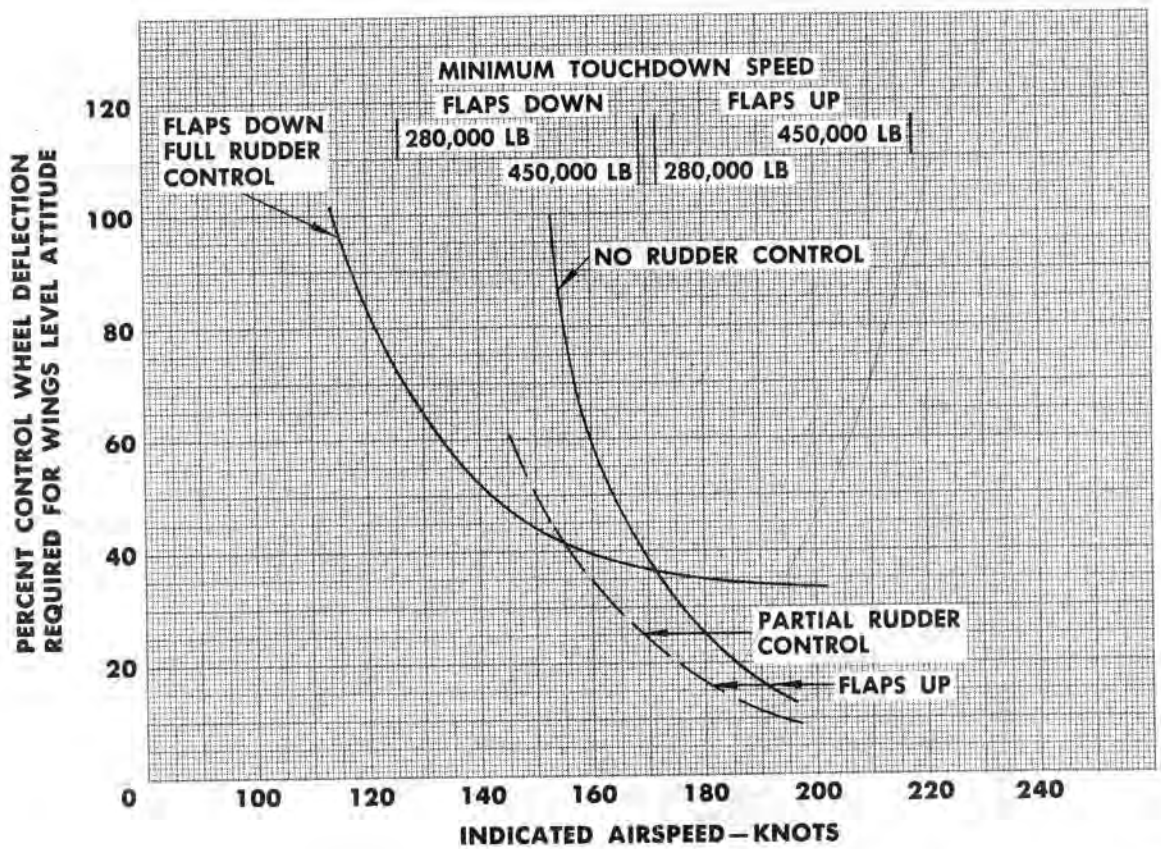
Figure 6-12.

force, with the remainder being supplied by the control wheel torsion bar. Simple aerodynamic balance with the addition of hinge moment regulators is used on each aileron.

SPOILER SYSTEM. Seven spoilers are provided on each wing, each having its own hydraulically operated actuator. The three inboard spoilers are interconnected and operate as one unit and the four outboard spoilers are interconnected and operate as one unit. The cable controls from the control wheels are so connected that approximately the first 4° of control wheel rotation will cause only the aileron control tab to move. Additional rotation of the control wheel above approximately 4° will give spoiler travel proportional to the additional wheel travel. Wheel travel of 80° will give full extension of the spoilers.

SPOILERS AS A LATERAL CONTROL DEVICE. The extension of spoilers on one wing decreases the lift produced by that wing and also increases the drag. The loss of lift on the wing with the spoilers extended causes it to rotate downward, thereby producing a rolling moment in that direction. The addition of drag causes a slight yawing motion in the direction toward the wing with the spoilers extended which assists the pilot in bringing the wing down or in starting a turn. No adverse yaw is produced by spoiler extension but the adverse yaw resulting from the rolling rate is noticeable. With application of roll control, a pitchup is induced directly proportional to the amount of spoiler deflection used. This pitchup is favorable during entry into a turn, but unfavorable in coming out of a turn. For large wheel deflections, the pilot will have to make small push corrections at the entry of a bank and large push corrections at the termination of a bank to prevent inadvertent nose high attitudes and pulling excessive "g's."

AIRBRAKES. All of the spoilers are also used as airbrakes. The extension of the airbrakes is controlled by an airbrake lever located at the pilot's station. In



lateral control required with one full drop tank

Figure 6-13.

the case of simultaneous actuation of spoiler and airbrake controls, the spoiler groups on the wing requiring spoiler action will rise to the angle called for by the spoiler control input plus the angle called for by airbrake control input up to the maximum. At the same time, the spoiler groups on the opposite wing will rise to the angle called for by the airbrake control input minus the spoiler control input. With airbrakes in position 6, a subsequent application of spoiler control input will result in a proportionate lowering of the spoilers on the wing which will rise and a proportionate raising of the outboard spoilers on the wing which will lower. A full application of the spoiler control will override the airbrake input to the extent of completely lowering the spoilers on one wing. Such action causes a maximum lift differential between the two wings resulting in a roll in the direction toward the wing producing the smallest lift.

NOTE

Application of airbrakes will tend to pitch the airplane nose up. The pitching moment produced by airbrake extension can be used to counteract an undesirable nose down airplane attitude.

SPOILER AND AIRBRAKE BUFFET. Flight testing with the spoilers and airbrakes in many different configurations and positions has been accomplished over the entire flight envelope of the airplane and no appreciable buffet has been encountered. Mild buffet will occur at position 2 or 3 with flaps up; therefore, position 4 should be used for all normal descents. At high altitudes, an abrupt buffet may be noted just as the spoilers begin to extend if the control wheel is rotated very rapidly, but this opening shock has no damaging effects.

CAUTION

- As the airbrakes are extended, a nose up pitching moment is produced. This pitchup tendency is more pronounced when the aircraft is in the clean configuration than when the flaps and gear are down. An increased pitchup tendency will occur when changing from position 2 to position 3 or 4. Therefore, to compensate for this pitchup tendency as airbrakes are extended, nose down elevator or stabilizer trim must be applied. The amount of corrective action necessary becomes larger with higher altitudes and higher indicated airspeeds. Full airbrake deflection at speeds up to 250 knots IAS requires nose down elevator equivalent to 50% of control column travel, or application of approximately 3.5° of nose down stabilizer trim. The airbrake lever should not be moved rapidly through its full travel since there will be an insufficient amount of stabilizer trim available immediately to fully compensate for the pitching moment produced. By moving the airbrake lever through not more than two positions, sufficient elevator will be available to counteract the pitching tendency and at the same time allow sufficient time for the stabilizer trim to keep up with trim requirements.
- If the airbrakes are up and are suddenly retracted, a pitchdown will result. If the trim system is operating normally, this pitch change can always be controlled. However, a simultaneous loss of trim and airbrakes during a descent could result in an uncontrollable maneuver. This is why the airbrake placard in Section V has been established. A possible loss of control of the airplane due to simultaneous loss of airbrakes and stabilizer trim may occur when using airbrake position 6 above 20,000 feet. Therefore, maintain a push force of 30 to 40 pounds on the control column, using stabilizer trim to keep the force constant during the descent.

SPOILER AND AIRBRAKE BLOWDOWN. At indicated airspeeds in excess of 250 knots, the air loads acting upon spoilers raised to the full up position (position 6) are greater than the force available from the spoiler actuators. Obviously, under these conditions, the spoilers will be unable to maintain the normal extension of position 6. This reduction of the spoiler or airbrake angle by air loads is termed "blowdown." The greater the speed above 250 knots IAS, the further the spoilers will blow down. For example, at the maximum airspeed without drop tanks (Section V), the maximum extension is reduced to approximately 20°. During blowdown, oil displaced from the hydraulic actuators exits through relief valves. Since it is difficult to adjust several relief valves to open at exactly the same pressure, blowdown may occur in one bank of spoilers sooner than in another. Such an occurrence will cause a rolling moment to be applied to the airplane which requires compensating lateral control. During asymmetrical airbrake blowdown from the full airbrake position, the pilot will feel a "dead spot" in control wheel movement. The first portion of control wheel travel will have greatly reduced effect, and considerable movement will be required to produce roll. A lag between the control wheel position and the spoiler position resulting from blowdown causes the dead spot. The most extreme condition will require control wheel rotation of approximately 55° to obtain lateral control from the spoilers. Depending on airplane speed, control forces required to reach the required wheel deflection may be greater than that obtainable with one hand operation of the control wheel. By using less airbrake at the higher speeds the dead spot will be reduced or possibly eliminated. Airbrake position 6 is satisfactory for speeds up to 305 knots IAS.

CAUTION

At speeds above 305 knots IAS, do not select an airbrake position greater than position 4 since an excessive dead spot may occur.

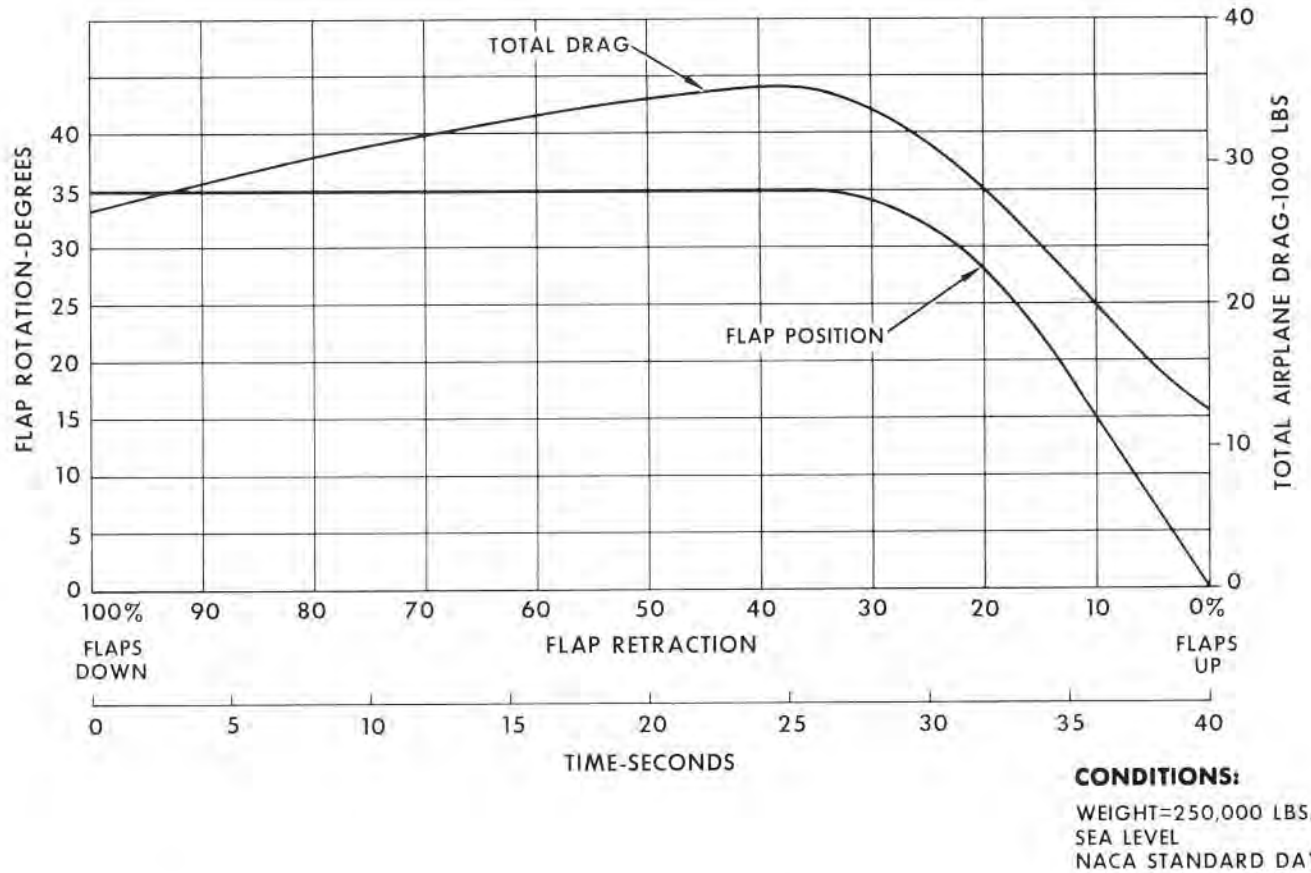
MALFUNCTION OF SPOILERS OR AIRBRAKES. For instructions pertaining to malfunction of spoilers or airbrakes, see "Takeoff and Landing Emergencies," Section III.

EFFECT OF FLAPS. The airplane roll rate which can be obtained by rotation of the control wheel is the same with flaps extended as it is with flaps retracted for the same airspeed and altitude. Since all normal landings will be made with the flaps extended, adequate lateral control is available for rapid lateral maneuvers. In case a landing must be made with the flaps retracted, such approaches will be made at higher speeds resulting in higher roll rates than with flaps down at lower speeds.

Directional Control

Directional control is provided by a 10% chord rudder located on the trailing edge of the fin. Directional trim is provided by a manual adjustment to the rudder control tab through the Q-spring centering arm. The rudder is positioned by a manually actuated control tab which picks up and deflects the stability tab after about 10° of control tab motion so that both tabs reach full deflection at the same time. Damping is introduced into lateral airplane oscillations by a stability tab in conjunction with a yaw damper. The rudder feel force and pedal centering are developed primarily by a Q-spring. Tab hinge moments also contribute to feel but are very small compared to Q-spring forces. Simple aerodynamic balance is used on the upper end of the rudder and the compound type of balance is used on the lower end. In this compound balance are hinge moment regulators which are used to adjust the rudder hinge moments to obtain the proper control characteristics at all rudder deflection angles.

RUDDER EFFECTIVENESS. The rudder control forces during normal operations are moderate at all airspeeds and altitudes. For sea level operations, the rudder control is sufficiently powerful to counteract asymmetrical thrust from two inoperative outboard engines on the same side with zero sideslip at indicated airspeeds of approximately 200 knots and higher, even with the remaining good engines at military rated thrust. At indicated airspeeds below 200 knots and down to takeoff and approach speeds corresponding to 290,000 pounds gross weight, the rudder is adequate to maintain zero



wing flap characteristics

Figure 6-14.

sideslip with the loss of one outboard engine with the remaining engines at military rated thrust. At lower weights under these conditions, some sideslip results and thus some lateral control is required to maintain the desired heading. Any time asymmetrical thrust is offset by a yawing moment from the vertical tail, the side thrust on this surface should be balanced by either sideslipping or banking the airplane, if a constant heading is to be maintained. Thus, if a flight with zero sideslip is desired, the airplane equilibrium attitude will include an angle of bank. Power may be reduced on the good side and flight continued with no sideslip or angle of bank.

RUDDER LIMITS. Structural strength of the fin is adequate to allow use of rudder trim to accomplish the trimming required for asymmetrical power operations; however, abrupt rudder manipulations must be avoided when using more rudder trim than indicated in "Rudder Trim Limitations" under "Airspeed Limitations," Section V. These limits were also provided to reduce the number of autopilot excursions into the autopilot rudder limit switches as well as to aid the pilot in staying within the structural limits of the vertical fin. The average thickness of the fin is 2% less than the average thickness of the wing. This was designed to insure that the fin would not reach its critical Mach number before the wing. Therefore, no buffet will be encountered resulting from the fin at speeds below that at which the wings start to buffet. Any tendencies for the airplane to get into the steady combined roll and yaw oscillation commonly known as "Dutch roll" are adequately canceled by the yaw damper. If conditions become such that very rough air is encountered, it will be the natural reaction for the pilot to attempt to assist the yaw damper in making the necessary corrections. This may be done by application of either aileron or rudder as required.

Wing Flap Characteristics

The wing flaps are designed so that the highest lift/drag ratio is achieved in the 100% down position. For this reason, full flaps are always used for both takeoff and landing. Extending the flaps causes the airplane to pitch up, and retracting the flaps causes the airplane to pitch down. During flap retraction, most of this pitchdown tendency will be noticed between the full up position and the 37 1/2% extended position; this is caused by pilot tendency to lag in initiating corrective trim until a noticeable out-of-trim condition exists. During climbout while accelerating the airplane to 180 knots IAS in preparation for flap retraction, a considerable amount of nose down trim may be required to maintain zero stick force. During the period of flap retraction, trim requirements change in the opposite direction, necessitating nose up trim if zero stick forces are to be maintained. Approximately the same trim change is required during the first 80% of retraction as during the last 20%, thus giving a requirement for a high trim change rate during this latter period. Figure 6-14 shows the rotational position of the flaps in relation to their percent of retraction. During flap retraction, drag builds up during the retraction to the 37 1/2% position and drops off as flaps are fully retracted. The effect of wing flaps on the stalling characteristics is discussed under "Stalls," this section.

FLIGHT CHARACTERISTICS UNDER VARIOUS SPEED CONDITIONS

LATERAL TRIM

When all engines are developing the same thrust and there is no lateral unbalance due to fuel load or other causes, the airplane normally can be trimmed at cruising conditions within 1 unit of rudder and 2 units of aileron trim. When the landing gear is extended however, the airplane will yaw and fly slightly left wing heavy. This is caused by the asymmetrical location of the landing gear doors on the fuselage. Approximately 4 units of rudder trim may be required to retrim the airplane. If desired, the airplane may be trimmed by the use of a slight amount of asymmetrical thrust. In the flaps down configuration, the control wheel forces required to balance the wing heavy tendency are so small that the condition may not be noticed. The correction used may vary with pilot preference and flight conditions.

TAKEOFF

Stabilizer Trim

If the normal takeoff procedure is used, no unusual characteristics will be experienced. The stabilizer trim settings as given in Parts 2 and 3 of the applicable Appendix have been calculated so that with the control column partially back at decision speed, the airplane will rotate about the rear gear and unstick at the proper speed at the planned ground run distance. With these stabilizer settings, it is assumed that the pilot can use stabilizer trimming at the time when the trim changes are greatest; that is, to hold nose down trim during landing gear retraction, during climbout of ground effect, and during acceleration to best flaps down climb speed. The stabilizer should always be set to the position corresponding to the cg location and the airplane gross weight. If too much nose down trim is used, the airplane will require a longer ground run and the rear gear will lift off the runway first. This can result in a difficult steering situation, particularly if any crosswind exists. A small amount of additional nose down stabilizer trim provides a smoother takeoff transition between the ground run and airborne flight and also reduces the stabilizer trimming needed to obtain flaps down climb speed. However, more nose down stabilizer trim than the manual calls for will result in a ground run penalty of 5% for each additional unit of nose down trim. It is imperative during flap retraction that the airplane be kept trimmed to a zero stick force condition. This is especially important during the last 20% of flap retraction. Considering the airspeed at this point of flap retraction coupled with 5° of nose down trim, the elevator authority is lost until the airspeed

has built up to a value of from 235 to 250 knots IAS (figure 6-11). During this period, the pilot cannot keep up with the trim requirements using the manual trim wheel. However, the airplane can be kept in trim quite easily using the trim button.

Engine Failure

In case of an engine failure during takeoff (takeoff to be continued), rudder response is adequate to maintain zero sideslip with the remaining engines at takeoff rated thrust for takeoff gross weights above 300,000 pounds at unstick speeds. It should be noted however that zero sideslip cannot be maintained without a slight angle of bank. At lower weights, some sideslip results and lateral control as well as bank angle is required to maintain the desired heading. All of this correction may be trimmed out so that the airplane will climb out from the field "feet off" the rudder pedals.

CLIMB

No unusual characteristics should be experienced during the climb. Adequate rudder control is available to handle the loss of one outboard engine with the remaining engines at military rated thrust. During initial climbout at altitudes near sea level, the rudder control in combination with bank angle is sufficiently powerful to maintain zero sideslip from two inoperative outboard engines on the same side at indicated airspeeds of approximately 200 knots and higher with the remaining good engines at military rated thrust. It should be noted however that zero sideslip cannot be maintained without a slight angle of bank. As much rudder and lateral trim as required may be used to trim out the asymmetrical thrust, but abrupt rudder manipulation must be avoided if the trim used is greater than recommended on the rudder trim placard.

CRUISE (LEVEL FLIGHT)

During a maximum range cruise operation, no unusual characteristics are to be expected if the recommended speeds and altitudes are maintained. However, if high airspeeds and/or high altitudes are to be flown, then buffeting or "tuck under" may be encountered.

DESCENT

The normal descent procedure will be used for most descents and requires that the landing gear be extended and airbrakes be extended to position 4. During the transition period between cruise and descent, application of airbrakes will cause a pitchup and lowering of the landing gear will cause a slight pitchdown. If the airbrakes are extended at a constant cruising speed, approximately 4.5° of airplane nose down trim will be required to compensate for the nose up pitching moment produced. Lowering the landing gear at speeds near the gear extension placard limit requires approximately 1° airplane nose up stabilizer trim to compensate for the nose down pitching moment produced. Therefore, if the gear and airbrakes are extended at approximately the same time, less change in stabilizer trim will be required. Airbrakes normally should be extended slowly to allow sufficient time for the stabilizer trim to keep up with the trim requirements. In case the emergency descent procedure is used, the descent speed shown by the chart in Part 8 of the applicable Appendix will take the airplane down the edge of the buffet region. Caution should be observed not to make any sudden maneuvers which will place the airplane within the buffet region. See "Buffet," this section, for additional information on this subject.

APPROACH

The main change in airplane attitude during the approach will be encountered when the flaps are extended. The first 37% of flap extension causes the greatest trim change resulting in a pitchup moment. Approximately 3° of airplane nose down trim is required during this interval and an additional 1° nose down trim is required during the remainder of the extension. When one-third airbrakes are extended, an additional nose up pitching moment is produced requiring approximately 1.5° nose down stabilizer trim.

FLARE

The flare is normal. In cases of forward cg's and/or heavy gross weights, power should not be reduced until the flare is complete, then gradual power reduction can be initiated and continued until touchdown. If the ability to flare appears marginal, the addition of power prior to flare will aid in checking the descent rate and thereby reduce the required angle of airplane rotation obtained from the control surfaces during the flare.

LANDING

After touchdown, adequate directional control can be maintained by the rudder at the higher speeds and by forward wheel steering at the lower speeds. The effectiveness of lateral control for maintaining a wings level attitude will decrease as the airplane slows down but the tip gear will maintain adequate clearance for the nacelles and tip tanks. In case a strong crosswind exists, the landing can be accomplished quite easily using the steering and crosswind crab system. In order to obtain most effective braking and increase

brake life, it is desirable to keep the wings as level as possible during the braking roll and not use any more braking than required to stop on the available runway.

GO-AROUND

The go-around is similar to a normal takeoff provided the airbrakes are retracted and the airplane is kept in trim after the decision is made to go around. Failure to retract airbrakes or retrim during a go-around will result in an approximate 6 unit nose down stabilizer trim condition at the end of flap retraction. At this point, if nose up trim is not applied, response to the elevator will be negligible until the airspeed has increased to 235 to 250 knots IAS.

NOTE

Starting with flaps down and airbrakes in position 2, 5 to 6 units of nose down stabilizer trim is required. Retracting the airbrakes requires introduction of 1 to 2 units of nose up trim. See figure 6-15 for a profile of stabilizer trim requirements during a typical go-around.

Stabilizer trim requirements vary radically when advancing thrust from idle to MRT especially at the lower altitudes with low gross weight configurations. During the rapid airplane acceleration and the high rate of climb encountered at light gross weights with MRT, a pronounced aft center of gravity shift is apparent due to fuel slosh. Under certain critical fuel loads, the center of gravity can shift aft as much as 5.5% MAC. This consideration along with the pitch change resulting from the change in engine thrust can tax the available pitch control at low altitudes while not being critical at higher altitudes.

PRACTICE LANDING PATTERNS AT ALTITUDE

Thrust available decreases rather rapidly with increased altitude. At 7,000 feet altitude, eight engines at MRT produce approximately the same thrust as seven engines at sea level; at 13,000 feet, eight engines are equivalent to six engines at sea level; at 20,000 feet, eight engines are equivalent to five engines at sea level; at 27,000 feet, eight engines are equivalent to four engines at sea level. Airplane acceleration and trim characteristics are affected by this decrease in thrust with increases in altitude and these characteristics are not directly comparable with those for sea level conditions. Because of altitude effects on initial buffet and airplane thrust, it is recommended that practice landing patterns be performed at airplane gross weights below 300,000 pounds and an altitude under 20,000 feet. If the best flare speed with No. 2 airbrake as presented in Part 9 of the Appendix is used, at least 10% cushion between initial buffet and the best flare speed will be available. It should be kept in mind that, as thrust available decreases with altitude, the change in pitch trim required as full power is applied at the best flare speed is less than would be encountered at sea level. Thus, when a go-around is accomplished at sea level, the change in nose down trim required to maintain zero stick force is much more severe than that encountered for a go-around at altitude. The amount of asymmetrical thrust for a simulated engine-out condition decreases with increases in altitude because of thrust decreasing with altitude. Since the thrust of an idling engine increases with altitude, this also further decreases the amount of asymmetry. The loss of No. 1 engine wet during takeoff under standard sea level conditions can be demonstrated at 10,000 feet by retarding No. 3 and 4 engines to idle and placing all other engines to MRT. The effort to maintain directional control at a given IAS will be the same. Even though an airplane can be easily controlled at altitude under a given asymmetrical thrust condition, sufficient control may not be available at sea level to maintain airplane heading under similar engine-out conditions.

PRACTICE MANEUVERS WITH ONE OR MORE ENGINES INOPERATIVE

WARNING

Simulation of engines out conditions is limited to a maximum of any two engines at idle on one side.

For practice of any partial power operation, observe the following:

1. Avoid turbulent air and limit maneuvering bank angle to 20° maximum to reduce the "g's" encountered and the resulting fuselage loads (two or more engines inoperative).
2. Simulated inoperative engines should be idled and not shut down.
3. Trim followup should be made with power changes.
4. Power should be applied smoothly when simulating a go-around.

During practice maneuvers simulating failure of one or two engines on one side, the airspeed should not be reduced below the minimums shown in figure 3-2. These minimum directional control airspeeds are based on the use of not more than 50% of the lateral control available. When practicing simulated failure of one or two engines on one side, the airplane gross weight should not be greater than 250,000 pounds nor less than 200,000 pounds. In addition, descents should not be made below a minimum altitude of 500 feet above the terrain. Under these conditions, minimum control speeds will be lower than those shown in figure 3-2; however, as a safety factor, the minimum airspeeds

shown in the chart should be adhered to. Within these limitations, maneuvers such as simulated approach and landing and go-around with reduced thrust may be practiced safely. When practicing these maneuvers, it is recommended that the engine or engines be retarded to idle rather than shut down completely. An engine at idle thrust will provide control and maneuverability problems essentially equivalent to those encountered with the engine shut down.

CAUTION

When simulating failure of more than one engine on one side, it is important that the engines not be retarded or accelerated suddenly. This will induce overyaw and then any sudden application of rudder could exceed structural limits of the airplane.

Simulated Failure of One Engine During Takeoff

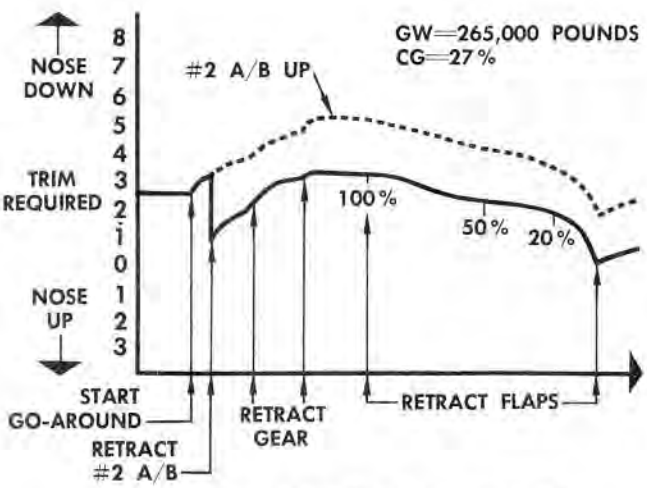
Simulated failure of an engine during takeoff will not be practiced below decision speed. No more than one engine will be failed at one time.

HIGH SPEED FLIGHT

Wing Buffeting

During high speed operations, a slight buffet begins when the airplane critical Mach number is reached. This is caused by the turbulent airflow behind the shock wave which is established when the airflow over a portion of the top surface of the wing has reached sonic velocity. As the speed of the airplane increases above this initial buffet speed, additional turbulence of the airflow over the upper surface of the wing is produced which causes a further increase in buffeting resulting in airplane vibration. Unless some emergency exists, the airplane should not be flown at speeds greater than that at which light buffeting is encountered. At higher altitudes or gross weights, buffeting can also occur at lower airspeeds.

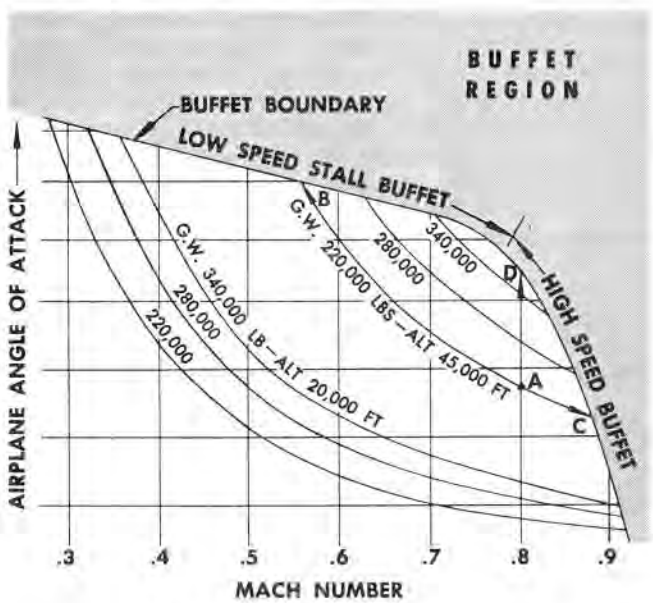
BUFFET BOUNDARY. The point where buffeting occurs is called the "buffet boundary" (figure 6-16). Smooth stabilized flight can be conducted in the area below the curve but, as the airplane approaches the buffet boundary, a small gust, maneuver, or a slight airplane acceleration can cause the buffet region to be entered. Buffeting occurs during flight in any portion of the shaded region. The two types of buffeting encountered at high altitudes are low speed stall buffeting which occurs on the curve in the vicinity of point B and high speed buffeting which occurs in the vicinity of point C. For example, an airplane weighing 220, 000 pounds and cruising at . 80 Mach at 45, 000 feet altitude would be at point A on the curve. If speed is decreased far enough while maintaining the same altitude, buffeting will be encountered at point B. The buffeting encountered at point B is a low speed stall buffet and is essentially the same in nature as that described in "Stalls," this section. The only difference between high altitude low speed buffeting and that described under "Stalls" is that at high altitude, low speed buffeting occurs at



TRIM REQUIRED FOR ZERO STICK FORCE

.....normal go-around

Figure 6-15.



.....buffet boundary limits

Figure 6-16.

higher indicated airspeeds. If the airspeed is increased from point A while maintaining the same altitude, buffeting will be encountered at point C. The airplane can be flown past point C in level flight by increasing power to military rated thrust. Therefore, use caution when flying in level flight at MRT since the high speed buffet region might be entered.

RECOVERY FROM BUFFET. Level flight operation near the high speed buffet boundary or in the high speed buffet region is not dangerous provided the airplane shaking is not great and the pilot understands that the quickest way to get out of the buffet region is to reduce speed or altitude or both. Since the airplane drag in the buffet region is very high, the most effective method of getting out of this region is by reduction of power without change of trim which will result in reduction of speed and loss of altitude. A very slight climb produced by slight back pressure on the control column while momentarily increasing the buffeting will eventually aid in the loss of speed. While operating at low altitudes in level flight, the low speed buffet region can be entered but at lower airspeeds than that for higher altitudes. During normal flight operations, the buffet region will never be entered.

Aileron Buffeting

As the airplane approaches high speed buffet, an oscillation is experienced by the aileron and tab which reacts through the control system and results in movement of the control wheel. This shaking is mild to strong depending upon how far beyond the initial buffet speed the flight is carried. Vortex generators have been installed on the top of each wing in front of the ailerons in order to delay this aileron buffet until initial wing buffet occurs and to keep the aileron buffet within acceptable limits as speed is increased beyond initial buffet speed to limiting airspeeds. The vortex generators each have a 2-inch span and chord evenly spaced, about 6 inches apart, and are attached to the in-spar skin immediately aft of the rear spar. Being small airfoils, they are mounted vertically and aligned at a small angle to the local airflow direction. They are effective because the spiral airflow or tip vortex created by each of the generators transfers high energy air into the wing boundary layer delaying the boundary layer airflow separation. The pulsating flow caused by the separation is responsible for the aileron and tab oscillation.

LOSS OF VORTEX GENERATORS. If more than four vortex generators per wing are missing or more than one is missing in any 48-inch length, the airplane speed should not exceed the maximum speed available in unaccelerated level flight.

Tuck Under

As the speed of any airplane is increased, the normal requirement is more airplane nose down trim. However, with this airplane, as with many other high speed airplanes, the trim requirement reverses as the buffet region is entered and nose up trim is required. Such a condition is called "tuck under" and is considered critical on those airplanes which do not provide sufficient longitudinal control or when the trim reversal is large. Since the airplane is equipped with an adjustable stabilizer, sufficient longitudinal control is available to handle any condition within structural capabilities. The inboard portion of the wing approaches the critical Mach number first with the result that the center of lift of this area moves rearward with increasing speed. Because of this action the resultant lift produced from the entire wing moves aft (center of pressure moves aft) which produces an airplane nose down pitching moment. The trim changes are small and gradual as speed is increased above the critical Mach number. They can be handled easily by use of the stabilizer trim or by use of elevator alone with not more than 50 to 60 pounds of pilot effort. Such a reversal of longitudinal trim is not unusual, but the amount of reversal and the speed at which reversal starts will vary depending upon the amount of sweepback used, flexibility of the wing, wing airfoil sections used, and wing taper ratio employed.

MANEUVERING FLIGHT

LOAD FACTOR

When the airplane is being flown in level unaccelerated flight, the wings produce sufficient lift to counteract the weight of the airplane such that a 1 "g" loading (a load factor of 1) is being produced. If the nose is pushed over, the loading decreases to less than 1 "g" during the maneuver, while if a pull-up is performed, a loading greater than 1 "g" is produced. If a turning maneuver is accomplished while maintaining the same speed, the wings produce less lift in a vertical direction and the angle of attack must be increased to compensate for this loss of lift if a constant altitude is to be maintained. This increase in angle of attack causes a loading increase greater than 1 "g."

EFFECT OF POSITIVE ACCELERATIONS

The effect of positive accelerations caused by coordinated turns or pull-ups is to increase the load factor which has the same effect as adding weight to the airplane. Performing some normal maneuver during a cruise condition is not critical since the effective increase in airplane weight is not great enough to place the airplane into the buffet region; however, if level flight is being maintained in an area very close to the buffet region, even a small maneuver can cause the airplane to enter the buffet region. Starting from level flight at point A (figure 6-16), a turn can be made at .80 Mach until buffeting is encountered at point D. A

coordinated bank of approximately 53° is required to reach point D for this condition. Recovery from buffeting occurring during a turn or a pull-up is best made by rolling out of the turn or nosing over slightly or both.

COMBAT BREAKAWAY MANEUVERS

Techniques for combat breakaway maneuvers may vary depending upon the nature of the bomb run and status of equipment being utilized. This maneuver may be accomplished either by using automatic pilot or by manual controls but a combination of the two is not advised. Prior to the bomb run, consult figure 6-17 to determine the maximum recommended bank angle. It will be noted that the maximum recommended bank angle chart has reduced the bank angle 10° from the maximum recommended buffet and there is no need to further reduce the bank angle if best performance is desired. When making this maneuver on automatic pilot, if desired bank angle is in excess of the capability of the automatic pilot installed in the airplane, an additional 7° of bank may be reached by use of the automatic roll trim knob (approximately 45° maximum). Some automatic pilot systems are modified to facilitate this maneuver. These modified systems will allow the usual 39° of bank when the turn knob is rotated up to a mechanical detent. Further rotation of the turn knob past this detent will allow up to 50° of bank. Autopilots so modified normally have effective roll trim knobs only in bomb and ILS modes. Entry into and recovery from the bank angle should be accomplished smoothly to prevent inadvertent disengagement of the autopilot. The autopilot turn knob will be used to establish an initial bank and, if further bank angle is desired (unmodified systems), the roll trim can be used. Straight and level flight will be initiated by first centering the roll trim knob and then utilizing the autopilot turn knob.

NOTE

In the event of autopilot disengagement during breakaway maneuver, be prepared for a pitchup during manual recovery resulting from the trimming accomplished by the autopilot in the turn.

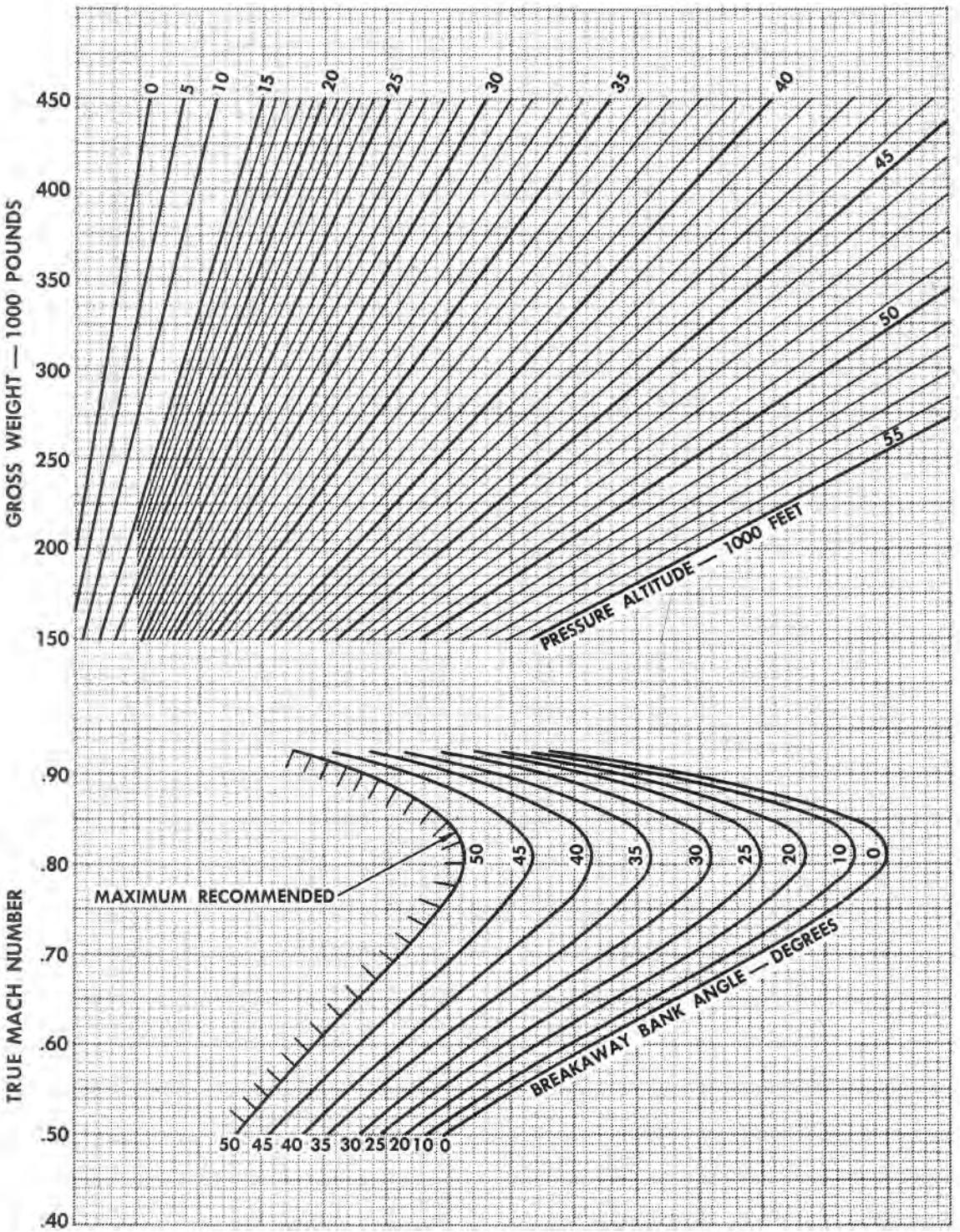
When performing this maneuver manually, the turn should be completed utilizing little or no stabilizer trim. Constant power and altitude should be maintained with a small resultant loss of airspeed during the breakaway maneuver; power should not be increased over that maintained during the bomb run.

RECOVERY FROM UNUSUAL POSITIONS

An unusual position is any abnormal bank attitude, pitch attitude, or speed which the airplane has inadvertently assumed. The recovery from unusual positions may be safe or unsafe, depending on whether or not there is an easily understood and executed procedure assuring straight and level flight without damage to the airplane. More specifically, an unusual position for this airplane may be considered as any attitude or speed which results in inadvertent operation outside the following limitations:

1. An unintentional bank angle greater than 45°.
2. A nose high attitude greater than that required for a maximum steady climb angle at airplane gross weights with which the pilot has had flight experience.
3. A nose down attitude greater than that required for the established descent procedures under conditions with which the pilot has had experience.
4. Maximum placard speed or structural load factor limitations for the particular airplane configuration.
5. Minimum recommended speed.

Airplane attitudes that exceed the above listed limits which the pilot has intentionally caused the airplane to safely assume, such as a combat breakaway maneuver, are not considered unusual positions and the following procedures for recovery from unusual positions will not apply if the airplane is operating safely after intentionally establishing the airplane attitudes or speeds. If, after intentionally exceeding the above limits, the airplane operation appears to become unsafe, then the recovery from unusual positions procedures will be used. Acrobatic maneuvers in this airplane are prohibited; however, it is imperative that procedures for recovery from inadvertent unusual positions be understood. During action over a target, it may be necessary to recognize and recover from extreme maneuvers. Incorrect recovery from normal over-the-target maneuvers or incorrect procedures during instrument flight, especially descents, can lead to unusual positions. During recovery from unusual positions, the pilot must be aware of the airplane limitations and be able to make a decision as to whether to attempt recovery or abandon the airplane. Recovery from normal over-the-target maneuvers can be safely practiced if ordinary precautions are taken. Any procedure however which requires the pilot to recognize and recover from an unusual position, with limits in excess of those established in this paragraph, which he has not observed being established is not recommended. This is because orientation cannot always be easily established unless maneuver entry has been progressively observed and incorrect interpretation of attitude may lead to incorrect recovery. Any protracted delay in recovery from an unusual position will result in a dive. The time required to exceed placard speeds from cruise Mach number at 30,000 feet at various dive angles is shown in figure 6-18. In a 13° dive, the flutter placard can be exceeded in less than 20 seconds. In a 25° dive, the structural placard and the flutter boundary can be exceeded in less than 20 seconds. At 45° or more, all placards are exceeded in less than 10 seconds if recovery procedures are not initiated immediately. Basically, the techniques required for recovery from unusual positions are the same as for other airplanes of this class, except that a higher degree of proficiency may be required. The pilot should, however, be familiar with the following pilot techniques and flight characteristics which are peculiar to this airplane:



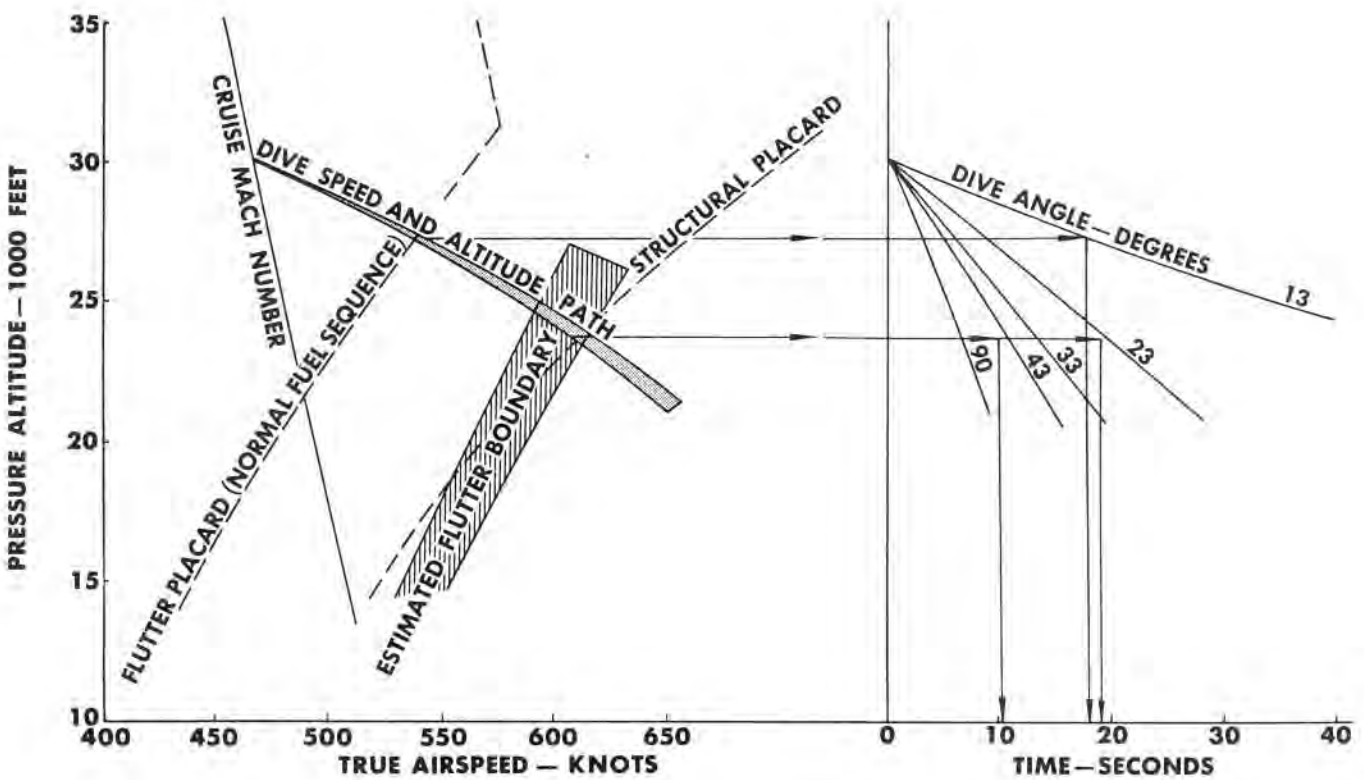
NOTE

BREAKAWAY BANK ANGLE IS 10 DEGREES LESS THAN THE BANK ANGLE FOR MAXIMUM RECOMMENDED BUFFET.

maximum recommended bank angle (breakaway maneuvering)

Figure 6-17.

1. Although the electrical trim features make it very easy to maintain elevator control forces at a minimum, little or no stabilizer trim should be used during fast rate roll-ins or pull-ups. This assures that release of the controls will return the airplane toward the original trim condition if rapid recovery is required.
2. Rolling the wings level during a dive recovery can be accomplished at high indicated airspeeds since lateral control reversal is no problem with this aircraft.
3. If lateral controls are used in the recovery, forward column movement is required to compensate for pitchup due to the lateral control spoilers unless the pitchup is required as part of the recovery procedure.
4. Application of stabilizer trim should very closely follow corrective control column movement. This is desirable in order to keep recovery effort to a minimum and to assure that the stabilizer screw is not loaded beyond operating capacity if airplane placard speeds are unintentionally exceeded in the recovery. It is not considered good practice to move the stabilizer ahead of time in anticipation of a certain airplane response unless it has been previously experienced that this response is certain to occur. This is especially true if placard speeds have inadvertently been exceeded. Control characteristics beyond placard speeds are covered in Section V.
5. Airbrakes can be used in emergencies, such as loss of stabilizer trim, for a pitch trimming device. When used at low airspeeds, extension of the airbrakes to position 4 or 6 coupled with full nose up elevator will cause an immediate recovery from a nose down attitude. In addition, they can be used as a drag device at high speeds; however, they should be applied gradually, keeping in mind their strong pitchup effects and blowdown characteristics at speeds above 250 knots IAS. Use of more than one-third airbrakes at high indicated speeds will make full lateral control more difficult to attain (higher wheel deflections and forces) and result in unpredictable but controllable roll caused by asymmetrical spoiler blowdown.
6. Extension of landing gear as a drag device in recovery from steep nose down attitudes is recommended but every effort should be made to extend the gear as soon as the attitude or the possibility of such an attitude is recognized. At high speeds however, successful egress of personnel without ejection seats is virtually impossible after gear extension. In addition, if airplane placard speeds are exceeded, it is likely that gear doors will be lost with possible collision damage to horizontal and vertical tail.
7. Since improper recovery from an unusual position may result in exceeding placard speeds, rudder trim should be returned to zero before initiating a deliberate



..... example of speed changes during a dive

Figure 6-18.

unusual position in order to preclude structural failure. In addition, steep dive angles or negative load factors will cause the bob-weight damper to become statically unstable. In this case, the stability tab will cause rudder deflections and consequent small yaw and rolling moments. These can be countered if necessary by appropriate rudder pedal application.

WARNING

Rudder deflection can cause structural failure if speeds greater than airplane placard speeds are inadvertently reached.

8. Airplane buffet cannot be relied upon as an indication that structural limit load factors have been reached since in most cases buffet is not reached until after structural load factor limitations have been exceeded. This is shown on the "Normal Acceleration at Maximum Recommended Buffet" chart (see Part 10 of the applicable Appendix). No reliable flight experience exists on the buffet characteristics at combined Mach numbers and indicated speeds above the structural and flutter placards.

WARNING

Instrument misinterpretation during the initial phase of the recovery would result in improper recovery action which could overstress the airplane. Pilots must be alert to prevent improper recovery action. Caution must also be exercised during recoveries because the accelerometer is not a precise or easily read instrument.

Nose High Attitude

A nose high condition can develop immediately after takeoff or touch and go because of the following conditions:

- Stabilizer trim not set properly for takeoff
- Stabilizer trim not reset properly for touch and go
- Airbrakes left extended
- Unscheduled and/or runaway nose up trim
- Misinterpretation of visual or artificial horizon.

WARNING

Do not use the stabilizer trim cutout switch until positive that the attitude change is due to runaway trim.

The use of a steep bank to control the airplane can be fatal if at a low airspeed and close to the ground, and should not be attempted. The best opportunity for recovery exists when using full forward control column, retracting airbrakes if extended, continuous application of nose down trim, and maintaining takeoff thrust and a wings-level attitude at all times. During touch and go, the trim must be reset prior to making the takeoff. If this action is not accomplished immediately following unstick, forward column will be required in order to prevent pitchup and nose down stabilizer trim will have to be initiated to obtain zero stick force. The forward control column required to maintain attitude will increase to the extent that at a speed of unstick plus 10 knots (approximately 4 seconds) all of the available forward control will have been used (approximately 30-pound push force is required). If nose down trim is not applied and continued at this time, recovery from the ensuing pitchup and steep climb attitude may be questionable. Even with nose down trim being applied and held continuously from the point at which full forward control column has been used, a time element of approximately 5 to 8 seconds will elapse before trim effectiveness becomes apparent to the pilot. To be sure that the trim action desired is being accomplished, note that the movement of the manual trim wheel is in the proper direction. If electrical trim appears inoperative, manual trim must be applied as rapidly as possible while holding wings level and the control column full forward. Recovery is still possible but will be slower. The airspeed will fall alarmingly low but lateral control will be good. The airplane will perform an over-the-top maneuver and recovery can be made as the descent is begun by use of trim and power as required. Do not release forward pressure on the control column until the desired attitude is established and airspeed increases to a safe value. Because of the tendency to overtrim during the recovery from the nose high condition, prompt opposite trim action will be required after the airplane assumes a nose down attitude. Caution must be exercised to avoid an accelerated stall. Even though a reduction of thrust will decrease the amount of mistrim in the nose up direction, there are definite advantages to be gained by maintaining thrust. When thrust is maintained, the minimum speed encountered in the recovery will be higher, altitude gained will be greater, and the possibility of a secondary stall in the recovery will be decreased. Do not use a steep turn maneuver for recovery from nose high attitudes, one reason being that dangerous sideslip could occur causing structural failure. If nose high attitude develops after takeoff, recover straight ahead. Maintain wings level, full takeoff thrust, and full forward control column. Retract airbrakes if extended and apply continuous nose down trim until recovery is made.

WARNING

Do not attempt to take off unless trim has been properly set for takeoff and airbrakes are down.

A steep turn as a last resort maneuver will compensate for a considerable amount of nose up mistrim; however, if the mistrim condition is undetected until a high nose up attitude and a low airspeed is reached, there is a danger, when entering a turn, of causing an uncontrollable maneuver which may result in structural failure. Two other factors should be considered: 1) While rolling the airplane, the spoilers aggravate the mistrim and 2) the time taken establishing a turn would be better spent trimming manually. Therefore, a steep turn maneuver to compensate for an excess of nose up trim is not recommended even at high altitude except in the case when both electric and manual trim are inoperative. When starting a steep turn under these circumstances, alert the crew to "prepare to abandon the airplane." If unscheduled nose up trim is encountered while in a turn, the best action will be to continue the turn and use the "Runaway or Unscheduled Stabilizer Trim Checklist," Section III. If nose down trim is encountered in a turn, roll wings level while using the "Runaway or Unscheduled Stabilizer Trim Checklist," Section III.

Dive Recovery

Dives can result from runaway stabilizer trim in the nose down direction, autopilot malfunction, unscheduled loss of airbrakes, or instrument misinterpretation or malfunction. Because of its extremely low drag with landing gear and flaps retracted, this airplane will increase in speed very rapidly any time the nose is dropped. Therefore, the application of a positive load factor (back stick) should be applied immediately during dive recovery. The application of load factor should have precedence over power reduction. See figure 6-18 for speed changes during a dive.

Spiral Dives

If an airplane reaches too large a bank angle or falls off on one wing, a spiral dive can result. This maneuver is easily entered when visual orientation is not possible or if instrument orientation is momentarily lost because of distraction or vertigo. To recover from a spiral dive, roll out of the bank and hold wings level while holding a constant heading. At the same time, the recommended procedures for dive recovery should be initiated.

Vertigo

When the pilot becomes disoriented or experiences vertigo, the airplane can be returned to wings level by engaging the autopilot. It is not necessary for the airplane to be in trim. If a spoiler is up when the autopilot is engaged, the airplane will only return to approximately wings level, with the autopilot holding some spoiler and rudder to compensate for an out-of-trim condition. After the pilot is reoriented, it is recommended that the autopilot be disengaged momentarily and then reengaged after trimming aircraft. Recovery from a climb or dive must be commanded through the pitch knob or the altitude control switch. If the autopilot disengages itself when engaged in such an emergency, continuous manual reengagements will introduce signals in a recovery direction.

Summary of Causes for Unusual Positions

The following conditions are the most prevalent causes for unusual positions in this airplane:

1. Pilot disorientation or vertigo
2. Turbulence or weapons effects
3. Improper use or malfunction of airbrakes
4. Improper use or malfunction of stabilizer trim
5. Split flap operation.

Summary of Procedures for Recovery from Unusual Positions

The following procedures will be used for recovery from nose high unusual positions when the bank is less than 45°:

1. Add thrust as required and later adjust as necessary to obtain the desired airspeed.
2. Lower nose of airplane to slightly below the horizon (approximately 3°) and maintain the original bank angle when lowering the nose. If the wings are level when starting the recovery, maintain wings-level attitude and lower nose to slightly below the horizon. If applicable, use the "Runaway or Unscheduled Stabilizer Trim Checklist," Section III, to help correct the nose high attitude.
3. After obtaining a slightly nose low attitude, roll wings level and establish straight and level flight.

The following procedures will be used for recovery from nose high unusual positions when the bank is more than 45°:

1. Add thrust as required and later adjust as necessary to obtain the desired airspeed.
2. Simultaneously lower nose of airplane to slightly below the horizon (approximately 3°) and reduce the bank to 45° or less. If applicable, use the "Runaway or Unscheduled Stabilizer Trim Checklist," Section III, to help correct the nose high attitude.
3. After obtaining a slightly nose low attitude, roll wings level and establish straight and level flight.

The following procedures will be used for recovery from nose low unusual positions:

1. Back stick, thrust reduced as required, and drag devices such as airbrakes and landing gear should be used as necessary to avoid exceeding airspeed limitations.
2. Simultaneously correct pitch and bank to establish level flight condition. Elevator control should be closely followed by stabilizer trimming in order to keep elevator control forces and jackscrew loads at a minimum. The structural or buffet limits should not be exceeded in an attempt to level off too rapidly. If the wings are level when starting the recovery, maintain wings-level

attitude when correcting the pitch attitude so the maximum effectiveness of lift will be available for producing a recovery flight path.

Spins

For spin recovery, see "Spins," this section.

Inverted Attitudes

The best way to recover from an inverted attitude with a minimum loss of altitude is to roll out. Since this airplane has spoilers and inboard ailerons, there is no problem of lateral control reversal.

FORMATION FLYING

Airplanes flying in close formation have an aerodynamic effect on each other due to the interaction of the airflow around the two airplanes. This effect, in general, tends to draw the two airplanes together and the strength of this effect is inversely proportional to the distance. The closer the two airplanes are, the stronger the effect. The strength is also directly proportional to the size and weight of the airplanes. For example, a T-33 chase plane would not noticeably affect a B-52 but the T-33 would experience a strong disturbance from the B-52. Two B-52's would experience similar forces but the lighter of the two would be disturbed more. Also the aerodynamic effect increases with decreasing airspeed since, for the same weight airplane, the distortion in the airflow is greater at slower speed. The extension of wing flaps distorts the airflow in a manner to increase the disturbance so that it is more hazardous to fly formation at low speeds with the flaps extended on the lead airplane. In addition, formation flying at high Mach numbers can introduce large unfavorable interactions between the two airplanes. The pilot feels all of these aerodynamic effects as changing control force requirements as the two airplanes maneuver near each other. If the relative position of the two airplanes is changing rapidly, the control force requirements will also change rapidly. For this reason, one of the basic rules for formation flying is to make all position changes slowly. The direction of the disturbing force is different for every relative position, but generally the force is in the direction to bring the two airplanes closer together. Consider a B-52 underrunning a KC-135 during an attempt to formate for refueling. If the center lines of the two airplanes coincide, they will tend to fly together and the B-52 pilot must push on the control column to maintain clearance. As the B-52 wing passes forward of the KC-135 wing, it passes from a region of downwash to a region of upwash and the lift is suddenly increased; therefore, the B-52 pilot must strongly increase the push force at this time to prevent pitching up into the tanker. If the B-52 were to underrun the tanker to one side so that their wings overlapped on one side only, the pitching tendency would not be quite as strong, but the two airplanes would tend to roll into each other due to a loss of lift which each would experience on the overlapping wings.

FORMATION FLYING LIMITATIONS

To prevent possible midair collision, intentional close formation flying is prohibited except during air refueling. (See Section IV for a discussion of normal refueling techniques.) Flying as close as the following limits is permissible only when authorized to do so and when properly briefed: 1) never fly over or under the other airplane and 2) maintain separation in all directions of 150 feet (approximate length of B-52 fuselage). In the event of an emergency in which an inspection of the airplane is to be made from another airplane, the pilot of the chase plane must be briefed to remain outside of the permissible formation flying limits.

DIVING

At cruising altitude, a considerable increase in speed above the maximum range cruise speed may be made before reaching the buffet boundary; therefore, a shallow dive may be made without entering the buffet region. However, because of the extremely low drag of the airplane with the gear and flaps retracted, the speed increases very rapidly at any time the nose is dropped or a dive is started. If the buffet region is entered while in a dive, recovery may be made by immediately retarding the throttle to IDLE and leveling out very slowly. Leveling off too rapidly will cause the load factor to increase to a value considerably greater than 1 "g" with the result that buffeting will increase. In cases where a rapid descent is to be accomplished, the landing gear and airbrakes should be extended and the procedures followed as outlined under "Descent," Section II.

FLIGHT WITH ASYMMETRICAL LOADS

See "Fuel Management for Lateral Trim," Section II; "Drop Tank Emergency Operation," Section III; and Part 9 of the applicable Appendix for information regarding flight with asymmetrical loads.

LOW ALTITUDE FLIGHT CHARACTERISTICS

Considering the airplane size and inertia, flight characteristics at low altitude are normal at 325 knots IAS or less. Considerable motion in the vertical and lateral planes from the effects of turbulence and strong or gusty surface winds is apparent. When gusts move horizontally due to surface wind, there is motion in the lateral plane, but motion in the vertical plane is most commonly encountered. When a vertical gust is encountered, the airplane continues to bounce vertically after passing through the gust and, if no further gusts are flown into, the bounce damps out after four to five cycles. When gusts are close together, the aircraft never stabilizes but continues to bounce at a frequency of two to three cycles per second. Wing and nacelle motion as viewed from the cockpit is very extensive and rapid in frequency. The aircraft is stable in turbulent flight and no undesirable deviations from the desired altitude or flight path have been caused by gusts. The normal operating limitations contained in Section V apply to low altitude operation. For "Low Altitude Operation" and "Navigation at Low Altitude," see Section II, and "Turbulence and Thunderstorms," Section IX.

NOTE

For operation of terrain avoidance system, see Section IV.

AIRPLANE RESPONSE TO FLIGHT CONTROLS

The most significant problem with which the pilot must familiarize himself at high speed is the aircraft control characteristics while encountering severe turbulence at low altitudes. Gust feedback through control surfaces at design speed of 400 knots with turbulent conditions causes considerable and sometimes violent displacement of the pilot's controls. The control wheel can rotate as much as 30° to either side of center position. The control column and rudder pedals move back and forth several inches. At design speeds, the rudders are not used since gust forces overpower pilot effort. Even if the pilot does attempt to use rudder, a gust will probably move the rudder to a new position. Aircraft response to use of the elevators only is sluggish, while response to change in stabilizer trim is rapid and positive. However, any change in pitch should be made by leading with the elevators and using stabilizer trim to relieve the physical effort required by the pilot. Fine control is then maintained by use of the elevators. On aircraft [SY] , use of the automatic flight control system will substantially reduce stick forces required and lateral forces will also be lighter than manual. With the electromechanical yaw damper engaged, lateral-directional oscillations of the aircraft are sensed and increased positive damping is provided for easier rudder control. The autopilot will also provide automatic stabilizer trim to compensate for any pitch or thrust changes. See "Automatic Flight Control System," Section IV. Figure 6-19 compares load factors developed during low altitude pull-ups at high and low airspeeds. See "Acceleration Limitations," Section V, for inflight limit load factors. On aircraft [SY], when using the automatic flight control system, a "g" limiter will automatically disengage the autopilot before the pilot inadvertently exceeds the normal acceleration (load) limits. For additional information, see "G Limiter" under "Automatic Flight Control System," Section IV. The use of airbrakes is not

advisable except in maintaining the necessary EPR for anti-icing, or under other controlled conditions. The upward pitch change associated with the use of airbrakes (or downward when retracted) can have undesirable effects at extremely low altitudes. Aircraft response to controls and control forces varies sharply with airspeed and it is only at high (near design) speeds that difficult control force problems are encountered.

PILOT CONTROL TECHNIQUE

During low altitude operations, pilot technique is extremely important and proper coordination between pilot and copilot is essential. An effective method of controlling the aircraft while experiencing difficult control forces may be accomplished by the pilot using both hands on the control wheel while the copilot controls airspeed with the throttles. On aircraft [XC], pilot effort required at high airspeed has been considerably reduced, although prolonged low altitude operation may require assistance from the copilot, depending on turbulence level and character of the terrain.

Less [SZ]

The autopilot is not suited to low altitude flying and cannot be relied upon to maintain control. Autopilot response, particularly in using the pitch control knob, is not rapid enough to perform low altitude maneuvers and is subject to disengagement due to turbulence.

[SZ]

The automatic flight control system, when in low level mode, may be used for low altitude operations. This system reduces loads imposed on the aircraft and also reduces pilot fatigue during low altitude flying by allowing the pilot to command the aircraft through the autopilot. The pilot flies the aircraft through the autopilot by control column and control wheel inputs in the same manner that he flies without the autopilot. Control column and wheel forces are considerably reduced because the autopilot is sensing the pilot's force on the controls and provides the necessary action to move the control surfaces. For additional information, see "Automatic Flight Control System," Section IV.

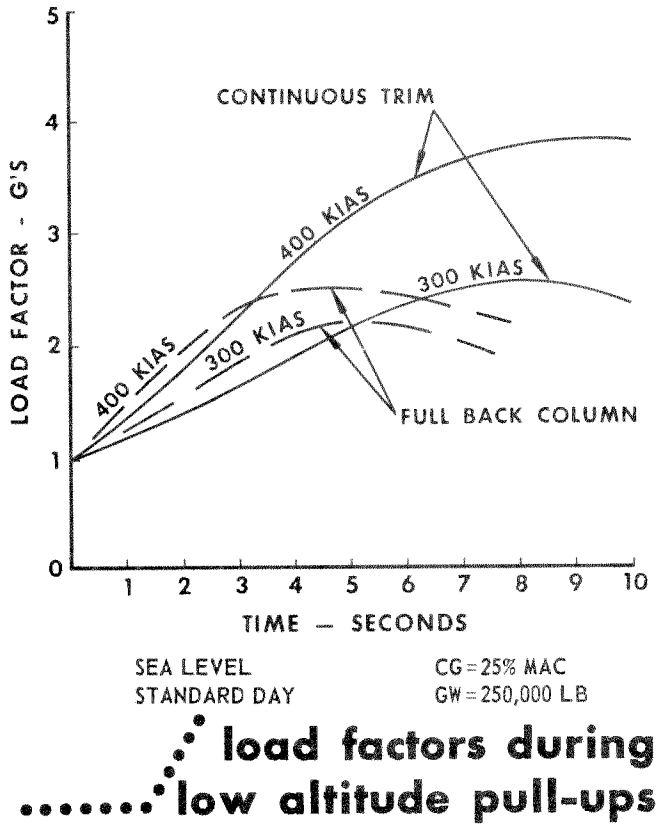
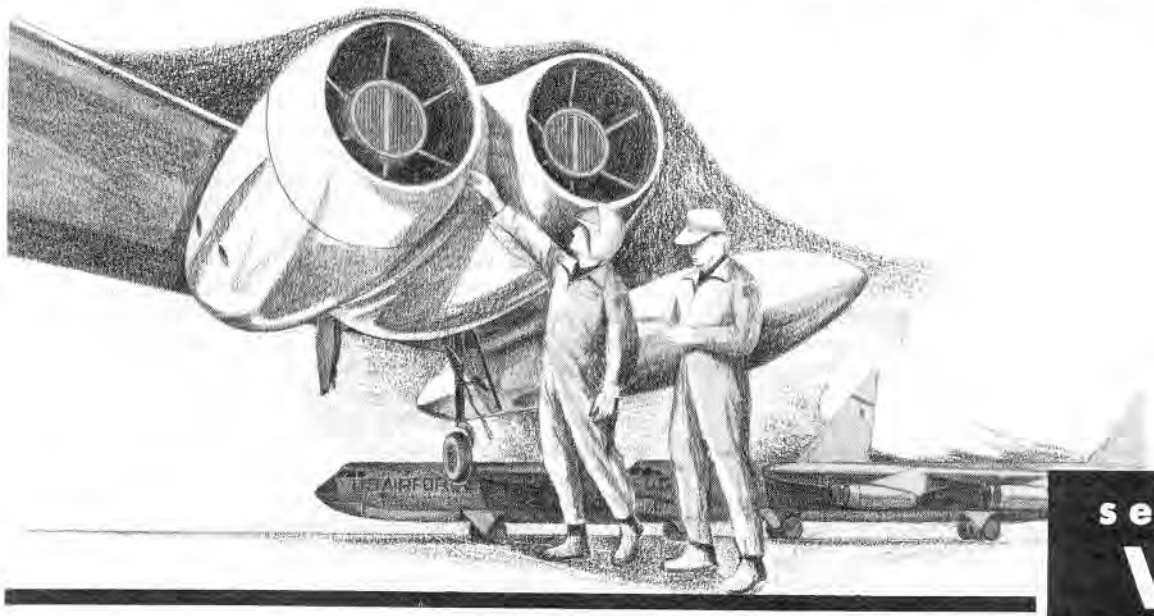


Figure 6-19.

SYSTEMS OPERATION



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ENGINE OPERATION

ENGINE COMPRESSOR STALL

Engine compressor stall is inherent in a jet engine due to the airfoil characteristics of the compressor blades. Compressor stall is an aerodynamic stall caused by the reduction of airflow through the engine. With reduced airflow through the engine, the compressor blades, which are in effect miniature airfoils, stall in a similar manner to an airplane wing during slow flight, and as a result of variations in the pattern of reduced airflow across the compressors, complex differences in stalls are created. Compressor blade stalls vary in severity, depending on whether the stall involves only a portion of a stage, a complete stage, several stages, or an entire compressor. Reduced airflow can occur over the complete engine inlet area and can extend back into all of the compressor stages right up to the diffuser section, or it can happen to only one or two stages, or to any degree between these extremes. The usual causes of compressor blade stall are low temperatures, reduced air densities, engine inlet conditions, and the adjustment and operation of the engine fuel control unit and overboard air bleed valve. The propagation of a stall occurs so rapidly it appears to be instantaneous and results in a complete reversal or breaking down of airflow in the engine. This breaking down of airflow occurs as a result of an imposed pressure rise across a

stage of compressor blades. An increased pressure rise across a compressor stage results in an increased angle of attack of incoming air with respect to the compressor blades. This also may be thought of as a reduction in the incoming air velocity component which results when pressure rise is increased. Stalling of a single blade or circumferential row of blades will reduce the pressure rise of that compressor stage. This in turn loads up the remaining stages of compression by requiring them to increase the pressure by the amount lost at the stage which stalled. The stalling of one stage will in turn increase the pressure rise at the next stage and cause it to stall since it also is highly loaded. In addition to the compressor blade design contributing to stalls, the high thrust output and low specific fuel consumption of an axial flow compressor engine necessitates that the engine be operated as close as possible to the stall region of the compressors. Stall can be designed out of an engine operating schedule but only at the expense of efficiency. This loss in efficiency would be so great that it is essential that the engine and fuel flow schedule be designed in such a manner that stall will normally be avoided during periods of acceleration, deceleration, and low thrust operation. The occasional stalls experienced during acceleration and deceleration are caused by blade stall. During acceleration, extra fuel is fed to the burners to provide the extra energy needed to accelerate the rotating masses. If engine inlet conditions cause operation to approach a stall, the process begins with a relatively high internal pressure being built up in the combustion chambers as a result of the extra fuel introduced. This slows down the air coming through the high pressure compressor to the point where the air velocity and the rpm in some part of the compressor no longer match up properly and a stall occurs. When a throttle is retarded with conditions which will produce stall during deceleration, the high pressure compressor slows first because it has the lightest mass. Slowing of the high pressure compressor, in effect, blocks the airflow through the low pressure compressor and, following blade stall, a stall of the low pressure compressor results when the air velocity through it gets low enough. The reduction of airflow through the engine is induced by rapid engine throttle movements, high angle of attack, extreme altitude operation, and high altitude turns. The most common of these conditions is the rapid advancement or retardation of the throttles and high altitude turns. There is another type of compressor stall which appears to originate with ice crystals in the air at high altitudes and which usually is encountered in and around thunderheads. The crystals apparently go into the engine with the air and ingest the engine with water as they are melted during compression. At high altitudes, the actual weight of airflow into the engine is low, so the amount of water required to mix with the air to establish the necessary water/air ratio for water injection is relatively small. Ice crystal stalls appear to be due to operation of the high pressure compressor approaching a stall condition when water is injected at the time of low air density as encountered at high altitude. Compressor stall is usually associated with unstable engine operation and may in some instances be recognized by compressor pulsations which cause very loud explosive reports to be emitted. This may be startling to a flight crew when a severe engine stall is first experienced. Some stalls do not make themselves known by noise or surges, but simply result in the engine not being able to accelerate or in losing rpm with no change in the throttle position. Incipient stall may produce roughness in engine operation with or without any audible reaction. More pronounced stalls may produce audible pulsations of varying intensity. As a "feel" of the engines is acquired with experience, an instinctive sense of how to handle the airplane attitude and the engines in order to avoid possible stall producing conditions becomes almost second nature. With recognition of the operational symptoms, it is possible to take corrective action in time to minimize the possibility of engine damage or to correct an engine malfunction. Stall may be avoided or the intensity of a stall reduced by use of the following procedures:

- Avoid erratic or abrupt throttle movements. Rapid throttle advances during periods of high distortion of the air at the engine inlet are sometimes the cause of acceleration stalls.
- Carefully coordinated flying will increase the efficiency of the air inlet ducts and reduce the tendency of engine stall. Airspeeds should be maintained above the acceptable minimum.
- Operation at a higher airspeed and at a reduced angle of attack or rate of climb of the airplane may help to eliminate a stall condition.
- When a stall occurs, slowly retard the throttle to IDLE or until the stall ceases, then slowly accelerate the engine until the desired thrust is obtained.
- During periods of compressor stall, observe the exhaust gas temperature closely. Reduce the throttle to avoid overtemperaturing when necessary.
- If a stall occurs at high altitude, reduce the altitude, if necessary, to aid stall recovery. Dropping the nose of the airplane slightly sometimes produces smoother airflow into the inlet duct, eliminating the stall.
- If the stall condition cannot be controlled, shut down the engine depending upon circumstances such as whether or not one or more engines have developed uncontrollable stall. Continued severe compressor stall could conceivably be detrimental to an engine.

The conditions of engine choo-choo, acceleration hang-up, engine surge, and engine flameout are associated with respective characteristics of engine compressor stall and may be either reduced in intensity or avoided by use of applicable procedures.

ENGINE SPEED FLUCTUATIONS

Engine instability may occur because of some malfunction in the engine or fuel control and may be recognized if any of the following are noted:

1. Erratic increase of turbine exhaust gas temperature.
2. Rapid reduction or fluctuation of rpm at constant throttle setting or failure of rpm to continue to increase during acceleration.
3. Shock of compressor pulsations felt in the airplane structure.
4. Loss of power reflected in aircraft instruments.
5. No response of EPR to throttle movement.

Corrective Measures

ACCELERATION. If erratic engine performance is experienced during acceleration of the airplane:
1. Retard throttle to IDLE position.
2. Obtain stable operation.
3. Slowly advance throttle to the desired power condition.

STEADY STATE OPERATION. While in a stabilized cruise condition, if erratic engine performance is experienced:
1. Slowly retard or advance throttle to a more stable power range.
2. Reduce altitude.

While in a stabilized climb condition, if erratic engine performance is experienced:
1. Slowly retard or advance throttle to a more stable power range.
2. Increase airspeed by reducing climb.

DECELERATION. During periods of deceleration of the airplane, if erratic engine performance is experienced:
1. Change the throttle position to obtain stable engine operation.
2. Slowly adjust throttle to the desired power condition.

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DECELERATION STALLS ABOVE 30,000 FEET. Observe the following instructions when retarding throttles above 30,000 feet:
1. Move throttles slowly and smoothly (15 to 30 seconds for full throttle movement).
2. Advance throttles momentarily.
3. Retard throttles to desired setting.

NOTE

A throttle increase immediately speeds up the N-2 rotor. Then, before the N-1 rotor can follow, the throttle decrease cuts fuel flow causing both rotors to decelerate together, thereby reducing stall possibility. Finally, the N-1 and N-2 rotors restabilize at the lower power setting.

4. If stall develops, increase airspeed to correct stall condition.
5. Monitor engine instruments.
6. Shut down engine if EGT approaches maximum limit.

NOTE

Restart may be attempted after engine has been shut down and windmill rpm stabilizes.

7. Make Form 781 entry of all deceleration stalls encountered.

ENGINE CHOO-CHOO

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Engine choo-choo is a mild form of engine compressor stall and sounds surprisingly like a steam locomotive under load. Choo-choo occurs on the ground only and is the result of accelerating the engine out of the idle position with rapid throttle movement. This unstable condition is of very short duration and ceases after a slight rpm increase above the idle position. Occasionally, choo-choo is inaudible, in which case it can be identified by erratic fuel flow fluctuations.

ACCELERATION HANG-UP

Acceleration hang-up is a type of malfunction in which the engine fails to accelerate past a specific rpm. This hang-up sometimes occurs after the throttle has been retarded and an attempt has been made to accelerate to a higher rpm. Acceleration hang-up can be attributed to a faulty fuel control unit or to continuous engine stall. In case of a faulty fuel control unit, engine shutdown may be necessary; in the case of continuous engine stall, it may be necessary to reduce power, increase airspeed, or decrease altitude.

ENGINE SURGE

Engine surge, which is an intermittent engine compressor stall, produces thrust variations which may be indicated by fuel flow fluctuations or a marked rise in EGT. Shock and pulsation frequently can be felt, and sometimes heard, in the cockpit during flight. Although there have been occasions when engine surge has occurred on the ground, it usually manifests itself above 40,000 feet. It generally occurs with rapid throttle movements during slow speed (high angle of attack) flight or high altitude turns. Surging which occurs during engine acceleration usually ceases as the engine speed increases. If it does not, a power reduction, followed by a slower rate of throttle advance, will usually give satisfactory results. Surging which occurs during slow speed high angle of attack flight (usually with fixed throttles) may require changing the throttle position of the affected engines and/or an increase in airspeed to furnish relief. Persistent or severe surge occasionally results in engine flameout unless very prompt corrective actions are taken.

ENGINE FLAMEOUT

Engine flameout is the complete loss of combustion. In most cases it occurs at altitudes above 40,000 feet

as a result of a too rapid throttle movement. It can also be caused by a change in the inlet air pressure gradient of the engine at high angles of attack. Following a flameout, the rpm, EPR, and EGT will begin dropping at once. Generally, engine flameout can be remedied by merely restarting the engine. For additional information and proper inflight restarting procedures, see "Engine Flameout and Relight" and "Engine Air Starting" under "Engine Failure" in Section III.

PRACTICE ENGINE SHUTDOWN AND AIR STARTING

CAUTION

It is recommended that engine shutdown and air starting be practiced at altitudes between 10,000 and 37,500 feet, one engine at a time. Practice starts should be made in the "normal windmilling start" area of the air start envelope (figure 3-3). Air starts may be demonstrated in the "probable start" range but the "possible slow or hot start" area should be avoided except in an actual emergency. Use of the engine starters for air starts is restricted to emergencies only.

1. Throttle - IDLE for 3 minutes

The throttle for the engine to be shut down should be retarded to IDLE for 3 minutes before the engine is shut down.

2. Alternator Circuit Breaker Switch B-52F (if applicable) - Opened

If the engine to be shut down drives an alternator, the alternator should be taken off the line so that it will not be motored by power from the others. Check that the alternator circuit breaker light comes on. Make certain that the remaining alternators are not overloaded.

3. Throttle - CLOSED

4. Restart - See "Engine Air Starting Checklist," Section III

After windmilling rpm has stabilized, the engine will be started using the procedure outlined under "Engine Air Starting," Section III.

MULTIPLE ENGINE FLAMEOUT

Flight through severe turbulence or icing conditions which are encountered with cumulus clouds at 40,000 feet or above may result in multiple engine flameout. Severe turbulence distorts the engine inlet airflow, causing compressor stalls, surging, and erratic fuel control unit operation. Icing of the engine inlet or flight at reduced airspeeds (high angles of attack) will further distort the inlet airflow. The possibility of multiple engine flameout under these conditions may be reduced by 1) turning on the engine and nacelle anti-icing system prior to penetration of high cumulus clouds and 2) energizing the engine ignition system for limited periods during flight through areas of turbulence. Energizing the ignition system will not prevent compressor surge or stall but will tend to prevent a stalled or surging engine from flaming out. See "Turbulence and Thunderstorms," Section IX, and "Engine Limitations," Section V.

ENGINE FLAMEOUT DUE TO ICING

Engine icing should not exist during a normal cruise power setting if anti-icing heat is used properly. Instances of engine flameout originally attributed to fuel icing may possibly have occurred due to ice formation within the engine compressor section resulting from lack of sufficient anti-icing heat. Engine flameout may be eliminated by use of ignition per the instructions under "Multiple Engine Flameout," this section. When EPR is reduced below the minimum required, the possibility of insufficient heat for anti-icing exists and, in the event of engine instability, the use of ignition is desirable. Instability will normally be expected to occur after sufficient power has been stabilized for adequate anti-ice heat. This is due to ice and water ingestion as inlet ice melts. The use of ignition during takeoff and landing phases of flight, when engine inlet icing exists, will provide additional protection against engine flameout due to instability or ice ingestion. The atmospheric conditions presently outlined in Section IV under "Engine and Nacelle Anti-Icing" should be used to determine when anti-ice is required.

ENGINE OVERSPEED

Engine overspeed is indicated by excessive rpm, fuel flow, and EGT compared to other engines or by exceeding the engine EGT and/or rpm limits. Immediate retarding of the throttle may be necessary to return engine readings to safe limits. The primary causes of engine overspeed are improper trimming of the engine during maintenance operations or failure of the fuel control unit.

NOTE

Engine overspeed should not be confused with the increase in takeoff rpm which occurs when runway temperatures are high. On hot days, takeoff rpm will exceed the rpm for which the engine is trimmed. This is normal as long as EGT and EPR remain within limits. See "Engine Limitations," Section V.

VARYING EXHAUST GAS TEMPERATURE

Varying exhaust gas temperature will be accompanied by engine rpm fluctuations that follow the EGT. Depending on the magnitude of the fluctuations, the indications will be the same as an unstable engine speed

fluctuation. The same corrective procedures will apply. Monitor the engine operation within operating limits of rpm and EGT.

MONITORING EGT DURING TAKEOFF

The EGT of a normally operating engine will usually peak considerably sooner than the 2-minute engine acceleration time limit. Therefore, it is important that the pilot not physically making the takeoff monitor EGT during the takeoff roll and as soon after unstick as possible. Throttles should be retarded to maintain the appropriate EGT limits. Normally, a very small reduction in throttle setting will return an EGT to within limits.

ENGINE INSTRUMENT FLUCTUATIONS

Intermittent or continuous operation of the engine fire detector system lights or erratic operation of the engine instruments may be an indication of burned or scorched electrical wire bundles as a result of an air bleed manifold pneumatic duct failure. If such indications are observed, shutdown of engines in the applicable engine pod should be accomplished in accordance with the "Emergency Shutdown Checklist," Section III. After engine shutdown, be sure the air bleed manifold pressure valves are turned off to prevent the passing of bleed air from other engines through the damaged duct. See "Air Bleed System Emergency Operation," Section III, for failure indications due to an air bleed manifold leak.

ENGINE STARTER HANG-UP

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Starter hang-up is a type of malfunction wherein the starter fails to drop out during engine start. Starter dropout should occur at approximately 35% to 45% rpm. J57-P-43W series engines are subject to "hung" starts, especially at temperatures of 45° F (7° C) and below. In freezing temperature, a hung start may result from improper sensing caused by water or ice formation if there is an accumulation of water in the compressor burner pressure bellows chamber of the engine fuel control unit. On some engines, a drain screw has been installed to provide a means for maintenance personnel of draining accumulated moisture from the compressor burner pressure bellows chamber. During freezing temperature, if ice has formed, it may be melted to allow drainage by directing hot air on the engine fuel control unit. Hung starts may also be prevented by blocking the escape of air from the compressor bleed valve in accordance with applicable maintenance procedures. The escape of compressor bleed air prevents the starter from disengaging due to lack of acceleration in starting rpm. Hung starts are usually characterized by failure of the engine to accelerate beyond 40% rpm. The EGT may rise slowly but should not be allowed to exceed the starting limit. The engines incorporate a compressor bleed valve which will remain closed during starting to eliminate hung starts caused by lack of acceleration. Also, an air metering baffle is installed to improve the acceleration during starting. If an engine does not accelerate to idle rpm within 90 seconds or if a tendency to exceed other limits is observed, proceed with engine shutdown in order to obtain a satisfactory start following applicable maintenance hung start procedures.

ENGINE IGNITION AND STARTING SYSTEM OPERATION

When the engine accelerates above starter cutout speed, the starter relay becomes deenergized. This prevents the starter from reengaging if the engine speed drops below starter cutout speed, even though the starter switch remains in ON position. If the starter switch is returned to OFF position however, and the engine speed drops below starter cutout speed, the starter relay will become energized. Then if the starter switch is turned ON while the engine is still rotating, starter coupling shaft failure can result.

FUEL SYSTEM OPERATION

Operation of the fuel system is performed by the co-pilot

FUEL SYSTEM CHECKOUT

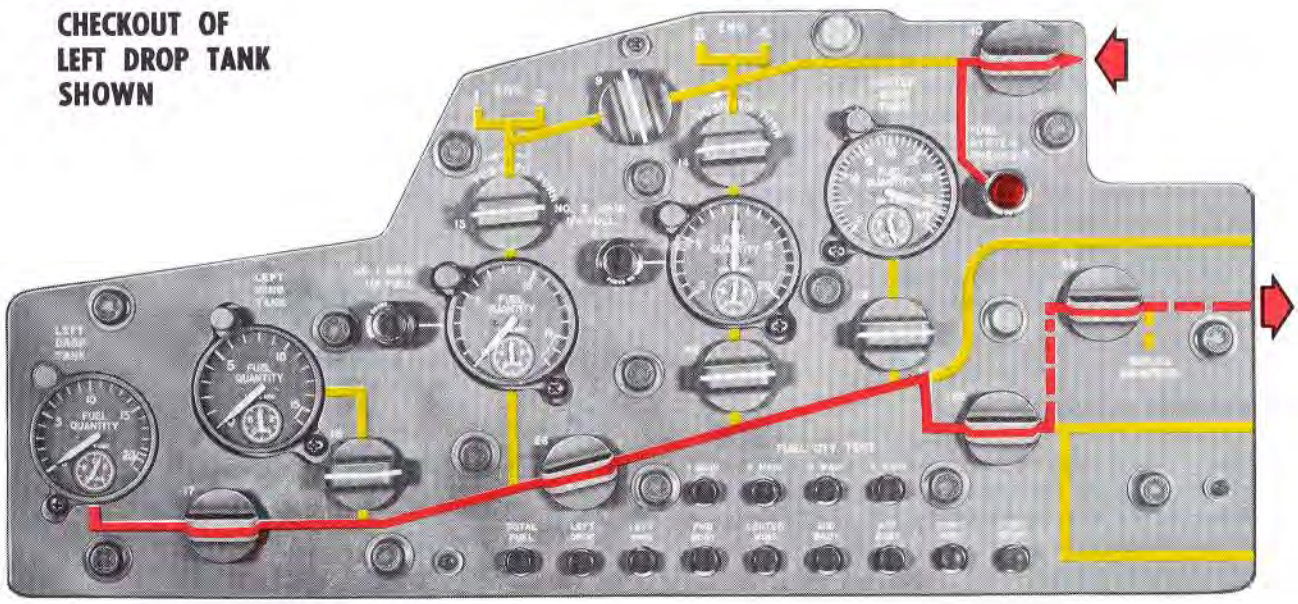
Fuel Feed and Transfer System Checkout Procedures for All Tanks Except Drop Tanks

A complete checkout of the fuel feed and transfer systems for all tanks except drop tanks may be accomplished as follows:

1. All fuel valve switches - OFF; throttles - CLOSED
2. Ground and electrical sources - Connected, electrical power on airplane buses
3. Fuel system checkout switch - AUX TANKS; fuel system checkout light remains out
4. Fuel valve switches No. 18, 26, 29, 30, and 10 - ON, light on
5. Fuel valve switch No. 26 - OFF, light out, after 10 seconds ON, light on

6. Fuel valve switch No. 18 - OFF, light out
   Fuel valve switch No. 26 - OFF
   Fuel valve switch No. 19 - ON, light on
7. Fuel valve switch No. 29 - OFF, light out
8. Fuel valve switches No. 27, 32, and 31 - ON, light on
9. Fuel valve switch No. 27 - OFF then ON, light out then on
10. Fuel valve switch No. 19 - OFF, light out
11. Fuel valve switches No. 27, 32, and 31 - OFF
    Fuel valve 25a circuit breaker - Pulled
    Fuel valve switch No. 25 - ON then OFF, light on then out
    Fuel valve 25a circuit breaker - Closed
    Fuel valve 25 circuit breaker - Pulled
    Fuel valve switch No. 25 - ON then OFF, light on then out
    Fuel valve 25 circuit breaker - Closed
12. Fuel valve switch No. 23 - ON, light on
13. Fuel valve switch No. 30 - OFF then ON, light out then on
14. Fuel valve switch No. 23 - OFF, light out
15. Fuel valve switch No. 30 - OFF
    Fuel valve switch No. 31 - ON
    Fuel valve 51 circuit breaker - Pulled
    Fuel valve switch No. 22 - ON then OFF, light on then out
    Fuel valve 51 circuit breaker - Closed
    Fuel valve 22 circuit breaker - Pulled
    Fuel valve switch No. 22 - ON then OFF, light on then out
    Fuel valve 22 circuit breaker - Closed
16. Fuel valve switch No. 24 - ON then OFF, light on then out
17. Fuel valve switches No. 20, 28, and 32 - ON, light on

CHECKOUT OF LEFT DROP TANK SHOWN



FUEL VALVE SWITCH POSITIONS FOR CHECKOUT OF FUEL FEED AND TRANSFER SYSTEMS

FUEL SYSTEM CHECKOUT SWITCH POSITION	AUXILIARY FUEL TANK TO BE CHECKED	FUEL VALVE SWITCHES — ON (All other fuel valve switches OFF)
MAIN TANKS	LEFT OUTBOARD WING	18, 26, 29, 30 and 10
	CENTER WING	19, 29, 30 and 10
	AFT BODY	25, 30 and 10
	MID BODY (LEFT)	23, 30 and 10
	FORWARD BODY	22, 31 and 10
	MID BODY (RIGHT)	24, 31 and 10
	RIGHT OUTBOARD WING	20, 28, 32, 31 and 10
	LEFT DROP	17, 26, 29, 30 and 10
	RIGHT DROP	21, 28, 32, 31 and 10
OFF		
AUX. TANKS		

Figure 7-1 (Sheet 1 of 2).

18. Fuel valve switches No. 28, 32, and 31 - OFF then ON (one at a time, in order), light out then on (each time)
19. Fuel valve switch No. 20 - OFF, light out
20. Fuel valve switches No. 28, 32, and 31 - OFF
    Fuel system checkout switch - MAIN TANKS, light out
21. Fuel valve switches No. 16, 12, 11, and 10 - ON, light on
22. Fuel valve switch No. 12 - OFF then ON, light out then on
23. Fuel valve switch No. 16 - OFF, light out
24. Fuel valve switch No. 12 - OFF
    Fuel valve switch No. 15 - ON, light on
25. Fuel valve switches No. 11 and 10 - OFF then ON (in order), light out then on (each time)
26. Fuel valve switch No. 15 - OFF, light out
27. Fuel valve switches No. 10 and 11 - OFF
    Fuel valve switches No. 13 and 9 - ON, light on
28. Fuel valve switch No. 9 - OFF then ON, light out then on
29. Fuel valve switch No. 13 - OFF, light out
30. Fuel valve switch No. 9 - OFF
    Fuel valve switch No. 14 - ON then OFF, light on then out
31. Fuel system checkout switch - OFF

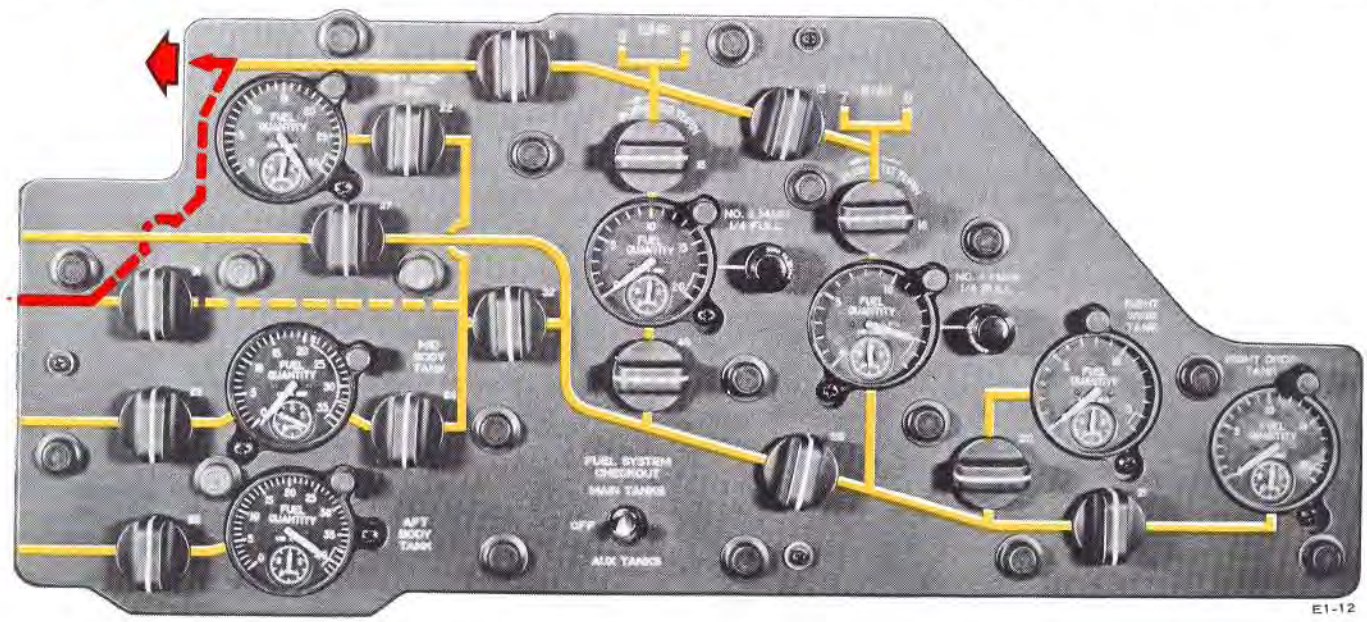
Fuel Feed and Transfer System Ground Checkout Procedure for Drop Tanks

A ground checkout of the drop tank fuel feed and transfer system may be accomplished as follows:

NOTE

Valve 46 may be momentarily opened to relieve residual pressure.

1. All fuel valve switches - OFF; throttles - CLOSED
2. Ground, electrical, and air bleed sources - Connected, electrical power on airplane buses
3. Air bleed manifold interconnect switches - OPEN



MAIN FUEL TANK TO BE CHECKED	FUEL VALVE SWITCHES — ON (All other fuel valve switches OFF)
NO. 4	16, 12, 11 and 10
NO. 3	15, 11 and 10
NO. 1	13 and 9
NO. 2	14

FUEL SYSTEM CHECKOUT SWITCH POSITION

MAIN TANKS

OFF

AUX. TANKS

FUEL FLOW
STATIC
LIGHT ON

fuel system checkout

Figure 7-1 (Sheet 2 of 2).

4. Fuel system checkout switch - AUX TANKS; fuel system checkout light remains out
5. Fuel valve switches No. 17, 26, 29, 30, and 10 - ON, light on
6. Fuel valve switch No. 17 - OFF, light out
7. All fuel valve switches - OFF
8. Fuel valve switches No. 21, 28, 32, 31, and 10 - ON, light on
9. Fuel valve switch No. 21 - OFF, light out
10. Fuel system checkout switch - OFF

Fuel Feed and Transfer System Inflight Checkout Procedure for Drop Tanks

CAUTION

To avoid exceeding flight limitations, do not reduce drop tank fuel quantity below 17,500 pounds each tank during this check. See "Airspeed Limitations," Section V.

An inflight checkout of the drop tank fuel feed and transfer system may be accomplished as follows:

1. Fuel valve switches No. 13, 14, 15, and 16 - ON
   Check all fuel valve switches except No. 13, 14, 15, and 16 - OFF
2. Fuel valve switches No. 17 and 21 - ON
3. Drop tank fuel quantity gage - Monitor
   Monitor each drop tank fuel quantity gage for a decrease in fuel quantity of 500 to 800 pounds.

NOTE

This checkout may require up to 5 minutes because of time needed to pressurize drop tanks.

Manifold Interconnect Valve Check

A test of the manifold interconnect valve (No. 46) is not included in either the normal preflight check covered in Section II or in the check outlined in this section. If a test of this valve is desired, it may be accomplished following step "5" of the fuel feed and transfer system checkout procedure.

NOTE

- The refuel manifold must be scavenged following the check of the manifold interconnect valves to remove fuel from the refuel system lines.
- Operation of the fuel level valves (No. 47, 48, 49, and 50) for main tanks are not checked in the fuel system checkout procedure outlined in this manual.

FUEL SYSTEM MANAGEMENT

The fuel valving system is designed so that normally only fuel from the main tanks feeds the engines. In an emergency, fuel may be transferred from any tank to any or all engines by using the fuel transfer and crossfeed manifolds.

WARNING

To avoid flutter, all outboard wing tank fuel must be used prior to using fuel from full drop tanks, in accordance with normal fuel usage sequence. If the normal fuel sequence cannot be followed, do not exceed the lower airspeed and Mach number flutter limitations given in Section V. If the EWO fuel sequence is used, the lower airspeed flutter limitation must be observed until all drop tank fuel is used.

CAUTION

- Fuel shall not be transferred directly between main tanks except through valve 46 and the refuel system. This is to prevent excessive surge pressure due to closure of transfer valves.
- Immediately turn off the auxiliary tank valve switches upon completion of fuel transfer. If fuel transfer from auxiliary tanks is required while the aircraft is on the ground, fuel quantity and pressure from main tanks 1 and 4 must be available through the thermal relief lines to cool and lubricate the auxiliary tank pumps. The transfer pump check valves are drilled to allow this backflow.

NOTE

- Icing of main fuel transfer valves can be detected by inability to transfer or inability to stop transfer (resulting in tank overflow).
- To allow the fuel transfer system to replenish the main tanks, fuel level valve switches No. 48 and 49 must be in ON position and the master refuel control switch must be in OFF position.
- The main tanks cannot be replenished with fuel from the auxiliary tanks until the main tank fuel level is 8% below the full level allowed by the refuel system.
- Do not use the fuel sequences placarded in the aircraft.

Normally fuel from the auxiliary tanks is routed to the main tanks and then to the engines. Proper management of the fuel feed and transfer systems for any step in the fuel usage sequence is given in figure 7-2. Since fuel is normally used to the 92% full level in the main tanks, no unusual precautions need be taken when using this sequencing. At any time an unusual combination of engines is used, care should be taken to manage fuel so as to maintain proper center of gravity and fuel distribution. See Section V for further information about fuel loading, cg location, and aircraft gross weight limitations. Also see "Fuel Management for Lateral Trim" under "Climb," Section II.

Normal Fuel Usage Sequence — Operating Weight (Basic Weight Plus Crew and Oil) CG From 24% to 31% MAC

NOTE

- If the operating weight (basic weight plus crew and oil) cg falls aft of 31% MAC, interchange steps 3 and 4 of the normal fuel usage sequence.
- During step 9, the aft cg limit will be exceeded when carrying full chaff and ammo and the total fuel quantity is below 14,000 pounds. This applies if the operating weight (basic weight plus crew and oil) cg falls aft of 31% MAC.
- The aircraft shall be loaded with fuel in accordance with procedures as outlined in T.O. 1-1B-40, Handbook of Weight and Balance Data. The fuel usage sequence given below was designed to be used in conjunction with proper fuel loading procedures and, by following this sequence, proper cg location can be maintained and maximum aircraft service life can be realized.
- For fuel sequence and fuel usage when carrying AGM-28's see figure 7-4.

The normal fuel sequence provides for maximum wing structural life by using all body fuel before using outboard, center wing, and drop tank fuel. After the first step of 8% mains, the 92% level in the four main tanks is maintained through step 7 by transfer from the auxiliary tanks. During step 8, main tanks 1 and 4 will be maintained at 92% until the drop tanks are empty. Main tanks 2 and 3 will be at approximately 9800 pounds each after completing step 8. Step 9 uses only main tank fuel with crossfeed valves 9 and 12 open when any main tank indicates 5000 pounds or less.

Step 1. 8% OF MAINS 1, 2, 3 & 4

Step 2. AFT BODY UNTIL EQUALIZED TO FORWARD BODY TO 1, 2, 3 & 4

Step 3. AFT BODY TO 1 & 2
FORWARD BODY TO 3 & 4

Step 4. MID BODY TO 1, 2, 3 & 4

Step 5. LEFT WING TO 1 & 2 (DOWN TO 5000 POUNDS)
RIGHT WING TO 3 & 4 (DOWN TO 5000 POUNDS)

Step 6. LEFT WING TO 1
CENTER WING TO 2 & 3
RIGHT WING TO 4

Step 7. LEFT DROP TO 1
CENTER WING TO 2 & 3
RIGHT DROP TO 4

Step 8. LEFT DROP TO 1
NO. 2 MAIN
NO. 3 MAIN
RIGHT DROP TO 4

Step 9. MAINS 1, 2, 3 & 4

EWO Fuel Usage Sequence — Operating Weight (Basic Weight Plus Crew and Oil) CG From 24% to 31% MAC

NOTE

For fuel sequence and fuel usage when carrying AGM-28's see figure 7-4A.

In cases where protected fuel is to be retained for use in the target area or it is necessary to jettison the drop tanks as early as possible, use the EWO fuel usage sequence. During this sequence, the main tanks are maintained at the 92% level until step 8. During step 8, mains 1 and 4 will be maintained at 92% until the wing tanks are empty. Mains 2 and 3 will be at approximately 6500 pounds each after completing step 8. Main tank fuel is used during step 9 with crossfeed valves 9 and 12 open when any main tank indicates 5000 pounds or less.

Step 1. 8% OF MAINS 1, 2, 3 & 4

Step 2. LEFT DROP TO 1
CENTER WING TO 2 & 3
RIGHT DROP TO 4

Step 3. LEFT DROP TO 1 & 2
RIGHT DROP TO 3 & 4

NOTE

Do not exceed 280 knots IAS or Mach .90 indicated until all drop tank fuel is used.

Step 4. AFT BODY TO 1, 2, 3 & 4 (EQUALIZE WITH FORWARD BODY)

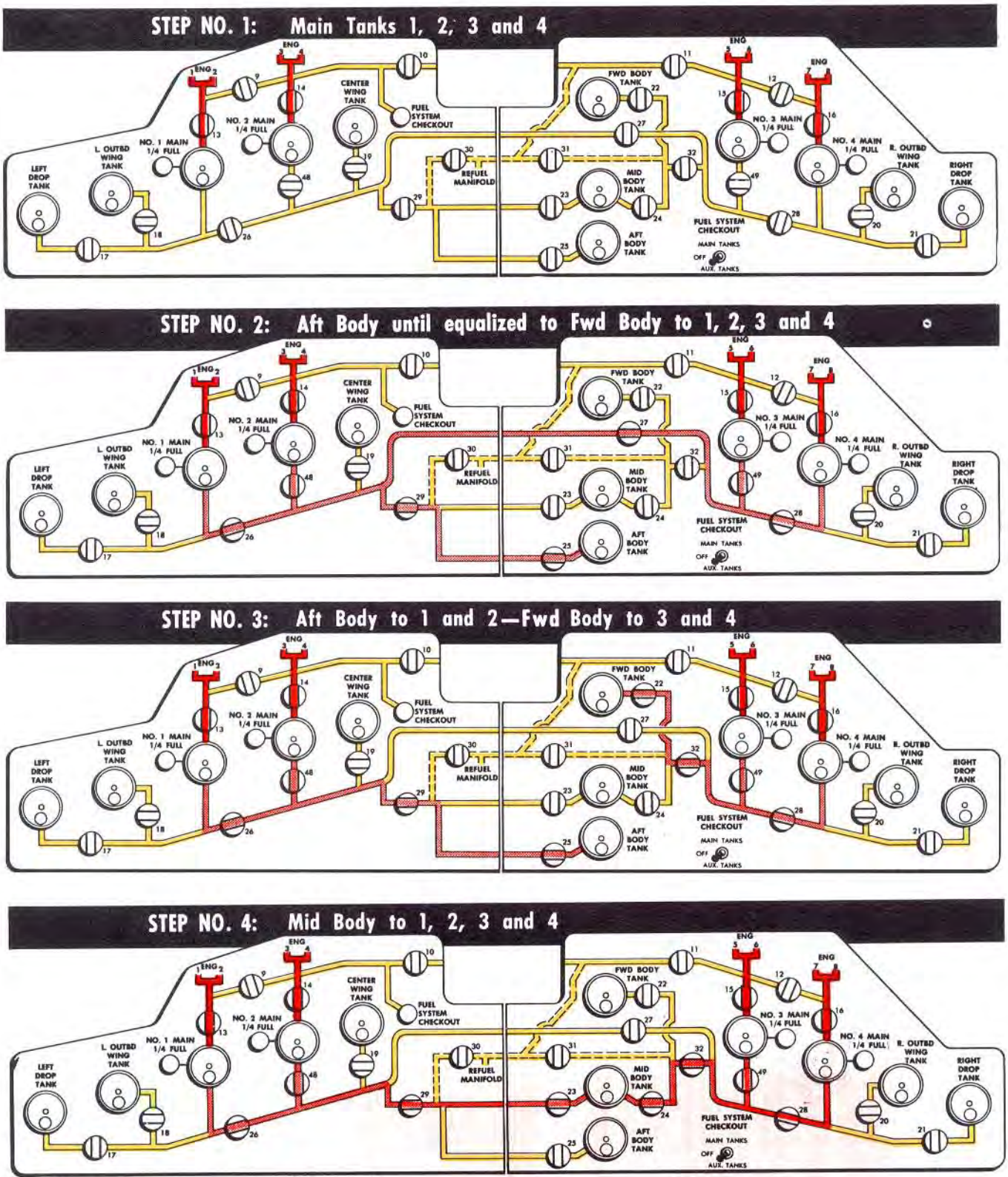
Step 5. AFT BODY TO 1 & 2
FORWARD BODY TO 3 & 4

Step 6. MID BODY TO 1, 2, 3 & 4

Step 7. LEFT WING TO 1 & 2 (DOWN TO 10,000 POUNDS)
RIGHT WING TO 3 & 4 (DOWN TO 10,000 POUNDS)

Step 8. LEFT WING TO 1
NO. 2 MAIN
NO. 3 MAIN
RIGHT WING TO 4

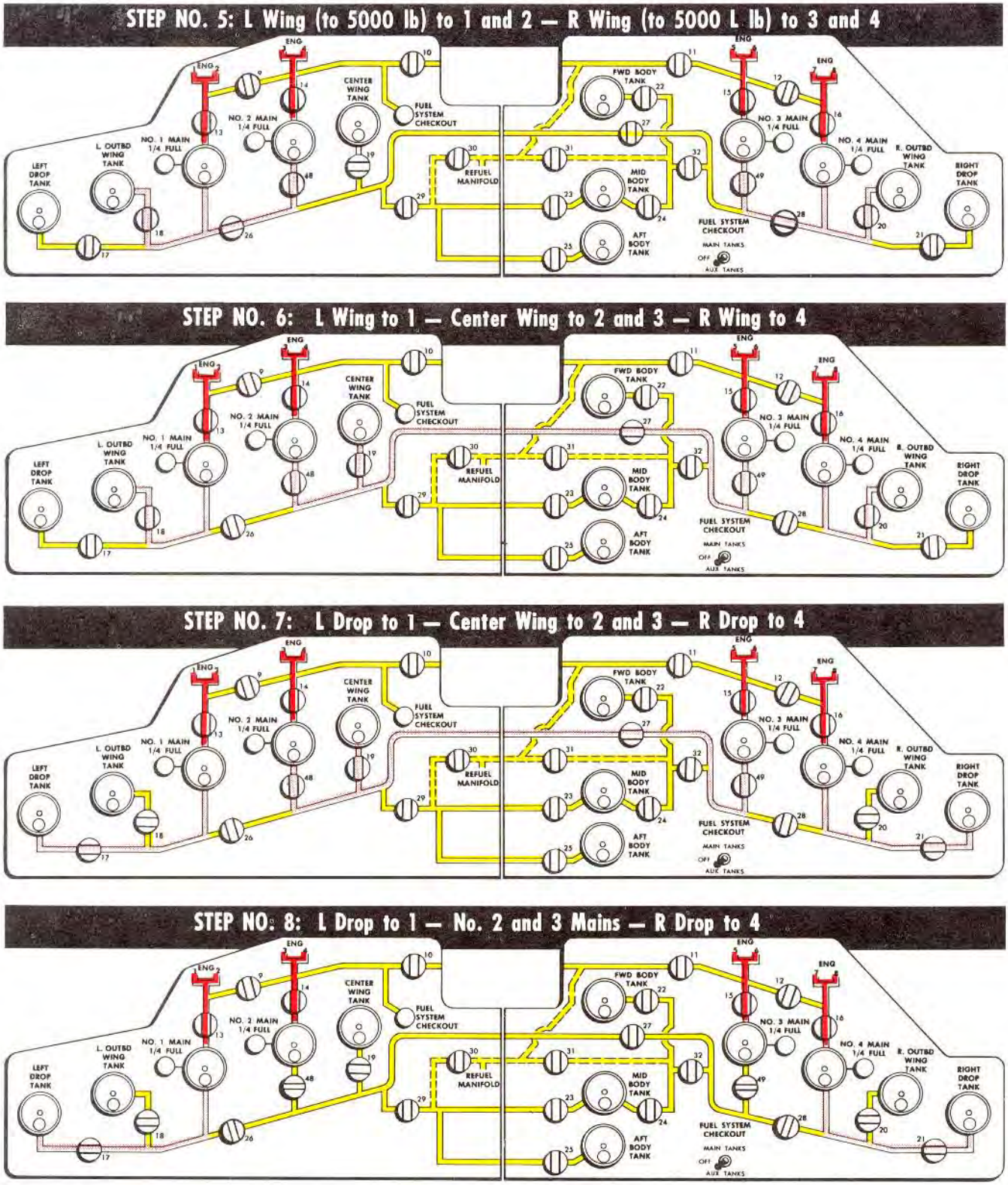
Step 9. MAINS 1, 2, 3 & 4



NOTE

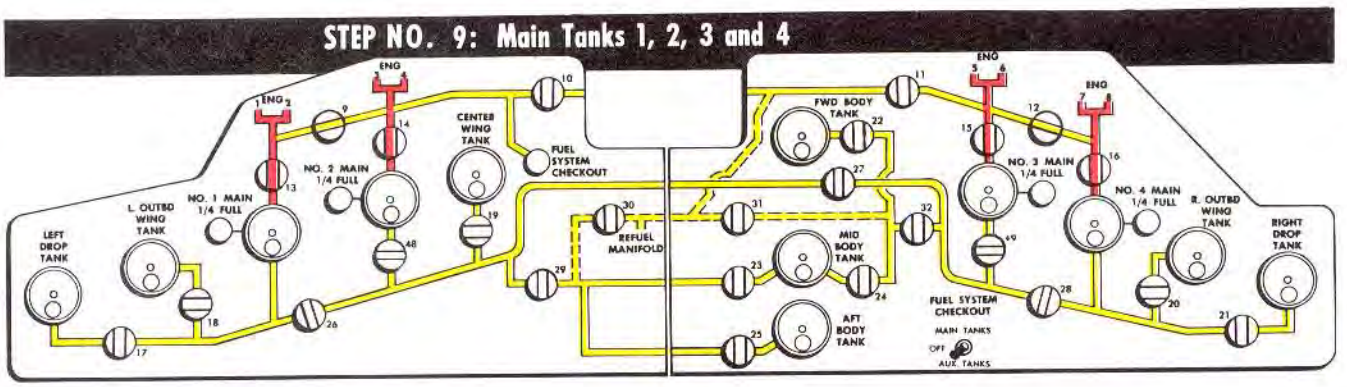
- IF THE OPERATING WEIGHT (BASIC WEIGHT PLUS CREW AND OIL) CG FALLS AFT OF 31% MAC, INTERCHANGE STEPS 3 AND 4 OF THE NORMAL FUEL USAGE SEQUENCE.
- SEE FIGURES 7-4, 7-4A, AND 7-4B FOR OPERATION WITH GAM-77 MISSILES.

Figure 7-2 (Sheet 1 of 3).



..... fuel system normal operation (typical)

Figure 7-2 (Sheet 2 of 3).



fuel system normal operation (typical) (cont)

Figure 7-2 (Sheet 3 of 3).

Normal Fuel System Operation With Two Missiles

The AGM-28A or AGM-28B missile is supplied fuel from the carrier aircraft fuel transfer manifold. Fuel to the missile fuel tank is controlled by special wing valves that have been installed in the carrier aircraft. Proper management of the fuel supply system is accomplished by using a special fuel sequence (figure 7-4) when carrying AGM-28's. This sequence will maintain the aircraft cg within safe limits as shown in figure 5-8A. It also provides for maximum wing structural life by using all body fuel before outboard, center wing, and drop tank fuel. After the first step of 8% mains, the 92% level in the four main tanks is maintained through step 4 by transfer from the body tanks. During step 5, main tank fuel will be used until mains 1 and 4 are down to 6000 pounds each. Provide missile tank refuel from the center wing tank by opening transfer valves 19 and 27. At this time, mains 2 and 3 will be approximately 8500 pounds each. During steps 6 and 7, fuel transfer from the outboards, center wing, and drop tanks will refill the main tanks to 92%. Step 8 provides for fuel transfer from the drop tanks to all mains until each drop tank contains 7000 pounds plus ballast fuel required. Step 9 provides for transfer of drop tank fuel to mains 1 and 4 (maintaining 92%) while using main tanks 2 and 3 fuel below the 92% level. During this step, use 7000 pounds of fuel from each drop tank down to the ballast fuel requirement and 7000 pounds from each of mains 2 and 3. Step 10 supplies fuel from all mains with crossfeed valves 9 and 12 open when any main tank reaches 5000 pounds.

NOTE

If missiles are not launched, determine the amount of drop tank ballast fuel to be retained from figure 7-4C.

EWO Fuel System Operation With Two Missiles

With two AGM-28 missiles carried aboard the aircraft under EWO conditions, the fuel management sequence is changed to provide the retention of protected fuel for use in the target area and for jettison of drop tanks at the earliest possible time. The fuel sequence described in figure 7-4A accomplishes this purpose. Step 1 uses 8% of main tank fuel. Steps 2 and 3 use drop tank and center wing fuel. Step 4 accomplishes fuel transfer from the aft body tank to all mains until the quantity is equal to that of the forward body tank plus the ballast requirements. Step 5 uses forward and aft body fuel equally until the forward body tank is empty and only ballast fuel remains in the aft body tank. Step 6 uses mid body fuel to all main tanks. In step 7, use outboard wing fuel to all mains down to 10,000 pounds in each outboard wing tank. During step 8, mains 1 and 4 will be maintained at 92% until the wing tanks are empty. Mains 2 and 3 will be at approximately 6500 pounds each after completing step 8. Main tank fuel is used during step 9 with crossfeed valves 9 and 12 open when any main tank indicates 5000 pounds or less.

NOTE

If missiles are not launched, determine the amount of aft body tank ballast fuel to be retained from figure 7-4C.

Fuel System Operation With One Missile

When carrying only one missile, lateral unbalance and trim requirements can be minimized by using a differential fuel load in the drop tanks. The off-loaded tank should be on the same side of the aircraft as the missile. The maximum differential fuel quantity which can be used without exceeding flutter limits is 2000 pounds. Lateral trim will also be required to completely counterbalance the single missile. Figure 7-4D shows the drop tank ballast fuel required for maintaining the aircraft cg aft of the forward structural limit at low gross weight. The single missile sequence shown in figure 7-4B is the same as the two-missile sequence except for fuel quantities in steps 8 and 9 and the ballast requirements. The sequence shown assumes the missile to be installed on the left wing.

NOTE

If missile is not launched, determine the amount of drop tank ballast fuel to be retained from figure 7-4D.

Fuel Usage Sequence with External Bomb Racks UM

NOTE

UM

For conventional bombing with external racks and bombs installed, the "EWO Fuel Sequence When Carrying Two Missiles," figure 7-4A, will be used. This sequence is valid whether or not drop tanks are installed. If drop tanks are not installed, delete steps 2 and 3 from the sequence. See figure 7-4C for aft body tank fuel ballast requirements if bombs are retained.

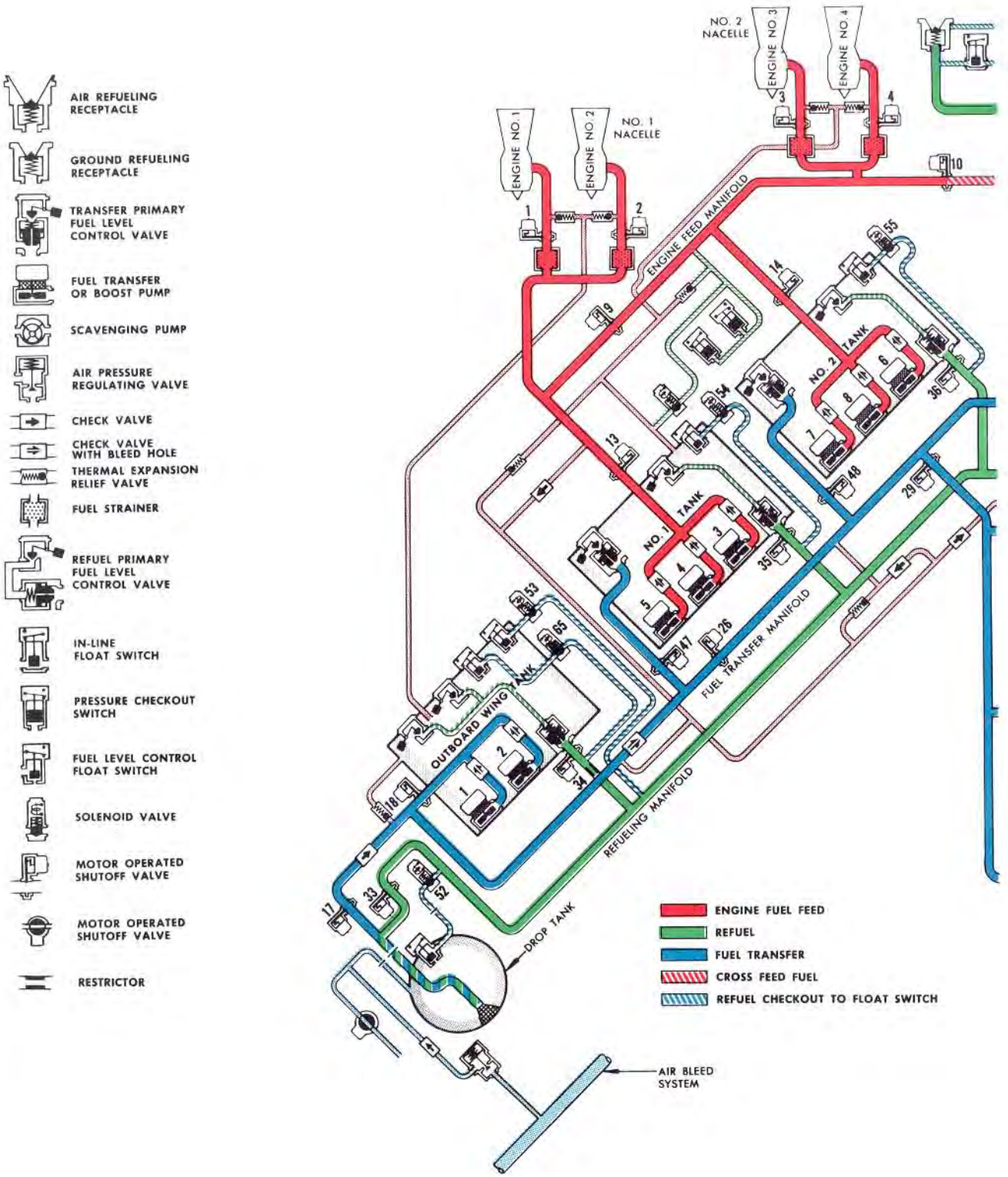
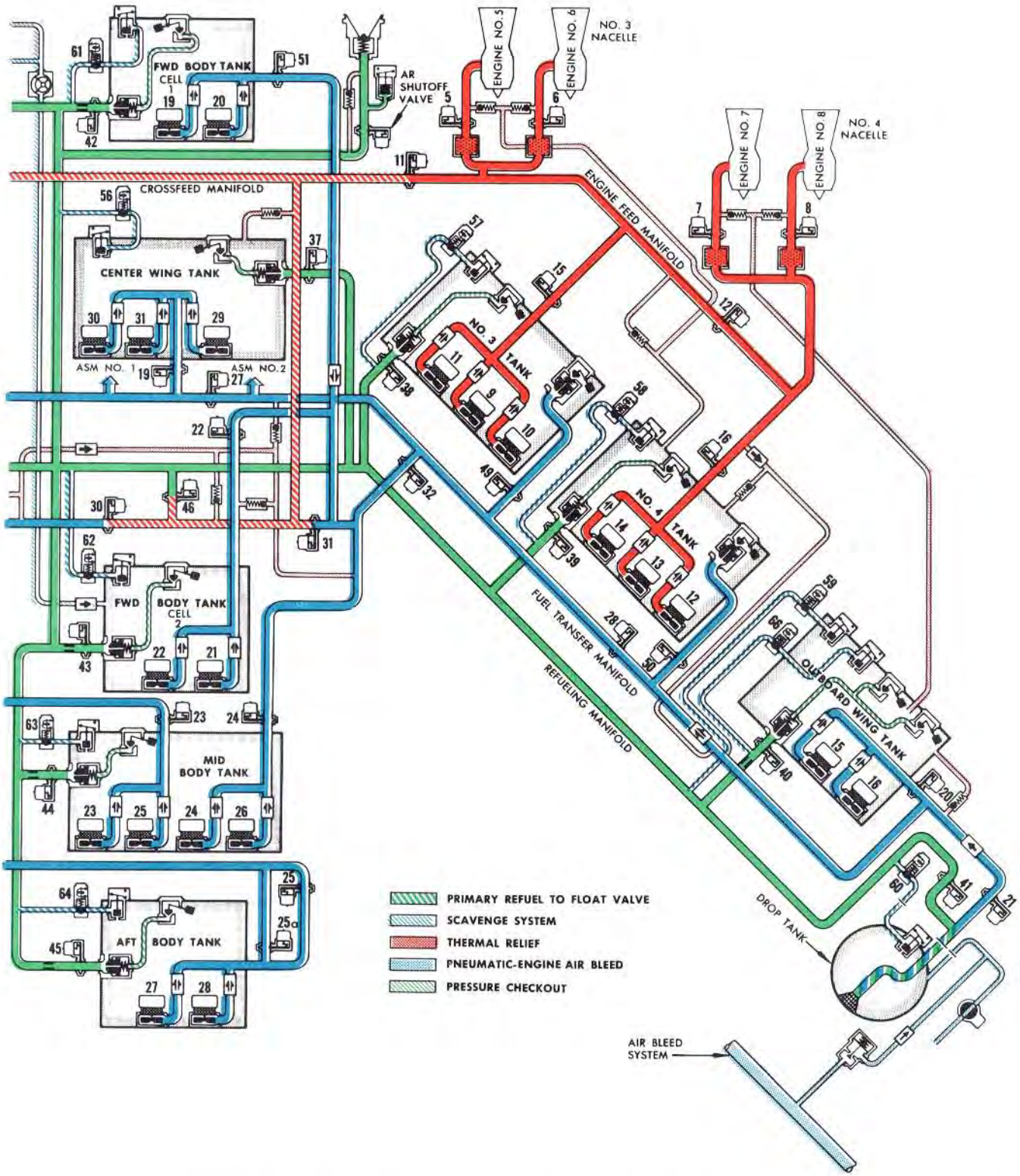


Figure 7-3 (Sheet 1 of 2).



.....fuel system composite (typical)

Figure 7-3 (Sheet 2 of 2).

NORMAL FUEL SEQUENCE WHEN CARRYING TWO MISSILES

NOTE

- FOR OPERATING WEIGHT (BASIC WEIGHT PLUS CREW AND OIL), CG FROM 24% TO 31% MAC.
- DETERMINE FROM FIGURE 7-4C THE AMOUNT OF DROP TANK BALLAST FUEL TO BE RETAINED IF MISSILES ARE NOT LAUNCHED.
- USE BALLAST FUEL IMMEDIATELY FOLLOWING MISSILE LAUNCH IF STEP 6 HAS BEEN ACCOMPLISHED. USE LEFT DROP TO MAINS 1 AND 2, RIGHT DROP TO MAINS 3 AND 4.
- THE FOLLOWING FUEL SEQUENCE WILL ALSO BE USED FOR ALL CONVENTIONAL BOMBING TRAINING MISSIONS WITH EXTERNAL RACKS AND BOMBS INSTALLED. DETERMINE FROM FIGURE 7-4C THE AMOUNT OF DROP TANK BALLAST FUEL TO BE RETAINED IF BOMBS ARE NOT DROPPED. UM

STEP 1	
Use 8% Mains	
STEP 2	
Aft Body (until equalized to Forward Body) to Mains 1, 2, 3, and 4	
STEP 3	
Aft Body to Mains 1 and 2 Forward Body to Mains 3 and 4	
STEP 4	
Mid Body to Mains 1, 2, 3, and 4	
STEP 5	
Mains 1, 2, 3, and 4	(DOWN TO 6000 POUNDS IN 1 AND 4) USE FUEL FROM CENTER WING FOR MISSILE TANK REFUEL. OPEN TRANSFER VALVES 19 AND 27
STEP 6	
Left Wing to Main 1 Center Wing to Mains 2 and 3 Right Wing to Main 4	
STEP 7	
Left Drop to Main 1 Center Wing to Mains 2 and 3 Right Drop to Main 4	
STEP 8	
Left Drop to Mains 1 and 2 Right Drop to Mains 3 and 4	(DOWN TO 7000 POUNDS PLUS BALLAST FUEL) (DOWN TO 7000 POUNDS PLUS BALLAST FUEL)
STEP 9	
Left Drop to Main 1 No. 2 Main No. 3 Main Right Drop to Main 4	(USE 7000 POUNDS) (USE 7000 POUNDS) (USE 7000 POUNDS) (USE 7000 POUNDS) DROP TANK BALLAST FUEL MUST BE RETAINED IF MISSILES ARE NOT LAUNCHED
STEP 10	
Mains 1, 2, 3, and 4	OPEN CROSSFEED VALVES 9 AND 12 WHEN ANY MAIN TANK INDICATES 5000 POUNDS OR LESS

normal fuel system operation with two missiles

Figure 7-4.

EWO FUEL SEQUENCE WHEN CARRYING TWO MISSILES

NOTE

- FOR OPERATING WEIGHT (BASIC WEIGHT PLUS CREW AND OIL), CG FROM 24% TO 31% MAC.
- DETERMINE FROM FIGURE 7-4C THE AMOUNT OF AFT BODY TANK BALLAST FUEL TO BE RETAINED IF MISSILES ARE NOT LAUNCHED.
- USE BALLAST FUEL IMMEDIATELY FOLLOWING MISSILE LAUNCH. USE AFT BODY TO MAINS 1, 2, 3, AND 4.
- UM THE FOLLOWING FUEL SEQUENCE WILL ALSO BE USED FOR CONVENTIONAL BOMBING WHEN EXTERNAL RACKS AND BOMBS ARE INSTALLED. IF DROP TANKS ARE NOT INSTALLED, DELETE STEPS 2 AND 3. DETERMINE FROM FIGURE 7-4C THE AMOUNT OF AFT BODY TANK BALLAST FUEL TO BE RETAINED IF BOMBS ARE NOT DROPPED.

STEP 1	
Use 8% Mains	
STEP 2	
Left Drop to Main 1 Center Wing to Mains 2 and 3 Right Drop to Main 4	DO NOT EXCEED 280 KNOTS IAS OR MACH .90 INDICATED UNTIL ALL DROP TANK FUEL IS USED
STEP 3	
Left Drop to Mains 1 and 2 Right Drop to Mains 3 and 4	
STEP 4	
Aft Body to Mains 1, 2, 3, and 4	AFT BODY BALLAST FUEL MUST BE RETAINED IF MISSILES ARE NOT LAUNCHED
STEP 5	
Aft Body to Mains 1 and 2 Forward Body to Mains 3 and 4	
STEP 6	
Mid Body to Mains 1, 2, 3, and 4	
STEP 7	
Left Wing to Mains 1 and 2 Right Wing to Mains 3 and 4	(DOWN TO 10,000 POUNDS) (DOWN TO 10,000 POUNDS)
STEP 8	
Left Wing to Main 1 No. 2 Main No. 3 Main Right Wing to Main 4	
STEP 9	
Mains to 1, 2, 3, and 4	OPEN CROSSFEED VALVES 9 AND 12 WHEN ANY MAIN TANK INDICATES 5000 POUNDS

EWO fuel system operation with two missiles

Figure 7-4A.

FUEL SEQUENCE WHEN CARRYING ONE MISSILE

NOTE

- FOR OPERATING WEIGHT (BASIC WEIGHT PLUS CREW AND OIL), CG FROM 24% TO 31% MAC.
- A MAXIMUM DIFFERENTIAL OF 2000 POUNDS MUST BE RETAINED IN DROP TANKS TO COUNTERBALANCE THE SINGLE MISSILE. QUANTITIES SHOWN ARE FOR MISSILE INSTALLED ON LEFT WING; REVERSE QUANTITIES FOR RIGHT WING INSTALLATION.
- DETERMINE FROM FIGURE 7-4D THE AMOUNT OF DROP TANK BALLAST FUEL TO BE RETAINED IF MISSILE IS NOT LAUNCHED.
- USE BALLAST FUEL IMMEDIATELY FOLLOWING MISSILE LAUNCH IF STEP "6" HAS BEEN ACCOMPLISHED. USE LEFT DROP TO MAINS 1 AND 2, RIGHT DROP TO MAINS 3 AND 4.

STEP 1	
Use 8% Mains	
STEP 2	
Equalize Forward and Aft Body Tank to Mains 1, 2, 3, and 4	
STEP 3	
Aft Body to Mains 1 and 2 Forward Body to Mains 3 and 4	
STEP 4	
Mid Body to Mains 1, 2, 3, and 4	
STEP 5	
Mains 1, 2, 3, and 4	(DOWN TO 6000 POUNDS IN 1 AND 4) USE FUEL FROM CENTER WING FOR MISSILE TANK REFUEL. OPEN TRANSFER VALVES 19 AND 27
STEP 6	
Left Wing to Main 1 Center Wing to Mains 2 and 3 Right Wing to Main 4	
STEP 7	
Left Drop to Main 1 Center Wing to Mains 2 and 3 Right Drop to Main 4	
STEP 8	
Left Drop to Mains 1 and 2 Right Drop to Mains 3 and 4	(DOWN TO 6000 POUNDS PLUS BALLAST FUEL) (DOWN TO 8000 POUNDS PLUS BALLAST FUEL)
STEP 9	
Left Drop to Main 1 No. 2 Main No. 3 Main Right Drop to Main 4	(USE 6000 POUNDS) (USE 6000 POUNDS) (USE 6000 POUNDS) (USE 6000 POUNDS)
STEP 10	
Mains 1, 2, 3, and 4	OPEN CROSSFEED VALVES 9 AND 12 WHEN ANY MAIN TANK INDICATES 5000 POUNDS OR LESS

fuel system operation with one missile and one pylon

Figure 7-4 B.

NORMAL FUEL SEQUENCE

DROP TANK FUEL BALLAST REQUIREMENTS WHEN CARRYING TWO MISSILES

OPERATING WEIGHT* CG % MAC	WITH FULL CHAFF AND FULL AMMO		WITH FULL CHAFF		WITH FULL AMMO		WITHOUT CHAFF OR AMMO	
	LEFT DROP POUNDS	RIGHT DROP POUNDS	LEFT DROP POUNDS	RIGHT DROP POUNDS	LEFT DROP POUNDS	RIGHT DROP POUNDS	LEFT DROP POUNDS	RIGHT DROP POUNDS
24	4,000	4,000	5,500	5,500	5,500	5,500	7,000	7,000
25	3,000	3,000	4,500	4,500	4,500	4,500	6,000	6,000
26	2,000	2,000	3,500	3,500	3,500	3,500	5,000	5,000
27	1,000	1,000	2,500	2,500	2,500	2,500	4,000	4,000
28	0	0	1,500	1,500	1,500	1,500	3,000	3,000
29	0	0	500	500	500	500	2,000	2,000
30	0	0	0	0	0	0	1,000	1,000
31	0	0	0	0	0	0	0	0

EWO FUEL SEQUENCE

AFT BODY FUEL BALLAST REQUIREMENTS WHEN CARRYING TWO MISSILES

OPERATING WEIGHT* CG % MAC	WITH FULL CHAFF AND FULL AMMO	WITH FULL CHAFF	WITH FULL AMMO	WITHOUT CHAFF OR AMMO
	AFT BODY FUEL POUNDS	AFT BODY FUEL POUNDS	AFT BODY FUEL POUNDS	AFT BODY FUEL POUNDS
24	10,000	12,500	12,500	15,000
25	8,000	10,500	10,500	13,000
26	6,000	8,500	8,500	11,000
27	4,000	6,500	6,500	9,000
28	2,000	4,500	4,500	7,000
29	0	2,500	2,500	5,000
30	0	500	500	3,000
31	0	0	0	1,000

*BASIC WEIGHT PLUS CREW AND OIL

NOTE

- IF EXTERNAL TANKS ARE RETAINED, THE AFT BODY FUEL BALLAST FIGURES MAY BE REDUCED BY 2,000 POUNDS.
- THESE CHARTS ARE TO BE USED FOR TRAINING FLIGHTS ONLY AND DO NOT INCLUDE BALLAST REQUIREMENTS FOR BOMB BAY LOADS. BALLAST REQUIREMENTS MUST BE DETERMINED WHEN CARRYING BOMB BAY LOADS TO INSURE THAT CG LIMITS WILL NOT BE EXCEEDED.

ballast requirements when carrying two missiles

Figure 7-4 C.

OPERATING WEIGHT* CG % MAC	WITH FULL CHAFF AND FULL AMMO		WITH FULL CHAFF		WITH FULL AMMO		WITHOUT CHAFF OR AMMO	
	LEFT DROP POUNDS	RIGHT DROP POUNDS	LEFT DROP POUNDS	RIGHT DROP POUNDS	LEFT DROP POUNDS	RIGHT DROP POUNDS	LEFT DROP POUNDS	RIGHT DROP POUNDS
24	0	0	1,000	1,000	1,000	1,000	2,000	2,000
25	0	0	0	0	0	0	1,000	1,000
26	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0
31	0	0	0	0	0	0	0	0

*BASIC WEIGHT PLUS CREW AND OIL

NOTE

THIS CHART IS TO BE USED FOR TRAINING FLIGHTS ONLY AND DOES NOT INCLUDE BALLAST REQUIREMENTS FOR BOMB BAY LOADS. BALLAST REQUIREMENTS MUST BE DETERMINED WHEN CARRYING BOMB BAY LOADS TO INSURE THAT CG LIMITS WILL NOT BE EXCEEDED.

ballast requirements when carrying one missile and one pylon

Figure 7-4D.

ELECTRICAL SYSTEM OPERATION

CONTROL CIRCUITS

A complete understanding of the d-c relays which control the primary electrical system is a valuable aid in the efficient operation of the electrical systems. All controls that effect the starting and routing of electrical power use 24-volt d-c switched-battery power with the exception of the voltage rheostats and frequency rheostats. This use of switched-battery power assures that with the battery switch in ON position, there will always be power available to start, control, and route power throughout the airplane. Control power for the external power relays is furnished by the external power carts.

INSTRUMENT INDICATIONS

Information which can be obtained from the electrical system instruments can be correctly interpreted only if the significance of the readings is understood. A brief explanation of the meaning of the instrument readings is given in the following paragraphs.

Voltage

Voltage is the electrical potential supplied by the batteries, TR units, or alternators. It can be thought of as the force which is pushing current through the lines. In the case of the alternators, the a-c voltmeter measures the effective voltage rather than the voltage at the peak of the cycle. The d-c voltmeter indicates either battery or TR voltage. Although TR voltage readings are taken from the individual units, resistance to current flow between each unit and the TR bus it feeds is so small that there is very little difference between bus voltage and unit voltage. For this reason, a TR unit voltage reading gives, in effect, the bus voltage. This is true even if the unit has failed.

Load

The d-c loadmeter measures current output of the TR units in decimal fractions of their rated loads. For instance, a reading of 0.5 for a TR unit rated at 100 amperes would indicate that a load of 50 amperes is being carried.

Frequency

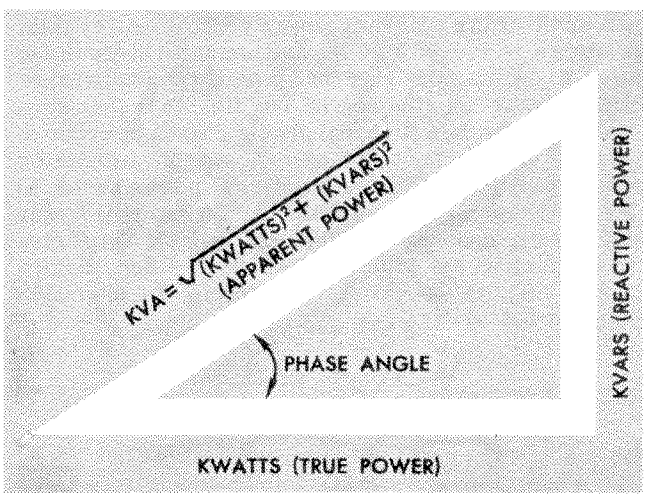
The a-c frequency meter tells the number of voltage (and current) cycles that occur in each second. One complete cycle is considered 360 electrical degrees and each phase reaches a voltage and a current peak in either direction once during each cycle. Since this is a balanced three-phase system, the voltage peaks of the three phases are separated by one-third of a cycle or 120°.

Power

If the current and voltage peaks occur simultaneously or are continuous as in a d-c system, the power (time rate of doing work) is the product of the current and the voltage. However, the reactive elements (inductance and capacitance) in an a-c system almost always cause the current to lead or lag behind the peak of the voltage and their product will give an apparent power. True power is a function of the apparent power and the amount of lead or lag. It can be read on the a-c power meter when the selector switch is in KWATTS position. Some of the power delivered to the circuit by the alternator during one part of the cycle is "kicked back" to the alternator during another part of the cycle by the reactive elements in the circuit. Such power is called reactive power and can be read on the power meters when the selector switch is in KVARS position. The apparent power, true power, and reactive power are related to each other in magnitude in the same way as the three sides of a right triangle (figure 7-5). The true power and reactive power can be represented by the legs of the triangle and the apparent power by the hypotenuse. The angle between the sides representing the true power and apparent power is equal in degrees to the cycle lead or lag of the current relative to the voltage and is called the phase angle. The power factor is used as a means of expressing the above relationships and can be most simply defined as the result of dividing the true power by the apparent power. In terms of KWATTS and KVARS, which can be read on the power meters, the power factor can be expressed as the result of dividing the KWATTS by the square root of the sum of the squares of the KWATTS and KVARS. Power limits established for the a-c system are based on a reasonable power factor of 0.75. See "Alternator Load Limits" (figure 7-6) and "Electrical Loads Chart" (figure 3-15A) for more detailed information on power limits.

Synchronization

In order that two or more alternators may be used simultaneously to supply power to a central bus (parallel operation), their voltage cycles must coincide and the voltage of all the alternators must be approximately equal. If the peak voltage of an alternator should occur at a different time than that of the bus, then current that should have been used to power the consuming units will flow between the bus and the alternator. This current can be directed through the synchronizing lights by means of the voltage and frequency selector switch.



$$\text{POWER FACTOR} = \frac{\text{KWATTS}}{\sqrt{(\text{KWATTS})^2 + (\text{KVARS})^2}}$$

A-C power relationships

Figure 7-5.

The lights will blink as the voltages of the bus and alternator are alternately in and out of phase until the cycles are brought into synchronization by means of the frequency rheostat. The two lights provided on the a-c control panel indicate the degree of synchronization between two of the three phases on the bus and the two corresponding phases on the selected alternator.

Phase Sequence

With faulty wiring, it is possible to have the three phases of the external a-c power enter the airplane system with their voltage peaks occurring in a reversed order in the cycle. As this situation can cause damage to some of the a-c units, the phase sequence indicator must be checked before routing external power into the central bus tie.

EXTERNAL POWER

To connect external power, several preliminary steps must first be accomplished. The battery switch should be turned on and a check made of the battery not charging lights. These lights should illuminate since TR power for charging is not available. The alternator circuit breakers should be open since the control circuit for external power is routed through the open side of these circuit breakers. A check that the four indicator lights are on would be sufficient to determine the correct position of the alternator circuit breakers since these lights use switched-battery power. If the lights are out, the circuit breaker switches should be pushed to OPEN. When external power is plugged in, the phase, voltage, and frequency can be checked with a single movement of the external power switch. After this, the switch is moved to ON position and external d-c power will close the external power circuit breaker bringing power into the central bus tie. It is then necessary that the bus tie breakers be closed in order to power all units on the airplane. Closing any alternator switch, positioning the main external power switch to OFF, or removing the plug will isolate external power from the airplane system if the "Ext Pwr CB Trip" circuit breaker on the copilot's panel is in. See "Before Starting Engines Checklist," Section II, for operation with external power.

ALTERNATOR OPERATION

Starting

B-52E

Before starting the alternators, the alternator circuit breakers should be open so that each alternator will be separated from the a-c power system. Bus tie breakers are closed to prevent "dropout" of power to any one bus when external power is cut as the first alternator is put on the line. To start the alternators, each of the four alternator switches is momentarily held to ON position. Each switch controls power through a pressure switch (if sufficient pneumatic pressure exists) to open the pneumatic shutoff valve and close the exciter control relay for its corresponding alternator. This will cause bleed air to be routed to the drive and completes a circuit which enables the exciter generator to energize the alternator field. When all four alternators are running, a check should be made with the ground crew to ascertain that alternator ground blowers are operating.

B-52F

Each alternator should be turned on before the engine which drives it is started. ON position of the alternator switch closes the exciter control relay. This completes a circuit which enables the exciter generator to energize the alternator field when the engine is started and the alternator driven. With the alternator turned on, low frequency a-c power will be generated as the engine begins to turn over. Therefore the alternator circuit breaker should be open to protect electronic equipment from the effects of low frequency power. The underspeed switch ordinarily provides this protection but normal procedures in Section II call for checking the circuit breaker open (light on), and manual opening if necessary, as an extra safeguard. Bus tie breakers should be closed. This will prevent the possible "dropout" of any electrical equipment when external power is cut as the first alternator is brought on the line. As soon as the engines are started, a check should be made with the ground crew to ascertain that alternator cooling air is coming out of the exhaust port in the nacelle.

B-52E B-52F

Before putting the alternators on the line, attention should be given to the voltage and frequency. The aircraft system was designed to operate on voltages from 200 to 210 volts. However, for more efficient operation of some of the electronic equipment, the voltage of all alternators should be checked and, if necessary, adjusted as close as possible to 205 volts. The frequency should be checked along with voltage. The frequency meter should read 400 (±5) cycles per second. The alternators are placed on the line in the sequence and manner described in "Starting Engines and Before Taxiing Checklist," Section II. When the first alternator circuit breaker is closed, the external power circuit breaker will trip and isolate external power from the aircraft. Power from the first alternator will be routed through the central bus tie to all of the distribution boxes. As each remaining alternator is put on the line, the automatic paralleling button will send closing pulses to both alternator circuit breaker and corresponding bus tie circuit breaker provided the synchronizing lights are blinking very slowly. If the lights are blinking too fast, or are on steady, it indi-

cates that there is too much difference between the frequencies of the alternator and the central tie bus for paralleling. If the frequencies of the alternator and the central bus are exactly equal, as indicated by the lights being out, the automatic paralleling device may not operate. On aircraft Less ND, the frequency of the alternator should be readjusted and the paralleling button again depressed. On aircraft ND, jogging of the engine speed is required if alternators do not parallel. After paralleling, all alternator circuit breaker lights and all bus tie breaker lights should be out.

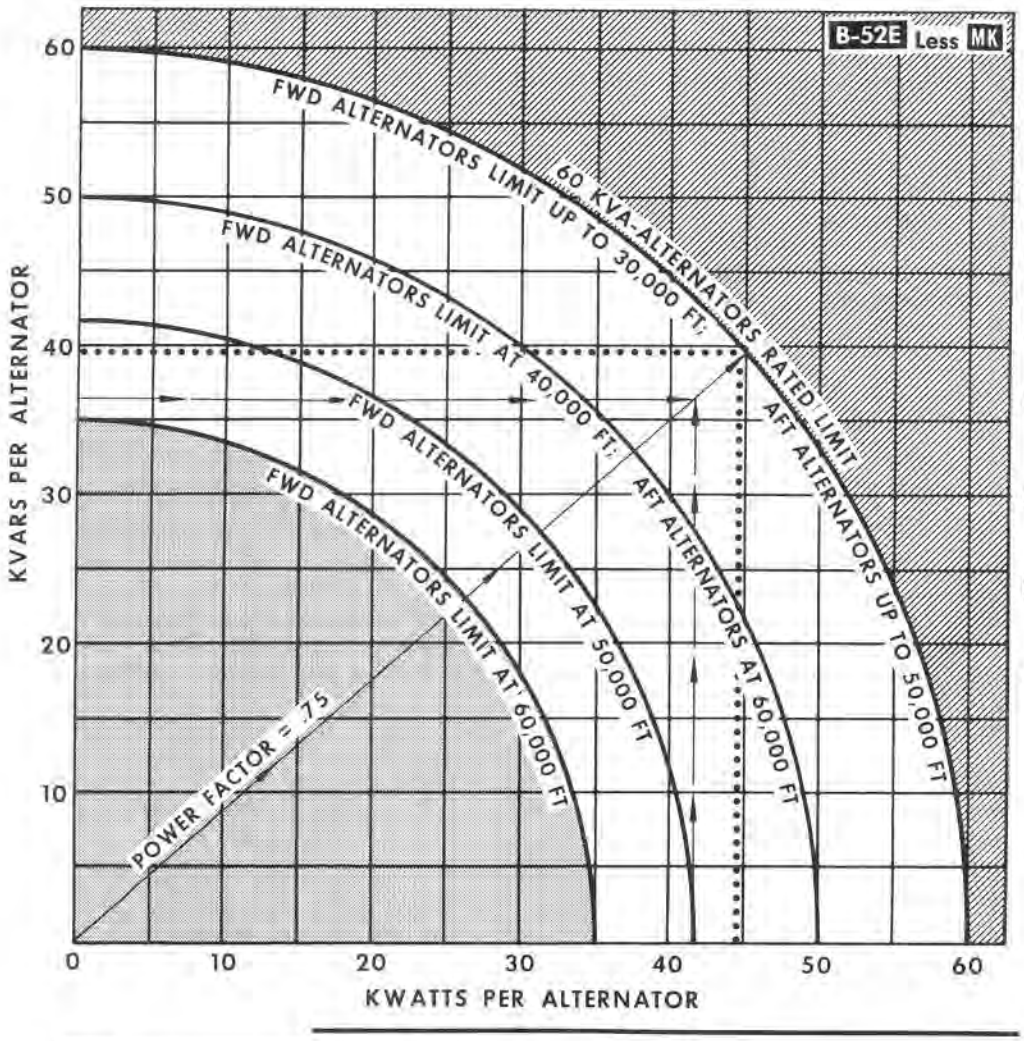
Shutdown

B-52E

The alternators should not be shut down in flight except when air bleed is insufficient to operate all four alternators. This condition will be indicated by consistent (several seconds or longer) illumination of the alternator overload lights. Normally this can be corrected by increasing engine power. Any combination of alternators may be shut down without a loss of equipment if the bus tie breakers remain closed. In the extreme case when only one alternator is operating, unnecessary electrical loads should be turned off. The alternators should always be shut down before cutting engines since low frequencies from lack of engine bleed air will cause high voltage and blow circuit limiters throughout the airplane. See "Electrical System Emergency Operation," Section III.

B-52F

Since each alternator is mechanically linked to an engine it is not possible to completely shut it down (that is, stop it from turning) without cutting the engine. However, there are three things which can be done if considered necessary: 1) the alternator can be isolated by opening its bus tie breaker, 2) it can be taken off the line by opening its alternator circuit breaker, and 3) its voltage output can be cut completely by placing the alternator switch to OFF position (or by pulling the firewall fuel shutoff valve switch) to deexcite the field. Automatic protective features may also accomplish one or more of the above actions in case of malfunction. Because of load requirements and rated limits an alternator normally should not be shut down in flight. However, the alternator circuit breakers should be opened before engine shutdown. This will protect the circuits from the effects of low frequencies in case the underspeed protective feature does not operate. See "Electrical System Emergency Operation," Section III.



NOTE: This chart is good at cruising speeds only. At slower than cruising speeds, the alternator load limits are further reduced.

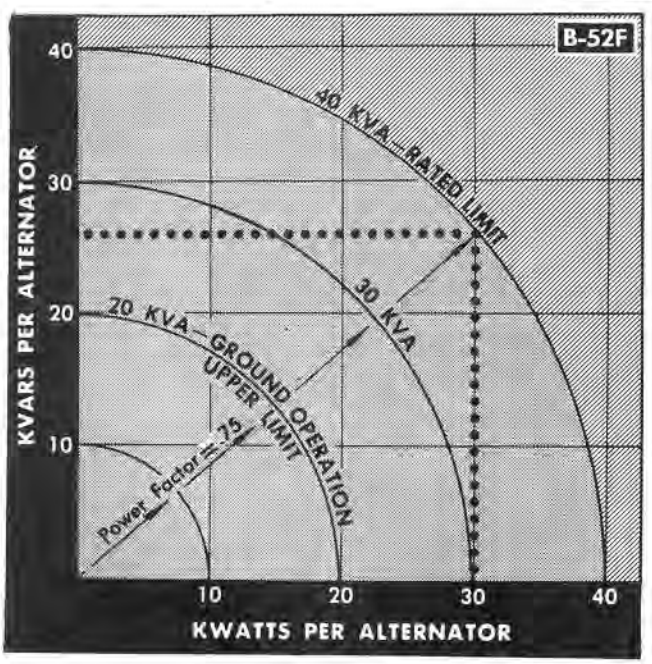
EXAMPLE: At 45,000 feet, a reading of 42 KWATTS and 36 KVARS is obtained. From the intersection of these coordinates it can be determined that this loading is damaging to the FWD alternators but not to the AFT alternators.

Permissible loading on any alternator below 60,000 feet.

Permissible loading on alternator as indicated by applicable limit line.

Prohibited loading on any alternator at any altitude.

KWATTS and KVAR limits as marked on power meters. See figure 5-1, INSTRUMENT MARKINGS.

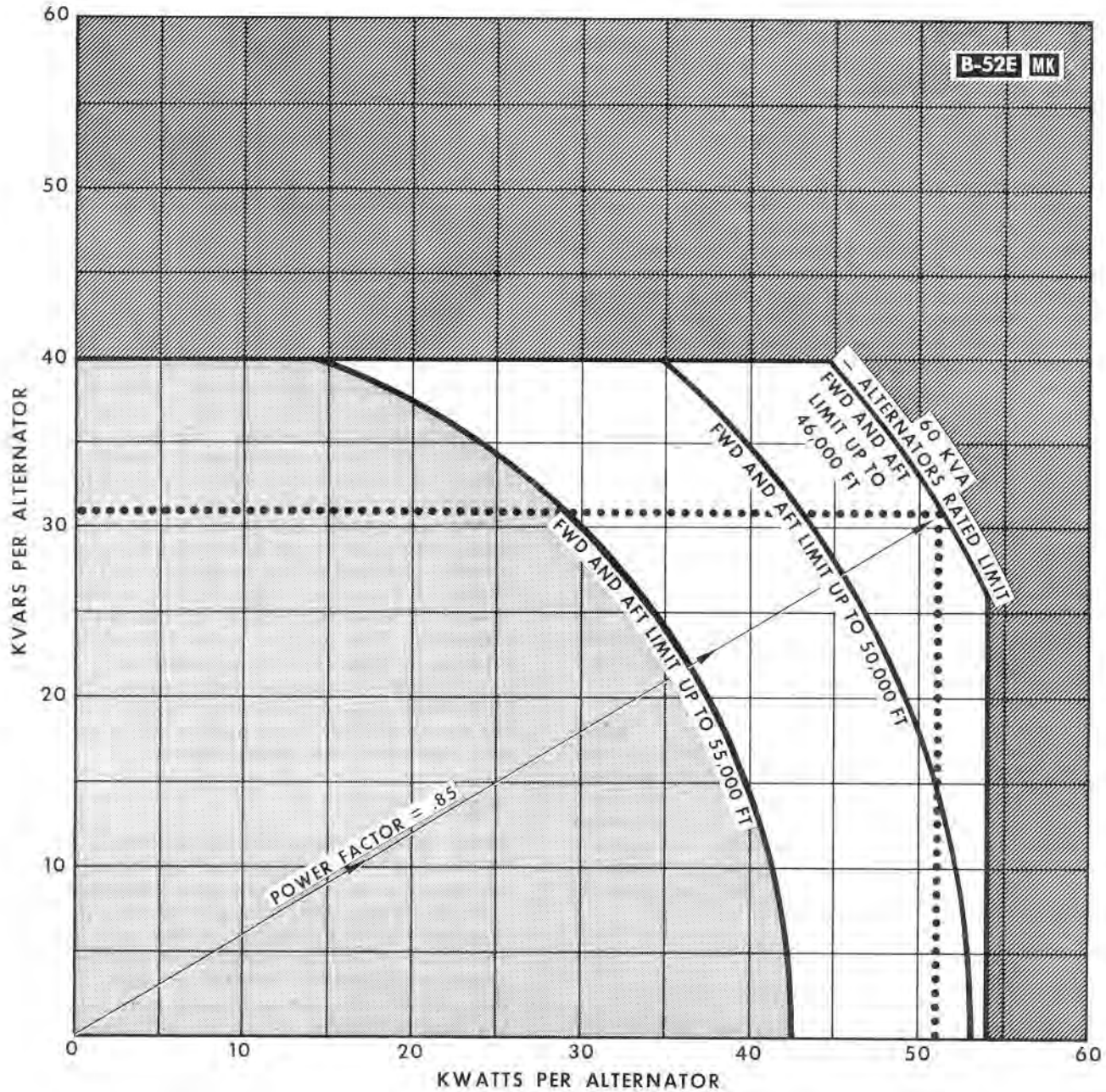


Permissible operating range

Prohibited operating range

KWATT and KVAR limits as marked on power meters. See figure 5-1.

Figure 7-6 (Sheet 1 of 2).



NOTE: This chart is good at cruising speeds only. At slower than cruising speeds, the alternator load limits are further reduced.

Permissible loading on any alternator below 55,000 feet.

Permissible loading on alternator as indicated by applicable limit line.

Prohibited loading on any alternator at any altitude.

KWATTS and KVAR limits as marked on power meters. See figure 5-1, INSTRUMENT MARKINGS.

alternator load limits

Figure 7-6 (Sheet 2 of 2).

ELECTRICAL LOADS

B-52E Less MK

The alternators are designed to carry 60 kva at a reasonable power factor; however, they are limited at altitude by less efficient cooling of the alternator packs. This is particularly true of the forward packs. For instance, if the airplane is at 45,000 feet and the alternator load readings are 42 kwatts and 36 kvars, it can be seen from figure 7-6 that the load would be damaging for the forward alternators. Even though this load would be permissible for the aft alternators, the output of the system must be reduced for parallel operation. For isolated (independent) operation, only the load on the forward alternators would have to be adjusted. All alternators have an overload capacity that allows them to operate at 120 kva for 5 seconds or at 90 kva for 5 minutes.

B-52E MK

The alternators are designed to carry 60 kva at a reasonable power factor; however, they are limited at altitudes above 46,000 feet due to lack of cooling air. For operation above 46,000 feet, the load limit lines shown on figure 7-6 must be used. Figure 7-6 shows the forward and aft alternators with the same capacity. If the alternators were operated isolated, the aft alternators could carry more load than indicated in figure 7-6. All alternators have an overload capacity that allows them to operate at 120 kva for 5 seconds or at 90 kva for 5 minutes.

B-52F

The alternators are designed to carry 40 kva at a reasonable power factor. All alternators have an overload capacity that allows them to operate at 72 kva for 5 seconds or at 60 kva for 5 minutes. During ground operation the alternators are limited to 50% of rated power (about 18 kwatts per alternator) due to insufficient cooling air. See figure 7-6 to determine the allowable alternator operating range.

Negative TR Loadmeter Indications

The output of each transformer-rectifier (TR) unit can be checked by using the voltmeter, loadmeter, and selector switches on the copilot's d-c control panel. When a check is made of any of the TR units of either the forward or aft bus, the loadmeter may show a negative indication for some of the units. Negative loadmeter readings are an inherent characteristic of the d-c system due to the nature of the loadmeter and voltmeter wiring, not the result of malfunctioning units. The reason for negative load readings on the loadmeter when little or no load is drawn from the TR bus is that a small portion of the current which operates the voltmeter flows backward through the loadmeter. This condition occurs independently of TR unit voltage.

Alternator Speed-Load Characteristics

The alternator drives are designed to maintain equal load division (for parallel operation) and constant alternator output frequency regardless of alternator load. For a description of the drives, see "A-C Power System," Section I.

Parallel Operation

All electrical loads are divided among the four alternators during parallel operation. Should any alternator or drive unit fail, the load would be automatically redistributed among the remaining three. Two or more alternators operating in parallel must have the same frequency (speed) and voltage. The real power (kwatts), however, may vary to some degree between alternators operating in parallel because of the tolerance in the speed load curve of the drive units. The real load difference can be adjusted by use of the frequency rheostats. Normally the difference should be set to within 2 kwatts and need not be readjusted until it exceeds 4 kwatts. If this spread cannot be held, a maximum difference of 9 kwatts on B-52E (6 kwatts on B-52F) is allowable. The reactive power (kvars) division between parallel alternators is controlled by the voltage adjust rheostats on the a-c control panel. The reactive load should be so adjusted that the difference between any two alternators is not greater than 4 kvars. Constant fine adjustment is not required.

Isolated Operation

Under certain conditions, as outlined in Section III, "Electrical System Emergency Operation," it may be necessary to operate one or more alternators isolated from the rest of the system by opening their corresponding bus tie breakers. In this case, each alternator that is isolated operates to supply power to a separate independent system and each such system has a distribution box and one or more load boxes for the electrical units.

NOTE

Do not attempt to equalize alternator loads during isolated operation. Since each alternator carries the load on its own bus and the real and reactive loads (kwatts and kvars) cannot be divided, the load difference limits do not apply. Attempts to balance loads by adjusting the voltage and frequency rheostats may increase voltage on an alternator enough to trip the overvoltage relay.

NOTE

NF

Do not isolate an alternator which is known to have a permanent malfunction since power will be lost to that alternator bus.

For a clear understanding of this operation, reference should be made to figures 1-17, 1-17A, 1-18, 1-23, and 3-16. After a general understanding of the layout of the system is gained from figures 1-17 and 1-17A, the load boxes, panels, and shields supplied power by any isolated alternator can be determined from figure 1-18. Following this, units operated through the above sources of distribution can be determined from figure 1-23. Further, the load effect of each unit can be found from figure 3-16. The possibility of failure of an isolated alternator, or even complete power failure on the central tie bus, and on aircraft Less NF, resultant transfer of the failed units load to an alternate source must be kept in mind. The alternator which assumes the extra burden could become overloaded and trip off unless its output is monitored and kept within the protected limits. On aircraft Less NF, figure 1-17 will show which alternator will assume a particular load as an alternate source during isolated operation.

WHEEL BRAKE SYSTEM OPERATION

WHEEL BRAKE OPERATION

Brakes, themselves, merely stop the wheels from turning, but stopping the airplane is dependent on the friction of the tires on the runway. This frictional force, in turn, is dependent upon the load imposed on the wheel. Therefore, optimum braking action on landings cannot be expected until the tires are carrying heavy loads. Although the antiskid system allows for immediate braking after touchdown, lift should also be decreased as much as possible by extension of the airbrakes. The tendency for the tires to skid decreases considerably when the full weight of the airplane is on the wheels. It has been found that optimum braking occurs with approximately a 15% to 20% rolling skid; that is, the wheel continues to rotate but has approximately 15% to 20% slippage on the surface so that the rotational speed is 80% to 85% of the speed which the wheel would have were it in a free roll. As the amount of skid increases beyond this amount, the coefficient of friction decreases rapidly so that with a 75% skid the friction is approximately 60% of the optimum and with a full skid becomes even lower. There are two reasons for this loss in braking effectiveness with skidding. First, the immediate action is to scuff the rubber, tearing off little pieces which act almost like rollers under the tire. Second, the heat generated starts to melt the rubber and the molten rubber acts as a lubricant between the tire and the ground surface.

BRAKE DESIGN

Aerodynamic braking should be utilized in an attempt to keep wheel brake usage to a minimum. To provide minimum brake weight, consistent with safe operation, the military specification to which the brakes are designed requires that they provide for only one maximum refused takeoff stop. Under such a condition, it is advisable to taxi clear of the runway using minimum braking before coming to a complete stop and not to apply the parking brake. It is possible that the overheated brakes may seize, resulting in considerable delay of runway operations. For brake energy limits, see figure 5-7A. Cold brakes on this aircraft may result from landing in a moderate headwind at light weight, on a long runway when little or no braking was done, or when there is a definite malfunction or failure of a brake. Usually some heat will be felt when approaching the wheel brake rotor or housing with the hand. The amount of heat radiating from the brake depends upon these variables: amount of braking needed to stop the aircraft, amount of hydraulic pressure delivered to the brakes, location of the wheel well doors affecting the airflow around the wheels, differential wheel loadings due to turns and crosswinds, and difference in rpm settings of the antiskid systems. Any heat at all radiating from a brake indicates that it has been operating satisfactorily, even though no two brakes will be at the same temperature.

WHEEL BRAKE LIMITATIONS

See "Wheel Brake Limitations" and "Tire Limitations," Section V.

ANTISKID OPERATION

The antiskid system is intended to prevent skids at high speed under light wheel loads and to provide optimum braking resulting in shorter stopping distances regard-

Figure 7-7 Deleted.

less of the surface conditions. Therefore, the antiskid switch should be ON during takeoff and landing. However, it should not be used to its maximum potential to purposely make all landing rolls as short as possible since this causes undue wear of the tires and brakes. While taxiing on a slippery surface with the antiskid switch ON, it is possible to lose up to 50% of the effective braking due to locked wheel conditions; the remaining braking action with antiskid protection is more effective than full braking without antiskid.

NOTE

Improper servicing of the shock struts or a malfunctioning landing gear safety switch may prevent transfer of the antiskid system from the "airborne" mode to the "ground" mode. If this occurs, the antiskid system automatically releases brakes when the aircraft is moving at a slow rate of speed as during taxiing. When loss of braking due to this condition is experienced, turning the antiskid switch OFF restores braking action without antiskid protection. When the antiskid switch is OFF, braking action depends entirely on the pressure applied to the brake pedals.

HYDRAULIC SYSTEM OPERATION

HYDRAULIC PACK LIMITATIONS

If an open circuit exists in the transmitting circuit between the hydraulic pressure transmitter and the hydraulic pressure gage, no signal will be generated to activate the gage autosyn. Thus a loss of pressure on a failed pack will not be reflected. Consequently, the pilot reads the same pressure for both the malfunctioning system and the system to which the selector switch was positioned just prior to being placed to the malfunctioning system.

ESCAPE SYSTEMS OPERATION

The airplane escape systems include the ejection seats and the jettisonable turret. Use of these systems will greatly increase the crew members' chances of safe escape from the airplane in time of emergency. Detailed descriptions and the inspection and operating checklists for the escape systems are properly placed in other sections of this flight manual. However, this discussion is presented to enable the crew members to round out their knowledge and to consolidate references made to the systems in other parts of the manual. Every crew member who might possibly be in a position to use an automatic escape system should be familiar with the system and have confidence in it. Although operation is simple, if you do not know the system well enough to operate it quickly and correctly, or if distrust of the automatic features causes you to manually override them, you may lessen your chances in an already dangerous situation. For step-by-step procedures and minimum altitudes for operating the escape systems, see "Bailout," Section III. A detailed description of the automatic opening parachute, which should be considered a part of each escape system, can be found under "Integrated Harness System," Section I. Information concerning the automatic release safety belts may also be found under the same title.

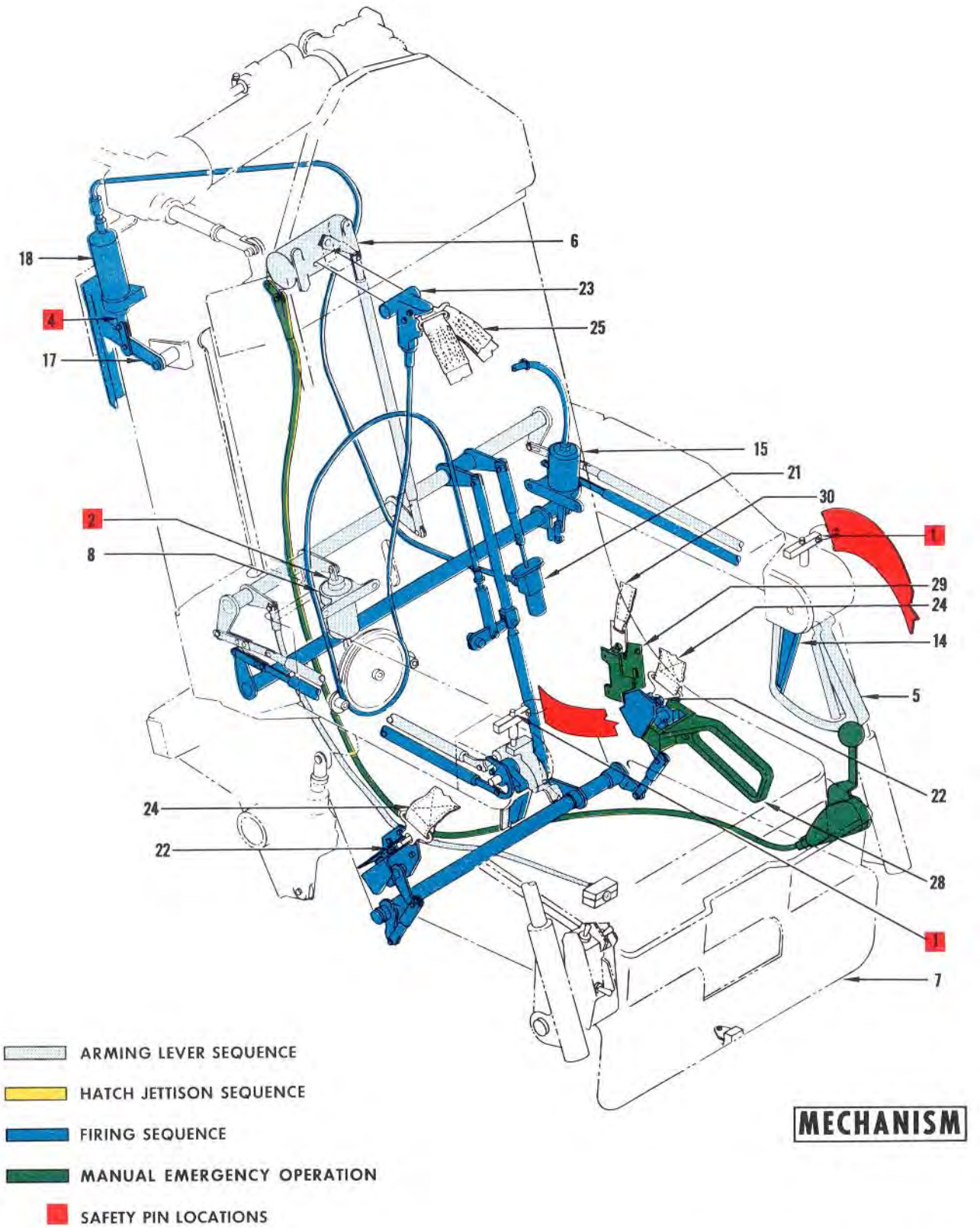
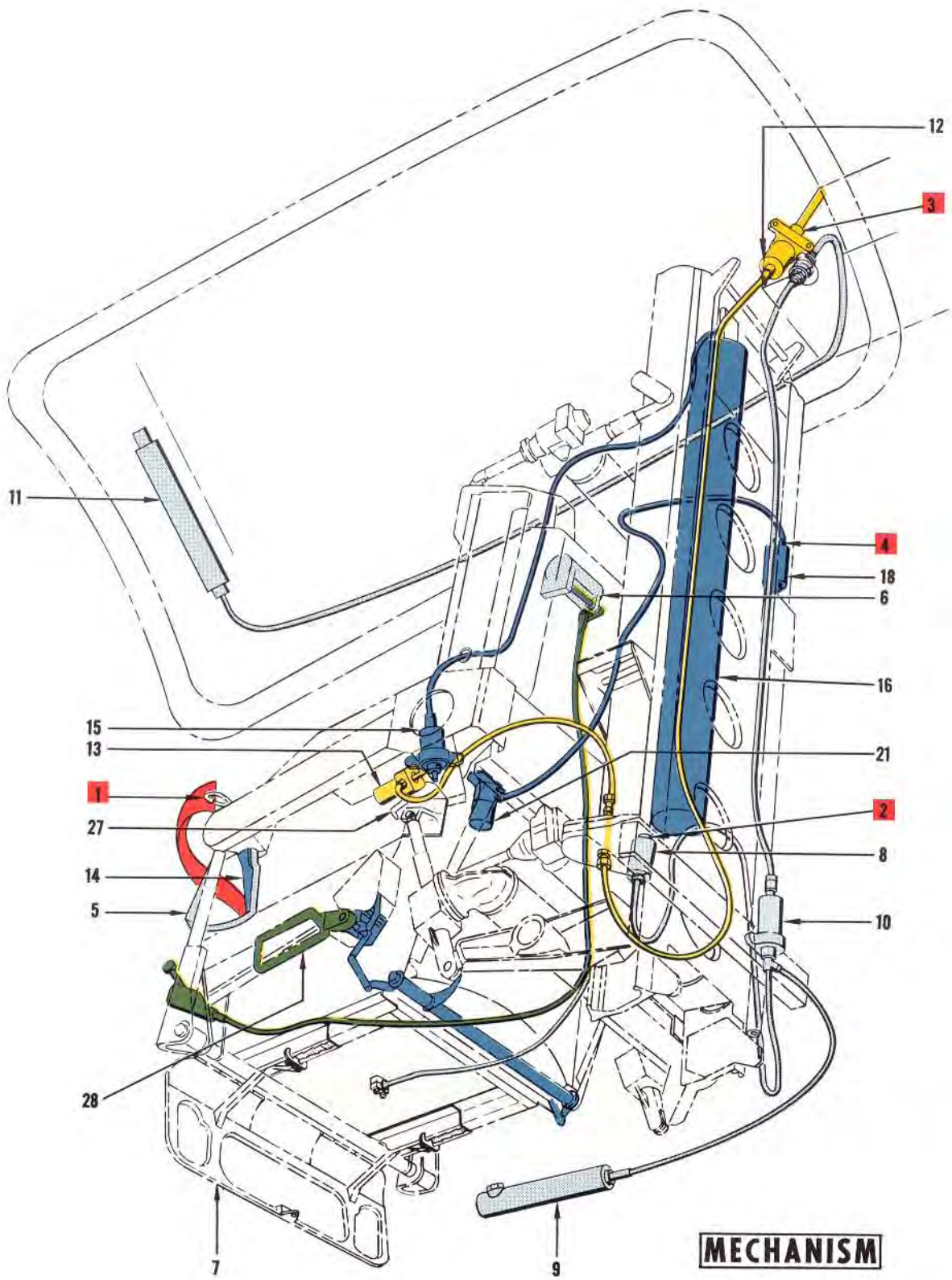


Figure 7-8 (Sheet 1 of 4).



upward ejection system

Figure 7-8. (Sheet 2 of 4)

NOTE
This is the key for sheets 1, 2, and 4.

EJECTION SEQUENCE

PRE-EJECTION PREPARATION

At least one of two **FLIGHT SAFETY PINS (1)**, and three **MAINTENANCE SAFETY PINS (2, 3, AND 4)** must be removed prior to accomplishing ejection sequence.

NOTE

The seat may be armed anytime the maintenance pins and either one of the No. 1 safety pins have been removed by rotation of same arming lever from which No. 1 pin has been removed.

ARMING SEQUENCE

Raise armrests to the up position. Squeeze arming lever release and rotate either, or both, **ARMING LEVERS (5)** forward and upward until locked. Rotation of arming lever locks **INERTIA REEL (6)**, thus locking shoulder straps (harness), unlocks **LEG SUPPORT (7)** which rotates and locks in armed position, and fires **ARMING INITIATOR (8)**. Gas expansion from arming initiator fires **CONTROL COLUMN STOWAGE THRUSTER (9)**, stowing the control column, and also fires the **HATCH JETTISONING INITIATOR (10)**. Gas expansion from the jettisoning initiator fires the **HATCH JETTISONING THRUSTER (11)** which unlocks and opens the hatch thus jettisoning the hatch. A link attached to the hatch and connected to the **CATAPULT SAFETY PIN-PULL INITIATOR (12)** fires the initiator. Gas expansion from the pin-pull initiator operates the **CATAPULT SAFETY PIN-PULL CYLINDER (13)**, withdrawing the pin from the catapult initiator (15) thus arming the seat.

NOTE

The control column stowage thruster (9) is not included on the EW officer's seat.

FIRING SEQUENCE

Pull **FIRING TRIGGER (14)**. Action of the linkage fires the **CATAPULT INITIATOR (15)**. Gas expansion from the initiator fires the **CATAPULT (16)**, ejecting the seat from the airplane. An **INTEGRATED HARNESS RELEASE TRIP (17)** actuates the **INTEGRATED HARNESS RELEASE INITIATOR (18)** as the seat leaves the airplane. After a 1-second delay the initiator fires.

Gas expansion from the harness release initiator (18) operates the **INTEGRATED HARNESS RELEASE PIN-PULL CYLINDER (21)**. Action of linkage unlocks the **SAFETY BELT RELEASE FITTINGS (22)** and the **SHOULDER STRAP RELEASE FITTING (23)**, releasing the **SAFETY BELT (24)** and **PARACHUTE HARNESS (25)** thus allowing the occupant to separate from the seat.

MANUAL EMERGENCY OPERATION

(Item 26 deleted)

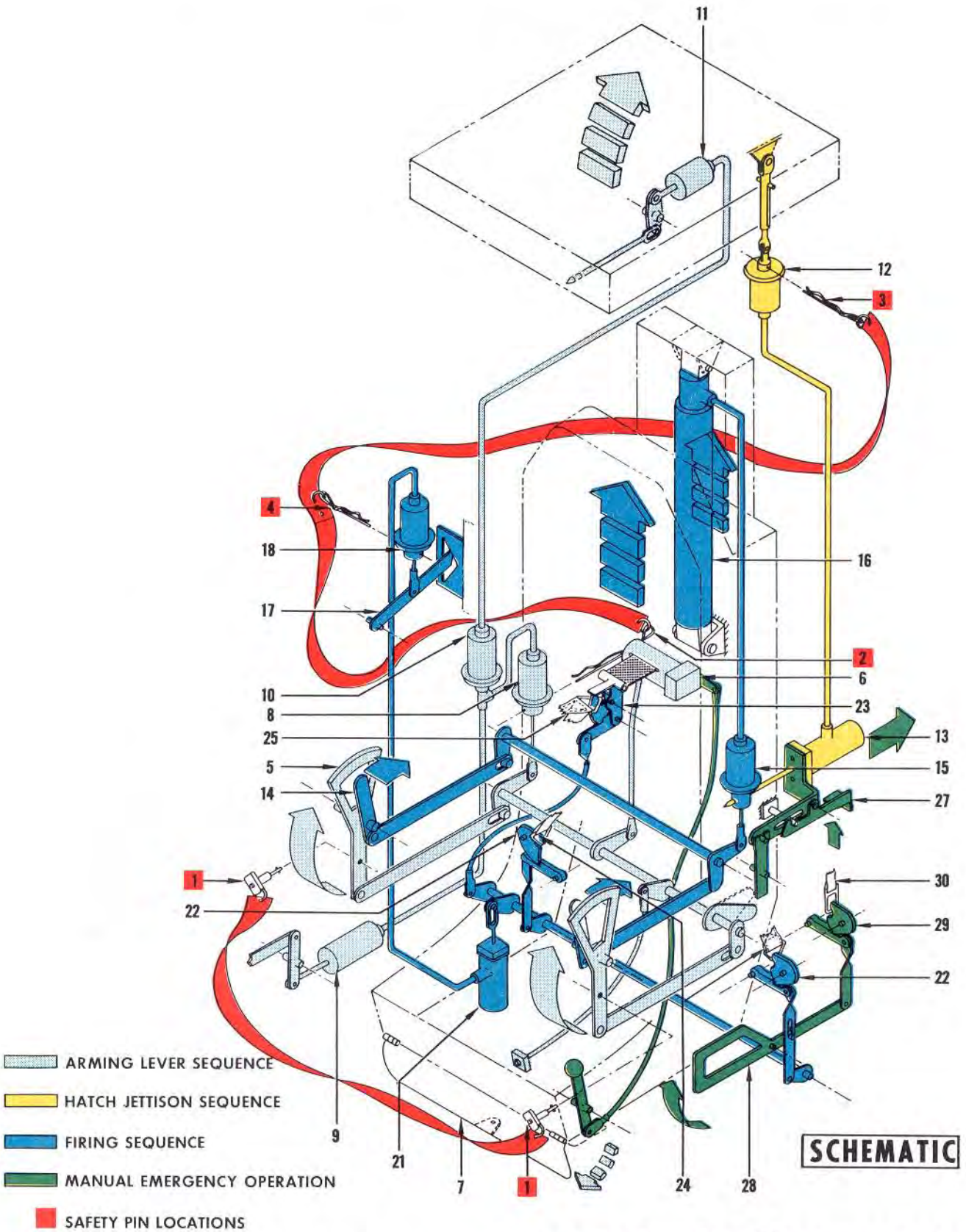
If the catapult initiator fails to fire when the trigger is squeezed, squeeze the **CATAPULT SAFETY PIN-PULL CYLINDER MANUAL RELEASE (27)** and withdraw the pin-pull cylinder, withdrawing the safety pin from the catapult initiator. Again squeeze trigger.

If the integrated harness release initiator fails to fire after a one-second delay, pull the **INTEGRATED HARNESS RELEASE HANDLE (28)**. Action of linkage unlocks the safety belt release fittings (22), the shoulder strap release fitting (23), and the **PARACHUTE ARMING LANYARD RELEASE FITTING (29)**, releasing the safety belt, parachute harness, and **PARACHUTE ARMING LANYARD (30)**, allowing the occupant to separate from the seat.

PREFLIGHT STATUS AND LOCATION OF SAFETY PINS

PIN NO.	LOCATION	REMOVED BY GROUND CREW	REMOVED BY FLIGHT CREW
No. 1	RH and LH Armrest (two)		✓
No. 2	RH Ejectable Rail (Arming Initiator)	✓	
No. 3	On rail support bulkhead at top of rails – (Catapult Safety Pin-Pull Initiator)	✓	
No. 4	On RH Ejectable Rail (Integrated Harness Release Initiator)	✓	

Figure 7-8. (Sheet 3 of 4)



upward ejection system

Figure 7-8. (Sheet 4 of 4)

PREFLIGHT STATUS AND LOCATION OF SAFETY PINS

PIN NO.	LOCATION	REMOVED BY GROUND CREW	REMOVED BY FLIGHT CREW
No. 1	Front Center of Seat Bucket (Ejection Control Trigger Ring **Less** V D) (Ejection Control Trigger Ring Release Mechanism Pin V D)		✔
No. 2	RH Ejectable Rail (Integrated Harness Release Initiator)	✔	
No. 3	Front Center of Seat Bucket (Arming Initiator)	✔	
No. 4	Fixed rail structure on lower LH side (Seat Positioning Initiator)	✔	
No. 5	RH rear corner of each hatch (Hatch Jettisoning Thruster)	✔	
No. 6	Body structure just aft of hatch only (Catapult Arming Pin-Pull Initiator)		✔

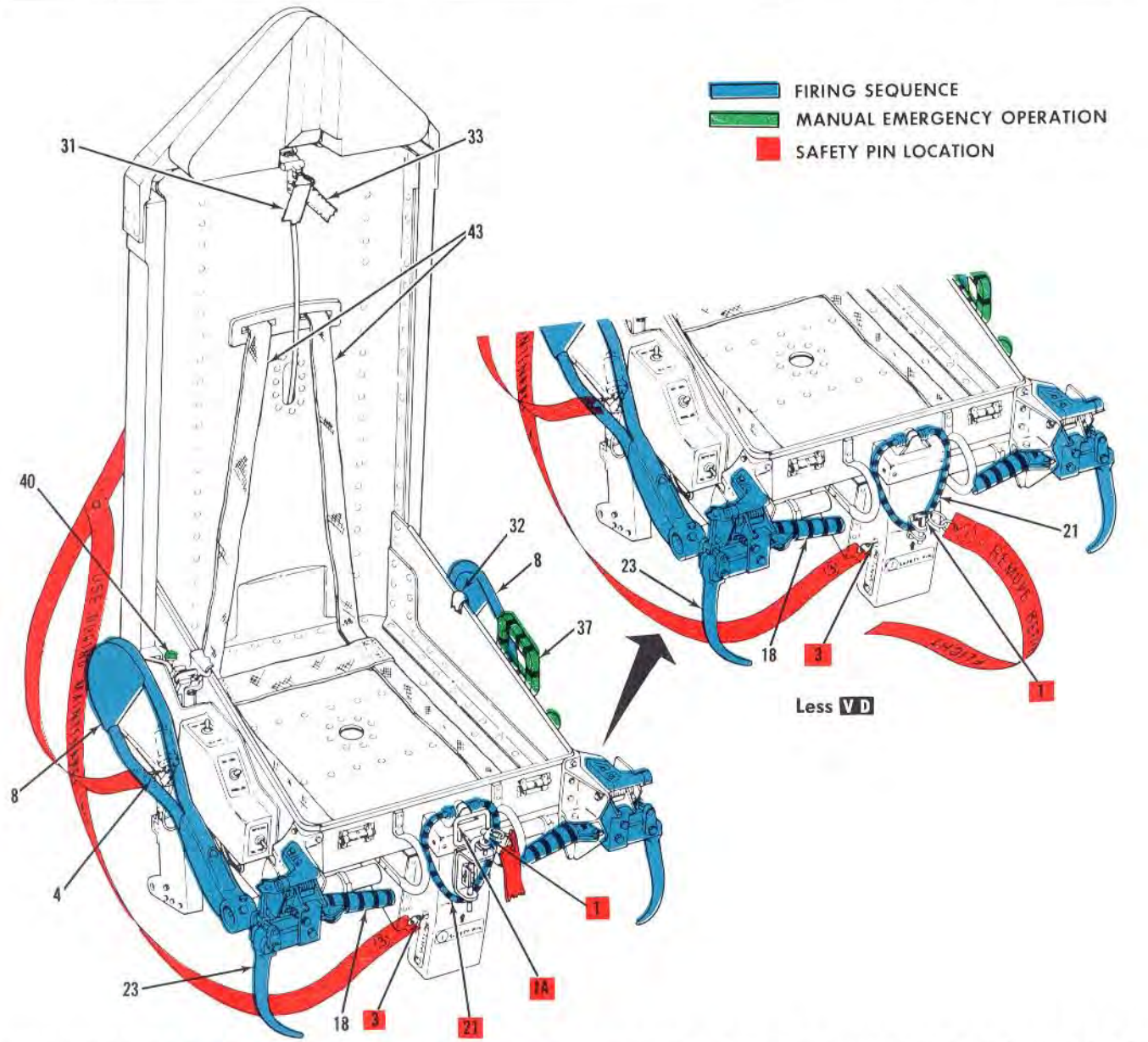


Figure 7-9 (Sheet 1 of 3).

NOTE

This is the key for sheets 1 and 3.

EJECTION SEQUENCE

PRE-EJECTION PREPARATION

Less VD

One FLIGHT SAFETY PIN (1) and five MAINTENANCE SAFETY PINS (2, 3, 4, 5, and 6) must be removed prior to accomplishing sequence.

VD

One FLIGHT SAFETY PIN (1) and five MAINTENANCE SAFETY PINS (2, 3, 4, 5, and 6) must be removed, and the EJECTION CONTROL TRIGGER RING RELEASE MECHANISM PIN (1A) must be actuated to release the ejection control trigger ring from the stowed position prior to accomplishing sequence.

ARMING AND FIRING SEQUENCE

Pull the EJECTION CONTROL RING (21) upward. A cable attached to the ring and connected through a shock absorber to the ARMING INITIATOR (11) fires the initiator. Gas expansion from the arming initiator fires the LEG GUARD THRUSTER (41) and operates the SEAT POSITIONING PIN-PULL CYLINDER (12). As the LEG GUARDS (8) rotate, the INERTIA REEL (9) is locked. Simultaneous action of mechanical linkage retracts the SEAT FORWARD LOCKING PINS (13), rotates the HATCH JETTISONING INITIATOR FIRING LUG (14) to the armed position and fires the SEAT POSITIONING INITIATOR (15). Gas expansion from the initiator fires the SEAT POSITIONING THRUSTER (16), swinging the seat back to the jettison position. Motion of the seat causes the hatch jettison firing lug to strike a cam which fires the HATCH JETTISONING INITIATOR (17). Gas expansion from the initiator fires the HATCH JETTISONING THRUSTER (18) which unlocks and opens the hatch, allowing the hatch to jettison. A link attached to the hatch and connected to the CATAPULT SAFETY PIN-PULL INITIATOR (19) fires the initiator. Gas expansion from the initiator operates the CATAPULT SAFETY PIN-PULL CYLINDER (20), withdrawing the pin from the CATAPULT INITIATOR (22), arming the seat. Further travel of cable linkage to the catapult initiator from the EJECTION CONTROL RING (21) through the shock absorber fires the CATAPULT (24), ejecting the seat from the airplane. As the seat leaves the airplane, an INTEGRATED HARNESS RELEASE INITIATOR TRIP (25) activates the INTEGRATED HARNESS RELEASE INITIATOR (26). After a delay of approximately 0.3 second, the initiator fires. Gas expansion from the integrated harness release initiator (26) operates the INTEGRATED HARNESS RELEASE PIN-PULL CYLINDER (29). (Items 27, 28, and 35 deleted.)

Action of linkage unlocks the SAFETY BELT RELEASE FITTINGS (30) and the SHOULDER STRAP RELEASE FITTING (31), releasing the SAFETY BELT (32) and PARACHUTE HARNESS (33). Gas expansion from the integrated harness release initiator also fires the INTEGRATED ROTARY ACTUATOR (42) which operates to pull the nylon MAN-SEAT SEPARATION STRAPS (43) and provide automatic controlled separation of the seat occupant from the seat following ejection.

MANUAL EMERGENCY OPERATION

If the radar navigator's (and the navigator's **Less UX Less UZ**) hatch jettisoning initiator fails to fire following seat positioning, pull the MANUAL HATCH JETTISON HANDLE (34) to fire the hatch jettisoning initiator. On aircraft **UZ**, simultaneously push the safety latch down with the thumb and pull the MANUAL HATCH JETTISON HANDLE (34) up with the forefinger.

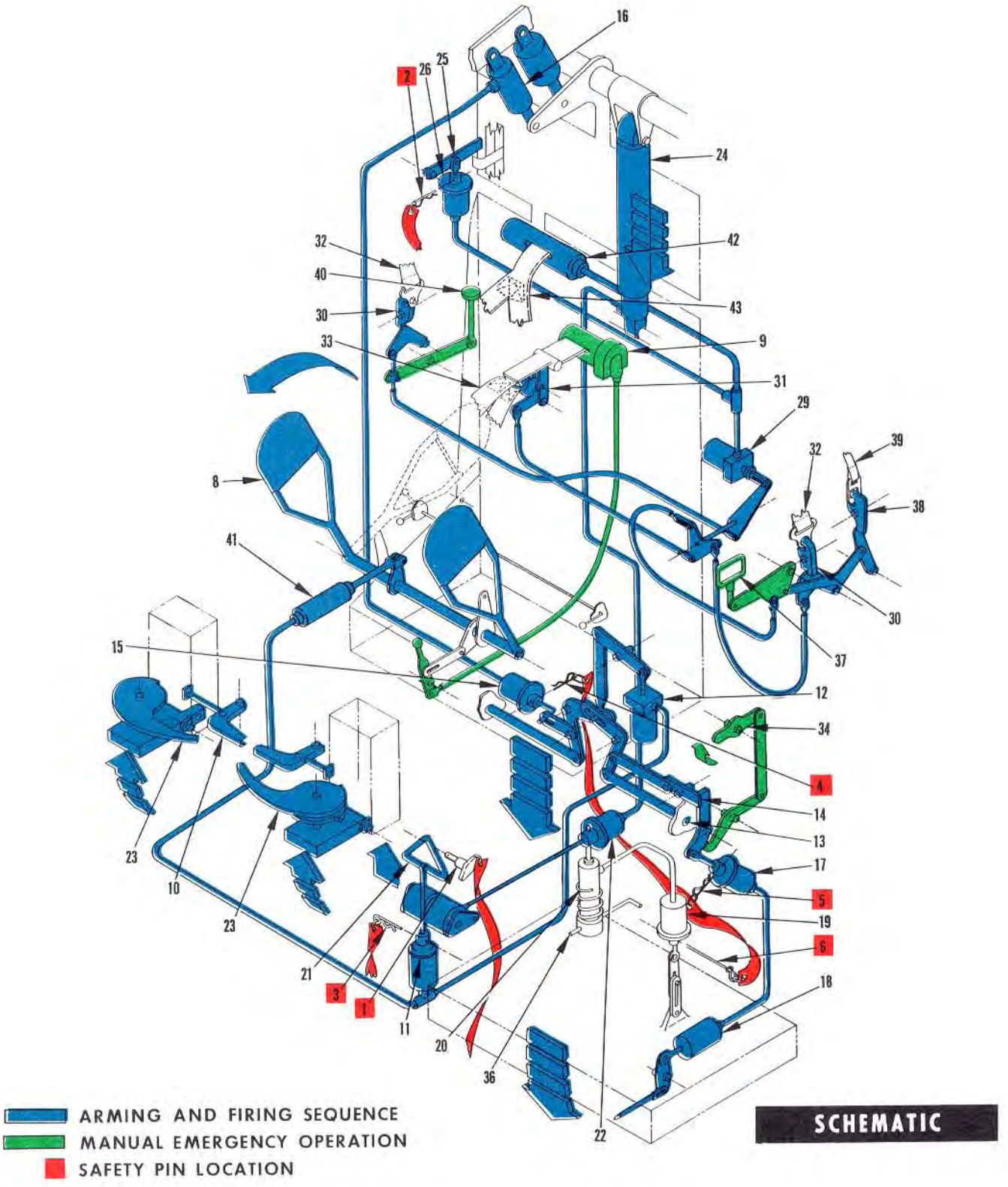
If the catapult initiator fails to fire when the ejection control ring is pulled, pull the MANUAL CATAPULT PIN-PULL RELEASE HANDLE (36) up to withdraw the pin-pull cylinder and pin from the catapult initiator.

If the integrated harness release initiator fails to fire, pull the INTEGRATED HARNESS RELEASE HANDLE (37). Action of linkage unlocks the safety belt release fitting (30), the shoulder strap release fitting (31), and the PARACHUTE ARMING LANYARD RELEASE FITTING (38), releasing the safety belt, parachute harness, and PARACHUTE ARMING LANYARD (39), allowing the seat occupant to separate from the seat.

If the integrated harness release handle has been pulled for reasons other than bailout and it is desired to reset the mechanism, push down on the INTEGRATED HARNESS RELEASE RESET BUTTON (40).

•••••••••••••••••••• downward ejection system

Figure 7-9 (Sheet 2 of 3).

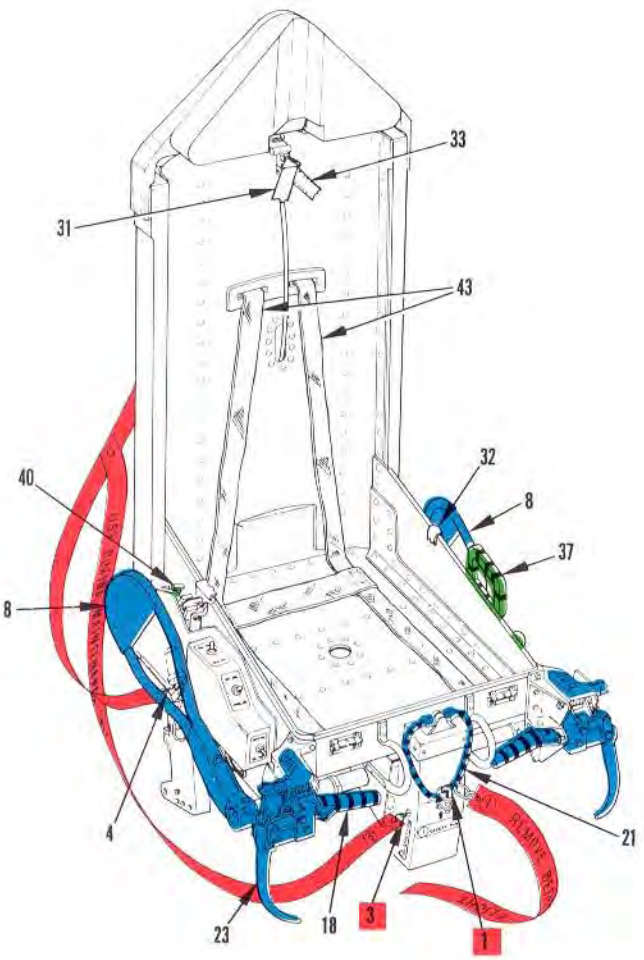


.....downward ejection system

Figure 7-9 (Sheet 3 of 3).

PREFLIGHT STATUS AND LOCATION OF SAFETY PINS HP KQ

PIN NO.	LOCATION	REMOVED BY GROUND CREW	REMOVED BY FLIGHT CREW
No. 1	Front Center of Seat Bucket (Ejection Control Trigger Ring)		✓
No. 2	RH Ejectable Rail (Integrated Harness Release Initiator)	✓	
No. 3	Front Center of Seat Bucket (Arming Initiator)	✓	
No. 4	Fixed rail structure on lower LH side (Seat Positioning Thruster Initiator)	✓	
No. 5	RH rear corner of each hatch (Hatch Jettisoning Thruster)	✓	
No. 6	Body structure just aft of hatch only (Catapult Arming Pin-Pull Initiator)		✓



HP KQ LW

downward ejection system (typical) (cont)

Figure 7-9 (Sheet 3 of 7).

NOTE

This is the key for sheets 1, 2, and 4.

EJECTION SEQUENCE Less KQ Less LW

PRE-EJECTION PREPARATION

One **FLIGHT SAFETY PIN** (1) and five **MAINTENANCE SAFETY PINS** (2, 3, 4, 5, and 6) must be removed prior to accomplishing ejection sequence.

ARMING SEQUENCE

SQUEEZE ARMING LEVER RELEASE (7) and rotate **ARMING LEVERS** (8) upward and forward until locked. Rotation of arming levers locks the **INERTIA REEL** (9), arms the **ANKLE RESTRAINT TRIGGERS** (10), and fires the **ARMING INITIATOR** (11). Gas expansion from the arming initiator operates the **SEAT POSITIONING PIN-PULL CYLINDER** (12). Action of mechanical linkage retracts the **SEAT FORWARD LOCKING PINS** (13), rotates the **HATCH JETTISONING INITIATOR FIRING LUG** (14) to the armed position, and fires the **SEAT POSITIONING INITIATOR** (15). Gas expansion from the initiator fires the **SEAT POSITIONING THRUSTER** (16), swinging the seat back to the jettison position. Motion of the seat causes the hatch jettison firing lug to strike a cam which fires the **HATCH JETTISONING INITIATOR** (17). Gas expansion from the initiator fires the **HATCH JETTISONING THRUSTER** (18) which unlocks and opens the hatch, allowing the hatch to jettison. A link attached to the hatch and connected to the **CATAPULT SAFETY PIN-PULL INITIATOR** (19) fires the initiator. Gas expansion from the initiator operates the **CATAPULT SAFETY PIN-PULL CYLINDER** (20), withdrawing the pin from the catapult initiator (22), arming the seat.

FIRING SEQUENCE

Pull the **FIRING TRIGGER RING** (21) upward. A cable attached to the ring and connected through a shock absorber to the **CATAPULT INITIATOR** (22) fires the initiator. Gas expansion from the initiator fires the **CATAPULT** (24), ejecting the seat from the airplane. As the seat leaves the airplane an **INTEGRATED HARNESS RELEASE INITIATOR TRIP** (25) activates the **INTEGRATED HARNESS RELEASE INITIATOR** (26). After a delay of one second, the initiator fires.

190 ▶ 237 W70 ▶ W119 Less HP

Gas expansion from the harness release initiator (26) operates the **AUTOMATIC OPENING SAFETY BELT RELEASE CYLINDER** (27), opening the **SAFETY BELT** (28), allowing the occupant to separate from the seat.

238 ▶ W120 ▶ Plus HP

Gas expansion from the harness release initiator (26) operates the **INTEGRATED HARNESS RELEASE PIN-PULL CYLINDER** (29). Action of linkage unlocks the **SAFETY BELT RELEASE FITTINGS** (30) and the **SHOULDER STRAP RELEASE FITTING** (31), releasing the **SAFETY BELT** (32) and **PARACHUTE HARNESS** (33) thus allowing the occupant to separate from the seat.

MANUAL EMERGENCY OPERATION

If the hatch jettisoning initiator fails to fire following seat positioning, pull the **MANUAL HATCH JETTISON HANDLE** (34) to fire the hatch jettisoning initiator.

(Item 35 Deleted)

If the catapult initiator fails to fire when the firing trigger ring is pulled, pull the **MANUAL CATAPULT PIN-PULL RELEASE HANDLE** (36) up to withdraw the pin-pull cylinder and pin from the catapult initiator.

190 ▶ 237 W70 ▶ W119 Less HP

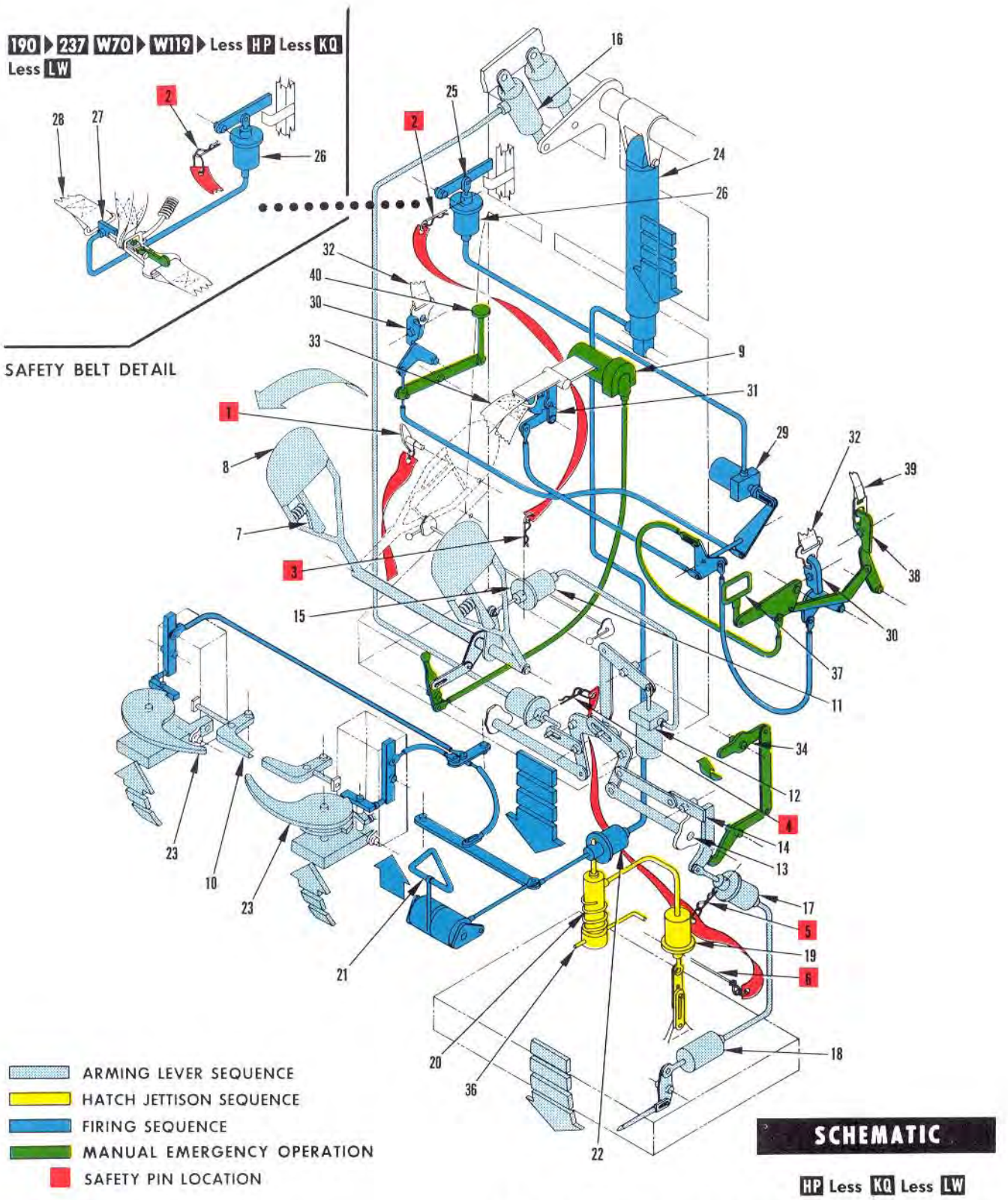
If the integrated harness release initiator fails to fire after one-second delay, manually open the safety belt to separate from the seat.

238 ▶ W120 ▶ Plus HP

If the integrated harness release initiator fails to fire after a one-second delay, pull the **INTEGRATED HARNESS RELEASE HANDLE** (37). Action of linkage unlocks the safety belt release fitting (30), the shoulder strap release fitting (31), and the **PARACHUTE ARMING LANYARD RELEASE FITTING** (38), releasing the safety belt, parachute harness, and **PARACHUTE ARMING LANYARD** (39), allowing the occupant to separate from the seat.

If the integrated harness release handle has been pulled for reasons other than bailout and it is desired to reset the mechanism, push down on the **INTEGRATED HARNESS RELEASE RESET BUTTON** (40).

Figure 7-9 (Sheet 4 of 7).



downward ejection system (typical) (cont)

Figure 7-9. (Sheet 5 of 7).

NOTE

This is the key for sheets 1, 3, and 7.

EJECTION SEQUENCE HP KQ LW

PRE-EJECTION PREPARATION

One **FLIGHT SAFETY PIN** (1) and five **MAINTENANCE SAFETY PINS** (2, 3, 4, 5, and 6) must be removed prior to accomplishing sequence.

ARMING AND FIRING SEQUENCE

Pull the **EJECTION CONTROL RING** (21) upward. A cable attached to the ring and connected through a shock absorber to the **ARMING INITIATOR** (11) fires the initiator. Gas expansion from the arming initiator fires the **LEG GUARD THRUSTER** (41) and operates the **SEAT POSITIONING PIN-PULL CYLINDER** (12). As the **LEG GUARDS** (8) rotate, the **INERTIA REEL** (9) is locked. Simultaneous action of mechanical linkage retracts the **SEAT FORWARD LOCKING PINS** (13), rotates the **HATCH JETTISONING INITIATOR FIRING LUG** (14) to the armed position and fires the **SEAT POSITIONING INITIATOR** (15). Gas expansion from the initiator fires the **SEAT POSITIONING THRUSTER** (16), swinging the seat back to the jettison position. Motion of the seat causes the hatch jettison firing lug to strike a cam which fires the **HATCH JETTISONING INITIATOR** (17). Gas expansion from the initiator fires the **HATCH JETTISONING THRUSTER** (18) which unlocks and opens the hatch, allowing the hatch to jettison. A link attached to the hatch and connected to the **CATAPULT SAFETY PIN-PULL INITIATOR** (19) fires the initiator. Gas expansion from the initiator operates the **CATAPULT SAFETY PIN-PULL CYLINDER** (20), withdrawing the pin from the **CATAPULT INITIATOR** (22), arming the seat. Further travel of cable linkage to the catapult initiator from the **EJECTION CONTROL RING** (21) through the shock absorber fires the **CATAPULT** (24), ejecting the seat from the airplane. As the seat leaves the airplane, an **INTEGRATED HARNESS RELEASE INITIATOR TRIP** (25) activates the **INTEGRATED HARNESS RELEASE INITIATOR** (26). After a delay of approximately 0.3 second, the initiator fires. Gas expansion from the integrated harness release initiator (26) operates the **INTEGRATED HARNESS RELEASE PIN-PULL CYLINDER** (29).

(Items 27, 28, and 35 deleted.)

Action of linkage unlocks the **SAFETY BELT RELEASE FITTINGS** (30) and the **SHOULDER STRAP RELEASE FITTING** (31), releasing the **SAFETY BELT** (32) and **PARACHUTE HARNESS** (33). Gas expansion from the integrated harness release initiator also fires the **INTEGRATED ROTARY ACTUATOR** (42) which operates to pull the nylon **MAN-SEAT SEPARATION STRAPS** (43) and provide automatic controlled separation of the seat occupant from the seat following ejection.

MANUAL EMERGENCY OPERATION

If the hatch jettisoning initiator fails to fire following seat positioning, pull the **MANUAL HATCH JETTISON HANDLE** (34) to fire the hatch jettisoning initiator.

If the catapult initiator fails to fire when the ejection control ring is pulled, pull the **MANUAL CATAPULT PIN-PULL RELEASE HANDLE** (36) up to withdraw the pin-pull cylinder and pin from the catapult initiator.

If the integrated harness release initiator fails to fire, pull the **INTEGRATED HARNESS RELEASE HANDLE** (37). Action of linkage unlocks the safety belt release fitting (30), the shoulder strap release fitting (31), and the **PARACHUTE ARMING LANYARD RELEASE FITTING** (38), releasing the safety belt, parachute harness, and **PARACHUTE ARMING LANYARD** (39), allowing the seat occupant to separate from the seat.

If the integrated harness release handle has been pulled for reasons other than bailout and it is desired to reset the mechanism, push down on the **INTEGRATED HARNESS RELEASE RESET BUTTON** (40).

Figure 7-9 (Sheet 6 of 7).

EJECTION SEAT SYSTEMS

Ejection seat systems, with their automatic features, increase the airspeed and the high and low extremes of altitude at which safe bailout can be accomplished. Automatic operation of a system includes stowing the control column, positioning the seat where applicable, jettisoning the hatch, ejecting the seat, releasing the occupant from the seat, and activating the automatic parachute opening device. Release from the seat and opening the parachute can be accomplished manually by overriding the automatic system. However, fully automatic operation can greatly reduce the time required for seat separation and chute deployment at low altitudes and make safe descent from high altitudes possible even if loss of consciousness occurs.

WARNING

It is important for occupants of ejection seats to be equipped with the proper protective helmets. It is possible to receive a blow on the head in a downward seat during preejection positioning or in an upward seat during ejection, which may be incapacitating if a soft helmet is worn.

Upward Ejection Seats

For a detailed description of the upward ejection seats, see "Pilots' Upward Ejection Seats," Section I. Detailed preflight checks of the pilots' seats are found in the "Power Off Interior Checklists," Section II. A detailed preflight check of the EW officer's seat is found in the "Interior Inspection Checklist" in Section VIII for that crew member.

Downward Ejection Seats

For a detailed description of the downward ejection seats, see "Crew Ejection Seats," Section IV. Detailed preflight checks are found in the "Interior Inspection Checklists" of Section VIII for the navigator and radar navigator.

Ejection Seat Illustrations

Illustrations of the upward and downward ejection seats accompany their respective descriptions in Sections I and IV. These pictures show the configuration of the seats and the component parts with which the crew member should be familiar in order to properly operate his seat. Figure 7-8 gives a schematic of the upward ejection seat system along with a sequence of events relative to the ejection operation. Color coding makes it possible to correlate the actuation of controls and mechanisms with the sequence of events. Figure 7-9 gives the sequence of events for the downward seats. One sheet of each illustration contains a detailed sequence of events and is numbered in sequence; the numbers correspond to the callouts on the other sheets of the illustration.

TURRET JETTISON SYSTEM

The jettisonable turret is described under "Turret Jettison System" in Section IV. An illustration showing the controls and safety pins accompanies the text. If the inside jettison handle is used, the system will release tail compartment pressure and, after a 2-second delay, detach and push away the turret section. The external handle accomplishes the same thing except that it does not actuate the pressure relief valve. Figure 7-10 shows the mechanism, including tubing runs, on sheet 1 and a schematic on sheet 3 so that the sequence of events can be studied along with the mechanical components which cause the actions. Some of these mechanisms can be checked from the ammunition compartment. Sheet 2 contains a detailed sequence of events and is numbered in sequence; the numbers correspond to the callouts on sheets 1 and 3.

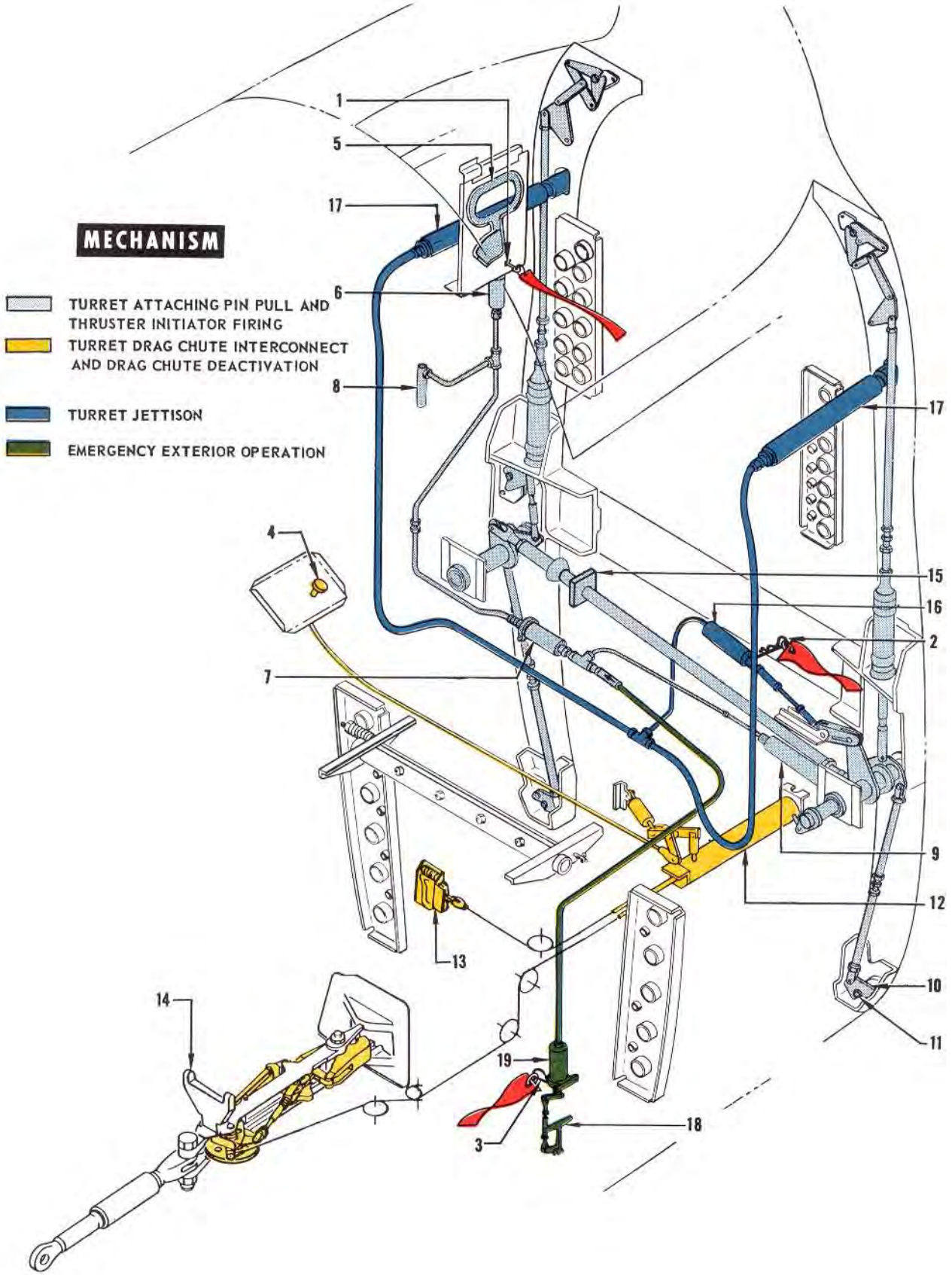


Figure 7-10 (Sheet 1 of 3).

JETTISON SEQUENCE

PRE-JETTISON SEQUENCE

One **FLIGHT SAFETY PIN (1)** and two **MAINTENANCE SAFETY PINS (2 and 3)** must be removed before turret jettison sequence can be accomplished.

THE TURRET-DRAG CHUTE INTERCONNECT CONTROL KNOB (4) is normally down. Pull up only on specific command of airplane commander.

JETTISONING

Pull **INNER EMERGENCY RELEASE HANDLE (5)** outward and forward (toward the gunner). Action of linkage fires the **INNER EMERGENCY RELEASE HANDLE INITIATOR (6)**. Gas expansion from the initiator activates the **TIME DELAY INITIATOR (7)**, and operates the **DUMP VALVE PIN-CYLINDER (8)** opening the dump valve and depressurizing the compartment. After a delay of two seconds, the mechanism actuating thruster initiator fires. Gas expansion from the initiator fires the **MECHANISM ACTUATING THRUSTER (9)** which rotates a torque tube. During the first part of rotation of the torque tube the **LOCK PLATES (10)** are released from the **ATTACHMENT PINS (11)** by means of mechanical linkage, and the **DEACTIVATION ACTUATOR SPRING CARTRIDGE (12)** is released. The action of the spring will disconnect the **DRAG CHUTE RIP CORD (13)** and unlock the **DRAG CHUTE JETTISON MECHANISM (14)** thus deactivating the drag chute.

NOTE

If the turret-drag chute interconnect control knob is pulled up prior to pulling the inner emergency release handle, a pin will have been inserted in the deactivation actuator preventing release of the spring cartridge, thus causing subsequent retention of the drag chute.

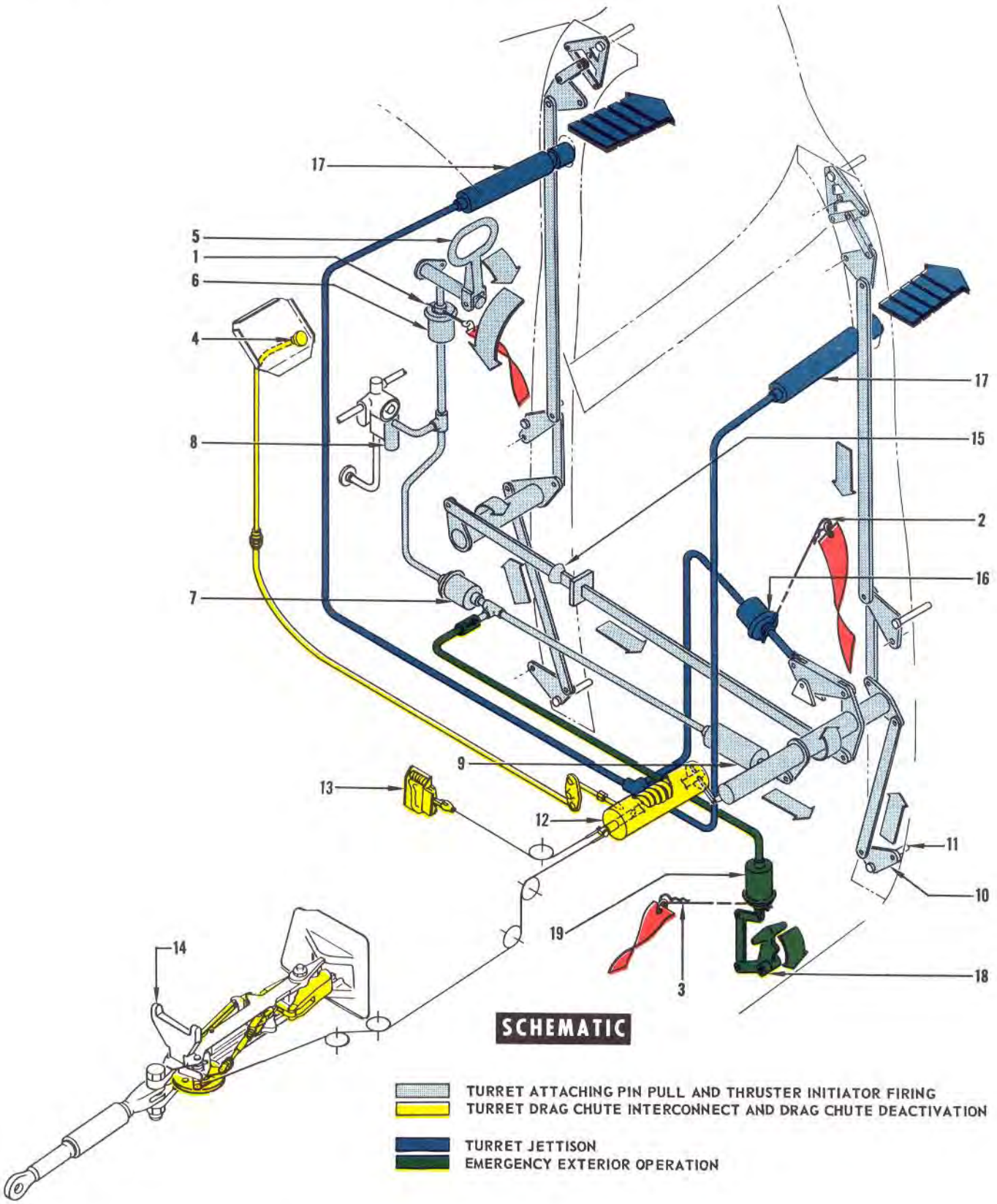
The release of the lock plates frees the turret attaching pins. A **CROSSOVER ROD STOP (15)** serves as a dampening device preventing the lock plate mechanism from rebounding and jamming the attachment pins. During the latter part of the torque tube rotation the **PUSH OFF THRUSTER INITIATOR (16)** is fired. Gas expansion from the initiator fires the two **PUSH OFF THRUSTERS (17)**, thus jettisoning the turret.

EMERGENCY EXTERIOR OPERATION

The turret may be jettisoned from the exterior of the airplane. To initiate the jettison sequence from outside, pull the **OUTER EMERGENCY RELEASE HANDLE (18)**. Pulling the release handle fires the **OUTER EMERGENCY RELEASE HANDLE INITIATOR (19)**. Gas expansion flowing through a check valve fires the mechanism actuating thruster (9) which through the normal sequence causes the turret to jettison. Note that the compartment dump valve is not actuated.

turret jettisoning system (typical)

Figure 7-10 (Sheet 2 of 3).



.....turret jettisoning system (typical)

Figure 7-10 (Sheet 3 of 3).

JETTISON SEQUENCE

PRE-JETTISON SEQUENCE

One **FLIGHT SAFETY PIN (1)** and two **MAINTENANCE SAFETY PINS (2 and 3)** must be removed before turret jettison sequence can be accomplished.

THE TURRET-DRAG CHUTE INTERCONNECT CONTROL KNOB (4) is normally down. Pull up only on specific command of airplane commander.

JETTISONING

Pull **INNER EMERGENCY RELEASE HANDLE (5)** outward and forward (toward the gunner). Action of linkage fires the **INNER EMERGENCY RELEASE HANDLE INITIATOR (6)**. Gas expansion from the initiator activates the **TIME DELAY INITIATOR (7)**, and operates the **DUMP VALVE PIN-CYLINDER (8)** opening the dump valve and depressurizing the compartment. After a delay of two seconds, the mechanism actuating thruster initiator fires. Gas expansion from the initiator fires the **MECHANISM ACTUATING THRUSTER (9)** which rotates a torque tube. During the first part of rotation of the torque tube the **LOCK PLATES (10)** are released from the **ATTACHMENT PINS (11)** by means of mechanical linkage, and the **DEACTIVATION ACTUATOR SPRING CARTRIDGE (12)** is released. The action of the spring will disconnect the **DRAG CHUTE RIP CORD (13)** and unlock the **DRAG CHUTE JETTISON MECHANISM (14)** thus deactivating the drag chute.

NOTE

If the turret-drag chute interconnect control knob is pulled up prior to pulling the inner emergency release handle, a pin will have been inserted in the deactivation actuator preventing release of the spring cartridge, thus causing subsequent retention of the drag chute.

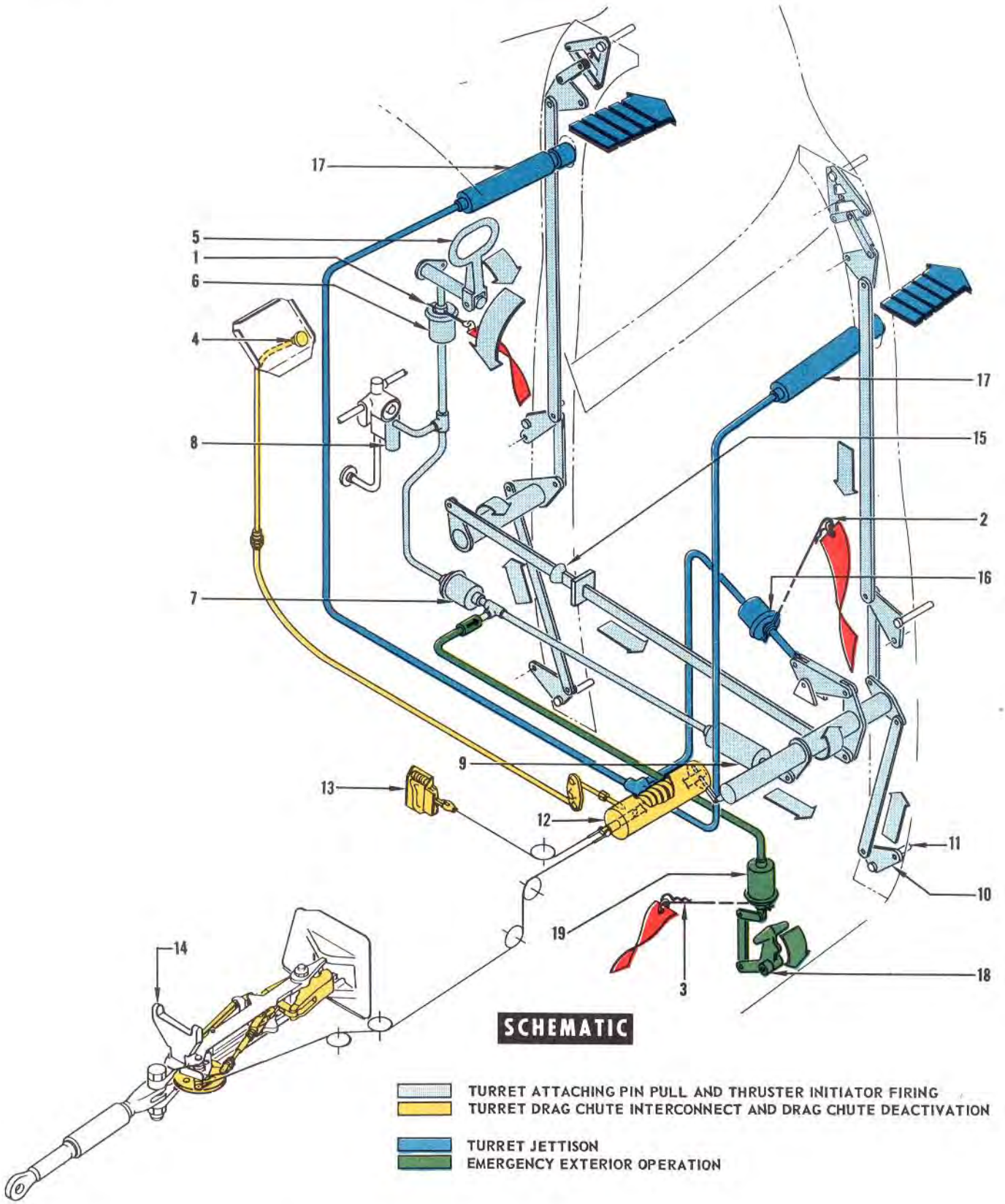
The release of the lock plates frees the turret attaching pins. A **CROSSOVER ROD STOP (15)** serves as a dampening device preventing the lock plate mechanism from rebounding and jamming the attachment pins. During the latter part of the torque tube rotation the **PUSH OFF THRUSTER INITIATOR (16)** is fired. Gas expansion from the initiator fires the two **PUSH OFF THRUSTERS (17)**, thus jettisoning the turret.

EMERGENCY EXTERIOR OPERATION

The turret may be jettisoned from the exterior of the airplane. To initiate the jettison sequence from outside, pull the **OUTER EMERGENCY RELEASE HANDLE (18)**. Pulling the release handle fires the **OUTER EMERGENCY RELEASE HANDLE INITIATOR (19)**. Gas expansion flowing through a check valve fires the mechanism actuating thruster (8) which through the normal sequence causes the turret to jettison. Note that the compartment dump valve is not actuated.

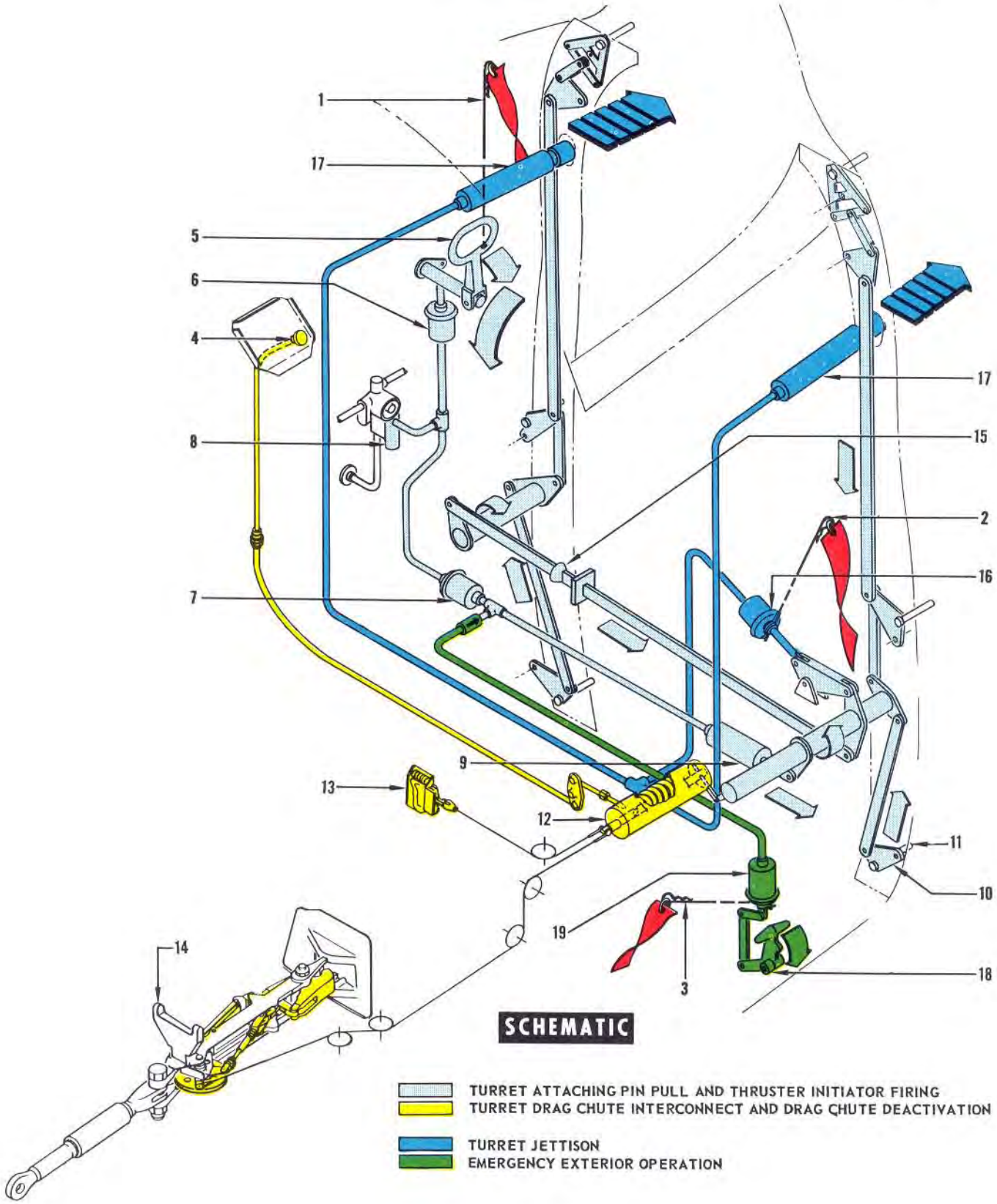
••••••••••••••••turret jettisoning system (typical)

Figure 7-10 (Sheet 2 of 3).



.....turret jettisoning system (typical)

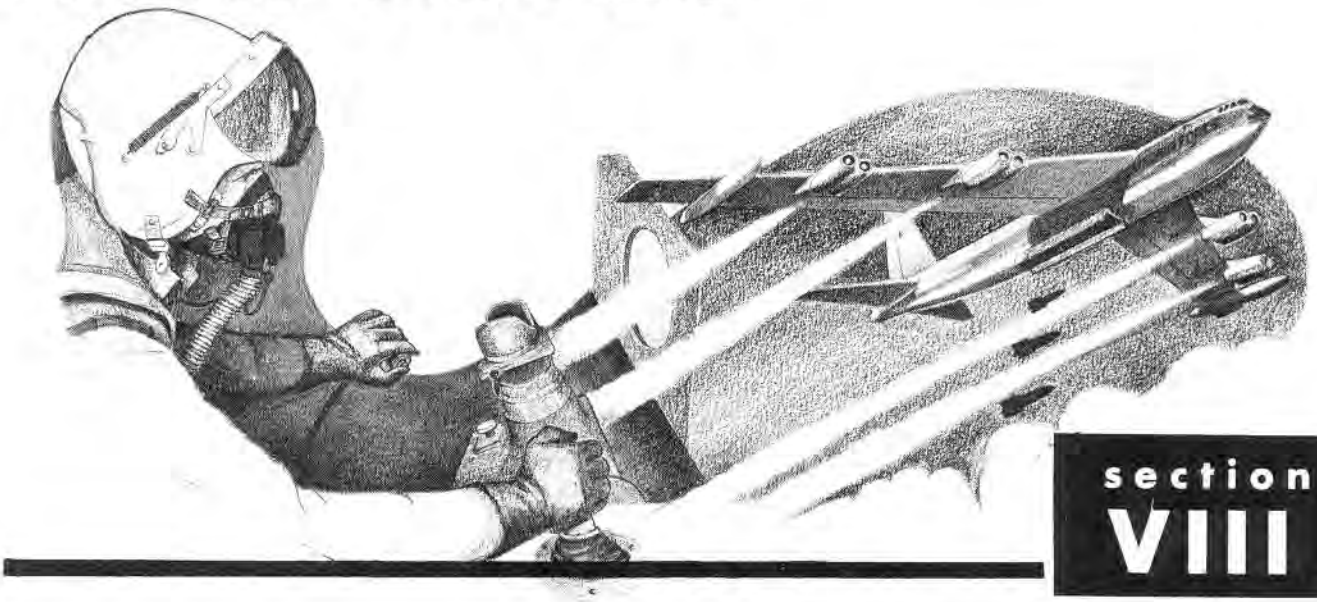
Figure 7-10 (Sheet 3 of 3).



.....turret jettisoning system (typical) (cont)

Figure 7-10. (Sheet 3 of 3).

CREW DUTIES



section VIII

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INTRODUCTION

The purpose of this section is to provide a compact collection of material wherein each crew member can readily determine his duties in relation to the accomplishment of the overall mission. Instructions relating to crew duties do not include information which is already covered in other sections.

CREW COORDINATION

Coordination of actions within a crew is of prime importance to insure the optimum degree of mission success and safety during all phases of operation. This coordination is not necessarily limited to actions alone. Complete familiarity with one's crew position, the responsibilities thereof, and a working knowledge of the other crew members' duties will contribute immeasurably toward crew coordination. Each crew member must be constantly on the alert and should notify the responsible crew member of any deviation or discrepancy which will affect successful accomplishment of the mission. Liaison between individuals concerned must be established prior to initiating any action or procedure which will alter aircraft configuration or require correlation of activities between crew members. Prior to flight, the pilot must insure that all crew members are thoroughly familiar with all aspects of the assigned mission as pertains to their crew specialty to include:

- Applicable instructions in the Flight Information Publications
- Departure routes, altitudes, obstructions, and traffic procedures
- Route of flight
- Navigation (to include low altitude)
- Air refueling information
- Bombing
- EW activities
- Gunnery
- Normal and emergency communications procedures
- Any special instructions or procedures pertaining to the mission.

NOTE

It is imperative that the pilot, copilot, and navigator be thoroughly familiar with the penetration, approach, missed approach, landing patterns, altitudes, and obstructions at both destination and alternate airfields. Available aids such as current FLIP Terminal and approach charts must be studied. A complete set of current approach charts must be available for inflight use of both the pilot and navigator. The navigator, as well as the pilot not actually flying the aircraft, will closely monitor all penetrations and approaches. The pilot at the controls will be notified immediately of any deviation from published procedures.

It is imperative that positive measures be taken to insure that safety of personnel and airplane are not jeopardized. Flight attitude of the airplane must be carefully monitored by either the pilot or copilot at all times. Prior to accomplishment of any of the following, verbal coordination between applicable crew members will be required when:

1. Control of the airplane is transferred between pilot and copilot.
2. Control column of either the pilot or copilot is disconnected or reengaged.
3. Changing fuel control settings, except when done silently during a checklist.
4. A crew member leaves position or goes off interphone.
5. A crew member goes off oxygen and when he resumes oxygen use during flight when oxygen is required.
6. Autopilot control of airplane is transferred between the radar navigator and pilot.
7. Any electrical power source is changed.
8. It is necessary for the pilot flying the airplane to transfer control of the airplane to the other pilot when he is required to do something which will divert his attention from flying such as check oxygen, tune radios, change fuel control settings, etc.
9. The pilot intends to perform any critical maneuver, at which time all crew members will be secured in their respective positions.
10. Changing air outlet knob positions (notify copilot) (not required for gunner).
11. The inflight safety pins are installed. Conditions requiring pin installation are:
    a. All ground operations.
    b. Whenever the crew member leaves his seat in flight.
    c. When the parachute is not worn.
    d. When the seat belt and shoulder straps are not fastened.

All applicable crew members will acknowledge that the intended course of action is understood prior to actual accomplishment and will conduct themselves accordingly. All crew positions, where practical, should monitor communications outside the airplane by using mixer switches during air refueling, takeoff and landing, and instrument approaches.

WARNING

- Whenever a change of crew position is necessary, climb to a safe altitude and area before the change is made. The pilots will not exchange seats when only two pilots are aboard the airplane.
- Any time during critical phases of flight and especially during night and/or instrument conditions, the pilot not flying the aircraft will closely monitor his flight instruments and cross-check them against the instruments of the other pilot. If an apparent error in aircraft attitude is detected, the pilot flying the aircraft will be advised immediately.
- Extreme care must be exercised by the pilots when leaving seats to avoid inadvertent operation of switches or controls on the aisle stand or overhead panel.
- If the safety belt is removed in flight or on the ground, place the belt carefully so as not to inadvertently operate any switch.

- When moving around an ejection seat, care must be taken not to actuate the seat ejection mechanism.

CHECKLISTS

The flight manual checklists have been designed so that they may be used for training missions with or without bombs/missiles, for alert posture, and for EWO missions.

NOTE

When no bombs or missiles are loaded, safety wires and seals are not required on the associated monitor control and release system controls.

Nuclear Bombs

Nuclear bomb procedures from the -25 Tech Orders (Pre-Takeoff and Inflight sections only) have been integrated within the flight manual checklists for all nuclear bombs monitored by the DCU-9A panels. Since the DCU-9A panels are located in the navigators' compartment, bomb procedures have been integrated primarily in Section VIII; however, a few bomb procedures will also be found in Section II. The bomb items appear as line items without amplification in both the amplified and abbreviated checklists. Amplification of the line items pertinent to nuclear bomb procedures may be found in Section I of T.O. 1B-52B-25-3-2. To complete a single checklist for a mission involving a nuclear bomb, the air crew must remove the applicable "Bomb Preflight" and "Descent and Landing Procedures" checklist pages from T.O. 1B-52B-CL-25-3-2-1 and insert them as indicated in the flight manual checklist.

Conventional Munitions

Conventional munitions procedures have been integrated with the affected flight crew checklists.

Missiles

The procedures that lend themselves to integration in existing checklists have been so integrated for applicable crew members. Otherwise, the procedures have been integrated as complete checklists. The integrated procedures appear as line items without amplification in both the amplified and abbreviated checklists. Amplification of the line items pertinent to missile normal procedures may be found in Section II of the appropriate publication as listed below. Numbering of checklist items in the abbreviated checklists will not coincide with the numbering in the amplified checklists as listed below unless the procedure has been integrated as a complete checklist.

ADM-20 CHECKLISTS. ADM-20 "Before Exterior Inspection," "Exterior Inspection," "Interior Inspection," and "Postflight Inspection" checklists will appear integrated in the "Normal" part of the navigator's and radar navigator's abbreviated flight crew checklists. All other ADM-20 checklists will appear as a nonintegrated package in the "Missile" part of the navigator's and radar navigator's abbreviated flight crew checklists. Amplification of all ADM-20 line items will appear in T.O.'s 1B-52G-1-2 and 1B-52E-1-4.

AGM-28 CHECKLISTS. The AGM-28 normal procedures amplified checklists will appear in the B-52/AGM-28 Aircrew Weapon Delivery Technical Manual, T.O. 1B-52C-30-1. The abbreviated checklists for certain AGM-28 normal procedures are integrated in the "Normal" part of the pilots', navigator's, and radar navigator's abbreviated flight crew checklists. However, "AGM-28 Inflight Procedures," "Ferry Mission Procedures," and "Unscheduled Landing with AGM-28 Missiles" will appear nonintegrated in the "Missile" part of the pilots', navigator's, and radar navigator's abbreviated flight crew checklists. The emergency procedures for AGM-28 will appear in the "Emergency" portion of the aircrew abbreviated checklists as nonintegrated items. In the pilots' checklists these are the "Emergency Shutdown," "Engine Fire During Ground Start," "Ballistic Drop," and "Jettison." In the navigator's and radar navigator's checklists these are the "Armament System Malfunction Indications," "Ballistic Drop," and "Jettison."

Bomb Runs

The bomb run checklists in Section VIII have been designed so that they may be used for both training and EWO missions. They have been consolidated for use by both the navigator and radar navigator. Large charge tactics have been incorporated in each bomb run checklist.

ELECTRONIC EQUIPMENT INTERFERENCE

Due to extensive intraplane electronic interference, an interference check will be made in such detail as necessary so that each crew member responsible for operation of such equipment will be thoroughly familiar with the effect of interaction, magnitude of interference, presence of spurious responses, and be able to determine the usable portion of frequency spectrum that will allow most effective coordinated operation of all electronic equipment. Amplification of the interference check will appear in the EW officer's checklist.

LOW ALTITUDE NAVIGATION

During low altitude flight, special emphasis by all crew members will be directed to maintaining route corridor and prescribed altitudes. Crew coordination is extremely essential for each change of heading and/or altitude. The navigator will notify the pilot when altitude deviates significantly from that planned. The navigator will announce the new magnetic heading, altitude, and ETA. This information will be cross-checked by the pilot. The pilot will monitor the aircraft position and take action as necessary to insure corridor limits are not exceeded.

PILOT

The pilot is the aircraft commander and is responsible for the airplane and crew. For simplification and to avoid any misunderstanding, the pilot and copilot will

be referred to as such during interphone transmissions. The successful accomplishment of the mission is of prime importance; in no instance, however, will the safety of the airplane or crew be compromised. The pilot is responsible for the issuance of instructions governing all phases of flight operation. In addition to his regular function, the pilot will perform the following.

Mission Preparation

1. Attend general briefing.
2. Coordinate with other crew members on route, charts, targets, and items pertinent to individual crew procedures and supervise the completion of required forms.
   a. The pilot's low level chart will contain data as required to orient the pilot to actions necessary for the accomplishment of the low level portion of the mission.

NOTE

If the planned mission includes a low altitude portion, a forecast altimeter setting will be obtained for the low altitude entry point. This forecast setting will be compared with that received from the Air Traffic Control agency prior to starting the descent. When executing a descent prior to landing or for low altitude tactic, the pilot coordinates the altimeter setting with the radar navigator and both will compare actual and forecast altimeter settings at this time.

3. Complete and file Form 175.
4. Attend the specialized briefings for air refueling, weather, and other pertinent information.
5. Compile latest information relative to flight to brief the crew.
6. Conduct specialized crew and emergency procedures briefing.

Bomb Run

1. Center FCI on radar navigator's request and transfer control of the airplane to the radar navigator.

NOTE

One of the pilots should maintain the desired IAS and monitor engine instruments on the bomb run to enable the other pilot to handle any emergency in minimum time and to visually clear the aircraft.

2. The pilot will call time to go and heading error indicator position at appropriate intervals and request "Tone on" at 20 seconds time to go.

COPILOT

The copilot is the deputy airplane commander and will assist the pilot in the proper flight of the airplane. Inasmuch as the fuel panel and electrical system are controlled by the copilot, he will also act as the flight engineer. In addition to this regular function, the copilot will perform the following:

Mission Preparation

1. Attend general briefing.
2. Assist the pilot and navigator in mission planning and flight plan preparation. The copilot will prepare the fuel prediction curve and compute takeoff performance data.
3. Prepare airplane loading and weight and balance forms for pilot's signature.
4. Attend specialized briefings with pilot.

RADAR NAVIGATOR/NAVIGATOR

The navigators must work continuously together to insure successful completion of the mission. It is mandatory that each navigator have sufficient knowledge of the other's duties to enable him to assume them in flight if the need arises.

Mission Planning

1. Attend general and specialized mission briefings as required. (RN-N)
2. Select maps and charts of suitable scale and projection as dictated by the requirements of the mission. (RN-N)
3. The low altitude portion of the mission will be plotted on ONC/WAC charts; ONC charts being mandatory when available. (RN-N)
4. Additional maps should be procured to provide coverage for briefed alternate and emergency airfields and for emergency changes in flight. (N)
5. The complete route will be correctly plotted. The routes will be planned from point to point and, when practicable, turns will be initiated in order to make good the planned track. (N)
6. Coordinates of prominent radar returns along the route no more than 100 NM apart for high altitude or no more than 60 NM apart for low altitude will be noted for resetting the latitude and longitude counters. (RN)
7. Grid/polar entry and exit points will be noted. Con-

vergence angles will be readily available. (RN-N)
8. The navigator will coordinate with the pilots on necessary reporting points and entries to and from control areas. Applicable warning and prohibited areas within 50 miles of planned route will be clearly marked on chart with time and altitude limitations. (N)
9. Planned air refueling area with altitude limitations, ingress and egress points, tanker orbit point, start descent point, ARCP, and ARIP will be annotated on chart. (N)
10. Points for performing EW activity will be annotated on chart. (N)
11. Points for performing gunnery will be annotated on chart. (N)
12. Low altitude entry, start descent, and start climb points for the low altitude portion of the mission will be annotated on chart. (N)
13. HHCL, positive control point, Pre-IP's, IP's, and targets will be annotated. (RN-N)
14. AGM-28 launch point will be annotated on chart. (N)
15. Coordinates and elevation for AGM-28 checkpoint fixes will be annotated. (RN-N)
16. ADM-20 heading reference leg will be annotated. (RN-N)
17. Complete applicable portions of SAC Form 650. (N) (RN-N)
18. Accomplish target study on assigned targets.
19. Complete bombing computation form. For training missions, the altitude computations, ballistics computations, and emergency bomb run portion of the precomp column need only be completed for the first run on each complex. (RN)
20. Complete flight plan as required. (N)
21. Radar letdown information will be available for primary and alternate destinations. (Flight Information Publication Terminal is adequate.) (RN)
22. Coordinate with armament and electronics personnel to determine the maintenance history and condition of the BNS. (RN)
23. Navigator will be responsible for providing the crew with an accurate time hack. (N)
24. Navigator checks AGM-28 missile Form 781 to ascertain whether a 300 or 400 flight tape has been filed into the guidance system memory.

EW OFFICER

The primary responsibility of the EW officer is the utilization of the installed electronic countermeasures equipment to provide an active electronic defense against ground based or airborne electronic devices that pose a threat to the safety of the airplane and the completion of its mission. This is accomplished through the coordinated efforts and aid of all crew members.

Secondary responsibilities include operation of the radar rendezvous equipment preceding inflight refueling and obtaining celestial observations by use of the periscopic sextant when requested by the navigator. These activities are accomplished through coordination with the radar navigator and navigator.

Mission Preparation

1. Attend general briefing.
2. Accomplish study of all intelligence data necessary for the accomplishment of the EW portion of the mission.
3. Accomplish flight planning in coordination with other crew members including EW activity, radar rendezvous planning, celestial navigation, and interference check.
4. Prepare annotated flight chart indicating planning for the accomplishment of required EW activities and other crew duties.
5. Attend specialized briefing when applicable.
6. Attend crew briefing.

GUNNER

The gunner is responsible for employment of the fire control system for active defense of the bomber against enemy fighters. He maintains constant visual and radar search for enemy aircraft, reporting enemy aircraft activity to other members of the crew. Such coordination permits the crew to utilize defensive maneuvers, electronic countermeasures, chaff, and gun fire to the optimum extent in defending the airplane. The gunner must also act as a scanner by assisting the pilot in clearing the airplane during ground operation and flight. He reports on normal and abnormal operation of engines, control surfaces, tip gear, and drag chute.

Mission Preparation

1. Attend general briefing.
2. Attend specialized briefing. Receive and study all intelligence data regarding anticipated fighter attacks, paying special attention to wing span of fighters that may be encountered.
3. Review all data on the gunner flimsy and advise the copilot of the ammunition load to be carried so that Form 365F (Form F) may be prepared accurately.
4. Make a careful check of all the personal and professional equipment to see that it is all present and in good condition.

RADAR NAVIGATOR'S CHECKLIST

EXTERIOR INSPECTION

1. Bomb Bay Interior: (RN)

   a. Nuclear Bombs - Checked

      When nuclear bombs are aboard, insert and use the appropriate bomb preflight checklist.

   b. Conventional Munitions, Pins, Arming Wires & Fuzes - Checked

      Check for the general condition of bombs. Check that safeing pins have been removed from each fuze and that lockpins have been removed from each shackle. Check that arming wires are properly inserted in fuzes and free of kinks.

   c. General Condition of Bomb Bay - Checked

      Check for fuel and hydraulic leaks and security of equipment.

2. Multiple Ejector Racks UM: (RN)

   a. Conventional Munitions - Checked

      Check conventional munitions in accordance with step "1b."

   b. Release Mode Selector Switches - SINGLE

3. Conventional Munitions Shackle Lockpins & Fuze Safeing Pins - Connected and stowed (RN)

   Count the shackle lockpins and fuze safeing pins that have been removed and stow them aboard the aircraft. There should be a lockpin for each shackle and a safeing pin for each fuze.

4. Shackle Safety Tools - Removed (RN)

   Remove shackle safety tools and give to ground crew.

5. Track Antijettison Tools (2) (Aft Track Assemblies) - Removed (RN)

INTERIOR INSPECTION

1. Equipment - Stowed

   Stow ADM-20 track antijettison tools and personal equipment.

2. Ejection Seat & Escape Hatch:

WARNING

- Carefully check to assure that no streamer has been torn from a maintenance safety pin, thus inadvertently leaving the pin installed. See figure 7-9 for location of pins.
- If a maintenance safety pin is installed, the status of the seat will be ascertained prior to removal of the pin.

RADAR NAVIGATOR'S CHECKLIST (Cont)

a. Ejection Trigger Ring - Stowed, pin No. 1 installed

Check that ejection trigger ring is properly seated in detent.

WARNING

If the ejection trigger ring is not properly seated in the detent, call maintenance and ascertain status of arming initiator before continuing seat inspection.

b. Manual Catapult Initiator Safety Pin-Pull Handle - Secure

Handle should be properly seated below left arming lever.

c. Ankle Restraints - Checked

Inspect ankle restraints for stowage in downward position.

NOTE

In the event ankle restraints have triggered, crew member can stow restraints by applying downward and outward pressure on either restraint arm until restraints and pivot mechanisms both lock.

d. Catapult Initiator - Checked

Inspect initiator for condition and installation.

WARNING

Shipping pin or maintenance safety pin with streamer should not be installed in catapult initiator.

NOTE

Insure pin-pull cylinder safety pin (plunger) is installed in catapult initiator.

e. Catapult Initiator Safety Pin-Pull Cylinder - Checked

Inspect position and condition of cylinder and safety pin (plunger).

f. Arming Initiator & Control Linkage - Checked, pin No. 3 removed

Check maintenance safety pin No. 3 removed. Inspect initiator for condition and installation.

g. Emergency Escape Hatch - Secure

Check that paint stripe on the lockpin is visible or the flat surface of the lockpin extends 1/4 inch from its housing. Check that latch pins overlap the long lip of the latch hooks by approximately 1/8 inch. Check that the hatch manual jettison lever is stowed (figure 1-54). Check all foreign matter removed from hatch.

h. Catapult Pin-Pull Initiator - Checked, pin No. 6 removed

Check maintenance safety pin No. 6 removed. Inspect link for condition and installation.

i. Hatch Jettison Initiator - Checked, pin No. 5 removed

Check maintenance safety pin No. 5 removed. Inspect initiator for condition and installation.

RADAR NAVIGATOR'S CHECKLIST (Cont)

j. Manual Hatch Jettison Handle & Linkage - Checked

Check manual hatch jettison handle for proper position. Inspect linkage for condition and installation. On aircraft [redacted], check that the guard assembly is properly installed over the manual hatch jettison handle. Actuate the guard to check the spring clip retaining action and insure that it can be easily released in an emergency.

k. Seat Positioning Initiator - Checked, pin No. 4 removed

Check maintenance safety pin No. 4 removed. Inspect initiator for condition and installation.

l. Hatch Jettison Firing Lug - Checked

Inspect firing lug for condition and mounting.

m. Integrated Harness Release Initiator - Checked, pin No. 2 removed

Check maintenance safety pin No. 2 removed. Inspect initiator for condition and installation.

n. Harness Release Initiator to Pin-Pull Cylinder Tube - Connected

Make certain the tube run from the integrated harness release initiator is connected to the integrated harness release pin-pull cylinder.

o. Survival Kit, Parachute, and Man-Seat Separator - Checked

Check parachute inspection record book for current inspection. Determine from the record the setting of the automatic release mechanism. Check bailout bottle for minimum pressure. Insure that the nylon man-seat separator straps are placed on the bare seat. Survival kit is then placed over man-seat separator straps. See figure 7-9 for correct arrangement of man-seat separator straps without survival kit and parachute in place.

p. Survival Kit, Inertia Reel, Parachute, Safety Belt & Parachute Arming Lanyard Anchor - Connected

Check parachute shoulder straps connected to inertial reel attachment. Check that survival kit attachment straps pass through the loops of the safety belt and are connected to the parachute as shown in figure 1-58. Assure that safety belt is connected to both sides of seat. Check that parachute arming lanyard is inserted in slot attachment on left side of seat and ascertain that anchor is securely fastened.

WARNING

- Adjust the parachute survival kit attachment straps as tightly as possible to prevent the safety belt from inflicting facial injuries during a manual bailout. Failure to attach the parachute arming lanyard anchor to seat will necessitate manual operation of the parachute.
- Do not hook zero delay lanyard to parachute ripcord T-handle when using a downward ejection seat since it is equipped with a man-seat separator.

RADAR NAVIGATOR'S CHECKLIST (Cont)

3. Compass & True Heading Computer Cutoff Switch - ON
4. Radar Navigator's Circuit Breaker Panels:
   a. Normal Release & Salvo/Jettison Power Circuit Breakers - Out
   b. ADM-20 Launch Control (1) & Missile Release Circuit Breakers (3) - Out
   c. All Other Circuit Breakers & Fuses - In
5. Release Circuits Disconnect PR - Disconnected
6. Interphone - Connected
7. Oxygen System:
   a. Shutoff Lever - ON

      Pressure gage reads approximately 300 psi.

   b. Regulator Diluter Lever - 100% OXYGEN
   c. Emergency Toggle Lever - EMERGENCY

      Flow indicator should indicate continuous flow. Block regulator hose with hand; indicator should indicate no flow.

   d. Emergency Toggle Lever - NORMAL
   e. Mask & Hose - Connect and test

      Check for 10- to 20-pound pull for disconnect

   f. Mask - Test
      (1) Emergency Toggle Lever - TEST MASK

         Hold breath; indicator should indicate no flow.

      (2) Emergency Toggle Lever - NORMAL
   g. Regulator Diluter Lever - NORMAL OXYGEN
8. BRIC - TRAIN and zero

8A. Terrain Computer Power Switch TH - OFF

9. BNS Power Panel:
   a. Power Switch - OFF
   b. Heaters Switch - ON

9A. Ground Blowers Switch - OFF

10. Sight Panel:
    a. Dial Illum Knob - CCW

RADAR NAVIGATOR'S CHECKLIST (Cont)

b. Reticle Illum Knob - CCW

CAUTION

To avoid burning out the affected lights, these knobs should remain in the full counterclockwise position at all times except when the lights are actually being used.

11. Master Bomb & Door Control Panel:

a. Master Bomb Control Switch - OFF

b. Bomb Indicator Lights Switch - ON

c. Bombing System Switch - MANUAL

d. Lights - Tested

12. Nuclear Bombs Checklist:

a. Special Weapons & ASM Lock Indicators - Indicate locked

b. Parachute Static Line Retain Lights - Off (for free fall), on (for retarded fall)

c. Weapon & ASM Release Light(s) - Off, tested (if nuclear bombs/missiles aboard)

d. Bomb Indicator Lights - Off, tested (applicable lights for multiple carriage)

e. Special Weapons Select Switch - As briefed

f. Bomb Release Mode Selector Switch [illegible] - NORMAL and safetied

12. Conventional Munitions Checklist:

a. Arming Switch [illegible] - SAFE

b. Release Power Switch [illegible] - OFF

c. Racks Loaded Lights Switch [illegible] - ON

d. Racks Loaded Lights [illegible] - On (for applicable racks)

e. Bomb Indicator Lights - On (for applicable munitions)

f. Special Weapons Select Switch - FWD

13. Air Outlet & Auxiliary Heat Knobs:

a. Upper Outlet Knobs - 1/2 to full out

b. Lower Outlet Knobs - Full out

c. Auxiliary Heat Knob - Full in

NOTE

These knob settings are approximate settings only. After the cabin temperature has stabilized, knob adjustment may then be varied slightly for crew comfort.

14. ADM-20 Checks:

a. ADM-20 Fire Warning System - Checked (RN-CP)

RADAR NAVIGATOR'S CHECKLIST (Cont)

b. ADM-20 Launch Control Panel:

(1) Master Power Switch - OFF and pinned

(2) Launch Selector Switch - OFF

(3) Missile Launch Switch - OFF and pinned

(4) Missile Jettison & Gear Jettison Switches - OFF and safetied

(5) Indicator Lights - Press to test

c. ADM-20 Training Panel:

(1) Engine Start Switch - NORMAL

(2) Indicator Lights - Press to test

d. ADM-20 Exercise Panel:

(1) Carriage Switch - NORMAL

(2) Missile Switch - NORMAL

(3) Gear Switch - NORMAL

(4) Missile Safe to Retract Light - Press to test

e. ADM-20 Program Panel:

(1) Time Before Index Counter - Checked and set

(2) Heading Reference Switch - OFF

(3) Program Selector Switch - OFF

f. ADM-20 Missile Programming - Complete

NOTE

Program missiles in this sequence: 2-1-4-3.

(1) Program Selector Switch - MISSILE No. 2

(2) Readout Switch - Depress

(3) No. 1 & 2 Turn Program Panel Counters - Set program per mission planning

(4) Enter Switch - Depress

(5) Readout Switch - Depress

(6) No. 1 & 2 Turn Program Panel Counters - Check

(7) Enter Switch - Depress

(8) Program Selector Switch - OFF

(9) Repeat steps (1) through (8) to program missiles 1, 4, and 3 in sequence.

15. Pres Adj Panel:

a. Sweep Delay Switch - OFF

b. Sweep Delay Marker Knob - CCW, in detent

RADAR NAVIGATOR'S CHECKLIST (Cont)

16. Radar Primary Panel:
    a. Radar Power Switch - OFF
    b. Antenna Switch - FAST
17. Terrain Radar High & Low Altitude Mode Selector Switch LH - HI ALT GM
18. Radar Tilt Panel Rcvr Tune Switch - AUTO
19. Range Sel Panel:
    a. Range Selector Switch - 20
    b. Sector Width Knob - CCW to detent
    c. Markers Selector Switch - NAV
20. Trgt Scl Panel Selector Switch - RADAR
21. Pres Gain Panel:
    a. Intensity Knob - CCW
    b. Rcvr Knob - CCW
    c. Video Knob - CCW
22. D-2 Bomb Release Switch - Stowed
23. Bomb Control Panel Heading Switch - NAV
24. Topocomp:
    a. Station Keeping Switch - OFF
    b. Radar-Map Switch - PPI-NS
25. BNS Data Preset Panel:
    a. Gyro Erect Switch - HI
    b. Gyro Lat Knob - Set local latitude
    c. Present Pos Switch - OFF
    d. Doppler Wind Switch - OFF
26. Emergency Controls Panel:
    a. TAS Switch - ON
    b. Stab Bypass Switch - ON
    c. All Other Switches - OFF

RADAR NAVIGATOR'S CHECKLIST (Cont)

27. Radar Recording Camera:

    a. Camera Data Plate - Completed

    EXAMPLE:

JOPLIN
HASTINGS
BISMARK
30 June 60
B-52F 7068
ASQ-38
SMITH, C.S.

    b. Clock - Set to GMT

28. SWESS Control Panel:

    a. Arm-Safe Switch - SAFE and sealed

    b. Armed Light - Off

    c. Warning Light - Off, tested

29. Topocomp Projector - Loaded

30. Crew Report - Completed (at pilot's request)

    a. The sequence for crew reporting is as follows: G, N, EW, RN, CP, P, IN, 10th man, bunk, and IP.

    b. Switch to CALL and report, "Radar navigator's station check complete."

    Station check consists of seat, oxygen, abandon signal, call light, interphone, and (if applicable) zero delay lanyard check.

31. Oxygen Regulator - OFF and 100% OXYGEN (if leaving the airplane for an extended period of time)

AFTER ENGINE START

CAUTION

After engine start, do not turn the BNS on until after being notified by the copilot that the alternators are on the line and cooling air is available.

1. BNS Turn-On:

    a. Ground Blowers Switch - ON

    b. Desiccators Switch - ON

RADAR NAVIGATOR'S CHECKLIST (Cont)

c. Radar Power Switch - ON

d. BNS Power Switch - ON

e. Terrain Computer Power Switch TH - ON

2. Press-to-Test Lights:

a. Tone On Indicator Light - Tested

b. Bomb Door Control Valve Lights - Tested

c. BDI TG = 0, BNS Steering, BNS Low Airflow Lights (3) - Tested

d. Overheat Power Supply, Radar Pressure Low Lights (2) - Tested

e. Release Circuits Connected Light PR - Tested

f. Offset-In Light - Tested

3. Topocomp Projector - Film aligned and operation checked

a. Film Image Operation Switch - S-S

b. Map Light Knob - Rotate CW

c. Right Takeup Knob - CCW to center frame

d. Film Slide Knob - Fully CW

e. Left Takeup Knob - CW slightly

f. Interlock Switch Button - Pull out

g. Film Advance Button - Press once

The film should move one frame and center properly.

h. Forward-Reverse Switch - Opposite direction

i. Film Advance Button - Press once

The film should move one frame in opposite direction and center properly.

j. Projector Cover Door - Replace

Insure that cover door handle is all the way up and the screws are secure in the coverplate.

4. Topocomp Alignment & Radar Tune-Up:

NOTE

If map match is not being used, perform **boldface** items only.

a. Test Meter Selector Switch — Checked —300, +120, +300

All readings should be 50 (±2).

RADAR NAVIGATOR'S CHECKLIST (Cont)

b. Film Advance Button - Depressed

Depress film advance button as many times as necessary to advance film to scaling frame nearest bomb run altitude.

c. Plane Above Sea Level Indicator - Set scaling altitude

Set altitude indicated on scaling frame.

d. Target Above Sea Level Indicator - Set to zero

e. Range Selector Switch - Set scaling range

Set range indicated on scaling frame.

f. Markers Selector Switch - NAV

g. (Topocomp) Horiz & Vert Centering Knobs - Center scaling frame

h. **Centering Check — Completed**

i. **Circularity Check — Completed**

j. Scale Adjust - Align 30-mile range marker

Check alignment of the 30-mile range mark with the projected 30-mile range marker.

k. Film Advance Button - First target (50-mile scale)

Press film advance button as many times as necessary to advance film to 50-mile scale photo of first target to be used.

l. Rotate Knob - Align north

Rotate knob to align photo to north using mark on photo and cursor.

m. **Radar Recording Camera & Crosshair — Checked**

Check operation of camera (O-32 mode sel switch in R) and movement of crosshair in search and track.

n. **Radar Recording Camera Power Switch — OFF**

o. Film Image Operation Switch (Topocomp) - OFF

p. **Plane Above Sea Level Indicator — Set field elevation or lower limit using H_{CAL}**

Place selector switch to H_{CAL} and hold set control depressed until H_A stabilizes before setting.

RADAR NAVIGATOR'S CHECKLIST (Cont)

q. Radiate Button — Depressed (after standby light illuminates)

Check that radiate light illuminates.

WARNING

- The BNS radar should not be in radiate when the airplane is within 200 feet of any ground refueling operation or open fuel tank.
- The area in line with the radiation of a nonrotating BNS radar antenna is hazardous to personnel. For this reason, do not stop the antenna while the BNS radar is in radiate operation.

r. Radar Indicator — Adjusted and checked

Adjust and check antenna tilt and scope presentation.

5. Terrain Avoidance System Check:

After radar navigator and navigator have adjusted and checked their radar indicators, radar navigator will accomplish his terrain avoidance system check and call pilot to inform him that the BNS is in radiate and that the pilots may accomplish their terrain avoidance system check.

a. Terrain Test Selector Switch - Checked +105, +50, -50, -150

All readings should read midscale plus or minus tolerance on meter.

b. BNS Frequency - Set to briefed frequency

c. Terrain Test Selector Switch - Checked XL1, XL2

All readings should be three divisions or higher.

NOTE

The ratio of XL1 to XL2 should not be greater than 3 to 2 or less than 2 to 3.

d. Terrain Test Selector Switch - OFF

e. Radar Display Selector Switch - LO ALT TA

f. Topocomp & 5-Inch Indicator - Checked (RN-N)

Assure doppler drift switch is OFF. Check for a sector of approximately 170° in width approximately 85° on each side of heading marker. Check indicators for acceptable radar returns.

RADAR NAVIGATOR'S CHECKLIST (Cont)

g. Clearance Plane - Set

Radar navigator sets his clearance plane as desired for the flight.

h. Radar Display Selector Switch - LO ALT GM

i. STC Amplitude - Checked, return to position 1

Rotate STC gain control and observe that returns near center of scope vary in brilliance.

j. Radar Display Selector Switch - HI ALT GM

k. Terrain Computer Power Switch TH - OFF (after being notified that pilots have accomplished their terrain avoidance system check)

6. Gyro Leveling Check:

a. Stab Bypass Switch - OFF

b. Gyro Erect Switch - NORM

c. Erect Cutoff Light - Off

If erection cutoff light illuminates, switch to high erect and perform gyro leveling check at a later time.

7. Preset Data:

The navigator may assist the radar navigator as desired.

a. Present Position Indicators - Set

b. Destination 1 & 2 Indicators - Set

c. Wind Indicators - Set Zero

NOTE

Items "8" and "9" are to be performed only if the crew is to leave the airplane for an extended period.

8. BNS Turn-Off:

a. Intensity Knob - CCW

b. Receiver Gain Knob - CCW

c. Video Knob - CCW

RADAR NAVIGATOR'S CHECKLIST (Cont)

d. Standby Button - Depressed

e. Range Selector Switch - 20

f. Radar Power Switch - OFF

g. BNS Power Switch - OFF

h. Ground Blowers Switch - OFF

i. Desiccators Switch - OFF

j. Stab Bypass Switch - ON

k. Gyro Erect Switch - HI

9. Oxygen Regulator - OFF and 100% OXYGEN

BEFORE TAKEOFF

CAUTION

- BNS turn-on should be accomplished prior to taxiing to prevent damage to gyros.
- Monitor the overheat and low airflow warning light during all low engine power operation. It is permissible to operate the BNS for a limited time with the cabin low airflow light illuminated. The BNS must then be shut down or power increased on engine (usually engine No. 4) until the cabin low airflow light goes out.
- Two minutes may elapse after advancing power before the cabin low airflow light goes out.
- The low airflow light is illuminated by low airflow and cabin temperature. If the low airflow light illuminates:
  1. Insure that engines 4 and 5 are 85% or higher.
  2. Turn temperature cabin control to 50°.
  3. Decrease airflow at all crew compartment air outlets.

  If the low airflow light remains on 10 minutes after performing the above steps, the BNS should be turned off for at least 1 hour to allow proper cooling.

RADAR NAVIGATOR'S CHECKLIST (Cont)

- Two minutes may elapse after advancing power before the cabin low airflow light goes out.

- The low airflow light is illuminated by low airflow and cabin temperature. If the low airflow light illuminates:
  1. Insure that engines 4 and 5 are 85% or higher.
  2. Turn temperature cabin control to 50°.
  3. Decrease airflow at all crew compartment air outlets.

  If the low airflow light remains on 10 minutes after performing the above steps, the BNS should be turned off for at least 1 hour to allow proper cooling.

NOTE

If radar has not been turned off, omit items "1" and "7."

1. BNS Turn-On:
   a. Ground Blowers Switch - ON
   b. Desiccators Switch - ON
   c. Radar Power Switch - ON
   d. BNS Power Switch - ON
2. Special Weapons & ASM Lock Indicators - Indicate locked

2A. Arming Switch UM - SAFE

3. Pin No. 1 - Removed

WARNING

To prevent accidental firing of the ejection seat, install pin No. 1 prior to leaving the seat during flight. Upon returning to the seat, remove pin No. 1 and fasten parachute and safety belt.

4. Parachute & Safety Belt - Fastened

NOTE

If it becomes necessary to leave the seat during flight, the crew member should open the safety belt and unbuckle the parachute harness leaving the parachute and survival kit in the seat. If the parachute is worn when leaving the seat, upon returning to the seat, it will be necessary to take it off in order to reinstall the parachute and safety belt in the seat.

5. Oxygen Regulator - ON and NORMAL OXYGEN
6. Bailout Bottle - Connected

RADAR NAVIGATOR'S CHECKLIST (Cont)

7. Radiate Button - Depressed (after standby light illuminates)

   Check that radiate light illuminates.

8. Radar Indicator - Adjusted and checked

   Adjust and check antenna tilt and scope presentation.

9. Forward Landing Gear - Checked

   Check visually through the optics for alignment. Check for evidence of fuel or hydraulic leaks in the landing gear area.

10. Altimeter - Set

    Set altimeter to field elevation.

NOTE

When setting altimeter, special attention should be given to the altimeter to insure the 10,000-foot pointer is reading correctly.

11. Takeoff Report - As required

    Copilot announces over interphone "Crew, stand by for takeoff." Acknowledgement not required unless some discrepancy exists that may compromise successful completion of the mission.

TAKEOFF

1. BNS Data Preset Panel (accomplish at start of takeoff roll):
   a. Doppler Wind Switch - ON
   b. Present Pos Switch - ON
   c. Gyro Erect Switch - NORM
2. Emergency Controls Panel:
   a. TAS Switch - OFF
   b. Stab Bypass Switch - OFF

AFTER TAKEOFF

1. Forward Landing Gear - Checked

   Check that forward wheels are braked and that the gear is fully retracted. Report only apparent malfunctions. Observe closely for evidence of fuel or hydraulic leaks.

NOTE

When carrying GAM-77 missiles, the rotating beacon will reflect from the polished surfaces of the missiles. The reflection from the left missile could easily be interpreted as flame or fire. When in doubt, the radar navigator should request the rotating beacon be turned off momentarily for a positive check of fire.

RADAR NAVIGATOR'S CHECKLIST (Cont)

2. Plane Above Sea Level Indicator - Adjusted

   Adjust the BNS altitude during climb as necessary.

3. Oxygen Check - Completed

   a. During the climb, copilot requests an oxygen and zero delay lanyard check at 12,000 feet. The sequence for oxygen report is the same as for crew report. Oxygen panels will be checked for:

      (1) Oxygen Supply Shutoff Lever - ON

      (2) Regulator Diluter Lever - NORMAL OXYGEN

      (3) Pressure - 300 psi

      (4) Flow Indicator - Functions normally

      (5) Emergency Toggle Lever - NORMAL

   b. Gunner and copilot report, "Cabin altitude _____ feet. Oxygen panel checked."

   c. Navigator, EW officer, radar navigator, and pilot report, "Oxygen panel checked." Pilot reports oxygen quantities.

   d. Under steps "b" and "c," the gunner, copilot, EW officer, and pilot will report "Zero delay lanyard stowed."

   e. Copilot, notify aircrew and receive gunner's acknowledgment when passing through 26,000 and 35,000 feet.

   f. The copilot will request an oxygen check at level-off. During cruise, the copilot will monitor the gunner's remote cabin altimeter and the tail compartment low pressure warning light at intervals not to exceed 15 minutes and initiate the oxygen checks at 30-minute intervals when both cabin altitudes are below 12,000 feet, at 15-minute intervals when either cabin altitude is 12,000 to 25,000 feet, and at no longer than 10-minute intervals when either cabin altitude is above 25,000 feet. If cabin altitude is below 12,000 feet, only the gunner and copilot/pilot will report. The remaining crew members will check their equipment and report if abnormal. At level-off, only the gunner and copilot/pilot need report if cabin pressure is 12,000 feet or below.

4. Altimeter - Set

LEVEL-OFF

1. BNS - Set

   Assure the proper setting of the altitude, wind, present position and destination counters, for accurate route navigation.

BEFORE DESCENT

1. TF & L Switches - ON

2. TF & L - Zero

   Set values approximately to zero with controls on the BNS data preset panel. Set exact values of zero with controls on emergency controls panel.

RADAR NAVIGATOR'S CHECKLIST (Cont)

3. Offset - Set

   Set components from approach end of runway to selected OAP.

4. Target Above Sea Level Indicator - Set runway elevation

5. Burst Point Above Target Indicator - Zero

6. Present Position - Set

7. Destination 1 or 2 - Set runway coordinates

8. Nuclear Bombs and External Missiles Safety Checklist:

   If nuclear bombs and/or external missiles are aboard, a bombing safety check must be made:

   a. Master Bomb Control Switch - OFF

   b. Bombing System Switch - MANUAL

   c. Readiness Switch Cover - Closed, pin inserted (RN-P)

   d. SWESS Control Panels: (RN-P)

      (1) Arm-Safe Switches - SAFE

      (2) Armed Lights - Off

      (3) Warning Lights - Off, tested

   e. Special Weapons & ASM Lock Indicators - Indicate locked

   f. Release Circuits Disconnect PR - Disconnected, light off

8. Conventional Munitions Safety Checklist:

   If conventional munitions are aboard, a safety check must be accomplished:

   a. Master Bomb Control Switch - OFF

   b. Bombing System Switch - MANUAL

   c. Arming Switch UM - SAFE

   d. Release Circuits Disconnect PR - Disconnected, light off

   e. Release Power Switch UM - OFF

DESCENT AND BEFORE LANDING

NOTE

Monitor the overheat and low airflow warning lights. If necessary, request that power be advanced on at least one engine (usually No. 4) to keep the cabin low airflow light out.

1. Parachute & Safety Belt - Fastened

2. Initial Point - Made good

   The radar navigator will coordinate with pilot in monitoring or directing airplane path to the VOR station or any other reference point to be used for initiating the penetration, arriving over the point on the desired heading for initial descent.

RADAR NAVIGATOR'S CHECKLIST (Cont)

3. Penetration - Initiated

Upon reaching point of initial penetration, the jet penetration as published in the Flight Information Publication will be initiated. Monitor or direct aircraft path over the ground and advise the pilot of any deviation from published penetration.

3A. Descent Altitude Calls - Accomplish

a. Coordinate with the pilot as to level-off altitude(s) to be used for descent and entry to landing pattern.

b. Call off altitude to pilot every 5000 feet during descent beginning at first multiple of 5000 feet. Upon reaching level-off altitude plus 5000 feet, report altitude to pilot every 1000 feet and at level-off altitude.

4. Forward Landing Gear - Checked

Immediately after gear is extended, check for proper extension and alignment. Observe closely for indications of fuel or hydraulic leaks. During transition, the radar navigator will check the gear after each landing. Do not report unless a discrepancy exists.

NOTE

When carrying AGM-28 missiles, the rotating beacon will reflect from the polished surfaces of the missiles. The reflection from the left missile could easily be interpreted as flame or fire. When in doubt, the radar navigator should request the rotating beacon be turned off momentarily for a positive check of fire.

5. Crosshairs - Positioned

Place crosshairs on offset aimpoint or the approach end of runway with the inner edge of the range marker on the edge of no return.

a. Track Button - Depressed

Monitor airplane path over the ground and advise pilot of any departure from prescribed penetration.

b. Bomb Control Heading Switch - BOMB

6. Plane Above Sea Level Indicator - Set

Upon reaching traffic pattern altitude, set altitude as indicated by the altimeter.

7. Traffic Pattern - Monitored or directed

Monitor or direct the airplane throughout the normal GCA pattern for the active runway, advising the pilot of any deviation noted or discrepancies between GCA and airborne radar. Navigator will monitor altitude throughout the pattern.

8. FCI - Centered (on final approach)

Upon completing the turn onto the final approach, the radar navigator will reposition the crosshairs on the approach end of the runway or offset aimpoint. If it is a directed approach, the FCI and time-to-go indicator will be used to make the final approach. If it is a monitored approach, the FCI and time-to-go indicator may be cross-checked by the pilot to determine progress on final approach.

9. Final Descent - Initiated

The descent phase of the GCA normally will be commenced when ground range is 8 NM from approach end of runway. Altitude should be checked at 100 seconds (1000 feet altitude) and 60 seconds (600 feet altitude). The time-to-go indicator will read zero when the airplane is approximately 1000 feet down the runway.

RADAR NAVIGATOR'S CHECKLIST (Cont)

AFTER LANDING

CAUTION

Monitor the overheat and low airflow warning lights. If necessary, turn equipment off.

1. Intensity Knob - CCW
2. Receiver Knob - CCW
3. Video Knob - CCW
4. Standby Button - Depressed
5. Pin No. 1 - Installed

AFTER PARKING

1. BNS Power Switch - OFF
2. Terrain Computer Power Switch [T] - OFF
3. BNS Heaters Switch - OFF
4. Radar Power Switch - OFF
5. Ground Blowers Switch - OFF
6. Desiccators Switch - OFF
7. Inform Pilot - BNS off
8. Interphone - Disconnected after engine off
9. Oxygen Regulator - OFF and 100% OXYGEN
10. Compass & True Heading Computer Cutoff Switch - OFF
11. Nuclear Bombs Aboard - Accomplish bomb "After Landing" checklist

    Insert and use the bomb "After Landing" checklist.

11. Conventional Munitions Aboard - Install fuze safeing pins

    If qualified personnel are not available to install the pins, the radar navigator and navigator will be responsible for proper installation of a fuze safeing pin in each fuze.

12. ADM-20 Track Antijettison Tools - Installed (if ADM-20's aboard)

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING PROCEDURES

BOMBING — GENERAL

On training missions, when ADM-20's are carried, the bomb doors will not be opened unless required for an extension or actual launch.

After release of practice bombs and/or ADM-20's and prior to RBS runs, camera attacks, or landing, a crew member will make a positive visual check to insure the bomb bay is free of bombs and ADM-20's and that opening of the doors would not result in release of any object.

The EBR handle will not be pulled when training shapes or bombs are released unless over a cleared designated salvo range and the bomb doors are opened prior to release with the radar navigator's bomb door switch.

If actual release of the bomb(s) was not effected on a bombing range, the special weapons racks will be locked and the indicator checked locked before departing the range. If the special weapons racks fail to lock at this time, the bomb(s) must be released on the range or the airplane returned by safe route to the nearest SAC base.

NOTE

Procedures for use of the special weapons manual release handles are not included in the checklists due to the variances in their usage depending on the type of run accomplished and the type of bomb(s) carried. Proper usage of the special weapons manual release handles for each bomb and the type of release system are described in "Bombing System," Section IV, and T.O. 1B-52B-25-1, Section II. If the planned method of release fails, an emergency release will be accomplished by use of the special weapons manual release handles.

The normal multiple carriage release sequence is LR, UR, LL, and UL. This sequence is dependent on closing the doors between releases. If the doors do not close after any release, the master bomb control switch will be turned OFF and then ON in order to maintain the normal sequence.

A knowledge of emergency bombing procedures is necessary whenever portions of the BNS become inoperable and cannot be repaired in flight through application of procedures outlined in the Radar Navigator's/Navigator's Manual, Inflight Malfunction Isolation and Correction Procedures, T.O. 1B-52E-1-6-2.

In the event of failure of the BNS radar with operable computers, the automatic crosshair laying (ACL) feature of the BNS will be utilized to the fullest extent. Maximum utilization of the optical capability will be employed consistent with existing conditions.

If the decision is made to make a "Fixed Angle," "Timing," or "Last Resort" release, care must be taken to insure that the bomb bay doors are opened manually and that the D-2 bomb release switch is actuated.

Prior to making any bomb runs, the BNS true heading will be checked using the automatic astrocompass on headings as close as possible to the planned bomb run headings. This heading error will be recorded. If the automatic astrocompass is inoperative, these heading checks will be made with the periscopic sextant. If, for some reason, it is impossible to obtain a true heading from the automatic astrocompass on the bomb run, the recorded heading error will be applied to the BNS true heading.

Bomb Run Monitoring

The navigator will monitor all phases of the bomb run. The navigator will indicate to the radar navigator any apparent errors in sighting; whether offset 1, 2, or OFF is being used properly; and will monitor the bombing panels, doppler radar, and MD-1 astrocompass for warning lights, switch positions, and any abnormal indications. At bombs away, the navigator will record all necessary bombing information and perform breakaway timing.

Fixed Angle Bombing

In this method of bombing, a track to the target is established and the bomb is released a computed time after the target is coincident with the 10- or 20-mile fixed range mark. The time to go to release after coincidence of the target with the desired range mark is extracted from applicable tables or graphs.

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING PROCEDURES (Cont)

Computations For Large Charge Fixed Angle

The distance between releases is equal to the distance between targets if the same ground speed exists for both bomb runs. With no change in ground speed, the time in seconds between targets may be added to the time to go computed from the 10/20 mile slant range marker to determine the total interval between starting the stopwatch and releasing on the second target. A change in ground speed will affect the time between releases. This can be corrected by computing the time to go from the 10/20 mile slant range table for both ground speeds. If the time between targets is added to the time to go computed for the first ground speed and this total time corrected by the difference between the two time to go's, the resulting total will be corrected for all factors readily available to the navigator.

An example of this computation is provided to aid in understanding the problem. Since the distance between targets can be determined prior to flight, ground computations may be made at the appropriate bombing altitude for differences in ground speed. Inflight computations would then consist of determining an accurate TTG based on the actual ground speed for the first bomb run, adding this to the time between targets, and adjusting for the recomputed difference between ground speeds.

The stopwatch will be started when the 10/20 mile slant range marker is coincident with the first target. The first release will be actuated on expiration of the first TTG. A turn must then be made, checklist items accomplished, and, on expiration of the total time interval, the second bomb released.

This is a complicated procedure and care must be taken to insure that the two time intervals are understood and monitored. Stopping the stopwatch at the time of the first release or failing to monitor the watch closely will jeopardize the second release. If the target is visible, the radar navigator should be prepared to restart the watch on coincidence of the second target and the 10/20 mile slant range mark.

TTG (10/20 NM Range Table) 1st tgt	60	sec
TTG (10/20 NM Range Table) 2nd tgt	58	sec
Difference ±	-2	- if 2nd tgt is less + if 2nd tgt is more
Time interval between targets	42	sec
TTG (10/20 NM Range Table) 1st tgt	60	sec
Total	102	
Difference ±	-2	
Time from starting watch to 2nd release	100	sec

Multiple Drift Procedures

Explanation: Establish track to the target using multiple drift corrections as follows: The multiple drift correction is obtained by comparing the target bearings at different ranges utilizing the etched cursor. The difference in bearings is multiplied by a range factor. This range factor depends on the range at which the first bearing is measured and the range at which the second bearing is measured. The "Multiple Drift Factors Chart" may be used to determine this factor. The factor is found at the intersection of the first bearing range and second bearing range. For example: After initial lineup, a target bearing of 240° is measured at a range of 80 nautical miles. At a range of 50 nautical miles, the target bearing is 242°. The factor from 80 nautical miles to 50 nautical miles is 2.7. The difference between the bearings is 2°. The turn correction is approximately 5.5° right. The direction of the turn is the same direction as the target appeared to drift. If the target drifts off during the remainder of the run, continue the multiple drift procedure until target is coincident with the 30-mile range marker. After the 30-mile range marker, multiple drift or arbitrary drift corrections may be made commensurate with scope centering, target appearance, and the range mark used for release.

NOTE

Accuracy is increased when smaller factors are used; where practical, factors smaller than 3 are recommended.

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING PROCEDURES (Cont)

Topocomp Procedure

If all electronic markers are lost but the radar remains operational, a release may be effected by use of the topocomp. Set the radar range selector switch to 50 nautical miles, the topocomp selector switch to SUP, with the 40,000-foot scaling photo for high altitude or the 1,500-foot scaling photo for low altitude. Utilizing the etched cursor with predetermined drift, continue the bomb run using fixed angle procedures.

ETA To Bomb Release Line Bombing (Timing)

If both the BNS radar and the computers fail, a release may be accomplished by timing. Principles employed in accomplishing a timing run should not be restricted to any particular type bomb run. The ETA to the bomb release line should be computed for all bomb runs and should be continuously revised according to the best known information. The ETA to the bomb release line is computed by determining the ETA to the target and subtracting the actual range expressed in time. Actual range in seconds can be extracted from the "Actual Range in Seconds Computation Chart" or by using this formula: AR in seconds = $\frac{\text{AR (feet)}}{\text{GS (feet/sec)}}$.

LAST RESORT BOMBING

The procedures for making a last resort bomb run must include methods to solve four problems: drift correction, establishing an accurate point to start, maintaining airplane heading after the target has disappeared, and establishing a correct bomb release point. Time to release is computed using the attitude and time to release charts.

The rings on the bar portion of the last resort bombsight can be moved laterally to compensate for drift. Detents are provided to indicate the amount of drift correction in 2° increments on aircraft Less UW and 3°15' increments on aircraft UW. Drift in excess of the mounting bar adjustment limitations must be estimated. There are 11 detents on each ring sight mounting bar. The zero drift position for the pilot's ring sight is the fifth detent from the left. The zero drift position for the copilot's ring sight is the fifth detent from the right. The line of sight from the pilot or copilot through the vertical (azimuth) crosshair, over the sighting post, to the aiming point represents 0° of drift when the above specified detents are being utilized. If the drift was 4° on aircraft Less UW or 6°30' on aircraft UW to the right, the rings would be moved two detents to the left of zero. Once the drift is killed, the aircraft is on a course that will permit it to pass directly over the target. Provision is not made to compensate for crosstrail.

As the airplane moves toward the target complex, the aiming point will appear to be moving toward the airplane. As the aiming point appears to approach the nose of the airplane, the stopwatch or airplane clock to be used during the timing phase should be readied. With the lowered head position, while utilizing the lower sighting ring, the aiming point continues to move in toward the airplane nose and first intersects the vertical (azimuth) crosshair on the lower ring. The aiming point continues to move upward, as head position is raised, until it intersects the horizontal (sighting angle) crosshair on the upper ring. When the upper ring crosshair intersects the top of the forward sighting post and the aiming point, the start timing point has been reached. Start the stopwatch and, at the expiration of time to go, actuate the D-2 bomb release switch.

A placard showing changes in time to release for deviations of predicted attitude, ground speed, and altitude should be prepared for each flight. The placard can be used in flight in lieu of the time to release chart or under emergency conditions. An example of one method to display required data on a placard is illustrated below. The middle line indicates predicted conditions, attitude 3, ground speed 480 knots, altitude 30,000 feet, and time to release 51 seconds. Deviations are included for each argument. If the bomb run altitude was changed to 32,000 feet, 3 seconds would be added to the predicted 51 seconds making the time to release change to 54 seconds; a ground speed change to 460 knots would result in time to release of 55 seconds, etc.

ATTITUDE	GROUND SPEED	ALTITUDE
4 + 8 sec	500 - 4 sec	32M + 3 sec
3 51 sec	480 51 sec	30M 51 sec
2 - 8 sec	460 + 4 sec	28M - 5 sec

REVERSE SIDE INTENTIONALLY LEFT BLANK

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NUCLEAR)

PERIODIC WEAPON MONITORING

NOTE

To be accomplished at level-off and at periodic intervals.

1. Special Weapons & ASM Lock Indicators - Indicate locked (RN)
2. Readiness Switch Cover - Closed and sealed (N-P)
3. SWESS Control Panels: (RN-P)
   a. Armed Lights - Off
   b. Warning Lights - Off, tested
4. DCU-9A Control Levers - OS and sealed (N)
5. SWK Monitor Select Switch - First bomb to be released (RN)
6. DCU-9A Selector Switches - SAFE (N)
7. DCU-9A Warning Lights - Off, tested (for each position of SWK box) (RN-N)
8. SWK Monitor Select Switch - First bomb to be released (RN)
9. Parachute Static Line Retain Lights - On (for retarded fall), off (for free fall) (RN)
10. AGM-28 Armament Selector Switch(es) - SAFE and sealed (N)

WEAPONS PREPARATION FOR RELEASE (RN-N)

NOTE

- Perform this checklist within the 15-minute period prior to HHCL or within the 15-minute period prior to point of descent, whichever is reached first and only after the "Go Code" has been received and authenticated.
- For training missions (no EWO bombs aboard), the WPR must be performed within the 15-minute period prior to established HHCL.
- Navigator will monitor the WPR and insure completion of all items.
- It is imperative that the following steps be completed in sequence.

1. Safety Check: (RN)
   a. Bombing System Switch - MANUAL
   b. Special Weapons & ASM Lock Indicators - Indicate locked
   c. Notify pilot "Safety check complete"

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NUCLEAR) (Cont)

1A. Monitoring Set System Select Switch - AUTO (N)

2. Bombing Equipment Check: (RN)

a. Normal Release and Jettison Power Circuit Breakers - In

b. Circuit Breakers - Set

NOTE

ADM-20 and AGM-28 circuit breakers set as required.

c. BRIC - SEL, light on

d. Crosshair - Positioned

Position crosshair along the heading of the aircraft a sufficient distance to complete equipment check.

e. BNS Hand Control Sensing Switch - LOS

f. Bomb Button - Depress

g. Heading Error Indicator - Checked

Using crosshair control handle, deflect steering needle to right and left and then zero. Request pilot to observe the flight command indicator for proper movement.

h. Request pilot to position autopilot turn control selector switch to BOMB.

i. BNS Steering Check - Completed

Using crosshair control handle, check for response of the airplane to a right turn. Release crosshair control handle; airplane should fly straight and level and steering needle should center. Repeat for a left turn.

j. Offset Checks - Completed

Check offsets 1 and 2, in turn, and observe that crosshair is correctly displaced.

k. UHF Radio (RBS only) - Set

Notify copilot to switch radio to an unused channel.

l. Time-to-Go Indicator - Checked for drive

Request pilot call TG at 25-second intervals and at TG zero.

m. Master Bomb Control Switch - ON

n. Bomb Release Check:

(1) Tone Break (RBS only) - Checked

(2) Search Button - Depress

(3) Master Bomb Control Switch - OFF

o. BNS Hand Control Sensing Switch - As desired

p. Hydraulic Packs 1, 2 & 4 - Indicate shut down

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (Cont)

WARNING

On training missions when ASMs are carried, the readiness switch cover will remain closed and sealed.

8. DCU-9A Selector Switches - SAFE (N)
9. DCU-9A Warning Lights - Off, tested (for each position of SWK box) (RN-N)
10. DCU-9A Selector Switches - GND or AIR (as briefed) (N)
11. DCU-9A Warning Lights - Off, tested (for each position of SWK box) (RN-N)

NOTE

On training missions when ASMs are carried and the readiness switch cover must remain closed, the warning lights will be on.

12. SWK Monitor Select Switch - First bomb to be released (RN)
13. Parachute Static Line Retain Lights - Off, tested (for free fall), on (for retarded fall) (RN)
14. Special Weapons Select Switch - As briefed (RN)

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (Cont)

ABORT PROCEDURES (NUCLEAR)

NOTE

- Accomplish only if WPR and/or missile preparation for launch check has been performed.
- Do not accomplish until out of enemy territory.

1. Internal Bombs:
   a. DCU-9A Selector Switches - SAFE (N)
   b. DCU-9A Control Levers - OS (N)
   c. DCU-9A Warning Lights - Off, tested (for each position of SWK box) (RN-N)
   d. Readiness Switch Cover - Closed, pin inserted (N-P)
   e. Special Weapons Manual Lock Handle - Locked (RN-EW)
   f. Special Weapons Racks - Indicate locked (RN)
   g. Parachute Static Line Control Switches (if applicable) - RETAIN (RN)
   h. Parachute Static Line Control Lights - On (RN)
   i. SWESS Control Panels: (RN-P)
      (1) Arm-Safe Switches - SAFE
      (2) Armed Lights - Off
   j. Normal Release & Salvo/Jettison Power Circuit Breakers - Out (RN)
   k. Release Circuits Disconnect PR - Disconnected, light off (RN)
2. AGM-28:
   a. Special Weapons Manual Lock Handle - Locked (N-EW)
   b. ASM Lock Indicators - Indicate locked (N)
   c. ASM Separation (4) & Jettison Control (2) Circuit Breakers - Out (N)
   d. Release Circuits Disconnect PR - Disconnected, light off (RN)
   e. Armament Selector Switches - SAFE (N)
   f. Readiness Switch Cover - Closed, pin inserted (N-P)
   g. Armament Warning Lights - Off, tested (N)
   h. Safe Time Interval Knobs - 30 minutes (N)
   i. Warhead Lights - Off (N)
   j. Tactical Altitude Selector Switches - LOW (N)

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (Cont)

HIGH ALTITUDE BOMBING (NUCLEAR)

BEFORE PRE-IP

The following checks are to be completed within 1 hour of the Pre-IP:

1. Readiness Switches - READY (RN-P)

WARNING

On training missions when ASMs are carried, the readiness switch cover will remain closed and sealed.

2. DCU-9A Selector Switches - GND or AIR (as briefed) (N)
3. DCU-9A Warning Lights - Off, tested (for each position of SWK box) (RN-N)

NOTE

On training missions when ASMs are carried and the readiness switch cover must remain closed, the warning lights will be on.

4. SWK Monitor Select Switch - On bomb to be released (RN)
5. Bombing Data: (RN-N)
   a. Ballistics Derivative Indicators - Set (RN)
   b. Preset Knots Indicator - Set (RN)
   c. Preset Ht of Fall Indicator - Set (RN)
   d. Burst Point Above Target Indicator - Set (RN)
   e. TF Indicator - Set (N)
   f. L Indicator - Set (N)
   g. Offset 1 and 2 Indicators - Set (N)
6. Gyro Lat Knob - Set (RN)
7. High and Low Altitude Mode Selector Switch - HI ALT GM (RN)
8. Present Position - Corrected (RN)
9. IP Coordinates - Set (RN-N)
10. Heading Select Switch - MD-1 (N)
11. Altitude Measurement - Completed (RN)
12. Bombing Altitude - Computed and cross-checked (for targets 1 and 2) (RN-N)
13. H_A - Adjusted (RN)

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (Cont)

14. Drifts for Bomb Run Axes - Determined (for targets 1 and 2) (N)

15. Initial Headings - Determined (for targets 1 and 2) (N)

16. Ground Speeds - Determined (for targets 1 and 2) (N)

17. Timing Computations:

    a. Time to Go from Range Mark to Release - Determined (for targets 1 and 2) (RN-N)

    b. ETA to Bomb Release Line for Target No. 1 - Determined (RN-N)

    c. Last Resort Times to Release - Computed and relayed to pilots (RN-N)

    d. Last Resort Bombsight Detent Settings - Computed and relayed to pilots (RN-N)

    e. Time to Release No. 2 from Release No. 1 - Determined (RN-N)

    For all practical purposes, the time between releases is the same as time between targets.

18. SWESS Control Panels: (RN-P)

WARNING

Do not arm SWESS under any of the following conditions:
- For low altitude bombing.
- When below 25,000 feet.
- Over friendly or neutral territory with bombs aboard.

a. Pilot's Arm-Safe Switch - SAFE and sealed (pilot acknowledges)

b. Radar Navigator's Arm-Safe Switch - ARM

c. Pilot's & Radar Navigator's Armed Lights - Off, tested (pilot acknowledges)

WARNING

If SWESS armed lights do not come on while pressed, do not arm pilot's arm-safe switch.

d. Pilot's Arm-Safe Switch - ARM (pilot acknowledges)

e. Pilot's & Radar Navigator's Armed Lights - On (pilot acknowledges)

f. Pilot's & Radar Navigator's Warning Lights - Off, tested (pilot acknowledges)

BEFORE IP

1. Circuit Breakers - Set (RN)

1A. Monitoring Set System Select Switch - AUTO (N)

2. Radar Camera Switches - As required (N)

3. IBDA Power Switch - ON (OFF for Large Charge) (RN)

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NUCLEAR) (Cont)

4. IBDA Mode Switch - PHOTO (RN)

   Hold in PHOTO position for at least two exposures.

5. Target No. 1 Coordinates - Set (RN-N)

6. Special Weapons Racks - Indicate unlocked (RN)

NOTE

On training missions when ASMs are carried, the ASM and special weapons lock indicators must indicate locked.

7. Special Weapons Select Switch - As briefed (RN)

8. Parachute Static Line Retain Lights - Off (for free fall), on (for retarded fall) (RN)

9. TAS - Checked (for planned TAS) (RN)

10. Bombing Data Check:

	RN CALLS	NAV RESPONSE
a.	"Ballistics Derivatives"	"Reads _____"
b.	"Preset Knots"	"Reads _____"
c.	"Burst Point Above Target"	"Reads _____"
d.	"Preset Height of Fall"	"Reads _____"
e.	"T_F and L"	"Reads _____ and _____"
f.	"Offset 1"	"Reads _____, _____, and _____"
g.	"Offset 2"	"Reads _____, _____, and _____"

11. Target No. 1 Coordinates - Checked (N)

12. Present Position - Corrected (RN)

13. Over IP - Notify pilot and give initial headings for both bomb runs (N)

BOMB RUN (SYNCHRONOUS)

1. Target No. 2 Coordinates - Set (RN-N)

2. Bombing Configuration Check:

   To be completed after departing the IP.

	NAV CALLS	RN RESPONSE
a.	"Target Above Sea Level"	"Set _____" (target elevation)
b.	"BRIC"	"SEL"

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NUCLEAR) (Cont)

c.	"Bomb Indicator Lights Switch"	"ON"
d.	"Offset"	"1, 2, or OFF"
e.	Map-Match Runs Only:	
	(1) "Operation Switch (Topocomp)"	"SS"
	(2) "Target Scale Selector Switch"	"50"
	(3) "Film Change Button"	"50-mile target photo"

3. Crosshair on Aimpoint or Map-Match Check: (RN)

NOTE

If map-match is not used, perform **boldface** items only.

a. **ACL Button — Depressed when green ACL light comes on (if desired)**

b. **Auto Fix — Completed (if desired)**

c. Radar Map Switch - NS-OC

d. Operation Switch (Topocomp) - SUP or FLK

e. **Bomb Button — Depressed**

f. **Destination Switch — Target No. 2 (Large Charge only)**

g. **BNS Steering (if applicable) — Requested, light on**

h. Film Image Horiz and Vert Controls - Center reticle on crosshair

i. Hand Control - Match radar picture to target photo

NOTE

After changing target scale, always center reticle on crosshair before matching

4. Bomb Door System Check:

	NAV CALLS	RN RESPONSE
a.	"Release Circuits Disconnect"	"Connected, light on"
b.	"Master Bomb Control Switch"	"ON"
c.	"Bombing System Switch"	"AUTO"
d.	"Bomb Door Control Valve Lights Off"	

5. Bomb Run Calldown:

a. Bomb Tone (RBS only) - On (20 seconds prior to bomb release) (RN)

b. Bomb Away Call - Completed (RN-N-P)

c. Applicable Weapon Released or Bomb Indicator Light - On (RN-N)

d. Stopwatch - Started at bomb release (RN-N)

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NUCLEAR) (Cont)

NOTE

The following steps performed for Large Charge only.

6. Perform immediately (RN); Monitor (N)

   a. Bomb Doors - Closed

   b. Track Button - Depressed

   c. ACL Button - Depressed (as required)

   d. Offset Selector Switch - 1, 2, or OFF

   e. Special Weapons Select Switch - As briefed

   f. Bomb Door Control Valve Lights - Off

TIMING

Items "g" through "l" will be performed for those Large Charge runs where the first release is a normal synchronous radar bomb run but the second release is accomplished by timing, using precomputed heading and time between releases.

   g. Bombing System Switch - MANUAL

   h. Bomb Doors - Opened

      Bomb doors will be opened manually using bomb door switch.

   i. Bomb Tone (RBS only) - On (20 seconds prior to bomb release)

   j. "Bomb Away" Call - Completed (RN-N-P)

   k. D-2 Bomb Release Switch - Actuated

   l. Applicable Weapon Released or Bomb Indicator Light - On

   g. Bomb Button - Depressed

   h. BNS Steering (if applicable) - Requested, light on

   i. Bomb Tone (RBS only) - On (20 seconds prior to bomb release)

   j. "Bomb Away" Call - Completed

   k. Applicable Weapon Released or Bomb Indicator Light - On

POST BOMB RELEASE CHECK

Proceed to post bomb release check.

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NUCLEAR) (Cont)

BOMB RUN (ALTERNATE)

1. Bombing Configuration Check: (RN-N)

   To be completed after departing the IP.

	NAV CALLS	RN-P RESPONSE
a.	"Detent Correction"	"Set _____" (P)
b.	"Time to Release"	"_____ seconds" (P)

If a last resort bomb run is to be made, pilot will correct for drift using last resort bombsight.

c.	"Release Circuits Disconnect"	"Connected, light on" (RN)
d.	"BRIC"	"SEL" (RN)
e.	"Bomb Indicator Light Switch"	"ON" (RN)
f.	"Master Bomb Control Switch"	"ON" (RN)
g.	"Bomb Door Control Valve Lights Off"	
h.	"Bombing System Switch"	"MANUAL" (RN)
i.	"Bomb Doors"	"Opened" (RN)

Bomb doors will be opened manually using bomb door switch.

2. Multiple Drift Corrections - Accomplished (RN-N)
3. Stopwatch - Started (RN-N-P)

   For fixed angle, radar navigator starts stopwatch or notifies navigator to start stopwatch when target is coincident with applicable slant range marker. For last resort, when the upper ring crosshair intersects the top of the forward sighting post and the aiming point, start the stopwatch or aircraft clock.

4. Bomb Tone (RBS only) - On (20 seconds prior to bomb release) (RN)
5. Expiration of Time to Release/ETA to Bomb Release Line:
   a. "Bomb Away" Call - Completed (RN-N-P)
   b. D-2 Bomb Release Switch - Actuated (RN)
   c. Applicable Weapon Released or Bomb Indicator Light - On (RN-N)

NOTE

- Do not stop the stopwatch at bomb away.
- Following steps performed for Large Charge only.

6. Perform immediately (RN); Monitor (N)
   a. Bomb Doors - Closed
   b. Special Weapons Select Switch - As briefed
7. Bomb Door Control Valve Lights - Off (RN)

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (Cont)

9. Stopwatch - Started (RN-N-P)

   If target separation allows, stopwatch may be stopped and the radar navigator or pilot may reaccomplish Fixed Angle or Last Resort Tactics. Radar navigator will be prepared to release second bomb at expiration of predetermined time interval between releases.

10. Bomb Tone (RBS only) - On (20 seconds prior to bomb away) (RN)

11. Expiration of Time to Release/ETA to Bomb Release Line:

    a. "Bomb Away" Call - Completed (RN-N-P)

    b. D-2 Bomb Release Switch - Actuated (RN)

    c. Applicable Weapon Released or Bomb Indicator Light - On (RN-N)

POST BOMB RELEASE CHECK

Proceed to post bomb release check.

LOW ALTITUDE BOMBING (NUCLEAR)

BEFORE DESCENT AND DESCENT

1. Terrain Computer Power Switch TH - ON (RN)

WARNING

TH

A 30-minute warmup time for the terrain computer is required before reliable terrain avoidance operation is available.

2. SWESS Arm-Safe Switches - SAFE (RN-P)

3. Bombing Data: (RN-N)

   a. Ballistics Derivative Indicators - Set

   b. Preset Knots Indicator - Set

   c. Preset Ht of Fall Indicator - Set

   d. Burst Point Above Target Indicator - Set

   e. TF Indicator - Set

   f. L Indicator - Set

   g. Offset 1 & 2 Indicators - Set

4. BRIC - SEL (RN)

5. Bomb Indicator Lights Switch - ON (RN)

6. Radar Camera Switches - As required (N)

7. IBDA Power Switch - ON (OFF for Large Charge) (RN)

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (Cont)

8. IBDA Photo-Norm Switch - PHOTO (RN)

   Hold in PHOTO position for at least two exposures.

9. Radar Camera - 1:12 (N)

10. Present Position - Corrected (RN)

11. Terrain Test Control Panel [L]:

    BNS radar must be in radiate while performing this check.

    a. Terrain Test Selector Switch - Checked +105, +50, -50, -150

       All readings should read midscale plus or minus tolerance on meter.

    b. BNS Frequency - Set to briefed frequency

    c. Terrain Test Selector Switch - Checked XL1, XL2

       All readings should be three divisions or higher.

NOTE

The ratio of XL1 to XL2 should not be greater than 3 to 2 or less than 2 to 3.

WARNING

If test results are not within limits, the terrain radar system should not be considered reliable.

    d. Terrain Test Selector Switch - OFF

12. Initial Level-Off Indicated Altitude - Determined (RN-N)

13. Descent Point - Pilot notified (N)

14. Altitude Calls - Accomplished (RN)

Coordinate with the pilot as to level-off altitude(s) to be used for descent and entry to the low altitude navigation leg. Radar navigator calls off altitude to the pilot every 5000 feet starting with the first multiple of 5000 feet. Upon reaching initial level-off altitude plus 5000 feet, the radar navigator informs the pilot every 1000 feet and at level-off altitude. Coordinate with the pilot as to proper heading and altitude to be used during the low altitude navigation leg at each change of heading and/or altitude.

NOTE

Level off momentarily and measure altitude at as low an altitude as practical if over reasonably level terrain of known elevation.

15. Terrain Radar System [L]:

Radar navigator reads to copilot at approximately 5000 feet above terrain.

WARNING

When using the terrain radar system, the BNS receiver tune switch must be in AUTO position. In MANUAL position, unreliable information may be supplied by the terrain computer.

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NUCLEAR) (Cont)

15. Radar Display Selector Switch - LO ALT GM (RN)

16. Altimeters - Set (to true altitude) (P-CP-N)

    True altitude will be determined from an altitude measurement if possible; otherwise use the predicted "D" value converted to an altimeter setting.

AFTER DESCENT

1. Deleted.

2. Special Weapons Racks - Indicate unlocked (RN)

NOTE

On training missions when ASMs are carried, the ASM and special weapons lock indicators must indicate locked.

3. Special Weapons Select Switch - As briefed (RN)

4. Parachute Static Line Retain Lights - Off (for free fall), on (for retarded fall) (RN)

5. Readiness Switches - READY (N-P)

WARNING

On training missions when ASMs are carried, the readiness switch cover will remain closed and sealed.

6. DCU-9A Selector Switches - GND or AIR (as briefed) (N)

7. DCU-9A Warning Lights - Off, tested (for each position of SWK box) (RN-N)

NOTE

On training missions when ASMs are carried and the readiness switch cover must remain closed, the warning lights will be on.

8. SWK Monitor Select Switch - On bomb to be released (RN)

9. Bombing Altitude - Computed and cross-checked (for targets 1 and 2) (RN-N)

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NUCLEAR) (Cont)

10. Bombing Data Check:

	RN CALLS	NAV RESPONSE
a.	"Ballistics Derivatives"	"Reads _____"
b.	"Preset Knots"	"Reads _____"
c.	"Burst Point Above Target"	"Reads _____"
d.	"Preset Height of Fall"	"Reads _____"
e.	"T_F and L"	"Reads _____ and _____"
f.	"Offset 1"	"Reads _____, _____, and _____"
g.	"Offset 2"	"Reads _____, _____, and _____"

11. Drifts for Bomb Run Axes - Determined (for targets 1 and 2) (N)
12. Initial Headings - Determined (for targets 1 and 2) (N)
13. Ground Speeds - Determined (for targets 1 and 2) (N)
14. Time to Go from Range Marker to Release - Determined and cross-checked (for targets 1 and 2) (RN-N)
15. ETA to Bomb Release Line for Target No. 1 - Determined (RN-N)
16. Time to Release No. 2 from Release No. 1 - Determined (RN-N)

    For all practical purposes, the time between releases is the same as the time between targets.

17. ETA to Start Climb Point - Determined (RN-N)

PRE BOMB RUN (START APPROXIMATELY 10 MINUTES PRIOR TO BOMB RELEASE)

1. Gyro Latitude Indicator Set Knob - Set (latitude of target) (RN)
2. Monitoring Set System Select Switch - AUTO (N)
3. Radar Recording Camera - 1:4 (N)
4. IBDA Power Switch - ON (OFF for Large Charge) (RN)
5. Target Coordinates - Set (for targets 1 and 2) (RN-N)
6. Plane Above Sea Level Indicator - Set level-off true altitude (with emergency controls, leave H_A switch ON) (N)
7. Target Above Sea Level Indicator - Set (RN)
8. Terrain Display Mode Selector Switch - As desired (RN-CP)
9. Radar Display Selector Switch - GM (HI ALT or LO ALT) (RN)
10. Offset Selector Switch - 1, 2, or OFF (RN)

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NUCLEAR) (Cont)

BOMB RUN (SYNCHRONOUS)

1. ACL Button - Depressed (if desired) (RN)
2. Auto Fix - Completed (if desired) (RN)
3. Bomb Button - Depressed (RN)
4. Destination Selector Switch - Target No. 2 (Large Charge only) (RN)
5. Bomb Door System Check:

	NAV CALLS	RN RESPONSE
a.	"Release Circuits Disconnect"	"Connected, light on"
b.	"Master Bomb Control Switch"	"ON"
c.	"Bombing System Switch"	"AUTO"
d.	"Bomb Door Control Valve Lights Off"	

6. Heading to Target No. 2 - Pilot notified (N)
7. Climb Point - Pilot notified (N)
8. BNS Steering (if applicable) - Requested, light on (RN)
9. Bomb Run Calldown:
   a. Bomb Tone (RBS only) - On (20 seconds prior to bomb release) (RN)
   b. "Bomb Away" Call - Completed (RN-N-P)
   c. Applicable Weapon Released or Bomb Indicator Light - On (RN-N)
   d. Stopwatch - Started at bomb release (RN-N)

NOTE

Following steps performed for Large Charge only.

10. Perform immediately (RN); Monitor (N)
    a. Bomb Doors - Closed
    b. Track Button - Depressed
    c. ACL Button - Depressed (as required)
    d. Offset Selector Switch - 1, 2, or OFF
    e. Special Weapons Select Switch - As briefed
    f. Bomb Door Control Valve Lights - Off

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NUCLEAR) (Cont)

TIMING

Items "g" through "m" will be performed for those Large Charge runs where the first release is a normal synchronous radar bomb run but the second release is accomplished by timing, using precomputed heading and time between releases.

g. Bombing System Switch - MANUAL

h. Bomb Doors - Opened

i. Bomb Tone (RBS only) - On (20 seconds prior to bomb release)

j. "Bomb Away" Call - Completed (RN-N-P)

k. D-2 Bomb Release Switch - Actuated

l. Applicable Weapon Released or Bomb Indicator Light - On

m. Bomb Doors - Closed

g. Bomb Button - Depressed

h. Bombing System Switch - AUTO

i. Bomb Door Control Valve Lights - Off

j. BNS Steering (if applicable) - Requested, light on

k. Bomb Tone (RBS only) - On (20 seconds prior to bomb release)

l. "Bomb Away" Call - Completed (RN-N-P)

m. Applicable Weapon Released or Bomb Indicator Light - On

POST BOMB RELEASE CHECK

Proceed to post bomb release check.

BOMB RUN (ALTERNATE)

1. Master Bomb Control Switch - ON (RN)
2. Heading to Target No. 2 - Pilot notified (N)
3. Climb Point - Pilot notified (N)
4. Bomb Door System Check:

	NAV CALLS	RN RESPONSE
a.	"Release Circuits Disconnect"	"Connected, light on"
b.	"Bomb Door Control Valve Lights Off"	
c.	"Bombing System Switch"	"MANUAL"
d.	"Bomb Doors"	"Opened"

Bomb doors will be opened manually using bomb door switch.

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (Cont)

5. Multiple Drift Corrections - Accomplished (RN-N)

6. Stopwatch - Started (RN-N)

   Radar navigator starts stopwatch or notifies navigator to start stopwatch when target is coincident with applicable slant range mark.

7. Bomb Tone (RBS only) - On (20 seconds prior to bomb release) (RN)

8. Expiration of Time to Release/ETA to Bomb Release Line:

   a. "Bomb Away" Call - Completed (RN-N-P)

   b. D-2 Bomb Release Switch - Actuated (RN)

   c. Applicable Weapon Released or Bomb Indicator Light - On (RN-N)

NOTE

- Do not stop stopwatch at bomb away.
- Following steps performed for Large Charge only.

9. Perform immediately (RN); Monitor (N)

   a. Bomb Doors - Closed

   b. Special Weapons Select Switch - As briefed

10. Bomb Door Control Valve Lights - Off (RN)

11. Bomb Doors - Opened (RN)

    Bomb doors will be opened manually using bomb door switch.

12. Stopwatch - Started (RN-N)

    If target separation allows, stopwatch may be stopped and the radar navigator may reaccomplish fixed angle procedures. Radar navigator will be prepared to release second bomb at expiration of a predetermined time interval between releases.

13. Bomb Tone (RBS only) - On (20 seconds prior to bomb release) (RN)

14. Expiration of Time to Release/ETA to Bomb Release Line:

    a. "Bomb Away" Call - Completed (RN-N-P)

    b. D-2 Bomb Release Switch - Actuated (RN)

    c. Applicable Weapon Released or Bomb Indicator Light - On (RN-N)

POST BOMB RELEASE CHECK

Proceed to post bomb release check.

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (Cont)

POST BOMB RELEASE (NUCLEAR) (RN-N)

Accomplish immediately after bomb release (RN); as soon as possible, perform required items and assure accomplishment of checks (N).

1. Bomb Doors - Closed
2. Bombing System Switch - MANUAL
3. Track Button - Depressed
4. Auto Fix Button - Depressed (if desired)
5. Search or Track Button - Depressed
6. Operation Switch (Topocomp) - OFF (if applicable)
7. Master Bomb Control Switch - OFF
8. Terrain Computer Power Switch TH - As required
9. Offset Switch - OFF
10. H_A Switch - OFF
11. Radar Camera Switches - As required
12. Hydraulic Packs 1, 2 & 4 - Indicate shut down (RN-P)
13. Monitoring Set System Select Switch - STDBY
14. SWESS Control Panels: (RN-P)
    a. Arm-Safe Switches - SAFE
    b. Armed Lights - Off

NOTE

After all bombs and external missiles are released, perform the following:

15. BRIC - TRAIN and zero
16. DCU-9A Selector Switches - OFF
17. Release Circuits Disconnect DR - Disconnected, light off

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (CONVENTIONAL MUNITIONS)

CONVENTIONAL MUNITIONS PREPARATION FOR RELEASE (RN-N)

NOTE

- Perform this checklist within the 15-minute period prior to HHCL or within the 15-minute period prior to point of descent, whichever is reached first.
- For training missions (no munitions aboard), the conventional munitions preparation for release (CMPR) must be performed within the 15-minute period prior to established HHCL.
- Navigator will monitor the CMPR and insure completion of all items.
- It is imperative that the following steps be completed in sequence.

1. Safety Check: (RN)
   a. Bombing System Switch - MANUAL
   b. Release Circuits Disconnect PR - Disconnected, light out
   c. Release Power Switch UM - OFF
   d. Master Bomb Control Switch - OFF
   e. Notify pilot "Safety check complete"
2. Monitoring Set System Select Switch - AUTO (N)
3. Bombing Equipment Check: (RN)
   a. Normal Release & Salvo/Jettison Power Circuit Breakers - In
   b. Circuit Breakers - Set
   c. Internal BRIC - SEL, light on
   d. External BRIC UM - SEL, light on
   e. Crosshair - Positioned

      Position crosshair along the heading of the aircraft a sufficient distance to complete equipment check.

   f. BNS Hand Control Sensing Switch - LOS
   g. Bomb Button - Depress
   h. Heading Error Indicator - Checked

      Using crosshair control handle, deflect steering needle to right and left, then zero. Request pilot to observe the flight command indicator for proper movement.

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (CONVENTIONAL MUNITIONS) (Cont)

i. Request pilot to position autopilot turn control selector switch to BOMB.

j. BNS Steering Check - Completed

Using crosshair control handle, check for response of the aircraft to a right turn. Release crosshair control handle; aircraft should fly straight and level and steering needle should center. Repeat for a left turn.

k. Offset Checks - Completed

Check offsets 1 and 2, in turn, and observe that crosshair is correctly displaced.

l. Time-to-Go Indicator - Checked for drive

Request pilot call TG at 25-second intervals and at TG zero.

m. Bomb Release Check:

(1) BDI TG = 0 Light - On, at TG = 0

(2) Search Button - Depress

n. BNS Hand Control Sensing Switch - As desired

o. Crew notified, "Bombing equipment check completed"

4. Monitoring Set System Select Switch - STDBY (N)

5. Release Circuits Disconnect PR - Connected, light on (RN)

NOTE

PR

When releases are to be made on a designated bombing range, do not connect release circuits disconnect until the aircraft is on the range.

6. Release Power Switch UM - ON (RN)

NOTE

UM

When releases are to be made on a designated bombing range, do not position the release power switch ON until the aircraft is on the range.

7. Bomb Release Mode Selector Switch UF - As briefed (RN)

8. Arming Switch UM - ARMED (RN)

9. Special Weapons Select Switch - FWD (RN)

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (CONVENTIONAL MUNITIONS) (Cont)

ABORT PROCEDURES (CONVENTIONAL MUNITIONS)

NOTE

- Accomplish only if CMPR has been performed.
- Do not accomplish until out of enemy territory.

1. Normal Release & Salvo/Jettison Power Circuit Breakers - Out (RN)
2. Release Circuits Disconnect PR - Disconnected, light off (RN)
3. Release Power Switch UM - OFF (RN)
4. Internal BRIC - TRAIN and zero (RN)
5. External BRIC UM - TRAIN and zero (RN)
6. Arming Switch UM - SAFE (RN)

HIGH ALTITUDE BOMBING (CONVENTIONAL MUNITIONS)

BEFORE PRE-IP

The following checks are to be completed within 1 hour of the Pre-IP:

1. Arming Switch UM - ARMED (RN)
2. Bombing Data: (RN-N)
   a. Ballistics Derivative Indicators - Set (RN)
   b. Preset Knots Indicator - Set (RN)
   c. Preset Height of Fall Indicator - Set (RN)
   d. Burst Point Above Target Indicator - Set (RN)
   e. T_F Indicator - Set (N)
   f. L Indicator - Set (N)
   g. Offset 1 & 2 Indicators - Set (N)
3. Gyro Latitude Indicator Set Knob - Set (RN)
4. Radar Display Selector Switch - HI ALT GM (RN)

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (CONVENTIONAL MUNITIONS) (Cont)

5. Present Position - Corrected (RN)
6. IP Coordinates - Set (RN-N)
7. Heading Select Switch - MD-1 (N)
8. Altitude Measurement - Completed (RN)
9. Bombing Altitude - Computed and cross-checked (RN-N)
10. H_A - Adjusted (RN)
11. Drift for Bomb Run Axis - Determined (N)
12. Initial Heading - Determined (N)
13. Ground Speed - Determined (N)
14. ETA to Bomb Release Line - Determined (RN-N)

BEFORE IP

1. Circuit Breakers - Set (RN)
2. Monitoring Set System Select Switch - AUTO (N)
3. Radar Recording Camera Switches - As required (N)
4. Special Weapons Select Switch - FWD (RN)
5. Internal BRIC - TRAIN and number of bombs to be released (RN)
6. External BRIC UM - TRAIN and number of bombs to be released (RN)
7. Bomb Release Mode Selector Switch UK - As briefed (RN)
8. TAS - Checked (for planned TAS) (RN)
9. Bomb Data Check:

	RN CALLS	NAV RESPONSE
a.	"Ballistics Derivatives"	"Reads _____"
b.	"Preset Knots"	"Reads _____"
c.	"Burst Point Above Target"	"Reads _____"
d.	"Preset Height of Fall"	"Reads_____"
e.	"T_F and L"	"Reads _____ and _____"
f.	"Offset 1"	"Reads _____, _____, and _____"
g.	"Offset 2"	"Reads _____, _____, and _____"

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (CONVENTIONAL MUNITIONS) (Cont)

10. Target Coordinates - Checked (N)
11. Present Position - Corrected (RN)
12. Over IP - Notify pilot and give initial heading for bomb run (N)

BOMB RUN (SYNCHRONOUS)

1. Bombing Configuration Check:

   To be completed after departing the IP.

	NAV CALLS	RN RESPONSE
a.	"Target Above Sea Level"	"Set_____" (target elevation)
b.	"Internal BRIC"	"TRAIN and _____" (number of bombs to be released)
c.	"External BRIC U M"	"TRAIN and _____" (number of bombs to be released)
d.	"Bomb Indicator Lights Switch"	"ON"
e.	"Racks Loaded Lights Switch U M"	"ON"
f.	"Offset"	"1, 2, or OFF"

2. Crosshair on Aimpoint: (RN)
   a. ACL Button - Depressed when green ACL light comes on (if desired)
   b. Auto Fix - Completed (if desired)
   c. Bomb Button - Depressed
   d. BNS Steering (if applicable) - Requested, light on
3. Bomb Door System Check:

	NAV CALLS	RN RESPONSE
a.	"Master Bomb Control Switch"	"ON"
b.	"Bombing System Switch"	"AUTO"
c.	"Bomb Door Control Valve Lights Off"	

4. Bomb Run Calldown:
   a. "Bomb Away" Call - Completed (RN-N-P)

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (CONVENTIONAL MUNITIONS) (Cont)

b. Applicable Bomb Indicator Lights - Off (at bomb release) (RN-N)

c. Racks Loaded Lights UM - Off (after all external munitions have been released) (RN)

WARNING

UM

After the last external munition release has been initiated (all external racks empty), advise pilot immediately if any racks loaded light remains illuminated.

POST BOMB RELEASE CHECK

Proceed to post bomb release check.

LOW ALTITUDE BOMBING (CONVENTIONAL MUNITIONS)

BEFORE DESCENT AND DESCENT

1. Terrain Computer Power Switch TH - ON (RN)

WARNING

TH

A 30-minute warmup time for the terrain computer is required before reliable terrain avoidance operation is available.

2. Bombing Data: (RN-N)
   a. T_F Indicator - Set and locked
   b. L Indicator - Set and locked
   c. Offset 1 & 2 Indicators - Set
3. Internal BRIC - TRAIN and number of bombs to be released
4. External BRIC UM - TRAIN and number of bombs to be released (RN)
5. Bomb Indicator Lights Switch - ON (RN)
6. Racks Loaded Lights Switch UM - ON (RN)

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (CONVENTIONAL MUNITIONS) (Cont)

7. Radar Recording Camera Switches - As required (N)
8. Radar Recording Camera - 1:12 (N)
9. Present Position - Corrected (RN)
10. Terrain Test Panel [LH]:

    BNS radar must be in radiate while performing this check.

    a. Terrain Test Selector Switch - Checked +105, +50, -50, -150

       All readings should read midscale plus or minus tolerance on meter.

    b. BNS Frequency - Set to briefed frequency

    c. Terrain Test Selector Switch - Checked XL1, XL2

       All readings should be three divisions or higher.

NOTE

The ratio of XL1 to XL2 should not be greater than 3 to 2 or less than 2 to 3.

WARNING

If test results are not within limits, the terrain avoidance system should not be considered reliable.

    d. Terrain Test Selector Switch - OFF

11. Initial Level-Off Indicated Altitude - Determined (RN-N)
12. Descent Point - Pilot notified (N)
13. Altitude Calls - Accomplished (RN)

Coordinate with the pilot as to level-off altitude(s) to be used for descent and entry to the low altitude navigation leg. Radar navigator calls off altitude to the pilot every 5000 feet starting with the first multiple of 5000 feet. Upon reaching initial level-off altitude plus 5000 feet, the radar navigator informs the pilot every 1000 feet and at level-off altitude. Coordinate with the pilot as to proper heading and altitude to be used during the low altitude navigation leg at each change of heading and/or altitude.

NOTE

Level off momentarily and measure altitude at as low an altitude as practical if over reasonably level terrain of known elevation.

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (CONVENTIONAL MUNITIONS) (Cont)

14. Terrain Avoidance System [G]:

    Radar navigator reads to copilot at approximately 5000 feet above terrain.

WARNING

When using the terrain avoidance system, the BNS radar receiver tune switch must be in AUTO position. In MANUAL position, unreliable information may be supplied by the terrain computer.

    a. Terrain Display Mode Selector Switch - PLAN

    b. Stabilization Reference Selector Switch - FRL

    c. Clearance Plane - Checked

15. Radar Display Selector Switch [H] - LO ALT GM (RN)

16. Altimeters - Set (to true altitude) (P-CP-N)

    True altitude will be determined from an altitude measurement if possible; otherwise, use the predicted "D" value converted to an altimeter setting.

AFTER DESCENT

1. Terrain Display Mode Selector Switch [F] [F] - As desired (RN-CP)
2. Special Weapons Select Switch - FWD (RN)
3. Arming Switch [M] - ARMED (RN)
4. Bombing Altitude - Computed and cross-checked (RN-N)
5. Bombing Data Check:

	RN CALLS	NAV RESPONSE
a.	"T_F and L"	"Reads _____ and _____"
b.	"Offset 1"	"Reads _____, _____, and _____"
c.	"Offset 2"	"Reads _____, _____, and _____"

6. Drift for Bomb Run Axis - Determined (N)
7. Initial Heading - Determined (N)

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (CONVENTIONAL MUNITIONS) (Cont)

8. Ground Speed - Determined (N)
9. ETA to Bomb Release Line - Determined (RN-N)
10. ETA to Start Climb Point - Determined (RN-N)

PRE BOMB RUN (START APPROXIMATELY 10 MINUTES PRIOR TO BOMB RELEASE)

1. Gyro Latitude Indicator Set Knob - Set (latitude of target) (RN)
2. Monitoring Set System Select Switch - AUTO (N)
3. Radar Recording Camera - 1:4 (N)
4. Target Coordinates - Set (RN-N)
5. Plane Above Sea Level Indicator - Set level-off true altitude (with emergency controls, leave H_A switch ON) (N)
6. Target Above Sea Level Indicator - Set (RN)
7. Terrain Display Mode Selector Switch - As desired (RN-CP)
8. Radar Display Selector Switch - GM (HI ALT or LO ALT) (RN)
9. Offset Selector Switch - 1, 2, or OFF (RN)
10. Bomb Release Mode Selector Switch UK - As briefed (RN)

BOMB RUN (SYNCHRONOUS)

1. ACL Button - Depressed (if desired) (RN)
2. Auto Fix - Completed (if desired) (RN)
3. Bomb Button - Depressed (RN)
4. Bomb Door System Check:

	NAV CALLS	RN RESPONSE
a.	"Master Bomb Control Switch"	"ON"
b.	"Bombing System Switch"	"AUTO"
c.	"Bomb Door Control Valve Lights Off"	

5. Climb Point - Pilot notified (N)
6. BNS Steering (if applicable) - Requested, light on (RN)
7. Bomb Run Calldown:
   a. "Bomb Away" Call - Completed (RN-N-P)

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (CONVENTIONAL MUNITIONS) (Cont)

b. Applicable Bomb Indicator Lights - Off (RN-N)

c. Racks Loaded Lights UM - Off (after all external munitions have been released) (RN)

WARNING

UM

After the last external munition release has been initiated (all external racks empty), advise pilot immediately if any racks loaded light remains illuminated.

POST BOMB RELEASE CHECK

Proceed to post bomb release check.

POST BOMB RELEASE (CONVENTIONAL MUNITIONS) (RN-N)

Accomplish immediately after bomb release (RN); as soon as possible, perform required items and assure accomplishment of checks (N).

1. Bomb Doors - Closed
2. Bombing System Switch - MANUAL
3. Track Button - Depressed
4. Auto Fix Button - Depressed (if desired)
5. Search or Track Button - Depressed
6. Master Bomb Control Switch - OFF
7. Terrain Computer Power Switch TH - As required
8. Offset Selector Switch - OFF
9. H_A Switch - OFF
10. Radar Recording Camera Switches - As required
11. Hydraulic Packs 1, 2, and 4 - Indicate shutdown (RN-P)
12. Monitoring Set System Select Switch - STDBY

NOTE

After all bombs are released, perform the following:

13. Internal BRIC - TRAIN and zero
14. External BRIC UM - TRAIN and zero
15. Release Circuits Disconnect PR - Disconnected, light off
16. Release Power Switch UM - OFF

NAVIGATOR'S CHECKLIST

BEFORE EXTERIOR INSPECTION (POWER OFF)

1. Ejection Seat:

WARNING

- Carefully check to assure that no streamer has been torn from a maintenance safety pin, thus inadvertently leaving the pin installed. See figure 7-9 for location of pins.
- If a maintenance safety pin, except No. 6, is installed, the status of the seat will be ascertained prior to removal of the pin.

a. Catapult Pin-Pull Initiator - Checked, pin No. 6 installed

Check maintenance safety pin No. 6 installed. Inspect link for condition and installation.

b. Ejection Trigger Ring - Stowed, pin No. 1 installed

Check that ejection trigger ring is properly seated in detent.

WARNING

If the ejection trigger ring is not properly seated in the detent, call maintenance and ascertain status of arming initiator before continuing seat inspection.

c. Catapult Initiator - Checked

Inspect initiator for condition and installation.

WARNING

Shipping pin or maintenance safety pin with streamer should not be installed in catapult initiator.

NOTE

Insure pin-pull cylinder safety pin (plunger) is installed in catapult initiator.

d. Catapult Initiator Safety Pin-Pull Cylinder - Checked

Inspect position and condition of cylinder and safety pin (plunger)

e. Arming Initiator and Control Linkage - Checked, pin No. 3 removed

Check maintenance safety pin No. 3 removed. Inspect initiator for condition and installation.

2. Pilot's ADM-20 Gear Jettison Circuit Breaker - Out
3. Readiness Switch Cover - Closed and sealed
4. Special Weapons Manual Lock Handle - Sealed
5. External Missile Manual Release Handle - Sealed
6. Forward & Rear Special Weapons Manual Release Handles - Stowed

NAVIGATOR'S CHECKLIST (Cont)

7. Release Circuits Disconnect DR - Disconnected
8. Normal Release & Salvo/Jettison Power Circuit Breakers - Out
9. ADM-20 Launch Control (1) & Missile Release (3) Circuit Breakers - Out
10. ASM Separation (4) & Jettison Control (2) Circuit Breakers - Out
11. SWK Monitor Select Switch - OFF
12. RN's SWESS Arm-Safe Switch - SAFE and sealed
13. DCU-9A Control Levers - OS, sealed
14. DCU-9A Selector Switches - OFF
15. AGM-28 Armament Selector Switches - OFF, safetied, and sealed
16. AGM-28 Armament Warning Lights - Off and tested
17. AGM-28 Launch Switches - OFF (guard closed)
18. AGM-28 Electrical Power Panel:
    a. Missile Power Switches - OFF
    b. B-52 Power Switches - OFF

EXTERIOR INSPECTION

1. Bomb Bay Interior: (RN)
    a. Nuclear Bombs - Checked

       When nuclear bombs are aboard, insert and use the appropriate bomb preflight checklist.

    b. Conventional Munitions, Pins, Arming Wires & Fuzes - Checked

       Check for the general condition of bombs. Check that safeing pins have been removed from each fuze and that lockpins have been removed from each shackle. Check that arming wires are properly inserted in fuzes and free of kinks.

    c. General Condition of Bomb Bay - Checked

       Check for fuel and hydraulic leaks and security of equipment.

2. Multiple Ejector Racks DR: (RN)
    a. Conventional Munitions - Checked

       Check conventional munitions in accordance with step "1b."

    b. Release Mode Selector Switches - SINGLE
3. Conventional Munitions Shackle Lockpins & Fuze Safeing Pins - Connected and stowed (RN)

   Count the shackle lockpins and fuze safeing pins that have been removed and stow them aboard the aircraft. There should be a lockpin for each shackle and a safeing pin for each fuze.

4. Shackle Safety Tools - Removed (RN)

   Remove shackle safety tools and give to ground crew.

5. Track Antijettison Tools (2) (Aft Track Assemblies) - Removed (RN)

NAVIGATOR'S CHECKLIST (Cont)

INTERIOR INSPECTION

1. Equipment - Stowed

   Stow personal equipment, unbuckle and stow spare parachute, and check water container stowed.

2. Ejection Seat:

   a. Manual Catapult Initiator Safety Pin-Pull Handle - Secure

      Handle should be properly seated below left arming lever.

   b. Catapult Firing Trigger Ring - Stowed

      Inspect for proper stowed position and attachment of lanyard.

   c. Ankle Restraints - Checked

      Inspect ankle restraints for stowage in downward position.

      NOTE

      In the event ankle restraints have triggered, crew member can stow restraints by applying downward and outward pressure on either restraint arm until restraints and pivot mechanisms both lock.

   d. Hatch Jettison Initiator - Checked, pin No. 5 removed

      Check maintenance safety pin No. 5 removed. Inspect initiator for condition and installation.

   e. Manual Hatch Jettison Handle & Linkage - Checked

      Check manual hatch jettison handle for proper position. Inspect linkage for condition and installation. On aircraft TF, check that the guard assembly is properly installed over the manual hatch jettison handle. Actuate the guard to check the spring clip retaining action and insure that it can be easily released in an emergency.

   f. Seat Positioning Initiator - Checked, pin No. 4 removed

      Check maintenance safety pin No. 4 removed. Inspect initiator for condition and installation.

   g. Hatch Jettison Firing Lug - Checked

      Inspect firing lug for condition and mounting.

   h. Integrated Harness Release Initiator - Checked, pin No. 2 removed

      Check maintenance safety pin No. 2 removed. Inspect initiator for condition and installation.

   i. Harness Release Initiator to Pin-Pull Cylinder Tube - Connected

      Make certain the tube run from the integrated harness release initiator is connected to the integrated harness release pin-pull cylinder.

   j. Survival Kit, Parachute & Man-Seat Separator - Checked

      Check parachute inspection record book for current inspection. Determine from the record the setting of the automatic release mechanism. Check bailout bottle for minimum pressure. Insure that the nylon man-seat separator straps are placed on the bare seat. Survival kit is then placed over man-seat separator straps. See figure 7-9 for correct arrangement of man-seat separator straps without survival kit and parachute in place.

NAVIGATOR'S CHECKLIST (Cont)

k. Survival Kit, Inertia Reel, Parachute, Safety Belt & Parachute Arming Lanyard Anchor - Connected.

Check parachute shoulder straps connected to inertial reel attachment. Check that survival kit attachment straps pass through the loops of the safety belt and are connected to the parachute as shown in figure 1-58. Assure that safety belt is connected to both sides of seat. Check that parachute arming lanyard is inserted in slot attachment on left side of seat and ascertain that anchor is securely fastened.

WARNING

- Adjust the parachute survival kit attachment straps as tightly as possible to prevent the safety belt from inflicting facial injuries during a manual bailout. Failure to attach the parachute arming lanyard anchor to seat will necessitate manual operation of the parachute.
- Do not hook zero delay lanyard to parachute ripcord T-handle when using a downward ejection seat since it is equipped with a man-seat separator.

3. Interphone - Connected

4. Oxygen System:

a. Shutoff Lever - ON

Pressure gage reads approximately 300 psi.

b. Regulator Diluter Lever - 100% OXYGEN

c. Emergency Toggle Lever - EMERGENCY

Flow indicator should indicate continuous flow. Block regulator hose with hand; indicator should indicate no flow.

d. Emergency Toggle Lever - NORMAL

e. Mask & Hose - Connect and test

Check for 10- to 20-pound pull for disconnect.

f. Mask - Test

(1) Emergency Toggle Lever - TEST MASK

Hold breath; indicator should indicate no flow.

(2) Emergency Toggle Lever - NORMAL

g. Regulator Diluter Lever - NORMAL OXYGEN

NAVIGATOR'S CHECKLIST (Cont)

5. N-1 Compass Master Indicator:
   a. Latitude Correction Pointer - OFF
   b. Synchronizer Knob - Synchronize N-1
6. True Heading System Panel:
   a. Mag-Syn-Gyro Switch - MAG
   b. Bias or Syn Knob - Zero bias indicator

NOTE

Magnetic variation indicator may drift due to lack of excitation from the BNS.

7. Doppler Drift Switch - OFF
8. 5-Inch Indicator:
   a. Video Knob - CCW
   b. Intensity Knob - CCW
   c. Marker Knob - CCW
9. DCU-9A Control Levers - OS and sealed
10. SWK Monitor Select Switch - First bomb to be released
11. DCU-9A Selector Switches - SAFE
12. DCU-9A Warning Lights - Off, tested (for each position of SWK box)
13. SWK Monitor Select Switch - OFF
14. DCU-9A Warning Lights - Off, tested

    If warning light(s) come on when pressed to test, call qualified personnel.
15. DCU-9A Selector Switches - OFF
16. SWK Box Illumination Control - Full CCW
17. AGM-28(s) Check:

CAUTION

When AGM-28's are not installed, check both B-52 power switches in OFF position.

   a. ASM Circuit Breaker Panel:
      (1) Separation (4) & Jettison Control (2) Circuit Breakers - Out
      (2) All Other Circuit Breakers - In
   b. Electrical Power Panel:
      (1) Missile Power Switches - OFF

NAVIGATOR'S CHECKLIST (Cont)

(2) B-52 Power Switch(es) - ON

(3) Electric Out Light(s) - On

(4) High Temperature Light(s) - Tested

c. Guidance Data Panel:

(1) Function Selector Switch - OFF

(2) Slew Switch - OFF

(3) Sun-Star Switch - SUN

(4) Track Switch - STANDBY

(5) Alt-Az Error Switch - AZ ERROR

(6) Tgt Fix Switch - SET

(7) GHA Set Switch - GHA SET

(8) Checkpoint Fix Switch - SET

d. Guidance Panel:

(1) ASM Selector Switch - As required

(2) Guidance System Power Switches - OFF

(3) Maneuver Switches - STRAIGHT IN (STR IN)

(4) Phototube Switches - NO. 1

(5) Secondary Azimuth Switches - OFF

(6) Slaving Master Switch - OFF

(7) Wait Lights - Off, tested

e. Indicator Lights Panel:

(1) Track Lights - Off

(2) Az Aline Lights - Off

(3) Level Aline Lights - Off

(4) A/N No Go Lights - Off

NAVIGATOR'S CHECKLIST (Cont)

f. Flight Control Panel:

(1) Flight Control Power Switches - OFF

(2) Tactical Altitude Selector Switches - LOW and locked

(3) F/C No Go Light(s) - On

g. Armament Panel:

(1) Safe Time Interval Knobs - Set 30.0 min

(2) Armament Selector Switch(es) - SAFE

(3) Armament Warning Light(s) - Off, tested

(4) Armament Selector Switches - OFF

h. Launch Panel:

(1) Warhead Light(s) - Off, tested

(2) Engine Ready Lights - Off, tested

i. Radar Altimeter Check Panel Selector Switches - OFF

18. AGM-28 Simulated Launch Switches - OFF

19. Radar Pressure Pump Control Switches - NORMAL ON

20. APN-69 Power Switch NF - OFF (code set)

21. Monitoring Set System Select Switch - OFF

22. Doppler Radar Silence Switch - SILENT

23. Doppler Radar System Power Switch - OFF

24. Thermal Curtains - Installed and fastened (EWO only)

25. Ground Locks & Bypass Keys - Counted and stowed

26. Crew Report - Completed (at pilot's request)

a. The sequence for crew reporting is as follows: G, N, EW, RN, CP, P, IN, 10th man, bunk, and IP.

b. Switch to CALL and report, "Navigator's station check complete."

Station check consists of seat, oxygen, abandon signal, call light, interphone, and (if applicable) zero delay lanyard check.

27. Oxygen Regulator - OFF and 100% OXYGEN (if leaving the aircraft for extended period of time)

BEFORE TAKEOFF

1. Emergency Escape Hatch - Secure

Check that paint stripe on the lockpin is visible or the flat surface of the lockpin extends 1/4 inch from its housing. Check that latch pins overlap the long lip of the latch hooks by approximately 1/8 inch. Check that the manual hatch release handle is stowed (figure 1-54). On aircraft TF, check that the guard assembly is properly installed over the manual hatch jettison handle.

2. Pin No. 6 (catapult pin-pull initiator) - Removed

NAVIGATOR'S CHECKLIST (Cont)

3. Pressure Door - Closed
4. Emergency Cabin Pressure Dump Handle - Closed
5. Oxygen Regulator - ON and NORMAL OXYGEN
6. Doppler Radar System Power Switch - ON
7. DCU-9A Selector Switches - OFF
8. AGM-28 Armament Selector Switches - OFF
9. IFF Master Switch - STDBY

   Allow to warm up for 1 minute before switching to NORM.

10. IFF Mode - Set (as briefed)
11. Automatic Astrocompass:
    a. Star Selector Switch - OFF
    b. Rate Switch - SOL or SID as required
    c. Lat-Long Switch - AUTO
    d. Heading Select Switch - N-1
    e. Power Filter Switch - SUN or STAR

NOTE

There is a 2-minute delay before information may be preset and an additional 5-minute delay before the system can track.

12. Vertical Camera Master Switch - ON
13. VGH Recorder Switch (if installed) - ON
14. Parachute & Safety Belt - Fastened

NOTE

If it becomes necessary to leave the seat during flight, the crew member should open the safety belt and unbuckle the parachute harness leaving the parachute and survival kit in the seat. If the parachute is worn when leaving the seat, upon returning to the seat, it will be necessary to take if off in order to reinstall the parachute and safety belt in the seat.

15. Pin No. 1 - Removed

WARNING

Less VD

To prevent accidental firing of the ejection seat, install pin No. 1 prior to leaving the seat during flight. Upon returning the seat, fasten parachute and safety belt, then remove pin No. 1. Crew members who are physically unable to remove pin No. 1 with the parachute and safety belt fastened may remove the pin prior to fastening safety belt and parachute; however, extreme caution must be exercised when fastening the parachute to avoid threading the parachute leg strap through the ejection seat trigger ring.

NAVIGATOR'S CHECKLIST (Cont)

15A. Ejection Control Trigger Ring VD - Released from stowed position

WARNING

To prevent accidental firing of the ejection seat, stow the ejection control trigger ring prior to leaving the seat during flight. Upon returning to the seat, fasten parachute and safety belt, then release the ejection control trigger ring from the stowed position.

16. Bailout Bottle - Connected

17. Monitoring Set:

    a. System Select Switch - STDBY

       The recorder failure light will remain on for approximately 20 seconds.

    b. Press-to-Test Button - Depressed

       The ready and failure indicators should illuminate.

    c. System Select Switch - AUTO (after ready indicator illuminates)

18. 5-Inch Indicator - Adjusted and checked

    Accomplish as soon as the radar navigator has put the BNS radar in radiate operation.

19. Automatic Astrocompass:

    a. Heading Correction - Set zero

    b. Clock - Set GMT

       When set time comes up, switch to GHA and check for clock drive.

    c. GHA - Set

       When set time comes up, switch to SHA and check GHA for drive.

    d. SHA and Dec - Set

    e. Star Selector Switch - As desired

20. Camera Doors - Closed (after bomb doors are closed)

21. Vertical Camera Master Switch - OFF

22. N-1 Compass - Cross-checked

    Cross-check against pilot's repeater and magnetic standby compass.

23. APN-69 Power Switch NF - STDBY

24. Doppler Drift Switch - ON

25. SIF/IFF (upon taking runway) - NORM

NAVIGATOR'S CHECKLIST (Cont)

TAKEOFF

1. Acceleration Timing - Checked

As the pilot announces "Now" at 70 knots, start the stopwatch. Announce over the interphone "coming up on _____ seconds" approximately three seconds prior to S_1 time. At S_1 time, announce "Now."

AFTER TAKEOFF

1. Doppler Radar Silence Switch - TRANSMIT

Place the doppler radar silence switch to TRANSMIT when attaining an altitude of approximately 200 feet above the ground.

2. Departure Plan - Monitored

Monitor airplane position to assure adherence to planned departure.

3. Altitude & Airspeed - Monitored

Monitor altitude and airspeed for safe margin until airplane has attained an altitude of 5000 feet above the terrain. Advise pilot if altitude falls below a safe margin or airspeed fails to show a positive increase.

4. Climb EPR Value - Computed

Copilot reports OAT to navigator and requests climb EPR value. Navigator computes climb EPR value from applicable EPR value chart included in T.O. 1B-52E-1CL-2.

5. AGM-28 After Engine Start

NOTE

The copilot will start the engine at the briefed time and notify navigator when the engine has stabilized.

a. Monitoring Set System Select Switch UI - AGM-28

b. Electrical Power Panel:

(1) Electric Out Light(s) - Off

(2) Missile Power Switch(es) - ON

6. Oxygen Check - Completed

a. During the climb, copilot requests an oxygen and zero delay lanyard check at 12,000 feet. The sequence for oxygen report is the same as for crew report. Oxygen panels will be checked for:

(1) Oxygen Supply Shutoff Lever - ON

(2) Regulator Diluter Lever - NORMAL OXYGEN

(3) Pressure - 300 psi

(4) Flow Indicator - Functions normally

(5) Emergency Toggle Lever - NORMAL

b. Gunner and copilot report, "Cabin altitude _____ feet. Oxygen panel checked."

c. Navigator, EW officer, radar navigator, and pilot report, "Oxygen panel checked." Pilot reports oxygen quantities.

NAVIGATOR'S CHECKLIST (Cont)

d. Under steps "b" and "c," the gunner, copilot, EW officer, and pilot will report "Zero delay lanyard stowed."

e. Copilot, notify aircrew and receive gunner's acknowledgment when passing through 26, 000 and 35, 000 feet.

f. The copilot will request an oxygen check at level-off. During cruise, the copilot will monitor the gunner's remote cabin altimeter and the tail compartment low pressure warning light at intervals not to exceed 15 minutes and initiate the oxygen checks at 30-minute intervals when both cabin altitudes are below 12, 000 feet, at 15-minute intervals when either cabin altitude is 12, 000 to 25, 000 feet, and at no longer than 10-minute intervals when either cabin altitude is above 25, 000 feet. If cabin altitude is below 12, 000 feet, only the gunner and copilot/pilot will report. The remaining crew members will check their equipment and report if abnormal. At level-off, only the gunner and copilot/pilot need report if cabin pressure is 12, 000 feet or below.

LEVEL - OFF

1. Heading Select Switch - MD-1
2. True Airspeed Indicators - Cross-checked

   If more than a 10-knot difference exists, compute TAS. If the BNS true airspeed is in error by 10 knots or more, set BNS true airspeed with emergency controls panel.

3. Periodic Weapon Monitoring - Initiated
4. Monitoring Set System Select Switch - STDBY

BEFORE DESCENT

1. Heading Select Switch - N-1
2. AGM-28 Check:
   a. Secondary Azimuth Switches - OFF
   b. Track Switch - STANDBY
   c. Guidance System Power Switches - OFF
   d. Missile Power Switches - OFF (N-CP)
   e. ASM Separation (4) & Jettison Control (2) Circuit Breakers - Out
   f. Armament Selector Switches - Checked SAFE
   g. Armament Warning Lights - Off, tested
   h. Armament Selector Switches - OFF
   i. Safe Time Indicators - Checked 30. 0 minutes
   j. Tactical Altitude Selector Switches - LOW and locked
   k. Warhead Lights - Checked Off
3. DCU-9A Selector Switches - SAFE
4. DCU-9A Warning Lights - Off, tested (for each position of SWK box)
5. DCU-9A Selector Switches - OFF

NAVIGATOR'S CHECKLIST (Cont)

6. SWK Monitor Select Switch - OFF
7. SWK Box Illumination Control - Full CCW
8. Parachute & Safety Belt - Fastened
9. Monitoring Set System Select Switch - AUTO
10. Best Flare Speed - Computed and cross-checked with copilot

    Obtain operating weight and total fuel from copilot. Using best flare speed chart, enter with gross weight and compute best flare speed for actual landing configuration.

DESCENT AND BEFORE LANDING

1. AGM-28 Flight Control Power Switch(es) - ON
2. Automatic Astrocompass:
    a. Set Selector Switch - GHA
    b. Power Filter Switch - SUN
    c. Star Selector Switch - OFF
    d. Lat-Long Switch - MANUAL
3. Doppler Radar Silence Switch - SILENT

    Place the doppler radar silence switch to SILENT when approximately 200 feet above the ground. During low approaches and taxi-back landings, the switch should be in SILENT position.

4. Emergency Controls Panel:

    The following steps will be accomplished immediately prior to touchdown. Switches will remain ON during touch-and-go landings.

    a. H_A Switch - ON
    b. TAS Switch - ON

AFTER LANDING

1. IFF Master Switch - OFF

    Turn IFF off as soon after landing as possible. This will eliminate signals from taxiing or parked airplanes which would otherwise block the controller's scope and interfere with the control of airborne airplanes.

2. 5-Inch Indicator:
    a. Video Knob - CCW
    b. Intensity Knob - CCW
    c. Marker Knob - CCW

NAVIGATOR'S CHECKLIST (Cont)

3. Radar Camera:
   a. Expose 20 frames
   b. Power Switch - OFF
4. APN-69 Power Switch NF - OFF
5. Pin No. 1 - Installed
6. Auto-Nav Radar System Power Switch - OFF
7. AGM-28 Check:
   a. Armament Selector Switches - SAFE
   b. Armament Warning Lights - Off, tested
   c. Armament Selector Switches - OFF
   d. Flight Control Power Switches - OFF
   e. B-52 Power Switches - OFF (CP-N)

NOTE

Do not turn B-52 power switch OFF until called for by the copilot. If the B-52 power switch is turned OFF before the engine control knob is placed to OFF, engine control will be lost.

AFTER PARKING

1. Astro Power Filter Switch - POWER OFF
2. Monitoring Set System Select Switch - OFF
3. Oxygen Regulator - OFF and 100% OXYGEN
4. VGH Recorder Switch (if installed) - OFF
5. Pin No. 6 - Installed

   Install maintenance safety pin No. 6 in catapult pin-pull initiator prior to opening of hatch.
6. Nuclear Bombs Aboard - Accomplish bomb "After Landing" checklist

   Insert and use the bomb "After Landing" checklist.
6. Conventional Munitions Aboard - Install fuze safeing pins

   If qualified personnel are not available to install the pins, the radar navigator and navigator will be responsible for proper installation of a fuze safeing pin in each fuze.
7. Missiles Aboard & Qualified Personnel Not Available - Accomplish "Unscheduled Landing with AGM-28 Missiles" checklist

REVERSE SIDE INTENTIONALLY LEFT BLANK

GROSS WEIGHT	FLAPS DOWN 100%		FLAPS UP	
	BEST FLARE SPEED (AIR-BRAKES NO. 2)	MINIMUM TOUCH-DOWN	BEST FLARE SPEED (NO AIRBRAKES)	MINIMUM TOUCH-DOWN
175,000	109	97	136	131
180,000	110	98	138	133
185,000	112	100	140	135
190,000	113	101	142	136
195,000	115	102	144	138
200,000	116	104	146	140
205,000	118	105	148	141
210,000	119	106	149	143
215,000	121	107	151	145
220,000	122	109	153	147
225,000	123	110	155	148
230,000	125	111	156	150
235,000	126	112	158	152
240,000	128	114	160	154
245,000	129	115	162	155
250,000	130	116	163	157
255,000	131	117	165	158
260,000	133	118	166	160
265,000	134	119	168	161
270,000	135	120	169	162
275,000	136	121	170	164
280,000	138	122	173	165
285,000	139	124	174	168
290,000	140	125	176	169
295,000	141	126	177	171
300,000	142	127	178	172
305,000	144	128	179	174
310,000	145	129	181	175
315,000	146	131	183	176
320,000	147	132	184	178
325,000	148	133	185	179
	BEST FLARE NO AIR-BRAKES			
330,000	137	134	187	181
335,000	138	135	188	182
340,000	140	136	189	183
345,000	141	137	191	185
350,000	142	138	192	186
355,000	143	139	193	187
360,000	144	141	195	188
365,000	145	142	196	190
370,000	146	143	198	191
375,000	147	144	199	192
400,000	152	146	206	198
425,000	156	151	212	204
450,000	161	155	218	210

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.....best flare speed (knots IAS) computation table .....

Figure 8-1.

RANGE AT 1st BEARING	RANGE AT 2nd BEARING									
	10	15	20	30	40	50	60	70	80	90
100	1.1	1.2	1.3	1.4	1.6	2	2.5	3.3	5	10
90	1.1	1.2	1.3	1.5	1.8	2.3	3	4.5	9	
80	1.1	1.2	1.3	1.6	2	2.7	4	8		
70	1.1	1.3	1.4	1.8	2.3	3.5	7			
60	1.2	1.3	1.5	2	3	6				
50	1.3	1.4	1.7	2.5	5					
40	1.3	1.6	2	4						
30	1.5	2	3							
20	2	4								

Bearings							
	@	NM=	°				
	@	NM=	°	Factor		Turn	
	DIFF	=	X		=		R L

Time to Go
from 10 20 NM FRM
SEC
From Applicable Time to Release Table

Bearings							
	@	NM=	°				
	@	NM=	°	Factor		Turn	
	DIFF	=	X		=		R L

.....multiple drift factors chart.....

Figure 8-2.

DISTANCE BETWEEN SLANT RANGE MARKS					
30		20		10	
sec	gs	sec	gs	sec	gs
310	356	215	343	102	362
300	367	210	351	100	369
290	380	205	359	98	376
280	394	200	369	96	385
270	409	195	377	94	392
260	424	190	388	92	401
250	440	185	399	90	410
245	449	180	410	88	419
240	459	175	421	86	429
235	467	170	434	84	439
230	479	165	446	82	450
225	489	160	461	80	461
220	500	155	475	78	473
215	511	150	491	76	486
210	524	145	509	74	499
205	536	140	527	72	512
200	550	135	546	70	526
195	564	130	567	68	542
190	579	125	590	66	559

NOTE — This chart is based on altitudes of 36,480 to 60,800 feet and upon average distance between fixed range marks. Stop timing at 30 frm to obtain usable accuracy.

.....radar ground speed by timing table.....

Figure 8-3.

Conversion Correction between Sub-Polar (conv. 78535) and Polar (conv. 1.) JN Charts

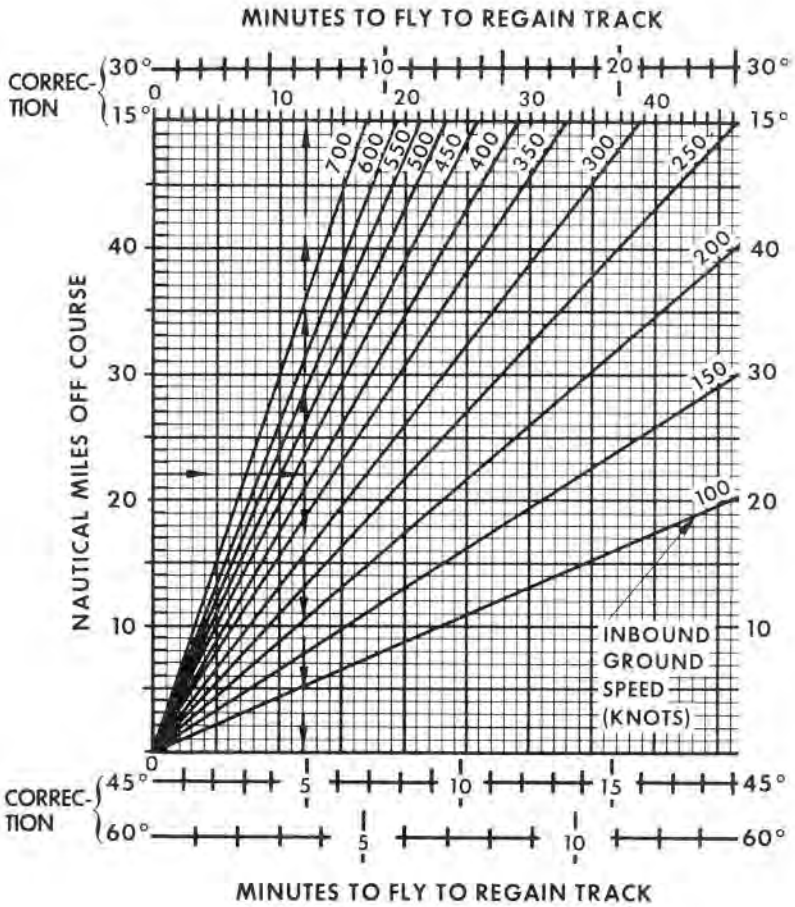
GEOGRAPHIC LONGITUDE (degrees)	CONVERSION CORRECTION (degrees)	GEOGRAPHIC LONGITUDE (degrees)	CONVERSION CORRECTION (degrees)
0 - 2	0	91 - 95	20
3 - 7	1	96 - 100	21
8 - 11	2	101 - 104	22
12 - 16	3	105 - 109	23
17 - 21	4	110 - 114	24
22 - 25	5	115 - 118	25
26 - 30	6	119 - 123	26
31 - 34	7	124 - 128	27
35 - 39	8	129 - 132	28
40 - 44	9	133 - 137	29
45 - 48	10	138 - 142	30
49 - 53	11	143 - 146	31
54 - 58	12	147 - 151	32
59 - 62	13	152 - 156	33
63 - 67	14	157 - 160	34
68 - 72	15	161 - 165	35
73 - 76	16	166 - 170	36
77 - 81	17	171 - 174	37
82 - 86	18	175 - 179	38
87 - 90	19	180 -	39

In WEST Longitude:
SUB-POLAR to POLAR — ADD
POLAR to SUB-POLAR — SUBTRACT

In EAST Longitude:
SUB-POLAR to POLAR — SUBTRACT
POLAR to SUB-POLAR — ADD

.....conversion correction table.....

Figure 8-4

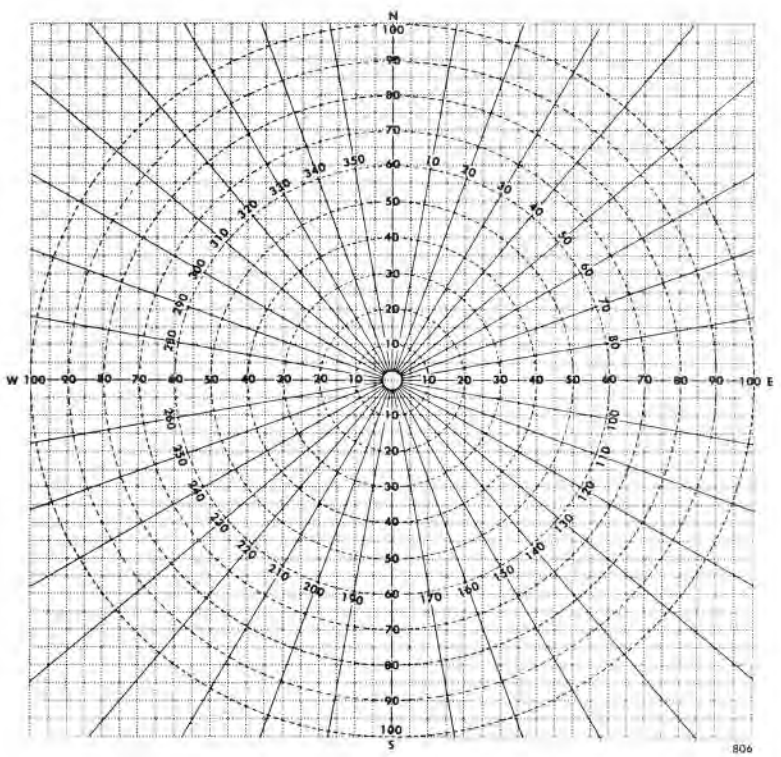


EXAMPLE:

22 NM off course
Ground speed (on inbound track) = 425 knots
Minutes required to regain track
15° correction = 12 minutes
30° correction = 6.4 minutes
45° correction = 4.9 minutes
60° correction = 3.5 minutes

..... off-course correction to track chart .....

Figure 8-5.



polar-rectangular coordinates chart

Figure 8-6.

MISSION DATA RECORDING PROCEDURES

1. Flight data will be recorded on the chart or on a separate form. The information recorded must permit complete and accurate reconstruction of the mission. Minimum information will consist of time, true heading, true airspeed, and wind for each position or fix. These items may reflect average data since the last position or fix or may show the information used in computing a new true heading and ETA. A stamp with a format similar to that shown below may be used as an aid.

Time	
TC _____	TH _____
GS _____	TAS _____
W/V _____	ETA _____

2. Positions and fixes will be indicated on the chart by appropriate symbols and time in GMT. A fix or position will be noted for each alteration of course and any other condition of importance to the mission or mission critique.

3. Altitude normally will be flown as planned. If a change is necessary, the new altitude will be recorded.

4. Pertinent observations will be noted with the time they take place.

5. A position will be recorded at appropriate intervals except during transition and similar periods.

AIRBORNE RADAR APPROACHES

1. In view of the fact that radar equipment installed in the airplane permits the radar navigator to monitor the position of the airplane constantly, regardless of weather conditions or outside approach facilities, it is essential that the equipment be utilized during instrument approaches. In an emergency, the equipment within the airplane will make it possible for the radar navigator to direct the pilot to a safe approach.

2. Radar navigators will properly monitor all letdowns and approaches regardless of type (i. e., VFR, GCA, ILS, etc) until the airplane is in the landing pattern and the pilot is definitely assured that visual contact with the runway can be maintained during the remainder of the approach, including an emergency go-around if necessary.

3. Radar approaches are divided into two classes:

   a. Radar monitored or directed approaches:

      These are approaches to fields for which standard jet penetrations or enroute penetrations have been published. The pilot directs the airplane by using normal approach facilities or the radar navigator directs the airplane using the BNS.

   b. Radar directed emergency approaches:

      These are approaches to fields for which no published letdown procedures have been established or where the normal ground or airplane field approach facilities are inoperative (e. g., GCA or omni equipment failure). The radar navigator directs the airplane by using the procedure outlined in this manual (figure 8-7).

AIRBORNE RADAR APPROACHES (Cont)

RADAR MONITORED OR DIRECTED APPROACH

Pilots and radar navigators should become completely familiar with the penetration patterns and approach and landing patterns to be used at both the destination and alternates. Applicable publication should be studied. Annotated scope photos of previous approaches, if available, will be a great aid to radar navigators.

Penetration Pattern

The published or interim jet penetration patterns for the specific station will be utilized by the pilot for the initial portion of the pattern.

Approach and Landing Patterns

The standard GCA pattern will be followed from the termination of the penetration. Radar navigators should be prepared for an approach to the active runway from either landing direction. The feasibility of entering the GCA pattern for a straight-in approach on the final should be considered.

Altitudes

Altitudes for any phase of this approach will be those in the published penetration procedures and the normal GCA pattern.

Airspeeds

1. Penetration - Maximum 250 knots IAS (landing gear down, throttles IDLE)
2. From End of Penetration to Base Leg - Best flare speed plus 30 knots
3. Base Leg or Positive Radar Contact with GCA for Straight-In-Approach - Best flare speed plus 20 knots
4. Final Approach (glide path) - Best flare speed plus 10 knots

RADAR DIRECTED EMERGENCY APPROACH

The radar navigator may accomplish a radar directed approach when:

1. An instrument approach is necessary at a field without a published penetration.
2. A normal instrument or visual approach cannot be made because of failure of ground or airplane equipment.
3. It is not prohibited by directives or known traffic at base of intended landing.

Required Information

Prior to attempting a radar directed emergency approach, the following information should be known:

1. Field elevation.
2. Active runway.
3. All terrain and prominent radar returns within a 25-mile radius of the airbase.
4. Obstructions located on the final approach.

AIRBORNE RADAR APPROACHES (Cont)

5. Offset aiming point.

6. Initial point will be a point approximately 25 miles beyond the approach end of the runway in the direction of intended landing.

7. Terminal weather.

Approach Procedure

All radar approaches will be made with the bomb control panel heading switch in BOMB and track button depressed.

1. Accomplish the "Before Descent" checklist.

2. Airplane will descend to 25,000 feet.

3. The "Descent and Before Landing" checklist will be completed as applicable.

4. The radar navigator will direct the airplane to the initial point and then start a simulated bombing run on the approach end of the runway. (Initial phase of run may be made with crosshairs on the airbase built-up area and crosshairs may be placed on the runway or OAP when identification becomes possible.)

5. Pilot should be instructed to follow the FCI over the runway.

6. When the time-to-go meter reads zero, the pilot will execute a standard rate turn to the right to the reciprocal of the runway heading plus 20° (drift must be considered if crosswind exists) and an immediate penetration will be initiated from 25,000 feet. Maintain crosshairs on the approach end of the runway or OAP during the entire approach.

7. Upon reaching 12,000 feet, a 200° standard rate turn to the left will be initiated, rolling out on the runway heading (to which drift correction angle has been applied), continuing the descent to 2000 feet above runway or 1000 feet above highest terrain within 5 miles of either side of approach heading, whichever is higher. After rolling out and leveling off, an IAS of best flare speed plus 20 knots will be established.

NOTE

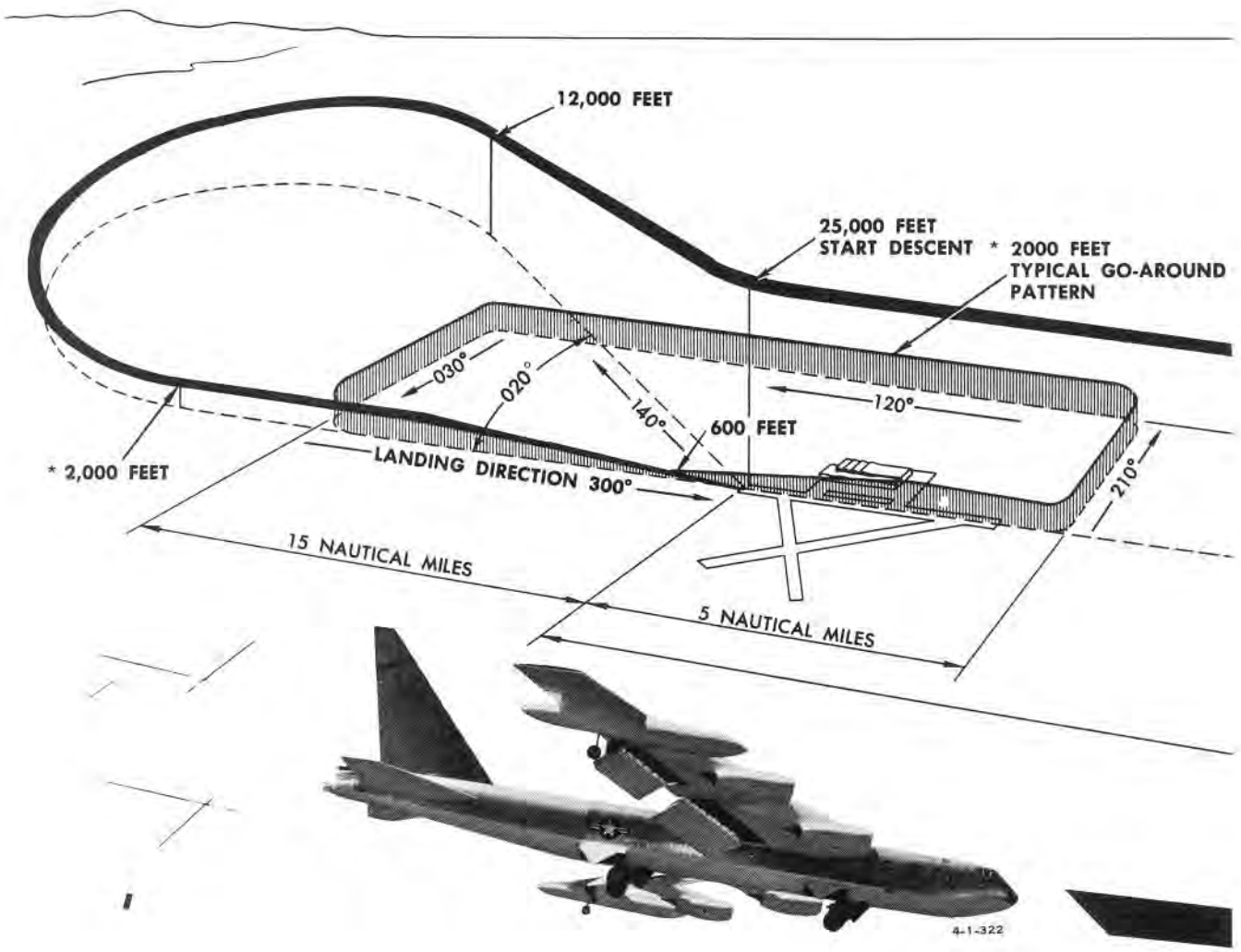
Right and left turns indicated above may be reversed if local terrain makes this advisable.

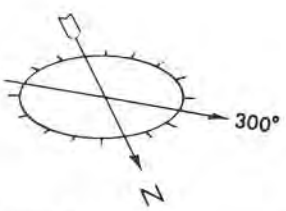
8. Pilot will continue to track the FCI using standard ADF instrument technique. Example: If aircraft is on runway heading and FCI is 10° to the left, pilot should turn 20° to the left and hold the new heading until the FCI moves 20° to the right. At this point the pilot should turn back 20° to the right. This will center the FCI and put the aircraft on the runway heading. Corrections should be continued as required to maintain FCI centering with aircraft on runway heading. The radar navigator should occasionally view a full scan presentation to check the position of the aircraft with respect to the on course track to the runway. If necessary, appropriate heading changes will be made to reposition the aircraft to the runway track after which the aircraft will be returned to the runway heading.

9. Normally at range of 8 miles, the 600 fpm descent will be initiated at an IAS of best flare speed + 10 knots. If the airplane was leveled off above 2000 feet, the descent will be initiated at a range determined by application of the formula: $\frac{\text{Altitude} \times 3.5}{1000}$

NOTE

If BFS + 10 knots has not been established, the time-to-go indicator reading of 200 seconds will indicate an erroneous descent.



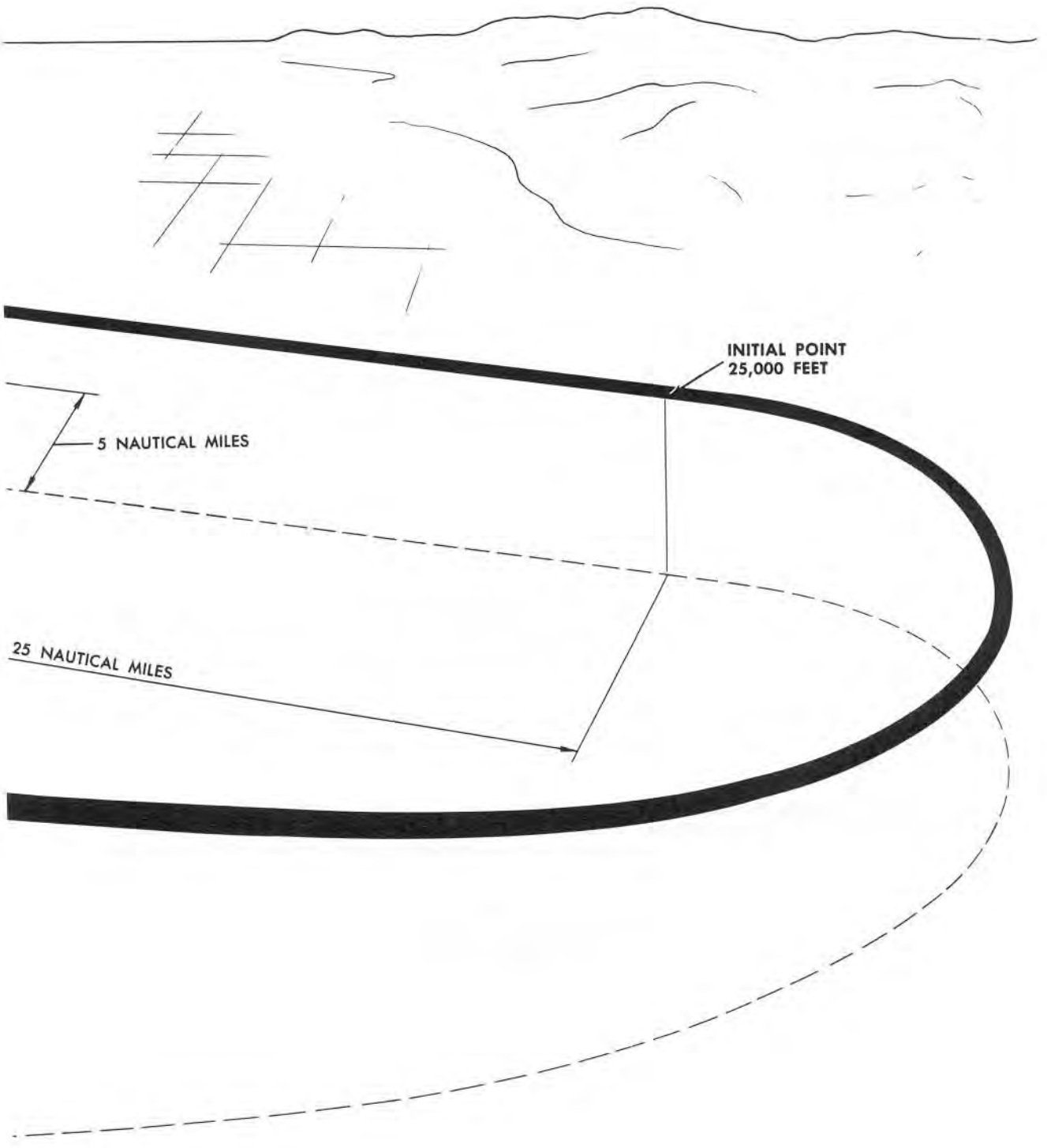


NOTE

ALL HEADINGS ON DIAGRAM ARE MAGNETIC. PUBLISHED RUNWAY HEADINGS ARE MAGNETIC HEADINGS AND MUST BE CORRECTED FOR VARIATION.

* 2,000 FEET ABOVE RUNWAY OR 1,000 FEET ABOVE HIGHEST TERRAIN WITHIN FIVE MILES.

Figure 8-7 (Sheet 1 of 2).



...typical radar directed emergency approach

Figure 8-7 (Sheet 2 of 2).

AIRBORNE RADAR APPROACHES (Cont)

10. During descent, the pilot will cross-check altimeter readings against time-to-go readings at 150, 100, and 60 seconds and will adjust rate of descent accordingly. At 60 seconds, the airplane should be at 600 feet and under visual conditions. Except under extreme emergency conditions, descents will not be made below 600 feet unless the pilot has visual contact with the runway.

11. If a practice approach is being made, it will be discontinued at the minimum altitude for nonprecision radar approaches. If the approach is continued, the aircraft will be approximately 1000 feet down the runway when time to go is zero.

MISSED APPROACH PROCEDURE

1. Go-arounds or GCA patterns: If a go-around becomes necessary or the pilot desires to complete the pattern utilized under normal GCA procedures, a pull-up will be made to 2000 feet at best flare speed plus 30 knots. Radar navigator will position the radar-map switch to PPI-NS and marker selector switch to NAV. This will allow him to utilize full scan and range marks during GCA pattern while crosshairs remain on runway.

2. Heading and altitude will be maintained until the airplane has reached a point approximately 5 miles beyond the approach end of runway. This may be determined by timing (90 seconds) or by reference to the ground range indicator. At this point, the pilot will be directed to execute a 90° turn to the left. This heading will be the crosswind leg and will be maintained for 90 seconds or until the runway is approximately 5 miles behind. At this point, the radar navigator will direct the pilot to turn 90° left to the downwind heading. Downwind heading should be maintained until the airplane is approximately 15 miles beyond the approach end of the runway. When the airplane is 15 miles beyond the approach end of the runway, another 90° turn to the left will be executed to the base leg and the IAS will be reduced to best flare speed plus 20 knots. After completion of the turn onto the base leg, radar navigator will place etched cursor to a relative bearing of 20° near side of runway heading. When etched cursor crosses end of runway, pilot will execute a left turn to runway heading and steps "8" through "11" of "Approach Procedure, Radar Directed Emergency Approach" will be repeated.

3. In the event of failure of the FCI or time-to-go meter, the same approach may be made utilizing range marks and azimuth marker. Under these conditions the radar navigator will direct the airplane. The 600 foot per minute descent will be started at 8 miles. The standard GCA glide path closely approximates 250 feet per mile and this may be cross-checked by checking ranges against the altimeter.

4. To prevent conflict with other traffic during simulated radar directed emergency approaches, the pilot will remain in contact with approach control or the tower and will keep them informed of airplane location.

5. The pilot will evaluate the approach at the point go-around is initiated. The approach will be considered successful if, in his opinion, a safe landing could be accomplished from that point. He will further note the position of the airplane when the time-to-go meter reads zero to evaluate the glide path.

WARNING

All altitudes referred to above, except penetration altitudes, are absolute altitudes above terrain.

GRID NAVIGATION

USAF grid system will be used at all times when flying in areas where magnetic compass indications become unreliable, where course angles change rapidly because of meridian convergence, and where large and rapidly changing magnetic variations exist. The unslaved N-1 compass is used as the primary steering instrument; however, grid legs may be flown with BNS steering engaged. Grid heading will be checked at appropriate intervals by celestial means. The MD-1 astrocomompass may be used to accomplish these checks. Grid headings, gyro readings of the N-1 compass, and the copilot's directional indicator will be recorded on a gyro log or graph. The precession rate for either gyro need not be determined unless it is used as the primary steering instrument, and then only if the difference between the steering gyro and celestial grid heading exceeds 4°. If the MD-1 astrocompass is used, recording gyro readings or determining precession rate is not necessary. Full use will be made of the information displayed by the present position indicators.

GRID NAVIGATION PROCEDURES (RN-N)

Entry

1. Grid Heading - Determined

   Apply latest grid wind to grid course to obtain grid heading.

2. Alter Heading - Completed

   When over entry position, turn airplane to magnetic heading desired.

3. BNS Steering - Disengaged

4. True Heading - Recorded

5. Emergency Controls Hdg Switch - ON

6. BNS Data Preset Panel Doppler Wind Switch - OFF

7. GAM-77 Simulated Launch Switches - ON

8. N-1 Compass Master Indicator:

   a. Latitude Correction Pointer - AUTO

   b. Synchronizer Knob - Set grid heading

9. True Heading System Panel:

   a. Mag-Syn-Gyro Switch - SYN

   b. Bias or Syn Knob - Center synchronize indicator

   c. Mag-Syn-Gyro Knob - GYRO

   d. Bias or Syn Knob & Fast Slew Button - Set true heading recorded in step "4"

10. Emergency Controls Hdg Switch - OFF

11. BNS Data Preset Panel Doppler Wind Switch - ON

12. GAM-77 Simulated Launch Switches - OFF

GRID NAVIGATION (Cont)

13. Heading Check:

    a. Heading - Checked by celestial means

    b. N-1 Compass - Reset to grid heading

    c. Copilot's Directional Indicator - Set to grid heading

    d. True Heading Indicator - Reset to true heading

14. Airplane Heading - Corrected

15. Radar Camera - As desired

In Flight (MD-1 Astrocompass Inoperative)

1. Heading Checks - Accomplished

   Grid azimuth will be used to determine grid heading. This does not preclude the use of the relative bearing method.

NOTE

- If N-1 compass reads within 4° of grid heading, heading check will be recorded but steps "2," "3," and "4" following may be disregarded.
- If copilot's directional indicator reads within 4° of celestial grid heading, step "2b" may be disregarded.

2. Heading Instruments:

   a. N-1 Compass - Reset to grid heading

   b. Copilot's Directional Indicator - Reset to grid heading

   c. True Heading Indicator - Reset to true heading

3. N-1 Compass Precession Rate - Determined

   Calculate the airplane heading change due to the N-1 compass precession, average grid heading flown, new desired grid heading, and new initial heading.

4. Airplane Heading - Corrected

   Turn airplane to new initial heading.

5. Wind Run - Accomplished

   In the absence of auto-nav radar, or if desired, memory point run will be accomplished.

In Flight (MD-1 Astrocompass Operative)

1. Inflight MD-1 Heading Checks:

   a. Grid Heading - Determined

      Apply convergence angle to MD-1 true heading to determine correct grid heading.

   b. N-1 & Copilot's Directional Indicator - Reset to correct grid heading

GRID NAVIGATION (Cont)

c. AJA-1 True Heading - Reset

Reset AJA-1 by zeroing MD-1 heading error correction using AJA-1 bias control.

Exit

The following steps will be accomplished when positive identification of the exit point has been made.

1. BNS Steering - Disengaged
2. Emergency Controls Hdg Switch - ON
3. BNS Data Preset Panel Doppler Wind Switch - OFF
4. GAM-77 Simulated Launch Switches - ON
5. True Heading - Recorded
6. N-1 Compass Master Indicator:
   a. Latitude Correction Pointer - OFF
   b. Synchronizer Knob - Center annunciator
7. True Heading System Panel:
   a. Mag-Syn-Gyro Switch - MAG
   b. Bias or Syn Knob & Fast Slew Button - Zero bias indicator
   c. True Heading Indicator - Checked by celestial means
8. Emergency Controls Hdg Switch - OFF
9. BNS Data Preset Panel Doppler Wind Switch - ON
10. GAM-77 Simulated Launch Switches - OFF
11. Copilot's Directional Indicator - Reset

Sub-polar and Polar Reorientation

Since the convergence factor of the polar series JN charts is different from the sub-polar series, their respective grid north orientations are not compatible. It is therefore necessary to reorient the compasses when changing from one chart to the other. If no change of course is intended, the reorientation is made as follows:

1. Reorientation Point - Determined

   Select a point that is common to the chart that is being departed and the new chart. This point should be a prominent radar return if possible.

2. Conversion Correction - Determined

   See Conversion Correction Table, figure 8-4

3. Grid Reference (N-1):
   a. Emergency Controls Hdg Switch - ON

GRID NAVIGATION (Cont)

b. Doppler Wind Switch - OFF

c. True Heading - Recorded

d. GAM-77 Simulated Launch Switches - ON

e. N-1 Compass Pointer - Set

Set the N-1 compass pointer to the new grid reference heading.

f. True Heading Indicator - Set

With bias or syn knob, set true heading as recorded in step "3c."

g. Emergency Controls Hdg Switch - OFF

h. Doppler Wind Switch - ON

i. GAM-77 Simulated Launch Switches - OFF

4. Copilot's Directional Indicator - Reset

Reset the copilot's directional indicator to the same value as the N-1 compass.

5. Grid Heading - Checked

Check grid heading by celestial means, using true heading plus or minus longitude when going to polar areas (true heading plus or minus convergence angle when going to subpolar areas). If a change of course is intended at the reorientation point, after completing the grid heading check, steer airplane to the intended new grid heading.

Fixing Using MD-1 Astrocompass

1. Fixing (automatic latitude and longitude):

a. Power Filter Switch - SUN or STAR (as required)

b. Rate Switch - SID or SOL, as required

The MD-1 has no automatic capability for rate determination for use with the moon.

c. Clock - Set to GMT

d. GHA Indicator - Set correct almanac value

e. SHA 1, 2, 3 & Dec 1, 2, 3 Indicators - Set

f. Lat-Long Switch - AUTO

g. Star Switch - 1, 2, or 3

Select star data package desired. Track light should come on within 140 seconds and MD-1 will display TH, altitude, azimuth, and intercept.

h. Star Switch - 1

Read and record true azimuth and altitude intercept.

GRID NAVIGATION (Cont)

i. Star Switch - 2

Read and record true azimuth and altitude intercept.

j. Star Switch - 3

Read and record true azimuth and altitude intercept.

k. Pres Pos Counters - Read and record at time of fix

Fix time should not exceed 12 minutes from time of any altitude intercept recording.

(1) Plot present position as assumed position.

(2) Plot altitude intercept of each star as recorded from 1, 2, and 3 star packages. This position is the fix for the time of the present position counter recording.

2. Fixing (manual latitude and longitude):

a. Power Filter Switch - SUN or STAR (as required)

b. Rate Switch - SID or SOL (as required)

c. Clock - Set to GMT

d. GHA Indicator - Set correct almanac value

e. SHA 1, 2, 3 & Dec 1, 2, 3 Indicators - Set

Set zero SHA for sun and planets, correct value for stars. Set current air almanac value in Dec indicator.

f. Latitude & Longitude Indicators - Set coordinates of assumed position

g. Lat-Long Switch - MANUAL

h. Star Switch - 1, 2, or 3

Select star data package desired. Track light should come on within 140 seconds and MD-1 will display TH, altitude, azimuth, and intercept.

i. Star Switch - 1

Read and record true azimuth, average altitude intercept, and midtime of the observation.

j. Star Switch - 2

Read and record true azimuth, average altitude intercept, and midtime of the observation.

k. Star Switch - 3

Read and record true azimuth, average altitude intercept, and midtime of the observation.

l. Resolve intercepts for fix time and plot lines of position. No observation time should exceed 12 minutes from fix time.

NOTE

Lat-long switch may be returned to AUTO between fixing operations.

PHOTOGRAPHY

RADAR RECORDING CAMERA (O-32)

Camera Data Plates

The following data will be entered on the camera data plate during preflight.

TARGET COMPLEXES. The complexes or ranges to be bombed during the mission will be entered in chronological order. A maximum of three complexes will be listed; if a greater number of targets are to be attacked, the data plate must be changed in flight after the first three targets are bombed. At the discretion of the radar navigator, the data plate may be corrected prior to bombing each complex to facilitate identification of film during critique. However, the complex bombed must appear on the data plate regardless of the method used.

DATE. The date entered on the data plate during preflight will be the Greenwich date of the ETA to the first complex.

AIRCRAFT TYPE AND NUMBER. The airplane type will be completely identified: B-52F, etc. The last four digits of the tail number of the airplane will also be entered.

TYPE RADAR EQUIPMENT. The BNS type will be identified: ASQ-38, etc.

LAST NAME OF RADAR NAVIGATOR. The last name (and initials in those cases requiring further identification) of the radar navigator will be entered.

EXAMPLE:

JOPLIN
HASTINGS
BISMARCK
30 June 60
B-52F 7068
ASQ-38
SMITH, C. S.

Inflight Operation Using the Vertical Camera Intervalometer

1. Camera Control Panel:
   a. Camera Master Switch - ON
   b. Camera Intervalometer Switch - AUTO
2. Delay, Interval & Exposure Limiter Control Knobs - Set as desired
   a. The camera exposure delay control setting is the time between initiation of the intervalometer (whether normal or remote) and the time the camera actually starts taking pictures. In normal operation this will be the ATF minus the time before impact it is desired to start taking pictures.

PHOTOGRAPHY (Cont)

b. The camera exposure interval control setting is the desired setting between pictures when the camera intervalometer power switch is on BOMBSPOT. It is the total length of time the camera will take pictures when the camera intervalometer power switch is on RUNAWAY.

c. The camera exposure limiter control is set for the desired number of pictures when the camera intervalometer power switch is on BOMBSPOT. This control has no effect when the camera intervalometer power switch is on RUNAWAY.

3. Camera Intervalometer Power Switch - BOMBSPOT

The camera intervalometer may be initiated manually by depressing the camera intervalometer manual initiation switch or remotely by a bomb release pulse.

Miscellaneous Data

With the camera master switch in ON position, the camera door opens automatically with the bomb bay doors, but does not close automatically. The camera door switch must be held in CLOSED position until the camera door closes when it is desired to close the camera door after the bomb bay doors have been closed. If photos are desired at other than bomb release, the camera door must be opened manually.

CAMERA OPERATION AT MAXIMUM RATE. To operate the camera at maximum rate, proceed as follows:

1. Camera Control Panel:

a. Camera Master Switch - ON

b. Camera Intervalometer Switch - AUTO

2. Delay & Interval Control Knobs - Set as desired

a. The camera exposure delay control setting is the time between initiation of the intervalometer (whether normal or remote) and the time the camera actually starts taking pictures. In normal operation this will be the ATF minus the time before impact it is desired to start taking pictures.

b. The camera exposure interval control setting will determine total time in seconds the camera will operate at maximum rate. Example: Interval control 100 seconds = 100 seconds of camera operation at maximum rate.

3. Camera Intervalometer Power Switch - RUNAWAY

The camera intervalometer may be initiated manually by depressing the camera intervalometer manual switch or remotely by a bomb release pulse.

EW OFFICER'S CHECKLIST

MISSION PREPARATION

1. General Briefing - Attended

2. Intelligence Data - Checked

   The EW officer will familiarize himself with all available intelligence data pertinent to the planning and accomplishment of the EW mission. Radar parameter information will be available for inflight reference.

3. Mission Planning - Completed

   a. Review mission requirements form for ECM equipment and amount, type, and weight of chaff load.

   b. On the basis of the intelligence data and mission requirments for EW activity, the EW officer will coordinate with other crew members to plan the required activities.

   c. The EW officer will coordinate with the navigator on the necessary phase of planned celestial navigation and air refueling activity.

4. Defensive Electronic Warfare Log/Chart - Prepared

   The EW officer will prepare his log/chart in accordance with applicable directives and mission requirements.

5. Crew Briefing - Attended

6. Personal & Professional Equipment - Checked

   Items of personal and professional equipment required for the briefed mission will be checked for completeness and proper condition prior to reporting to the aircraft.

BEFORE EXTERIOR INSPECTION

1. Form 781 - Checked

   Check Form 781 for pertinent equipment writeups and chaff loadings not specifically covered in the pilot's review of the form. On airplanes NF, confirm with ground crew that any missing transmitter component receiving ram air cooling has been replaced by a dummy box to block ram air outlet. If any ECM equipment that receives air from a common cooling duct is removed and not replaced with a dummy box, none of the other equipment that receives cooling from that cooling duct can be operated since cooling air will be lost through the open hole and adequate cooling will not be available for the remaining equipment. If this is applicable, see airspeed limitation Section V.

2. Bomb Check - As required

3. All Communication & ECM Power Switches - Checked OFF

EXTERIOR INSPECTION

1. Forward Exterior Antennas - Checked

   Check protruding ECM antennas and antenna covers mounted on the fuselage for condition, security, and cleanliness.

2. ALE-20 Ground Test Switch QL - OFF

   Check that the ALE-20 ground test switch (in forward wheel well) has not been inadvertently left propped in the ON position. (Switch is spring-loaded to OFF position.)

EW OFFICER'S CHECKLIST (Cont)

3. Aft Exterior Antennas - Checked

   Check protruding ECM antennas and antenna covers mounted on the fuselage for condition, security, and cleanliness.

4. ALE-20 Flare Ejectors QL - Checked

   Visually check that ejector covers are secure (if flares are not loaded) or that the openings are unobstructed (if flares are loaded).

5. ALE-20 Safety Interlock Switch Door QL - Checked open, then close

   Check that the ALE-20 flare ejector safety interlock switch door is open, then close the door. If the door is found closed, check with maintenance personnel on the status of the ALE-20 equipment. When the aircraft is on ground alert in a cocked configuration, the ALE-20 safety interlock switch door will be closed.

INTERIOR INSPECTION

1. Section 41 Power Distribution Panel Circuit Breakers - Checked

2. Equipment - Stowed

2A. Upper Deck Spare Parachute(s) - Checked and stowed

   Check upper deck spare parachute(s) record book for current inspection. Determine from the record the setting of the automatic release mechanism. Check bailout bottle for minimum pressure. Unbuckle and stow spare parachute(s).

3. Ejection Seat:

   a. Arming Levers - Stowed, armrest safety pins No. 1 installed, and locked

   190▶ 215 W70▶ W103

   Inspect both arming lever releases to make certain the arming levers are locked in the stowed position. Do not rotate the arming levers during the inspection. An unlocked arming lever is indicated by a depressed arming lever release and exposed leaf springs on the arming lever. The leaf spring is installed between the inside of the curved portion of the arming lever and the arming lever release (figure 1-56). To lock the arming lever, depress the exposed leaf springs and allow the arming lever release to spring back to the locked position. Do not attempt to lock the arming lever unless it is in the stowed position and the No. 1 safety pins have been installed and locked.

   WARNING

   If the arming lever has been rotated, call maintenance immediately and stay clear of the seat.

   b. Hatch Link - Checked

   Check link connecting escape hatch to catapult safety pin-pull initiator.

   c. Maintenance Safety Pins - Checked removed

   Check No. 2, 3, and 4 pins removed. Take care that no streamer was torn free of a safety pin during removal, thus inadvertently leaving the pin installed. Also make certain that no safety pin is overlooked because the streamer has been detached previously. See figure 1-55 for location of safety pins.

EW OFFICER'S CHECKLIST (Cont)

d. Catapult Initiator Safety Pin-Pull Cylinder - Pin in place

Catapult initiator safety pin should extend through the catapult initiator. If pin is pulled out, initiator may have been fired; call maintenance immediately.

WARNING

Shipping pin or safety pin with streamer must not be installed in catapult initiator.

e. Manual Catapult Pin-Pull Lever - Checked

Lever latched, pin-pull cylinder secured.

f. Catapult to Initiator Tube Run - Checked connected

Check tube for proper and secure connection.

g. Harness Release Initiator to Pin-Pull Cylinder Tube - Connected.

Make certain that tube run from the integrated harness release initiator is connected to the integrated harness release pin-pull cylinder.

3A. Parachute:

a. Preflight Check - Performed

Perform preflight check on parachute if not previously performed by checking parachute inspection record for current inspection. Determine from this record the setting of automatic ripcord release mechanism. Check bailout bottle for minimum pressure and bailout oxygen hose connector for security.

b. Survival Kit, Inertia Reel, Parachute & Safety Belt - Installed and interconnected.

Parachute, survival kit, inertia reel, and safety belt are interconnected with the parachute-survival kit attachment straps passing through the loops in the safety belt. Check that the survival kit is properly bottomed in the seat to insure that the arming plunger is fully depressed.

WARNING

Care must be taken to assure the survival kit attachment straps are properly laced through the safety belt.

c. Zero Delay Lanyard - Hooked

d. Parachute Arming Lanyard Anchor - Installed

WARNING

Be certain that the parachute arming lanyard anchor is securely fastened in the attachment fitting on the seat. Failure to attach the lanyard anchor to the seat will necessitate manual operation of the parachute after ejection.

4. Circuit Breakers - Set

Check that all circuit breakers on ECM circuit breaker panel are set to "in" position. Chaff dispenser and flare ejector circuit breakers will be left "out" until ready to dispense chaff or eject flares and "out" after activity is complete.

EW OFFICER'S CHECKLIST (Cont)

5. Air Outlet Knobs:

   a. Upper - 1/2 to full out

   b. Lower - Full out

   c. Spray Bar - Full out

NOTE

These knot settings are approximate settings only. After the cabin temperature has stabilized, knob adjustment may then be varied slightly for crew comfort.

6. Interphone - Monitor

   The EW officer will monitor the interphone at the station he is occupying.

7. Oxygen System:

   a. Shutoff Lever - ON

      Pressure gage should read approximately 300 psi.

   b. Regulator Diluter Lever - 100% OXYGEN

   c. Emergency Toggle Lever - EMERGENCY

      Flow indicator should indicate continuous flow. Block regulator hose opening with hand; indicator should indicate no flow.

   d. Emergency Toggle Lever - NORMAL

   e. Mask and Hose - Connect and test

      Check for 10- to 20-pound pull for disconnect.

   f. Mask - Test

      (1) Emergency Toggle Lever - TEST MASK

         Hold breath; indicator should indicate no flow.

NOTE

Flow condition may be indicated by a slight leak around the face form. If light hand pressure against the mask does not stop the flow, the mask is unacceptable.

      (2) Emergency Toggle Lever - NORMAL

   g. Regulator Diluter Lever - NORMAL OXYGEN

8. Lights - Checked and set

   Check light switches and controls for proper operation and set as desired.

EW OFFICER'S CHECKLIST (Cont)

9. ECM Equipment Controls Preset:

a. AN/ARC-65:

WARNING

Observe the ARC-65 ground operation limitations given in Section V.

(1) Control Switch - ON

(2) Volume Control - Midposition

(3) Emission Switch - SSB/AME as required

(4) Power Switch - HIGH or as directed

(5) Frequency Channelization Card - Checked

Check frequency card for standard or briefed frequency listings. Enter discrepancies in Form 781 and correct as required for mission.

(6) Access Door Thumbscrews - Locked

(7) Reception - Checked

Allow 15 minutes warmup before any transmission.

b. AN/APN-69:

(1) Power Switch - OFF

(2) Volume Control - Midposition

(3) Code Selector Switches - _____(briefed setting)

c. AN/ALT-7 (T-464 & T-465):

(1) Power Switch - OFF

(2) Plate Switch - OFF

(3) Antenna Coupling Control - 4

(4) Meter Switch - OSC AMPS

(5) Modulation Bandwidth Switch - As desired

(6) Sweep Rate Control - OFF

d. AN/APR-14:

(1) Power Switch - OFF

(2) Manual-Sweep Switch - MAN

(3) FM-AM Switch - 6.0 position

(4) AGC Switch - OFF

(5) IF Attn DB Control - 0 db

EW OFFICER'S CHECKLIST (Cont)

e. AN/ALA-7:

(1) Power Switch - OFF

(2) Pulse Length Control - 5

(3) Slow-Fast Control - CW

(4) Pulse Delay Control - 10

(5) Polarity Switch - OFF

f. AN/APS-54:

(1) C-1323 Control:

(a) Power Switch - OFF

(b) Audio Gain Control - Midposition

(c) Audio Selector Switch - BOTH

(d) Delay Switch - IN

(2) AM-924 Amplifier:

(a) PRF Lower Limit Switches - Minimum or briefed low limit

(b) Gain Controls - 10

g. AN/ALT-6B:

(1) Antenna Indicator Light - Press to test

(2) Power Switch - OFF

(3) Meter Switch - MOD CUR

(4) Transmit-Standby Switch - STBY

(5) Rate and Width Controls - Unlocked, CW to zero

h. ALT-16:

(1) Power Selector - OFF

(2) Channel Selector Buttons - OUT

i. ALT-15:

(1) Power Selector - OFF

(2) Channel 2 Button - Depressed

j. ALT-13:

(1) Power Selector - OFF

(2) Center Frequency Control - Midrange

(3) RF Bandwidth Control - Minimum

EW OFFICER'S CHECKLIST (Cont)

k. QRC-218A-(T) TY:

(1) Power Switch - OFF

(2) Master Output Switch - OFF

(3) Output Switches (6) - OFF

l. Chaff Dispenser Controls:

(1) Power Switch - OFF

(2) Speed Selector - Set as required

(3) Chaff Reserve Counters - Checked

Check for number of bundles loaded (should agree with Form 781 entry).

(4) Circuit Breakers - In

Depress each circuit breaker individually while checking both press-to-test indicator lights to assure that only proper light illuminates.

(5) Indicator Lights - Press to test

(6) Circuit Breakers - Out

m. AN/APR-9:

(1) Power Switch - OFF

(2) AGC Switch - OFF

(3) Bandwidth Switch - WIDE

(4) Sector Limit Controls - Maximum

(5) Band Switch - Desired tuning unit

(6) IF Attn DB Control - 0 db

(7) Fixed OSC Switch - OFF

(8) Sector Sweep Switch - MANUAL

(9) BFO Switch - OFF

10. ECM Equipment Controls Preset: NF

a. ARC-65:

WARNING

Observe the ARC-65 ground operation limitations given in Section V.

(1) Control Switch - ON

(2) Volume Control - Midposition

(3) Emission Switch - SSB/AME as required

EW OFFICER'S CHECKLIST (Cont)

(4) Power Switch - HIGH or as directed

(5) Frequency Channelization Card - Checked

Check frequency card for standard or briefed frequency listings. Enter discrepancies in Form 781 and correct as required for mission.

(6) Access Door Thumbscrews - Locked

(7) Reception - Checked

Allow 15 minutes warmup before any transmission.

b. ALE-20: QT

(1) Power Switch - OFF

(2) Interval Selector - As required

(3) Transfer Switch - OFF

(4) Burst Remaining Indicator - Checked

Check for number of flares loaded (should agree with Form 781 entry).

(5) Burst Selector - As required

(6) Automatic Release Switch - OFF

c. ALE-1 less TR :

(1) Power Switch - OFF

(2) Speed Selector - Set as required

(3) Chaff Reserve Counters - Checked

Check for number of bundles loaded (should agree with Form 781 entry).

(4) Circuit Breakers - In

Depress each circuit breaker individually while checking both press-to-test indicator lights to assure that only proper light illuminates.

(5) Indicator Lights - Press to test

(6) Circuit Breakers - Out

c. ALE-27 TR :

(1) Selector Control:

(a) Dispense Switches - OFF

(b) Chaff Counters - Checked

Check for number of packages loaded (should agree with Form 781 entry).

(2) Programmer Control:

(a) Power Switch - OFF

(b) Automatic Dispense Switch - OFF

(c) Program Selector Switches - Set as required

EW OFFICER'S CHECKLIST (Cont)

d. APS-54:

(1) C-1323 Control:

(a) Power Switch - OFF

(b) Audio Gain Control - Midposition

(c) Audio Selector Switch - BOTH

(d) Delay Switch - IN

(2) AM-924 Amplifier:

(a) PRF Lower Limit Switches - Minimum or briefed low limit

(b) Gain Controls - 10

e. ALT-6B:

(1) Power Switch - OFF

(2) Meter Switch - MOD CUR

(3) Transmit-Standby Switch - STBY

(4) Rate and Width Controls - Unlocked, CW to zero

f. ALR-18:

(1) Power Switch - OFF

(2) Mode Switch - STANDBY

(3) Seq-Track Switch - As directed

(4) IF Attenuation - 30 db

(5) Search Width Control - Maximum width

(6) Sweep Width & Rate Controls - CW to zero

(7) Center Frequency Control - Midfrequency

EW OFFICER'S CHECKLIST (Cont)

g. ALT-16:

(1) Power Selector - OFF

(2) Channel Selector Buttons - OUT

h. ALT-13:

(1) Power Selector - OFF

(2) Center Frequency Control - Midrange

(3) RF Bandwidth Control - Minimum

i. QRC-218A-(T) TY :

(1) Power Switch - OFF

(2) Master Output Switch - OFF

(3) Output Switches (6) - OFF

j. ALT-15:

(1) Power Selector - OFF

(2) Channel 2 Button - Depressed

k. APR-14:

(1) Power Switch - OFF

(2) Manual-Sweep Switch - MAN

(3) FM-AM Switch - 6.0 position

(4) AGC Switch - OFF

(5) IF Attn DB Control - 0 db

l. APR-9:

(1) Power Switch - OFF

(2) AGC Switch - OFF

(3) Bandwidth Switch - WIDE

(4) Sector Limit Controls - Maximum

(5) Band Switch - Desired tuning unit

(6) IF Attn DB Control - 0 db

(7) Fixed OSC Switch - OFF

(8) Sector Sweep Switch - MANUAL

(9) BFO Switch - OFF

EW OFFICER'S CHECKLIST (Cont)

11. Celestial Station Lights - Checked and set

    Check lights and controls for proper operation.

12. Celestial Station Oxygen System:

    When the station is not occupied:

    a. Shutoff Lever - ON

       Pressure gage should read approximately 300 psi.

    b. Regulator Diluter Lever - 100% OXYGEN

    c. Emergency Toggle Lever - EMERGENCY

       Flow indicator should indicate continuous flow. Block regulator hose opening with hand; indicator should indicate no flow.

    d. Emergency Toggle Lever - NORMAL

    e. Mask & Hose - Connect and test

       Check for 10- to 20-pound pull for disconnect.

    f. Shutoff Lever - OFF

       When the oxygen system at the celestial station is not in use, place the regulator diluter lever to 100% OXYGEN and the shutoff lever to OFF.

13. Periscopic Sextant and Mount:

    a. Sextant Mount - Drained and closed (open when airplane is on alert)

    b. Azimuth Counter - Checked

       Rotate azimuth knob until 0° is exactly aligned with the aft index on mount. Azimuth counter should read 0. (Any difference greater than 1/2° should be entered in Form 781.)

    c. Sextant - Inserted

NOTE

Before accepting sextant, check desiccant indicators in the optical barrel and the left cover. If either indicator is pink or white, the sextant should be returned to maintenance.

    d. Sextant Lights - Checked

       Connect power cable and check mount and sextant for proper illumination.

NOTE

The EW officer may perform steps "e," "h" and "j" prior to inserting the sextant or after removing it from the mount and omit these steps at this time.

    e. Time Dial Accuracy Check - Completed

       (1) Averager Rewind Lever - Depressed and released

       (2) Averager Actuating Button - Depressed and released

EW OFFICER'S CHECKLIST (Cont)

(3) Shutter - Falls 2 seconds prior to averager stop

(4) Time Dial & Watch - Compared

Start stopwatch simultaneously with averager. Double the final dial readings and compare with watch reading. The period of operation should be 120 (±4) seconds.

f. Bubble Formation Check - Completed

g. Projection Lens Alignment Check - Completed

Collimate on centerline of vertical stabilizer at top edge of upper airscoop. Check for reading of 180° under index line. (Care should be taken to align on the top of the ellipse.) If an error exists, remove by rotation of the projection lens. If unable to remove, error should be recorded and applied to any true heading read during flight.

h. Altitude Averager Accuracy Check:

(1) Averager Rewind Lever - Depressed and released

This should wind and zero the averager, zero the time dial, and raise the shutter.

(2) Altitude Knob - Set

(3) Averager Actuating Lever - Depressed and released

(4) Averager Actuating Lever - Depressed and released (when time dial reads exactly 15)

NOTE

Repeat steps (2), (3), and (4) using altitude and time dial settings as indicated in chart below.

Altitude Settings	Time	Time Dial
13	30 sec	15
12	30 sec	30
8	30 sec	45
7	30 sec	60 (stops automatically)
Av 10	Total 120 sec	

(5) Altitude Knob - Rotate until red blocks on indicator drums are aligned and read altitude average

NOTE

Timer dial should stop automatically at 60 or in 120 seconds. If it does not or if average altitude is in error over ±2 minutes from 10°, then sextant requires maintenance.

i. Sextant - Retracted, port closed

j. Spare Bulbs in Sextant Case - Checked

k. Sextant - Stowed

NOTE

Bubble adjust knob should be at full increase and averager actuating button depressed and released.

EW OFFICER'S CHECKLIST (Cont)

14. Celestial Station:

    a. ECM Console Cabling - Checked visually

    Perform a visual check of all accessible ECM cabling and cable connections for security and excessive wear or unsafe condition.

    b. Scanning Lamp & Filters - Checked

    Check for presence, stowage, and lamp operation.

    c. Thermal Curtains - Aboard, stowed

15. Liaison Radio:

    a. Transmission - Checked (if required)

    Allow 40 seconds for channelization and 15 minutes warmup before any transmission.

WARNING

Ground operation of the AN/ARC-65 transmitter (interphone selector switch positioned to LIA and mike switch actuated) is prohibited on any tactical aircraft under the following condition:
1. Nuclear weapons loaded and bomb bay doors open.

NOTE

This restriction applies only to AN/ARC-65 installed on the tactical aircraft having nuclear weapons aboard and does not apply to adjacent aircraft regardless of separation distance. This does not prohibit AN/ARC-65 receiver operation on the ground.

    b. Control Switch - OFF

16. Crew Report - Completed

    a. Pilot actuates emergency alarm switch to ABANDON, switches interphone to CALL, and announces "Crew report."

    b. EW officer reports on interphone following navigator. Switch interphone to CALL and report, "EW station check complete." Station check consists of seat, oxygen, interphone, alarm light/abandon signal, and zero delay lanyard check.

    c. If the celestial preflight is interrupted by "Crew Report," the EW officer may report from the celestial station. On return to his seat, the interphone CALL position will be checked with another crew member.

EW OFFICER'S CHECKLIST (Cont)

STARTING ENGINES

WARNING

Whenever contamination is suspected, 100% oxygen will be used during ground operation and takeoff.

1. ALR-20 Rack NF - Stowed and locked

WARNING

To prevent serious injury, the ALR-20 rack must be stowed and locked before ejection from the EW officer's seat.

2. Stand by to Taxi - Report if not ready to taxi

NOTE

Steps "3" through "6" may be accomplished during taxi.

3. Liaison Radio - On

CAUTION

Operating the liaison radio during periods of abnormally high voltage or fluctuating power will decrease the operational life of the equipment and can cause material failure.

4. Parachute & Safety Belt - Fastened

WARNING

Tighten the parachute-survival kit attachment straps as tightly as possible to prevent the safety belt from inflicting facial injuries during a manual bailout or delaying escape during crash landing or ditching.

NOTE

If it becomes necessary to leave the seat during flight, the crew member should install the arming lever safety pins, open the safety belt, and unbuckle the parachute harness leaving the parachute and survival kit in the seat. If the parachute is worn when leaving the seat, upon returning to the seat it will be necessary to take it off in order to reinstall the parachute and safety belt in the seat. Upon returning to the seat, remove the arming lever safety pins after fastening the seat belt.

EW OFFICER'S CHECKLIST (Cont)

5. Oxygen Hose & Bailout Bottle - Connected to mask

CAUTION

Insure that oxygen supply hose is under the seat arm before hookup with mask hose.

6. Oxygen Regulator - NORMAL OXYGEN and ON

7. Arming Lever Safety Pins (No. 1) - Removed (remove simultaneously with pilots' removal of No. 1 pins during "Before Lineup Checklist")

WARNING

Replace the arming lever safety pins (No. 1) in the armrests prior to unfastening the safety belt when leaving the seat. Upon returning to the seat, remove the safety pins after fastening the safety belt.

TAXIING CHECKLIST (Copilot/EW reads)

Checklist appears in EW officer's abbreviated checklists and will be read on request of the pilot.

BEFORE LINEUP CHECKLIST (Copilot/EW reads)

Checklist appears in EW officer's abbreviated checklists and will be read on request of the pilot.

AFTER TAKEOFF/CLIMB

1. Zero Delay Lanyard - Stowed (on notification)

   See figure 3-5 for zero delay lanyard chart.

2. Periscopic Sextant - Inserted as required

WARNING

The EW officer's ejection seat may remain unoccupied during the time that he is performing celestial duties. His parachute will remain in the seat which will be configured for immediate reoccupancy and ejection, except that the No. 1 safety pins will be installed. Should the EW officer elect to return to his seat between celestial observations, he will fasten parachute and seat belt and remove No. 1 safety pins. Should the EW officer elect to remain at the celestial station, he will utilize and fasten into the extra parachute. While taking celestial observations, the spare parachute may be temporarily disconnected but it will be refastened upon completion of the actual sighting series.

3. Oxygen Check - Completed

   a. During the climb, copilot requests an oxygen and zero delay lanyard check at 12,000 feet. The sequence for oxygen report is the same as for crew report. Oxygen panels will be checked for:

      (1) Oxygen Supply Shutoff Lever - ON

EW OFFICER'S CHECKLIST (Cont)

(2) Regulator Diluter Lever - NORMAL OXYGEN

(3) Pressure - 300 psi

(4) Flow Indicator - Functions normally

(5) Emergency Toggle Lever - NORMAL

b. Gunner and copilot report, "Cabin altitude _____ feet. Oxygen panel checked."

c. Navigator, EW officer, radar navigator, and pilot report, "Oxygen panel checked." Pilot reports oxygen quantities.

d. Under steps "b" and "c," the gunner, copilot, EW officer, and pilot will report "Zero delay lanyard stowed."

e. Copilot, notify aircrew and receive gunner's acknowledgment when passing through 26,000 and 35,000 feet.

f. The copilot will request an oxygen check at level-off. During cruise, the copilot will monitor the gunner's remote cabin altimeter and the tail compartment low pressure warning light at intervals not to exceed 15 minutes and initiate the oxygen checks at 30-minute intervals when both cabin altitudes are below 12,000 feet, at 15-minute intervals when either cabin altitude is 12,000 to 25,000 feet, and at no longer than 10-minute intervals when either cabin altitude is above 25,000 feet. If cabin altitude is below 12,000 feet, only the gunner and copilot/pilot will report. The remaining crew members will check their equipment and report if abnormal. At level-off, only the gunner and copilot/pilot need report if cabin pressure is 12,000 feet or below.

4. ECM Equipment:

a. ECM equipment power switches (except chaff/flare) will be turned on during climbout after flaps up and will remain on until all EW activity including equipment postflight, prior to landing, is completed. Care should be exercised that ECM transmitters are in standby except when they are to be used.

WARNING

To prevent accidental actuation of the transmitter switches, extreme care must be exercised when leaving or returning to the seat.

b. ALT-6( ) Slow Width Controls - Approximately 1/4 turn CCW

c. ALR-18 Sweep Width Controls - Approximately 1/4 turn CCW

LEVEL OFF

1. ECM Equipment Calibration & Systems Interference Check - Completed

See "EW Calibration and Interference Checklist."

AIR REFUELING

Checklist appears in T.O. 1-1C-1-5.

EW OFFICER'S CHECKLIST (Cont)

BEFORE LANDING

1. Periscopic Sextant - Stowed, port closed
2. ECM Equipment Postflight Check - Completed

   All ECM equipment and components not utilized on the sortie will be checked for operation prior to landing in accordance with procedures for the abbreviated check as outlined in the prepenetration checklist, consistent with clearance requirements and operating restrictions. Discrepancies will be entered on appropriate forms.

3. All ECM Equipment Off - Checked
   a. Transmit-Standby Switches - STBY
   b. Power Switches - OFF
   c. ALR-18 Receiver Attenuation Control - 30 db
   d. Chaff Dispenser Circuit Breakers - Out
   e. Flare Ejector Circuit Breakers - Out
4. Safety Belt & Parachute Harness - Fastened
5. Dome & Flood Lights - Adjusted

   White lights will be adjusted to preclude interference with night vision of pilot and copilot.

6. Zero Delay Lanyard - Hooked (on notification)

   See figure 3-5 for zero delay lanyard chart.

DESCENT CHECKLIST (Pilot/Copilot/EW reads)

Checklist appears in EW officer's abbreviated checklists and will be read on request of the pilot.

BEFORE LANDING CHECKLIST (Copilot/EW reads)

Checklist appears in EW officer's abbreviated checklists and will be read on request of the pilot.

EW OFFICER'S CHECKLIST (Cont)

AFTER LANDING

NOTE

The "After Landing" checklist will be performed in the event the mission is ground aborted after preflight has been initiated.

1. Arming Lever Safety Pins (No. 1) - Installed
2. All Equipment Switches - Off

NOTE

Recheck all power switches OFF just prior to leaving position to prevent inadvertent jamming with the application of ground power.

3. Ejection Seat - Down and aft
4. Oxygen System:
   a. Regulator - OFF and 100% OXYGEN
   b. Supply Hose & Interphone Cord - Stowed
5. Celestial Station:
   a. Regulator - OFF and 100% OXYGEN
   b. Supply Hose & Interphone Cord - Stowed
   c. Scanning Lamp - Stowed
6. ALE-20 Safety Interlock Switch Door QL - Open

   Check that the ALE-20 flare ejector safety interlock switch door is open.
7. Required Forms - Completed
8. Crew Debriefing - Completed

   Forms, logs, and classified material turned in as briefed.

EW CALIBRATION AND INTERFERENCE CHECKLIST

The calibration of ECM equipment and interference to and from other aircraft systems will be determined prior to reaching the passive detection line (PDL). The purpose of this check is to determine whether the equipment meets the minimum requirements for dependable operation. If this abbreviated check reveals a malfunction or failure, and conditions permit, refer to the applicable portion of T. O. 1B-52E-1A for malfunction analysis and determine whether the system can be used in defense of the aircraft. Each transmitter will be checked for normal efficiency by comparing the output with like systems, taking the antenna position into consideration. Transmitters will be momentarily activated in a clear band consistent with clearance and operating restrictions. On training missions only, when the mission profile precludes accomplishing the entire check prior to the PDL, only systems and frequency bands programmed for use will be checked. The entire crew must be alerted for coordination during this check. UHF guard frequency must be monitored throughout the check.

EW CALIBRATION AND INTERFERENCE CHECKLIST (Cont)

1. AIC-10 Mixer Switches - As required
2. APR-14:
   a. Antenna Switch - As desired
   b. Band Switch - As desired
   c. Scope Presentation - Optimum
   d. Reception, Calibration & Interference - Checked

      Check reception and calibration against a known signal.

      NOTE

      Repeat steps "a" through "d" for each band as it is checked.

   e. AGC Switch - ON, check operation, OFF
   f. Audio Gain Control - Set
3. APR-9/APR-22:
   a. Line Volt Test Switch - Depress, check 110 to 120 volts
   b. Band Switch - As desired
   c. ID-226/ID-117 Controls - As desired
   d. Manual Tuning Switch - Check lower limit light on, set frequency indicators
   e. Reception, Calibration & Interference - Checked

      Check reception and calibration against a known signal.

      NOTE

      Repeat steps "b" through "e" for each tuning unit as it is checked.

   f. ID-117 Manual Variable Sweep Control - As required
   g. Volume Control - Set
4. APS-54, System 1:
   a. APS-54 System 1 Mixer Switch - Up
   b. Test Switch - Up and hold, check lights (P-N-EW-G)

      Nose and tail lights on pilot, navigator, EW, and gunner indicators should illuminate.

   c. Audio Selector Switch - TAIL-BOTH-NOSE, check for tone
   d. Test Switch - Released

EW CALIBRATION AND INTERFERENCE CHECKLIST (Cont)

e. TACAN - Receiver only (P)

f. SIF/IFF - STDBY or LOW (P or N), (Obtain clearance)

If FAA approval cannot be obtained to turn the SIF/IFF to STDBY or LOW, switch to the TN-128/APR-9 and observe the SIF/IFF signal. Correlate the visual signal with the APS-54 audio signal.

g. BNS - Standby (RN)

If the aircraft is in weather or if the BNS is necessary for safety of flight, the BNS portion of this check will be delayed until flight conditions permit completion.

h. FCS - Standby (G)

i. Video Gain Controls - Optimum

Check gain controls in NOSE and TAIL with the audio selector switch in the corresponding channel.

j. APS-54 System 1 Mixer Switch - Down

5. APS-54, System 2:

a. APS-54 System 2 Mixer Switch - Up

b. Test Switch - Up and hold, check lights

c. Audio Selector Switch - TAIL-BOTH-NOSE, check for tone

d. Test Switch - Released

e. Video Gain Controls - Optimum

Check gain controls in NOSE and TAIL with the audio selector switch in the corresponding channel.

f. APS-54 System 1 Mixer Switch - Up

g. BNS, FCS, SIF/IFF, TACAN - ON

Return aircraft equipment to normal operation, one at a time, noting interference of both APS-54 systems. APS-54 mixer switches will be left on throughout transmitter checks.

6. ALR-18 (System 16) NF :

a. Manual Mode:

(1) Sweep Width & Rate Controls - CW to zero

(2) Mode Switch - MAN

(3) Signal Presentation & Calibration - Checked

(4) Sweep Width & Rate - Checked

(5) Mode Switch - STBY

EW CALIBRATION AND INTERFERENCE CHECKLIST (Cont)

b. Automatic Mode:

(1) Receiver Attenuation Control - 0 DB

(2) Search Width - 600 MCS

(3) Seq-Track Switch - TRACK

(4) Mode Switch - AUTO

(5) Receiver Attenuation Selector - Adjusted

Adjust to eliminate noise triggering (db value should be 9 db or less).

(6) Passive Override Button - Depressed

The passive override and radiate lights should illuminate immediately and the jam light should not illuminate. For system 15, have the gunner depress the deactivate switch. Check that the reset light comes on and the radiate light goes out.

(7) Seq-Track Switch - SEQ, checked, then TRACK

(8) Mode Switch - STBY

(9) Center Frequency Control - Center of planned operating band

(10) Mode Switch - MAN

Request RN to tune to best operating frequency.

(11) Mode Switch - STBY

(12) Slow Width Control - 1/4 CCW

NOTE

Repeat applicable portion of check for system 15.

7. ALT-6B:

a. Tuning Control - Set to clear frequency

b. Slow Width Control - CW to zero

c. Transmit-Standby Switch - Transmit, check meter

Meter readings should be: MOD CUR 4.5 to 5.5, MOD VOLTS 3.0 to 6.0

d. Reception, Calibration & Interference - Checked

e. Sweep Width & Rate - Checked, then CW to zero

f. Transmit-Standby Switch - STBY

g. Slow Width Controls - 1/4 CCW

EW CALIBRATION AND INTERFERENCE CHECKLIST (Cont)

8. ALT-13:

   a. Center Frequency Control - Set to clear frequency

   b. Power Selector - TRANS

   c. Reception, Calibration & Interference - Checked

   d. RF Bandwidth Control - Checked and set

9. QRC-218A-(T) [AN] :

   a. Power Switch - ON

   b. Master Output Switch - ON

   c. Sweep Frequency Manual-Preset Switch - As desired

   d. Deviation Manual-Preset Switch - As desired

   e. Modulation Control - As desired

   f. Desired Output Switch - ON

   g. ID-226/ID-117 Reception & Presentation - Checked

10. ALT-13:

   a. Power Selector - STBY

11. ALT-15 and ALT-16:

   a. Channel Selector Buttons - Depressed as desired

   b. Power Selector - TRANSMIT

   c. Power Monitor Meter - Checked

      Meter should read 50 or greater.

   d. VSWR Button - Checked

      Meter should read 20% or less of reading in item "c."

CAUTION

Do not operate transmitter if meter reading in step "d" is more than 20% of step "c" as damage to the transmitter may result.

EW CALIBRATION AND INTERFERENCE CHECKLIST(Cont)

e. Reception, Calibration & Interference - Checked

f. Power Selector - STANDBY

12. ALT-7: (T-464 and T-465)

a. Frequency Control - Set to clear frequency

b. Plate Switch - ON

c. Meter Readings - Checked, return to OSC AMPS position

NOTE

Forward power reading times 10 less back power reading times 10 equals the power radiated. If the following minimum conditions do not exist, retune as necessary: T-464, CW - 70 watts and MOD - 60 watts; T-465, CW and MOD - 100 watts.

d. Reception, Calibration & Interference - Checked

e. Sweep Rate Control - Checked, then OFF

f. Plate Switch - OFF

13. ALA-7:

a. T-465 Plate Switch - ON

b. APR-14 - Tuned to T-465 frequency

c. Polarity Switch - Positive

d. Window Control - Optimum

e. Polarity Switch - OFF

f. T-465 Plate Switch - OFF

EW EQUIPMENT SET CHECKLIST

Operational ECM equipment will be programmed for use prior to the PDL and start of each EW attack by accomplishing the applicable portion of this checklist. Transmitters will not be reactivated. Antenna locations, axis of attack, and the results of the "EW Calibration and Interference Checklist" will be considered when selecting equipment to be used for each attack.

1. AIC-10 Mixer Switches - As required
2. APR-14:
   a. Antenna Switch - As required
   b. Band Switch - As required
   c. Audio Gain Control - As desired
3. APR-9/APR-22:
   a. Frequency Indicators - Set for multiband operation
   b. Volume Control - As desired
4. APS-54:
   a. PRF Lower Limit - Set
   b. Video Gain - Optimum
   c. Audio Selector Switch - Set
   d. Audio Gain - As required
   e. Delay - Set
5. ALR-18 NF :
   a. Seq-Track Switch - As required
   b. Receiver Attenuation Selector - Optimum
   c. Center Frequency Control - Set as required
   d. Sweep Width & Rate Controls - As required
   e. Search Width Control - As required
   f. Mode Switch - As required
   g. Advise RN of best BNS frequency range.

EW EQUIPMENT SET CHECKLIST (Cont)

6. ALT-6B:
   a. Center Frequency - As required
   b. Rate & Width Controls - As required
7. ALT-13:
   a. Center Frequency Control - As required
   b. RF Bandwidth Control - As required
8. QRC-218A-(T) [TV] :
   a. Power Switch - ON
   b. Master Output Switch - OFF
   c. Output Switches - As desired
9. ALT-15 and ALT-16:
   a. Channel Selector Buttons - Depressed as required
10. ALT-7 (T-464 and T-465):
    a. Frequency Dial - As required
    b. Sweep Rate Control - As required
11. ALA-7:
    a. Controls - Optimum
    b. Polarity Switch - OFF
12. ALE-1 less [TR] :
    a. Power Switch - OFF
    b. Dispensing Rate - Set
    c. EW Officer's Circuit Breakers - In or as directed
    d. Gunner's Circuit Breakers - In or as directed

EW EQUIPMENT SET CHECKLIST (Cont)

13. ALE-27 T R :
    a. Power Switch - OFF
    b. Programmer Selector Switches - As required
    c. Dispense Switches - OFF
    d. Circuit Breaker - In or as directed
    e. Power Switch - ON or as directed
14. ALE-20 Q T :
    a. Power Switch - OFF
    b. Flare Ejection Program - As required
    c. Pilot's Flare Ejector Switch - ON or as directed
    d. Circuit Breakers - In or as directed
    e. Power Switch - ON or as directed
15. Lights - Set
16. UHF Radios - Monitored as required
17. Clearance - Obtained

NOTE

- The following will be done on all training missions concerning the EW expendables (chaff, flares, etc):
  - All circuit breakers available in flight to the crew will be pulled at all times.
  - Pilot's flare ejector switch will be in OFF at all times.
- When chaff or flares are scheduled to be expended, the proper positioning of applicable circuit breakers and switches will be governed by existing directives and/or regulations.

ECM EQUIPMENT OPERATIONAL CHECK

This operational check, or any portion, may be performed by the EW officer prior to flight or whenever an aircraft is being accepted for alert status, if the status of his ECM equipment dictates. Restriction to operation of any system will be governed by existing regulations and/or directives.

PRE-OPERATIONAL SAFETY CHECK

1. Before Exterior Inspection - Completed
2. Ground Cooling Equipment - As required

CAUTION

On NF aircraft, ground cooling must be supplied to the applicable ram air inlet or aircraft compartment when extended ground operation of the ECM transmitters is conducted. However, the transmitters may be operated without ground cooling provided the ram air inlets are open and operation is within the following permissible limits: (Transmitter operation defined as power-selector/switch in any position other than OFF.)

- One transmitter per cooling shroud area operated.
- Outside air temperature 100° F or below.
- ALT-15 transmitter operated for 3 minutes or less.
- ALT-16 transmitter operated for 5 minutes or less.
- ALT-13 and ALT-6B transmitters operated for 8 minutes or less.
- ALR-18/ALT-6B transmitter/receiver operated for 9 minutes or less.
- Any transmitter operated with at least a 60-minute cooling period after prior operation.

3. Battery Switch - ON
4. External Power Switch - OFF, phase sequence, volts and cycles indicators correct, then ON
5. Interphone Power Switch - ON
6. UHF Radio - On as required
7. Armrest Safety Pins (No. 1) - Installed
8. ECM Equipment Controls - Preset as specified in the "Interior Inspection" checklist
9. Antennas - Cleared

WARNING

Insure that all personnel are clear of hazardous radiation areas (within a 6-foot radius of transmitting ECM antennas).

10. ECM Power Switches - ON/STANDBY

OPERATIONAL CHECK

NOTE

Transmitter operation will be conducted only in locally cleared frequency bands. UHF guard frequency will be monitored during transmitter operational checks.

ECM EQUIPMENT OPERATIONAL CHECK (Cont)

1. AN/APS-54 SYSTEMS:

   a. Test:

      (1) Test Switch - Up and hold

      Audio tone should be heard at once and warning lights should illuminate after 2-second delay.

      (2) Delay Switch - OUT

      (3) Audio Select Switch - NOSE, check for tone

      (4) Audio Select Switch - BOTH, check for tone

      (5) Audio Select Switch - TAIL, check for tone

      (6) Test Switch - NORMAL

      (7) Tail Gain (AM-924) - Rotate; check volume change and reset to optimum

      (8) Audio Select Switch - NOSE

      (9) Nose Gain (AM-924) - Rotate; check volume change and reset to optimum

      (10) Audio Select Switch - BOTH

      (11) Audio Gain (C-1323) - CW to comfortable noise level

      Monitor the APS-54 during transmitter checks for interference signals.

2. HIGH FREQUENCY RECEIVER-TRANSMITTER SYSTEMS:

   a. AN/APR-9:

      (1) Line Volts Switch - Depress, check 110 to 120 volts

      (2) ID-226 Controls - Optimum settings

      (3) Manual Tuning Switch - Check lower limit light on, set frequency indicators

      (4) Sector Sweep Switch - SECTOR SWEEP, check required frequency range

         (a) Crystal Current - Meter deflection, minimum 10

      (5) BFO Switch - ON, center, OFF

      (6) IF Attn DB Control - 0 db, observe minimum of 1/4 inch grass

      NOTE

      On airplanes equipped with CV-43C/APR-9 mixer amplifiers, no grass will be observed.

      (7) Volume Control - Adjust to comfortable noise level

      (8) Manual Tuning Switch - Tune to intercept signal

ECM EQUIPMENT OPERATIONAL CHECK (Cont)

(e) Passive Override Button - Depress

The green passive override and red radiate lights should illuminate immediately; the jam light should not illuminate. Confirm with the radar operator that the BNS (or FCS) radar is receiving sweep jamming. Have the gunner depress the deactivate switch and check that sweep jamming ceases. The system No. 15 white reset light should illuminate and the radiate light (and the jam light if it is illuminated) should extinguish when the deactivate switch is depressed.

(f) Mode Switch - STBY

(g) Sequential-Track Switch - SEQ

(h) Mode Switch - AUTO

The radiate and jam lights should not be illuminated by the BNS (or FCS) signal.

(i) Passive Override Button - Depress

The green passive override and red radiate lights should illuminate immediately and the jam light should not illuminate. Confirm with the radar operator that the BNS (or FCS) radar is receiving sweep jamming. Have the gunner depress the deactivate switch and check that sweep jamming ceases. The system No. 15 white reset light (and the jam light if it is illuminated) should extinguish when the deactivate switch is depressed.

(j) Mode Switch - STBY

(3) Self-Activation:

(a) Receiver Attenuation Selector - 0 db

(b) Search Width - Minimum

(c) Sweep Width & Rate - Minimum

(d) Mode Switch - MAN

The radiate light should illuminate immediately and the jam light should not illuminate unless an external signal is present. Rotate the center frequency control from the lower limit to the upper limit. If the jam light illuminates and an external signal is not present, record the frequencies where illumination occurred and the db setting required to prevent jam light illumination.

(e) Mode Switch - STBY

(f) Power Switch - OFF

c. AN/ALT-6B:

SPOT

(1) Receiver Tuning Control - Set to predetermined frequency

(2) Transmitter Tuning Control - Set to predetermined frequency

(3) Transmit-Standby Switch - A (transmit)

(4) Meter Switch - MOD CUR, 4.5 to 5.5

(5) Meter Switch - MOD VOLTS, 3.0 to 6.0, return to MOD CUR

(6) Receiver-Transmitter Calibration - Checked

ECM EQUIPMENT OPERATIONAL CHECK (Cont)

SLOW SWEEP

(7) Slow Rate - Adjust to desired sweep rate

(8) Slow Width - Adjust to desired sweep excursion

COMBINATION SWEEP

(9) Fast Rate - Adjust to desired sweep rate

(10) Fast Width - Adjust to desired sweep excursion

FAST SWEEP

(11) Slow Rate, Slow Width - CW to zero, check for fast sweep

(12) Fast Rate, Fast Width - CW to zero

(13) Transmit-Standby Switch - STBY

(14) Power Switch - OFF

d. AN/ALT-13:

(1) Receiver Tuning Control - Set to predetermined frequency

(2) Transmitter Center Frequency Control - Set to predetermined frequency

(3) Power Selector - TRANS

(4) Receiver-Transmitter Calibration - Checked

Check calibration in first quarter, center half, and last quarter of the transmitter frequency range.

(5) RF Bandwidth Control - Adjust for increased sweep excursion, return to minimum

e. QRC-218A-(T) TY:

(1) Power Switch - ON

(2) Master Output Switch - ON

(3) Sweep Frequency Manual-Preset Switch - As desired

(4) Deviation Manual-Preset Switch - As desired

(5) Modulation Control - As desired

(6) Desired Output Switch - ON

(7) ID-226/ID-117 Reception & Presentation - Checked

f. AN/ALT-13:

(1) Power Selector - OFF

CAUTION

To insure proper operation of the cooling cycle of the ALT-13, airplane power must remain on for 5 minutes after placing the ALT-13 power selector in OFF position.

ECM EQUIPMENT OPERATIONAL CHECK (Cont)

3. LOW FREQUENCY RECEIVER-TRANSMITTER SYSTEMS:

a. AN/APR-14:

(1) AN/APR-14 Antenna Switch - LOW

(2) Frequency Band Switch - Low band

(3) Scope Presentation - Optimum settings

(4) IF Attn DB Control - Adjust, 1/4 inch grass

(5) Manual Tuning Control - Tune to intercept signal on LOW band

(6) IF Attn DB Control - Adjust for 1/2 scope deflection

(7) Scope Controls - Optimum settings

(8) Audio Gain Control - Adjust for comfortable noise level

(9) AGC Switch - ON, check operation, OFF

(10) FM-AM Switch - 6.0, check; 0.6, check; FM, check

(11) FM-AM Switch - 6.0

(12) Manual Tuning Control - Set to predetermined frequency

b. AN/ALT-7 (T-464):

(1) Overload Reset Switch - Depress if required

(2) Frequency Control - Set to predetermined frequency

(3) Plate Switch - ON, red light illuminated

(4) Meter Switch - OSC AMPS, peak antenna coupling (16 max)

(5) Meter Switch - LV, checked (16 max)

(6) Meter Switch - HV, checked (12 max)

(7) Meter Switch - FWD PWR, read meter, times 10

(8) Meter Switch - BACK PWR, read meter, times 10

NOTE

Subtract; difference is power radiated. If following minimum conditions do not exist, retuning is necessary: (T-464) CW - 70 watts; MOD - 60 watts.

RETUNE BY:

(9) Meter Switch - OSC AMPS, readjust antenna coupling

(10) Repeat steps (9), (7), and (8) until maximum output is obtained

(11) Meter Switch - OSC AMPS

(12) Receiver-Transmitter Calibration - Checked

(13) Sweep Rate (if required) - Desired rate and off

ECM EQUIPMENT OPERATIONAL CHECK (Cont)

c. AN/ALA-7:

(1) Polarity Switch - Positive

(2) Pulse Delay Control - Adjust for proper window position

(3) Pulse Length Control - Adjust for desired gate width

(4) Slow-Fast Control - Adjust for optimum presentation

(5) Polarity Switch - OFF

d. AN/ALT-7 (T-464):

(1) Plate Switch - OFF

e. AN/APR-14:

(1) AN/APR-14 Antenna Switch - MID

(2) Frequency Band Switch - Midband

(3) Manual Tuning Control - Tune to intercept signal on mid band

(4) Manual Tuning Control - Set to predetermined frequency

f. AN/ALT-7 (T-465):

(1) Overload Reset Switch - Depress if required

(2) Frequency Control - Set to predetermined frequency

(3) Plate Switch - ON, red light illuminated

(4) Meter Switch - OSC AMPS, peak antenna coupling (16 max)

(5) Meter Switch - LV, checked (16 max)

(6) Meter Switch - HV, checked (12 max)

(7) Meter Switch - FWD PWR, read meter, times 10

(8) Meter Switch - BACK PWR, read meter, times 10

NOTE

Subtract; difference is power radiated. If following minimum conditions do not exist, retuning is necessary: (T-465) CW - 100 watts, MOD - slightly less.

RETUNE BY:

(9) Meter Switch - OSC AMPS, readjust antenna coupling

(10) Repeat steps (9), (7), and (8) until maximum output is obtained

(11) Meter Switch - OSC AMPS

(12) Receiver-Transmitter Calibration - Checked

(13) Sweep Rate (if required) - Desired rate and off

ECM EQUIPMENT OPERATIONAL CHECK (Cont)

g. AN/ALA-7:

(1) Polarity Switch - Positive, check for proper window, OFF

(2) Power Switch - OFF

h. AN/ALT-7 (T-464):

(1) Plate Switch - ON, red light illuminated

(2) Antenna Switching System - Checked

NOTE

With both transmitters operating and the receiver tuned off transmitter frequencies, there should be no reception on either the low or mid band of the AN/APR-14.

i. AN/ALT-7 (T-464 and T-465):

(1) Plate Switches - OFF

(2) Power Switches - OFF

j. AN/ALT-16:

(1) APR-14 Band Switch - Desired band

(2) APR-14 Antenna Switch - As applicable

(3) Desired Channel Button - Depressed

(4) Power Selector - TRANSMIT

(5) Selected Channel Excursion Limits - Checked on receiver

(6) Power Monitor Meter - Checked

Check meter for reading of 50 or greater.

(7) VSWR Button - Depressed, meter checked

Check meter for reading of 20% (or less) of reading in item (6).

CAUTION

Do not operate transmitter if meter reading in item (7) is more than 20% of reading in item (6) since damage to the transmitter may result.

NOTE

Repeat steps (3) through (7) for each channel to be checked.

ECM EQUIPMENT OPERATIONAL CHECK (Cont)

(8) Power Selector - OFF

CAUTION

To insure proper operation of the cooling cycle of the ALT-16, airplane power must remain on for 5 minutes after placing the power selector to OFF position.

k. AN/ALT-6B:

SPOT

(1) Receiver Tuning Control - Set to predetermined frequency

(2) Transmitter Tuning Control - Set to predetermined frequency

(3) Transmit-Standby Switch - A (transmit)

(4) Meter Switch - MOD CUR, 4.5 to 5.5

(5) Meter Switch - MOD VOLTS, 3.0 to 6.0, return to MOD CUR

(6) Receiver-Transmitter Calibration - Checked

SLOW SWEEP

(7) Slow Rate - Adjust to desired sweep rate

(8) Slow Width - Adjust to desired sweep excursion

COMBINATION SWEEP

(9) Fast Rate - Adjust to desired sweep rate

(10) Fast Width - Adjust to desired sweep excursion

FAST SWEEP

(11) Slow Rate, Slow Width - CW to zero, check for fast sweep

(12) Fast Rate, Fast Width - CW to zero

(13) Transmit-Standby Switch - STBY

(14) Power Switch - OFF

l. AN/ALT-15:

(1) APR-14 Band Switch - Desired band

(2) APR-14 Antenna Switch - As applicable

(3) Desired Channel Button - Depressed

(4) Power Selector - TRANSMIT

ECM EQUIPMENT OPERATIONAL CHECK (Cont)

(5) Selected Channel Excursion Limits - Checked on receiver

(6) Power Monitor Meter - Checked

Check meter for reading of 50 or greater.

(7) VSWR Button - Depressed, meter checked

Check meter for reading of 20% (or less) of reading in item (6).

CAUTION

Do not operate transmitter if meter reading in item (7) is more than 20% of reading in item (6) since damage to the transmitter may result.

NOTE

Repeat steps (3) through (7) for each channel to be checked.

(8) Power Selector - OFF

4. APR-14/APR-9/APS-54:

(1) Power Switch - OFF

POST- OPERATIONAL CHECK

1. Form 781 Entries - As required
2. UHF Radio - Off
3. Interphone Power Switch - OFF
4. External Power Switch - OFF
5. Battery Switch - OFF

GUNNER'S MD-9 CHECKLIST

MISSION PREPARATION

1. Mission Planning - Completed
   a. Study all intelligence data regarding anticipated fighter attacks.
   b. Review all data on gunnery flimsy and coordinate as necessary to accomplish the mission.
   c. Give the ammunition requirements to copilot for preparation of Form 365 (Form F).

BEFORE EXTERIOR INSPECTION

1. Crew Lineup
   a. Pilot reads Form 781. (Gunner notes pertinent FCS discrepancies.)
   b. Gun Status - Checked

EXTERIOR INSPECTION

1. Turret Jettison Linkage - Checked

   The gunner visually checks for general condition of jettison linkage, that all maintenance safety pins are removed, and loose objects are secured or removed.

2. Ammunition Access Door - Secured

NOTE

The gunner performs a walkaround inspection of the turret, visually checking for general condition.

BEFORE INTERIOR INSPECTION

1. Spare Parachute - Checked and stowed

   Check parachute inspection record for inspection date. Determine from this record the setting of the automatic release mechanism. Check bailout bottle for minimum required pressure. Stow parachute adjacent to the auxiliary oxygen regulator.

2. Equipment - Checked and stowed

   Check equipment for necessary items and condition and stow at crew position.

INTERIOR INSPECTION

NOTE

All [D] flagged items will be accomplished by the gunner on the daily alert preflight.

WARNING

- Damaged or disconnected waveguides and/or coax cables may cause personal injury due to arcing or RF burns. NF
- Exercise extreme care when moving personal equipment or operating the seat backrest and do not use waveguides or coax cables for handhold. NF

GUNNER'S MD-9 CHECKLIST (Cont)

D 1. Auxiliary Oxygen Regulator - OFF and 100%

D 2. ALR-18/ALT-6B Waveguides & Coax Cables NF - Checked

Check the ALR-18 system for exposed portions of waveguides and coax cable for damage and proper connection.

D 3. Jettison Handle - Stowed, No. 1 safety pin installed

Check handle in stowed position and visually check linkage and line connection. Check that safety pin is correctly installed in the inner emergency release handle initiator.

3. and 4. Deleted.

5. Thermal Curtains - Aboard

6. Seat - Checked

CAUTION

- The seat should be in full aft position with respect to the aircraft before extending the seat backrest to recline position. Move seat fore and aft with caution when seat backrest is near the 45° position. These procedures should be followed to prevent possible damage to equipment or cables.
- When moving the seat, avoid catching the parachute arming knob and actuating the parachute arming mechanism.

a. Parachute & Bailout Bottle Preflight - Performed

Perform preflight check on parachute by checking parachute inspection record for inspection. Determine from this record the setting of automatic release mechanism. Check bailout bottle for minimum required pressure and bailout oxygen hose connector for security.

b. Seat Operation - Checked

Fasten safety belt and move seat in azimuth and elevation insuring that the seat locks in the different positions and seat controls operate properly.

c. Integrated Harness Manual Release Handle Operation - Checked

Lock inertia reel and check operation of integrated harness manual release handle by pulling up on the integrated harness release handle. The safety belt and parachute shoulder straps should release from the seat. The integrated harness release handle is spring-loaded and will reposition when released. Reengage shoulder harness and safety belt quick-release fittings. Unlock inertia reel.

d. Survival Kit, Parachute & Safety Belt - Installed

Check safety belt and shoulder harness for condition and proper installation.

e. Parachute Static Line LJ :

(1) Parachute Static Line & Reel Assembly - Checked

Check that parachute static line extends to its full travel and is connected to the reel assembly. Insure that parachute static line, when released, returns to stow.

(2) Parachute Static Line to Lanyard - Connected

f. Zero Delay Lanyard LJ - Hooked to ripcord T-handle

GUNNER'S MD-9 CHECKLIST (Cont)

7. Gunner's Circuit Breaker Panel - Set

   All circuit breakers in unless otherwise directed.

8. Interphone - Connected and set

   a. Volume Control - As desired

   b. Selector Switch - INTER

   c. Auxiliary Listen Switch - NORMAL

   d. Interphone Mixer Switches - As desired

NOTE

The pilot actuates the emergency alarm switch to ALERT to check the alarm system on emergency battery power. At this time, the gunner immediately connects his interphone to be ready for crew report.

9. Oxygen System - Checked

   a. Shutoff Lever - ON

      Pressure gage reads approximately 300 psi.

   b. Regulator Diluter Lever - 100% OXYGEN

   c. Emergency Toggle Lever - EMERGENCY

      Flow indicator should indicate a continuous flow. Block regulator hose with hand; indicator should indicate no flow.

   d. Emergency Toggle Lever - NORMAL

   e. Mask & Hose - Connect and test

      Check for 10- to 20-pound pull for disconnect.

   f. Mask - Test

      (1) Emergency Toggle Lever - TEST MASK

      Hold breath; indicator should indicate no flow.

NOTE

Flow condition may be indicated by a slight leak around the face form. If light hand pressure against the mask does not stop the flow, the mask is unacceptable.

      (2) Emergency Toggle Lever - NORMAL

   g. Regulator Diluter Lever - NORMAL OXYGEN

GUNNER'S MD-9 CHECKLIST (Cont)

[D] 10. Crew Report - Completed

NOTE

If pilot has not called for crew report by the time the gunner reaches this point in the checklist, the gunner should continue with his compartment checks while awaiting the call from the pilot.

a. Pilot actuates the emergency alarm switch to ABANDON, switches interphone to CALL, and announces "Crew report."

b. Gunner switches the interphone to CALL and reports "Station check complete."

Station check consists of seat, oxygen, alarm lights/abandon signal, call light, interphone, and zero delay lanyard (if applicable) checked.

11. Radar Control Panel Switches - Set

a. Search Emergency Off Switch - ON (up)

b. Track Emergency Off Switch - ON (up)

c. Auxiliary Standby Switch - OFF (down)

d. Search Auxiliary Operate Switch - OFF (down)

e. Search Antenna Auxiliary On Switch - OFF (down)

f. Track Range Marker Switch - OFF (down)

g. Track Auxiliary Operate Switch - OFF (down)

12. FEO/FEA Selector Unit - Checked

a. FEO/FEA Selector Switch - OFF

[D] 13. FCS Control Panel - Checked

a. FCS Power Switch - OFF

b. Search Radar Switch - OFF (down)

c. Emergency Search Switch - OFF (down)

d. Emergency Switch - OFF (down)

e. Fire Safety Switch - SAFE (down) and pinned

f. Spare Fuses (B panel) - Checked/installed

14. Radar Indicator Panel - Checked

a. B and C Scope Intensity Controls - CCW

b. Cursor Intensity Control [MT] - CCW

GUNNER'S MD-9 CHECKLIST (Cont)

15. Control Column & Handle Switches for Normal Operation - Set

    a. Track Select Switch - RADAR

    b. Course Switch - PURSUIT

    c. Range Select Switch - RADAR

16. Hemispheric Sight - Checked

    a. Spare Reticle Lamps - Checked

    b. Hemispheric Sight Cover & Handle - Checked

    Operate handle to OPEN and CLOSED position and observe movement of cover; leave in the OPEN position.

D 17. Gun Charger Air Pressure Gage - Checked (800 (±100) psi)

18. Air Conditioning Panel - Checked

    a. Master Switch - OFF

    b. Master Switch Lock Spring Exerts Positive Pressure - Checked

    c. Air Bleed Selector Switch - NORMAL

    d. Cabin Temperature Selector Switch - MANUAL

    e. Window Defog Switch - As desired

    f. Cabin Pressure Release Switch - RESET and safety wired

D 19. Light Check - Completed

Check all press-to-test lamps, signal lamp, signal lamp filters, dome, ammunition counters, instrument panel, entrance light, and trouble light for proper operation. The auxiliary standby switch must be ON to check search and track low pressure warning lights.

20. Search & Track Low Pressure Warning Lights Adjustable Lens Control - Checked open

21. Hemispheric Sight Desiccator Switch - TEST, then NORMAL

To check desiccator pump operation, momentarily position hemispheric sight desiccator switch to TEST.

22. Aft Equipment Compartment Inspection - Completed

NOTE

The gunner performs a walkthrough inspection of the aft equipment compartment checking for general condition, loose or foreign objects, and/or leakage of any units.

23. Emergency Cabin Pressure Dump Handle - Checked

Check handle in CLOSED position.

24. Bulkhead Door - Closed

GUNNER'S MD-9 CHECKLIST (Cont)

BEFORE ENGINE START

1. Jettison Handle - Stowed, No. 1 safety pin removed
2. Turret Drag Chute Interconnect Control Knob - Check NORMAL (down)
3. Maintenance Safety Pin No. 3 (thruster initiator) - Checked, removed

AFTER ENGINE START

WARNING

Whenever contamination is suspected, 100% oxygen will be used for ground operation and takeoff.

1. Air Conditioning Master Switch - 7.45 PSI
2. Cabin Temperature Selector Switch - As desired
3. Window Defog Switch - ON
4. Stand by to Taxi - Report

   Pilot announces "Crew, stand by to taxi"; gunner reports "Gunner ready/not ready for taxi."
5. FCS Power Switch - WARMUP (after alternators are on the line)
6. FCS Normal Operation - Position switches for normal operation

CAUTION

In no case will the turret be operated on the ground, during takeoff, or until gyros have timed out.

a. Search Radar Switch - ON (up)

   Check that turret is stowed by depressing second target button and observing position of dot cursor.

b. B & C Scope - Adjusted

   Adjust focus, intensity, and overlay intensity as desired.

c. FCS Power Switch - ON

d. Range Sweep Switch & C-Gate Length Control - Checked

   (1) C-Gate at 4000 yards (on line 4) & Range Switch at "10" - Set

   (2) Range Sweep Switch at "5" - Set

   C-Gate marker moves on scope to the equivalent of 4000 yards in range (on line 8).

GUNNER'S MD-9 CHECKLIST (Cont)

(3) Range Sweep Switch at "20" - Set

C-Gate marker moves on scope to the equivalent of 4000 yards in range (on line 2).

(4) Range Sweep Switch - As desired

(5) C-Gate Marker at 7500 Yards - Set

BEFORE TAKEOFF

1. Parachute & Survival Kit - As required

The survival kit will be fastened to the parachute when, in the gunner's estimation, survival after bailout under climatic and terrain conditions being overflown depends on retention of the kit.

WARNING

- Care must be taken to assure that survival kit attachment straps are not entangled in the safety belt. Always fasten the survival kit to the parachute before fastening the safety belt.
- Tighten the parachute-survival kit attachment straps as tightly as possible to prevent the safety belt from inflicting facial injuries during bailout.

2. Safety Belt & Shoulder Harness - Fastened

WARNING

A tight harness is necessary to avoid injury during impact deceleration.

NOTE

If the gunner must leave his seat during flight when utilizing the integrated harness, he should open the safety belt and unfasten the parachute, leaving the parachute in the seat. If a parachute is desired, the spare parachute should be utilized.

a. Parachute Static Line and Zero Delay Lanyard - Checked

Check zero delay lanyard hooked to the parachute ripcord T-handle (no report required).

3. Bailout Bottle - Connected

4. Tip Gear - Monitor and report

Monitor and report clearance, obstructions, and movement.

GUNNER'S MD-9 CHECKLIST (Cont)

5. Ready for Takeoff - Report

   a. Check flaps down, airbrakes down, and tip gear struts outboard (report only if abnormal).

   b. Gunner reports "Ready for takeoff."

6. Air Conditioning Master Switch - RAM (if water injection is to be used)

7. Engine Check - Accomplished

   Gunner visually checks wings, flaps, and engines after full power is applied and reports any abnormal conditions.

TAKEOFF

NOTE

During takeoff roll and acceleration phase, gunner monitors wing flaps, tip gear, and engines for abnormal operation whenever possible.

AFTER TAKEOFF

1. Tip Gear - Report (if abnormal)

2. Air Conditioning Master Switch - Checked 7.45 PSI

3. Zero Delay Lanyard [illegible] - Stowed

   Disconnect and stow zero delay lanyard when copilot announces during climb.

4. Survival Kit Attached - As required

   The survival kit will be fastened to the parachute when, in the gunner's estimation, survival after bailout under the climatic and terrain conditions being overflown depends on retention of the kit.

GUNNER'S MD-9 CHECKLIST (Cont)

5. Oxygen Check - Completed (CP-G)

NOTE

On extended flights (flights in excess of 17 hours duration), the gunner may be relieved of crew duties for periods of crew rest by the copilot. Before the gunner is relieved from crew duties, the copilot will request a cabin pressure and oxygen check and ascertain that the gunner is on interphone and oxygen. During the period of the gunner's crew rest, the copilot will monitor the gunner's remote cabin altimeter and the tail compartment low pressure warning light at intervals not to exceed 15 minutes. Close crew coordination between the pilot and copilot is mandatory to insure frequent monitoring.

a. During the climb, copilot requests an oxygen and zero delay lanyard check at 12,000 feet. The sequence for oxygen report is the same as for crew report. Oxygen panels will be checked for:

(1) Oxygen Supply Shutoff Lever - ON

(2) Regulator Diluter Lever - NORMAL OXYGEN

(3) Pressure - 300 psi

(4) Flow Indicator - Functions normally

(5) Emergency Toggle Lever - NORMAL

b. Gunner and copilot report, "Cabin altitude _____ feet. Oxygen panel checked."

c. Navigator, EW officer, radar navigator, and pilot report, "Oxygen panel checked." Pilot reports oxygen quantities.

d. Under steps "b" and "c," the gunner, copilot, EW officer, and pilot will report "Zero delay lanyard stowed."

e. Copilot, notify aircrew and receive gunner's acknowledgment when passing through 26,000 and 35,000 feet.

f. The copilot will initiate an oxygen check at level-off. During cruise, the copilot will monitor the gunner's remote cabin altimeter and the tail compartment low pressure warning light at intervals not to exceed 15 minutes and initiate the oxygen checks at 30-minute intervals when both cabin altitudes are below 12,000 feet, at 15-minute intervals when either cabin altitude is 12,000 to 25,000 feet, and at no longer than 10-minute intervals when either cabin altitude is above 25,000 feet. If cabin altitude is below 12,000 feet, only the gunner and copilot/pilot will report. The remaining crew members will check their equipment and report if abnormal. At level-off, only the gunner and copilot/pilot need report if cabin pressure is 12,000 feet or below. Oxygen checks are not required below 10,000 feet MSL.

GUNNER'S MD-9 CHECKLIST (Cont)

EWO/AIRBORNE ALERT LAUNCH AMMO CHAMBERING PROCEDURES

NOTE

This procedure will be used only on EWO/airborne alert launches when chambering can be accomplished over uninhabited areas. Under no circumstances will this procedure be used for routine training missions.

WARNING

In the event of a runaway gun, the operator will actuate the emergency switch (emergency mode switch, "B" panel) to ON to gain positional control and point guns into an uninhabited area.

1. Ammunition Chambered - Completed

   a. Fire Safety Switch - SAFE and pinned

   b. Aft Area Clear and Not Over Populated Area - Checked

      Check with radar navigator that aft area is clear.

   c. Gun Charger Switch - Actuated (one operation only)

IN FLIGHT

WARNING

NF

The ALR-18 system will be on during climbout and will remain on for the entire flight. If, during flight, it is observed that the waveguides or coax cable of the ALR-18 system in the gunner's area become disconnected, the gunner will immediately depress the system No. 15 deactivate foot switch and immediately notify the EW officer to shut down the ECM system No. 15.

GUNNER'S MD-9 CHECKLIST (Cont)

NOTE

The gunner makes frequent visual check of wings and control surfaces and engines and reports any abnormal condition.

1. Airplane Clearance - Check and report
   a. Maintain careful watch for other airplanes during flight.
   b. Report position and direction of movement of other airplanes in immediate vicinity.
   c. Verbally clear pilot for turns in congested flying areas.
2. Oxygen Checks - Completed

   Check and report in accordance with procedure outlined under "After Takeoff."
3. Search Radar Scope - Monitored for tanker position
4. Air Refueling Check - Accomplished
   a. FCS Switches - Positioned (when observation position reached)
      (1) FCS Power Switch - WARMUP
      (2) Search Radar Switch - OFF
   b. Air Conditioning Master Switch - 7.45 PSI
   c. Fuel Spillage - Report
5. Gunnery Equipment Operation - Accomplished
   a. Crew Notified Prior to Operating FCS - Accomplished

WARNING

When performing operational checks on training missions with ammo loaded, the fire safety switch must be in SAFE and pinned, chargers released (BATTERY position), and trigger(s) not pressed except over designated firing areas.

CAUTION

- Do not operate system over 50,000 feet as arcing of components can occur at high altitudes.
- To prevent compressor failure due to low air volume available at high cabin altitudes, pull the compressor three-phase and heater circuit breakers when the aft cabin altitude is at or above 35,000 feet.
- If the search low pressure warning light comes on, position the search radar switch in OFF and operate in emergency search. If the track low pressure warning light comes on, position the track emergency off switch OFF (down).
- The FCS may be operated below 6000 feet pressure altitude if either or both low pressure warning lights are on.
- Any time the radar indicator is not being monitored by the gunner, the search radar switch will be positioned to OFF. This will prevent damage to the FCS in the event of search low pressure.

GUNNER'S MD-9 CHECKLIST (Cont)

b. Fire Control System - Normal Operation

CAUTION

Illumination of the gyros ready light is the only indication that the gyros have timed out. If the gyros ready light does not indicate that the gyros have timed out, do not attempt operation of the system in any track mode.

(1) Sight - Adjusted

(a) Reticle Intensity - Set (set as desired for illumination of reticle, range card, and wing span card)

(b) Range Ring Alignment - Checked

Check for centering over crosshairs and adjust if necessary.

(c) Wingspan Card - Checked and set (43 feet or as briefed)

(d) Dioptic Control - Set

Set focus and sun filter as required.

c. Search:

(1) Action Switches - Depressed

(a) Check for C scope cursor presentation.

GUNNER'S MD-9 CHECKLIST (Cont)

(b) Line of Sight Servo Control (Rate) - Checked

1 Check circle cursor, optics, and line of sight pointer.

(2) Action Switches - Released

Check that line of sight servos stow.

d. Acquisition:

(1) Action Switches - Depressed

(2) Track Button - LIGHT PRESS (RG 7500)

(3) Track Button - HARD PRESS (RG 2500)

(4) Line of Sight & Turret Control - Checked

(a) Turret Control - Checked

Check that dot cursor appears at center of circle cursor with line of sight at center and that the dot and circle maintain nominal prediction angle as the line of sight angle is increased and decreased. Check that circle cursor continues to travel when the turret stops at a limit and that the turret moves off the limit when the nominal prediction angle is reestablished.

NOTE

Turret position may be checked by depressing second target button and observing dot cursor.

(b) Track Button & Action Switches - Released

System stows.

(5) Track Range Marker Switch - ON

(a) Action Switches - Depressed

(b) Track Button - LIGHT PRESS

1 Range Gate Sweeps (locks on 500-yard marker) - Accomplished

e. Radar Track:

(1) Track Button - Released

(a) Control Handles (no control) - Checked

(b) Range Dial in Optics (1500 feet) - Checked

(c) Ready to Fire Light On - Checked

GUNNER'S MD-9 CHECKLIST (Cont)

(2) Ranging Check - Accomplished

(a) Rotate Thumbwheels - Out

1 Range gate should unlock from 500-yard marker and relock on the 2000-yard marker.

2 Ready to Fire Light Out - Checked

3 Range Dial in Optics (6000 feet) - Checked

(b) Rotate Thumbwheels - In

1 Range gate should unlock from 2000-yard marker and jump in approximately 1500 yards and lock on.

f. Second Target:

(1) Action Switches - Depressed

(2) Second Target Button - Depressed

(a) Dot Cursor (appears) - Checked

(b) Line of Sight Servo Control (Rate) - Checked

Circle cursor, optics and line of sight pointer now under control of control handles.

(3) Track Button - Depressed

(a) Dot Cursor & Range Gate - Checked

Dot cursor moves toward circle cursor.

(b) Second Target Button - Released

(c) Track Button & Action Switches - Released

(d) Turret Stow Button - Depressed

g. Emergency Search:

This sequence of operation utilizes the track radar for searching, acquiring, tracking, and ranging.

(1) Emergency Search Switch - ON

(a) Track Radar Light (A panel) - On

(b) Indicator Presentation - Checked

1 B Scope Presentation - Checked

2 C Scope Presentation - Checked

GUNNER'S MD-9 CHECKLIST (Cont)

(2) Emergency Search Search:

(a) Action Switches - Depressed

1 Line of Sight Servo Control (Rate) - Checked

Check optics and line of sight pointer.

(3) Emergency Search Synchronization:

(a) Track Button - LIGHT PRESS

1 Turret Control (Rate) - Checked

2 Radar Indicator Presentation (Rate) - Checked

(4) Emergency Search Acquisition:

(a) Track Button - HARD PRESS

1 Indicator Presentation - Checked

Indicator display stops programming and moves toward line of sight position in azimuth and elevation.

2 Range Gate Sweep - Checked

Check range gate sweeps and locks on 500-yard marker. System is now in normal radar track mode.

(b) Track Button & Action Switches - Released

(c) Emergency Search Switch - OFF

(d) Stow Button - Depressed

System should go to stow position.

h. Manual Track-Radar Range (using cursor):

(1) Track Select Switch - MANUAL

(a) Action Switches - Depressed

1 Track target with circle cursor or optics. Optics and cursor in rate control.

(b) Track Button - Depressed

1 Range gate locks on range marker.

2 Range Dial - Checked (1500 feet)

3 "On Target" light and ready to fire light on.

(c) Track Button - Released

1 Acceleration Control of Turret, Optics & Cursor - Checked

GUNNER'S MD-9 CHECKLIST (Cont)

(d) Action Switches - Released

(e) Track Range Marker - OFF

(f) Turret Stow Button - Depressed

1 Turret, Circle Cursor, Optics & Range Servo - Stowed

i. Manual Track-Manual Range:

(1) Range Select Switch - MANUAL

(2) Action Switches - Depressed

(3) Track Button - Depressed and released

(a) Control of System (acceleration) - Checked

Check acceleration control of system by use of control handles.

(b) Range Reticle Control - Checked

1 Rotate Thumbwheels - In

Check range reticle increases in size.

2 Rotate Thumbwheels - Out

Check range reticle decreases in size.

(4) Action Switches - Released

(5) Stow Button - Depressed

Turret and line of sight servos stowed.

NOTE

The emergency mode may be used any time rate control of the system is lost.

j. Emergency Mode:

(1) FCS Power Switch - WARMUP or ON

(2) Emergency Switch - ON

(3) Emergency Mode Light (A panel) - On

(4) Turret Control (positional) - Checked

k. Set FCS for Normal Operation - Accomplished

6. Fighter Intercept Safety Procedures - Accomplished

NOTE

Whenever scheduled fighter intercepts are to be performed, the gunner will comply with the following procedures prior to the first attack by the interceptor.

a. Fire Safety Switch - SAFE and pinned

GUNNER'S MD-9 CHECKLIST (Cont)

b. Gun Charger Switch - RELEASE

c. Ammo Booster Circuit Breakers - Pulled

d. Do not depress trigger(s).

e. UHF Mixer Switches - On (up)

f. Safety Check Accomplished - Navigator notified

7. Burst Control, Cooling & Safety Procedures:

a. Ammo Chambered - Accomplished

Upon entering the firing area, place charge release switch to CHARGE and then RELEASE to chamber ammo.

b. Commence Firing - On pilot's command

(1) Fire Safety Switch - READY

(2) Depress action switches and trigger switches. Use a 3-second burst (maximum) and a 45-second cooling period (minimum).

c. Fire Safety Switch - SAFE and pinned

Before leaving firing area, place fire safety switch to SAFE, insert pin, and depress triggers (guns should not fire).

d. Notify pilot when firing and safety check completed.

8. FEO Operation - As required

a. FEO Selector Switch - WARMUP

FEO selector switch should be placed in WARMUP for a minimum of 5 minutes.

b. FCS Switches - Set (as desired)

FCS should be set up for operation with FEO as required; i. e., normal radar/radar, emergency search, manual track/radar range, manual track/manual range.

c. FEO Selector Switch - PHANTOM TARGET (as applicable)

The FEO programmer will generate a test pattern prior to the starting of the phantom target problems. Each set of phantom target cams contains a set of rectangular test patterns which are incorporated for maintenance purposes and gunner check of scope calibrations.

(1) Search, Acquisition & Track - Accomplished

Sixteen phantom target problems of either one or two targets each will be presented. The gunner will take necessary action to cause the FCS to search, acquire, and track targets during each problem. Triggers will be depressed at the appropriate time during each problem, even though the fire safety switch is in SAFE.

GUNNER'S MD-9 CHECKLIST (Cont)

d. FEO Selector Switch - REAL TARGET (as applicable)

With the FEO selector switch placed in REAL TARGET position, the FEO is ready to record gunner actions when operating the FCS against actual targets.

(1) Search, Acquisition & Track - Accomplished

The "real target" mode of operation will record gunner actions in all modes of system operations. When operating in manual track/manual range, the track auxiliary operate switch must be ON to provide target reference.

e. FEO Selector Switch - OFF

The FEO selector switch will be placed in OFF after completion of FEO operation.

9. FEA Operation - As briefed

NOTE

Do not depress second target button during FEA operation as turret will not follow programmed signals. To check turret position, monitor the circle cursor.

a. FEA Selector Switch - WARMUP

The FEA selector switch should be placed in WARMUP for a minimum of 5 minutes.

b. Track & Range Select Switches - RADAR

c. Fire Safety Switch - READY

WARNING

Do not proceed with test or place fire safety switch in READY until over firing area and clearance has been obtained from pilot.

d. FEA Selector Switch - 0, 0

Rotate the course-off-calibrate switch to the position marked "0, 0."

e. Acquisition Mode - Entered

Depress the action switches and track button to HARD PRESS position. When the range gate stops sweeping and locks at a range of approximately 400 yards, release the action switches and track button.

f. Start Program Button - Depressed

Hold the start program button on the FEA selector unit depressed for 2 seconds, then release. The "Program On" lamp should illuminate.

g. Firing Circuits - Activated

(1) Action & Trigger Switches - Depressed

The action switches should be depressed immediately after releasing the start program button and held until "Program On" light goes out. The guns will fire a 1.3-second burst 21 seconds after program begins.

GUNNER'S MD-9 CHECKLIST (Cont)

h. Repeat steps "f" and "g" for the FEA selector switch positions of +AZ, -AZ, +EL, and -EL.

NOTE

Leave FEA selector switch in -EL position and rerun -EL to prevent the turret from driving into an elevation limit when proceeding with course runs.

i. Fire Safety Switch (if applicable) - SAFE and pinned

j. FEA Selector Switch - UL

Rotate the selector switch to UL position in the COURSE section of the switch.

k. Start Program Button - Depressed and released

Hold the start program button depressed for 2 seconds, then release. Observe that the "Program On" lamp lights and remains lit for the period of the test timing cycle (approximately 26 seconds).

l. Start Program Button - Depressed

It is not necessary to physically move the FEA course selector switch during this check.

m. Repeat steps "k" and "l" at the selector switch positions of LL, UR, and LR.

n. FEA Selector Switch - OFF

The FEA may be returned to OFF or WARMUP between any program cycle.

o. Turret Stow Button - Actuated

Depress and release stow button after completion of FEA operation.

BEFORE DESCENT/LANDING

1. Survival Kit Attached - As required

The survival kit will be fastened to the parachute when, in the gunner's estimation, survival after bailout under the climatic and terrain conditions being overflown depends on retention of the kit.

2. Loose Equipment - Stowed

3. FCS Power Switch - WARMUP

4. Turret - Stowed

The gunner will notify the pilot in the event the turret is in a lower limit and cannot be stowed.

5. Shoulder Harness & Safety Belt - Fastened

6. Zero Delay Lanyard [9] - Hook (on copilot's command)

NOTE

Gunner monitors wing flaps, tip gear, and engines for abnormal operation whenever possible. During touch-and-go landings, gunner checks tip gear after each landing; however, he will not make a verbal report unless gear appears to be abnormal.

7. Tip Gear Position (if abnormal) - Report

GUNNER'S MD-9 CHECKLIST (Cont)

AFTER LANDING

1. Drag Chute - Check and report

   a. Report when drag chute is deployed. If drag chute does not deploy within a few seconds after door opens, gunner advises pilot.

   b. Advise pilot when additional air is needed to prevent chute deflation or dragging on runway at end of landing roll.

   c. Carefully monitor drag chute position in relation to horizontal stabilizer at all times and immediately advise pilot to jettison chute if danger of fouling exists.

   d. Report if clear to jettison when intended jettison area is reached.

   e. Report when drag chute falls free of airplane.

2. Strange Field Safety Procedures - Accomplished (if applicable)

   If ammunition is aboard or has been fired on the mission, the Strange Field Safety Procedures checklist will be accomplished before turning FCS off.

3. Fire Control System - OFF

NOTE

For bases where facilities preclude a safe gun disarming area, the commander may select an area where turrets can be elevated by the gunner after landing. This area must be located so as to prevent possible injury to personnel or damage to property if inadvertent firing should occur.

4. Wings & Tip Gear - Report

5. Air Conditioning Panel Control - OFF

6. Parachute Static Line [U] - Disconnected

AFTER PARKING

1. Jettison Handle - Stowed, No. 1 safety pin installed

   Check handle in stowed position and safety pin installed in inner emergency release handle initiator.

2. Interior Inspection - Completed

   a. Check compartment for cleanliness.

   b. Interphone Cord & Signal Light - Stowed

3. Oxygen System - OFF and 100%

   a. Bleed down system.

   b. Supply Hose - Disconnect and clip to stowage tape

4. "Hot Guns" Sign - As required

   Install "Hot Guns" sign on FCS control panel.

5. Lighting Panel Controls - OFF

6. Exterior Inspection - Completed

   Visually check turret for loose or missing cowling and general condition.

GUNNER'S MD-9 CHECKLIST (Cont)

7. Forms - Completed

   a. FCS Log - Completed

   b. Form 781 - Completed (if applicable)

8. Crew Debriefing

STRANGE FIELD SAFETY PROCEDURES

If the guns have been armed prior to flight or fired on the flight and it is necessary to land the aircraft at an airfield where normal ground support is not available, there are several items which must be accomplished by the gunner after parking the aircraft and/or prior to takeoff.

Postflight

1. Turret Stowed - Full up

   a. FCS Power Switch - WARMUP

   b. Emergency Mode Switch - ON

   c. Control Handles - Full up

      Depress second target button to check that turret is stowed up by observing position of the dot cursor.

   d. FCS Power Switch - OFF

      Hold control handles up for approximately 30 seconds to insure that turret remains elevated.

2. All FCS Switches - OFF/SAFE and pinned

3. Gunner's Circuit Breaker Panel - Checked

   a. D-C Circuit Breakers (2) - Pulled

   b. Compressor Heater Circuit Breaker - Pulled

   c. Ammo Booster Circuit Breakers - Pulled

4. FCS Control Panel Fuses (4) - Removed and stowed (B panel)

   Stow fuses in safety pin stowage container adjacent to signal lamp.

5. Forms - Completed

   a. FCS Log - Completed

   b. Form 781 (if applicable) - Completed

      A statement will be entered in Part II of Form 781 that guns are armed.

6. Crew Debriefing - Completed

Preflight

Gunner will use the normal preflight checklist.

RADAR SCOPE ANNOTATION CHARTS

Radar scope annotation charts pertaining to the MD-9 gunnery system are contained in the T.O. 1B-52E-1CL-5 abbreviated flight crew checklist.

GUNNER'S STRANGE FIELD DISARMING PROCEDURES

When an aircraft lands with hot guns (rounds in the chambers), the guns will be disarmed as soon as practical, all other operational safety factors considered; e. g., weather, proper equipment, ample light, qualified personnel, etc. Until such time as guns are disarmed, turret will be stowed with guns up, FCS electrical circuits disabled, and the aircraft positioned so that guns point toward an uninhabited area.

NOTE

Gunner will supervise the following disarming procedure performed by the disarming team. In the event no team is present, he will accomplish disarming with the aid of another crew member.

WARNING

During the entire disarming procedure, use extreme caution to insure ammunition is handled in a safe manner and the guns are pointed in an area that assures maximum safety to personnel and property.

1. FCS Switches - OFF/SAFE and pinned
   a. Gun Charger Air Pressure Gage - Checked (200 psi minimum)
2. Gunner's Circuit Breaker Panel - Checked
   a. D-C Circuit Breakers (2) - Pulled
   b. Compressor Heater Circuit Breaker - Pulled
   c. Ammo Booster Circuit Breakers - Pulled
3. FCS Control Panel Fuses (4) (B panel) - Removed and stowed
4. Turret Cowling - Removed

NOTE

There is a turret interlock switch and one or two gun heater switch(es) located on each side arm. The turret interlock (three-position) switch is located on the left side arm. The gun heater switch(es) are located on the right side arm. The switch on the left side arm controls a-c power to the hydraulic system. The top switch on the right side arm controls d-c power to the two upper gun heaters and the lower switch controls d-c power to the two lower gun heaters. If there is only one gun heater switch, this switch controls d-c power to all four gun heaters. With the turret side panels on, the switches are held in, allowing power to be supplied to the gun heaters and the hydraulic system. By removing the turret side panels, the switches will spring to the intermediate position, preventing power from being supplied to the hydraulic system and gun heaters. When the interlock and gun heater switches are pulled to out position, power is supplied to the gun heaters and hydraulic systems.

   a. Remove left side panel and check that turret interlock and gun heater switches are in intermediate position. Unfasten upper and lower cowling fasteners.
   b. Remove right side panel and check that turret interlock and gun heater switches are in intermediate position. Unfasten remaining fasteners on upper and lower cowling and remove.
5. Ammunition Chutes - Disconnected
   a. Disconnect ammunition chutes from ammunition boosters and break belts at boosters.
   b. Position double link of each belt out through the side of the flexible chute and attach the single round.

GUNNER'S STRANGE FIELD DISARMING PROCEDURES (Cont)

6. Bolts Position - Checked

WARNING

If any gun bolt is not in battery position, do not proceed with "Strange Field Disarming Procedures" but reconnect ammo chutes. Replace turret cowling and reaccomplish "Strange Field Safety Procedures."

a. Visually check that upper gun bolts are in battery position by looking through the side of the receiver.

b. Visually check that lower gun bolts are in battery position by looking up through the bottom of the receiver.

7. Gun Covers - Raised

8. Link Chutes - Removed

9. Ammunition Boosters - Removed (if applicable)

10. Feedways - Cleared

a. Remove ammunition by pulling belt toward direction of feed.

11. Gun Covers - Closed

12. Gun Chambers Cleared - Accomplished

a. Gun Charger Control Valve Less ST Less UJ - Actuated

Actuate the gun charger control valve at the turret to manually clear the guns.

b. External Gun Charger Switch Chamber Clearing Procedure UJ - Accomplished

(1) FCS D-C Circuit Breaker - Set

Either d-c circuit breaker on the gunner's circuit breaker panel for the control column must be set prior to external gun charger switch actuation.

(2) External Gun Charger Switch - Actuated

Actuate the gun charger switch to clear the guns.

c. Gun Chambers Cleared with FCS Power On ST Less UJ - Accomplished

NOTE

Aircraft having gun charger control valves modified in accordance with T.O. 11W1-21-7-501 will require FCS power to clear the gun chambers. Chambers will be cleared from the gunner's position by use of the gun charger switch located on the FCS control panel.

GUNNER'S STRANGE FIELD DISARMING PROCEDURES (Cont)

WARNING

Interphone contact will be maintained at all times between the gunner at the gunner's station and the assisting crew member(s). The assisting crew member(s) will be outside the aircraft on interphone assuring that stands are clear of the turret and that the turret is pointed to a clear area. This will be accomplished prior to the gunner, at the gunner's station, positioning the FCS power switch to WARMUP and actuating the gun charger switch.

(1) Fire Safety Switch - SAFE and pinned

(2) Gunner's Circuit Breaker(s) - Set

(3) FCS Control Panel Fuse (B panel) - Installed

WARNING

If the turret drifts to a limit or oscillates when FCS power is applied and the hydraulic interlock switch is in the intermediate position, "Strange Field Disarming Procedures" will be discontinued. The gunner will turn OFF the fire control system, recowl the turret, and accomplish "Strange Field Safety Procedures." No further attempt will be made to disarm the guns until the aircraft is returned to a facility where qualified personnel can correct the malfunction.

(4) FCS Power Switch - WARMUP

(5) Gun Charger Switch - Actuated

(6) FCS Power Switch - OFF

(7) Gunner's Circuit Breaker(s) - Pulled

(8) FCS Control Panel Fuses (B panel) - Removed

13. Bolts Position - Checked

WARNING

If any gun bolt is not in battery position, do not proceed with "Strange Field Disarming Procedures" but reconnect ammo chutes. Replace turret cowling and reaccomplish "Strange Field Safety Procedures."

GUNNER'S STRANGE FIELD DISARMING PROCEDURES (Cont)

NOTE

Repeat steps "6," "6a," "6b," "11," and "12c(1)" through "12c(8)" if gun chambers are not cleared upon completion of steps "14," "14a," and "14b."

14. Gun Covers - Raised
    a. Visually check upper gun bolts "T" slots are clear.
    b. Visually check lower gun bolts "T" slots are clear by looking up through the bottom of the receiver.
15. Link Chutes - Replaced
16. Ammunition Boosters - Replaced (if applicable)
17. Gun Covers - Closed
18. Ammunition Chutes - Reconnected
19. Ammunition - Secured
    a. Position double link of each belt out through the side of the flexible chute and attach the remaining rounds (this precludes the possibility of ammunition feeding into the boosters).
    b. Safety wire loose end of ammunition belt to ammunition chutes.
20. Turret Cowling - Replaced
21. Forms - Completed
    a. FCS Log - Completed
    b. Form 781 (if applicable) - Completed

    A statement will be entered in Part II of Form 781 that guns are cold.
22. Crew Debriefing - Completed

GROUND CREW CHECKLIST

1. When the aircraft is moved into the alert line, the ground crew accomplishes the "Alert Line Preparation Checklist."

2. After the alert aircrew has "cocked" the aircraft, the ground crew will install "cocked" sign and clean up alert parking area.

WARNING

Entrance to or into the fuselage or bomb bay area of a "cocked" configured aircraft will be in accordance with command directives.

3. When the execution order to scramble is given, the ground crew removes all plugs and covers and accomplishes the applicable ground crew scramble checklist without delay.

NOTE

To accomplish either ground crew scramble checklist, two ground crew members will be required.

4. When practice alerts are terminated, the alert line preparation checklist will be completed in conjunction with the flight crew recocking the aircraft.

ALERT LINE PREPARATION

1. Position aircraft in designated parking position.

2. Position wheel chocks. (Install one chock in front of each forward gear and one chock behind each aft gear.)

3. Install static ground wire (forward).

4. Position AGE.

   a. General. Position AGE in a location that will permit the aircraft to safely taxi over units following engine start. If MA-1A unit is used, position with MD-3.

   b. When AGM-28's are installed, position MD-3 and MA-1A between inboard and outboard engine pods. Use 60-foot cable for MD-3. Use extra length of MA-1A air hose when using MA-1A.

5. Check AGE fuel and oil service.

6. Position fire extinguishers. (One 50-pound CO_2 or one 10-gallon (CB) unit at each wing tip.)

7. Connect interphone ground cord and place in AGE unit.

8. Cold Weather Operation: Position ground heaters, as required, to preheat the MD-3, MA-1A, and crew compartment. A three-way air duct outlet will be used.

9. Position stands as required.

10. Install nose and tail covers (climatic, or as desired).

11. Install chaff dispenser plugs or covers (as required).

12. Install pitot covers (climatic).

13. Install ram air inlet plugs (climatic, or as required).

14. Install engine inlet and tailcone plugs (climatic).

15. Windows & Hatches - Climatic (normally open unless inclement weather prohibits)

GROUND CREW CHECKLIST (Cont)

16. Remove and secure all unnecessary stands and equipment.

17. After aircraft is cocked, place "cocked" sign on entrance hatch. (If hatch is to remain closed, place "cocked" sign in cockpit facing pilots' window.)

GROUND CREW SCRAMBLE WITHOUT AGM-28 PNEUMATIC START

This checklist will be accomplished by the ground crew when the order to scramble is given when AGM-28's, if aboard, are not to be ground started pneumatically. However, this checklist is applicable for AGM-28B cartridge starts.

WARNING

- If a missile cartridge start is accomplished, man 1 should not disconnect aircraft external air until missile engines are at idle. The missile engine cartridge starter exhaust is 1400° F. Therefore, remain clear of an area within a radius of 6 feed around the missile cartridge starter exhaust when the missile engines are being started.

- During aircraft engine cartridge starts, the cartridge starter exhaust is 850° F. Therefore, remain clear of a 4-foot radius area around the cartridge starter exhaust directly below nacelles of engines 2 and 8.

NOTE

Steps of this procedure or instructions within steps of this procedure which apply to the use of an external air power cart are not applicable during cartridge starting of aircraft engines.

Man No. 1 — Crew Chief

1. Positions MA-1A start switch to START.

2. Removes front and rear engine plugs from engines 4, 3, 2, and 1, in that order, and places at left wing tip.

3. Opens MA-1A air switch.

4. Starts MD-3 and applies power.

5. Puts on headset and stands by for engine start.

6. Removes AGM-28 pitot cover, astrotracker cover, and engine plugs and places between MA-1A and MD-3.

7. Monitors starting of all aircraft engines and checks alternator cooling air.

8. Cuts off MA-1A and removes from aircraft. On hearing the copilot state, "A-C power checked, alternators on the line," shuts down and disconnects MD-3.

9. Closes entrance hatch.

10. Removes chocks from forward gear when instructed by the pilot.

11. Advises flight crew that all ground equipment is clear, disconnects ground cord, and moves into proper position (as local conditions require) to direct pilot while taxiing out of parked position.

12. Accomplishes the preparation checklist when practice alerts are terminated.

GROUND CREW CHECKLIST (Cont)

Man No. 2 — Assistant Crew Chief

1. Removes front and rear engine plugs from engines 5, 6, 7, and 8, in that order, and places at right wing tip.
2. Removes aircraft pitot covers.
3. Removes and stows aircraft ground wires.
4. Removes right AGM-28 pitot cover, astrotracker cover, and engine plugs and places between MD-3 and MA-1A.
5. Cuts off heaters.
6. Removes heater and ducting from ground power units and moves clear of left wing tip.
7. Removes forward bay heater and ducting clear of left wing tip.
8. Signals man No. 1 when all equipment is clear of aircraft and alternator cooling has been checked.
9. Stands by left or right wing tip (as local conditions require) to clear aircraft for taxi.

GROUND CREW SCRAMBLE WITH AGM-28 PNEUMATIC START

This checklist will be accomplished by the ground crew when the order to scramble is given and when AGM-28's are to be ground started with a pneumatic starter unit.

Man No. 1 — Crew Chief

1. Positions MA-1A start switch to START.
2. Removes front and rear engine plugs from engines 4, 3, 2, and 1, in that order, and places at left wing tip. Removes left AGM-28 (No. 1) pitot cover, astrotracker cover, and engine plugs and places at left wing tip.
3. Opens MA-1A air switch. Checks air selector switch on MA-1A to insure B-52 position.
4. Starts MD-3 and applies power.
5. Puts on headset and stands by for engine start.
6. Monitors starting of all engines and checks alternator cooling air.
7. Returns to MA-1A and, at flight crew direction, selects ASM NO. 2 on air selector switch for ASM NO. 2 start (monitors AGM-28 NO. 2 start).
8. Selects ASM NO. 1 on air selector switch and flight crew direction.
9. Monitors AGM-28 NO. 1 engine start.
10. Cuts off MA-1A. Removes B-52 air hose and positions to trail aft of MA-1A.
11. Removes starter unit and electrical lead, closes and latches access door AGM-28 No. 1.
12. Positions starter and air hose on ground between missile and No. 2 pod.

GROUND CREW CHECKLIST (Cont)

13. Closes entrance hatch.

14. Removes chock from left forward gear when instructed by the pilot.

15. Advises flight crew when all ground equipment is clear (posted as ground signal man). Disconnects ground cord, then clears left or right wing tip (as local conditions require) for taxi.

16. Accomplishes the preparation checklist when practice alerts are terminated.

Man No. 2 — Assistant Crew Chief

1. Removes front and rear engine plugs from engines 5, 6, 7, and 8, in that order, and places at right wing tip. Removes right AGM-28 (No. 2) pitot cover, astrotracker cover, and engine plugs and places at right wing tip.

2. Removes aircraft pitot covers.

3. Removes and stows aircraft ground wires.

4. Cuts off heater.

5. Removes heater and ducting from ground power unit and moves clear of right wing tip.

6. Removes forward bay heater and ducting clear of right wing tip.

7. Signals man No. 1 when all heater equipment is clear and alternator cooling air has been checked.

8. Monitors AGM-28 No. 2 engine start.

9. Moves to inboard side of right AGM-28 (No. 2), disconnects starter and electrical lead, and closes and latches starter access door.

10. Removes chock from right forward gear. Removes starter unit and hose by moving across centerline of aircraft just aft of forward trucks in front of AGM-28 No. 1 to MA-1A.

11. Moves into proper position (as local conditions require) to direct pilot while taxiing out of parked position.

NOTE

The abbreviated ground crew checklist is contained in the "Pilots' Abbreviated Flight Crew Checklist," T.O. 1B-52E-1CL-1. It is the responsibility of each unit to ascertain that the ground crew portion of that checklist is routed to the appropriate personnel.

B-52E AND F EMERGENCY TAXI CHECKLIST

WARNING

DO NOT USE FOR FLIGHT

NOTE

- Minimum cockpit crew may be one pilot and one ground crew member who serves as copilot.
- Pilot and copilot will perform their respective "Before Starting Engines" checklists simultaneously.
- This checklist is designed for emergency use. Two copies of the abbreviated checklist are to be placed in the cockpit of each aircraft by the Wing Standardization/Evaluation Division. It is not to be carried in the crew member's individual checklist folder.

BEFORE STARTING ENGINES (Pilot)

1. Status of Aircraft - Checked

   Pilot will check with ground crew for status of aircraft, for taxiing, and for desired starting mode (cartridge/pneumatic). He will issue instructions to clear aircraft of all obstructions and to stand by on interphone.

2. Circuit Breakers - Set
3. Interphone Power Switch - ON
4. Ground, Start External Power & Air - Roger (GC)
5. Landing Gear Standby Pump - ON
6. Navigation Lights - BRIGHT and FLASH
7. Antiskid Switch - ON
8. Parking Brakes - Set
9. Steering Ratio Selector Lever - TAXI
10. Ground, Remove Bypass Keys - Roger (GC)
11. Radio Call - Completed

    Contact command post or tower. Advise ready to start engines and request instructions.

BEFORE STARTING ENGINES (Copilot)

1. Circuit Breakers - Set

   Leave ADM-20 gear jettison circuit breaker pulled.

2. UHF Radios - ON
3. Firewall Switches - IN

B-52E AND F EMERGENCY TAXI CHECKLIST (Cont)

4. Battery Switch - ON
5. Alternator Switches No. 3 and 5 B-52F - ON
6. External Power - Checked and ON
7. Engine Starter Switches - OFF and GROUND START (for pneumatic start); No. 2 and/or 8 START and FLIGHT START (for cartridge start)
8. Air Bleed Switches - OPEN
9. Fuel Switches 14 & 15 (pneumatic start); 13, 14, 15 & 16 (cartridge start) - ON
10. Wing Flaps - UP, lever OFF (GC)

    Ground crew will advise flap position and movement.

STARTING ENGINES AND TAXIING (Pilot/Copilot reads)

1. Stand By to Start Engines - Fire guard posted and clear (GC)
2. Start Engines 4, 3, 5 & 6 (pneumatic start); 2 and/or 8, 3, 4, 5 & 6 (cartridge start) - Started (CP)

    Copilot starts No. 4 engine, then engines 3, 5, and 6 with normal starting procedures. When starting with cartridge(s) installed, copilot starts engines 3, 4, 5, and 6 after engines 2 and/or 8 are started. See Section II, "Starting Engines and Before Taxiing Checklist," line item "Start Engines - Started (CP)" for detailed starting procedures.

3. Starter Switches & Light - OFF and out (CP)
4. Left Aft Alternator B-52E - Started, checked, and on the line (CP)
5. Alternators No. 3 & 5 B-52F - Checked and on the line (CP)
6. Hydraulic Packs 1, 2, 3 & 4 - ON, pressures checked (P)
7. Ground, Clear Aircraft for Taxi, Remove Chocks & Disconnect Interphone - Roger (CG)
8. Taxi on Crew Chief's Signal (P-CP)

NOTE

Engines 2 and/or 8 may be shut down as desired if cartridge(s) were used for starting.

9. Brakes - Checked (P)

ENGINE SHUTDOWN (Copilot reads)

1. Parking Brakes - Set (P)
2. Landing Gear Standby Pump Switch - OFF (P)
3. Seat Positioning Switch - DOWN and AFT (P-CP)
4. Left Aft Alternator Switch B-52E - OFF (CP)

B-52E AND F EMERGENCY TAXI CHECKLIST (Cont)

5. Alternator Circuit Breaker Switches for Engines 3 & 5 B-52F - OPEN (CP)
6. External Power - ON (if available) (CP)
7. Throttles - 75% rpm, then CLOSED (P)

   Advance throttles to 75% for 30 seconds, then retard to CLOSED.
8. UHF Radios - OFF (CP)
9. Fuel Switches - OFF (CP)
10. Hydraulic Pack Switches - OFF & RESET (guards open) (P)
11. Wheel Chocks - In place (GC)
12. Parking Brake Lever - OFF (P)
13. Light Switches - OFF, or as required (P-CP)
14. Battery Switch - OFF (CP)
15. Interphone Switch - OFF (P)

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CUT ON DASHED LINE

B-52E AND F EMERGENCY TAXI CHECKLIST

WARNING

DO NOT USE FOR FLIGHT

NOTE

- Minimum cockpit crew may be one pilot and one ground crew member who serves as copilot.
- Pilot and copilot will perform their respective "Before Starting Engines" checklists simultaneously.
- This checklist is designed for emergency use. Two copies are to be placed in the cockpit of each aircraft by the Wing Standardization/ Evaluation Division. It is not to be carried in the crew member's individual checklist folder.

BEFORE STARTING ENGINES (Pilot)

1. Status of Aircraft – Checked
2. Circuit Breakers – Set
3. Interphone Switch – ON
4. Ground, Start External Power & Air – Roger (GC)
5. Gear Standby Pump – ON
6. Navigation Lights – BRIGHT and FLASH
7. Antiskid Switch – ON

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CUT ON DASHED LINE

8. Parking Brakes – Set
9. Steering Ratio – TAXI
10. Ground, Remove Bypass Keys – Roger (GC)
11. Radio Call – Completed

BEFORE STARTING ENGINES (Copilot)

1. Circuit Breakers – Set
   Leave ADM-20 gear jettison circuit breaker pulled.
2. UHF Radios – ON
3. Firewall Switches – IN
4. Battery Switch – ON
5. Alternator Switches No. 3 & 5 B-52F – ON
6. External Power – Checked and ON
7. Starter Switches – OFF and GROUND START (for pneumatic start); No. 2 and 8 START and FLIGHT START (for cartridge start)
8. Air Bleed Switches – OPEN
9. Fuel Switches 14 & 15 (pneumatic start); 13, 14, 15 & 16 (cartridge start) – ON
10. Flaps – Up, lever OFF (GC)

STARTING ENGINES AND TAXIING (Pilot/Copilot Reads)

1. Stand By to Start Engines – Fire guard posted and clear (GC)
2. Start Engines 4, 3, 5 & 6 (pneumatic start); 2/8, 3, 4, 5 & 6 (cartridge start) – Started (CP)
3. Starters & Light – OFF and out (CP)
4. Left Aft Alternator B-52E – Started, checked, and on the line (CP)

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CUT ON DASHED LINE

5. Alternators No. 3 & 5 B-52F – Checked and on the line (CP)
6. Hydraulic Packs 1, 2, 3 & 4 – ON, pressures checked (P)
7. Ground, Clear Aircraft for Taxi, Remove Chocks & Disconnect Interphone – Roger (CG)
8. Taxi on Crew Chief's Signal (P-CP)
9. Brakes – Checked (P)

ENGINE SHUTDOWN (Copilot Reads)

1. Brakes – Set (P)
2. Standby Pump – OFF (P)
3. Seats – DOWN and AFT (P-CP)
4. Left Aft Alternator B-52E – OFF (CP)
5. Alternator Circuit Breakers for Engines 3 & 5 B-52F – OPEN (CP)
6. External Power – ON (if available) (CP)
7. Throttles – 75% rpm, then CLOSED (P)
8. UHF Radios – OFF (CP)
9. Fuel Switches – OFF (CP)
10. Hydraulic Packs – OFF & RESET (guards open) (P)
11. Wheel Chocks – In place (GC)
12. Brakes – OFF (P)
13. Lights – OFF, or as required (P-CP)
14. Battery Switch – OFF (CP)
15. Interphone – OFF (P)

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ACCEPTANCE AND/OR FUNCTIONAL CHECK FLIGHT CHECKS

Procedures and criteria for functional check flights will be accomplished in accordance with T.O. 1B-52E -1-5 and T.O. 1B-52E-1-5A, acceptance and/or functional check flight manuals. Each manual contains three amplified checklists identified as "Before Inflight Checklists," "Inflight System Operational Checks," and "After Inflight Checklists." Flight crew abbreviated checklists are contained in T.O. 1B-52E-1-5CL-1 through -5. These abbreviated checklists are applicable to the "Before Inflight Checklists" and "After Inflight Checklists," and the numbered line items in these abbreviated checklists correspond identically to the numbered line items in the amplified checklists in the acceptance and/or functional check flight manuals. Worksheets containing only the headings of the "Inflight System Operational Checks" are contained in T.O. 1B -52E-1-5WS-1CF. The "Emergency Procedures" contained in T.O. 1B-52E-1 will be used. Aircraft requiring functional check flights are redelivered aircraft, modification maintenance aircraft, and aircraft wherein maintenance performed requires a functional check flight as specified in T.O. 1-1-300.

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ALL WEATHER OPERATION

section IX

INTRODUCTION: Except for some repetition necessary for emphasis, clarity, or continuity of thought, this section contains only those procedures that differ or are in addition to the normal operating instructions covered in Section II. Any discussions relative to system operations are covered in Section VII.

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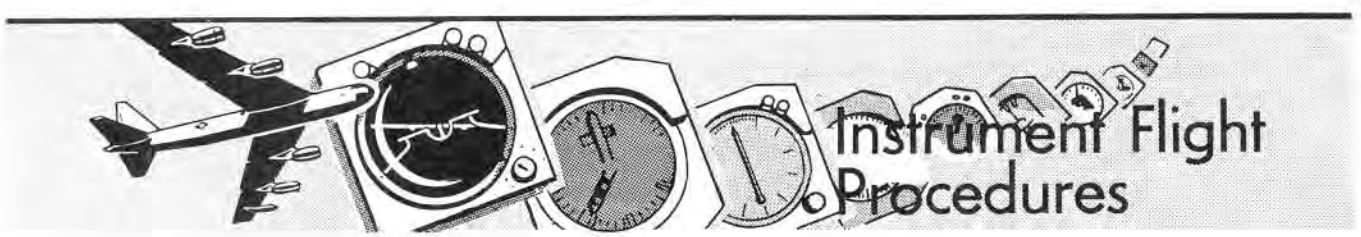
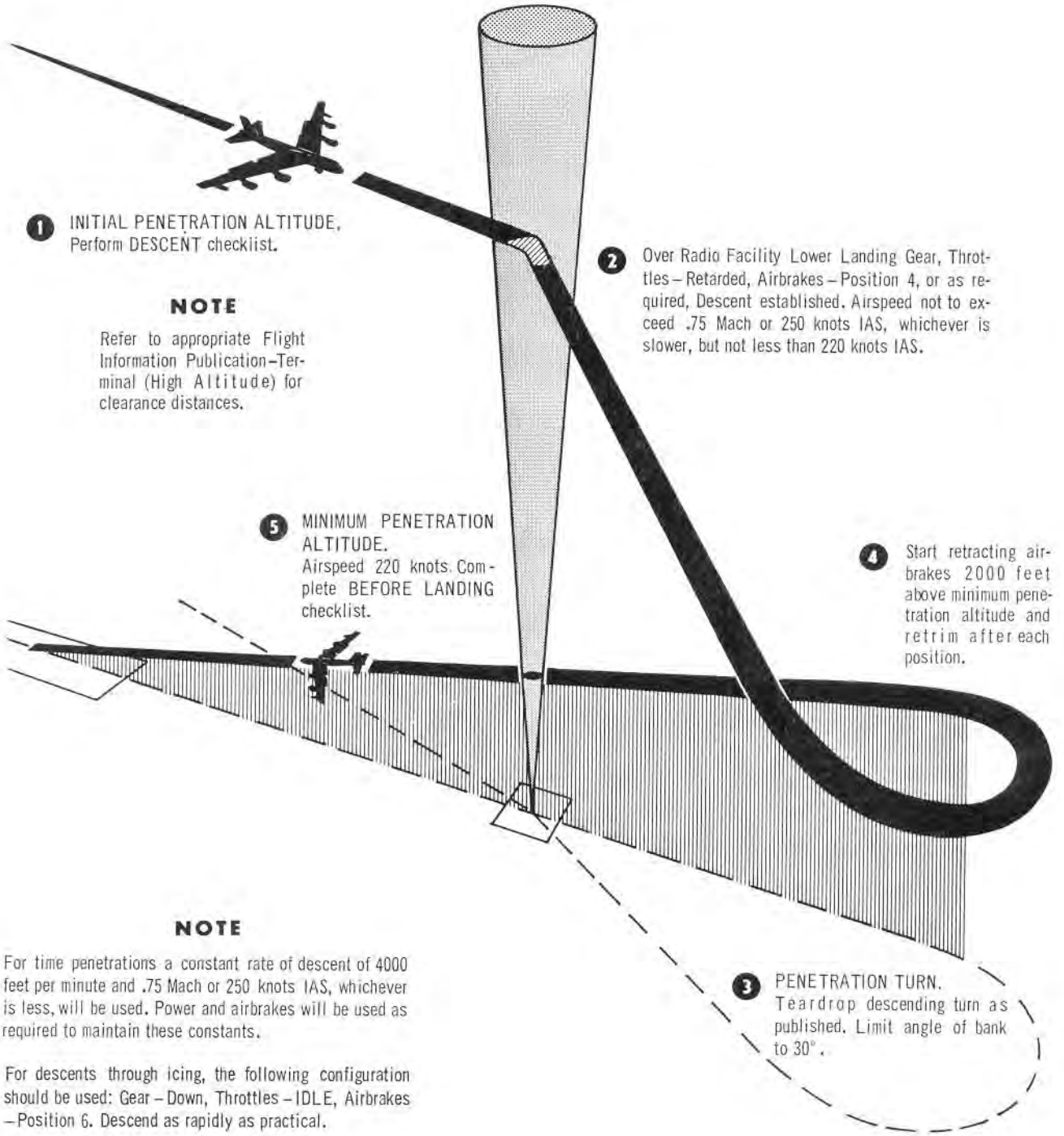


INSTRUMENT TAKEOFF AND INITIAL CLIMB

An instrument takeoff is essentially the same as a normal VFR takeoff. The same procedures are used as given in Section II.

1. Align the airplane visually with the runway. The copilot will visually monitor the takeoff and initial climb. Due to acceleration error during the takeoff roll, the pilot's and copilot's attitude indicators show



NOTE

- For time penetrations a constant rate of descent of 4000 feet per minute and .75 Mach or 250 knots IAS, whichever is less, will be used. Power and airbrakes will be used as required to maintain these constants.
- For descents through icing, the following configuration should be used: Gear – Down, Throttles – IDLE, Airbrakes – Position 6. Descend as rapidly as practical.
- For penetration, throttles and airbrakes may be used as required.

typical jet penetration

Figure 9-1.

a climb indication at unstick speed. A takeoff with reference to instruments exclusively may be required because of low visibility conditions.

2. As the airplane breaks ground, maintain the unstick attitude as indicated by the attitude indicator until a crosscheck of vertical velocity indicator and altimeter indicate a definite rate of climb with increasing airspeed.

WARNING

- If a pitchup occurs as the airplane becomes airborne, failure to initiate positive action with the elevator control and trim to stop the airplane nose up rotation could result in a stall.
- It is possible that a malfunction of the attitude indicator might be determined only by crosschecking it with the remaining flight instruments.

NOTE

An error in the pitch indication of the attitude indicators is generated during accelerations or decelerations. The error is indicated in a nose high direction during and after a forward acceleration and in a nose down direction during and after deceleration. The longer the duration of acceleration (or deceleration), the greater will be the indicated error and the longer it will persist when acceleration (or deceleration) ceases. The erection system will reduce the error at about the same rate it was generated. With the Type MM-4 attitude indicator, pitch error may reach one bar width during a high gross weight takeoff while, with earlier installed indicators, the error under the same conditions may be more than three times greater.

3. Retract the gear as recommended in Section II for a VFR takeoff; however, be certain that a safe stabilized climb has been established. Adjust pitch as necessary to maintain a climb at 180 knots IAS.

4. Retract flaps as recommended in Section II for a VFR takeoff.

INSTRUMENT CLIMB

Maintain recommended best climb schedule as given in Part 4 of the applicable Appendix. Limit the angle of bank to 30°.

INSTRUMENT CRUISE

The airplane has satisfactory handling characteristics throughout the design airspeed and altitude range. Use recommended procedures given in Part 5 of the applicable Appendix for cruise operation. For normal operation, limit angle of bank to 30° in all turns.

HOLDING

Enter the holding pattern in accordance with procedures as outlined in current directives. Establish a holding airspeed of 230 knots IAS for all altitudes from 15,000 feet to 35,000 feet and for all gross weights up to 300,000 pounds. For all gross weights greater than 300,000 pounds, refer to Part 6 of the applicable Appendix with the existing gross weight and altitude for a best endurance indicated airspeed. Maintain the airspeed 10 knots above that given or Mach .77, whichever is less, for endurance at the given weight to allow for holding turns. Limit the angle of bank to 30°.

NOTE

If it is necessary to endure and fuel quantity is low, establish the holding airspeed recommended in Part 6 of the applicable Appendix for the existing gross weight and altitude. Increase the airspeed 10 knots or maintain Mach .77, whichever is less. Maximum endurance altitude is recommended.

TYPICAL DESCENTS AND JET PENETRATIONS

1. Jet penetrations start at a specified altitude known as the initial penetration altitude published for each station in the "Flight Information Publication - Terminal (High Altitude)." Pilots should plan flights so as to arrive over the facility at the published penetration altitude and expected approach time. Penetrations can be started at any altitude above initial approach altitude provided the controlling agency concurs and proper procedures are followed to insure that the airplane does not exceed penetration pattern clearance limits.

2. The recommended descent is achieved with the gear down, throttles IDLE, airbrakes extended to position 4 or as required, and at a rate of descent of 4000 feet per minute not exceeding an airspeed of .75 Mach or 250 knots IAS, whichever is slower, but not less than 220 knots IAS. See figure 9-1 for a typical penetration.

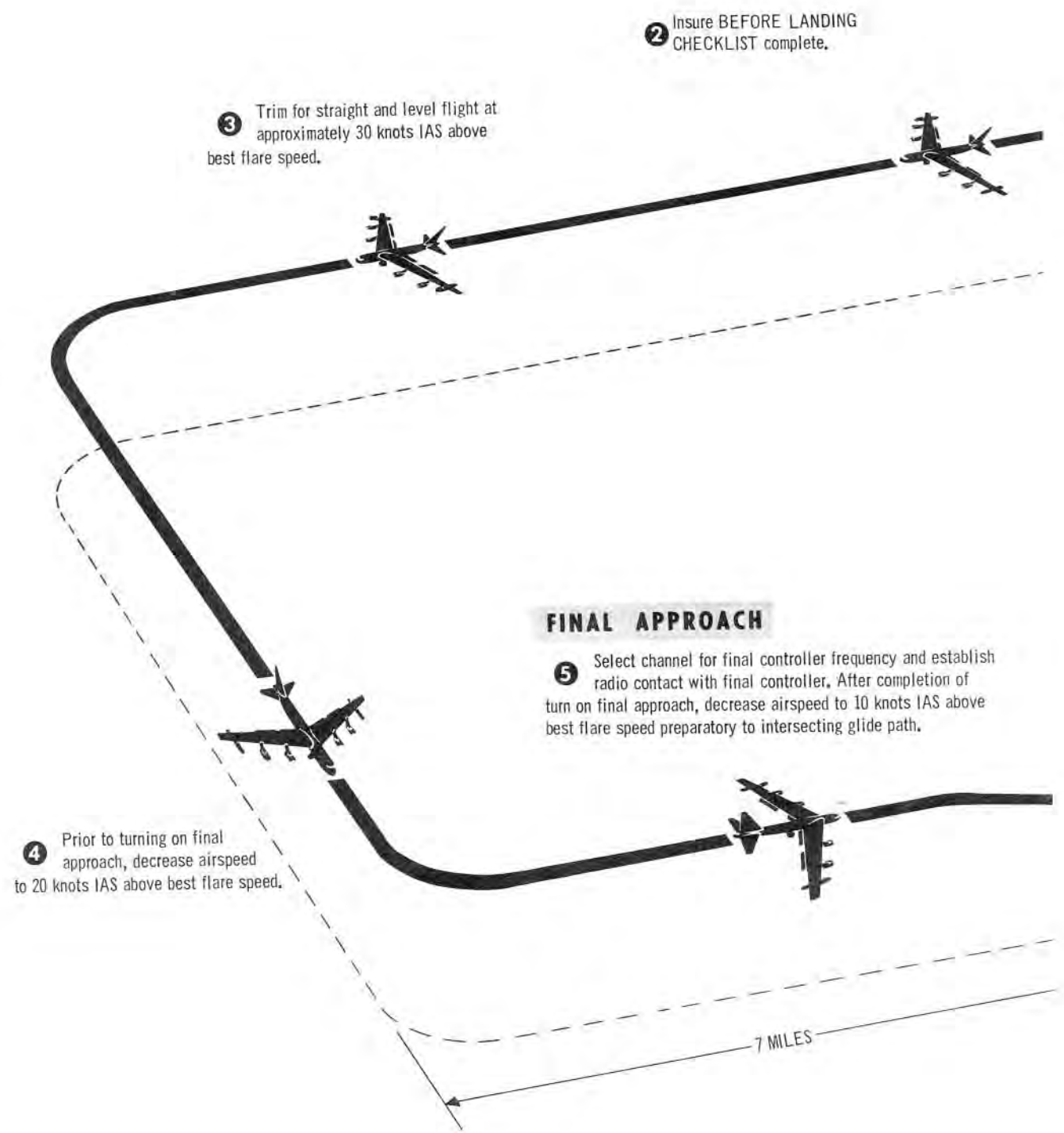
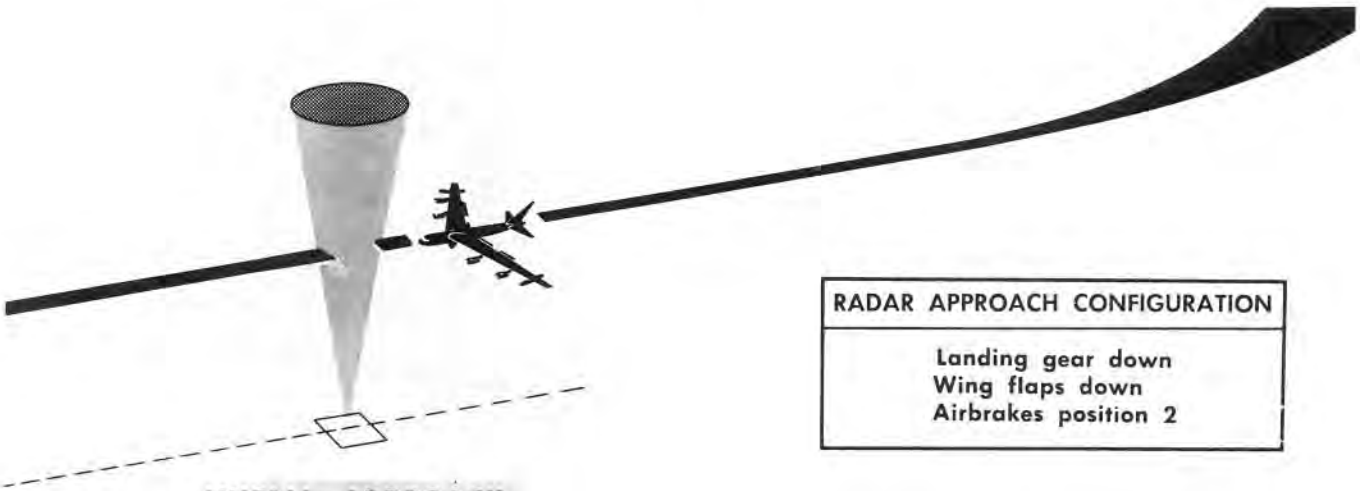


Figure 9-2. (Sheet 1 of 2).



RADAR APPROACH CONFIGURATION
Landing gear down Wing flaps down Airbrakes position 2

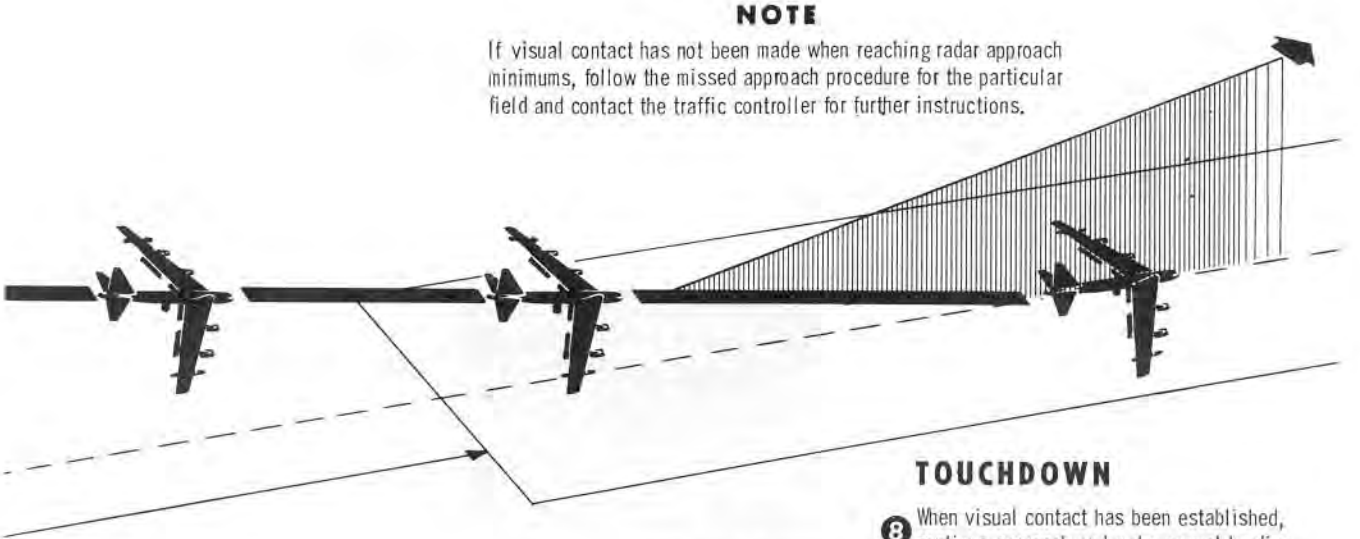
INITIAL APPROACH

❶ Contact approach control at destination for release to radar approach. When cleared by approach control, contact radar approach on appropriate frequency. The local radar approach traffic director will instruct the pilot to fly one or more headings so the airplane can be identified on the radar screen. After positive identification has been made, the pilot will be directed into the traffic pattern.

Normally the pilot will receive information on the latest weather, direction of landing, length of runway and other pertinent landing information. Complete "Before Landing Checklist." (See Section II.)

NOTE

If visual contact has not been made when reaching radar approach minimums, follow the missed approach procedure for the particular field and contact the traffic controller for further instructions.



TOUCHDOWN

❽ When visual contact has been established, continue approach and make normal landing.

PRE-LANDING

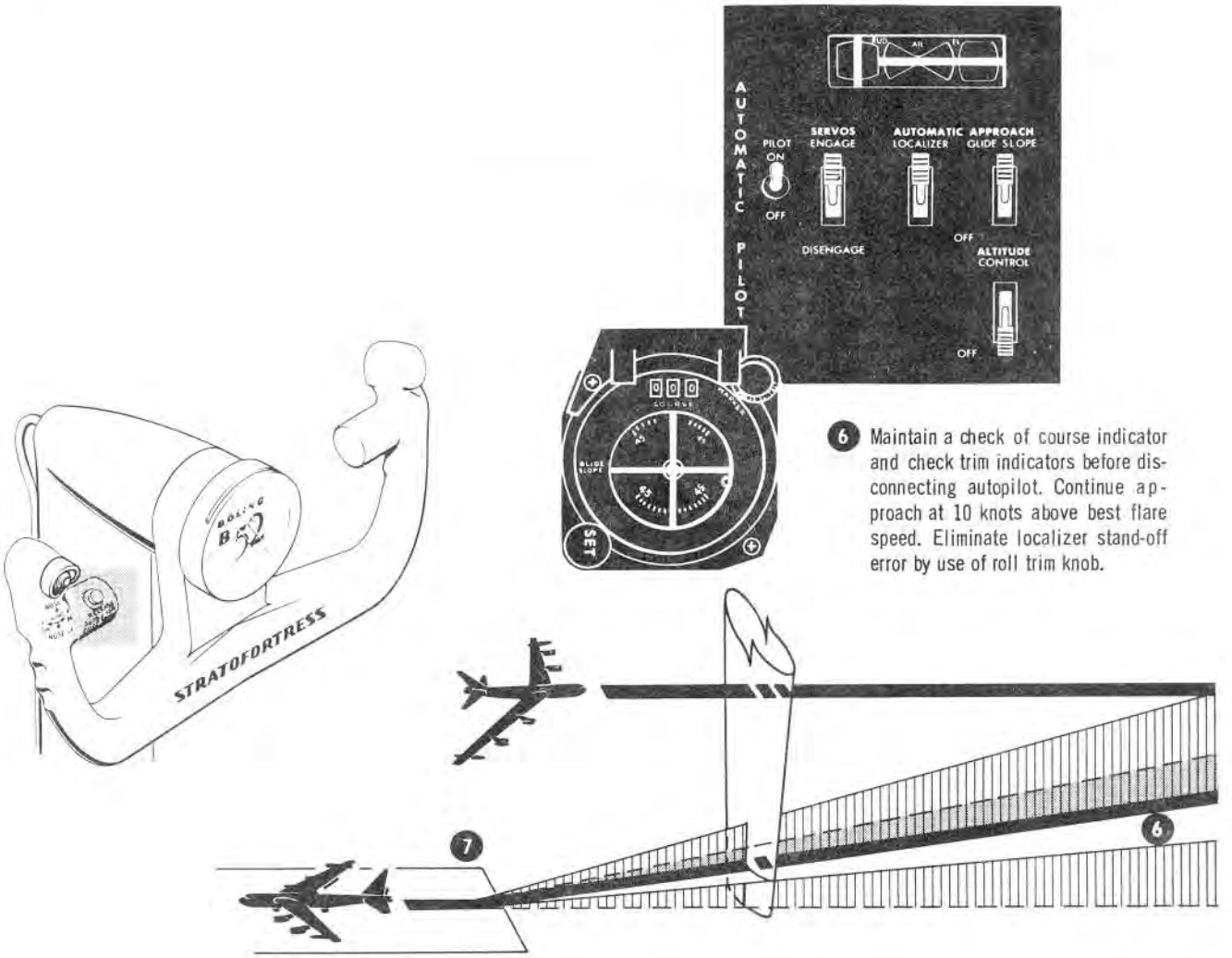
❻ Upon instructions from final controller, reduce power to give desired vertical velocity along glide slope. Final controller will inform pilot when reaching radar approach minimum altitude during approach.

❼ Establish visual contact with runway.

TYPICAL PATTERN
MISSED APPROACH

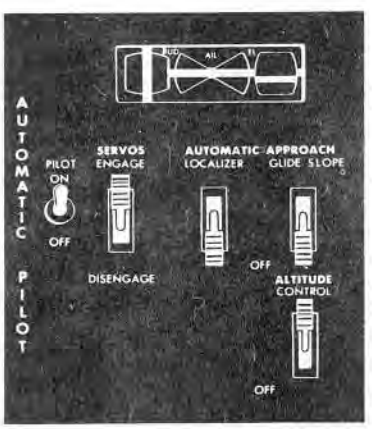
radar approach

Figure 9-2. (Sheet 2 of 2).



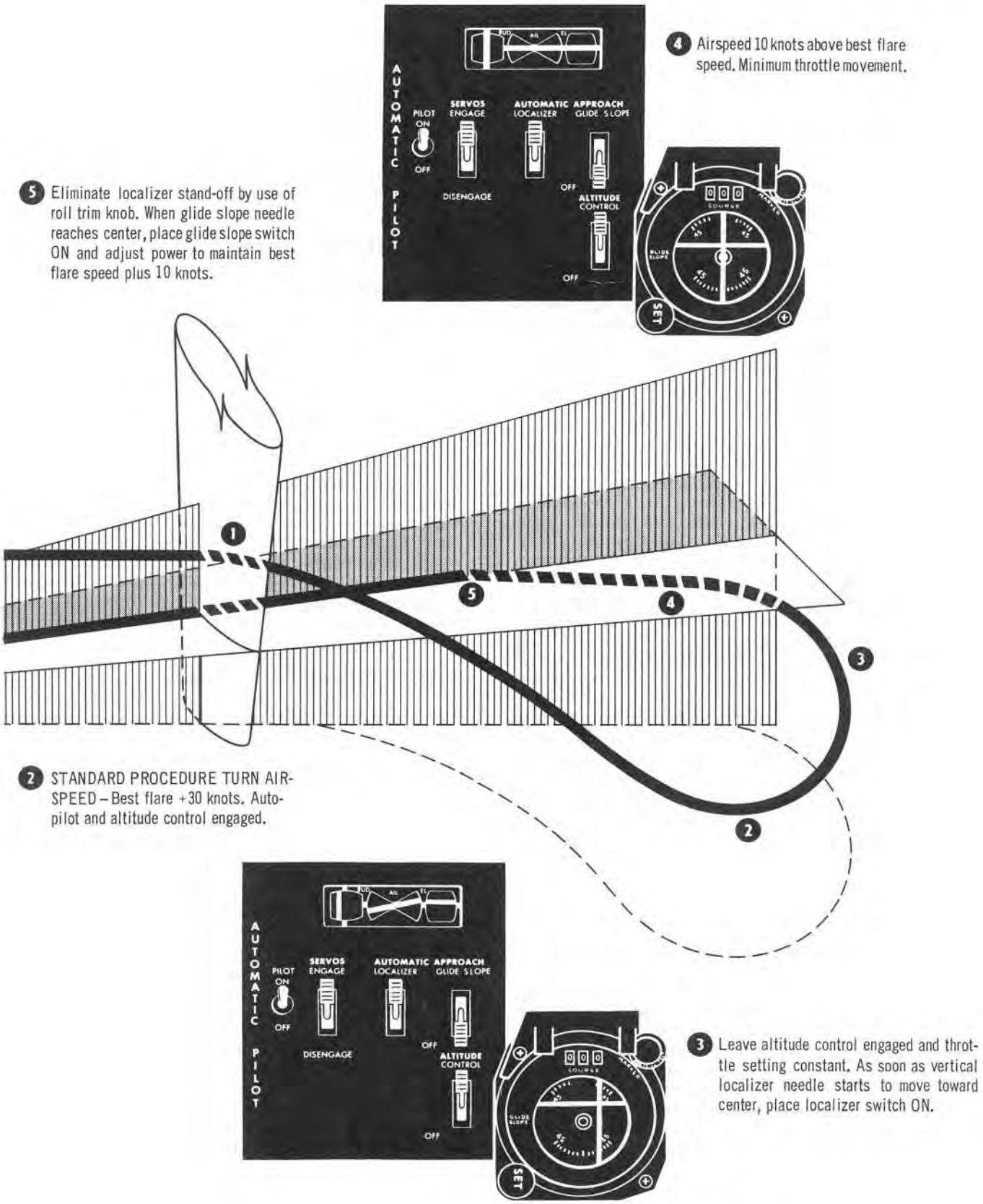
6 Maintain a check of course indicator and check trim indicators before disconnecting autopilot. Continue approach at 10 knots above best flare speed. Eliminate localizer stand-off error by use of roll trim knob.

7 Disengage autopilot and accomplish landing.



1 OUTER MARKER OUTBOUND
Have BEFORE LANDING checklist completed. Stabilizer trim cutout switch closed. Airspeed 30 knots above best flare speed for airbrakes in position 2. Plan approach to intercept localizer on turn in from procedure turn.

Figure 9-3 (Sheet 1 of 2).



4 Airspeed 10 knots above best flare speed. Minimum throttle movement.

5 Eliminate localizer stand-off by use of roll trim knob. When glide slope needle reaches center, place glide slope switch ON and adjust power to maintain best flare speed plus 10 knots.

2 STANDARD PROCEDURE TURN AIRSPEED – Best flare +30 knots. Autopilot and altitude control engaged.

3 Leave altitude control engaged and throttle setting constant. As soon as vertical localizer needle starts to move toward center, place localizer switch ON.

automatic approach

Figure 9-3 (Sheet 2 of 2).

3. Operate airbrakes in even positions (2, 4, and 6) and retrim after each position.

NOTE

For descents into known or suspected icing conditions, see "Ice and Rain," this section.

See Part 8 of the applicable Appendix for time, fuel, and distance requirements.

4. Conform to published procedures. Limit angle of bank to 30°.

5. Copilot obtains altimeter setting and pilot, copilot, and navigator set altimeters at the prescribed time during descent. During the descent, the radar navigator will call off passing through each 5000-foot level down to 5000 feet above level-off and each 1000 feet thereafter to the level-off altitude. The pilot and copilot will cross-check each altitude called by the radar navigator. Start level-off at least 2000 feet above minimum penetration altitude.

6. If a straight-in approach is approved or if radar pickup is possible before reaching minimum penetration altitude, retract to or leave airbrakes in position 2 during level-off. After level-off, allow the airplane to decelerate to 220 knots IAS. Complete "Before Landing Checklist" and establish best flare speed plus 30 knots IAS. When on final approach prior to reaching glide slope, gradually reduce airspeed to best flare plus 10 knots IAS and maintain this airspeed until the roundout or flare for landing is started. About 25,000 pounds per hour total fuel flow will be required during descent on final approach. If visual contact is not established at minimum altitude, execute the missed approach procedure.

7. If a straight-in VOR approach or radar approach is not approved, begin retracting airbrakes so that minimum penetration or initial approach altitude is reached with airbrakes as required. Allow airplane to decelerate to 220 knots IAS and proceed to the station. For a VOR approach other than straight-in, conform to published procedures. Use airspeeds and configuration for the pattern as specified for ILS approach (figure 9-3).

TIMED PENETRATION APPROACHES

During formation flights or streamer-type missions, it may be necessary to use timed penetration approach procedures in order to land all aircraft without delay. The term "Timed Penetration Approaches" is used to describe an air traffic control procedure which provides longitudinal and/or altitude separation between aircraft operating at the same specified rate of descent, rate of turn, and indicated airspeed while conducting an approved straight-in, procedure turn, or teardrop-type penetration, followed by an approved straight-in instrument approach procedure. For B-52 airplanes, these constants will be as follows:

- Rate of descent - 4000 fpm
- Angle of bank - Limit to 30° maximum
- Airspeed - Mach .75 or 250 knots IAS, whichever is less.

During penetration or approaches of this type, it will be necessary to use airbrakes and power as required to maintain these constants.

INSTRUMENT APPROACHES

RADAR APPROACH

When over the fix (figure 9-2) for a standard rectangular radar approach at 220 knots IAS, lower the gear if not already down and maintain airspeed until on radar approach downwind leg. When on downwind leg, complete "Before Landing Checklist" as outlined in Section II. Adjust power to maintain best flare speed plus 30 knots IAS after the flaps are down. Reduce airspeed to best flare plus 20 knots on base leg. After the turn to final approach and just prior to reaching the glide slope, reduce airspeed to best flare plus 10 knots IAS. When the glide slope is intercepted, reduce throttles, establish 25,000 pounds per hour total fuel flow, and establish a descent at best flare speed plus 10 knots. Maintain this airspeed until the roundout or flare for landing is started. A 28 nautical mile radar approach pattern requires an average of 10 minutes and 5000 pounds of fuel.

INSTRUMENT LANDING SYSTEM

The airplane is equipped with an approach coupler which permits automatic ILS approaches. Except for the use of the autopilot and approach coupler, the following procedures also apply to manual approaches.

WARNING

Patterns must be flown according to published procedures to insure proper terrain clearance throughout the maneuver.

Complete "Before Landing Checklist" and establish best flare speed (for airbrakes position 2) plus 30 knots IAS prior to reaching the outer marker. When over the outer marker at initial approach altitude, initiate a standard procedure turn and descend to procedure turn altitude. Engage autopilot and turn altitude control switch ON. Complete the procedure turn and, when localizer indicator indicates less than full deflection either side, turn localizer switch ON and make an automatic turn to the inbound course. When on lo-

calizer inbound, establish best flare speed plus 10 knots IAS. Eliminate localizer stand-off by use of the roll trim knob. When the glide slope needle reaches the center, turn glide slope switch ON (up) and adjust power to maintain best flare speed plus 10 knots. Continue down the glide slope until visual contact is established or to published minimums, whichever is higher. When visual contact has been established, disengage the autopilot and make a normal landing. If visual contact is not made at minimum altitude, disengage the autopilot and execute the published missed approach procedure. Limit angle of bank to 30° in all turns. An ILS approach requires an average of 5000 pounds of fuel and 10 minutes.

MISSED APPROACH

Airplane acceleration upon executing the missed approach procedure is such that at light weights under instrument conditions, flap placard speeds may be rather quickly exceeded. Also, during the final 20% of flap retraction particularly, the pilot must not be distracted from holding a level or slightly nose high attitude, using stabilizer trim as required to maintain zero stick force. Missed approaches are accomplished, using the same procedures as given in Section II for VFR go-arounds. Advance throttles as required, retract airbrakes, level off, trim as required, and check for a positive increase in airspeed.

WARNING

Care should be exercised in applying power at light gross weights due to pitchup developing during acceleration. See "Go-Around," Section VI for a detailed discussion of this characteristic.

Retract gear as soon as it is certain that the airplane will not touch the ground and retract flaps as specified in Section II if the published missed approach procedure is to be followed or if proceeding to an alternate airport. During the flap retraction cycle, it is required that the pilot monitor the airplane attitude indications as closely as possible, keeping the airplane trimmed to a zero stick force, especially during the last 20% of flap retraction.

NOTE

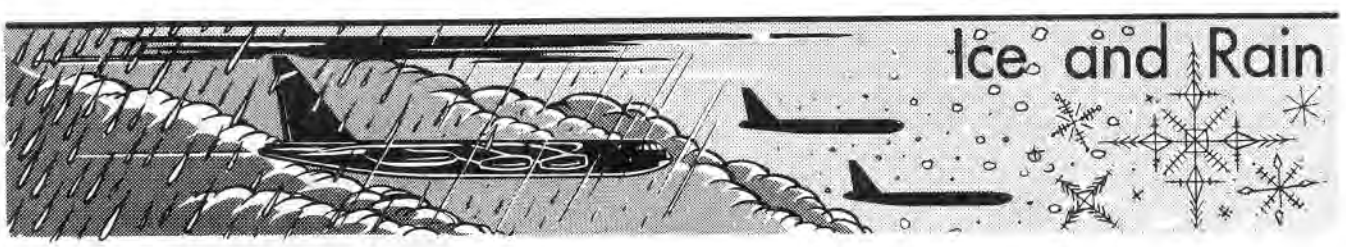
- If a closed radar approach pattern is approved and another approach is to be made, leave the gear and flaps down and maintain airspeeds as specified for a normal radar approach pattern. Make all turns two needle widths (3° per second). Limit the angle of bank to 30° in all turns.
- Allow approximately 7000 pounds of fuel and 12 minutes for a closed radar approach pattern.

AIRBORNE RADAR APPROACH

See "Airborne Radar Approaches," Section VIII, for proper procedures and techniques.

PARTIAL PANEL OPERATION

In case of flight instrument failure, especially the attitude indicators and directional indicator, do not use airbrakes during descent and use minimum angles of bank in all turns (1.5° per second maximum rate). Make descent under radar control if possible and limit airspeed to .75 Mach or 250 knots IAS, whichever is slower, but not less than 220 knots IAS. Plan a long straight-in approach, keeping turns to a minimum.



ICING

The airplane is provided with equipment which will prevent ice formation in and around the critical areas of each engine, nacelle, alternator, forward and aft air conditioning ram airscoop, and the Q-spring ram air inlet. In addition, anti-icing heat is provided for the pitot heads, pitot mast fairings, pilots' windshield and windows, and the gunner's windows. If rain repellent has been applied to the windshield, do not use windshield wipers unless necessary.

WARNING

- Ice formation in the Q-spring system is possible during some flight conditions even with the anti-icing system on. This may constitute a hazardous flight condition due to loss of Q-spring pressure. On airplanes RG, an additional tension spring is added to the elevator system which will provide partial artificial feel. For additional information, see "Q-Spring" under "Flight Control System Components," Section VI.

Less PP

- Caution must be observed when flying in known or suspected icing conditions with TR power failure since no fairing heat will be provided. Flight tests in icing conditions have indicated that, without fairing heat, the pitot tubes will ice up even though the right (pilot's) pitot tube is heated. Therefore, loss of airspeed indication at the pilot's station in addition to that of the copilot's station can result.

PP

- Caution must be observed to avoid areas of known or suspected icing conditions when flying with complete a-c power failure since no pitot anti-icing is available.

TAXIING

B-52E

Following heavy rain, large amounts of water may be observed coming from the alternator air inlets during taxiing and takeoff.

FLIGHT OPERATION

CAUTION

There is a possibility of engine damage occurring when the engine is operated during freezing rain. No part of the system has sufficient capacity to anti-ice during extended operation in a freezing rain.

NOTE

The engine and nacelle anti-icing system should be turned ON 5 minutes before suspected icing conditions are encountered. All engines should show a noticeable EPR drop at time of switch actuation to indicate a properly operating system.

Takeoff

If precipitation is present or icing conditions are anticipated during or immediately after takeoff, place starter switches to START and anti-icing switches to ON before advancing throttles to takeoff thrust. This is to prevent engine surge and flameout. If anti-icing is turned on at high power settings (above NRT), do not turn starter switches OFF until rpm and EPR have stabilized.

Climb

If icing conditions are known to exist within the climb flight path, the anti-icing switches should be turned to ON position prior to the time the icing conditions are encountered since less heat is required to keep the ice from forming than for removal once ice has formed. If sudden icing conditions or freezing rains are encountered, anti-icing switches should be turned ON at the first sign of icing. Ice collected during climb will reduce the rate of climb and range. If excessive ice formations remain on the airplane after climbing through an icing layer, flexing of the wings at normal climb speed may be beneficial in removing the larger formations.

Cruise

Icing conditions at cruise altitude will be rare, with the area and vertical extent of these conditions being generally small. Normally these areas may be avoided by slight changes in course or altitude. Icing of the vortex generators will not create a hazardous flight condition.

Descent

If forecasted or suspected icing conditions exist within the descent flight path, anti-icing switches should be turned to ON 5 minutes prior to the time icing conditions are encountered since less heat is required to keep ice from forming than for removal once ice has formed. When the engine and nacelle anti-icing switch is turned on, check for an appreciable EPR drop on all engines.

CAUTION

No EPR drop noted on one or more engines upon actuating the engine and nacelle anti-icing control switch would indicate possible malfunction of the anti-icing system and known or suspected icing conditions should be avoided.

For descent through or into known or suspected icing conditions, turn the engine and nacelle anti-icing system on and make the descent as rapidly as practical using gear down and airbrakes position 6. No minimum EPR is held during the descent so that anti-icing is not insured during this time. This is the most practical procedure since a rapid descent to pattern altitude will minimize exposure to icing conditions. Once the pattern altitude is reached and flaps extended, the minimum EPR to insure anti-ice can readily be held. See "Approach and Landing," this section.

CAUTION

- Ignition should be turned ON during descent. Leave ignition ON until sufficient power for anti-ice heat has been reestablished and stable engine operation obtained.
- With the gear extended during descent, it is possible for ice to build up on the landing gear and landing gear doors. This could result in damage to the doors if the gear was retracted.

Approach and Landing

Ice formations on the airplane will increase the stalling speed and, consequently, the final approach speed should be increased above normal. The amount of increase required depends upon the thickness and shape of the ice formations on the wings and empennage of the airplane. For ice formations less than 1 inch in thickness, increase final approach speed 5 knots IAS. Increase speed 10 knots IAS for 1 to 2 inches and 15 knots IAS for more than 2 inches. Except for increased speed on final approach, use normal approach and landing procedures. When making an approach under known or suspected icing conditions, the minimum EPR given in the following table must be maintained to insure adequate anti-icing for the engines and nacelles. Under most conditions, normal approach configuration (flaps and gear down, airbrakes position 2) will be sufficient to maintain these EPR's. However, if necessary, the airbrakes may be further extended.

Altitude	B-52E Minimum EPR	B-52F Minimum EPR
Sea Level	1.60	1.61
5,000 ft	1.60	1.75
10,000 ft	1.70	1.83

When landing under possible inlet icing conditions, ignition should be ON prior to final power reduction. Turn ignition OFF as soon as possible after landing to keep operating time to a minimum.

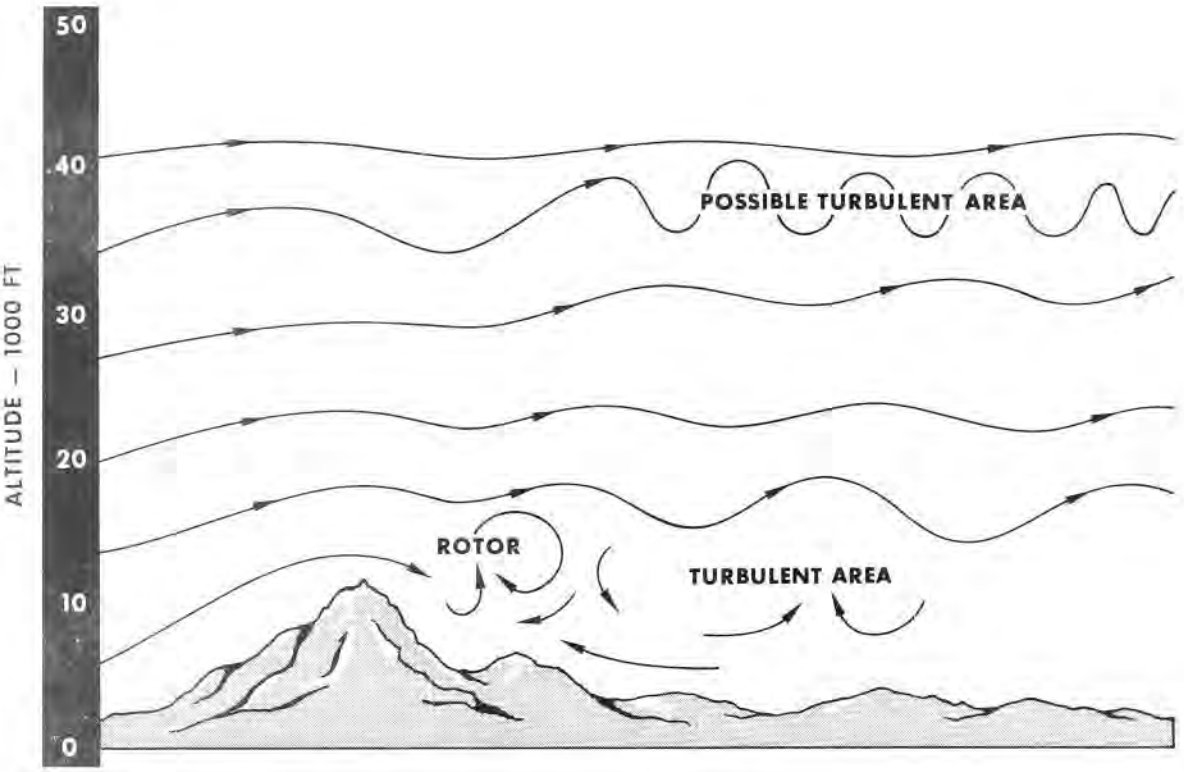
Anti-Icing System Inoperative

In cases of engine and nacelle anti-icing system malfunction wherein ice formations are observed on the engine cowl lips, engine struts, and oil coolers, insure that ignition is ON and idle the respective engines if operating conditions permit before the ice is ingested. There is considerably less possibility of damage at low engine rpm. After the ice has been ingested, check idle engine operation and, if normal, increase power.

The swept wing on this airplane is thin and therefore naturally flexible. It will withstand a movement arc at the tip of 31 feet before collapsing. This means a smoother and safer ride under turbulent conditions as the wing tends to absorb much of the shock.

NOTE

- During turbulent flight conditions, liquid oxygen sloshes inside the converter, cooling the gas and allowing part of it to return to the liquid state, resulting in a lowered gas pressure. Lowering of the gas pressure is not detrimental to crew consumption as long as pressure remains above 50 psi in a 70 psi system and at 150 psi in a 300 psi system.
- Negative "g" loading during turbulence could cause temporary loss of quantity indication. Stabilization of flight conditions should result in reasonably rapid stabilization of the oxygen pressure and quantity indications.



mountain wave turbulence

Figure 9-4.

MOUNTAIN WAVE TURBULENCE

Turbulence created by mountain wave activity occurs when a strong wind blows from a direction nearly perpendicular to a large mountain range. The air is forced up and over the mountain range and a series of standing waves is formed in the flow downstream of the range (figure 9-4). The mountain wave effect extends up above the range and, if well developed, will extend up into the stratosphere. The wave is created when the air is deflected upward by the mountain and the air, having some degree of stability, tends to return to its original level. Due to its momentum, it will overshoot and an oscillatory motion will be set up in the lee of the mountain range. Isolated peaks will not produce as strong an effect as a ridge or range of mountains extending across the wind and the higher the mountain range and the stronger the wind, the more pronounced the wave will be. A reversal in wind direction on the ground occurs in the lee of the mountain range because of the presence of a rotor. The name "rotor" is derived from the rotating appearance of clouds or dust that may be visible in the area. Mountain waves are sometimes accompanied by unique cloud formations which serve as a warning of turbulent and possible hazardous flying conditions. The level of turbulence associated with mountain waves can be as strong as that found in thunderstorms but the entire region influenced by the wave may not be turbulent. The bulk of the wave may consist of a smooth flow of air with strong vertical components while certain parts will break down into true turbulence. Maximum turbulent areas during mountain wave activity occur just downward and below the ridge line, from the top of the range upward for several thousand feet, and at the tropopause. Turbulence created by the mountain wave may extend leeward as much as 300 miles.

TURBULENT AIR PENETRATION

The following restrictions and operating procedures are necessary to avoid severe turbulence and reduce the effects of turbulent air:

1. Do not plan flights into areas at altitudes of known or forecast severe clear air turbulence.

2. Thunderstorm cells must be avoided and operation in thunderstorm areas is prohibited unless the aircraft is equipped with a serviceable radar system which will permit the crew to identify and avoid the cells. If thunderstorm activity cannot be avoided, a penetration altitude of at least 5000 feet below maximum range altitude is required for better control of the aircraft prior to entering the storm.

3. Corrective action to be taken if turbulence greater than forecast is encountered will be preplanned with the assistance of the weather forecaster during the weather briefing for all flights. For further information on corrective action, see step "6."

CAUTION

- The turbulent air penetration speeds are as follows:
  - On UR, penetrate at 270 KIAS or .77 Mach, whichever is less.
  - On Less UR, establish penetration speed commensurate with aircraft gross weight (figure 9-5).
- When in turbulence at any altitude, extreme care should be exercised to assure that all control and thrust inputs are applied in a smooth positive manner, avoiding abrupt application of thrust and flight controls whenever possible. Uncoordinated control inputs and applied corrections out of phase with the inherent aircraft stability reactions will aggravate and increase yaw deviations and dutch roll. Such out-of-phase inputs can induce large structural loads on the aircraft empennage and must be avoided.
- If the aircraft has been trimmed for the turbulent air penetration speed, disregard momentary airspeed changes and do not change the stabilizer trim setting.

NOTE

- The standard MA-2 autopilot will repeatedly disengage in turbulence and should not be used in turbulence at low altitudes. The A/A42G-11 autopilot (AFCS) will not disengage in turbulent conditions when operated in low level mode and will assist in relieving the effect of gust loads on the aircraft.
- The electromechanical yaw damper, if installed, will assist in relieving the effect of gust loads and should be left on at all times.
- Bank angles in excess of 15° should be avoided.
- Allow the aircraft to ride out gust strikes.

4. At altitudes other than low level, if turbulence is encountered, observe the MA-1 accelerometer readings immediately. If the readings exceed 1.4 or 0.6 "g" (1.0 (±0.4) "g"), disengage autopilot to prevent an inadvertent disconnect in an unusual attitude and to allow the pilot to assess the degree of turbulence. If the readings reach 1.6 or 0.4 "g" (1.0 (±0.6) "g") more than twice per minute UR, 1.2 or 0.8 "g" (1.0 (±0.2) "g") more than twice per minute Less UR, adjust speed immediately to the appropriate turbulent air penetration speed and place airbrakes in position 2 (see "Dutch Roll Damping," this section).

WARNING

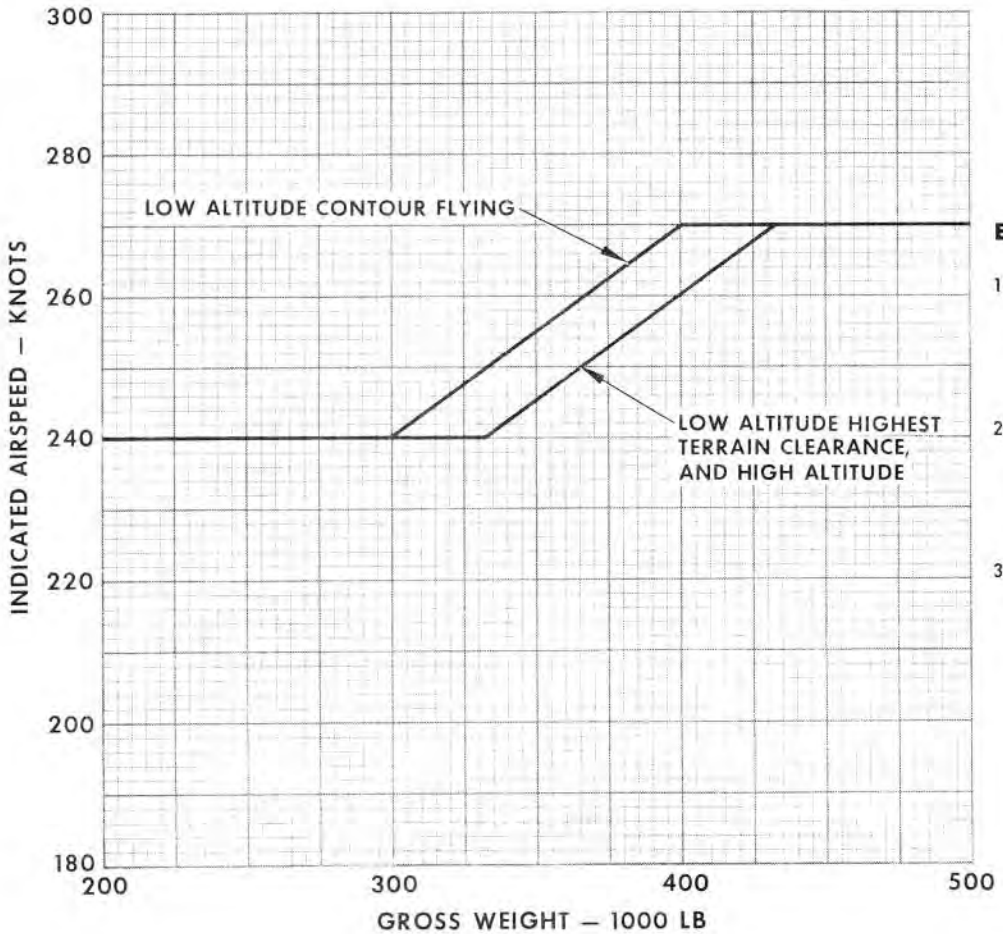
Never climb above maximum range cruise altitude to clear the turbulence.

5. During TA contour operations, flights are prohibited in mountainous areas if peaks extend more than 1000 feet above the terrain within 5 miles either side of the low level corridor when reported or observed flight level winds are 40 knots or greater UR, 25 knots or greater Less UR. All low level operations, either TA or highest terrain clearance, are prohibited when mountain wave activity is reported or forecast.

NOTE

- Prior to descending for any low level operation, the latest forecast or inflight reports regarding winds or mountain wave activity along the intended low level route will be obtained from the Air Traffic Control facility or the nearest Pilot to Forecaster service.
- See Section VI for "Low Altitude Flight Characteristics."

Doppler radar will be used to measure flight level winds. If doppler is inoperable, alternate wind finding methods will be used. If turbulence is encountered, observe the MA-1 accelerometer readings immediately. If the magnitude and frequency of the readings reach 1.6 or 0.4 "g" (1.0 (±0.6) "g") more than twice per minute UR, 1.2 or 0.8 "g" (1.0 (±0.2) "g") more than twice per minute Less UR, adjust speed immediately to the appropriate turbulent air penetration speed. If AFCS low level mode is not available, place airbrakes in position 2.



PENETRATE TURBULENT AIR AT MACH .77 OR CHART SPEED, WHICHEVER IS THE LOWER AIRSPEED.

EXAMPLES:

Find turbulent air penetration speeds.

1. Given: Weight 255,000 pounds. Altitude 45,000 feet. Chart speed is 240 knots IAS which is higher than Mach .77 at this altitude.
   Answer: Mach .77 indicated.

2. Given: Weight 345,000 pounds. Altitude 30,000 feet. Chart speed is 244 knots IAS which is lower than Mach .77 at this altitude.
   Answer: 244 knots IAS.

3. Given: Weight 300,000 pounds. Altitude, Low Alt Contour.
   Answer: 240 knots IAS – Chart speed minimum.

NOTE

The above chart provides the correct indicated airspeed to fly for the particular gross weight when penetrating turbulent air. Note that higher speeds are prescribed for turbulent air penetration during low altitude contour operations. This to provide better control response for this operation. For all other types of flight, including low altitude highest terrain clearance, use the lower speed schedule.

I..... turbulent air penetration speeds Less UR

Figure 9-5.

6. When operating at turbulent air penetration speed and the MA-1 accelerometer readings reach 1.6 or 0.4 "g" (1.0 (±0.6) "g") more than twice per minute UR, 1.4 or 0.6 "g" (1.0 (±0.4) "g") more than twice per minute Less UR, preplanned corrective action must be initiated. Corrective action will be as follows:

a. During low level training (highest terrain clearance or contour operations), start a gradual climb not to exceed 1000 feet per minute at turbulent air penetration speed. Continue the climb until the turbulence decreases to an allowable level or the altitude becomes too high to be of value for low level training, then resort to alternate training, mission abort, etc, as planned or directed.

b. During operations other than low level, corrective action may include turns, descent, or climb at penetration airspeed to avoid the areas of turbulence. When the turbulence decreases to an allowable level, continue the mission or resort to alternate training as planned or directed.

NOTE

- The incremental acceleration criteria based on MA-1 accelerometer readings are intended for use as a guide to assist in identifying the level of turbulence in which the aircraft should not be operated without severely compromising flight safety. Turbulence having intensity levels below that associated with these criteria may cause incremental accelerations in excess of the values previously noted at frequencies less than twice per minute. These criteria alone will not provide adequate warning in cases where the turbulence intensity increases abruptly from light or moderate to extremely severe.

- At any time in the pilot's judgment, if turbulence is approaching a critical level (horizontal or vertical) regardless of whether limiting accelerometer readings are observed or not, penetration airspeed should be established and preplanned corrective action taken.

7. If turbulence is encountered such that the MA-1 accelerometer readings exceed 1) those charted on figure 5-6 for UR; 2) plus or minus 0.7 "g" incremental (1.7 or 0.3 "g") for Less UR; or 3) if, in the pilot's opinion, the aircraft has encountered heavy loads due to turbulence, the pilot will make entry on Form 781 after landing to the effect that turbulence was encountered and will enter the highest and lowest accelerometer readings so that the appropriate structural inspection will be made prior to the next flight.

DUTCH ROLL DAMPING

"Dutch roll" is the name given to a combined rolling, yawing motion, often described as "wallowing." The motion is named for its resemblance to the characteristic rhythm of an ice skater, where the yawing is out of phase with the rolling; e.g., the nose will be yawing to the left while the right wing is still going down. This motion is more pronounced with swept wing aircraft than with straight wing aircraft of similar size because of the larger rolling moments produced by side slip or yaw. Dutch roll is usually generated by disturbances such as gust encounters together with lateral/directional overcontrolling. The frequency of the dutch roll oscillation in the B-52 will be one complete cycle in 6 to 8 seconds. The amplitude however depends on the magnitude of the disturbances, the fuel loading, and the flight condition (angle of attack). Because the cyclic yawing motion of the dutch roll will add to the loading already imposed on the vertical tail by random turbulence, it is important to minimize the dutch roll, particularly when flying in turbulence.

The directional damping stability of the aircraft has been increased by means of a mechanical yaw damper and on recently modified aircraft, an electromechanical yaw damper. These devices will operate satisfactorily in turbulence unless the magnitude of the turbulence becomes so great that the yaw dampers no longer have sufficient authority to overcome the resulting dutch roll. In this event, the pilot will have to use manual inputs to assist in damping the dutch roll. If these manual inputs are not correctly applied, the dutch roll will be aggravated and the loads on the vertical tail increased. Dutch roll exists because of a combination of rolling and yawing motions which, being out of phase, tend to complement or "feed" each other. Dutch roll cannot exist in the absence of either of these motions. In order then, to stop dutch roll, at least one of these motions must be controlled. Rudder control can be used to damp dutch roll, but this action requires close observance of the turn rate needle since it can and does become erratic in turbulence. Because the yawing motion is out of phase with, and of considerably lower amplitude than, the rolling motion, it is considered most effective to apply corrective action with lateral control.

In the application of lateral control corrections, the pilot's natural inclination will be to correct for displacement rather than rate; i.e., he will apply control inputs to raise the low wing rather than to stop the rolling motion. Continued lateral control inputs in this manner can cause the dutch roll to diverge (increase in amplitude). The pilot will actually be "feeding" the dutch roll rather than damping it. The lateral

control inputs must therefore be applied in opposition to the rolling motion. In the turbulence-induced dutch roll situation, the mechanical yaw damper and the electromechanical yaw damper, when installed, are still attempting to stabilize the aircraft about the yaw axis but are prevented from being fully effective by the magnitude of the turbulence upsets. The pilot, by applying lateral control deflections in opposition to the direction of the rolling motion, reduces the magnitude of the dutch roll sufficiently to allow the yaw damper to regain control of the yawing motion. Thereafter, continued lateral control inputs as necessary to oppose any tendency to roll away from a wings level attitude should prevent regeneration of the dutch roll. Extending the airbrakes will increase the dutch roll stability and therefore decrease the vertical tail loads. For low altitude airbrake usage, see "Turbulent Air Penetration," this section. The maximum recommended position is airbrake position 2. Although some spoiler buffet will be experienced in airbrake position 2, this is not considered detrimental. Airbrake positions greater than 2 are not recommended because of the associated pitch trim change and the possibility of an unfavorable gust encounter while the aircraft is in a mistrimmed condition. Extension of airbrakes to position 2 should be accomplished cautiously in turbulence making every effort to maintain zero mistrim throughout the procedure to minimize loading. The transient mistrim incurred during airbrake extension is justified by the considerably more stable configuration which results. Based on the foregoing discussion, the following technique for manually damping dutch roll is recommended:

1. Apply lateral control as necessary in opposition to the direction of the rolling motion.
2. Continue lateral control inputs in small pulses to maintain wings-level attitude.
3. When moderate or greater turbulence is encountered, raise airbrakes to position 2 except when in AFCS low level mode.

NOTE

Extend airbrakes cautiously and maintain as near to zero mistrim as possible during extension.

MULTIPLE ENGINE FLAMEOUT B-52E

Flight through cumulus clouds or areas of severe turbulence at 40,000 feet or above may result in multiple engine flameout. (See "Engine Operation," Section VII.) To reduce the possibility of flameout under these conditions, the following procedures are recommended:

1. Turn on the engine and nacelle anti-icing system as soon as possible prior to weather penetration. (The system is not fully effective unless used before ice buildup occurs.)
2. Energize all engine ignition systems by checking the starter selector switch in FLIGHT START and moving all starter switches to START. Energizing the ignition systems will aid in preventing a stalled or surging engine from flaming out. Under these circumstances, continuous use of the ignition system for a period of time not in excess of that given in Section V under "Ignition System Limitations" is permissible.

CAUTION

During flight through severe turbulence at altitudes of 40,000 feet and above, monitor EGT and EPR for possible increase above operating limits. If limits are exceeded, reduce power. Lose altitude in order to maintain adequate airspeed for optimum engine inlet airflow.

3. If multiple engine flameout occurs, retard the affected engine throttles to OFF, reduce altitude, and

employ normal engine restart procedures. (See "Engine Failure," Section III.)

NOTE

During descent and restart procedure, maintain the highest practicable airspeed permitted by flight conditions and airspeed limitations in order to regain normal engine inlet airflow.

ENGINE COMPRESSOR STALL

Compressor stall may occur when flying in or around thunderheads due to ice crystal ingestion. At high altitudes, the weight of airflow into the engine is low so the water/air ratio for water injection may be exceeded as the ice crystals melt, causing compressor stall in extreme cases. Normal compressor stall procedures as described in Section VII under "Engine Operation" should be employed to counter this condition.

NOTE

Only those cold weather operating procedures not common to all large jet aircraft are included here. Icing conditions during flight are covered under "Ice and Rain," this section.

Many cold weather operating difficulties can be eliminated by proper caution during ground operation. Extreme diligence on the part of both flight and ground crews is essential to successful cold weather operation. If preheating is required, arrange preheating periods so that all airplane equipment will be inspected, warmed, ready, and operating at the time of starting the engines. While preheating is being accomplished, inspections and operational checks can be made. This work must be thorough since low temperatures may cause hidden difficulties. Avoid touching cold metal with bare skin; it may freeze to the metal.

GROUND

BEFORE ENTERING THE AIRPLANE

Snow removal should be completed prior to beginning the preheating operation since running water from melted snow will seek hidden places and refreeze. Any personnel on the wings and fuselage should be protected by safety lines to prevent their falling to the ground. All surfaces should be swept with brooms and not beaten or chopped since skin damage may result. Isopropyl alcohol applied with sprayers is effective in removing ice and snow and is particularly valuable in removing ice from between the stabilizer and the fuselage. Snow or ice accumulations can increase takeoff distance and adversely affect climbout performance, stalling speed, and handling characteristics. Inflight structural damage can result from vibrations induced by unremoved accumulations. Preheat the airplane, preferably by placing in a warm hangar or dock at least 6 hours prior to takeoff. If hangar facilities are not available and the airplane has been severely cold soaked, it will be necessary to preheat the pneumatic-driven alternators and hydraulic packs to insure their starting. Preheat the BNS high speed radar antenna drive system for 15 minutes if ambient temperatures have been consistently below -20° F (-29° C).

NOTE

- The same special tool is used to attach a hot air line to the radome ram air inlet for this purpose as is used for a ground cooling air line when cooling is required.
- Leakage can be expected of the antenna high pressure air when operation is begun at extremely low ambient temperatures. The pressurization system pump will recycle frequently in attempting to maintain pressure during the 20 to 30 minutes which may be required for operation to warm the equipment sufficiently for the seals to hold pressure.

CAUTION

At temperatures below -50° F (-46° C), the high speed radar antenna will not rotate unless preheated. An attempt to operate without preheating may result in failure of the drive motor.

Although not required, it is desirable to preheat the crew compartment to prevent frosting of instruments.

CAUTION

Failure to remove snow from the fuselage before applying interior heat will result in ice refreezing on the sides of the fuselage, causing drag and possible erratic airspeed indications if it forms around the pitot heads or static ports.

Ice formed from runoff water has been found in a thin clear sheet over static ports. The air refueling slipway doors are vulnerable to runoff icing as are the static ports for both the forward and aft air conditioning systems. Melting snow from above the aft compartment may refreeze on the junction of fuselage and horizontal stabilizer, thus preventing movement of the stabilizer. Check control surface hinge lines for ice as the primary flight control surfaces, with the exception of the elevators, cannot be moved on the ground by manipulation of the controls in the cabin. These surfaces should be checked for freedom of movement prior to entry into the airplane. When operating out of a nose dock and snowfall is occurring, open nose dock doors in time to cool the skin of the airplane before removing it from the dock, as snow will cling to a warm surface and freeze. Flight tests have revealed that takeoff can be made with frost formations up to 1/8 inch thick on the lifting surfaces without appreciably affecting performance.

CAUTION

If heat is used to remove ice or snow, check that the runback of water does not freeze on the airplane surfaces. Check control surface hinge lines for ice as the primary flight control surfaces, with the exception of the elevators, cannot be moved on the ground by manipulation of the controls in the cabin. These surfaces should be checked for freedom of movement prior to entry into the airplane.

STARTING ENGINES

Whenever an airplane is removed from a heated hangar or dock, a ground heater should be available to supply heat to the engine fuel control units, starter valves, and starter turbine if this becomes necessary. If an air supply is available inside the dock or hangar, the engines should be motored for a short period before removing the airplane. This procedure should remove any moisture from the ducts and starter system.

NOTE

B-52F

The indicated oil pressure may be slow to rise to the normal operating range after starting a cold-soaked engine during very cold weather. Provided some indication of oil pressure is observed when the engine is first started, up to 3 1/2 minutes may be allowed for the indicated oil pressure to reach the minimum limit.

If a starter valve fails to open during engine start, use of the starter switch and hot pressurized air is recommended for thawing of the starter valve. Often the starter valve will open after the starter switch has been energized for 3 minutes and hot pressurized air is being supplied from an adjacent engine or ground cart. The heat created by the energized starter solenoid will penetrate the regulator housing and the hot pneumatic air, through gradual flow, will help heat the valve area thus allowing the valve to open and operate properly.

AFTER STARTING ENGINES

NOTE

If the ambient temperature is -30° C (-22° F) or below, idle the engines for a 2-minute warm-up period.

Lubrication pump failures on hydraulic packs can be lessened in cold weather if the pack is idled for approximately 15 minutes during preflight. Operating the pack at low rpm thins the hydraulic fluid which may have congealed in the lubrication pump shaft housing and prevents lubrication pump shaft failures. This idling operation is accomplished on external air by operating five or six hydraulic packs simultaneously as necessary to lower pneumatic duct pressures below 10 psi. Control switches of packs to be idled should be turned to ON position prior to application of external air. This prevents high speed pack operation. When a pack is started on high air pressure, as in normal operation, it accelerates to its normal operating rpm in several seconds. This rapid acceleration of a cold hydraulic pack is the cause of many cold weather pack failures.

NOTE

Apply external electrical power to the airplane, position the desired hydraulic pack switches to ON position, disconnect the external electrical power, then position the hydraulic pack switches to OFF position. External air may be applied periodically to the airplane to preheat the hydraulic packs. If external electrical power is reapplied, all hydraulic pack shutoff valves will close.

Several minutes prior to closing the navigator's entrance hatch, heat should be applied to soften the door seal to insure proper latching.

B-52E

Alternators are subject to difficult starts during cold weather operation. Preheating of drives prior to starting will aid lubrication, assist regulatory systems and valves to work properly, and improve alternator reliability. Heated air from a ground heater with a maximum gage temperature of 250° F should be directed through the drive cooling air exhaust for approximately 30 minutes. After this is accomplished, if a drive will not rotate with the alternator switch turned to the ON position, if it rotates and is automatically tripped to OFF position, or if the speed oscillates, it is possible that the shutoff and modulating valve actuators are not

warm enough to function properly. If this occurs, the drive should be shut down and hot air directed from the ground heater directly on the shutoff and modulating valve actuators for a period of 15 minutes or until the drive starts and operates properly. Under extremely cold operating conditions, the control circuitry on the bottom of the alternator drive may require from 10 to 20 minutes of drive operation before it becomes warm enough to provide normal frequency control.

CAUTION

B-52E

No attempt should be made to heat control circuitry with hot air from a ground heater as extreme heat will damage circuitry components.

B-52E

If an alternator fails to start properly and adequate heat is not available or time does not permit additional ground heating, the modulator valve and pilot piston may be heated by operating the alternator on very low air pressure. If the alternator is operated on very low air pressure, it will not operate fast enough to trip off from overspeed. It will be necessary to remain on ground power during the low air idling procedure. All engines may remain operating. With all possible hydraulic packs, air conditioning packs, and alternators operative, retard the throttles and adjust pneumatic pressure to 10 psi or below. Attempt to start the affected alternator. If no other difficulty exists but a frozen modulator valve or pilot piston, the alternator will rotate slowly. Allow the alternator to operate for 3 to 5 minutes, then increase pneumatic pressure with the throttles. If it runs normally, parallel and proceed.

TAXIING

On ice- and snow-covered areas, taxi speed should be reduced and the normal taxi interval between planes should be increased. Taxiing in deep snow should be avoided as taxiing and steering are extremely difficult and frozen brakes and gear may result. During low temperatures, a slight delay in brake response can be expected. Care should be taken when maneuvering near other parked aircraft as the jet blast will blow melted snow onto other airplanes where cold metal will freeze it. The wide span of the wing tip protection gear requires close observation during taxiing to prevent damage from snow banks.

WARNING

In cold weather, make sure all instruments have warmed up sufficiently to insure normal operation. Check for sluggish instruments during taxiing.

CAUTION

- On very slick surfaces, come to a complete stop prior to attempting to turn the airplane.
- Under no circumstances allow a drop tank to be pushed through or dragged over a snow bank. Dislocation of the tank from the suspension lugs and damage to the tailcone may result, causing unplanned jettisoning of the damaged tank.
- Under certain atmospheric conditions, at temperatures of -30° C (-22° F) and lower, a large amount of ice fog may be caused by the engines. Taxiing on the runway should be kept to a minimum to avoid lowering the visibility.

FLIGHT

TAKEOFF

Water and slush standing on the runway will decrease the acceleration rate and extend the ground run. For effect of water or slush on takeoff performance, refer to Part 2 of the Appendix.

WARNING

Takeoffs with water or slush on the runway should be planned and executed with extreme care. If the depth of water or slush evenly distributed on the runway exceeds 1 inch, the takeoff should not be attempted.

When icy runways exist, move the decision point back 1000 feet from normal and determine the balance of the takeoff data using the shorter decision distance. Refer to Part 2 of the Appendix for additional information.

NOTE

At very low temperature and low pressure altitude, burner pressure limiters on the engines will operate to keep the internal engine pressure from exceeding fixed limits. This operation is very smooth, causing no temporary drops in thrust, and cannot be detected by the crew.

It is recommended that the anti-icing switches be turned to ON position on takeoff when icing conditions prevail, especially if slush or water is on the runway Under slush and wet runway conditions in winter weather, leave landing gear down approximately 30 seconds after takeoff to allow moisture to be blown from landing gear prior to braking wheels and retraction. If the engine and nacelle anti-icing is to be used during takeoff, refer to Part 2 of the applicable Appendix for performance loss.

DURING FLIGHT

Range and endurance are both affected favorably by low temperatures. See Parts 5 and 6 of the applicable Appendix for appropriate correction factors. Information regarding inflight icing may be found under "Ice and Rain," this section.

CROSSWIND OPERATION

On takeoffs and landings, set in any crosswind crab component required. See the crosswind landing gear position charts in Parts 2 and 3 of the applicable Appendix.

NOTE

When landing on a slippery runway, allow the aircraft to slow to taxi speed before actuating the crosswind crab centering switch.

LANDING APPROACH

Long flat unbroken stretches of snow make depth perception difficult. The tendency is to overestimate the airplane altitude. During snow periods, if approaching at night, visibility will be reduced by using both landing lights.

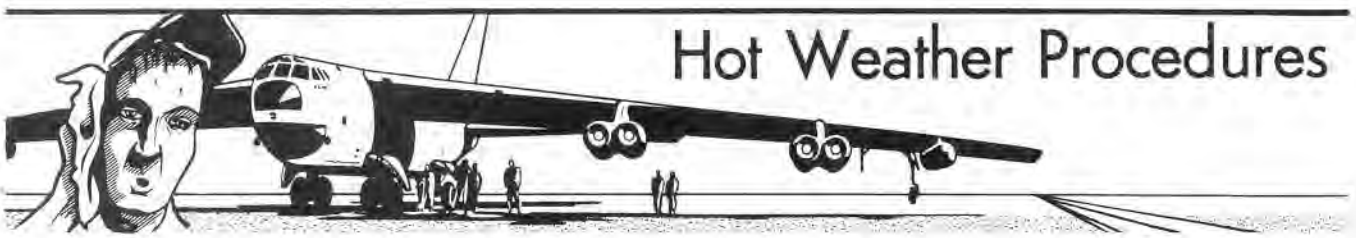
LANDING

If the runway is slick and landing is made in a crosswind, jettison the drag chute if directional control cannot be maintained by other corrective methods. If steering cannot compensate for a tendency to weathervane, differential power and proper use of spoilers are a definite asset on very slick runway surfaces. The chute should be recovered as soon as possible after landing to prevent its being frozen to the ground. Braking action approaches normal on a slippery runway if all-weather tires are installed. When landing on snow or ice, use normal braking action. Refer to Part 9 of the applicable Appendix for increase in ground run using the proper RCR number.

AFTER LANDING

Stopping of Engines

At low temperatures, the engines should be permitted to idle for at least 2 minutes before shutdown. This will prevent damage resulting from rapid temperature changes.



Hot Weather Procedures

Hot weather operation, both arid and tropical, requires additional attention and preparation other than the normal operating instructions given in Section II. Only specific information for care of the airplane during ground and flight operation will be covered in this section.

GROUND

BEFORE ENTERING THE AIRPLANE

1. Wear gloves and use care when working around metal surfaces of the airplane that are exposed to the sun.
2. Delicate electrical equipment such as communications and instruments must be completely dry. In locations where high humidity is encountered, equipment will be subject to malfunctions due to corrosion, fungus, and moisture absorption by nonmetallic materials. Such equipment should be kept warmer than the ambient temperature if possible to prevent condensation of moisture inside the units.
3. Units incorporating plastic or rubber should be protected from excessive temperatures and direct sun rays by the use of suitable covers.
4. Crew compartments will be cooled with a portable air conditioner prior to entering the airplane.

WARNING

When outside temperature is 80° F or above, the tail compartment must be precooled by a portable air conditioner. This will prevent the excessive heat condition that could cause serious injury to the gunner.

ON ENTERING THE AIRPLANE

If high humidity has caused instruments and cabin controls to become covered with moisture, dry thoroughly with flow of warm air from portable ground heater.

STARTING ENGINES

Use normal engine starting procedures, keeping ground tests to the minimum required time.

NOTE

Engines will accelerate to idle rpm on a hot day much more slowly than on a normal or cold day.

TAXIING

Use brakes as little as possible as cooling will be retarded by high temperatures.

FLIGHT

TAKEOFF AND CLIMB

1. Required takeoff distance increases during hot weather operation. See Parts 2 and 3 in the applicable Appendix for takeoff distances.
2. Follow normal climb pattern for conditions prevailing.

NOTE

The rate of climb should be held as low as practicable to reduce fuel vaporization losses.

LANDING

Use normal landing technique but expect a longer ground roll in hot weather. As soon as the parking position has been reached, have wheel chocks securely placed and release parking brakes at once to forestall possible damage to brake assemblies because of excess heat generated during taxiing.

POSTFLIGHT

1. Have closures and covers installed for protection from sun.
2. Leave windows and doors open for ventilation.

NOTE

If fuel tanks are topped off, overflow from expansion may present a fire hazard.

Desert Procedures

Very high and low temperatures and low humidity, together with the abrasive effect of blowing sand and dust, make desert operation considerably more difficult than normal conditions which are covered by operating instructions in Section II. Considerable damage to both airplane and engines can occur if the extra precautions covered here are not observed.

GROUND

BEFORE ENTERING AIRPLANE

On exterior inspection, if sand is evident on shock strut pistons or other hydraulic pistons where piston touches cylinder seal, have it removed with a dry soft cloth.

CAUTION

Position the airplane so that consideration can be given to other aircraft, personnel, and ground installations when engines are started. Sand blown by operating engines of one airplane can add hours to the maintenance problems of other aircraft or do bodily harm to personnel.

ON ENTERING THE AIRPLANE

Excessive dust accumulations on instrument dials and blown sand on and around movable flight controls, dials, and switches must be cleaned away.

STARTING ENGINES

Use normal starting procedures.

CAUTION

Get the airplane into the air as soon as possible after engines have been started so that dust and blowing sand will not be drawn through the engines with resultant damage to internal parts.

TAXIING

When taxiing, keep adequate distance between airplanes to prevent sand and dust kicked up by engine blast from being blown on and into the airplane and engines.

BEFORE TAKEOFF

Do not take off during sand or dust storms unless absolutely necessary; instead, head airplane into wind, stop engines, and have all protective covers and closures installed.

FLIGHT

TAKEOFF

Be prepared for sudden gusts of wind during takeoff run. In arid localities, extreme temperature variations may occur within a relatively short time; therefore, takeoff data should be reviewed immediately prior to takeoff.

DURING FLIGHT

CAUTION

Avoid flying through dust storms if possible; excessive dust and grit in the air will cause considerable damage to internal parts of the engine.

STOPPING ENGINES

Have dust covers and closures installed immediately to prevent blowing sand and dust from entering the engines.

POSTFLIGHT

See that all ducts and openings are covered. Have both forward and aft main landing gear wheel wells, fuselage, nose, pitot tube, and windshield covers installed if such covers are available.

NOTE

In extremely dusty locations where it is necessary to leave hatches or doors open for ventilation, all equipment in the cabin should be covered with dust-proof covers where possible to keep out dust and blowing sand.

NOTE

For Performance Data B-52E refer to T. O. 1B-52B-1-2.
For Performance Data B-52F refer to T. O. 1B-52E-1-2.

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