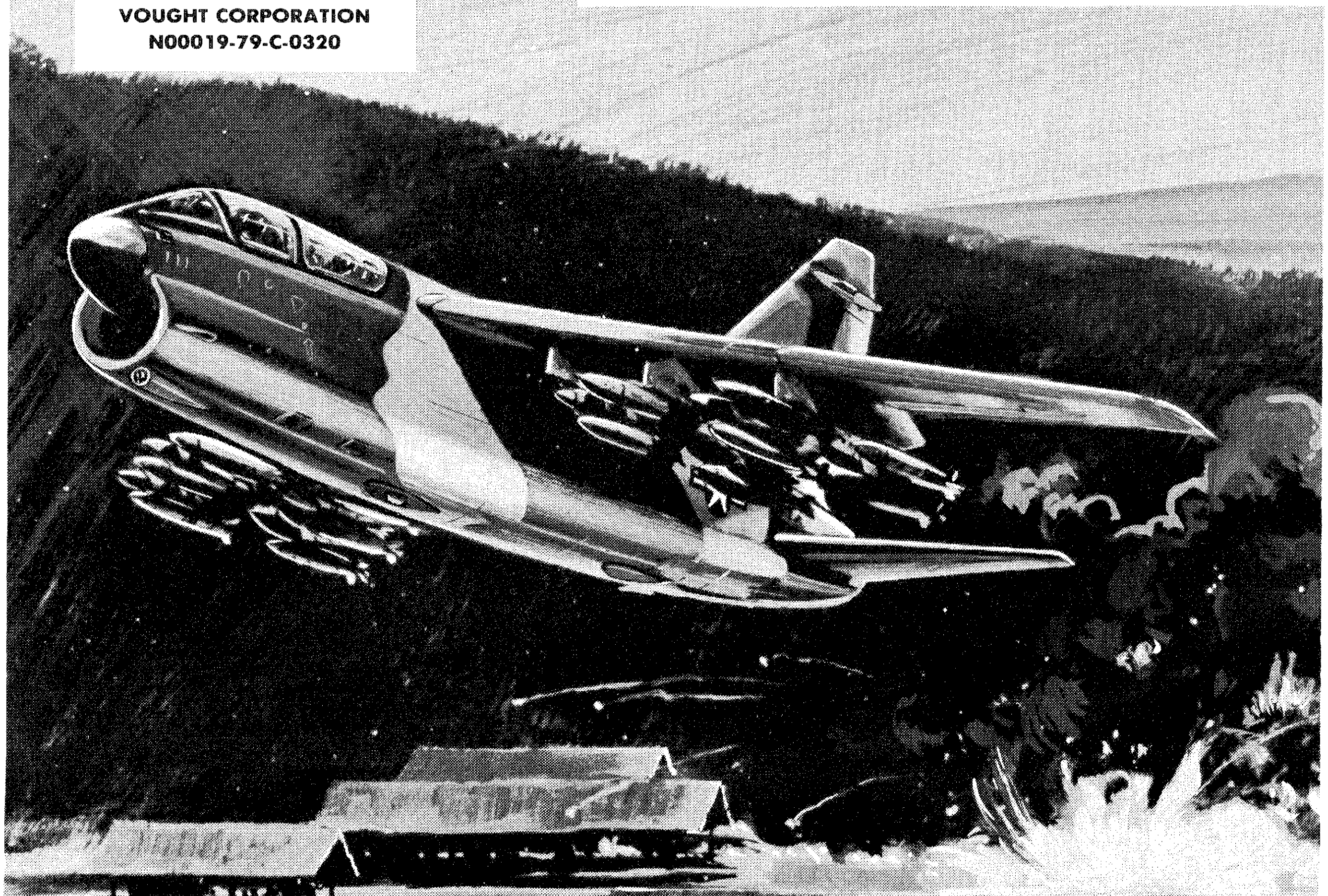
A-7K

AIRCREW WEAPON DELIVERY MANUAL (NONNUCLEAR)

USAF SERIES AIRCRAFT

VOUGHT CORPORATION
N00019-79-C-0320



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THIS PUBLICATION IS INCOMPLETE WITHOUT T.O. 1A-7K-34-1-1-1 AND T.O. 1A-7K-34-1-2.

REFER TO THE LATEST SAFETY/OPERATIONAL SUPPLEMENT INDEX FOR THE CURRENT STATUS OF NONNUCLEAR DELIVERY MANUALS, SAFETY/OPERATIONAL SUPPLEMENTS, AND FLIGHT CREW CHECKLISTS.

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15 October 1981

LIST OF EFFECTIVE PAGES

INSERT LATEST CHANGED PAGES. DESTROY SUPERSEDED PAGES.

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Dates of issue for original and changed pages are:

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TOTAL NUMBER OF PAGES IN THIS PUBLICATION IS 492 CONSISTING OF THE FOLLOWING:

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CURRENT FLIGHT CREW CHECKLISTS

T.O. 1A-7K-34-1-1CL-1
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TABLE OF CONTENTS

INTRODUCTION

SCOPE.

The A-7K is designed to attack the target in fully computed modes. Use of computed attack modes increases the effectiveness of the aircraft as a weapon delivery platform while substantially reducing the pilot's workload. A decrease in vulnerability to ground fire is realized in computed modes, since munitions can be dive tossed or lofted. Computed dive toss or loft deliveries permit releases at higher altitudes and reduce the requirement for target flyover. An additional benefit derived in the computed modes is the ability to take evasive action during the target run-in, prior to weapon release, while maintaining a lock on the target. This manual describes the computed attack modes and explains basic delivery tactics to the extent necessary to describe the Navigation/Weapon Delivery System and the derivation of ballistic tables. (Delivery tactics and weapons employment are described in greater detail in Air Force Manual 3-1, Secret Noforn.)

ASSOCIATED NONNUCLEAR WEAPON DELIVERY MANUALS.

Descriptive and procedural information related to confidential aircraft systems or munitions is presented in (Confidential) T.O. 1A-7K-34-1-1-1. T.O. 1A-7K-34-1-2, which also supplements this manual, consists strictly of ballistic tables. Since the NAV WD Computer stores its own ballistic data, the ballistic tables are of interest to the pilot only for anticipating a manual (noncomputed) delivery. Normal and emergency weapon release procedures are presented in abbreviated form in T.O. 1A-7K-34-1-1CL-1.

EXTERNAL STORES LIMITATIONS.

Limitations related to carrying, releasing, and jettisoning externally carried munitions, ECM pods, and fuel tanks are presented in T.O. 1A-7K-1. Limitations are presented in table form showing specifically how a given store shall be loaded on the aircraft and the airspeed, g limitations, and maximum dive angle for delivery. The limits shown in T.O. 1A-7K-1 represent maximum safe performance limits for the specific aircraft/store combinations depicted. This manual presents data to allow computation of optimum delivery envelopes and, as sucn, occasionally presents numbers which exceed the limits presented in T.O. 1A-7K-1. In such cases the limits in T.O. 1A-7K-1 are authoritative and override the data presented in this manual.

ARRANGEMENT.

SECTION I — DESCRIPTION.

Section I is divided into eight parts. Part 1, Mission Description, describes the overall aircraft mission with respect to weapon delivery capabilities. Included in Part I are descriptions of dive, level, ripple release, dive toss, loft, and over-the-shoulder delivery tactics. Also included are seoarate descriptions of bomb, mine, dispenser, gun, and rocket attacks and flare dispensing with delivery envelopes for each munition. Part 2, Navigation/Weapon Delivery System, describes the system which makes computed attack possible. The various attack modes and accompanying HUD symbology are presented, as well as the backup modes available in the event of equipment failure. The navigation functions of the system are presented in T.O. 1A-7K-1. Part 3, Aircraft Weapon Release System, describes all the equipment required to release, fire, or jettison munitions mounted on wing and fuselage stations. The main component of this system is the Armament Station Control Unit (ASCU), which is preset on the ground for munitions loaded for a given mission.

Part 4, Jettison Controls, describes the three basic store jettisoning capabilities: salvo, select, and auxiliary jettison. Part 5, Weapon Suspension Systems, briefly describes the wing and fuselage pylon arrangement, basic bomb ejector rack, triple ejector rack, multiple ejector rack, and fuselage pylon launcher. Part 6, Nonnuclear Combat Weapons, describes the aircraft-mounted M61A1 gun and all fuselage- and wing-mounted munitions presently certified for carriage on the aircraft.

Part 7, Nonnuclear Weapon Fuzes, provides descriptions of all current fuzes used with munitions carried on the aircraft. A bomb-fuze compatibility chart in Part 7 indicates which fuzes are compatible with any given munition. Part 8, Nonnuclear Training Weapons and Equipment, provides descriptions of practice equipment such as practice bomb/rocket dispensers, practice bombs, and target rockets.

SECTION II — NORMAL AIRCREW PROCEDURES.

Section II begins with general preflight checks common to all munitions. Following general preflight checks are procedures relating to specific munitions. Since procedures for computed attack modes are common to all munitions, the computed attack procedures are presented under Bombs and referenced under other munition headings. At the end of the section is a general dearming check common to all munitions.

SECTION III — EMERGENCY AIRCREW PROCEDURES.

Section III contains procedures for releasing hung ordnance, for jettisoning, and for firefighting and evacuation. The three basic types of jettisoning available are salvo, select, and auxiliary (live or inert).

SECTION IV — SUPPLEMENTARY DATA.

Section IV contains information on the amount of impact error to be expected for deviations from planned TAS, altitude, or dive angle in a manual mode of attack. Error analyses are presented for manual dive bombing, manual low level bombing, and noncomputed rocket launching.

SECTION V — PLANNING PROCEDURES AND SAMPLE PROBLEMS.

Section V provides the pilot with the steps required to plan a weapon delivery mission. Included are a description of Section VI charts and tables, paragraphs on use of ballistic tables in T.O. 1A-7K-34-1-2, and sample mission problems.

SECTION VI — PLANNING CHARTS.

Section VI provides charts applying to the delivery of any munition. Charts in this section are used along with the ballistic tables in T.O. 1A-7K-34-1-2 to determine sight settings and release parameters.

CHANGE SYMBOL.

The change symbol, as illustrated by the black line in the margin of this paragraph, indicates text changes made to the current revision. Changes to illustrations are indicated by a miniature hand.

WARNINGS, CAUTIONS, AND NOTES.

The following definitions apply to warnings, cautions, and notes found throughout the manual.

WARNING

An operating procedure, practice, etc, which, if not correctly followed, could result in personal injury or loss of life.

CAUTION

An operating procedure, practice, etc, which, if not strictly observed, could result in damage to, or destruction of, equipment.

NOTE

An operating procedure, condition, etc, which it is essential to highlight.

USE OF WORDS SHALL, WILL, SHOULD, AND MAY.

The words "shall" or "will" are used to indicate a mandatory requirement. The word "should" is used to indicate a non-mandatory desire or preferred method of accomplishment. The word "may" is used to indicate an acceptable or suggested means of accomplishment.

YOUR RESPONSIBILITY — LET US KNOW.

This manual is kept up-to-date through review conferences with operating personnel. The updating process includes incorporation of accident and flight test reports and modifications to aircraft systems. Oklahoma City Air Logistics Center is the Air Force agency responsible for the technical content of this manual. If you have any comments or questions regarding this manual, forward them to Oklahoma City Air Logistics Center (MMSRKE), Tinker AFB, Oklahoma 73145. Corrections to this manual should be forwarded on AF Form 847 through your Aircrew Standardization/Evaluation channels to Oklahoma City Air Logistics Center (MMSRKE), Tinker AFB, Oklahoma 73145.

AUTHORIZATION FOR LOCAL REPRODUCTION.

Local reproduction of charts, tables, or any data appearing in this manual, the classified supplement, checklists, and T.O. 1A-7K-34-1-2 is authorized.

PUBLICATION DATE.

The date appearing on the title page of this manual represents the currency of material in the manual. (The publication date is not the printing or distribution date.) When referring to the manual, use the publication date plus the date of the latest change.

TECHNICAL ORDER SUMMARY

This summary contains only those modifications affecting safe or efficient operation of the aircraft or its systems. Upon completion of the modification, or incorporation of the TCTO in all applicable aircraft, the modification will be withdrawn from the list and information pertaining to the unmodified configuration deleted from the manual.

TECHNICAL ORDER	ECP NO.	TITLE/DESCRIPTION	PRODUCTION EFFECTIVITY	RETROFIT EFFECTIVITY

NONNUCLEAR DELIVERY MANUAL AND SUPPLEMENT STATUS

This page will be published with each Safety Supplement, Operational Supplement, and Nonnuclear Delivery Manual Change or Revision. It provides a listing of the current Nonnuclear Delivery Manual and Safety and Operational Supplements. The supplements received should follow in sequence. If one listed on this page is missing, see the Publications Distribution Officer and get a copy. The latest Safety/Operational supplement index should be checked periodically to make sure you have the latest basic manuals, checklist, and supplements.

CURRENT NONNUCLEAR DELIVERY MANUAL	DATE	CHANGED
T.O. 1A-7K-34-1-1	15 October 1981	
T.O. 1A-7K-34-1-2	1 May 1981	
T.O. 1A-7K-34-1-1-1	15 October 1981	

CURRENT FLIGHT CREW CHECKLIST	DATE	CHANGED
T.O. 1A-7K-34-1-1CL-1	15 October 1981	

SAFETY SUPPLEMENTS PREVIOUSLY INCORPORATED, RESCINDED, OR REPLACED

SUMMARY OF SAFETY SUPPLEMENTS INCORPORATED IN THIS CHANGE

Number	Date	Short Title	Pages Affected

OUTSTANDING SAFETY SUPPLEMENTS

OPERATIONAL SUPPLEMENTS PREVIOUSLY INCORPORATED, RESCINDED, OR REPLACED

SUMMARY OF OPERATIONAL SUPPLEMENTS INCORPORATED IN THIS CHANGE

Number	Date	Short Title	Pages Affected

OUTSTANDING OPERATIONAL SUPPLEMENTS

GLOSSARY

A

ADC	Air Data Computer.
ADI	Attitude Director Indicator.
AFCS	Automatic Flight Control System.
AGL	Altitude above ground level.
AGM	Air-launched surface attack guided missile.
AGR	Air-to-ground ranging.
AIM	Air-launched intercept-aerial guided missile.
Aiming point	In bombing, the point on the ground used as a reference to determine the moment of designation or bomb release. The target itself may not be the aiming point.
Aiming symbol	A diamond-shaped symbol on the HUD, provided to enable the pilot to locate or track a target.
AN	A prefix to a mark or model designation to denote use by both Army/Air Force and Navy.
AOA	Angle of attack.
AOD	Aim Off Distance.
AOP	Aim Off Point.
AP	Armor piercing.
API	Armor piercing incendiary.
ASCU	Armament Station Control Unit.
ASL	Azimuth Steering Line.

B

BARB	Beacon Aided Radar Bombing.
BFD	Battery firing device.

Glossary (continued)

BITE	Built-In Test Equipment.
BL	Bore line. A line through a gun barrel bore extending to infinity.
BOC	Bomb-on-Coordinates.
Bomb stick	The number of bombs released on a bombing run.
BLU	Bomb, live unit.
Breakaway X	A flashing X on HUD to indicate that an immediate pullup action must be made to avoid impact with target area or weapon blast radius.

C

CBU	Cluster Bomb Unit.
CCIP	Continuously Computed Impact Point.
CCIPSL	Continuously Computed Impact Point Steering Line.
CCRP	Continuously Computed Release Point.
CEP	Circular error probability.
CG	Center of gravity.

D

Designation	An action that ground-stabilizes the HUD aiming symbol or radar cursors on the selected aiming point and records the aiming point in the computer. Also used in updating procedures.
DFP	Depression from Flight Path.

E

ECP	Engineering Change Proposal.
EOB	Electro-optical bomb.

F

FDC	Flight Director Computer.
FFAR	Folding fin aircraft rocket.
FFOD	Firefighting operational distance.
Fire bomb	An incendiary or napalm bomb.
Fire pulse	An electrical impulse transmitted by the ASCU to fire/release stores.

Glossary (continued)

FLR	Forward-Looking Radar, AN/APQ-126(V)6.
FMU	Fuze munition unit.
FOV	HUD Field of View.
FPM	Flightpath marker. Represents the terminus of the aircraft velocity vector resultant.
FRL	Fuselage reference line.

G

GBU	Guided Bomb Unit.
GMP	Ground map, pencil.
GMS	Ground map, spoiled.
GP bomb	General purpose bomb.
GPU	Gun Pod Unit
Ground track	The actual line of movement of an aircraft over the ground.
GSR	Ground Speed Required.

H

HDGP	High-drag general purpose bomb.
HE	High explosive.
HEAP	High-explosive armor-piercing.
HEAT	High-explosive antitank.
HEI	High-explosive incendiary.
Horizon and flightpath angle lines	Lines displayed on HUD every 5° on a one-to-one ratio with the real world.
HUD	Head-Up Display. An optical and electronic device that projects flight information, in symbolic form, into the pilot's forward field of view.
HVAR	High velocity aircraft rocket.

Glossary (continued)

I

ICAO	International Civil Aviation Organization.
IMS	Inertial Measurement Set.
IP	Initial point. A point over which an aircraft begins an attack.
IR	Infrared.

L

Lateral steering error	Difference between actual and desired ground track.
LAU	Launcher unit.
LDGP	Low-drag general purpose bomb.
LGB	Laser guided bomb.
LOD	Line of departure. Direction of a bullet at the instant it clears the muzzle; direction of a bomb or rocket at the instant it is launched.
LOS	Line of sight.
LTS	Laser Target Symbol.
LUU	Illumination unit.

M

Manual ripple	An attack using a manual release with computed bomb spacing.
MAU	Miscellaneous armament unit.
MER	Multiple Ejector Rack.
MIL	Milliradian. One mil = 0.0573 degree. One degree = 17.45 mils. Approximately 1 foot at 1,000 feet.
MN	Mach number.
MOD	Modification.
MSL	Mean sea level.

N

NAV WD Computer	Navigation/Weapon Delivery Computer, AN/ASN-91(V).
NMI	Nautical mile.

Glossary (continued)

O

OAP	Offset aiming point.
Offset bombing	Bombing procedure which employs an aiming point other than the actual target.
OFP	Operational flight program (tape).
O/S	Over-the-shoulder bombing attack.

P

Passive detection	Target detection by a means that does not reveal the detecting source.
Passive homing	Guidance that uses energy emitted by a target. AIM-9B is a passive homing weapon.
PCO	Power changeover.
PPI	Plan Position Indicator.
Pullup anticipation cue	Displayed in attack mode to indicate an approaching pullup requirement.
Pylon	A component attached to an aircraft to carry, release, or jettison external stores.

R

RBL	Radar boresight line.

S

Sight setting	The value in mils that the HUD standby reticle is depressed.
Slant range	LOS distance from the aircraft to the target.
Solution cues	Indicate that a valid weapon delivery solution has been reached. Lower solution cue indicates solutions for dive, level and dive toss deliveries. Upper solution cue is used for loft and over-the-shoulder deliveries. In CCRP modes, cues appear on ASL when target is in range. In CCIP mode, lower cue is displayed on CCIPSL to indicate weapon instantaneous impact point.
Standby aiming reticle	A display on the HUD used in the event of HUD failure. Can be used for computed delivery with NAV/WD Computer operating, or for manual delivery. May be depressed manually from 0 to 210 mils with respect to aircraft datum line.
SUU	Stores suspension and release unit.

Glossary (continued)

T

TCA	Track crossing angle.
TDD	Target Detecting Device.
TER	Triple Ejector Rack.
TGM	Training Guided Missile.
TGTT	Desired Time of Arrival at Target (Target Time).
TISL	Target Identification Set, Laser.
TP	Target practice.
TPT	Target Practice-Tracer.
Trajectory	Flightpath of a projectile/bomb from firing/release to impact.
TTG	Computed Time to Go.

U

UTM	Universal Transverse Mercator.

V

Velocity vector	A vector quantity denoting both magnitude and direction.
VT	Variable time.

Z

ZSL	Zero sight line.

SECTION I
DESCRIPTION

TABLE OF CONTENTS.

PART 1 – MISSION DESCRIPTION

INTRODUCTION.

Weapon delivery with the A-7K aircraft will generally be performed in one of four continuously computed release point (CCRP) modes (VISUAL ATTACK, VISUAL ATTACK OFFSET, BOMB-ON-COORDINATES, and BOMB-ON-COORDINATES OFFSET) or one continuously computed impact point (CCIP) mode. The following paragraphs describe the maneuvers available in both computed and manual weapon delivery, the maximum accuracy parameters of the NAV WD Computer in computed attack modes, and the general procedures involved in manual bombing, gun and rocket attacks, and flare delivery.

DELIVERY MANEUVERS.

DIVE BOMBING (ALL COMPUTED MODES EXCEPT CCIP).

Computed dive bombing is normally performed in visual flight conditions using either the VISUAL ATTACK or the VISUAL ATTACK OFFSET mode. The capability for computed dive bombing is also available in BOMB-ON-COORDINATES (BOC) mode or BOMB-ON-COORDINATES OFFSET (BOC OFFSET) mode. In a computed dive bombing attack, the NAV WD Computer solves the bomb ballistics problem using weapon ballistic equations which are stored in the computer. Mission planning is reduced to determining the number, spacing, and type of munition to be released on the target during each pass. During the dive bombing run, the pilot is free to vary airspeed and pitch angle, if desired. If conditions dictate and weapon type selected permits, he can pull up and convert what began as a dive bombing run into a level, dive toss, loft, or over-the-shoulder maneuver. The computer solution is displayed between the pilot's eyes and the target on a Head-Up-Display (HUD). Figure 1-1 illustrates dive bombing in both computed and manual modes.

Dive bombing in a manual mode requires a great deal more preflight planning. Manual mode is normally selected only when a NAV WD Computer failure or multiple electronic failures preclude use of a fully computed attack mode. The parameters of dive angle, altitude, airspeed, distance from target, and power setting must be determined to place the aircraft at a predetermined release altitude and distance from the target with a predetermined bomb release velocity to effect an accurate impact. Release parameters and trajectory data for various dive angles are provided in the dive bombing tables in T.O. 1A-7K-34-1-2.

Because of the long periods of wind effect on bomb trajectory, it is also important that the pilot know the amount of wind effect and, primarily, the wind velocity at release altitude. The standby reticle is used with the altimeter to determine the release point. The bombing tables provide the standby reticle depression angle below the flightpath. To obtain the actual standby reticle setting, the depression angle from the bombing table is algebraically summed with the zero sight line angle of attack obtained from the angle-of-attack chart in Section VI.

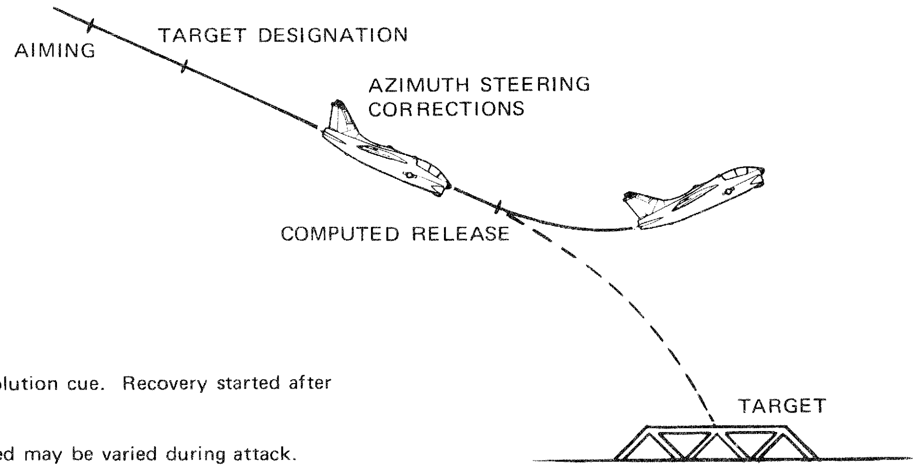
Several factors must be considered when determining an indicated release altitude for dive bombing in a manual mode: altitude loss during pullout, minimum aircraft ground clearance, altimeter lag, fragment envelope clearance, fuze arming time, altimeter position error, and target elevation. The altimeter is set according to target pressure reduced to sea level. Immediately following bomb release, a 3g or 4g pullout is initiated. The acceleration rate of 3g's or 4g's is normally attained in 2 seconds after bomb release.

LEVEL BOMBING (ALL COMPUTED MODES EXCEPT CCIP).

Level bombing can be performed with or without the NAV WD Computer. The primary method is using the computer in one of the four CCRP computed attack modes (VISUAL ATTACK, VISUAL ATTACK OFFSET, or BOC OFFSET). The degree of target visibility determines which computed attack mode to use. The computer solves the ballistic problem for various release speeds and altitudes, depending on the weapon used. Weapon ballistics are stored in the computer. Mission planning consists only of determining the numbers, spacing, and type of munition to be released on the target during each pass. During the level bombing approach run, the pilot is free to vary airspeed and pitch angle, if desired. However, at the bomb release point, airspeed and altitude must be maintained constant or the selected bomb spacing will not be achieved. If conditions dictate and the weapon type selected permits,

DIVE BOMBING

DIVE BOMBING
IN ALL COMPUTED ATTACK MODES EXCEPT CCIP



- Release is on lower solution cue. Recovery started after weapon release.
- Dive angle and airspeed may be varied during attack.

DIVE BOMBING
IN MANUAL OR MANUAL RIPPLE MODES

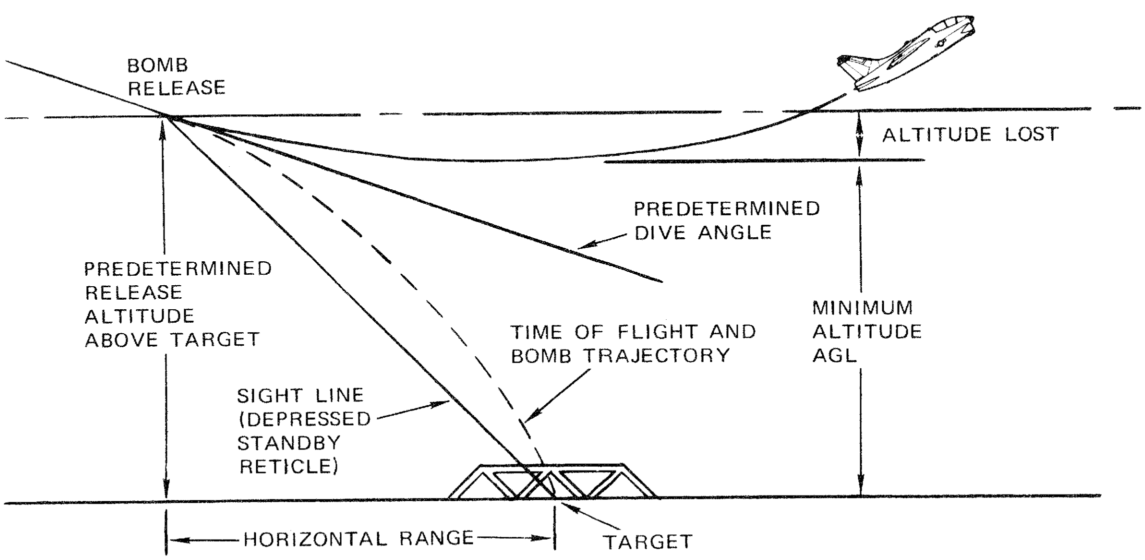


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Figure 1-1

he can pull up and convert what began as a level bombing run, into a dive toss, loft, or over-the-shoulder maneuver. The computer solution is displayed on the HUD. Figure 1-2 illustrates level bombing in both computed and manual modes.

Level bombing in manual modes requires more extensive preflight planning. Considerations are essentially the same as in dive bombing. The pilot flies the aircraft to position it at a predetermined release altitude, slant range from the target, and release velocity in order to have an accurate bomb impact. A depressed standby reticle line corrected for rangewind is used as a release reference. Correction for crosswind during this delivery requires an offset aimpoint due to aircraft drift at release affecting bomb line of flight. Level bombing tables for general purpose bombs are provided in T.O. 1A-7K-34-1-2 for altitudes from 500 feet to 20,000 feet.

Approaching the target in a manual mode, the aircraft is flown wings level at a constant altitude and a stabilized airspeed. After bomb release, the approach course may be held or an escape maneuver performed. The most critical parameters affecting level bombing accuracy are release altitude above target and pitch attitude.

DIVE TOSS BOMBING AND LOFT BOMBING.

Dive toss and loft bombing are performed only with the aid of the NAV WD Computer. Any of the following computed attack modes can be used: VISUAL ATTACK, VISUAL ATTACK OFFSET, BOC, or BOC OFFSET. The degree of target visibility determines which computed attack mode to select. The advantage of dive toss or loft bombing is the reduced exposure to ground fire.

Approach the target in a dive. Two solution cues appear at the top of the HUD when the target is in range. A maximum angle pullup at the earliest in-range indication results in a maximum range dive toss of the weapon to the target. However, the pilot will normally delay pullup until sometime after the cue becomes unpegged and starts down toward the flightpath marker (FPM). To effect a dive toss, the pilot pulls up to intercept the lower solution cue. He presses the armament release button before the FPM intercepts the lower cue. If a loft is desired, the pilot pulls up through the lower cue without pressing the release button. He presses the button before the FPM intercepts the upper solution cue. In either the dive toss or loft delivery, weapon release occurs when the flightpath marker intercepts the appropriate solution cue. Dive toss and loft deliveries are illustrated in figure 1-3.

Release altitude in any computed dive toss maneuver must consider required fuze arming time and desired impact pattern lengths on the ground. Refer to Section VI to determine dive angles, altitudes, airspeeds and g forces required to ensure adequate fuze arming times.

OVER-THE-SHOULDER BOMBING.

An over-the-shoulder delivery can be made with the NAV WD Computer. Over-the-shoulder is not considered a primary delivery tactic, but can be used as a backup for a dive level or dive toss bombing attack. If a release is not made on the first solution cue, the attack may be converted to an over-the-shoulder delivery by overflying the target and then executing a 4g pullup, while following HUD symbology. Release occurs on the second (upper) solution cue, provided the armament release button is held depressed. This tactic is used only in delivery of low-drag bombs. See figure 1-4.

RIPPLE RELEASE BOMBING.

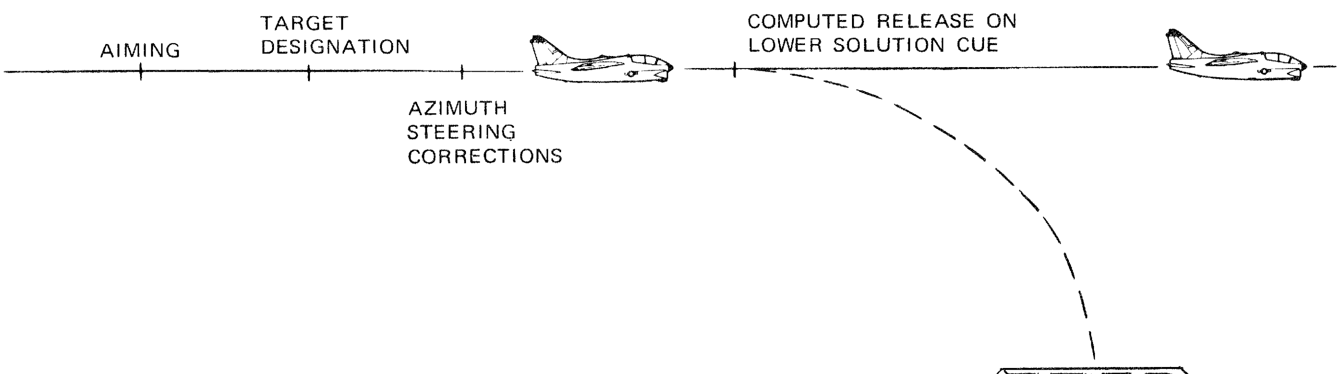
Ripple release bombing is the release of two or more bombs in sequence with a predetermined interval between release pulses. The NAV WD Computer provides this capability in all computed attack modes and in the manual attack mode in either SINGLES or PAIRS release sequence. The interval between release pulses is selected by the pilot using the INTERVAL-FT thumbwheel with the interval selected subject to the computer's programmed minimum release interval (MRI). The number of release pulses selected on the QUANTITY thumbwheel while in the PAIRS release sequence is the number of paired releases made, not the number of bombs released. Figure 1-5 depicts, a typical ripple release. Refer to Minimum Release Interval description in this section for a discussion on MRI. Refer to Part 3, Aircraft Weapon Release System, for a description and illustrations of the QUANTITY and INTERVAL-FT thumbwheels.

NOTE

> When dive toss bombing in ripple, a pronounced g buildup occurs as the bombs are released. The g limits published for delivery of these bombs take this effect into consideration. Aircraft limits will not be exceeded if delivery restrictions are observed.
>
> In both computed ripple release mode and manual ripple release mode, all QUANTITY and INTERVAL-FT thumbwheel setting changes are ignored while the ripple release is in progress.

LEVEL BOMBING

LEVEL BOMBING
IN ALL COMPUTED ATTACK MODES EXCEPT CCIP.



- Release is from level flight on lower solution cue.
- Flightpath and airspeed may be varied during approach.

LEVEL BOMBING
IN MANUAL OR MANUAL RIPPLE MODE

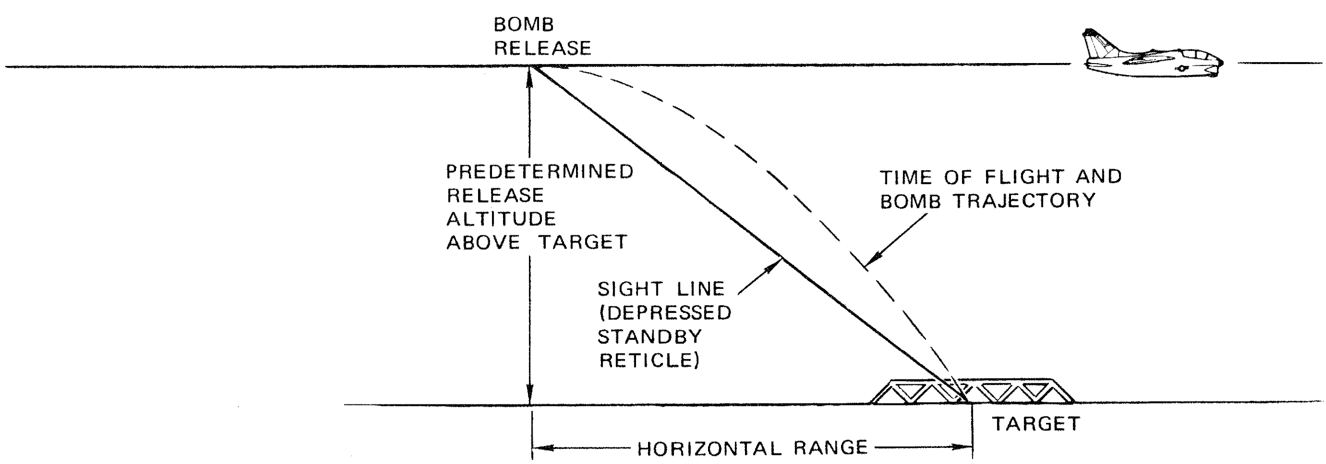


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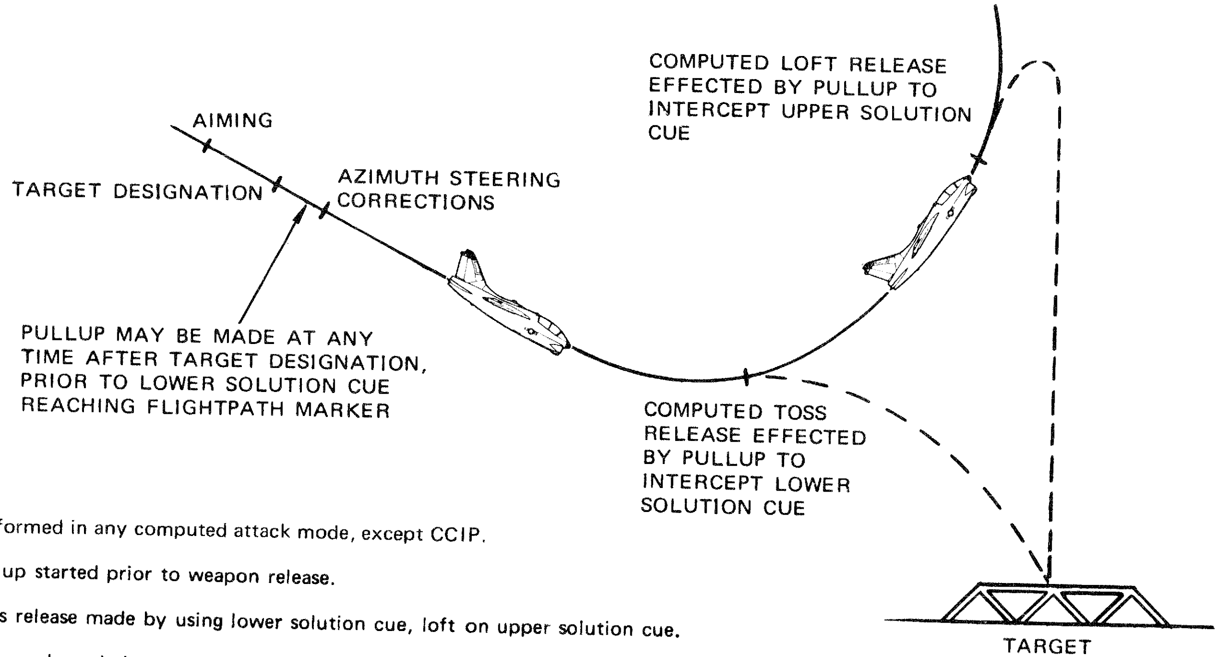
Figure 1-2

DIVE TOSS OR LOFT BOMBING



- Performed in any computed attack mode, except CCIP.
- Pullup started prior to weapon release.
- Toss release made by using lower solution cue, loft on upper solution cue.
- Dive angle and airspeed may be varied during attack.

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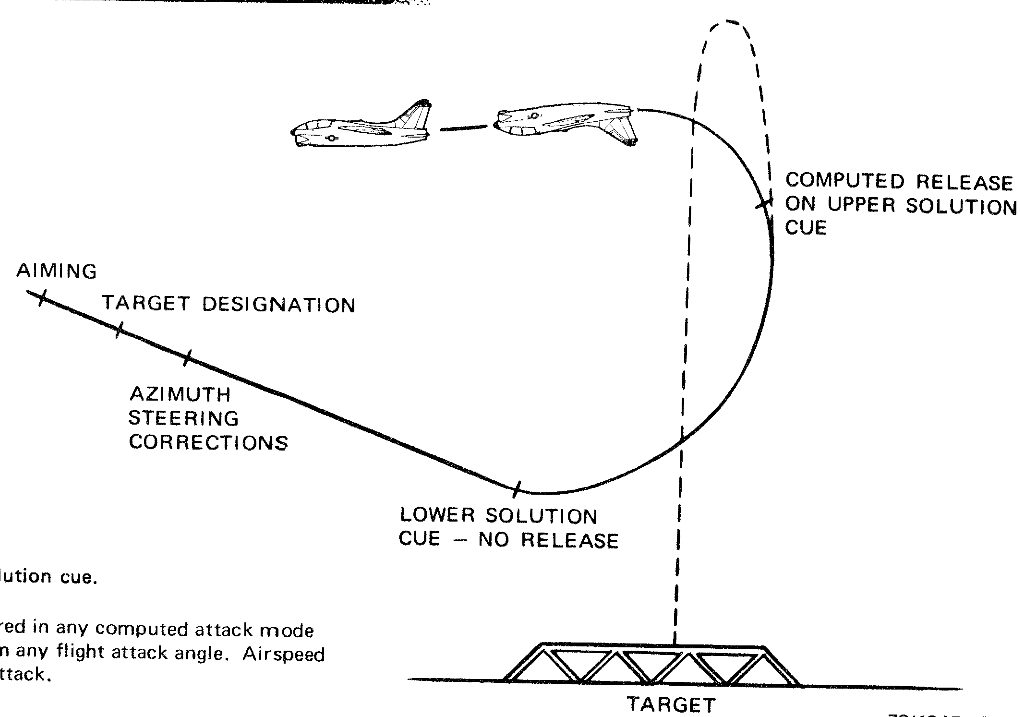
Figure 1-3

OVER-THE-SHOULDER BOMBING



- Release is on upper solution cue.
- Maneuver may be entered in any computed attack mode (except CCIP) and from any flight attack angle. Airspeed may be varied during attack.

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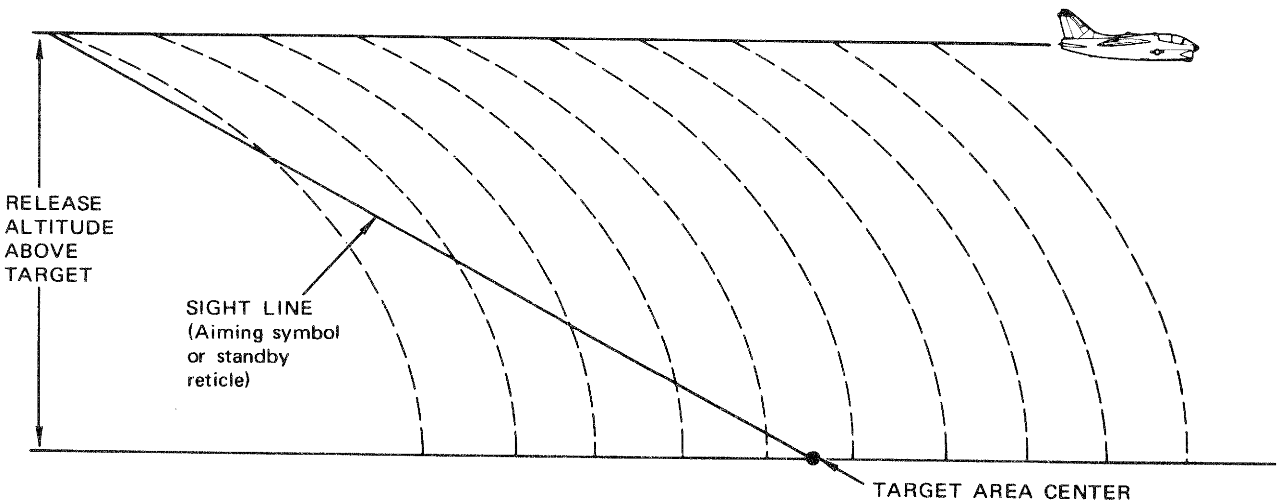
Figure 1-4

TYPICAL RIPPLE RELEASE



- A computed ripple release is compatible with level, dive, dive toss, or loft delivery tactics. Computer centers bomb stick on target center.
- In a manual ripple release, the interval set on the INTERVAL/FT thumbwheel is available only in straight and level flight. Computer does not center bomb stick on target center.

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Figure 1-5

Computed Ripple Release Mode.

In computed bombing modes, the NAV WD Computer provides a bombing solution to center the stick (quantity selected) of bombs on the target. If an odd number of bomb releases is selected, the computer places the center bomb (or pair of bombs) on the target. If an even number of releases is selected, the computer places the two middle bombs (or pair of bombs) an equal distance short of and beyond the target. Also, the computer will provide release pulses at the interval which will result in spacing between bomb impact points on the ground as selected on the INTERVAL-FT thumbwheel, unless the MRI imposes a higher interval. If the MRI is higher than the selected interval, the computer will adjust the stick length to obtain equal spacing between bomb impact points and will adjust the initial release point to center the stick on the designated target.

The first bomb in a stick is released when the solution cue intersects the flightpath marker while holding the armament release button depressed. The armament release button must be depressed until the complete stick of bombs is released. If the armament release button is released prematurely the computer will continue to provide release pulses to the ASCU but the bombs will not be released. Computed ripple release may be performed using level, dive, dive toss, and loft delivery tactics.

Computer ripple release of submunitions from aircraft retained dispensers is possible if the dispenser has a single release capability compatible with the NAV WD Computer release pulse duration. Most dispensers of this type also have integral intervalometers to provide a ripple release from the dispenser; however, these intervalometers are not always compatible with the NAV WD Computer. Information concerning the compatibility of dispenser intervalometers with the NAV WD Computer is contained in the description for individual dispensers in Parts 6 and 8, Section I.

Manual Ripple Release Mode.

In manual ripple bombing, the NAV WD Computer acts as an intervalometer and provides the selected quantity (QUANTITY thumbwheel) of release pulses at the selected interval (INTERVAL-FT thumbwheel). The stick is not automatically centered on the target and the first bomb (or pair of bombs) is released upon depression of the armament release button. The computer provides the second and subsequent release pulses as the aircraft travels the distance over the ground equal to the INTERVAL-FT thumbwheel setting, unless the MRI imposes a higher release interval. If the MRI is higher than the selected interval, a larger than planned bomb spacing results.

In manual ripple release, the standby reticle is used to determine the release point with the armament release button being depressed when the reticle pipper is on the center of the target. The standby reticle depression is preplanned to place the center of the bomb stick on the center of the target using the ballistic tables in T.O. 1A-7K-34-1-2 and the planning charts in Section VI. Calculations must also be made to determine airspeed, altitude, slant range to target, and dive angle to be used in the attack. Section V contains directions for computing the manual ripple release envelope and parameters.

Manual ripple release may be accomplished using the level or dive delivery tactic. In a dive delivery, impact patterns must be determined from the charts in Section VI. Delivery in manual ripple is identical to the single release in manual with the following additions:

Safe escape and dive recovery must be based on the release altitude of the last bomb.

The standby reticle depression or bomb range is computed to place the center of the impact pattern on target.

Wind correction is based on the time of fall of the first bomb released.

The minimum release altitude for a level ripple release is based on a straight ahead escape.

During the manual ripple release, a straight line flightpath must be maintained if the calculated pattern length is to be obtained. Pullup can be executed as bombs are releasing, however the tossing effect and decreasing dive angles of the pullup will increase the bomb spacing and pattern length on the ground. The bomb spacing can reach and even surpass the spacing selected on the INTERVAL-FT thumbwheel. If dive toss delivery is planned, the effects of the pullup must be accounted for in mission preplanning. If a small number of bombs is being released, pullup can be started as bombs are releasing with little or no effect on bomb spacing as release should be completed before the effects of pullup are felt. The pipper passes beyond the target during the ripple release. (The first bomb should be released when the pipper is on target. Section V contains an explanation of how to calculate pattern length and standby reticle depressions.)

An additional factor must be considered when performing manual ripple release using the dive delivery tactic. In manual ripple mode, the interval selected on the INTERVAL-FT thumbwheel is the distance flown over the ground by the aircraft between release pulses and is only obtained as actual spacing between bomb impact points when the delivery is made in straight and level flight. Therefore, when delivery is made while in a dive, the actual bomb spacing on the ground is less than the interval selected, and the difference between the two increases as dive angle increases. This effect is depicted in figure 1-6 for a typical dive bombing mission. Section V contains directions for determining bomb spacing using a dive delivery in manual ripple release mode.

DIVE BOMBING OR LEVEL BOMBING (CCIP MODE).

The continuously computed impact point (CCIP) bomb mode can be used to attack visually acquired targets using dive, low altitude level, or low altitude banked delivery. The computed impact point is continuously calculated, and HUD symbology displays LOS to the point. Azimuth steering information is not calculated, and the mode is unusable if the HUD fails. The NAV WD Computer generates a release pulse as soon as the armament release button is depressed, provided Master Arm is selected.

The CCIP bomb mode is initiated when CCIP is selected on the Master function switches and the priority selected station's ASCU code has computed bomb ballistics. Any DEST/MARK, including 0, is allowable.

All HUD attack symbology associated with the CCIP bomb mode is enabled at mode initiation. The attack symbology consists of the continuously computed impact point steering line (CCIPSL), lower solution cue, pullup anticipation cue, and pullup cue. The pullup anticipation cue is displayed at mode initiation and appears along an imaginary line directly below the FPM. Both ground and blast avoidance calculations are performed. The point of intersection of the CCIPSL and the lower solution cue identifies the continuously computed impact point. For a computed ripple release, the point is for the center of the calculated bomb stick.

TYPICAL BOMB SPACING IN MANUAL RIPPLE

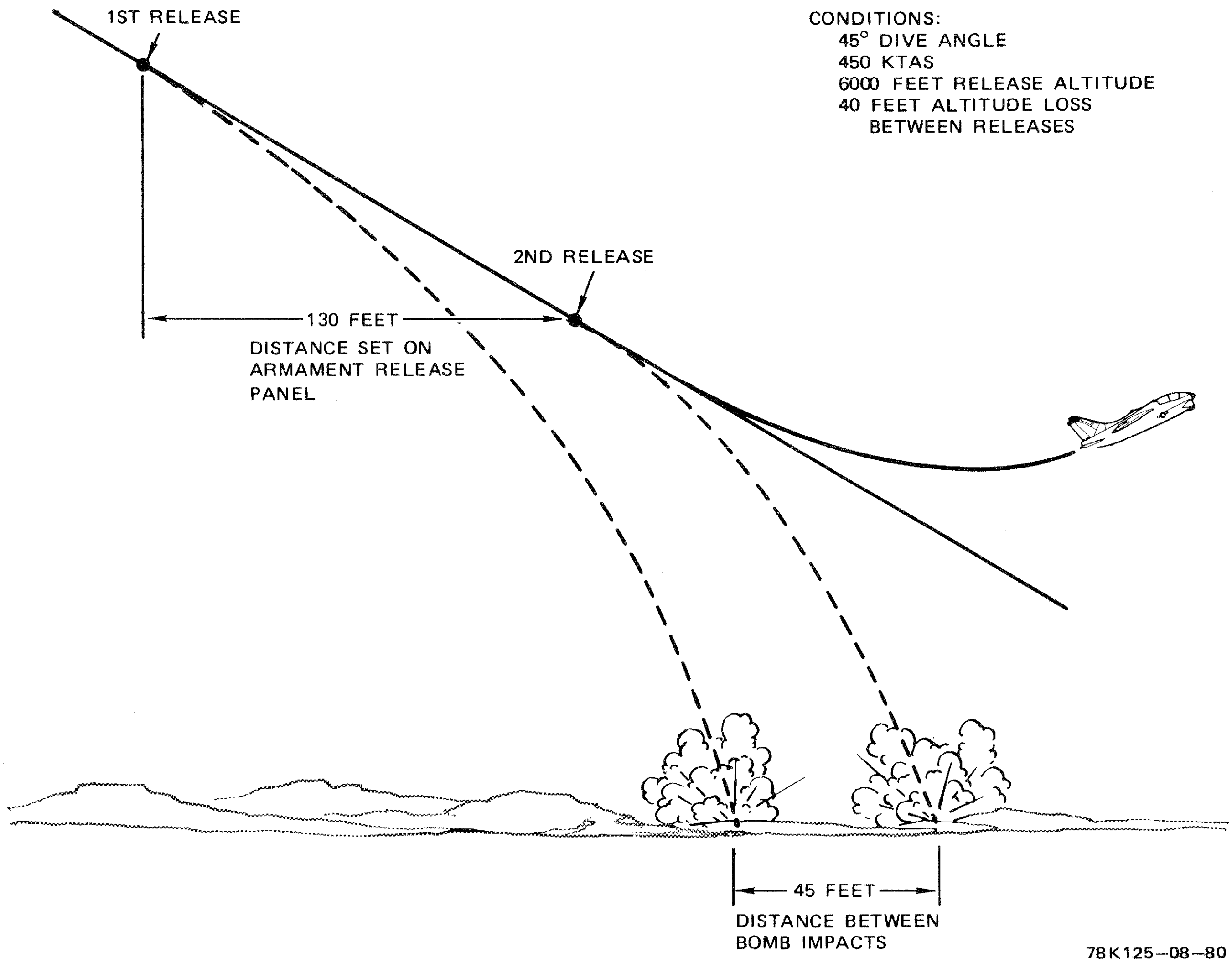


Figure 1-6

All three ranging sensors are available, if reliable and reasonable. The forward-looking radar (FLR), is ON, automatically switches to the AGR mode and begins radiating at mode entry. DATA 24 determines whether BARO (−000000) or Radar Altimeter (+000000) ranging has priority. The stored value for Burst HT, corresponding to the selected DEST/MARK, is ignored in weapon delivery calculations. Stored values for ALT/MSLP are used if BARO ranging is in priority.

Target designation is not required in the CCIP bomb mode. The mode is fully mechanized at mode initiation and all weapon delivery calculations associated with the mode begin immediately.

The positioning of the CCIPSL with respect to the FPM and the display of the lower solution cue are determined by the angle of impact. The HUD symbology displays the CCIPSL as an earth vertical line through the FPM until the computed impact point is within the usable HUD FOV. When the computed impact point is within the usable HUD FOV, the lower solution cue appears and the CCIPSL is detached from the FPM and positioned through the solution cue. The intersection of the CCIPSL and the solution cue indicates the instantaneous impact point of the selected store. CCIP bombing symbology is depicted in figure 1-29.

1. The NAV WD Computer continuously computes the impact to angular FOV limits measured from the center of the HUD combiner. Elevation is up and down along a line parallel to the side of the combiner and azimuth is left and right.

2. When the computed impact point is outside of 16° in azimuth or 20° in elevation, the CCIPSL is centered in the FPM, is parallel to earth vertical, and is perpendicular to the HUD pitch lines.

3. When the computed impact point is between 11° and 16° in azimuth or 16° and 20° in elevation, the CCIPSL shifts vertically downward so that 4° of the line is above the FPM and 12° is below. This 4° drop in CCIPSL position is to alert the pilot that the lower solution cue is about to be displayed in the usable HUD FOV. The CCIPSL remains parallel to earth vertical and perpendicular to the HUD pitch lines.

4. When the computed impact point is less than 11° in azimuth and 16° in elevation, the lower solution cue is displayed on the HUD and the CCIPSL shifts from the FPM to a position through the solution cue. The CCIPSL is now positioned 12° above and 4° below the solution cue, is parallel to the side of the HUD combiner, and perpendicular to the solution cue.

5. Subsequent to movement of the CCIPSL to intersect the solution cue, the CCIPSL may or may not continue to pass through the flightpath marker. Any offset of the CCIPSL in respect to the FPM after solution cue appearance is a function of aircraft roll or crosswind effects and may be ignored.

The computed impact point is being continuously recalculated even when the lower solution cue is not displayed in the HUD FOV. When the cue is first displayed, it will be 4° below the lower end of the CCIPSL, but still centered on the computed impact point. Bombs can be released any time after the CCIP mode is initiated. The NAV WD Computer will generate release pulse whenever the armament release button is depressed, regardless of the target to impact angle or the computed impact point-to-target relationship.

NOTE

The range and bearing displayed by the HSI, with AUTO NAV mode selected, is always to the selected DEST/MARK.

The NAV WD Computer calculates the relative position (3-dimensioned slant range/relative bearing) of the computed impact point from the aircraft using range and angle information provided by the priority available ranging sensor. The calculation is performed continuously (25 times per second) after mode initiation. The source of the ranging data used in calculations will change whenever the priority ranging sensor on its validity changes.

NOTE

ALT/MSLP, corrected for D value and ADC correction, should always be entered for the selected DEST. It is always possible for FLR AGR and Radar Altimeter ranging to become invalid too close to release for the pilot to abort the delivery.

When the NAV WD Computer first calculates relative position, it will always use a ranging sensor other than FLR AGR. Once a tentative impact point has been computed, the FLR antenna can be slaved to the point, and as soon as FLR ranging data are valid, they can be used to improve the accuracy of the computed impact point. This process usually is completed within 2 seconds after mode initiation and is not noticed by the pilot.

In the event of a HUD failure before bomb release, the CCIP bomb mode is unusable. There is no backup for determining the position of the computed impact point with respect to the target. However, if the HUD standby reticle was depressed to a predetermined mil value and the weapon delivery is flown to attain the corresponding manual delivery parameters, it is still possible to attack the target. Bombs can still be released immediately upon depression of the armament release button.

There is no slew inhibit feature associated with the CCIP bomb mode because slew commands are ignored in the weapon delivery calculation.

In order to use the CCIP bomb mode, the delivery maneuver must place the computed impact point in the HUD FOV from some time prior to it reaching the target until it passes through the target. Any delivery that could be performed manually, utilizing a mil setting out of the ballistic tables, is acceptable.

In level deliveries, the impact angle for the selected weapons must be small enough for the lower solution cue to be displayed. If a level delivery is mandatory, then fly lower; however, a 10° dive maneuver just prior to release will usually produce better results.

If the dive delivery maneuver is familiar, the FPM can be initially placed long of the target the same amount as used for a comparable manual delivery. If the maneuver is unfamiliar, initially place the FPM close to the target. If the lower solution cue has not yet appeared and/or you want to hasten the release, let the FPM move long of the target until the solution cue appears close to the target.

Overlay the target with the CCIPSL and keep it there until release. The release can be made while continuing a straight path delivery or after a dive-toss recovery has begun. The armament release button is pressed when the lower solution cue passes through the target, causing the NAV WD Computer to immediately generate a release pulse. The OFP provides a 150-ms pilot reaction advance to the solution cue movement, so it is not necessary for the pilot to anticipate the cue's movement.

Jinking is possible as long as the target is back on the CCIPSL before the solution cue reaches the target.

There is no reattack phase associated with the CCIP bomb mode. The NAV WD Computer does not provide command steering or calculate its position relative to a target because target designation is not accomplished.

GUIDED WEAPON DELIVERY.

AGM-65 Maverick Missile Delivery.

The AGM-65 is an air-to-ground missile with a self-contained television (electro-optical) guidance system. Prior to launch, the scene viewed by the missile's camera is presented to the pilot on the radar scope, providing the necessary video acquisition and identification capability. After the pilot locks the guidance system on the target and the missile is launched, he may take immediate evasive action to avoid enemy ground fire or attacking aircraft. The missile will continue to track the target on a collision course, even if the target is maneuvering. The missile tracks the centroid of the target area which it recognizes by the difference in brightness (contrast) between the target and its background. The missile contains a conical shaped charge warhead designed to destroy heavily armored fixed or moving targets such as tanks, armored personnel carriers, field fortifications and reinforced buildings.

AGM-65 Airborne Alignment Technique.

The missile seeker line of sight is nominally in line with the HUD standby reticle in the VISUAL ATTACK bombing mode. However, in order to facilitate lock-on, the pilot may elect to perform an airborne alignment prior to reaching the target area. This assures that the displays are functioning properly and define a sighting point. This sighting point is a reference on the HUD which compensates for misalignment of the missile. Placing this point, instead of the HUD pipper, on the target eases the pilot's lock-on task since the amount of seeker head slewing is minimized.

To determine this point, the AGM-65 is activated and the air ignite switch is pressed to remove the dome cover and activate the video. The aircraft is maneuvered, while the FLR indicator is observed, until a well-defined object appears in the tracking window. This object can be a wingman, a distant cloud, or a point on the ground. The aircraft is stabilized to keep the target in the tracking window, and the target's position on the HUD is noted. Any verticle misalignment should be cancelled by adjusting the standby reticle depression and recording the setting required. Lateral displacement cannot be cancelled, but should be noted on the knee pad.

During the first pass, the pilot should adjust the HUD depression to its predetermined value and dive the aircraft to place the standby reticle on the target. The target should appear in the tracking window or very close to it as soon as the aircraft is stabilized. This procedure eliminates lost time in positioning the tracking window over the target when errors in alignment are noted. Since the dome cover protects the lens of one missile from the rocket motor debris of the others, only one missile on each wing should be aligned.

Very small differences in alignment between missiles from the same station are expected, so subsequent launches from the same station can be made using that station's alignment if time is not available between launches for further airborne alignment.

AGM-65 Launch Sequence.

After removing the dome cover and performing an airborne alignment, if desired, the pilot maneuvers the aircraft to put the HUD aimpoint (or a previously determined aimpoint) on the target. The target appears on the radar indicator near the tracking window. After stabilizing the aircraft, the pilot presses the target designate button, moves the tracking window over the target with the Bullpup Controller, and then commands lock-on by releasing the designate button. With AGM-65B missiles as an additional aid to the pilot, a good lock-on is indicated by the scene magnification identifier and the pointing cross. If any combination of target size or look angle is such that lock-on does not have a good probability of surviving launch transients, the scene magnification identifier and pointing cross will be displayed intermittently (flashing) at approximately a 4-hertz rate. If target size and look angle are within the prescribed limits, the two symbols will be displayed at a steady intensity. Collectively, the two symbols are referred to as good lock-on indicators. Although tracking logic for the AGM-65A is identical to the AGM-65B, the good lock-on symbology is not present with the AGM-65A missiles. With the AGM-65A missile, a good lock-on can only be ascertained by observing that the target remains within the tracking window after the track command is given. With lock-on confirmed, the pilot may immediately press the armament release button to launch the missile and begin evasive maneuvers or maneuver the aircraft to engage another target.

See figures 1-86 and 1-87 for allowable launch envelopes for the AGM-65 missile. See figure 1-7 for a typical AGM-65 delivery profile.

Guided Bomb Delivery.

The GBU-8/B electro-optical (formerly Mk 84 EO) guided weapon is an air-to-ground glide bomb with a self-contained television guidance system. The guidance system is the primary feature of the weapon; the weapon can lock-on and be released at considerable ranges from a ground target. After the weapon separates from the aircraft, there are no further weapon control responsibilities for the pilot and any desired evasive action can be taken immediately. The guidance system automatically tracks any surface target that has sufficient contrast and size to satisfy the guidance system.

Dive bombing, with lock-on accomplished prior to release, is the primary method used to deliver the GBU-8/B guided bomb. The method of delivery is similar to that of ordinary dive bombing except that the parameters of altitude, airspeed, distance from target, and power setting are not as restrictive. Refer to (Confidential) T.O. 1A-7K-34-1-1-1 for the allowable launch envelopes for various speeds. See figure 1-7 for a typical EO bomb delivery profile.

WEAPON DELIVERY PARAMETERS.

Delivery of bomb type munitions can be performed from any altitude, dive angle, and airspeed within the limits prescribed in T.O. 1A-7K-1. The NAV WD Computer will provide computed delivery solutions within the limits shown in figure 1-8. However, the accuracy of these computed solutions is improved if the delivery tactic used is kept within the optimized envelope listed below for the individual weapon types. Additionally, ballistic tables contained in T.O. 1A-7K-34-1-2 provide manual delivery information for the most commonly used delivery envelopes.

GUIDED BOMB DELIVERY.

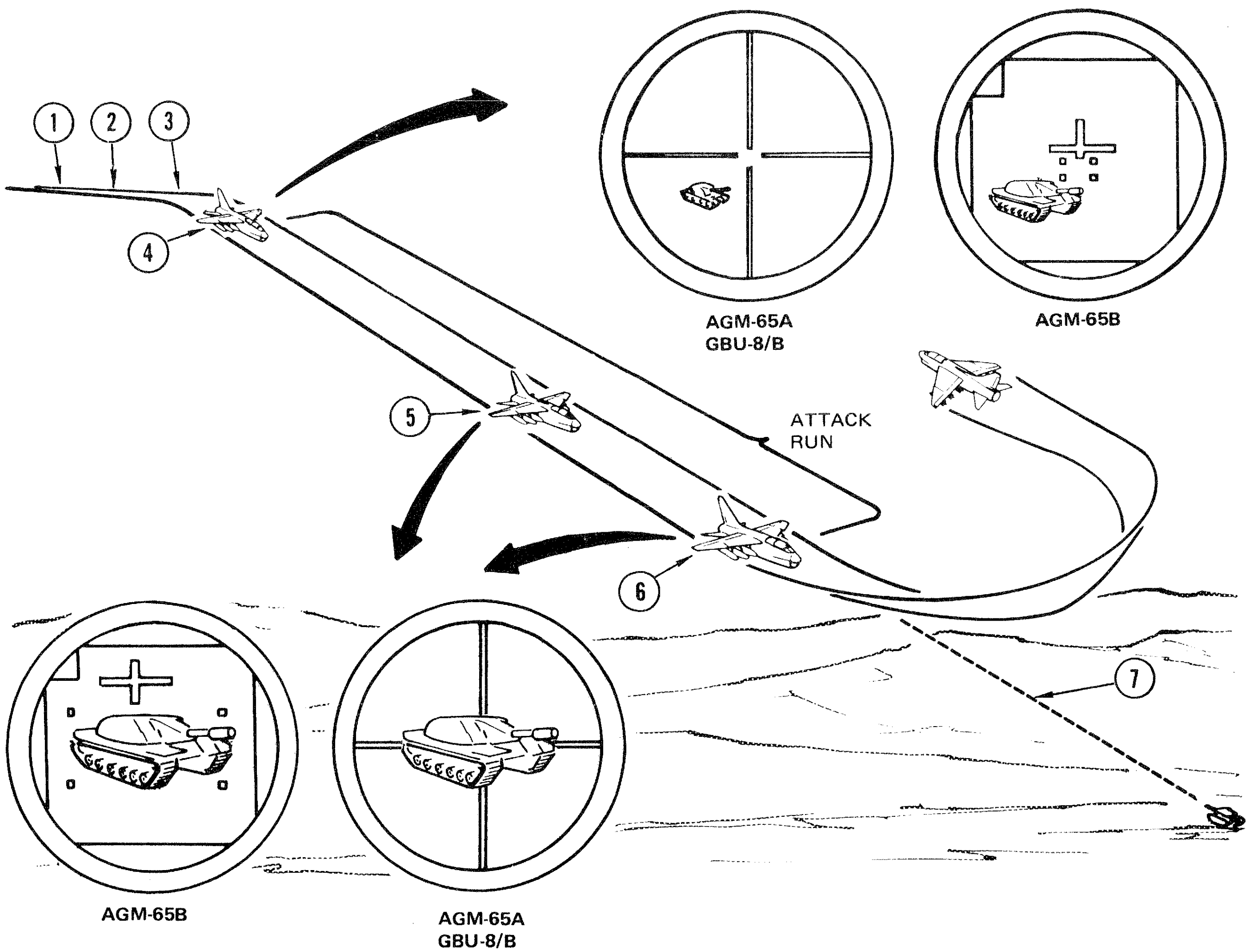
Refer to (Confidential) T.O. 1A-7K-34-1-1-1 for ballistics and weapon delivery envelope/profile data on GBU-8/B (Mk 84 EO) guided bomb.

Refer to Section VI for ballistics and weapon delivery envelope/profile data on GBU-10 series (Mk 84 LGB) and GBU-12 series (Mk 82 LGB) guided bombs.

LOW-DRAG BOMB DELIVERY.

Low-drag general purpose bombs can be delivered in any computed attack mode or manual mode. In a

GUIDED WEAPON DELIVERY PROFILE – AGM-65 AND GBU-8/B



GBU-8/B DELIVERY

1. Enroute to target area – airborne alignment completed.
2. Minimum 5-minutes prior to target area entry – PCO check, station(s) remain selected, MASTER ARM off, NORM-OVERRIDE switch OVERRIDE.
3. Prior to attack run – NORM-OVERRIDE switch NORM (TV display), VISUAL ATTACK selected, MASTER ARM on, radar range switch actuated (STA RDY lights on).
4. Aiming symbol on target, target appears in TV display.
5. Designate button actuated, bomb seeker uncaged and tracking target.
6. Bomb release.
7. Bomb self-guides to target – aircraft leaves target area.

AGM-65 DELIVERY

1. Not applicable.
2. Minimum 3-minutes prior to attack run – radar on, station(s) selected, standby reticle on/VISUAL ATTACK selected.
3. Prior to attack run – air ignite button actuated (uncage and TV display), MASTER ARM on.
4. Pipper/aiming symbol on target, target appears in TV display.
5. Designate button actuated (slew enable), missile seeker slewed to center target, designate button released (target designate – seeker lockon and track).
6. Missile launch.
7. Missile self-guides to target – aircraft leaves target area.

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Figure 1-7

NAV WD COMPUTER DELIVERY ENVELOPES

STORE	VELOCITY (KTAS)	ALT ABOVE BURST HT (FT) SLANT RANGE (FT)	FLIGHTPATH ANGLE (DEG)
LDGP bomb	200 to 600	50 to 15,000 ABH	–75 to +125
HD retarded bomb	200 to 600	50 to 5,000 ABH	–60 to +5
Fire bomb	200 to 600	500 to 15,000 ABH	–60 to +5
Cluster bomb dispenser	200 to 600	1,250 to 10,000 ABH	–60 to +5
Rockets	200 to 600	15,360 maximum slant range	0 to –60
Gun	200 to 600	8,448 maximum slant range	0 to –60

NOTE

If above parameters are exceeded, releases are not inhibited; however, degraded accuracy may result.

The above envelopes indicate limits of NAV WD Computer delivery accuracy only. Refer to Section V. T.O. 1A-7K-1, for more restrictive envelopes within which weapon/aircraft separation is certified.

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Figure 1-8

computed attack mode, the delivery tactic used should be flown to fall within the following envelope to ensure accurate computer delivery: 350 to 550 KIAS, 50 to 15,000 feet, and pitch attitude −75° to +125°. This envelope encompasses dive, level, dive toss, loft, and over-the-shoulder delivery tactics.

NOTE

Ballistic equations for the M117 GP bomb, but not the MC-1 gas bomb, are included in the NAV WD computer program. However, these munitions use ASCU codes FK and FL which are interchangeable and provide M117 ballistics. Since the ballistics for the MC-1 gas bomb are not identical to those of the M117 bomb, a comparison of their respective ballistic tables in T.O. 1A-7K-34-1-2 at the planned computed delivery point should be made to determine the amount of error to be expected and possible aiming corrections required to eliminate this error.

If manual mode is employed, release parameters must be predetermined and the standby reticle depressed as necessary. Bombing tables are provided in T.O. 1A-7K-34-1-2 for predetermining release parameters for LDGP bombs from dive angles of −10° to −60°, altitudes from 500 to 20,000 feet, and airspeeds from 400 to 560 KTAS. The tables provide for release from MER's/TER's or wing pylon ejector racks. Crosswind correction for low altitude delivery of low-drag bombs is usually achieved by crabbing to maintain a straight ground track through the target. No rangewind correction is necessary for level deliveries if the bomb is released at a groundspeed equal to the preplanned true airspeed. Rangewind correction factors are contained in the bombing tables of T.O. 1A-7K-34-1-2 or may be determined using the directions in Section V and the charts in Section VI. Minimum release altitudes can be determined by reference to dive recovery, fuze arming, and safe escape charts in Section VI.

RETARDED (HIGH-DRAG) BOMB AND FIRE BOMB DELIVERY.

The largest single factor affecting accuracy in computed delivery of retarded bombs and fire bombs with the A-7K is measurement of slant range. During level deliveries, use of the FLR AGR to measure slant range can lead to large errors due to the low grazing angle. The NAV WD Computer will not accept any FLR AGR range if the grazing angle is less than 4°; thus the use of the level delivery is not recommended. For retarded bomb and fire bomb delivery, dive angles of 10° or more allow use of FLR AGR ranging which is more accurate than either radar altimeter or barometric altitude ranging.

Computed delivery of retarded bombs and fire bombs should be perfomed in a straight path dive maneuver. When a dive toss maneuver is performed and weapon release is forced, the computer will tend to toss the bombs long. The best way to prevent forced entry into a dive toss maneuver is to roll in at a dive angle higher than planned (overdive) and use point blank aiming to designate the target and then pullup to the planned release dive angle. An overdive of 3° to 3.5° can add as much as 500 feet to the release altitude which will allow the pilot to remain in a straight path dive until all desired weapons are released. Due to the low angles normally used for delivery of retarded bombs and fire bombs, continuous refinement of the aiming symbol position should be performed until just prior to weapon release.

Retarded Bombs.

High-drag retarded bombs can be delivered in any computed attack mode or in the manual mode. In a computed attack mode, the delivery tactic used should be flown to fall within the following envelope to ensure accurate computer delivery: 350 to 550 KIAS, 50 to 5,000 feet, and pitch attitude −60° to +5°. This envelope encompasses dive, level, and toss delivery tactics. The high-drag characteristic of the retarder tail fin permits the aircraft to approach the target more closely, yet escape the fragmentation envelope safely. Bomb range is reduced; time of fall and impact angles are increased.

If manual mode is used, release parameters must be predetermined and the standby reticle depressed as necessary. Bombing tables are provided in T.O. 1A-7K-34-1-2 for predetermining release parameters for retarded bombs from dive angles of 0° to −30°, altitudes from 100 to 3,000 feet, and airspeeds from 400 to 560 KTAS. The tables provide for release from MER's/TER's or pylon ejector rack. Minimum release altitudes can be determined by reference to dive recovery, fuze arming, and safe escape charts in Section VI.

NOTE

Pilot option bombs are authorized for MER/TER carriage only. Fixed high-drag and fixed low-drag bombs may be carried on MAU-12 or MER/TER.

Bombs fuzed with the Mk 43 Target Detecting Device (TDD) and FMU-54A/B fuze are restricted to the fixed high-drag configuration. Additionally, the Mk 43 TDD cannot be used with any fuze other than the FMU-54A/B.

In the fixed high-drag mode, minimum fuze arming settings of 2 seconds on the M904E2/E3 and 2.5 seconds on the FMU-54/B and FMU-54A/B fuzes can be used subject to the following conditions:

1. Nose fuze arming wire withdrawal must be initiated by retarder fin opening action.
2. The published munitions release limits and correct loading procedures must be closely adhered to.

WARNING

Do not fly over or near fragmentation envelope within 20 seconds of detonation as aircraft damage can result from flying debris. During training missions, at least 20 seconds spacing between aircraft must be observed when inert or sand filled bombs are released. In the training situation, observing the 20-second spacing between aircraft will prevent a bomb-to-aircraft collision in the event a bomb releases low drag and ricochets in the air after impact.

Pilot Option High-Drag/Low-Drag Mk 82 Snakeye I Bombs.

Mk 82 Snakeye I bombs can be configured for a pilot high-drag/low-drag option. Differences in fuze arming wire rigging for pilot option and fixed high-drag bombs are portrayed in Part 7 of this section and in Section II. Because of these differences, it is necessary that the FUZE switch be set to the proper position for the option selected. High-drag delivery of the pilot option bomb requires selection of the TAIL position of the FUZE switch. Low-drag delivery of the pilot option bomb requires selection of the NOSE position of the FUZE switch. Under no circumstances shall the NOSE/TAIL position of the FUZE switch be selected when delivering pilot option configured Mk 82 Snakeye I bombs. Additionally, when the Mk 82 Snakeye I bomb is configured for high-drag/low-drag option, the FMU-54/B and FMU-54A/B tail fuzes shall have a minimum arming time setting of 2.5 seconds and the M904 nose fuze shall have a minimum arming time setting of 6 seconds. These minimum settings do not apply to fixed high-drag bombs.

WARNING

Since certain mechanical and human errors inherent with this type delivery option can result in hazardous or degraded reliability situations, the operational commander should consider the following warnings and notes which point out the possibility of self-inflicted damage, injury to friendly ground forces, single fuze reliability, and delivery accuracy degradation before approving this option for operational use.

When the Mk 82 Snakeye I bomb is configured for inflight selectivity for high-drag/low-drag releases, the minimum nose fuze setting is 6.0 seconds for the M904E2/E3 fuze and the minimum tail fuze setting for the FMU-54/B and FMU-54A/B fuzes is 2.5 seconds. With current arming time tolerances, the minimum bomb time of fall to provide time for the fuzes to arm is 6.6 seconds for the nose fuzes and 2.8 seconds for the tail fuze (high-drag arming only).

With the inflight option of high-drag/low-drag selection, strict adherence to the prescribed cockpit switchology is mandatory. If the pilot inadvertently selects high-drag (TAIL) or experiences an arming solenoid malfunction when the intent is to release a low-drag bomb, a fully armed high-drag bomb would impact considerably short of the intended aimpoint. If friendly ground forces are in the immediate area, this could result in diastrous consequences. Conversely, if the pilot inadvertently selects low-drag (NOSE), or experiences an arming solenoid malfunction when the intent is to release a high-drag bomb during close-in attack conditions, the result (if the bomb time of fall is less than 6.6 seconds) would be an unarmed bomb with an initial impact considerably downrange of the intended impact point. This could also result in diastrous consequences if friendly ground forces are in the area; particularly if the bomb detonates, or ricochetes then detonates. If the bomb time of fall exceeds 6.6 seconds in this case, a fully armed low-drag bomb would impact considerably downrange from the intended impact point.

There is also a possibility of the delivery aircraft suffering self-inflicted fragment damage if an intended high-drag bomb releases low-drag during a close-in attack condition, and for some reason detonated at initial impact. To provide an additional margin of safety in this event, the pilot should execute a 4g pullup or a 4g, 60° banked escape maneuver immediately after release.

Minimum release altitudes with respect to fragment envelope clearance should be observed even if the bomb is released SAFE. This would protect the aircrew in the event of an arming wire hang-up, solenoid malfunction, etc, resulting in an arming wire being extracted and the bomb becoming fully armed.

NOTE

With the approved arming wire and fin release wire routing for the inflight high-drag/low-drag option, single fuze reliability (nose fuze only) is available with the low-drag option (FUZE switch NOSE position). Dual fuze reliability (nose and tail) is available with the retarded high-drag option (FUZE switch TAIL position) if the bomb time of fall exceeds 6.6 seconds. If the high-drag bomb time of fall is less than 6.6 seconds, only the FMU-54/B or FMU-54A/B tail fuze arming is available.

If the retarded bombs are configured to exclude any cockpit selection of an armed low-drag bomb release (fixed high-drag bomb), a 2.0-second nose fuze arming delay setting may be used.

Pilot option bombs are authorized for MER/TER carriage only. Fixed high-drag and fixed low-drag bombs may be carried on MAU-12 or MER/TER.

Because of the method of rigging fixed high-drag bombs, the NOSE/TAIL position of the FUZE switch is used to deliver these bombs. This position is used to ensure the energizing of the solenoid used for the fin release wire.

Fire Bombs.

Fire bombs can be delivered in any computed attack mode or in the manual mode. In a computed attack mode, the delivery tactic used should be flown to fall within the following envelope to ensure accurate computer delivery: 350 to 550 KIAS, 500 to 15,000 feet, and pitch attitude −60° to +5°. This envelope encompasses dive, level, and dive toss delivery tactics.

Bombing tables are provided in T.O. 1A-7K-34-1-2 for predetermining release parameters for fire bombs from dive angles of 0° to −45°, altitudes from 50 to 6,000 feet, and airspeeds from 400 to 560 KTAS. The tables provide for release from MER's/TER's or pylon ejector racks. Sight depression angles are computed to place the first bomb on target. If it is desired to place the bomb short of the target, the distance must be estimated or the sight setting recomputed using the sight depression charts in Section VI.

The procedure used for figuring wind corrections for manual delivery of low-drag bombs also applies to manual fire bomb deliveries. Minimum release altitudes can be obtained from the dive recovery charts in Section VI.

BOMB TYPE CBU DELIVERY.

Computed delivery of bomb type (clamshell) CBU munitions should be flown to fall within 350 to 550 KIAS, 1,250 to 10,000 feet AGL, and pitch attitudes of −60° to +5°. Delivery computations and attack symbology for delivery of the CBU-24B/B, CBU-49B/B, CBU-52B/B, CBU-58 series, CBU-71 series, and Mk 20 cluster bombs will depend on the fuze functioning time and altitude entered into the computer.

NOTE

Ballistic equations for the CBU-52A/B are not included in the NAV WD Computer program. However, ballistic equations for the CBU-24B/B and CBU-49B/B are included under ASCU code JK, which is common for the three munitions. Therefore, computed delivery and manual ripple delivery of the CBU-52A/B is possible. Since the ballistics for the CBU-52A/B are not identical to those of the CBU-24B/B and CBU-49B/B, a comparison of their respective ballistic tables in T.O. 1A-7K-34-1-2 at the planned computed delivery point should be made to determine the amount of error to be expected and possible aiming corrections required to eliminate this error.

If manual mode is used, release parameters must be predetermined and the standby reticle depressed as necessary. Bombing tables are provided in T.O. 1A-7K-34-1-2 for predetermining release parameters for CBU munitions. Data included are for level attack at altitudes from 1,500 feet to 5,000 feet at airspeeds from 400 to 560 KTAS. Data for dive attacks are provided for 15°, 30°, and 45° dives at the same airspeeds.

DISPENSER TYPE CBU DELIVERY.

Any computed attack mode or manual mode may be used with dispenser type (aircraft retained) CBU munitions. In computed attacks, the delivery tactic should be flown to fall within 350 to 550 KIAS, 100 to 500 feet AGL, and pitch attitudes of −5° to +5°.

Some aircraft retained dispensers (CBU-30/A, CBU-38 series, and SUU-42 series) have integral intervalometers which provide a ripple delivery capability of the submunitions through the dispenser alone. These intervalometers are set prior to takeoff and cannot be changed during flight. The cockpit QUANTITY switch is set to 01 when performing a ripple delivery using the internal intervalometers of these munitions. Do not confuse ripple release of these munitions with computed or manual ripple release of munitions not having an integral intervalometer.

Ballistic equations for ASCU codes CP (CBU-38) and CQ (CBU-30) are included in the NAV WD Computer program. With green ready lights on CBU-30/38 stations, the NAV WD Computer will issue a continuous solid fire pulse, starting at the computed release point (intersection of lower solution cue and flightpath marker for dead-reckoned targets and when the armament release button is depressed in CCIP or Manual Ripple bombing modes). The solid fire pulse will continue until the armament release button is released. Since the length of the fire pulse is pilot controlled, bomb stick length is set to zero and the solution is given for the beginning of the drop. Therefore, the aiming symbol, or CCIP impact point, must be placed over the beginning of the area to be covered. Because of the solid fire pulse, the FPM will not flash and the release freeze data will not be calculated.

The mechanization in the current OFP provides for computed release of the CBU-12 series and the CBU-46/A munitions with the aiming symbol placement representing a point 900 feet long of the first submunition impact point (cockpit QUANTITY switch set to 01). Since one tube of CBU submunitions from the SUU-7 dispenser covers about 1,800 feet for a level release at 450 KTAS, the aiming symbol will be approximately in the center of the stick. The number of tubes fired from the SUU-7 for each fire pulse (whether computer or manually generated) is selectable before flight at 2, 4, or 6 tubes plus a salvo release capability for the SUU-7C/A dispenser. Since all of the tubes set on the selector fire simultaneously for a given fire pulse, the number set affects submunition density but not stick length. Total stick length is determined by the settings on the QUANTITY and INTERVAL-FT switches on the armament release panel. For quantities greater than one, the second and subsequent sticks will be delayed by a distance equal to the interval selected. The aiming symbol placement will be moved along by an additional distance equal to half the increase in stick length that results from a given QUANTITY and INTERVAL-FT setting. This causes the aiming symbol to be always in the center of the stick. Fire pulses are routed to the highest station or stations in priority with SINGLE and PAIRS logic the same as for MER's/TER's with bombs. The number of the tubes fired from the dispenser may not be the same as the number set on the dispenser selector because of the dispenser internal mechanization. Thus, the actual number of tubes which will fire for a series of fire pulses with a selector setting of 4 will be 4, 4, 4, 2, and 2 for the CBU-12 series (16 tubes loaded) and 4, 4, 3, 4, and 3 for the CBU-46/A (18 tubes) loaded. OFP mechanization for the CBU-46/A does not include the left drift inherent with the BLU-66/B bomblet; the pilot must manually offset for this effect. See figure 6-26 for a chart to be used in offset aimpoint calculation.

The CBU manual delivery consists of a low level or low angle approach to target at the predetermined speed and altitude above target. Crosswind correction is applied (in addition to crabbing the aircraft) by offsetting the flightpath parallel to, and upwind of, the no-wind ground track. Flightpath offset to correct for crosswind is required for the high-drag CBU munitions because of their longer time of flight. The standby reticle is used to establish the release point. Rangewind correction may be ignored for the CBU delivery. The bombing tables provide the sight depression angle from flightpath that will place the first bomblet 750 feet short of the target for the CBU-12 series and CBU-46/A dispensers. Use the Sight Depression Charts, Section VI, when other than 750 feet short impact is required.

When a dive delivery is used for CBU series weapons using the SUU-7 dispenser, a straight line flightpath should be maintained during the release and for 2 seconds after release. The minimum release altitude should be based on altitude lost during recovery plus altitude lost during the 2.0-second stabilized dive after release. This procedure is necessary to prevent voids in the bomb impact pattern.

GUN AND ROCKET ATTACKS.

AIR-TO-GROUND GUN AND ROCKET ATTACKS.

Gun and rocket attacks can be performed with the aid of a computed HUD display or manually with the standby reticle. The computed gun attack is obtained by selecting VISUAL ATTACK, BOC, or CCIP with GUN HIGH or LOW selected and/or a wing station with a SUU-23/A gun pod selected. The computed rocket attack is obtained by selecting any computed attack mode with a rocket launcher or SUU-20 series dispenser selected and in priority. The HUD display in a computed gun or rocket attack consists of an aiming symbol indicating the computed impact point, an in-range cue which appears atop the aiming symbol when the target is in range, and a pullup cue. The pilot maneuvers the aircraft so that the aiming symbol overlays the target. Target designation is not applicable. In the computed gun attack, the delivery tactic should fall within the following envelope to ensure computed gunfiring accuracy: 350 to 550 KIAS, 8,448 feet maximum slant range, and pitch attitude −30° to 0 p . The delivery tactic used for computed rocket attack should fall within the envelope defined by 350 to 550 KIAS, 15,360 feet maximum slant range, and pitch attitude −60° to 0°.

NOTE

> Rocket ballistics included in the current OFP are based on the Mk 1 warhead/Mk 4 motor combination. Rocket firing using other warhead/motor combinations must be made in the manual mode.
>
> When carrying 2.75-inch FFAR's with flechette warheads, burst slant range and desired flechette dispersal pattern must be manually determined using tables in T.O. 1A-7K-34-1-2 and Section VI of this manual. If the target is radar reflective, the FLR may be used to assist in determing firing slant range.

If computed HUD symbology is not desired or is unavailable, the pilot uses the standby reticle for gun and rocket aiming. Firing parameters must be predetermined and the standby reticle depressed as necessary. M61 gunfiring tables are provided in T.O. 1A-7K-34-1-2 for predetermining firing parameters from dive angles of −60° to −5°, altitudes from 200 to 10,000 feet, and airspeeds from 400 to 560 KTAS. Rocket firing tables are provided for various warheads for dive angles from −10° to −60°, altitudes from 1,000 to 10,000 feet, and airspeeds from 400 to 560 KTAS. Computed and noncomputed gun and rocket firing are illustrated in figure 1-9.

Wind and sight corrections for noncomputed gun or rocket attacks are less than for bombs because of the reduced flight time. Sight settings are presented in T.O. 1A-7K-34-1-2 as a function of angle of attack. Safe escape considerations must consider terrain avoidance, secondary target explosions, and gunfire ricochet.

AIR-TO-AIR GUNNERY.

A limited air-to-air gunnery capability is available when no master function switch (attack or TF) is selected and the GUN switch is in either the HIGH or LOW position, and/or a wing station loaded with a SUU-23/A gun pod is selected. The computed lead (indicated by the aiming symbol and based on a projectile time of flight of 0.56 second and aircraft turn rate) is limited as follows:

Aircraft speed and altitude are not considered.

Attack is assumed to be co-airspeed.

NOTE

The horizontal offset of approximately 5 feet between HUD and gun pods on wing station 3 and 6 is also not considered by the NAV WD Computer. Procedures have been developed to boresight gun pods to converge with the internal gun at 2,250 feet in front of the aircraft. If planning to fire a gun pod, the pilot must determine the boresight status of the pod, and if not so boresighted, adjust aim 3 mils left or right at 1,600 feet firing range.

A normal impact pattern (80% of the projectiles) will be within a 9- to 12-foot diameter based on a 1,500 foot range.

Computed air-to-air HUD symbology is also obtained by selecting either of the two fuselage stations. A computed attack mode must be selected and either a gun pod station selected or the GUN switch placed in the HIGH or LOW position. Aiming symbol positioning (computed lead) is identical to that received when selecting the internal gun or a gun pod station with no computed attack mode selected.

Refer to the Air-to-Air Gunnery discussion, Section I, Part 2, for information on aiming symbol positioning. The application of the manual corrections discussed will place impact pattern on or near target.

NOTE

If electronic failure precludes use of computed guns mode, turn on standby reticle. Computed lead will not be available.

FLARE DELIVERY.

MK 24 MOD 4 FLARE.

The Mk 24 Mod 4 parachute flare is ejected from the SUU-25 flare dispenser. A level approach or pilot-estimated angled approach is used in flare delivery. Flares are released only in manual mode. Figure 1-10 illustrates a typical Mk 24 flare profile. Release airspeed is not critical. Release altitude is critical only when it is desirable to obtain flare burnout above the ground. The flare release tables in T.O. 1A-7K-34-1-2 provide minimum release altitude AGL to provide flare burnout at impact. Desired burnout altitude AGL must be added to minimum release altitude to determine actual release altitude. Flare ejection fuze delay time and flare ignition fuze delay time are determined by mission requirements. Rangewind and crosswind correction is applied using the wind correction factors chart provided in Section VI.

LUU-1/B AND LUU-5/B TARGET MARKER FLARE.

The LUU-1/B parachute target marker flare is a longer burning, red colored flare designed to burn for 30 minutes on the ground (figure 1-10). The LUU-5/B is identical to the LUU-1/B flare except that the LUU-5/B burns with a green flame. Delivery of these flares is similar to that for the Mk 24 flares. During mission planning, a release altitude, an ejection fuze setting, and an ignition fuze setting must be selected which will

GUN AND ROCKET FIRING

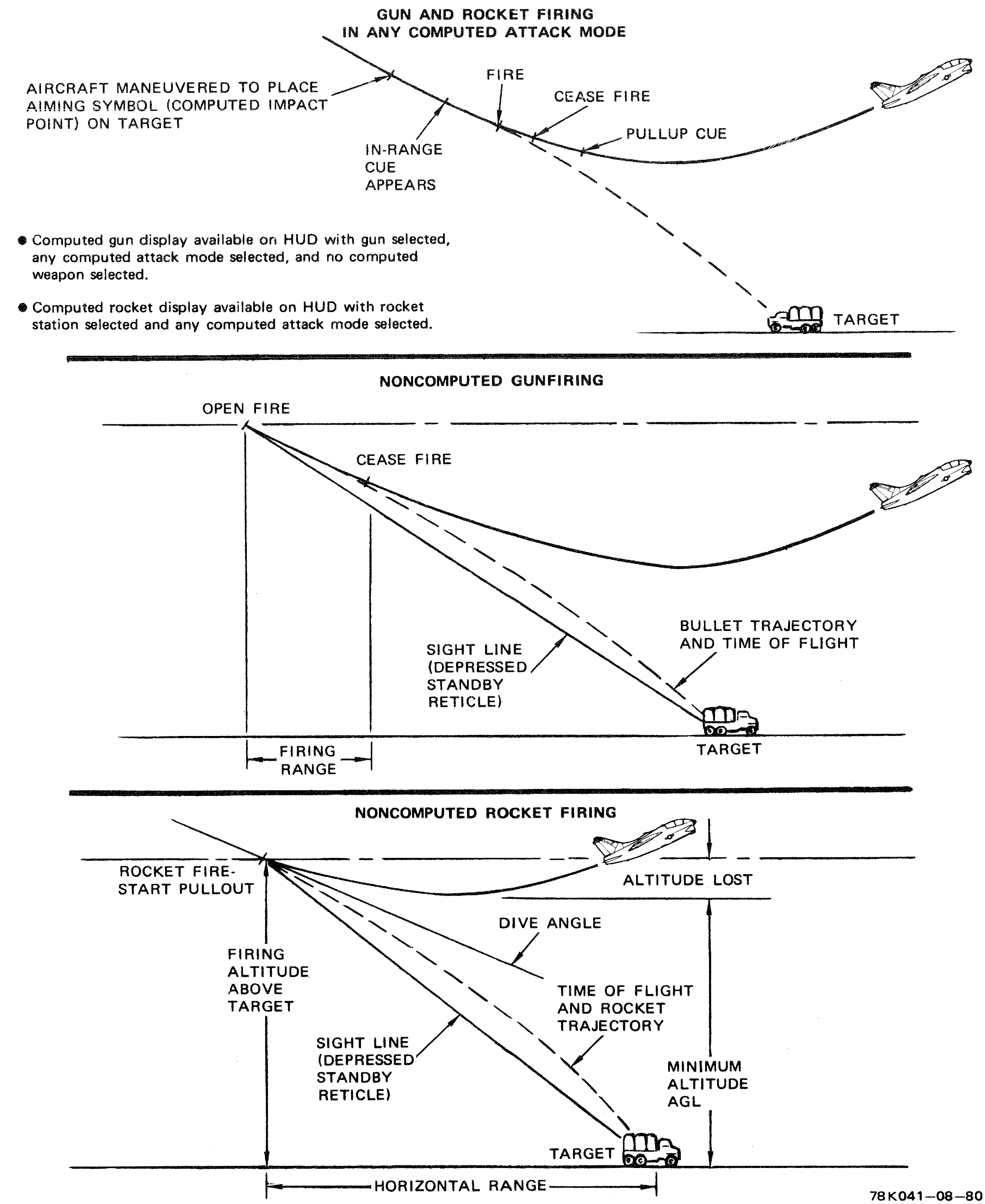


Figure 1-9

FLARE DROP PROFILES (TYPICAL)

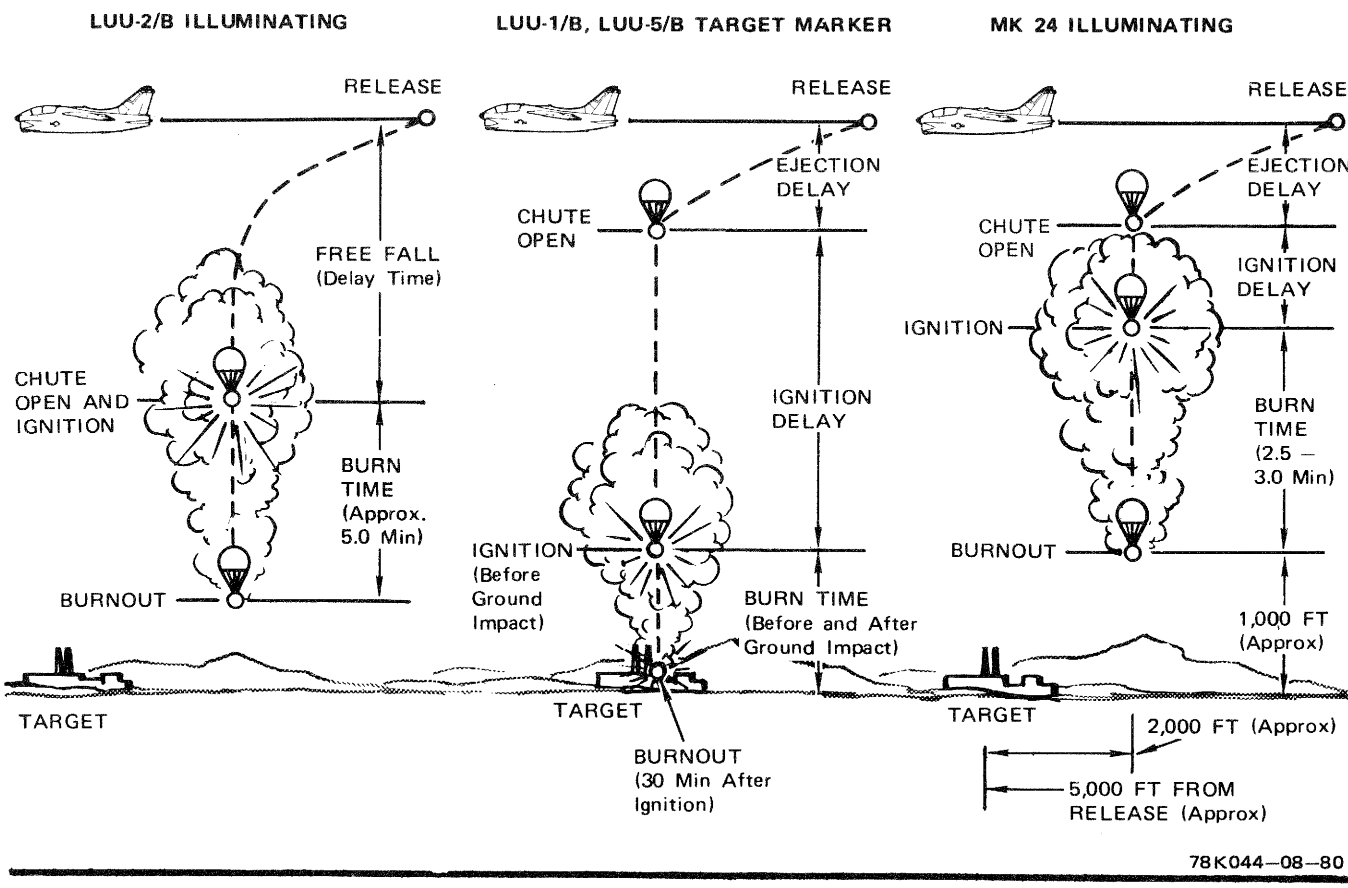


Figure 1-10

assure flare ignition before ground impact. The flare has a rate of descent of approximately 15 feet per second after flare ignition. A flare wind correction chart is provided in Section V. A level release table is provided in T.O. 1A-7K-34-1-2.

LUU-2 SERIES FLARE.

The LUU-2 flare is a free-fall illuminating flare with a burn time of approximately 5 minutes (figure 1-10). The available free-fall distance delay settings from flare release to parachute deployment followed by flare ignition are dependent on the model of the flare being used. This selection must be determined during mission planning. The average rate of descent of the flare after parachute deployment is 8 feet per second and the flare descends approximately 2,500 feet during the 5-minute burn time. Because the pyrotechnic candle consumes the flare housing, the flare tends to hover during the last 2 minutes of burn time. Delivery of the flare is similar to that for the Mk 24 flare. A level release table is provided in T.O. 1A-7K-34-1-2.

PART 2 – NAVIGATION/WEAPON DELIVERY SYSTEM

INTRODUCTION.

The Navigation/Weapon Delivery System is a flexible integrated system designed to assist the pilot in getting to the target area, delivering the munitions as accurately as possible, and returning to base safely. The following descriptions apply primarily to the weapon delivery portion of the system. Refer to T.O. 1A-7K-1 for descriptions of the navigation portion of the system.

DELIVERY SYSTEM COMPONENTS.

The components of the weapon delivery system are the Navigation/Weapon Delivery (NAV WD) Computer, Head-Up Display (HUD), Target Identification Set, Laser (TISL), Inertial Measurement Set (IMS), Forward-Looking Radar (FLR), Air Data Computer (ADC), Angle-of-Attack (AOA) transducer, Doppler radar, radar altimeter, and weapon release system. Refer to Part 3, Aircraft Weapon Release System, for a description of the weapon release system components and operation. Refer to Part 4, Jettison Controls, for a description of emergency and selective jettisoning of external stores. System components and related equipment used in weapon delivery are illustrated in figure 1-11.

NAV WD COMPUTER.

The NAV WD Computer is a general purpose digital computer located in the left avionic bay with a computer control and display panel located on the right console in the forward cockpit and a computer digital display indicator located on the right console in the aft cockpit. The computer provides the pilot with continuously computed attack solutions during weapon delivery. Computer generated symbology is displayed on the HUD and provides the pilot with steering, target envelope, and safe escape information. The NAV WD Computer is compatible with all conventional delivery tactics or evasive maneuvering during the computed target run.

When in a continuously computed release point (CCRP) weapon delivery mode, the computer receives navigational data and weapon identification signals from system components and mode selection, target identification, amount and spacing of weapons, and the release enable signal from the pilot. Using this information, the computer continuously computes an impact point for the selected weapon on a time-sharing basis with related weapon delivery computations which occur 25 times per second. This impact point is based upon the best known velocity vector of the aircraft, the position of the aircraft with respect to the target, the ballistics of the weapon, the density of the airmass along the trajectory, and the wind at the point of the computation. As the computed trajectory solution approaches the computed target position, the range miss distance is resolved into a time-to-go release. When this time has elapsed, the weapon will release if the armament release button is being depressed.

The pilot is provided with steering information in azimuth and a solution of the time-to-release in elevation/range. The pilot may, at any time during the target run, reject the computed solutions by undesignating the target, deselecting the attack mode, or not pressing the armament release button (release enable signal).

When in the continuously computed impact point (CCIP) delivery mode the computer computations furnish instantaneous impact point data for the selected weapon on a continuous basis with immediate release of the weapon occurring when the armament release button is depressed.

Attack mode selection is made by depressing the appropriate master function switch or pair of switches. Target identification (designation) is done by showing the computer the target's location in relation to the aircraft position or designating the target's geographical location. Designating the target's relative position is accomplished by depressing either the target designate button or the armament release button. With the TISL system, designation on a laser illuminated target can occur automatically or by pilot actions, depending on the designate status when a valid TISL track is acquired. For a more detailed discussion of the attack modes and target designation, refer to Computed Bombing Modes description in this section.

Refer to T.O. 1A-7K-1 for an illustration of the NAV WD Computer panel controls and indicators. Figure 1-12 illustrates and describes the attack mode master function switches.

NAV WEAPON DELIVERY SYSTEM – WEAPON DELIVERY PORTION

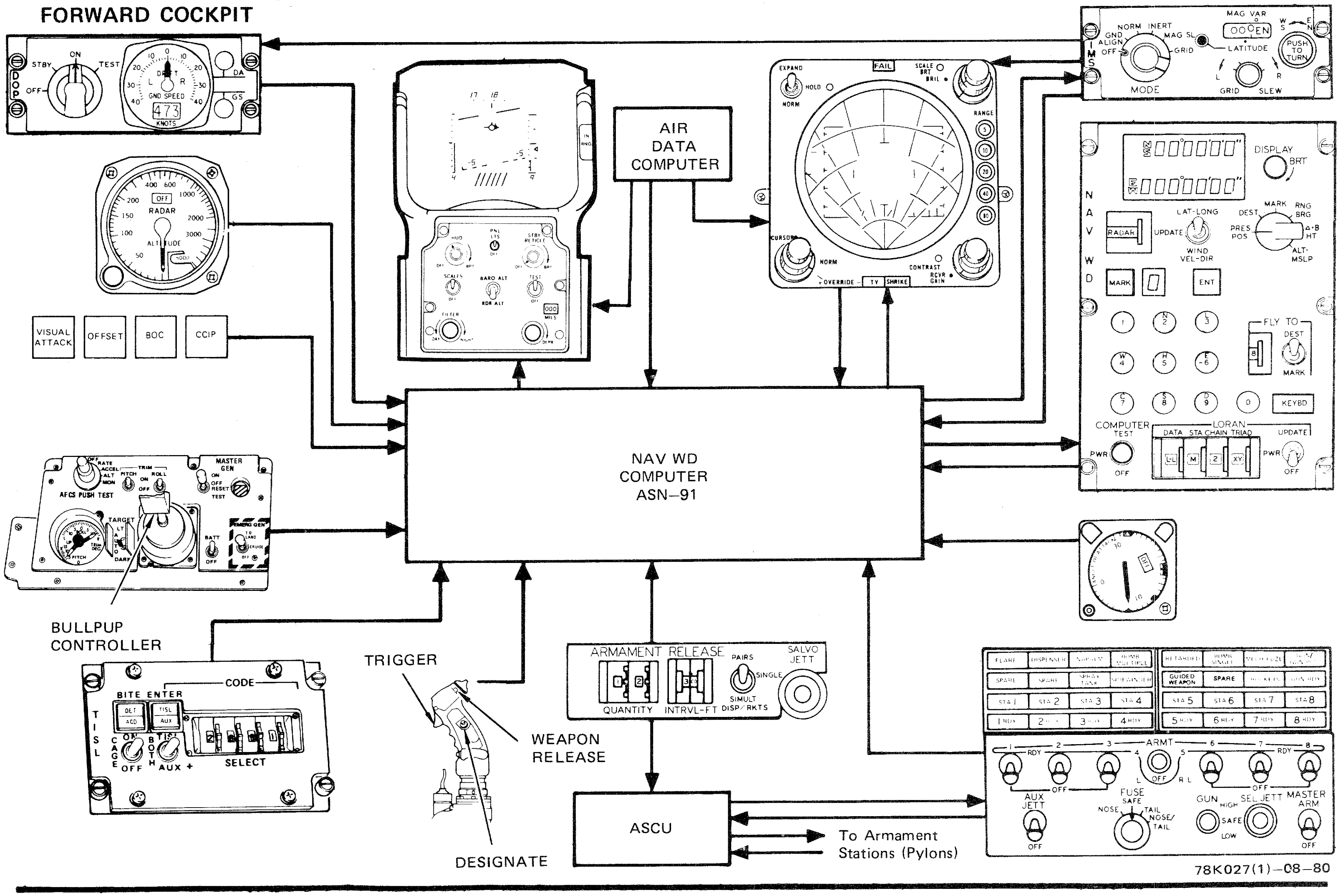


Figure 1-11 (Sheet 1)

NAV WEAPON DELIVERY SYSTEM – WEAPON DELIVERY PORTION

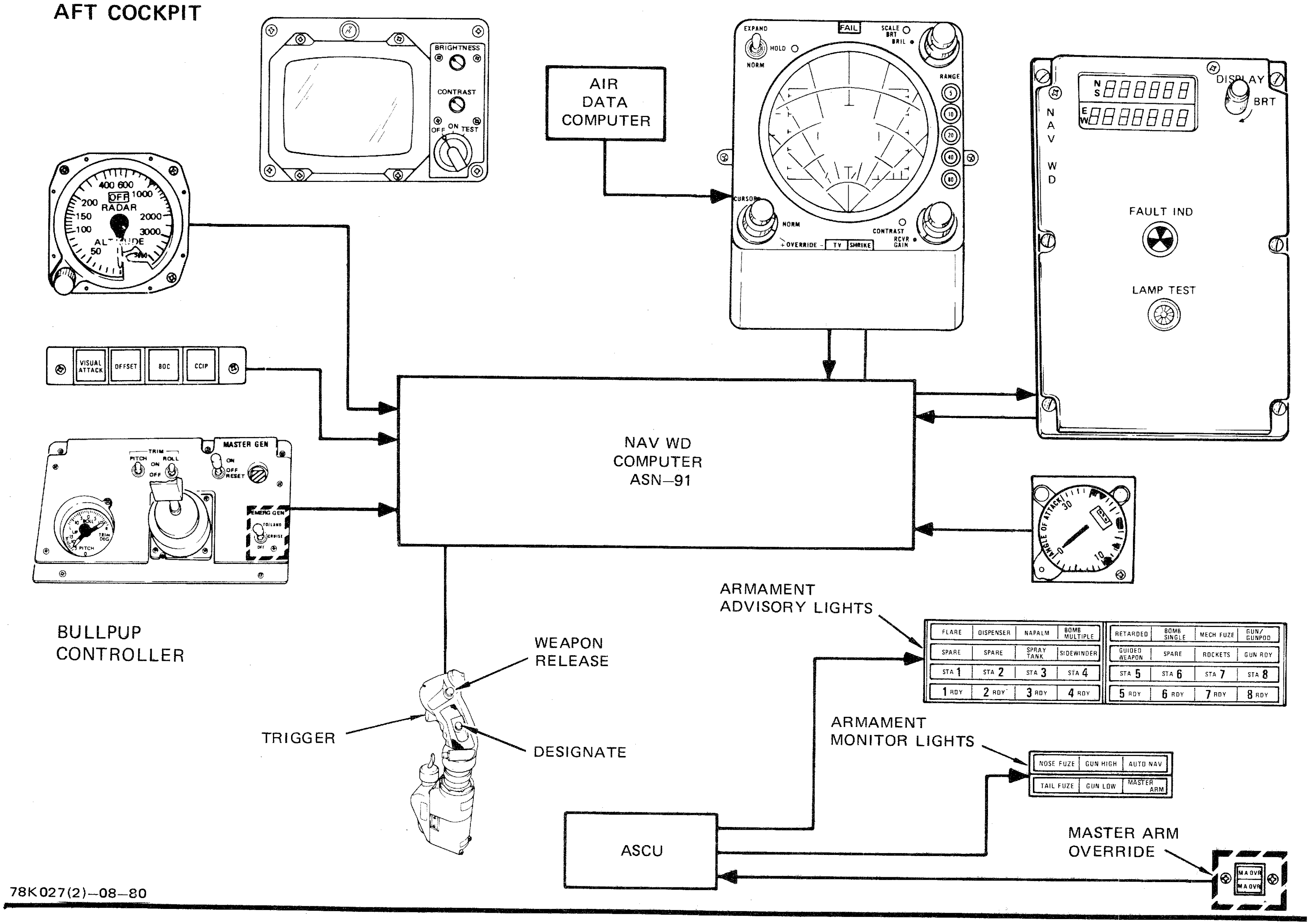
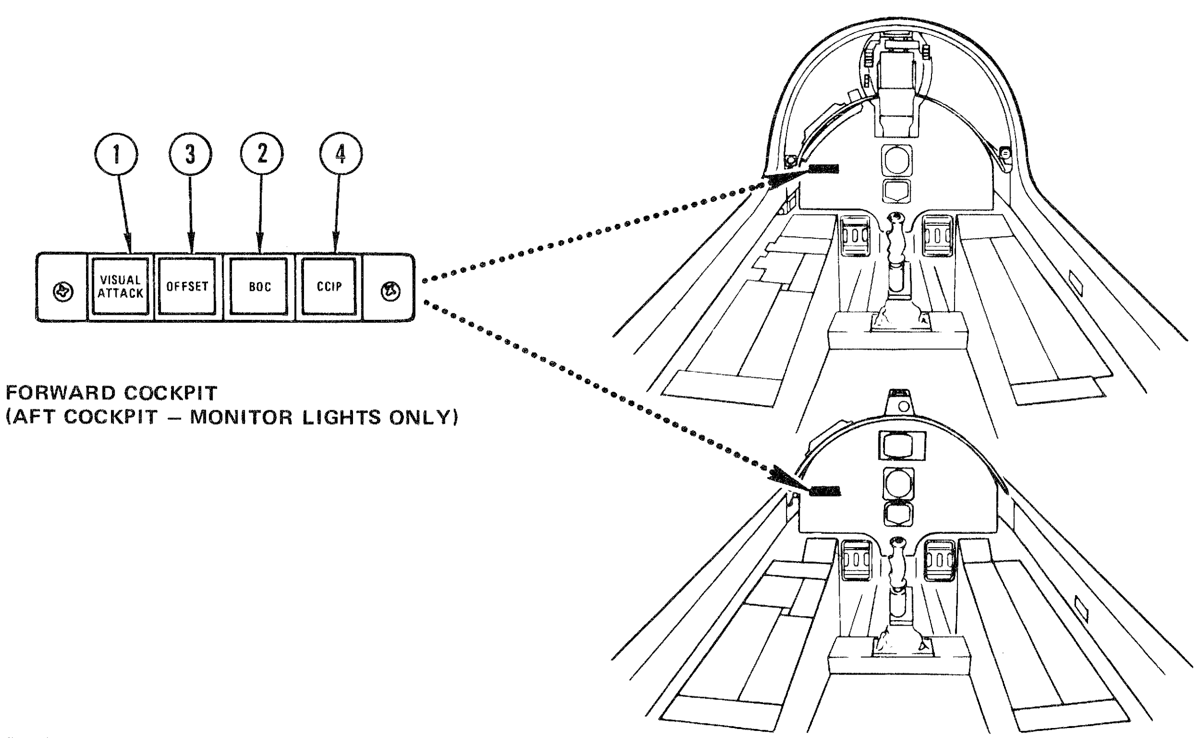


Figure 1-11 (Sheet 2)

ATTACK MODE MASTER FUNCTION SWITCHES AND MONITOR LIGHTS



Nomenclature	Function
1. VISUAL ATTACK	Mode initiated by pressing switch. NAV WD Computer records selected weapon data. Attack symbology appears on HUD. When target is acquired visually and designated, target location is recorded in NAV WD Computer. With armament release switch on pilot's stick grip pressed and held, NAV WD Computer generates fire pulses to ASCU corresponding to selected drop interval and quantity. If fuselage gun is selected in this mode and no other computed munition is selected, computed lead is delivered to HUD to place aiming symbol over impact point. If stations loaded with rockets are selected and in priority, computed lead is for rockets. Deselected by pressing switch second time or by selecting BOC or CCIP.
2. BOMB-ON-COORDINATES (BOC)	Mode selection allows for designation and attack of target using target coordinates and radar returns, if available. Target is designated automatically on mode entry. Deselected by pressing switch second time or by selecting another mode.
3. OFFSET	Mode selected by first pressing either the VISUAL ATTACK or BOC switch and then pressing the OFFSET switch. Gives capability to attack a target not visible or not radar reflective, but within system range of prominent landmark referred to as offset aiming point (OAP). OAP must be visible for VISUAL ATTACK OFFSET and discernible on ground map display for BOC OFFSET. After OAP designation the computer slews the HUD aiming symbol over the target. Attack sequence is same as VISUAL ATTACK or BOC. Deselected by pressing switch second time or by selecting another mode.
4. CONTINUOUS COMPUTED IMPACT POINT (CCIP)	Mode selection displays the computed impact point at the intersection of the CCIPSL and lower solution cue. Aiming symbol is not displayed and the armament release button is hot. Deselected by pressing switch second time or by selecting another mode.

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Figure 1-12

Operational Flight Program (OFP).

The NAV WD Computer is programmed by an Operational Flight Program (OFP) which provides the computer with the information necessary to convert input signals and commands into attack and navigation solutions for pilot use.

The program within the computer is identified under Data Address 99. When this Address is called up, the display panel upper window will display OFP A7 and the lower window will display the revision identifiers. The current program will read AF-3 in the lower display windows.

The OFP contains ballistics equations for those weapons which have a computed delivery capability and the equations necessary to use aircraft sensor inputs and designated target location to derive weapon impact point from the ballistics. Using the target location and the weapon impact point, the computer provides steering cues to the pilot to place the impact point on the target's location.

The OFP also contains sensor input rejection criteria which gives the computer values for acceptance or rejection of sensor (IMS, Doppler, etc) inputs based on the input reliability and reasonability. As a part of these rejection criteria, the OFP contains directions for the computer to automatically enter backup modes of operation when unreliable sensor inputs are received. These backup modes may involve use of other sensor inputs, computer memory, or pilot inserted data. Refer to Delivery System Management description in this section for additional information concerning computer backup modes, their use, and the pilot actions required, if any, when these modes are used.

The OFP also gives the pilot the ability to call up or recall data from the computer. This data is provided in the form of readouts in the windows of the computer control panel. These readouts display the values the computer is using for its computations, either sensor input data or pilot inserted data. The readouts also show which of the sensors the computer considers reliable and which sensors are considered unreliable. Figure 1-13 gives a breakdown of the data display for weapon delivery information, including showing which values are pilot inserted and displayed or only displayed. Refer to T.O. 1A-7K-1 for a complete breakdown of the computer data display.

OFP Special Characteristics.

The current computer OFP has special characteristics which affect system operation in the weapon delivery role. These characteristics and their effects are described below.

Aircraft roll in the presence of high crosswinds will cause the flightpath marker (FPM) to be positioned above or below the correct real-world pitch angle, particularly in level turns, due to the FPM being limited in azimuth. In an attack mode with bombs selected and the target designated, this may cause the azimuth steering line (ASL) to jump on initial movement of the Bullpup controller and again when the Bullpup controller is returned to the neutral position. However, the steering display indicated by the FPM and ASL relationship is correct and should be followed.

The ASL may lock at altitudes of approximately 50 feet or less above the target, causing the ASL to roll with the aircraft. However, the azimuth steering indications of the ASL will be accurate under this condition. As altitude is increased, the ASL will unlock. When unlock occurs, the ASL may jump.

Once pullup is initiated with the target designated, the aiming symbol may be pulled off the target due to aircraft pitch rate. It is mandatory that the pilot not slew the aiming symbol after pullup has been initiated.

Pullup initiated before solution cue appearance, or at a rate greater than programmed in the computer when near maximum range, may result in no release. This may be a problem in high-drag bomb deliveries where solution cue appearance occurs close to the target. In this situation, the solution cue may appear during pullout but will never move through the FPM.

Solution cue jumps may be observed if a large quantity (greater than 12) of weapon releases is selected and the spacing selected results in a release interval smaller than the programmed minimum release interval. Solution cue jumps may also be observed if a quantity of 4 or more weapon releases is selected and the spacing selected results in a release interval greater than the programmed maximun release interval of 1.3 seconds.

COMPUTER ENTRIES AND DISPLAYS FOR WEAPON DELIVERY

INPUT/READOUT	MEASUREMENT	PERFORMANCE CAPABILITY				† DISPLAY READOUT WINDOW
		SIGN	RANGE OF VARIABLE	MINIMUM INCREMENT	ACCURACY	
Latitude (present position, mark*, destination)	Deg-Min-Sec	N/S	90°00'00"	1" (Sec)	1" (Sec)	Upper
Longitude (present position, mark*, destination)	Deg-Min-Sec	E/W	180°00'00"	1" (Sec)	1" (Sec)	Lower
Target Altitude	Feet		-65,500 to +65,500	1 Foot	2 Feet	Upper
Mean Sea Level Pressure (MSLP)	Inches-Hg		0 – 40.5	0.01 in.	0 Inch	Lower
Target Offset Range	Feet		0 – 131,068	1 Foot	2 Feet	Upper
Target Offset Bearing	Deg-Min-Sec		360°00'00"	1" (Sec)	20" (Sec)	Lower
Δ Height	Feet	±	-9,999 to +9,999	1 Foot	2 Feet	Upper
Burst Height	Feet		0 – 16,383	1 Foot	2 Feet	Lower

*Mark latitude and longitude arc not inserted, only displayed.
† Forward and aft cockpits

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Figure 1-13

In CCIP mode, the aiming symbol is not displayed; bomb impact point is the intersection of the CCIPSL and lower solution cue. The armament release button is hot in the CCIP mode.

In both computed ripple release mode and manual ripple release mode, all Quantity/Interval setting changes are ignored while the ripple release is in progress.

PMDS/HSI DME indications are displayed in 1,000-foot increments when within 10 miles of a selected target or a selected destination in a computed bombing mode or air/ground guns. This ground range indication will be the distance to the selected FLY-TO-DEST (if undesignated) or the distance to the ground-stabilized aiming symbol, if present. The DME range is recomputed following any postdesignate slew. The 1,000's HSI digit is also displayed when the HSI/PMDS is indicating DME in thousands of feet. For example, a target range of 42,000 feet will be displayed as 1042 on the HSI.

When changing from BOC or BOC OFFSET bombing modes to VISUAL ATTACK or VISUAL ATTACK OFFSET bombing modes after target designation, FLR AGR data are not used for ranging information unless the aiming symbol is slewed with the Bullup controller. The NAV WD Computer does use FLR AGR data to compute ground/blast avoidance.

The NAV WD Computer will not issue a fire pulse if a slew is performed within 0.2 second of the computed weapon release point. To reduce the possibility of a missed computed release due to a late slew, the OFP inhibits slew start whenever the lower solution cue is adjacent to or within the upper half of the FPM (figure 1-14). Slew actions initiated prior to the lower solution cue becoming adjacent to the FPM are allowed to continue until the slew (Bullpup) controller is released and may prevent the issuance of a fire pulse. Slew inhibit is terminated when the lower solution cue goes below the center of the flightpath marker.

If a BDU-33 station is in priority (ASCU — HR or HS) and TAIL or NOSE/TAIL fuzing is selected, all blast avoidance calculations used to position the pull-up anticipation cue and pullup cue on the HUD will not be performed by the NAV WD Computer. This feature should be used only while practicing high-drag deliveries.

Minimum Release Interval.

To prevent bomb-to-bomb collisions during ripple release bombing, the OFP contains a minimum release interval (MRI) as a part of the program. The INTERVAL-FT thumbwheel setting made by the pilot is converted by the computer into a time interval between bomb releases. The MRI becomes a factor when the pilot selects an INTERVAL-FT setting that converts to less than the programmed MRI for the weapon selected. When this occurs, the computer automatically, and with no indication to the pilot, uses the programmed MRI as the interval between bomb releases.

The MRI used depends upon the type of weapon selected, the release sequence selected, and whether the selected weapons are loaded on MAU-12 racks or MER's/TER's. Figure 6-24 depicts the programmed MRI in tabular form showing the minimum intervals obtainable and the conditions under which they apply. Release intervals less than those shown in figure 6-24 are not possible.

In computed bombing modes, the computer will provide the selected quantity (QUANTITY thumbwheel) of release pulses at time intervals which will result in spacing between bomb impact points on the ground equal to that selected on the INTERVAL-FT thumbwheel, unless the resultant time interval is less than the programmed MRI, in which case the MRI is used. If the MRI is higher than the derived interval, the computer will adjust the spacing between bombs to match the MRI and will determine the initial release point to center the stick on the designated target. The displayed computed solutions will reflect the effects of the MRI imposition although the pilot will be unable to detect it.

In manual ripple bombing, the NAV WD Computer acts as an intervalometer and provides the selected quantity (QUANTITY thumbwheel) of release pulses at the selected interval (INTERVAL-FT thumbwheel). The first release occurs upon depression of the armament release button. The computer provides the second and subsequent release pulses as the aircraft travels the distance over the ground equal to the INTERVAL-FT thumbwheel setting unless the resultant time interval between release pulses is less than the programmed MRI, in which case the MRI is used. The effect of the MRI is more critical in manual ripple release than in computed ripple release since the stick of bombs is not automatically centered on target. Imposition of the MRI results in a larger than planned bomb spacing, a larger than planned portion of the stick hitting long (beyond the center of the target), and the last bombs in the stick impacting further from the target center than planned.

NOTE

When calculating the spacing between impact points for manual ripple release, ensure that the release interval obtained is equal to, or greater than, the MRI for the weapon and release mode to be used.

Minimum release intervals established for MER carriage take into consideration that there could be one or two empty ejector units between loaded ones. There are, however, a limited number of authorized configurations where MER carriage on aircraft station 7 involves stores loaded on ejector units 1 and 6, with four empty units between. In selecting the INTERVAL-FT setting and the release mode to be used with these configurations, the pilot must consider that it will take 100 milliseconds for the MER to step from ejector unit 1 to 6 (20 milliseconds from one unit to the next). If the release interval obtained (whether or not it is the MRI) is less than 100 milliseconds, no release will occur from ejector unit 6.

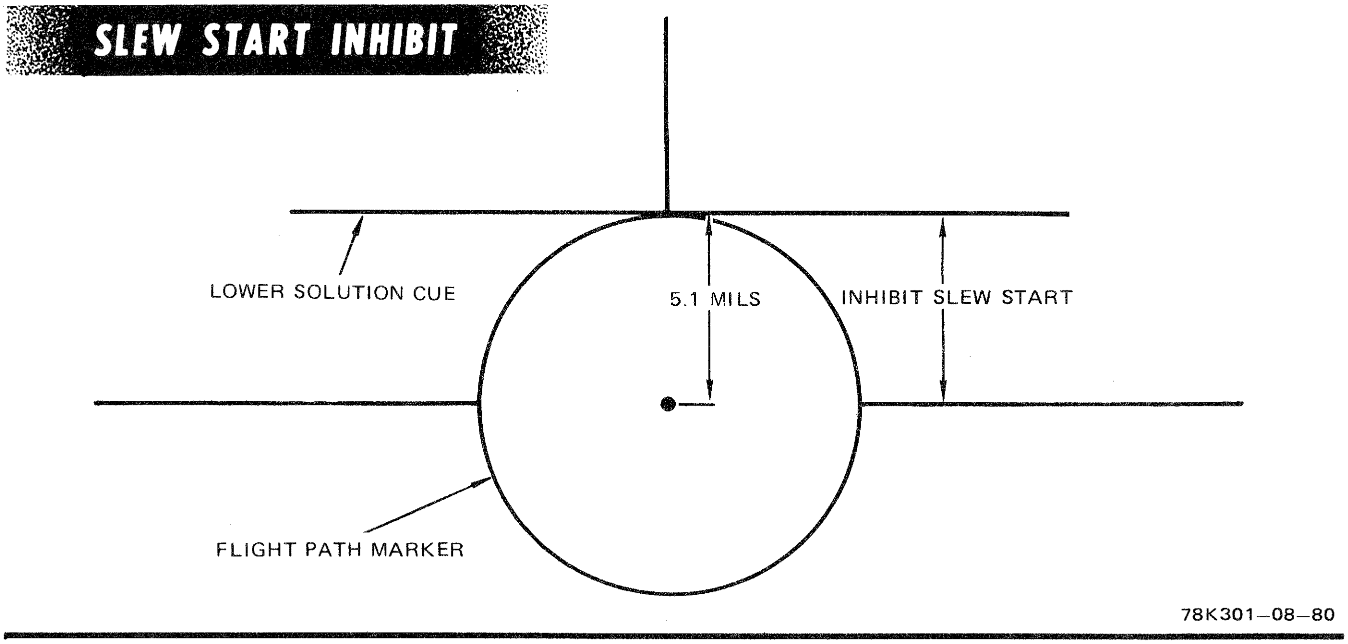


Figure 1-14

HEAD-UP DISPLAY.

The Head-Up Display (HUD) is an optical and electronic device that projects flight information in symbolic form into the pilot's forward field of view. The HUD symbols are formed on a cathode ray tube and focused onto a combiner glass through a series of collimating lenses. A standby reticle is included for use if the normal HUD symbols fail.

The HUD is the primary flight instrument and weapon delivery sight used in computed weapon delivery. HUD attack mode symbology is shown in figure 1-15. Refer to T.O. 1A-7K-1 for HUD symbology in navigation and landing modes.

The HUD presentation will be in accordance with the selection of the master function switches and the weapon type (bombs, guns, rockets, or missile) on the highest priority station.

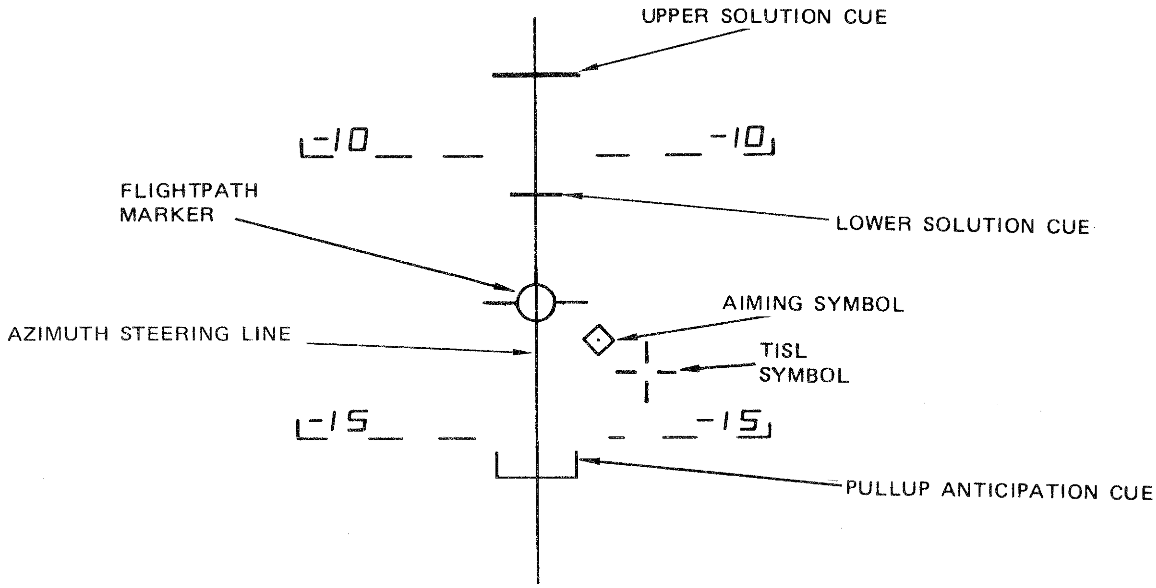
The HUD comprises three primary units, the pilot's display unit, the electronic unit, and the display unit mount. The pilot's display unit contains the controls for the HUD as well as the combining glass on which the symbols are projected. The electronic unit converts input signals from the various avionic systems into appropriate symbology. The mount provides means for boresighting the HUD.

Attack Symbology.

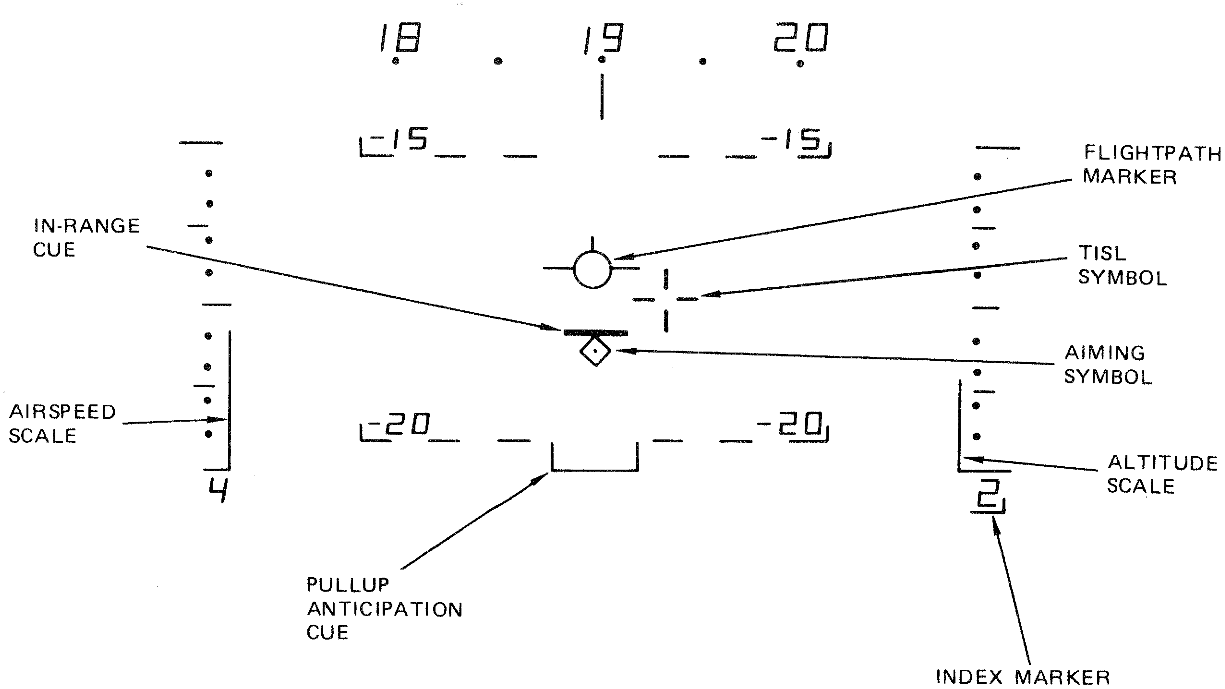
Pitch Lines.

The pitch lines, 140 mils in width, represent each 5° of pitch between plus or minus 90°. The pitch lines are positioned by the NAV WD Computer to display pitch and roll information. Negative lines are dashed and positive lines are solid. Each line is numbered (except the zero pitch line) to show the angle of dive or climb. To further aid the pilot in attitude interpretation, the negative pitch angle numbers are prefixed by a minus sign. These lines, which represent pitch and roll, appear in all operating modes. The pitch lines are positioned about local levels, not the actual horizon. This causes the zero pitch line to be above the actual horizon by an amount proportional to altitude. The scale factor of pitch lines to real world is 1:1.

HUD ATTACK SYMBOLOGY



VISUAL ATTACK MODE
(without scales)



GUNS AND ROCKETS
(with scales)

78K065–10–81

Figure 1-15

Flightpath Marker.

The flightpath marker (FPM) consists of a 10-mil circle with 10-mil wings and a 5-mil tail. The FPM indicates the aircraft's velocity vector in all modes and is positioned by the NAV WD Computer. If the NAV WD Computer is inoperative or invalid, the HUD automatically uses Doppler drift angle and angle-of-attack information from the AOA transducer to position the FPM in azimuth and elevation. In computed bombing modes the FPM will blink five times per second for 2 seconds beginning with the release of the last weapon selected.

NOTE

> The OFP limits FPM to ±6° azimuth and ±8° elevation (from center of HUD) within +4.3° and −11.7° from armament datum line. During certain flight conditions (high angle of attack), the FPM can become limited and indicate erroneous flightpath angle. This limit occurs at approximately 20 units AOA.

Aiming Symbol.

A diamond-shaped aiming symbol, 10 mils in height and width and containing a 1-mil dot in the center, appears on the HUD in all computed attack modes except CCIP. The aiming symbol is used by the pilot to show the NAV WD Computer the target or OAP location in VISUAL ATTACK. In the BOC mode, the computer positions the aiming symbol to show the pilot the target or OAP computed position. At designation, the aiming symbol becomes ground stabilized on the designated point. Pilot movement of the aiming symbol is accomplished with the Bullpup controller (azimuth and elevation). The aiming symbol is also used for position updates in the navigational modes of the NAV WD system (refer to T.O. 1A-7K-1).

In computed air-to-ground gunnery and rocket attack modes, the aiming symbol indicates the computed impact point of the projectile/rocket. In computed air-to-air gunnery, the aiming symbol indicates computed lead for the target based on a 0.56-second time of flight, corrected for aircraft turn rate. Pilot movement of the aiming symbol is not possible in computed gun and rocket attacks.

Aiming symbol movement is not limited to the HUD total field of view and may move off the HUD in computed bombing attacks.

When an AGM-65 missile station is in priority and VISUAL ATTACK mode is selected, the aiming symbol is fixed at the 0° depression and 0° azimuth position to assist the pilot in centering the target within the missile video display. In this mode, aiming symbol slewing is inoperative.

When a GBU-8/B bomb station is in priority and VISUAL ATTACK mode is selected, the NAV WD Computer can be used to boresight the bomb. The aiming symbol will appear on the zero sight line or at a location corresponding to weapon boresight from a previous flight. The Bullpup controller can be used to slew the aiming symbol in azimuth and elevation to overlay an object also appearing in the video crosshairs. When the target designate button is actuated, the aiming symbol offset is entered into the computer.

In the BOC mode with DEST 0 or MARK 0 selected on the FLY TO thumbwheel, the aiming symbol is auto-positioned 8 nmi ahead of the aircraft. Under these conditions, it is possible to slew the aiming symbol to a maximum of 20 nmi.

Whenever BOC or BOC OFFSET is selected on the master function switches, the HUD aiming symbol (AS) is blinked continuously at a 5-hertz rate. This blinking action serves as a visual reminder that the cursor intersection on the FLR indicator should be used for target (OAP) location refinement, not the HUD AS.

TISL Symbol.

The TISL symbol (an open cross) appears when the Target Identification Set, Laser system has identified and is tracking a target illuminated by a laser beam of the proper characteristics. If the target is within the HUD field of view (FOV), the TISL symbol is steady and appears superimposed over the target's ground location. If the target is outside the HUD FOV, the TISL symbol will appear at the edge of the field of view nearest the actual target and will flash at a 5-hertz rate to indicate the limited condition.

Azimuth Steering Line (All Computed Modes Except CCIP).

The azimuth steering line (ASL) is a line, 16° in length, placed perpendicular to the HUD pitch lines, and used to provide azimuth steering commands in the VISUAL ATTACK, VISUAL ATTACK OFFSET, BOC, and BOC OFFSET modes. The ASL position is controlled by the NAV WD Computer and, prior to target designation, is located in the HUD FOV, dependent upon the attack mode selected. After target designation, the ASL is deflected from the FPM to indicate azimuth steering error. Azimuth steering represented by the ASL to FPM relationship is equal to one-half of the true steering error. The computed target is 10° from the FPM when the ASL is 5° from the FPM. The pilot corrects azimuth steering error by flying the aircraft so as to place the FPM over the ASL. As the ASL is always positioned perpendicular to the HUD pitch lines, any crosswind factor used by the NAV WD Computer is indicated by the ASL to aiming symbol relationship, as depicted on the HUD, subsequent to FPM and ASL alignment. Consequently, the ASL need not be aligned with the aiming symbol for release to occur in a crosswind environment. The ASL does not show the predicted path of bomb impacts across the ground.

Continuously Computed Impact Point Steering Line (CCIP Mode Only).

The continuously computed impact point steering line (CCIPSL) is identical to the ASL in length. When in the CCIP mode, the CCIPSL provides an earth vertical line through the FPM until the computed impact point is within the usable HUD FOV. When the computed impact point is within the usable HUD FOV (less than 11° in azimuth and 16° in elevation), the lower solution cue appears. Simultaneously, the CCIPSL detaches from the FPM and is positioned through the solution cue. Subsequent to this position change, the CCIPSL is always parallel to the side of the HUD combiner and parallel to the solution cue. This feature eliminates the obscuration of the solution cue within the CCIPSL at bank angles near 90°. The intersection of the CCIPSL and the solution cue represents the instantaneous impact point of the selected store.

Solution Cues (All Computed Bombing Modes Except CCIP).

The HUD solution cues appear when the aircraft is within the maximum slant range for the weapon selected. There are two solution cues, one above the other, with the upper cue 30 mils long and the lower cue 20 mils long.

For low-drag bombs, both cues appear superimposed above the FPM on the ASL when a 4g pullup will result in a 42° (maximum range) release angle. The solution cues indicate the amount of pullup required for release. After the solution cues begin to move, 1° of solution cue vertical displacement above the FPM equals 8 ° of pullup with a maximum vertical displacement of 4 ° (32° of pullup). The 10° disparity between the initial appearance of the solution cues and the 32° pullup point for solution cue separation is caused by the placement of the cues within the HUD instantaneous field of view (IFOV). In order to maintain the cues within the HUD IFOV, 4° vertical displacement was the maximum allowable. Initiating a pullup at solution cue appearance will cause solution cue separation immediately. As the aircraft approaches the release point, the lower cue separates and moves down the HUD at a rate proportional to the decrease in amount of pullup required for release. Since the NAV WD Computer computes the weapon delivery solution on a real-time basis, solution cue vertical displacement indicates the amount of instantaneous pullup required for release. Thus, when the lower solution cue is 2° above the FPM, the computer is indicating that if 16° more pullup was being felt at that instant, release would occur. If the armament release button is depressed before the lower cue intersects the FPM, a straight path, toss, or low angle loft release will be obtained. If the armament release button is not depressed until the upper solution approaches and intersects the FPM, a high angle loft or OTS release will be obtained if the pilot has executed a pullup.

For high-drag (retarded) bombs and bomb type CBU munitions, only the lower solution cue is displayed. The cue appears 4.0° above the FPM when the distance to release becomes less than 6,000 feet. When the distance to release becomes less than 4,000 feet, the lower solution cue will begin to move down the ASL and will intersect the FPM when the distance to go to release is zero.

Solution Cues (CCIP Mode).

In the CCIP bombing mode, the upper solution cue is not displayed. The lower solution cue appears when the impact angle is −16° or less below the FPM center. The intersection of the lower solution cue and the CCIPSL indicates the instantaneous bomb impact point or the center bomb in a bomb stick.

Solution Cues (Computed Air-To-Ground Gun and Rocket Modes).

For air-to-ground gun and rocket attacks, only the lower solution cue is displayed. The cue is placed atop the aiming symbol to indicate that select range to the computed impact point is less than a specified maximum.

Solution Cue Blinking.

Solution cues are blinked at a rate of five times per second in computed weapon delivery modes (except CCIP) when FLR air-to-ground ranging (AGR) information is requested by the NAV WD Computer and the AGR information is not valid. This blinking continues until the AGR information becomes valid or until the attack has been completed and attack symbology is removed from the HUD. Solution cue blinking occurs in the different attack modes as follows:

VISUAL ATTACK — solution cues blink at target designation and/or at completion of slewing performed after designation. Blinking does not occur following slewing if designation has not been performed.

VISUAL ATTACK OFFSET — solution cues blink at completion of manual slewing performed after OAP designation. Solution cues do not blink unless manual slewing is performed after designation.

NOTE

In a true VISUAL ATTACK OFFSET situation (target not visible), there is no indication that FLR AGR data are not being used.

BOMB-ON-COORDINATES — solution cues do not blink as FLR AGR data are not used.

BOMB-ON-COORDINATES OFFSET — solution cues do not blink as FLR AGR data are not used.

CONTINUOUSLY COMPUTED IMPACT POINT — solution cues do not blink. If FLR AGR data are not available/invalid, NAV WD Computer reverts to the backup ranging dictated by Data 24.

Rocket Attack or Air-to-Ground Gunnery (any attack mode selected) — the in-range cue begins blinking upon cue appearance or loss of valid FLR AGR information, whichever occurs last.

Pullup Anticipation Cue (All Computed Modes Except CCIP).

The pullup anticipation cue appears when a computed weapon delivery mode is selected. The pullup anticipation cue remains stationary on the ASL at 3.5° below the FPM until aircraft slant range is 4,000 feet-to-go to the pullup point. As the aircraft tracks from 4,000 feet-to-go to the pullup point, the pullup anticipation cue moves toward the FPM at a linear rate. When the pullup anticipation cue passes the FPM, the pullup command appears, providing ground avoidance or blast avoidance (750 feet for CBU-24, -49, -52, -58, and -71 and Mk20 Rockeye; 1,500 feet for all other munitions), assuming the pilot executes an immediate 4g pullup. Ground avoidance calculations are based on inserted or computed target elevation, depending on the range sensor being used and the assumption of flat terrain in the target area. If the rate of descent is less than 3 feet per second, the calculations for ground avoidance are bypassed.

The blast radius calculation is not performed if any of the following conditions are true:

1. The aircraft slant range to target is greater than 32,000 feet.
2. The pilot has not designated or is in gun mode.
3. The aircraft velocity vector will not pass through the blast radius.
4. The aircraft will have passed the blast by the time the weapon strikes the ground (napalm, retarded weapons).
5. With a quantity of 01 selected on the QUANTITY thumbwheel when the aircraft has overflown the computed target position.
6. With a quantity of 02 or more selected on the QUANTITY thumbwheel when the aircraft has overflown the computed impact point of the last bomb selected.
7. With a BDU-33 station in priority and tail or nose/tail fuzing selected.

Considered in the blast avoidance equations are the following parameters:

1. Aircraft velocity.
2. Pitch angle.
3. Bomb time of fall.
4. Distance to far extremity of blast radius.
5. Angle between line of sight to the target (aiming symbol) and extremity of the blast radius.
6. Angle between aiming symbol and flightpath marker.
7. Single or stick of bombs.

Pullup anticipation cue movement (and subsequent appearance of the pullup command) should not be regarded as a valid indication of blast avoidance in all situations. The NAV WD Computer provides blast avoidance based on a 1,500-foot blast radius (750 foot for CBU-24, -49, -52, -58, and -71 and Mk20 Rockeye), which is not an accurate assumption for all weapons or delivery situations. Therefore, the pilot must determine that the 1,500-foot or 750-foot blast radius will actually provide safe escape from weapon effects with the weapons and delivery tactics planned for the mission. Figure 6-13 provides minimum release altitudes for safe escape for a variety of weapons and delivery tactics.

Pullup anticipation cue movement is somewhat different if the pilot is exercising the flexible fuze capability of the NAV WD Computer. In this case, the cue not only indicates approach to a pullup point based on ground or blast avoidance, but the cue is also used to indicate either approach to the proper release point or minimum altitude required to ensure adequate fuze arming time.

For bomb type CBU munitions with time fuzes installed, the computer moves the pullup anticipation cue up to the FPM to indicate approach to the optimum release point. This optimum release point is the point in space from which the munition will reach the desired functioning altitude at the expiration of the time set on the fuze (and entered into the computer). The pilot has only to fly the aircraft so as to achieve simultaneous intersection of the solution and pullup anticipation cues with the FPM to obtain the optimum fuze functioning altitude and desired dispenser submunition pattern size.

For bomb type CBU munitions with altitude sensing fuzes, the computer moves the pullup anticipation cue as a function of the difference between the actual fuzing time (time of fall from release to functioning altitude) and a nominal four seconds. The pilot has only to fly the aircraft so as to keep the cue below the FPM to ensure adequate time for the fuze to arm before the munition reaches the fuze functioning altitude.

For general purpose bombs, the computer moves the pullup anticipation cue as a function of the difference between the entered fuze arming time and the actual ballistic time of fall of the bomb. The pilot has only to fly the aircraft so as to keep the cue below the FPM to ensure adequate time for fuze arming before bomb impact. If zero fuze arming time is entered, the fuze function computations are not done and the pullup anticipation cue functions for ground/blast avoidance.

When the pullup cue is operating in this mode, it has the following characteristics:

1. It will work with bomb type munitions only.
2. It will work only after the target has been designated. It will not work in go-around steering.
3. It will work only when within 32,000 feet slant range of the designated target.
4. No provision will be made for differences between individual munitions in computed ripple mode. All munitions are assumed to have the same fuze setting and desired altitude.
5. The pullup command (flashing X) will not function when the pullup cue intersects the FPM. The pullup command is reserved for blast and ground avoidance warnings and will appear whenever a pullup is required for aircraft safety regardless of the position of the pullup cue.
6. If the pullup cue is below the FPM at the approach to a pullup required for blast/ground avoidance, the cue will revert to its pullup anticipation function. The two functions of the cue operate parallel to each other.
7. The pullup cue movement is based on the next munition to be released; therefore, the solution indicated by the cue movement will change minutely for each munition when performing a stick release.

8. Pullup cue movement is dependent on airspeed and initial cue movement is based on this factor remaining constant. A dive delivery (from 4° to 45°) at 475 KTAS with time fuzed CBU munitions will produce initial cue movement approximately 3 seconds prior to reaching the release point. (In the current OFP, the time from initial movement of the cue to intersection with the FPM has been reduced for lower dive angles. This change provides a more consistent time once the cue begins to move until release altitude is reached for all dive angles from 4° to 45°.) A higher airspeed results in a lower time (faster pullup cue movement) and vice versa.

Pullup Anticipation Cue (CCIP Mode).

In CCIP mode, the pullup anticipation cue (PUAC) indicates ground/blast avoidance, as in other modes, but is displayed directly below the FPM and not on the continuously computed impact point steering line (CCIPSL). When using the flexible fuze capability in conjunction with the CCIP mode, the PUAC provides fuze arming time and safe escape information for employment of GP bombs, destructors, and fire bombs and steering information relative to optimum release altitudes for bomb type CBU dispensers having time fuzes installed. In CCIP, bomb burst height, if entered, will be ignored.

Refer to NAV WD Computer Data Entry discussion, this section, for information on the data entry requirements to use this capability.

TISL Symbol.

The TISL symbol appears when the Target Identification Set, Laser (TISL) system has identified and is tracking a target which is illuminated with a laser beam of the proper characteristics. When the target is within the HUD field of view, the TISL symbol is steady and displayed over the target's ground location. When the target is outside the HUD field of view, the TISL symbol is held at the outside (top, bottom, or either side) edge of the field of view and flashes five times per second.

Pullup Command.

The pullup command advises an immediate 4g pullup in all operating modes. It is a large flashing X, 100 mils by 100 mils, that appears on the face of the HUD when the pullup anticipation cue intersects the flightpath marker in attack modes. In the attack modes it is controlled by the NAV WD Computer. In the terrain following mode it is controlled by the forward-looking radar.

Slant Range Indicator.

The HUD vertical velocity (VV) scale may be used to display slant range to the target in all computed attack modes, except air-to-air guns. The slant range is indicated by the position of the vertical velocity indicator (VVI) along the VV scale (figure 1-16). The slant range display is controlled by entering a maximum range value in Data Address 34. Slant range values from 2,048 feet (minimum) to 131,072 feet (maximum) can be entered in the data address. The maximum range value is represented by the top of the VV scale. The bottom of the scale always represents a 0-foot range. The HUD scales switch must be positioned to SCALES to enable the slant range indicator feature. Normally, the value entered in Data Address 34 is twice that of the desired open-fire/weapon release range. This provides for a VVI midscale indication at the desired range.

Bullpup Controller.

The Bullpup controller is located forward on the cockpit left console. It is used to slew the HUD aiming symbol in elevation/range and azimuth in computed bombing modes except CCIP. In normal usage, in other than the BOC attack modes, the pilot moves the controller like an aircraft stick grip to overlay the target with the HUD aiming symbol. Prior to target/OAP designation, the HUD ASL is slaved to and will follow the aiming symbol in displacement from the FPM. In the BOC attack modes, the controller is used to slew the radar range and azimuth cursors in the same manner as the aiming symbol is slewed in visual modes. In the BOC modes, aiming symbol movement is slaved to the radar cursor movement.

The slewing rates are nonlinear. When the Bullpup controller slew signal input to the NAV WD Computer is relatively low (small movement of the controller), the slew rate is slow. When the Bullpup controller is moved further from center, the slew rate (rate of aiming symbol, cursor, or map drive movement per volt on input line) increases gradually. At maximum slew (full deflection of the controller from center), the slew rate becomes a relatively large value. This nonlinear scaling allows more precise control of the HUD aiming symbol, FLR cursors, and PMDS map display when making small corrections and decreases the amount of time required for making large corrections. In addition to being

HUD SLANT RANGE DISPLAY

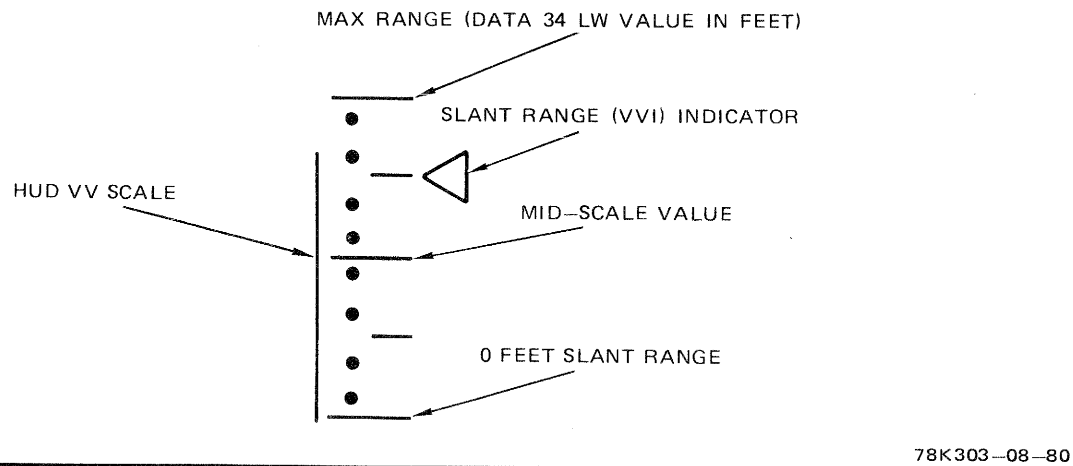


Figure 1-16

nonlinear, the slew rates also differ according to the function being served. The overall slew rates for FLR cursor and PMDS map display slewing (over the entire range of Bullpup controller inputs) are higher than the rate used for HUD aiming symbol slewing.

When an AGM-65 missile is loaded on the selected station, the Bullpup controller is used to slew the missile seeker head in azimuth and elevation. Seeker head slewing is enabled only when the target designate button is depressed.

When a GBU-8 EO bomb is loaded on a selected station, in priority, the Bullpup controller is used to slew the HUD aiming symbol line of sight (LOS) to the LOS of the bomb electro-optical sensor during airborne alignment procedures.

Controls and Indicators.

Refer to T.O. 1A-7K-1 for illustrations of the HUD display unit and the Bullpup controller.

TARGET IDENTIFICATION SET, LASER.

The AN/AAS-35(V) Target Identification Set, Laser (TISL) consists of a forward cockpit mounted control panel, a laser detector pod mounted just behind the lower lip of the intake duct, an adapter control-detector (ACD), and the interconnecting wiring for interface with the NAV WD Delivery System. Other hardware includes: a modified HUD which adds the TISL symbol (-¦-), a modified NAV WD Computer to interface with the TISL system, and a dummy pod for installation in the airframe when the detector pod is removed. The TISL system is used as a target acquisition aid and will search for, detect, and track targets which are illuminated with a laser beam of the proper characteristics. The TISL system can be used in all modes except landing.

The TISL pod consists of a gimbal mounted laser detector and the electrical interface with the ACD. The ACD provides the necessary interface between the detector pod, TISL control panel, NAV WD Computer, cockpit caution and advisory light panel, and aircraft electrical system.

As part of its control functions, the ACD receives inputs from the control panel and NAV WD Computer. The control panel provides power, mode control, code input, and BITE test control for the TISL. The ACD provides directional outputs to the computer on the scanning, lock-on, and tracking of the detector and BITE results and failure and overtemperature conditions to the control panel and caution and advisory light panel.

The pilot programs the TISL system with a standard USAF laser code. First, a four-digit code is entered on the CODE SELECT thumbwheels. The code is then entered into the TISL system by selecting TISL on the BOTH/TISL/AUX switch and pressing the CODE ENTER switch. When the CODE ENTER (TISL light) goes off, the code has been entered and verified within the TISL system.

The TISL operates in three basic modes: cage, computer directed, and track. In the cage mode, the detector pod seeker head is electrically caged to the boresight axis. This mode is used for ready standby during airborne carriage. In the computer directed mode, the detector seeker head scans about or points along a line of sight (LOS) defined by the NAV WD Computer. If the aiming symbol is present on the HUD, the search pattern (±10° azimuth and ±4° elevation) will be about the aiming symbol. If the aiming symbol is not present, the search is about the zero line of sight. For 10 seconds after loss of track, the TISL points toward the last known laser position. During the 10 seconds of pointing, the TISL search pattern is ±2° in both azimuth and elevation. If the target is not detected within the 10-second point command, the TISL reverts to a normal search.

The TISL CAGE-ON-OFF switch must be positioned to ON, and the proper code for the laser signal to be detected must have been entered on the TISL control panel code selector thumbwheels before the TISL will be under control of the NAV WD Computer. The track mode is then automatically entered any time the TISL detects properly coded laser energy. The TISL symbol will be displayed on the HUD, indicating the location of the laser illuminated target. If the laser target is not in the HUD field of view (FOV), the TISL symbol will be placed at the edge of the FOV nearest the target and flashed at a 5-hertz rate.

In an attack mode which uses a ground stabilized target or OAP, if the target/OAP has been designated before a valid TISL track is acquired, the weapons solution is based on the designated target. The TISL target position is presented on the HUD for information purposes only. If the target has not been designated in an attack mode when a valid TISL track is acquired, the aiming symbol is auto-positioned on the TISL symbol. The solution is then dead reckoned and is subject to system drift and pilot slewing as in existing modes.

NOTE

> In the VISUAL ATTACK and BOC modes, automatic designation occurs when the aiming symbol is auto-positioned on the TISL symbol. The pilot must designate the OAP in the OFFSET modes to accept the offset range and bearing.

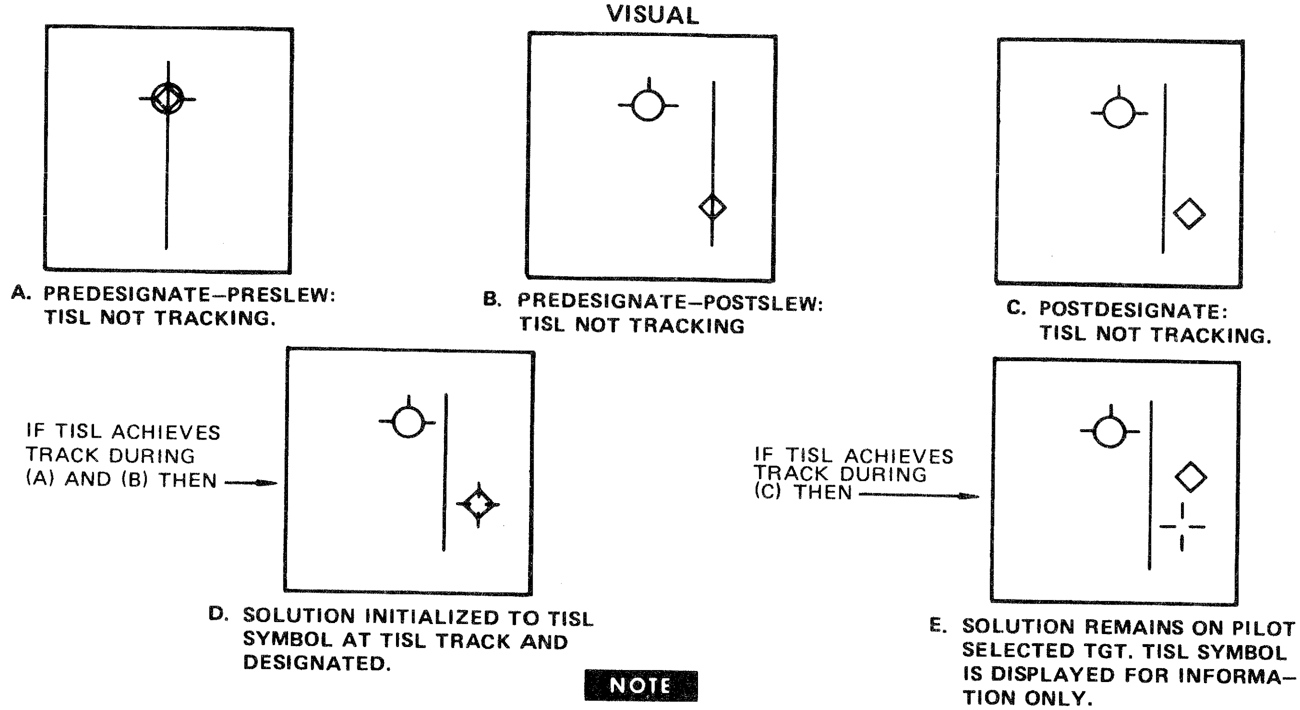
In the VISUAL ATTACK OFFSET and BOC OFFSET modes, the laser illuminated location is always assumed to be the OAP and not the target. The pilot must designate in the OFFSET modes to accept the offset range and bearing. In the modes where the target/OAP has been designated, redesignate action will cause the aiming symbol to auto-position to the TISL symbol if a valid track is present or initialize the mode if a valid TISL track is not present.

Typical TISL symbology is shown in figure 1-17. The TISL system cockpit controls and indicators are illustrated in T.O. 1A-7K-1. Refer to (Confidential) T.O. 1A-7K-34-1-1-1 for additional information on TISL codes, system characteristics, and limitations.

FORWARD-LOOKING RADAR.

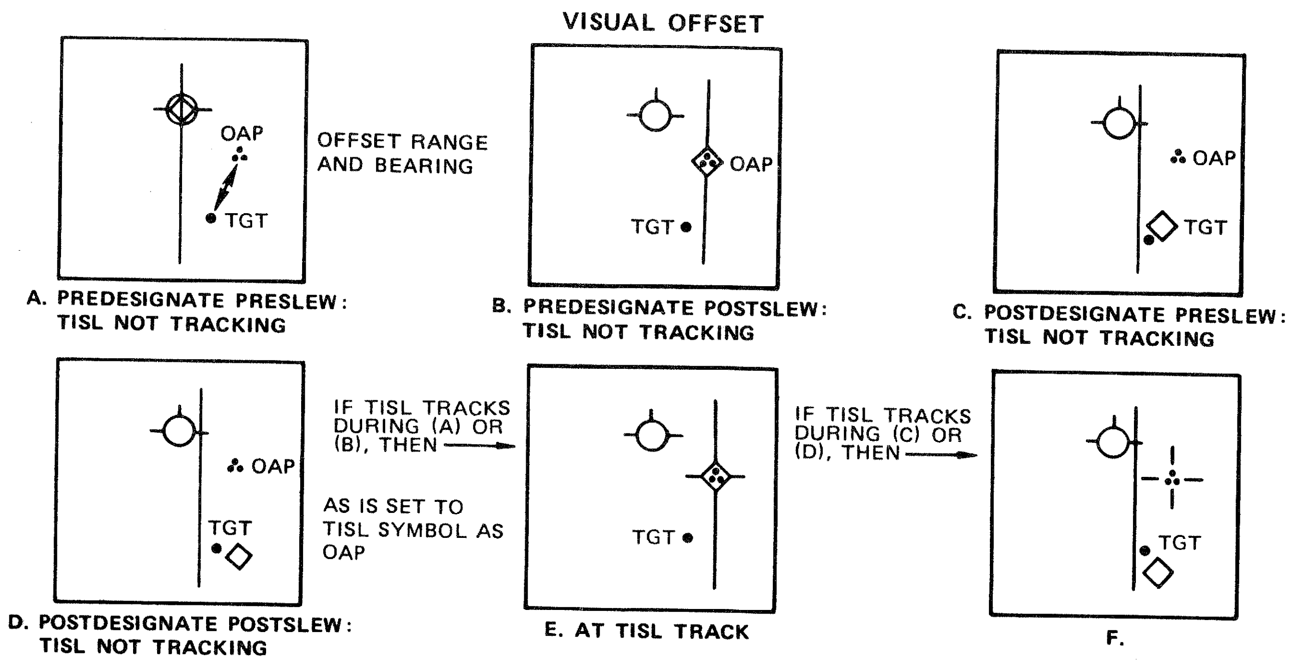
The AN/APQ-126 Forward-Looking Radar (FLR) is used in weapon delivery to locate and designate the target and to provide slant range to the target. Upon entry into any of the computed attack modes, except air-to-air gunnery, the NAV WD Computer assumes control of the FLR and places it in the mode of operation determined by the attack mode and weapon type selected. The following discussion describes the FLR operation and characteristics in the weapon delivery role. Refer to T.O. 1A-7K-1 for a discussion of FLR operation in navigational modes and for illustrations depicting the FLR controls and indicators.

TISL SYMBOLOGY (TYPICAL)



NOTE

(E) also indicates slew after (D) or as drift due to system errors. If pilot again depresses designate button then (D) appears if TISL is tracking. (A) appears if TISL not tracking.



NOTE

(F) also indicates slew after designate or AS drift due to system errors. If pilot again depresses target designate, then (E) appears if TISL is tracking, or (A) appears if TISL is not tracking.

Offset modes involve an aimpoint (initial point). This is a real world point but is depicted as ∴ and the target will be depicted by •.

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Figure 1-17

In computed rocket attacks and computed air-to-ground gunnery with any attack mode selected, the FLR is placed in the air-to-ground ranging (AGR) mode and begins radiating upon mode entry. The FLR antenna is slaved to and ranges to ground position under the HUD aiming symbol. The AGR data are provided to the computer which uses the data to continuously update the slant range to the HUD aiming symbol ground position and to determine when the aircraft is within the optimum range for firing (in-range cue).

NOTE

> To ensure against an erroneous in-range cue when utilizing the AGR mode, the RANGE SET control should be set between 00.5 and 00.9 whenever an in-range indication is not desired. Setting of the RANGE SET thumbwheels to a lower value may result in an instantaneous in-range cue.
>
> When performing computed gun and rocket attacks using FLR range data, actuate the radar range/target reject switch upon appearance of the HUD aiming symbol. This will ensure that the FLR is ranging off the proper point and not locked at an improper range.

In all computed bombing modes except BOC and BOC OFFSET, the FLR provides AGR data to the NAV WD Computer for use in the weapon delivery solution. The computer uses or rejects the AGR data depending on the mode selected, the line of sight angle (grazing angle), and the range at which the radar is locked on. If the FLR AGR is not used at designation or slewing because it is not valid, its range input will be used to update the weapon delivery solution at the time it becomes valid. The AGR data is not used if the grazing angle is less than 4° below the horizontal or when the radar locks on to a target more than 52,672 feet or less than 1,344 feet away. When the AGR data is not used because of a false (long or short) lock-on, the lock-on may be rejected by momentarily depressing the range/target reject switch on the throttle which causes the FLR to unlock and relock on the target. If the new lock-on is within the 52,672 to 1,344-foot range, the computer will utilize the AGR data with no further action required. If the AGR data is not valid for either of the above reasons or because of FLR failure, the HUD solution cues are blinked (except CCIP) indicating computer entry into one of the backup modes of ranging. Refer to Delivery System Management description in this section for a discussion of the backup modes of ranging.

In the VISUAL ATTACK computed bombing mode, with the FLR power switch in POWER and any FLR operating mode selected, the FLR enters the computer controlled AGR mode.

Upon VISUAL ATTACK selection, the NAV WD Computer slaves the FLR to the aiming symbol position and places the FLR in the AGR radiating mode. This immediate slaved AGR command increases the chances of having AGR lock-on at target designation in a point-blank delivery. FLR radiation can be controlled by placing the power switch in STBY.

The initial FLR/AGR range sample is used to establish a preliminary slant range to the target. Five additional range samples are then taken and averaged by the computer (0.45 second) yielding a smoothed and presumably more accurate final slant range. Therefore, a maximum of about 1.4 seconds may be required after designation before the computer has available the final smoothed AGR slant range to the target.

The NAV WD Computer OFP has provisions for automatic reversion under certain conditions from FLR (AGR) ranging to either barometric or radar altimeter ranging if Data 26 is set positive (seven zeros). Reversion to one or the other of the backup ranging modes will occur if either the AGR slant range and the slant range calculated using a back-up device differ by approximately 5,000 feet or three of the five point smoothing sample-to-sample changes in AGR slant range exceed 112 feet. If reversion occurs, the backup ranging mode used will be determined by the setting in Data 24.

In the first test, the NAV WD Computer compares the FLR slant range to a slant range computed by dividing the height above target by the sine of the dive angle. Height above target will be either barometric or radar altimeter altitude depending on entry in Data 24. The computer will reject FLR ranging if the difference between these two slant ranges exceeds 5,000 feet. Since BARO/RAD ALT ranging is also subject to error, the difference between FLR slant range and real slant range can exceed 5,000 feet before reversion occurs.

In the second test, the sample-to-sample change in FLR range during the five point smoothing process is compared. If three of the five samples differ from the previous sample by more than 112 feet, the FLR range data are rejected and backup ranging data are used as determined by the setting in Data 24. Since radar ranging data are sampled at 40-millisecond intervals, a change of 112 feet between samples corresponds to an aircraft velocity of 1,650 knots. Three bad FLR samples are required before automatic reversion to compensate for the possible jitter in FLR range data during the initial five point smoothing samples. This second test is not used in the continuous ranging modes, i.e., CCIP and Guns and Rockets. Automatic reversion, caused by failure of either test, is indicated by flashing solution cues. At computer turnon, Data 26 is set negative, provided the aircraft is not airborne and the IMS is not ready.

VISUAL ATTACK selection will cause the FLR/AGR to radiate and lock on; slant range information will therefore be immediately available to the NAV WD Computer when designation is accomplished. The computer then averages the next five consecutive AGR data samples if available, and updates the slant range with this average. If five consecutive data samples are not available, then the first data sample is used as slant range for the weapon delivery computations. Subsequent to the initial sampling, the FLR antenna remains continuously slaved to the ground position under the HUD aiming symbol and therefore provides immediate new AGR data in the event further aiming symbol slewing is required.

If the VISUAL ATTACK mode is entered directly from the BOC or BOC OFFSET mode and the target was designated in the previous mode, several additional conditions exist.

1. The location of the target is already recorded in the computer, and this information will be retained by the computer provided mode reversion is accomplished properly.

2. The FLR will automatically shift from a ground mapping mode to the AGR mode and begin providing AGR slant range to the designated target to the computer, provided the aiming symbol is slewed after VISUAL ATTACK is selected. If release is made before this shift is completed and AGR data is available, the release will be based on the backup ranging mode which was in priority in the previous attack mode. AGR data may not become available for a maximum of 1.4 seconds due to the inherent delays discussed previously.

3. When AGR data becomes available, the solution cue may jump due to a new slant range information.

Weapons release attempted by pressing the armament release button and pulling to a release condition without prior designation or slewing places the delivery system in a condition where one of the following problems can occur:

1. Computed release may occur using data from another range sensor with possible degradation in accuracy.

2. Computed release may not occur if FLR/AGR slant range is less than that computed using the Data 24 range sensor. This situation would occur if the FLR/AGR data became available prior to reaching the release point computed using the other sensor but after passing the release point computed using FLR/AGR data.

3. Computed release may occur using the initial FLR/AGR range sample rather than the final smoothed slant range.

4. Computed release accuracy may be degraded if the FLR/AGR slew rate has not been rapid enough to correct for changes in aircraft flightpath.

These problems can be eliminated by designating as early as possible in the run and accomplishing final aiming by slewing near the release point; ideally, a stable flightpath should be maintained during final aiming and for about 0.5 seconds thereafter to ensure the best possible AGR ranging data is available.

When the VISUAL ATTACK mode is deselected, the NAV WD Computer returns the FLR to the operating mode selected on the FLR control panel.

FLR operation in the VISUAL ATTACK OFFSET bombing mode is essentially the same as in the VISUAL ATTACK bombing mode. The FLR begins to radiate at mode selection, but the NAV WD Computer does not use the AGR range data until slewing or target designation. AT designation, the aiming symbol and FLR are slewed by the computer to the computed target location. During this slewing period, approximately 1 second, the Bullpup controller is inoperative (no manual slewing possible) and weapon release is inhibited. The FLR continues to radiate after slewing to the target but the AGR data are not used by the computer unless manual slewing of the aiming symbol is performed. Usage of the AGR data by the computer and reversion to its original operating mode are the same as in VISUAL ATTACK bombing mode.

FLR operation in the BOC bombing mode begins upon attack mode selection. The NAV WD Computer places the FLR in the ground map pencil (GMP) mode unless it is operating in the ground map spoiled (GMS) mode (in which case it remains in GMS). If FLY TO DEST 0/MARK 0 is selected on the computer control panel, the FLR cursors will appear fixed at a range of 8 nmi and 0° in azimuth at mode entry but are slewable out to a maximum range of 80 nmi (FLR SDC on and reliable) or 20 nmi (FLR SDC off or failed) and ±45° in azimuth. Target designate is manually accomplished using the target designate button or armament release button. The FLR cursors ground stabilize and start tracking the target at designation. Pressing the target designate button a second time (undesignate) returns the FLR azimuth cursor to 0°. However, the range cursor remains fixed at the undesignation range. The BOC master function switch must be deselected and reselected or the FLY TO thumbwheel selection must be changed momentarily to regain the mode initial cursor positions of 8 nmi and 0°. With other than DEST 0/MARK 0 selected on the FLY TO switches, the FLR cursors appear ground stabilized on the computed target location when within 80 nmi (FLR SDC on and reliable) or 30 nmi (FLR SDC off or failed). Target designation is automatic and aiming is refined by positioning (slewing) of the FLR cursors. The radar will revert to its original operating mode upon completion of the attack (all selected weapons released or attack mode deselected). If the attack mode is changed to VISUAL ATTACK after target designation has been performed, the FLR will automatically shift to the AGR mode and will be slaved to the target location. A change to VISUAL ATTACK prior to target designation will cause the radar to enter the computer controlled AGR mode.

The GMP mode provides a narrow pencil beam (aproximately 6° in elevation and 2.5° in azimuth) which gives best resolution of point targets. GMP should be used for long range mapping or for improved resolution of point targets at low altitudes where the 15° limit on antenna tilt does not interfere with illumination of the area of interest. As range decreases, antenna tilt must be continually depressed in the area of interest on the scope moves down.

The GMS mode has a cosecant-squared-shaped beam pattern (2.5° by approximately 50°) which provides an equal illumination distribution over a large area. The spoiled beam is achieved by the use of a lower feed horn on the antenna. When GMS is selected, the antenna is automatically tilted to maintain the maximum energy point (located near the top of the beam) at the same elevation position as the GMP beam for a given tilt knob setting. This mode is generally used for medium range ground mapping during high altitude navigation; it also reduces the requirement for tilt adjustments at short ranges regardless of the altitude.

Selecting the GMS mode switches the radar from the normal 45° linear polarization to horizontal linear polarization; this improves the mapping qualities of the radar for horizontally oriented targets but reduces illumination of vertically oriented targets.

The A-7K does not have a cockpit-controllable sensitivity time constant which would reduce the intensity of the near returns and increase the intensity of the far returns. Therefore, when receiver gain is adjusted to break out targets in the upper portion of the scope, the near returns will flood the lower portion of the scope. As range decreases, receiver gain must be continually reduced to keep from losing the target return in the ground clutter. The sensitivity time constant can be adjusted by maintenance personnel.

Although maximum range is somewhat reduced in the GMS mode due to the beam used for ground mapping, BOC BOMB accuracy is not affected by the radar mode selected. Generally, GMP should be used to break out weaker returns but polarization effects may cause some targets to show better in GMS. If a target can be identified in GMS, the advantage of fewer antenna tilt adjustments while approaching the target makes GMS preferable to GMP.

FLR operation in the BOC BOMB OFFSET bombing mode is similar to operation in the BOC BOMB bombing mode. As in BOC BOMB, the FLR is placed in the GMP mode unless it is operating in the GMS mode in which case it remains in GMS. The radar cursors appear ground stabilized over the OAP. Aiming and OAP designation are performed using the cursors as in BOC mode. Aiming may be performed at any time before and after designation.

After designation, the FLR cursors will remain locked on the OAP location allowing continuous aiming refinement up to the computed weapons release point. Slant range to the OAP will be provided by the backup ranging sensor in priority. If the target becomes visible after OAP designation, change to the VISUAL ATTACK mode may be accomplished while retaining the designation (aiming symbol will remain on the target). This mode change is subject to time restrictions in shifting to the FLR AGR mode and obtaining usable AGR data and should not be attempted unless at least 1.5 seconds remains before weapon release.

The NAV WD Computer has the capability for beacon aided radar bombing (BARB). The APQ-126 Forward-Looking Radar displays the location of ground beacons when BCN is selected on the control panel. The ground beacon receives an interrogation signal from the APQ-126 and responds with a coded pulse train that is displayed on the cockpit scope to indicate the location and identity of the beacon. If the pilot has entered the geographical location of the beacon as a destination and selects BOC, BOC Offset, or Radar Update and is less than 20 nmi from the beacon, the radar cursors will be displayed and can be refined as necessary for weapons delivery or update. The beacon will normally be used as an OAP for BOC Offset deliveries. However, radar beacons require a short period of time to decode and respond to the APQ-126 interrogation. This causes the location of the beacon on the scope to be slightly in error.

For additional discussions on FLR operation, its use in computed attack modes, and backup sensors used in case of FLR failure, refer to Computed Bombing Modes and Delivery System Management descriptions in this section.

ATTITUDE DIRECTOR INDICATOR.

The ARU-21/A Attitude Director Indicator (ADI), located on the instrument panel, displays heading, attitude, rate of turn, slip, glideslope deviation, and pitch and bank steering information and failure indications. Included in the ADI are an attitude and azimuth sphere, pitch and bank steering bars, rate of turn and slip indicators, displacement pointer, a miniature aircraft, warning flags, and pitch trim knob. The attitude sphere displays pitch, bank, and heading in relation to the miniature aircraft. Signals for pitch, bank, and heading display are provided by the Inertial Measurement Set, and the other displays are controlled by the NAV WD Computer system, turn rate gyrotransmitter, APQ-126 Forward-Looking Radar, or Flight Director Computer.

In the CCRP bombing modes with the HDG MODE switch in AUTO NAV, the ADI bank steering bar is slaved to the HUD azimuth steering line (ASL). Like the ASL, the bank steering bar gives the pilot steering commands in azimuth to zero out any azimuth steering error. With the ADI, the pilot should fly the aircraft toward the bank steering bar until the bar is centered and keep the bar centered until the release is completed. The ADI is illustrated and further described in T.O. 1A-7K-1.

HORIZONTAL SITUATION INDICATOR.

The AQU-6/A Horizontal Situation Indicator (HSI), located on the instrument panel, displays course, heading, distance, and bearing information. The indicator provides selected course outputs to the TACAN and Flight Director Computer and selected heading to the Automatic Flight Control System and the Flight Director Computer.

The HSI compass card is servo driven and receives heading signals from the magnetic compass through the Inertial Measurement Set. Range to destination, bearing pointers, course deviation bar, and warning flags display information from the NAV WD Computer, TACAN, ADF, and ILS localizer depending upon guidance mode selected.

In en route navigation modes, air-to-air guns, manual deliveries, and all update modes, the HSI No. 1 pointer will always indicate relative bearing and the range will always be displayed in miles. In air-to-ground guns/rockets, AGM-65, and CCIP modes, the HSI will always display relative bearing and range to the selected DEST/MARK. If the range is greater than 10 miles, the mileage indicator will read out in miles. If the range is less than 10 miles, the HSI will display the distance in thousands of feet.

In VISUAL ATTACK, VISUAL ATTACK OFFSET, BOC, and BOC OFFSET if the target is beyond 30 nmi and prior to destination, the HSI will display relative bearing and range to the selected FLY TO DEST/MARK (in BOC DEST 1-9 only). If the range is greater than 10 miles, the range will be displayed as miles; if it is less than 10 miles, the range will be displayed in thousands of feet.

NOTE

In BOC with FLY TO DEST 0 or FLY TO MARK 0 selected, the HSI displays 1048 (48,000 feet nominal) at mode entry. At postdesignate (ground stabilization) the HSI DME indicator and azimuth bearing pointer indicate distance and bearing to the radar cursor intersection.

If the target is less than 30 nmi or has been designated (in BOC DEST 1 — 9 only), the HSI displays relative bearing and range to the target. If the range is over 10 miles, the indication on the DME will be in miles. If the range is less than 10 miles, the DME indication will be in thousands of feet.

The HSI is illustrated and described in T.O. 1A-7K-1.

BOMB TONE GENERATOR.

A dual purpose, computer controlled tone generator unit provides a steady 1,200-hertz bomb release tone signal during weapon delivery operations. This signal is triggered by the NAV WD Computer and transmitted to the aircrew headsets via the aircraft intercommunication system.

The bomb tone comes on in all weapon delivery modes, including manual (quantity 01 selected) and manual ripple, when the armament release button is depressed in either cockpit. In the CCRP modes (VISUAL ATTACK, VISUAL ATTACK OFFSET, BOC, BOC OFFSET, and backup reticle) the tone goes off at bomb release (quantity 01 selected) or midstick bomb (quantity 02 or greater selected). In CCIP, manual ripple, computed EO bomb (VISUAL ATTACK selected), computed Maverick missile (VISUAL ATTACK selected), computed rockets, and all manual delivery modes, the tone goes off when the armament release button is released.

The tone generator also provides a warbling (700- to 1,700-hertz) low altitude warning signal through the aircraft intercommunication system. This signal is triggered by the radar altimeter. If the radar altimeter low altitude warning tone is on when a weapon release is initiated, the 1,200-hertz bomb tone (steady signal) will replace the warbling low altitude warning tone in the headsets. See T.O. 1A-7K-1 for a complete discussion of the low altitude warning feature of the tone generator.

ASSOCIATED COMPONENTS.

Other components associated with the NAV WD Computer in the weapon delivery role are the Inertial Measurement Set (IMS), Doppler radar, Air Data Computer (ADC), angle-of-attack (AOA) transducer, and the radar altimeter. Each of these components provides data which the computer combines to derive aircraft velocity, altitude, attitude, true airspeed, true wind, and present position. Refer to T.O. 1A-7K-1 for a complete description of each of the above components. Refer to Delivery System Management description in this section for a discussion on the use of these components in the weapon delivery role.

HUD TELEVISION MONITOR SET.

The HUD television (TV) monitor set consists of a TV camera mounted above the HUD combiner glass in the forward cockpit and a closed circuit TV monitoring unit in the aft cockpit. The HUD TV monitor set is a complete airborne television system that displays, in the aft cockpit, a video presentation of the symbology viewed on the HUD in the forward cockpit. The aft cockpit presentation consists of HUD symbolic information superimposed over a real world background. A detailed description and illustration of the HUD TV monitor set is contained in T.O. 1A-7K-1.

COMPUTED BOMBING MODES.

INTRODUCTION.

The primary weapon delivery method employed by the A-7K is a computed delivery. The Navigation/Weapon Delivery (NAV WD) Computer, in conjunction with other subsystem components and indicators, provides weapon delivery computations and steering cues which are presented to the pilot on the HUD, HSI, and ADI.

Attack modes are selected by depressing the appropriate master function switch or switches. HUD symbology is obtained only if a weapon station with a computed weapon loaded is selected and in priority. Refer to Part 3, Aircraft Weapon Release System, for a discussion on selection, arming, and establishing priority of weapon stations.

After acquisition and designation of a target, the weapon delivery steering and release solution is basically the same in all attack modes (except CCIP). Any attack maneuver compatible with the weapon type may be performed to reach the weapon release point. Constraints of precise dive angle, altitude, airspeed, and g loading imposed for accurate manual weapon delivery do not apply to computed delivery. Pilot effort can be concentrated on aiming refinement and precise azimuth steering.

After target designation, the NAV WD Computer continuously computes aircraft position relative to the target. Release will occur when down-range bomb travel conditions have been met. Smooth coordinated flight will result in best accuracy. If Inertial or Doppler velocities and true airspeed from the ADC are available, the computed solution includes winds at release altitude. Changes in wind velocity between release altitude and target will have little effect on bomb impact. For example, with Mk 82 low-drag bombs in a 30° dive and 500 KTAS with a release altitude of 5,000 feet AGL, a 5-knot wind shear immediately below release altitude will cause a miss of only 3 feet. These conditions give a weapon time of flight of over 9 seconds. It can be seen that if groundspeeds are available as reference velocities, wind shear has much less effect on bombing accuracy than in airmass referenced bombing systems.

Preparation for a computed bombing mission consists of determining the attack mode to be used and the data available for insertion into the NAV WD Computer for use in the computed attack solution. The attack mode selected will be determined by conditions in the target area and the type of target being attacked. Target area conditions which must be considered are weather, lighting conditions, and terrain around the target, especially along the planned ground track. Target considerations include visibility against the background and amount of radar reflectivity expected from the target, if any.

If it becomes desirable to change attack modes during the attack, the armament release button must not be depressed during the change. Recent tests concluded that a weapon release may occur during a transition from one attack mode to another if the armament release button is depressed. When a master function attack mode switch is depressed, it transmits a switch release signal to deselect automatically any previously selected master function attack mode switch. There is a brief period when neither mode is selected, and with a quantity of 01 selected on the QUANTITY switch, the system is in the manual bomb mode. Under these conditions, a release pulse is initiated if the armament release button is depressed, possibly resulting in a weapon release.

All known target data should be inserted into the computer regardless of the attack mode to be used. This will ensure that sufficient data will be available upon reaching the target area in case the attack mode choice must be changed or failure of one or more system components causes reversion to backup modes of computation. Refer to Delivery System Management description in this section for a discussion on computed weapon delivery backup modes.

The HUD symbology is identical in all attack modes for a given weapon (except CCIP). The sequence of presentation and use of the symbology will vary with the attack mode selected. Attack symbology consists of azimuth steering line (ASL) and aiming symbol (except CCIP), continuously computed impact point steering line (CCIPSL) (CCIP only), flightpath marker (FPM), solution cues, pullup anticipation cue, TISL symbol, pullup command, pitch lines, and airspeed indicator. Refer to Delivery System Components description in this section for detailed discussions of HUD symbology.

BACKUP MODE FOR HUD FAILURE.

In the event of a HUD failure (HUD FAIL light on or HUD turned off), computed gun and rocket attacks and CCIP mode bombing are not possible. However, computed bombing attacks are possible in all other computed attack modes. With the HDG MODE switch in the AUTO NAV position, the ADI bank steering bar will provide azimuth steering commands. Wind and azimuth correction is applied by centering the ADI bank steering bar. Weapon release occurs as the aircraft flies through the computed release point with the armament release button depressed.

WARNING

Without HUD symbology, there is no cockpit indication as to when to begin pullup. The pilot must estimate his own pullup point.

The failed HUD may not display any attack symbology; however, one depression of the target designate button designates the target/offset aiming point (OAP). The NAV WD Computer assumes that the target/OAP is along the zero sight line (0 mils) whenever the designate button is pressed. Initial designation can be accomplished using either the designate button or the armament release button, but once this mode is **designated it cannot be redesignated using the armament release button. Neither the designate button nor the armament release button can be used to undesignate the HUD fail modes. The modes can be undesignated by deselecting and reselecting the appropriate master function switch(es) or by changing the FLY-TO designation or MARK selection.**

If reattack of a target with a HUD failure is performed, the attack mode should be reselected to eliminate any target location errors accumulated in the computer during go-around. In the two offset modes, redesignation must be on the OAP and not the target.

NOTE

In the event of an intermittent HUD failure (HUD fail light flashing or intermittent), the HUD should be turned off before using the standby reticle to ensure the computer receives the HUD fail signal and does not erroneously use the aiming symbol information from the HUD at designation.

NAV WD COMPUTER DATA ENTRY.

Data are entered into the NAV WD Computer to provide required information to enable the computer to compute accurately weapon delivery solutions and to provide navigational updates en route to the target area. The data entry procedure is essentially the same for every data item to be entered. The rotary mode selector switch is placed in the position corresponding to the data to be entered. To enter data, the keyboard enable pushbutton (KEYBD) is momentarily depressed. This action clears the computer control panel display and simultaneously enables the keyboard digital pushbuttons (0 through 9) and information entry pushbutton (ENT). The digital pushbuttons corresponding to the destination identification number are the momentarily depressed, identifying to the computer the destination under which the data are to be recorded. As data cannot be recorded under DEST (destination) 0 or Mark 0, only destinations 01 through 09 and 11 through 19 are available for data insertion.

New data are selected for entry by depressing the keyboard digital pushbuttons. When two data quantities (such as latitude and longitude) are entered in the same procedure, complete data for one quantity must be selected prior to selecting any part of the second quantity. If the data are signed (plus or minus) the sign is selected first. A plus sign is selected by depressing the 0 digital pushbutton. A minus sign is selected by depressing the 6 (E/−/6) digital pushbutton. The numerical quantity is then selected in reading order. Latitude and longitude signs (N, S, E, and W) are selected by pressing the corresponding digital pushbutton.

In selecting numerical data, all available display spaces must be filled. Decimal point, degree, minute, and second marks are ignored when entering data. (The OFP places these marks automatically.) The data entry procedure is completed by momentarily depressing the ENT pushbutton. Errors in data entries can be corrected before or after the ENT pushbutton is depressed.

If an error is discovered before depressing the ENT pushbutton, the KEYBD pushbutton can be depressed to backspace and erase (one space at a time) the displayed data. After the erroneous data has been erased, reenter the correct data. If an error is discovered after data entry (ENT pushbutton depressed), repeat the steps required to obtain data display; then depress the KEYBD pushbutton and reenter the data.

The memory destination numbers under which pertinent mission data are entered should be recorded separately for inflight reference. See figure 1-18 for a breakdown of NAV WD Computer data used when DEST 0 or MARK 0, 6, 7, or 8 are selected for a computed attack mode.

Destinations (geographical coordinates) to be entered can be used for en route navigational updates and are required for BOC and BOC OFFSET attack modes. Destinations are entered by identifying the hemispheric location (N or S and E or W) and momentarily depressing (typing) the digits of the coordinates in the same order as they are read, i.e., degrees, minutes, and seconds. As the coordinates are typed, they appear in the data display window for verification. After verification of the displayed data for accuracy, the data are recorded by momentarily depressing the ENT pushbutton.

The RNG BRG position of the rotary mode selector switch is used to enter offset data required for use in both offset attack modes. These data consist of range, in feet, from the offset aimpoint (OAP) to the target and the true bearing from the OAP to the target. The maximum allowable offset range from the OAP to the target is 131,068 feet and the digits are typed in from left to right, e.g., 4,500 feet is typed in as 004,500 feet. The digits appear in the upper display window as they are typed. The offset bearing is entered in the order of degrees, minutes, and seconds, and the digits appear in the lower display window. After verification of the displayed data for accuracy, the data are recorded by momentarily depressing the ENT pushbutton.

The ΔB HT (delta height and bomb burst height) position of the rotary mode selector switch allows entry

COMPUTER DATA FOR DEST 0 AND MARK 0-9

MODE \ FLY TO SWITCH	ZERO DEST. ZERO MARK	NUMBERED MARK
VISUAL ATTACK	A	C
VISUAL ATTACK OFFSET	B	C and E
BOC BOMB	A and D	C
BOC BOMB OFFSET	B	C and E
CCIP BOMB	A	C
Guns or Rockets (Any Computed Mode)	E	C

A – Nominal value of 0 feet assumed for bomb burst height.

B – HUD attack symbology not displayed; enroute navigation computations in progress, but flight director not displayed. NAV WD Computer does not enter any of the bombing modes.

C – Steering information to reach stored latitude and longitude provided on HUD, ADI, and HSI.

D – Radar cursors set initially at 8 NMI along ground track and not ground stabilized.

E – Mark No. 9 illegal for offset mode attacks (Note B applies).

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Figure 1-18

of two separate bits of data. Δ height is required for use in both offset modes and is the difference in height between the OAP and the target. Bomb burst height is the altitude above the target desired for bomb burst. The bomb burst height entry for all currently authorized weapons should always be 0000000 (seven zeros). Any other entry will adversely affect ballistic computations and cause long hits. (The bomb burst height data entry has no relationship to the Data Address 29 entry and the two should not be confused with each other.) Δ height can be entered as a minus value by momentarily depressing the – pushbutton before typing in the digits. A Δ height of up to 10,000 feet may be entered and all six digits must be used, e.g., a Δ height of –650 feet is typed in as –000,650. The digits for Δ height appear in the upper display window and the digits for bomb burst height appear in the lower display window as they are typed. After verification of the display data for accuracy, the data are recorded by momentarily depressing the ENT pushbutton.

The ALT MSLP position of the rotary mode selector switch is used to enter the altitude and barometric pressure of the coordinates entered under the same destination number. These data are used when the NAV WD Computer enters a backup mode of ranging computation. When the values entered are to be used for an offset attack, the values should be that of the OAP and not the target. Target altitudes from −65,500 feet to +65,500 feet can be entered, and all six digits must be used, e.g., an altitude of 532 feet is typed in as 000,532. Minus altitudes (below sea level) are prefixed with −, e.g., an altitude 450 feet below sea level is typed in as −000,450. MSLP is entered to the nearest 0.01 inch. The digits for altitude appear in the upper display window and the digits for MSLP appear in the lower display window as they are typed in. After verification of the displayed data for accuracy, the data are recorded by momentarily depressing the ENT pushbutton. Refer to Barometric Altitude Ranging Mode description in this section for a detailed discussion on determining the ALT MSLP data to be entered.

In addition to the data entered into the NAV WD Computer via the control panel switches, there are data entries made via the control panel pushbuttons. These data entries are made via Data Addresses 23 through 37, 50 through 54, and 58. There are also data readouts available via Data Addresses 70 through 79, 93, and 94. These data addresses are called up by placing the rotary mode selector to the PRES POS position, selecting DATA on the UPDATE thumbwheel, and selecting the appropriate data address via the panel pushbuttons. The data address number will appear in the upper display window and information previously entered under the address will appear in the lower window. Refer to T.O. 1A-7K-1 for a complete breakdown of data displays, including those values which may be inserted and displayed and those values which may be displayed only.

In Data Addresses 30, 31, 32, 50, 51, 53, 54, and 70 through 79, both the upper and lower windows display data information. The data address number will appear on the display only when the data address is being called up.

NOTE

Do not attempt to enter data in a nonprogrammable data location (Data Addresses 70 through 79, 93 and 94). With the current OFP, any attempt to do so will initiate an error display and the data will be rejected.

Sensor Management Data Entry.

Data Address 23 controls the OFP corrections applied to the ADC true airspeed (TAS) and barometric altitude inputs to the NAV WD Computer. Data Address 23 should always be set to −000000 (minus six zeros) for the A-7K aircraft.

Data Address 24 controls ranging sensor priority between the radar altimeter and the barometric altimeter. Entry of 0000000 (seven zeros) under Data 24 places the radar altimeter in priority over the barometric altimeter. Entry of −000000 (minus six zeros) under Data 24 places the barometric altimeter (ADC) in priority.

Data Address 25 controls computer usage of Doppler inputs to maintain the IMS platform alignment when the IMS is in the INERTIAL mode. Entry of 0000000 (seven zeros) under Data 25 couples the Doppler to the IMS and Doppler inputs are used. Entry of −000000 (minus six zeros) decouples the Doppler so that its inputs are monitored by the computer but not used.

Data Address 26 is used for automatic reversion to a backup ranging sensor if the NAV WD Computer detects invalid FLR ranging. If Data 26 is positive, the NAV WD Computer will automatically revert to the backup ranging mode (determined by Data 24) if either of the following conditions exist:

1. If FLR AGR slant range differs from backup sensor range by 5,000 feet or more.
2. If three sample-to-sample changes in FLR slant range exceed 112 feet.

Automatic reversion, caused by a failure of either test, is indicated by flashing solution cues in all bombing modes except CCIP.

Computer powerup using the procedures in T.O. 1A-7K-1, entry of present position, or performing computer self-test causes −000000 to be entered under Data 23 through 26.

NOTE

Data Addresses 23 through 26 are not automatically set to −000000 if the computer is turned on after completion of IMS coarse alignment. Therefore, if entry of present position or computer self-test is not performed, it is recommended that the pilot verify Data 23 through 26 are in the desired state.

GPU-5/A 30MM Gun Pod Ballistics.

Data Address 27, in conjunction with the Loran power switch, provides a computed ballistic solution for the GPU-5/A 30mm gun pod. Entry of 0000000 (seven zeros) under Data Address 27 allows the position of the Loran power switch to distinguish between 20mm and 30mm gun pods. With Data Address 27 set to 0000000 (seven zeros) and the Loran power switch positioned to PWR or UPDATE, the OFP performs 30mm ballistic calculations and the HUD in-range cue is displayed at a slant range of 13,406 feet. With Data Address 27 set to 0000000 (seven zeros) and the Loran power switch positioned to OFF, the OFP performs 20mm ballistic calculations and the HUD in-range cue is displayed at a slant range of 8,192 feet. If −000000 (minus six zeros) is entered under Data Address 27, the OFP assumes 20mm ballistics are required and the position of the Loran power switch is disregarded. On NAV WD Computer power up, Data Address 27 is automatically set to −000000 (minus six zeros).

Flexible Fuze Data Entry.

Data Addresses 28 and 29 provide a flexible fuzing capability for bomb type CBU dispensers and impact-fuzed general purpose bombs. The flexible fuzing function is operable in all computed bomb modes except EO bomb and manual ripple. The function is controlled by pertinent data manually entered in Data Addresses 28 and 29 and by Armament Station Control Unit (ASCU) store type switch inputs to the NAV WD Computer.

Fuze functioning/arming time is entered under Data Address 28. The time entered is in increments of one-hundredth of a second, and the maximum setting is 10.00 seconds. All seven digits in the window must be filled, e.g., a fuze function time of 5.5 seconds is entered as 0000550, with the computer automatically putting the decimal point between the 5's. For bomb type CBU dispensers with time fuzes, the time entered is the time set on the fuze. For bomb type CBU dispensers with altitude sensing fuzes, the time entered must be zero, which causes the computer to calculate ballistics based on the selected fuze functioning altitude entered under Data Address 29. For general purpose bombs with impact fuzes, the time entered should be the bomb time of fall from the minimum acceptable release altitude or the time actually set on the fuze, whichever is greater. Refer to Section V for a discussion, and Section VI for charts, in determining minimum acceptable release altitude. If this fuze function capability is not desired, a fuze time of zero should be entered under Data Address 28.

Fuze functioning altitude is entered under Data Address 29. The altitude entered may be from 0 to 32,000 feet and all seven digits in the window must be used, e.g., an altitude of 600 feet is entered as 0000600. For GP bombs, any altitude entered is ignored by the computer.

These data entries are valid only for one setting. Mixed loads of different munitions require that the data entries be changed to match the fuze settings and desired functioning altitude of the munition to be delivered.

Universal Transverse Mercator Destination Update.

Data Address 30 allows for entry of Universal Transverse Mercator (UTM) coordinates for selected fly to destinations. The UTM values entered in Data Address 30 are converted to latitude-longitude increments and added to the UTM grid origin coordinates previously stored in any destination (01 through 18, except 10). The resulting latitude-longitude values are then stored as the coordinates of a selected (addressed) destination (01 through 18, except 10). Placing the NAV WD Computer fly to controls to the stored (addressed) destination then provides steering to the UTM destination.

Prior to entering UTM coordinates in Data Address 30, the latitude-longitude of the origin of the applicable UTM grid(s) must be stored as a fly to destination or mark (01 through 18, except 10). Since the UTM origin and fly to destination numbers are both selectable, preplanning will allow inflight entry of different UTM coordinates without having to reenter the grid origin coordinates.

When entering values in Data Address 30, two leading zeros (00) are first entered in the upper windows followed by two digits which denote the destination (01 through 18, except 10) containing the UTM grid origin coordinates, followed by two digits (01 through 18, except 10) to identify the destination location in which the converted UTM coordinates are to be stored. Next, a leading zero (0) is entered in the lower windows, followed by three digits for UTM easting and three digits for UTM northing coordinates.

The NAV WD Computer computations for converting the UTM easting and northing values to latitude-longitude coordinates uses a fixed value for earth radius at 42° latitude. This results in a maximum error of 0.5 mile when the destination is 0° latitude or 70° latitude. Because of this computation error and rounding off the UTM coordinates to three digits, a UTM destination should not be used for BOC bombing unless a radar target is available.

Time On Target/Clock.

Data Address 31 displays time on target in the upper window and clock time in the lower window. The time on target display is affected by the route navigational final destination/target number entered in Data Address 36. The clock display is programmable and can be set to any time desired. Both windows are 24-hour displays and degree markings (°) are included to indicate hours, minutes, and seconds. At NAV WD Computer power up (IMS not reliable and not airborne) the clock time is automatically set to zero and the clock does not run. A time of 000°00°01° can be entered to make the clock an elapsed timer. Note that the left zero must be entered. The clock will automatically reset at midnight; i.e., the display will change from 24°00°00° to 00°00°0°. Since the NAV WD Computer updates the clock display only once per second, the displayed clock time is accurate to ±1 second.

The time on target displayed in the upper window is the sum of the clock time and the computed time to go (TTG). The TTG is computed by dividing the distance to the DEST/MARK selected on the FLY TO thumbwheel or final route navigational destination/mark (Data Address 36) by the total velocity of the aircraft. The computation is not done unless the aircraft is airborne. If the time on target is after midnight with reference to clock time, the displayed time on target will be next day's time; i.e., clock time is 23°00°00°, TTG is 2 hours, and time on target is 01°00°00°. If the clock time is not set, it remains zero and the time on target indication becomes TTG.

The three display modes for Data 31 are as follows:

1. Inactive — the clock time is left at the power up value (00°00°00°). The clock does not run and time on target becomes a TTG value.
2. Elapsed time — 000°00°01° entered for clock time. The clock displays elapsed time since the value was entered and time on target is the computed value of elapsed time at destination/target arrival.
3. Clock time — actual clock time entered (24-hour clock). The clock displays actual clock time and time on target is the computed value of clock time at destination. When entering actual clock time in Data Address 31, select a time slightly ahead of actual time; then, press the information entry pushbutton at the selected time.

Groundspeed Required and Desired Time of Arrival at Target.

Data Address 32 displays groundspeed required (GSR) in the upper window and desired time of arrival at target, or target time (TGTT), in the lower window. The GSR display is computed using the DEST/MARK selected on the FLY TO thumbwheel or the final route destination/mark entered in Data Address 36. This distance is divided by the time remaining before the target time. If the clock time (Data Address 31) is set to 000°00°01° and a TGTT value is entered, the GSR displayed will be that value required to reach the target at the elapsed time entered as TGTT. As the clock time approaches the target, a division by zero becomes imminent. Therefore, at 20 seconds before TGTT the GSR is set to zero.

When the HSI and PMDS are indicating range information to the fly to destination/mark, Data Addresses 31 (time on target) and 32 (GSR and TGTT) also provide information for a destination/mark (current fly to destination or final destination/target). When the HSI and PMDS are indicating range to the target or FLR cursors, the displays in Data Addresses 31 and 32 provide target data for the same point.

The Data Address 32 display is not usable when the Data Address clock value is left at 000°00°00° (inactive mode).

Beacon Aided Radar Bombing.

Data Address 33 is used for range cursor correction in the Beacon Aided Radar Bombing (BARB) mode. On NAV WD Computer power up, Data 33 is automatically set to all zeros (0000000). This all-zero value inhibits the BARB function of the NAV WD Computer. If any negative number is entered in Data 33 −000001 will be displayed, and 148 feet will be added to the range cursor (correction for the AN/PPN-18, SST-122, and AN/TPN-28 beacons). If any positive number is entered in Data 33, 000001 will be displayed, and 492 feet will be added to the range cursor (correction for the SST-181, AN/TPN-23, and AN/TPN-26 beacons). If Data 33 is not zero, a cursor correction will be made in all modes where the cursors are used. Therefore, the pilot must ensure that Data 33 is set to zero for all uses of the radar cursors not associated with a beacon. Data 33 entries have no effect on FLR AGR ranging.

HUD Slant Range Display.

Data Address 34 is provided for use with the HUD slant range display. The HUD vertical velocity (VV) scale is mechanized to provide a slant range to target/impact point display in all computed attack modes (except air-to-air guns) when the HUD scales switch is positioned to SCALES. This ranging information is presented by the relative positioning of the HUD vertical velocity indicator (VVI) symbol along the VV scale.

The slant range display is controlled by the manual entry of a maximum range value in the lower window of Data Address 34. During display, this value is represented by the top of the VV scale. The bottom of the VV scale is always equal to a slant range of 0 feet.

Slant range values varying from 2,048 feet (minimum) to 131,072 feet (maximum) may be entered in Data Address 34. Normally, a value equal to twice the desired open fire/weapon release range is entered. This technique provides for a midscale VVI indication when the desired slant range is reached.

Data Address 34 is initialized to a value of 5,000 feet during NAV WD Computer power up. This provides a nominal 2,500 foot VVI midscale indication unless otherwise changed by the pilot.

In the visual attack Maverick missile mode the HUD slant range display is meaningless. This display will indicate a constant slant range of 16,384 feet in the visual attack Maverick mode. Thus, the VVI will be pegged at the top of the VV scale if the value stored in Data Address 34 is less than 16,384 feet or pegged at a representative point along the VV scale if the stored value is greater than 16,384 feet.

In the visual attack electro-optically guided bomb (GBU-8) mode, the HUD slant range display indicates range to the designated target following designate (seeker head lock-on). Thus, the slant range display can be used to monitor the desired weapon release range during this mode of delivery.

Release Freeze Data Table.

Data Address 35 implements the release freeze data table feature. The OFP allows a set of release and sensor freeze data to be stored and recalled for 1 to 12 separate weapon release sequences. The data accumulated in this process is referred to as the release freeze data table. This table includes values for the Data Address 73 through 77 displays (release freeze data) and the Data Address 78 and 79 displays (sensor freeze data). Values are stored in the release freeze data table in all computed bomb modes, except EO bombs or attacks using the CBU-30 and CBU-38 series vertical dispensers (all modes). Figure 1-19 shows the status of the release freeze data table in the various attack modes.

A display counter number entered or stored in Data Address 35 is used to access data for the appropriate release sequence in the freeze data table. In addition, the OFP contains a release pass counter used to sequentially identify the table locations wherein the freeze data is stored. The release pass counter is reset to 01 and the Data Address 35 display counter is set to all zeros (0000000) at NAV WD Computer power up (the release pass counter can also be reset to 01 at any time by entering all zeros into Data address 35). After being reset, the release pass counter is automatically incremented one digit during the next release sequence in an applicable mode. The display counter (Data Address 35) is simultaneously set to the previous value of the pass counter. This process is repeated for each subsequent release sequence up to a maximum of 12 passes. If more than 12 release sequences are performed without resetting Data Address 35 to all zeros, the data values for the 13th and subsequent passes are not stored (the NAV WD Computer does not overwrite previously stored entries in this case).

To recall release freeze data table values for a release sequence just completed, select the desired Data Address (73 through 79) on the NAV WD Computer control and observe the selected data on the panel display. To recall the values for releases prior to the last sequence, or after flight, select Data Address 35 on the NAV WD

RELEASE FREEZE DATA TABLE DISPLAYS

	RELEASE FREEZE DATA								SENSOR FREEZE DATA			
	DATA 73 AND 74		DATA 75		DATA 76		DATA 77 (2)		DATA 78 (3)		DATA 79 (2)	
MODE	UW	LW	UW	LW	UW	LW	UW	LW	UW	LW	UW	LW
VISUAL ATTACK BOC OFFSETS (1) BACKUP RETICLE	SELECTED DATA AT RELEASE	SELECTED DATA AT RELEASE	FLIGHTPATH ANGLE AT RELEASE	TAS AT RELEASE	TARGET SLANT RANGE AT RELEASE	TARGET LOS AT RELEASE	PRIORITY AGL ALT AT RELEASE	SECOND PRIORITY AGL ALT AT RELEASE	SELECTED DATA AT LAST SLEW/ DESIGNATE	SELECTED DATA AT LAST SLEW/ DESIGNATE	PRIORITY AGL ALT AT LAST SLEW/ DESIGNATE	SECOND PRIORITY AGL ALT AT LAST SLEW/ DESIGNATE
CCIP	SELECTED DATA AT RELEASE	SELECTED DATA AT RELEASE	FLIGHTPATH ANGLE AT RELEASE	TAS AT RELEASE	IMPACT POINT SLANT RANGE AT RELEASE	IMPACT POINT LOS AT RELEASE	PRIORITY AGL ALT AT RELEASE	SECOND PRIORITY AGL ALT AT RELEASE	SELECTED DATA AT RELEASE	SELECTED DATA AT RELEASE	PRIORITY AGL ALT AT RELEASE	SECOND PRIORITY AGL ALT AT RELEASE
MANUAL RIPPLE BOMB (4) (GUN/GUN POD NOT SELECTED)	SELECTED DATA AT RELEASE (5)	SELECTED DATA AT RELEASE (5)	FLIGHTPATH ANGLE AT RELEASE	TAS AT RELEASE	ZERO	ZERO	SECOND PRIORITY (6) AGL ALT AT RELEASE	SECOND PRIORITY AGL ALT (6) AT RELEASE	SELECTED DATA AT RELEASE (5)	SELECTED DATA AT RELEASE (5)	PRIORITY AGL ALT (6) AT RELEASE	SECOND PRIORITY (6) AGL ALT AT RELEASE
A-T-A GUNS A-T-G GUNS ROCKETS MAVERICK EO BOMB MANUAL MODES	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE

NOTE

(1) Includes all legal bombs and CBU except CBU-30/-38 series vertical dispensers (ASCU store type codes CP and CQ). No release freeze data is stored when one of these vertical dispensers is selected.

(2) Data 77 and 79 upper and lower window values are preceded by a letter code which denotes the sensor source. The letter codes are as follows:

Code	Sensor
F	FLR
r	Radar Altimeter
b	Barometric Altitude (ADC)

(3) Data address 78 values are selected by entering codes in data address 58. However, the data address 58 codes are set for slant range and LOS angle at NWDC power-up initialization. Therefore, data address 78 displays will be slant range and LOS angle if programmable data codes have not been entered in data 58 since last NWDC power-up.

(4) No release freeze data are stored in manual ripple bomb mode if the fuselage gun or a gun pod is selected (air-to-air gun and manual ripple bomb modes in progress at same time).

(5) Provided selected data are computed in manual ripple mode. (Data 78 default values, slant range, and LOS are meaningless in manual ripple bomb mode).

(6) FLR AGR range data is not available in manual ripple bomb mode. Therefore, AGL altitude values are always barometric or radar altitude data.

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Figure 1-19

Computer control panel and enter the desired release sequence pass number of 01 through 12 (entered as 0000001 through 0000012). Next, select the Data Address (73 through 79) for the desired freeze table values and observe the selected data on the control panel display. To recall other data values from the same release sequence, repeat the Data Address 73 through 79 entry and observation procedures. To recall data values from a different release sequence, repeat the Data Address 35 and Data Address 73 through 79 steps.

Only 12 sets of freeze data may be stored from the time that Data Address 35 was set to zero. Data Address 35 must be reset to zero to save the data from pass No. 13 and subsequent. Computed releases following reset of Data Address 35 write over data frozen from previous passes, beginning at pass 1. To preclude the loss of release freeze information from previous passes, the data must be manually recorded prior to reset of Data Address 35.

Release freeze data (Data Addresses 73 through 77) and sensor freeze data (Data Addresses 78 and 79) are stored for all visual attack, visual attack offset, BOC, BOC offset, and HUD fail (0 mils) passes when the solution cue passes through the FPM whether or not the armament release button is pressed. For CCIP passes, these data are stored when the armament release button is pressed.

To indicate that the next pass is to be the first pass for data storage purposes, the freeze data history store may be reset by entering all zeros (0000000) in Data Address 35 (Data Address 35 is set to 0000000 during NAV WD computer power-up initialization).

The release freeze data table values are retained in computer memory until the pass counter is reset to 01 (either manually by entering all zeros in Data Address 35 or automatically at NAV WD Computer power up) and new release passes are performed (causing the previous values to be overwritten) or the OFP is reloaded into the NAV WD Computer.

Route Navigation Timing.

Data Address 36 is programmed to allow entry of a final destination/target number. This number can be any available destination from 01 through 18, except 10. The number entered in Data Address 36 affects both the time on target (Data Address 31) and GSR (Data Address 32) displays.

Route navigation timing is operative only when the final destination/target number entered in Data Address 36 is greater than the destination/mark number currently selected on the fly to controls.

When route navigation timing is being used, the flight route is always assumed to be from the present position to the current fly to selection; then, sequentially through each successive destination to the final destination/target number entered in Data Address 36.

The distance to the current fly to selection is added to the distance between each of the successive destinations up to the final destination/target. The sum of these distances is the current distance to the final destination/target.

The current distance to the final destination/target is divided by the present groundspeed to obtain the time-to-go value for the destination entered in Data Address 36. This time-to-go value is then used to compute the time-on-target value displayed in Data Address 31.

The current distance to the final destination/target is divided by the time left before the desired target arrival time to obtain the GSR value for the Data Address 32 display. When using the route navigation timing feature, the desired arrival time for the final destination/target (Data Address 36) must be entered in the Data Address 32. (The entry of an arrival time for any destination other than the number entered in Data Address 36 will provide an erroneous GSR display in Data Address 32.) If the final destination/target number entered in Data Address 36 is greater than the current fly to selection, Data Addresses 31 and 32 will display present route navigation timing. If the final destination/target number entered in Data Address 36 is equal to or less than the current fly to selection, Data Address 31 and 32 will display present data for the current fly to destination.

The route navigation timing feature cannot be used to fly a reversed course (i.e. from destination 0000019 back to 0000001). Neither can it be used for timing a closed course unless the end point is entered as the largest destination/target number. A closed course away from the home base can also be timed if the start and end points of the closed portion are entered as two separate destinations (i.e. 03 and 12).

Data Address 36 is initialized to all zeros (0000000) during the NAV WD Computer power up. This provides for the display of current fly to destination data in Data Addresses 31 and 32 unless otherwise changed by the entry of a final destination (0000001 through 0000018, except 0000010).

Waypoints Entry.

Data Address 37 is programmed to allow for automatic computation of coordinates of a point of interest. This is done by manually entering the range and bearing from a known point (previously stored destination). The NAV WD Computer converts the range and bearing values entered in Data Address 37 into latitude and longitude increments. These increments are then added to the coordinates of the known point (any destination number from 01 through 18, except 10). Selecting the storage destination number on the NAV WD Computer fly to controls then provides steering to the waypoint.

Prior to entering the range and bearing values in Data Address 37, the latitude-longitude of the reference point used for these measurements must be stored as a fly to destination or mark (01 through 18, except 10).

NOTE

Operational use of the waypoint entry feature may require conversion from magnetic bearing to true bearing prior to computer entry. (True bearing equals magnetic bearing minus west variation or plus east variation.)

When entering values in Data Address 37, two leading zeros (00) are first entered in the upper windows, followed by two digits which denote the destination location (01 through 18, except 10) containing the reference point coordinates, followed by two digits (01 through 18, except 10) used to identify the destination location in which the computed coordinates for the waypoint are to be stored. Next, a leading zero (0) is entered in the lower windows followed by three digits each for the true bearing and range to the waypoint. The true bearing value is in degrees (90° is entered as 090) and the distance (range) value is in tenths of a nautical mile (xx.x miles).

Because the bearing and distance values entered for the waypoint are in 1° and 0.1-mile increments respectively, a waypoint should not be used for unrefined BOC or BOC OFFSET bombing (no radar target).

NOTE

The same destination number (01 through 18, except 10) can be used both as a UTM grid origin and as a reference point for waypoint measurements.

Programmable Data Displays.

Data Addresses 50 through 54 and 58 can be manually programmed to obtain specific data displays in Data Addresses 70 through 74 and 78 respectively. Two predetermined six-digit codes can be entered in Data Addresses 50, 51, 53, 54, and 58. One predetermined six-digit code can be entered in Data Address 52. These codes determine what data will be displayed by Data Addresses 70 through 74 and 78.

Data Addresses 50, 51, 70, and 71 are for coding and display of variables which are continuously displayed and are updated once per second. Data Addresses 53, 54, 73, and 74 are for coding and display of weapon release freeze data. These release freeze data are stored at single bomb release (quantity of 01 selected) in the computed release modes or at stick center release in the computed and manual ripple weapon delivery modes (quantity of 02 or greater selected). Data Addresses 58 and 78 are for coding and display of sensor freeze data. These sensor freeze data are frozen at last slew or designate input to the NAV WD Computer. The release and sensor freeze data are not available for guns, rockets, AGM-65 missiles, CBU-30 and CBU-38 vertical dispensers, EO bombs or any manual weapon delivery mode other than manual ripple.

Data Address 52 allows code insertion in only the lower window which will cause a 16-bit display of the asssociated memory location of the NAV WD Computer in Data Address 72. The bits displayed in Data Address 72 are numbered from left to right with the first 8 bits appearing in the upper window and the remaining bits in the lower window. The Data Address 72 display is updated once each second. This 16-bit pattern is useful in monitoring computer discrete inputs for troubleshooting system discrepancies.

Data Address 50 through 54 codes remain in the computer memory until reprogrammed by another code insertion or by reloading the OFP.

Release Freeze Data Display.

Data Addresses 75 through 77, 93, and 94 display values frozen at a computed single bomb release (quantity of 01 selected) or the center bomb of a stick release (quantity of 02 or greater selected). Figure 1-20 provides a detailed description of these displays and a pictorial view of typical values displayed by Data Addresses 75, 76, 77, and 94. Two programmable Data Addresses (53 and 54) and the associated displays (Data Addresses 73 and 74) can also be used for storing release freeze data. Release freeze data are not available for guns, rockets, AGM-65 missiles, CBU-30 and CBU-38 series vertical dispensers, EO bombs, or any manual delivery mode other than manual ripple bombs.

The values for the Data Address 73 through 77 displays are always stored in the release freeze data table for up to 12 consecutive release passes performed in an applicable mode. (Refer to Release Freeze Data Table, this section, for a description of how the data table is controlled and the procedures for recalling data stored in the table for display.) The values for the Data Address 93 and 94 displays are not stored in the release freeze data table.

Sensor Freeze Data.

Data Addresses 78 and 79 are sensor freeze data displays and are updated on aiming symbol slew or target designation. In BOC or BOC OFFSET the displays are also updated when in-range transition occurs (30 or 80 nmi). Following a release sequence, the data displayed will be the last sensor data used by the computer to compute the weapon release signal. In the continuous ranging modes, CCIP and Guns/Rockets, the display is updated continuously and never frozen (figures 1-19 and 1-20).

Data Address 78 is initialized to display slant range and line of sight (LOS) to the target at NAV WD Computer power up. Additionally, Data Address 78 can be programmed to display other diagnostic data by entry of variable codes in Data Address 58. If a variable code has not been entered in Data Address 58 subsequent to last NAV WD Computer power up, Data Address 78 will display target slant range in the upper window and LOS to the target in the lower window. Data Address 79 will display the priority sensor height above target in the upper window and the second priority sensor height (as determined by Data Address 24 entry) above target in the lower window. Data address values are as follows:

1. Data Address 78

   upper window — Slant Range (feet) or as programmed in Data Address 58
   lower window — LOS to Target (degrees) or as programmed in Data Address 58

2. Data Address 79

   upper window — Priority Sensor Height Above Target (feet)
   lower window — Second Priority Sensor Height Above Target (feet)

Munition Function Data Readout.

Munition function data is read out of Data Addresses 93 and 94. These data addresses are used for comparison purposes for the parameters entered in Data Addresses 28 and 29.

1. For bomb type CBU munitions with time fuzes installed, Data 93 will display the time entered in Data 28, which is the time until fuze function. Data 94 will display the achieved altitude (AGL) at which this time was reached.

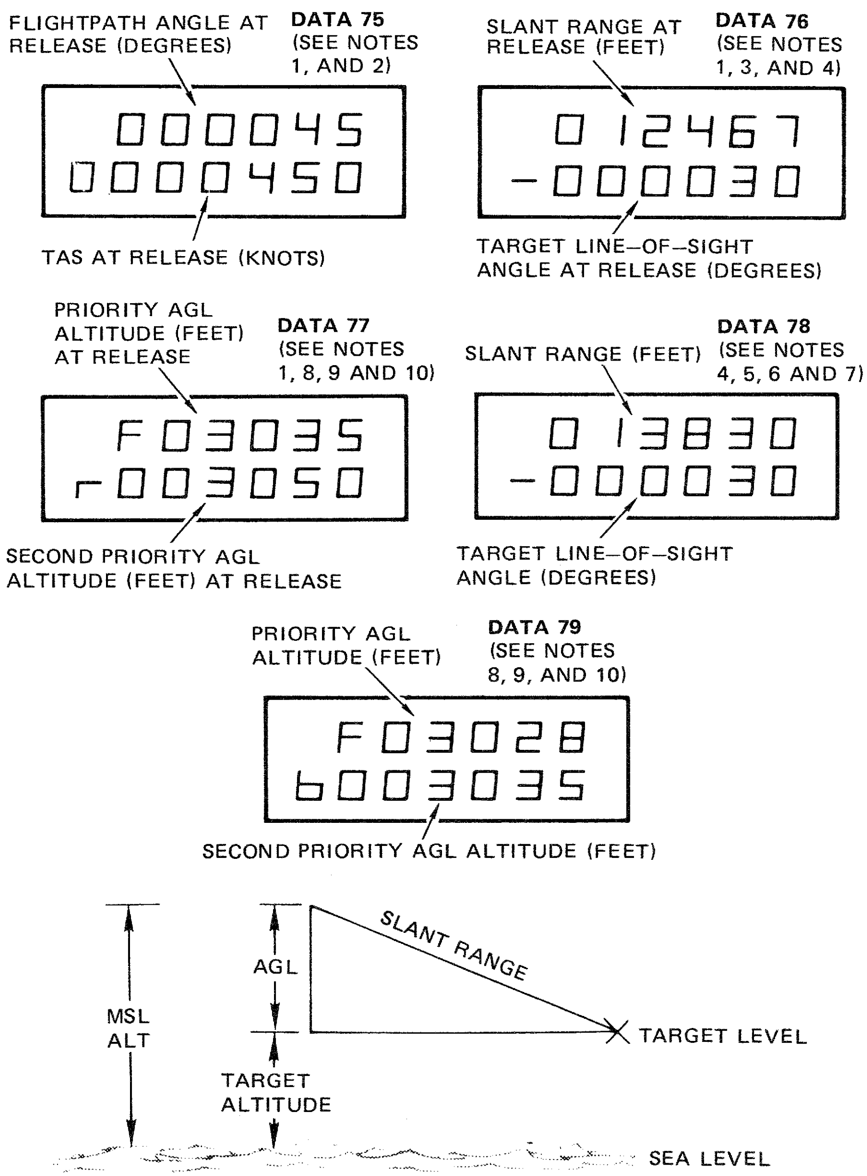
2. For bomb type CBU munitions with altitude sensing fuzes, Data 93 will display the time after release before the munition reached the altitude entered in Data 29, which was the function altitude set of the fuze.

3. For GP bombs with impact fuzes, Data 93 will display time of fall to impact and data 94 will display the release altitude AGL.

TARGET LOCATION AND ALTITUDE STORE.

Destination 19 (FLY TO MARK 9) is used to store the most recent aiming symbol coordinates in all continuously computed release point (CCRP) delivery modes. At the time of slew stop or target designate, the coordinates are automatically stored and the destination 19 altitude is calculated using the current barometric altitude, based on the current FLY TO MSLP, and the priority sensor height above target. The calculated target altitude is stored as the DEST 19 ALT and the current FLY TO MSLP is stored as the DEST 19 MSLP. This information can be used for bomb damage assessment (BDA) purposes, update of target altitude, or reattack of a target of opportunity.

RELEASE FREEZE DATA DISPLAYS



NOTE

1. Release freeze data (data addresses 75 through 77) apply only to computed bomb releases, including manual ripple bomb mode. (Freeze data are not stored for manual bomb deliveries, nor for guns/rockets, uncataloged stores, CBU-30/38 vertical dispensers, or TV weapon deliveries.) These data are stored at weapon release (single bomb) or at center bomb in a multiple release sequence.
2. Flightpath angle (FPA) is airplane vector in earth vertical plane, referenced to local horizontal. A minus sign indicates airplane diving.
3. Slant range value is set to zero in manual ripple mode.
4. Target line-of-sight (LOS) angle is measured in earth vertical plane, with respect to local horizontal. A minus sign indicates target is below airplane. LOS value is set to zero in manual ripple mode.
5. Data 78 is programmable data address (readout only). Applicable codes may be inserted in data address 58. Data 58 will be initialized at NWDC power-up to display slant range and LOS angle.
6. The sensor freeze data (data addresses 78 and 79) are stored/updated at in-range (BOC and BOC OFFSET only), at target designation, and at each slew in applicable attack modes. In these modes, displayed values are last sensor data used to compute target ranges. In the continuous ranging modes (CCIP and air-to-ground guns/rockets), these displays are updated once each second (never frozen).
7. Sensor freeze data are not available in air-to-air gun and manual ripple modes, nor in manual delivery modes.
8. The priority AGL altitude is the altitude above the target as determined by the priority sensor at time of last range data request (Data 79) or at the time of release (Data 77).
9. The second priority AGL altitude is the altitude above the target as determined by the second priority sensor at time of last range data request (Data 79) or at the time of release (Data 77).
10. The priority and second-priority AGL altitude values are preceded by a letter to indicate the ranging sensor used. The letter designators are as follows:
    a. F indicates FLR.
    b. r (R) indicates radar altimeter.
    c. b (B) indicates barometric altitude (ADC).

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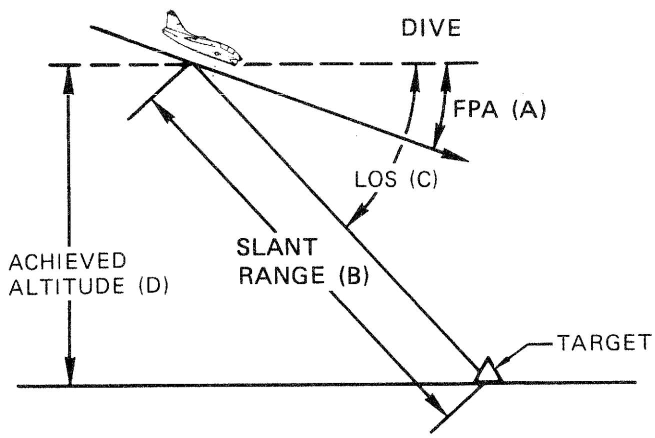
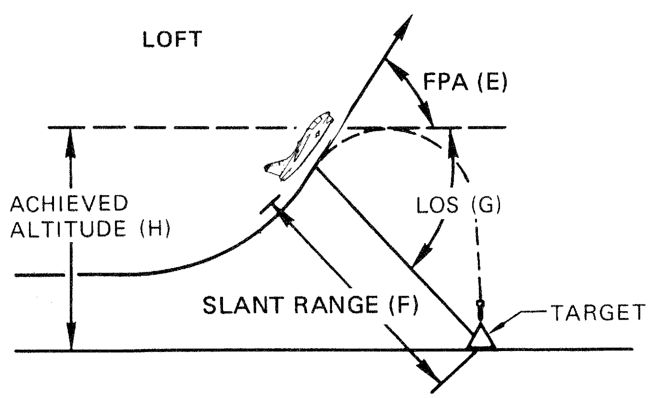
Figure 1-20 (Sheet 1)

RELEASE FREEZE DATA DISPLAYS



TYPICAL DIVE DELIVERY VALUES

Data	Window	Display	Value
75	Upper(A) Lower	Flight Path Angle True Airspeed	–28 Degrees 450 Knots
76	Upper(B) Lower(C)	Slant Range Line of Sight	10,000 Feet –30 Degrees
77	Upper Lower	Priority AGL Altitude 2nd Priority AGL Altitude	8,000 Feet 7,800 Feet
94	Lower(D)	Achieved Altitude	5,000 Feet



TYPICAL LOFT DELIVERY VALUES

Data	Window	Display	Value
75	Upper(E) Lower	Flight Path Angle True Airspeed	45 Degrees 450 Knots
76	Upper(F) Lower(G)	Slant Range Line of Sight	10,000 Feet –30 Degrees
77	Upper Lower	Priority AGL Altitude 2nd Priority AGL Altitude	2,000 Feet 1,900 Feet
94	Lower(H)	Achieved Altitude	5,000 Feet

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Figure 1-20 (Sheet 2)

VISUAL ATTACK MODE.

The VISUAL ATTACK mode can be used against any target that can be acquired visually. Target coordinates need not be inserted unless desired for navigation purposes.

Initiation.

Initiation is accomplished by selecting a station with a computed bomb type ASCU code and depressing the VISUAL ATTACK master function switch. On the HUD, the ASL replaces the flight director (figure 1-21). The ASL will pass through the flightpath marker (FPM) and will be perpendicular to the horizon. The aiming symbol will appear stowed within the FPM, and the pullup anticipation cue will appear 3.5° below the FPM on the ASL. The Forward-Looking Radar (FLR) enters the computer controlled AGR mode and radiates.

VISUAL ATTACK can be selected to bomb any visually acquired target without regard to the destination address number on the FLY TO thumbwheel. However, if the barometric ranging mode comes into priority the altitude and MSLP stored for the destination selected on the FLY TO thumbwheel are used for slant range computations. If these values are not correct for the target being attacked, the desired accuracy will not be obtained. The best known target altitude and MSLP should therefore be entered under the appropriate destination address for all VISUAL ATTACK deliveries. Selecting DEST 0 or any MARK on the FLY TO switches causes the computer to assume nominal values for target altitude (512 feet above sea level), MSLP (29.92), and bomb burst height (ground level). These values will not provide the desired accuracy in the barometric ranging mode unless the target is actually at the assumed altitude/MSLP.

Designation and Aiming.

Normally, target designation should be accomplished as early as possible in the attack. Pressing the designate button or the armament release button on the control stick designates the target location to the NAV WD Computer as the point on the ground under the aiming symbol. The computer then stabilizes the aiming symbol to remain on the designated point on the ground. Precise aiming should be accomplished with the Bullpup controller after designation.

If pullup is initiated with the target designated, the aiming symbol may be pulled off the target due to aircraft pitch rate. This is caused by the time lag between aiming symbol position calculation and HUD display service plus HUD service rate, which is 25 times per second. For example, with the aircraft flying at 400 knots with a 3g pullup, the aiming symbol will lag the target by approximately 3.8 mils. The lag will increase as g increases; i.e., the above case will produce a lag of approximately 9.5 mils with a 6g pullup. Aiming symbol lag will be produced by rapid azimuth changes, although azimuth lag will not be of nearly the same magnitude because of the smaller g forces experienced in azimuth changes. Because of these effects on the aiming symbol, the aiming symbol-to-target relationship is only valid when the relative line of sight is stabilized. This aiming symbol lag is purely a display function and does not affect the weapon delivery calculation.

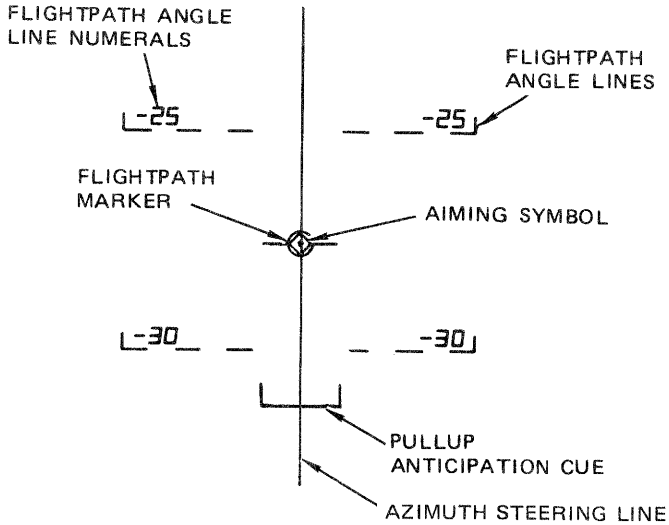
Before target designation, aiming is accomplished by placing the aiming symbol on the target using one of the following methods:

1. Flying to place the aiming symbol, stowed within the FPM, on the target. This technique is referred to as point blank aiming.
2. Using the Bullpup controller to slew the aiming symbol and the BFL to overlay the target (figure 1-22).

Selecting VISUAL ATTACK causes the FLR to enter the Air-to-Ground (AGR) mode and radiate, slaved to the aiming symbol position. Movement of the Bullpup controller will move the aiming symbol both in azimuth and elevation with the ASL slaved to the aiming symbol. The point on the ground under the aiming symbol represents, to the NAV WD Computer, the intended point of impact of the selected weapons. Positioning of the aiming symbol is only valid for targets that are within 43 miles, i.e., if the aiming symbol is positioned on a target that is 60 miles away, the computer will assume that the target is 43 miles away. In this case, FLR AGR is not used as AGR ranges in excess of 52,672 feet are not accepted by the computer.

Termination of aiming symbol slewing causes the aiming symbol to become ground stabilized just as though target designation had been accomplished. HUD symbology is identical at postslew predesignate as it is at postdesignate with one exception; the ASL will be through the aiming

SYMBOLOGY AT SELECTION OF VISUAL ATTACK



Aiming symbol stowed within flightpath marker.

Pullup cue positioned on azimuth steering line.

Azimuth steering line extends through flightpath marker and computed bomb impact point.

Forward Looking Radar is in computer controlled AGR mode.

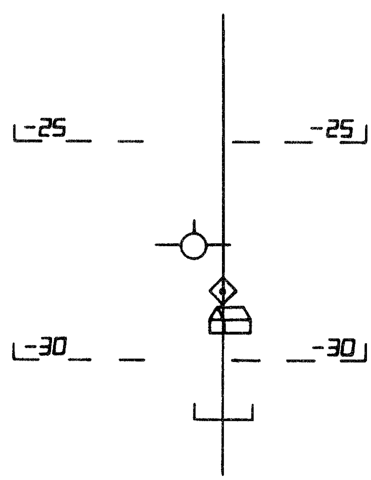
78K030–08–80

Figure 1-21

SYMBOLOGY FOR VISUAL ATTACK – AIMING

AIMING SYMBOL SLEWING BEFORE DESIGNATION

BULLPUP CONTROLLER



Bullpup controller can be used to move the aiming symbol in any direction. Azimuth steering line moves with aiming symbol.

After slew termination, aiming symbol becomes ground stabilized just as though target designation had been accomplished.

78K031–08–80

Figure 1-22

symbol until designation is actually performed, then will move to halfway between the aiming symbol and the FPM. In order that there be no doubt as to the designated condition of the system, it is recommended that target designation be performed as early as possible with the aiming symbol anywhere near the target; then precise aiming refinement can be performed as the distance to the target decreases.

After target designation, for low-drag bombs, two solution cues appear 4° above the FPM on the ASL when within target range (based on a 4g pullup) and relate to a solution against the ground point indicated by the aiming symbol. The solution cues will blink at a rate of five times per second when FLR range is requested by the NAV WD Computer and AGR data are not reliable or available. The displacement of either solution cue from the FPM represents the elevation steering error or angle of pullup that must be zeroed to cause the weapon to impact the point shown under the aiming symbol.

After target designation, for high-drag bombs or cluster bomb munitions, one solution cue appears when the present computed horizontal miss distance, with respect to the spot (target) under the aiming symbol, is 6,000 feet. The solution cue remains stowed above the FPM until miss distance decreases to 4,000 feet. The cue then moves toward the FPM at a rate proportional to the closing rate of the impact point and target.

Target designation records the target location in the NAV WD Computer and ground stabilizes the aiming symbol to remain on the target. Designation is accomplished by pressing the armament release button or the target designate button on the control stick. It is recommended that designation be accomplished as soon as possible and that the target designate button be used (it should be held depressed for at least one second). As the aircraft advances toward the target, the aiming symbol (and the target) may disappear from the pilot's field of view; however, visual contact with the target is no longer mandatory to complete the delivery if accurate aiming was previously completed.

Target designation causes the ASL to move halfway from the aiming symbol to the FPM, indicating the required azimuth steering (figure 1-23). If the HDG MODE switch is in AUTO NAV, the ADI vertical pointer becomes slaved to the ASL position. At designation the HSI No. 1 pointer and mileage indicator cycle to indicate relative bearing and range to the designated target.

Depression of the target designate button a second time will undesignate the target and restow the aiming symbol and ASL on the FPM. The armament release button cannot be used to undesignate the target.

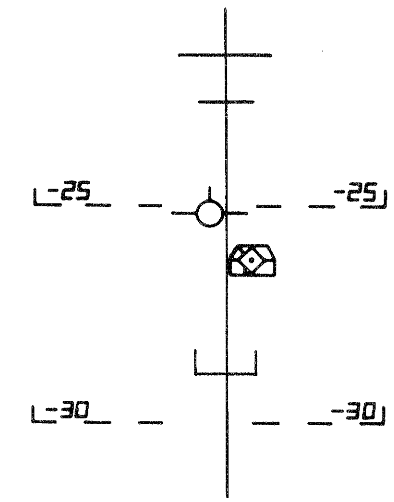
Target designation can occur in BOC or BOC OFFSET mode with subsequent change to the VISUAL ATTACK mode without loss of target data (this is referred to as designate retention). If this capability is used, at least 1.5 seconds should be allowed to enable FLR AGR data to become available before attempting weapon release. Mode change requires the FLR to change from a ground mapping mode to the AGR mode, to slave to the aiming symbol position, and determine range to the target. These changes, coupled with the NAV WD Computer time requirement to smooth the AGR data and update the slant range, take a maximum of 1.4 seconds. Any required aiming symbol slewing to refine the target position information to the computer must be added to the FLR changeover time. Slewing need not be delayed to allow the FLR to slave to the aiming symbol position as releases which occur prior to FLR AGR data availability will use the slant range derived from the ranging sensor which was in priority in the original bombing mode.

NOTE

When changing from BOC or BOC OFFSET bombing modes to VISUAL ATTACK or VISUAL ATTACK OFFSET bombing modes after target designation, FLR AGR data are not used for ranging information unless the aiming symbol is slewed with the Bullpup controller. The NAV WD Computer does use FLR AGR data to compute ground/blast avoidance.

Unless a proper roll-in technique is used, the computed release point may be passed before designation and no release will occur. To prevent this, roll in with the FPM on a lower position than the target, then designate and slew to refine aiming. Pull the FPM up to a position above the target before reaching the desired release conditions. The FPM is the aircraft velocity vector and, if the FPM is held below the target, the aircraft will underdive the target. This technique of underdiving the target at roll-in will always provide a solution although other techniques are acceptable.

SYMBOLOGY AFTER TARGET DESIGNATION



Aiming symbol ground stabilized on target.

Azimuth steering line positioned half way between the flight path marker and the aiming symbol to indicate azimuth steering error.

Pilot may refine aiming symbol location with the Bullpup controller.

Solution cues appear if the ground point under the aiming symbol is in range.

Forward Looking Radar slaved to aiming symbol within antenna limits.

78K032-08-80

Figure 1-23

Delivery.

If all subsystems are functioning normally, the aiming symbol will automatically track the precise point on the target where it was placed at designate. As range to the target decreases and visual resolution improves, small aiming errors may become apparent and aiming symbol position should be refined with the Bullpup controller. Refer to Delivery System Management in this section for additional procedures if all subsystems are not functioning normally and for aimpoint refinement techniques.

After designation, if visual contact with the target is maintained, the Bullpup controller may be used to refine the aiming symbol position on the target. Any slewing of the aiming symbol also causes an automatic radar ranging update, however slewing should not be done just to acquire fresh ranging data. Solution cues will be removed from the HUD, and weapon release will be inhibited during aiming symbol slewing.

If the FPM is above the aiming symbol as the solution cue approaches the FPM, aim refinement may preclude release. The NAV WD Computer requires five consecutive computation cycles (0.2 second) after designation or updating to generate a release signal. If the computed impact point is 10 feet or more beyond the computed target 0.2 second after the aim refinement, there will be no release. If the FPM is above the aiming symbol and a long drift is observed, aim refinement may preclude release even though the solution cue is not approaching the FPM when aim refinement is initiated.

If the sensor being used for ranging measurement is in error, the computed target will not coincide with the actual target. If the FPM does not overlay the aiming symbol, the aiming symbol will appear to drift away from the target. It is important that this drift be recognized and corrected by refining the aiming symbol position with the Bullpup controller. Each time the Bullpup controller is activated, the computer receives a new ranging measurement. If this revised measurement is correct, the aiming symbol will no longer drift away from the target, provided there are no boresight or velocity errors. For this reason, the pilot should put the aiming symbol on the target at the earliest opportunity and maintain a separation between the aiming symbol and the FPM.

After target designation, the ASL is positioned halfway between the FPM and the aiming symbol to indicate the required azimuth steering. The correction for azimuth steering error is to fly the FPM to overlay the ASL. While the ASL position is limited to the HUD total field of view, the aiming symbol is not so limited and may leave the HUD, especially during high altitude level bombing or loft bombing attacks. However, loss of the aiming symbol only precludes further aiming refinement and does not preclude completion of the attack. Once the target is designated, the pilot need only ensure the FPM is on the ASL when the solution cue intersects the FPM.

When using the flexible fuze capability of the computer program with GP bombs, destructors, and fire bombs, the pullup anticipation cue is used to provide the pilot with fuze arming time/safe escape information. The pilot has only to keep the anticipation cue below the FPM until weapon release occurs to ensure sufficient fuze arming time or safe escape altitude is available.

For bomb type CBU dispensers with time fuzes installed, the computer moves both the solution cue and the pullup anticipation cue based on the entries under Data Addresses 28 and 29. The desired fuze function altitude (Data 29) tells the computer at what point the dispenser is to open. The fuze function time (Data 28) tells the computer how long the dispenser is to fall prior to opening. The computer uses these inputs, along with the designated target location and the aircraft velocity vector, to position the two cues. The solution cue is moved down the HUD to indicate approach to the desired release point based on the fuze function time. The pullup anticipation cue is moved up to indicate approach to the desired release point based on the fuze function altitude. Required pilot action is to fly the aircraft until both cues begin movement, then adjust the dive angle so that the cues intersect the FPM simultaneously.

For bomb type CBU dispensers with altitude sensing fuzes, the computer moves both the solution cue and the pullup anticipation cue based on a nominal 4-second fuze arming time and the entry under Data Address 29. The fuze function altitude (Data 29) tells the computer at what point the dispenser is to open. The nominal 4-second arming time (Data 28 entry of zero) tells the computer the minimum time the dispenser must fall in order to be armed prior to reaching the function altitude. The computer uses these inputs, along with the designated target location and the aircraft velocity vector, to position the two cues. The solution cue is moved down the HUD to indicate approach to any release point which will provide the proper trajectory to the desired fuze function point. The pullup anticipation cue is moved up the HUD to indicate approach to the minimum release altitude at which the minimum fuze arming time can be obtained. Required pilot action is to fly the aircraft so as to keep the pullup anticipation cue below the FPM until weapon release occurs.

NOTE

With altitude sensing fuzes installed, Data 28 (fuze arming time) is entered as zero. This causes the computer to assume a nominal 4-second fuze arming time. If the arming time set on the fuze is greater than 4 seconds, the dispenser may pass the selected height of burst prior to arming. Such conditions will not be reflected in the computed solution and may result in dud munitions.

The pullup cue is also moved as a function of the distance to a ground/blast avoidance condition. If the avoidance calculation would place the pullup cue closer to the FPM (higher along the ASL) than the fuzing calculation, the avoidance calculation is used to position the pullup cue. The reverse is also true, however once an avoidance condition is reached, the pullup cue moves to the FPM and the pullup command flashes.

While maintaining the FPM on the ASL, the pilot depresses the armament release button at the appropriate time to achieve release on either the lower or upper solution cue. For a level, dive, dive toss, or low angle loft (up to approximately 42°) the armament release button is pressed before the lower solution cue reaches the FPM. When the solution cue reaches the center of the FPM, release should occur and the FPM will flash for at least 2 seconds after the last release.

For low-drag bombs, if release is not selected (armament release button not pressed) when the lower solution cue intersects the FPM, a high angle loft or over-the-shoulder delivery may be made by executing a pullup and pressing the armament release button before the upper solution cue intersects the FPM. Computations for weapon release and for solution cue movement are separate so the intersection of the solution cue with the FPM may not exactly coincide with release.

During a multiple release for either solution, release pulses will be transmitted in selected quantities and intervals with the pulse series advanced to center the multiple weapon stick and with equal spacing between bomb impact points. The solution cue will intersect the FPM at release of the first weapon and the FPM will begin flashing at release of the last weapon. Lateral steering error will not prevent computer release unless it exceeds 20°.

See figure 1-24 for a sequence of events chart and figure 1-25 for a profile of a typical VISUAL ATTACK delivery.

Reattack.

If the computer senses that stores are still present on selected stations, the target location (up to a range of 260,000 feet) is retained in the computer so that on repeated delivery passes, the aiming symbol, and the ASL are displayed to assist the pilot in reacquiring and reattacking the target. If no reattack is desired, the pilot may again press the designate button which will undesignate and restow the aiming symbol. The pilot may also deselect the mode by deselecting the VISUAL ATTACK master function switch. The steering information presented to the pilot in reattack will depend upon the aircraft and target relative positions as follows:

1. Over-the-Shoulder (OTS) — OTS steering is presented when the target is behind (less than 13,000 feet) the aircraft. Target behind the aircraft is interpreted by the NAV WD Computer as meaning that a turn of 90° or more must be made to point at the target. When the OTS phase is entered, the lower solution cue returns to the top of the ASL. The ASL will present steering commands to orient the aircraft tail-on to the target. This is designed to ensure that the OTS maneuver will be done in a vertical plane.

   OTS bombing should not be used for high-drag weapons. For high-drag, retarded, and CBU type weapons, the upper solution cue is not displayed. The lower solution cue goes to 4° below the FPM and is stowed until reattack is initiated or the target is 13,000 feet behind the aircraft. However, the ASL functions are the same as in low-drag OTS bombing.

2. Go-Around — go-around steering is presented for conventional attacks when the target is more than 13,000 feet and less than 43 miles behind the aircraft. The steering presented in this situation will be the closest direction to turn for reattack. During this phase the ASL is displayed perpendicular to the horizon, solution cues are not displayed, and release is inhibited. When outside of 43 miles, the attack mode is exited. Attack symbology is removed from the HUD and navigational symbology will not appear until the attack mode is deselected.

3. Target in front of the aircraft — in reattack when the pilot has maneuvered the aircraft so that the target is in front of the aircraft, the information presented is the same as in an original attack.

NOTE

When performing a reattack using FLR AGR data, actuate the radar range/target reject switch after getting the target in front of the aircraft. This will ensure the FLR is not locked on at maximum range.

SEQUENCE-OF-EVENTS CHART — VISUAL ATTACK

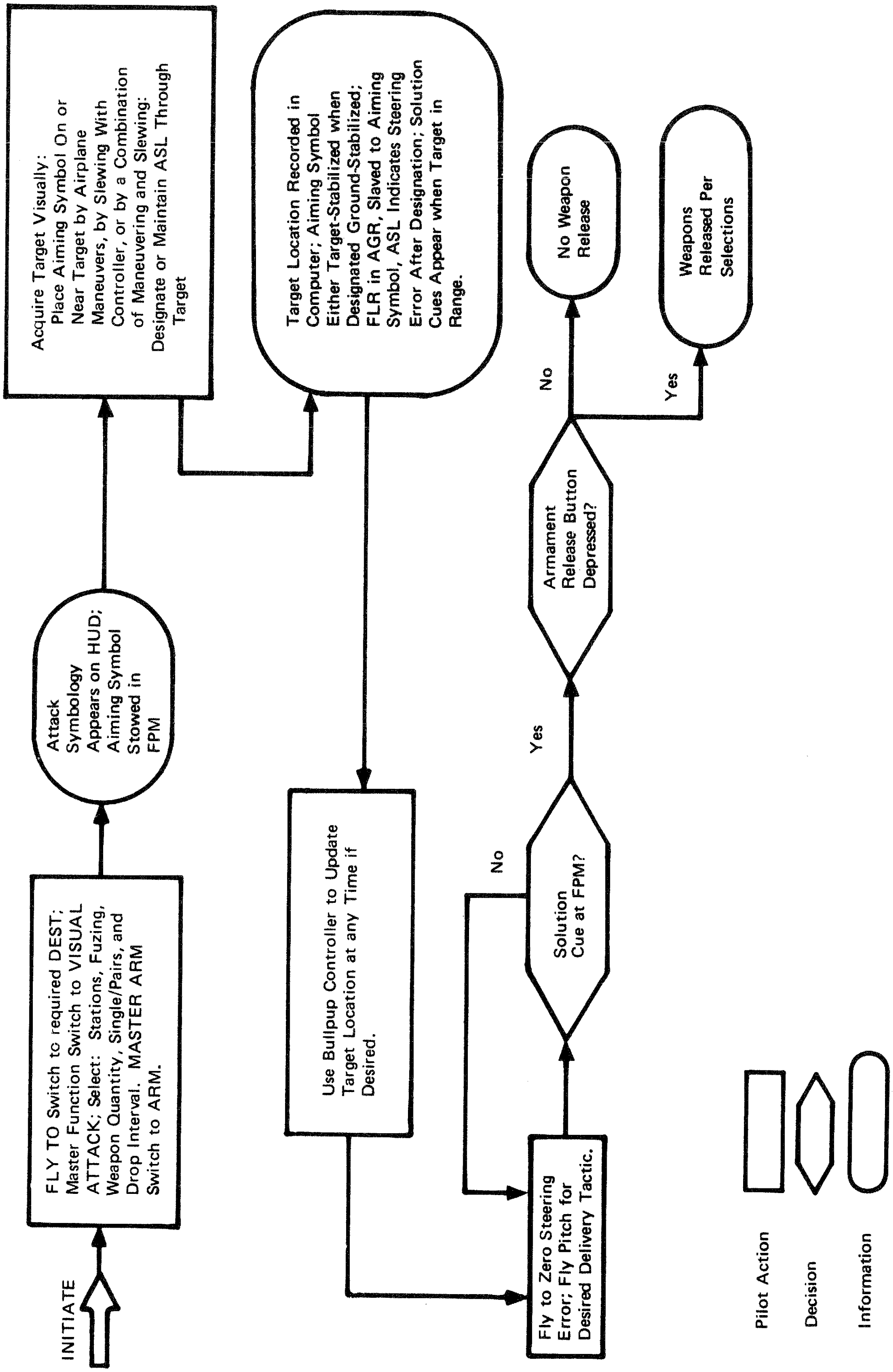
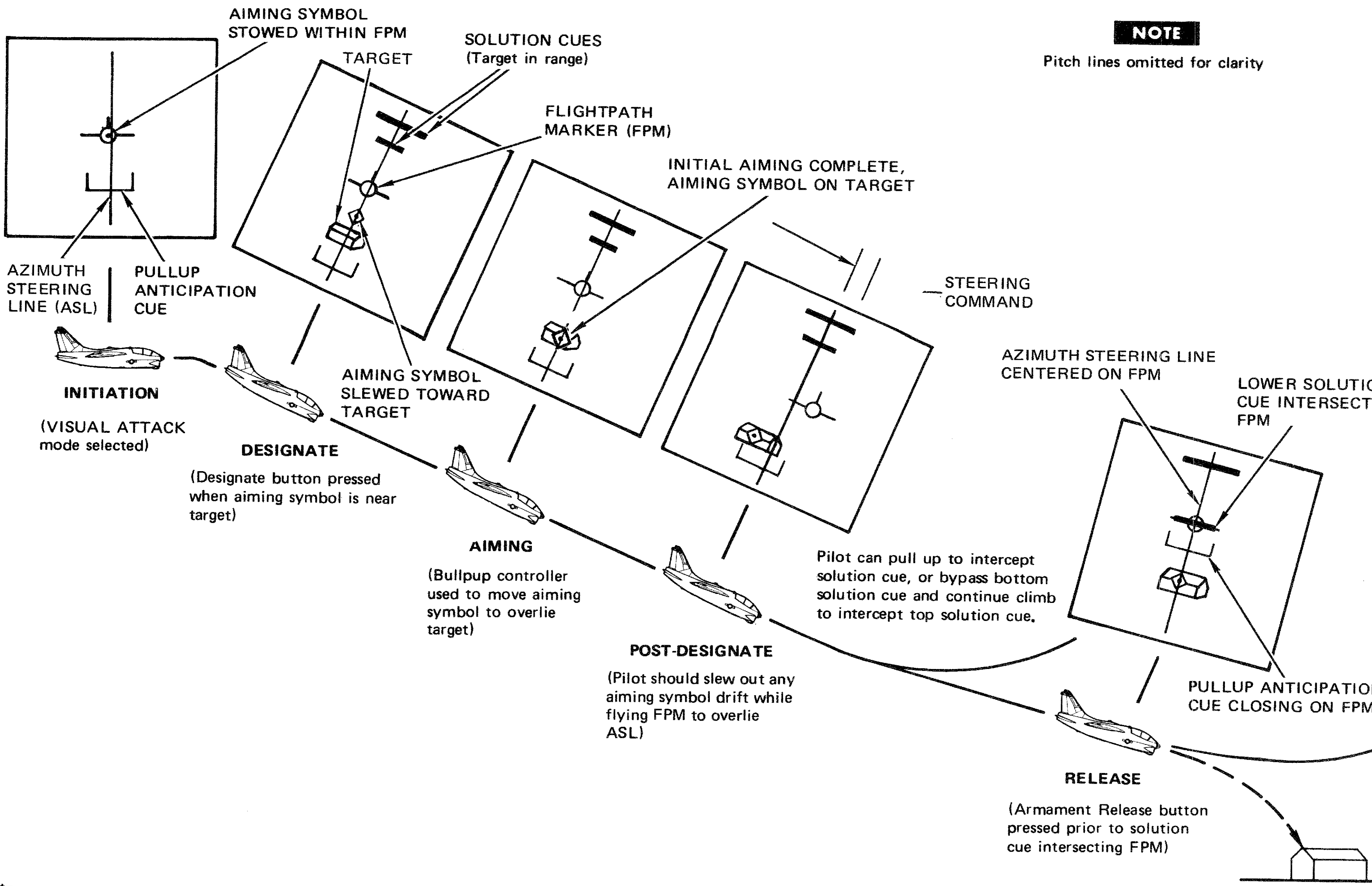


Figure 1-24

TYPICAL VISUAL ATTACK DELIVERY PROFILE

DIVE/DIVE-TOSS DELIVERY MANEUVER



NOTE

Pitch lines omitted for clarity

Figure 1-25

Delivery Variations.

In the VISUAL ATTACK mode, the pilot is free to maneuver the aircraft as desired except for suitable azimuth steering. All attack tactics are simultaneously available, as is the capability to change from one tactic to another during the attack. Once a tactic is started, the pilot is free to maneuver to any release point within the weapon envelope programmed in the NAV WD Computer.

1. Dive — the dive is accomplished as described above. The dive is continued until the lower solution cue crosses the FPM and the weapon is released. The altitude of release can be controlled to some extent by the angular separation maintained between the FPM and aiming symbol, i.e., the larger the angular difference, the higher the release.

2. Dive-Toss — the dive-toss delivery is accomplished as described above; however, after designation, the pilot executes a pullup at any g loading within prescribed limits to the lower solution cue to effect a toss.

3. Level Laydown — the level laydown delivery is accomplished as described above except that the aircraft is flown in a level attitude until release.

    a. Low altitude level attacks may be accomplished in VISUAL ATTACK mode provided consideration is given to computer range error sensitivity. The NAV WD Computer will not accept FLR range if the grazing angle is less than 4.0°. Grazing angle is defined as the line of sight angle below the horizon. At low grazing angles, a very small ranging error or altitude measurement error can result in a large error in the computed target position. See Delivery System Management description in this section for additional information.

    b. In situations where the ordnance load requires a low altitude attack (retarded Snakeye or fire bomb), a shallow dive attack with a 10° to 15° line of sight angle is recommended with continuous aiming symbol refinement until pullup is required.

4. Loft — a loft delivery is made by designating the target and pulling up above the horizon to intercept either solution cue. If a maximum range loft is desired, the pilot executes a 4g pullup at the initial appearance of the solution cues (in-range indication). A low angle loft is executed in a manner similar to the maximum range loft except that some time after the appearance of the in-range indication, the pilot executes a pullup and presses the armament release button to release on the lower solution cue. In a high angle loft, the pilot bypasses the lower solution cue and continues the pullup to release on the upper solution cue.

NOTE

Computed loft bombing with high-drag weapons is not recommended due to possible degradation of NAV WD Computer ballistics for loft conditions.

In loft deliveries the OFP program will allow the weapon to be released from a lower altitude than target elevation, i.e., uphill bombing.

5. Point Blank Delivery — a point blank delivery may be made by flying the aircraft to place the aiming symbol (stowed within the FPM) on the target, designating with the armament release button, and starting a pullup. Average accuracy will be inferior to the designate then slew method. There are several factors which must be considered when using point blank aiming:

    a. The pilot cannot monitor velocity and ranging errors prior to release and will not be able to apply correctional techniques. If a gross ranging error is accepted by the computer, an immediate release can occur upon pressing the armament release button.

    b. The computer does not compute pullup anticipation cue movement for flexible fuze data entries until after target designation. This may cause the cue to jump to the FPM at designation if at or below the computed release point derived from the flexible fuze data entries.

c. Blast avoidance cueing is not provided. Unless used to cue for flexible fuze release point, the pullup anticipation cue is placed on the HUD to cue the pilot only for ground avoidance. This may put the pilot in the blast envelope. In this case the pullup cue will jump to the FPM and the pullup command will flash at designation. Additionally, ground avoidance cueing is not accurate if a ranging error is present. If the computed range to the target is greater than the actual range to the target, ground avoidance cueing will be insufficient.

Backup Mode for HUD Failure.

When a HUD failed signal is received by the NAV WD Computer prior to target designation, the computer automatically assumes the line of sight (LOS) to be 0° in elevation. Target designation should occur with the standby reticle set on zero. The antenna tilt control will be inoperative. Required pilot action is as follows:

1. Turn HUD power switch to OFF.
2. Turn STBY RETICLE on.
3. Set MILS DEPR knob to first detent (0 mils).
4. Fly the aircraft so that the standby reticle overlays the target.

NOTE

Initial designation can be accomplished using either the designate button or the armament release button; however, only the designate button can be used for subsequent redesignation of the target.

5. Designate when the target is in the center of the standby reticle. After designation, the pilot must turn to center the vertical pointer on the ADI (steering error) and disregard the standby reticle.
6. Hold the armament release button down on the approach to the target. The weapon will release at the proper time as the aircraft flies through the computed release point.

NOTE

If the decision is made to use the 0-mil computed bombing mode, the HUD should be turned off to preclude an intermittent HUD FAIL signal from complicating the computed release sequence.

If HUD failure occurs after target designation, further designation is not necessary. The attack may be completed using the ADI bank steering bar to indicate azimuth steering error and to perform a level or dive delivery with pullup initiated at release or as required to provide ground/blast avoidance.

VISUAL ATTACK OFFSET MODE.

VISUAL ATTACK OFFSET mode can be used against targets whose locations are known in relation to some prominent point or landmark which is used as an offset aimpoint (OAP). Target or OAP coordinates need not be inserted unless desired for navigation purposes. Range and true bearing from the OAP to the target and Δ height between the OAP and target must be inserted. OAP altitude and MSLP should be inserted, using the target data destination number, in the event of FLR and radar altimeter malfunction.

Initiation.

Initiation is accomplished by selecting a station with a computed bomb type ASCU code, depressing the VISUAL ATTACK and OFFSET master function switches, and selecting the OAP's destination number on the FLY TO switches. On the HUD, the azimuth steering line (ASL) replaces the flight director, extending through the flightpath marker (FPM) and perpendicular to the horizon. The aiming symbol will appear stowed within the FPM, and the pullup anticipation cue will appear on the ASL 3.5° below the FPM. The Forward-Looking Radar (FLR) enters the computer controlled AGR mode and radiates.

If the HDG MODE switch is in AUTO NAV, the HSI mileage indicator and number 1 pointer will indicate range and relative bearing to the coordinates recorded under the destination number selected on the FLY TO switches, and the ADI bank steering bar will indicate azimuth steering to the same coordinates.

Aiming and Designation.

Aiming is accomplished by placing the aiming symbol over the OAP in the same manner as the target is overlaid in the VISUAL ATTACK bomb mode. The aiming symbol becomes ground stabilized with respect to the OAP when slewing is stopped. When the aiming symbol is on the OAP, the pilot presses the target designate button or the armament release button, recording the OAP location in the NAV WD Computer. From the OAP location and the OAP-to-target relative location (offset) previously recorded, the computer calculates the aircraft-to-target location. The pilot should ensure that he has good aim at designation and that the slant range and line of sight angle are conducive to accurate ranging.

Delivery.

After designation on the OAP, the aiming symbol moves to the computed target location and is ground stabilized. The FLR AGR continues radiating and is slaved to the position of the aiming symbol. The Bullpup controller is inoperative for approximately 1 second after designation and during this time releases are inhibited. This allows the FLR to slew from the OAP to the target. The displayed ASL is positioned with respect to the FPM to indicate azimuth steering error. The vertical pointer of the ADI displays steering equivalent to the ASL if the HDG MODE switch is in AUTO NAV. When in range for weapon delivery, the solution cues appear. The HSI number 1 pointer and mileage indicator cycle to indicate relative bearing and range to the target.

After the FLR has slewed to the target location, if the target becomes visible, aiming corrections should be made by slewing the aiming symbol with the Bullpup controller. No data will be accepted from the FLR unless the Bullpup controller is used; slewing, however, should not be done solely for the purpose of obtaining fresh FLR data.

Reattack and Delivery Variations.

Reattack capability, HUD symbology, and delivery variations are the same as in VISUAL ATTACK bomb mode. If redesignation is required, it must be on the OAP and not the target, even though the target may be visible. If the target has become visible, change to VISUAL ATTACK may be accomplished, if desired.

Backup Mode for HUD Failure.

When a HUD failed signal is received by the NAV WD Computer prior to target designation, the computer automatically assumes the line of sight (LOS) to be 0° in elevation. Target designation should occur with the standby reticle set on zero. The antenna tilt control will be inoperative. Required pilot action is as follows:

1. Turn HUD power switch to OFF.
2. Turn STBY RETICLE on.
3. Set MILS DEPR knob to first detent (0 mils).
4. Fly the aircraft so that the standby reticle overlays the OAP.

NOTE

Initial designation can be accomplished using either the designate button or the armament release button; however, only the designate button can be used for subsequent redesignation of the target.

5. Designate when the OAP is in the center of the standby reticle. After designation, the pilot must turn to center the bank steering bar on the ADI (steering error) and disregard the standby reticle.
6. Hold the armament release button down on the approach to the target. The weapon will release at the proper time as the aircraft flies through the computed release point.

NOTE

If the decision is made to use the 0-mil computed bombing mode, the HUD should be turned off to preclude an intermittent HUD FAIL signal from complicating the computed release sequence.

If HUD failure occurs after OAP designation, further designation is not necessary. The attack may be completed using the ADI bank steering bar to indicate azimuth steering error and to perform a level or dive delivery with pullup initiated at release or as required to provide ground/blast avoidance.

BOMB-ON-COORDINATES MODE.

BOMB-ON-COORDINATES (BOC) attack mode should be used against radar reflective targets with known coordinates when there is little possibility of visual acquisition (i.e., dark night or low ceiling and visibility). The target coordinates, altitude, and MSLP must be inserted into the computer. In the event the target cannot be acquired on radar or with laser seeker equipment, the computer will bomb on the coordinates recorded. If visual contact can be established with a geographic position whose coordinates are known and inserted in the computer, the automatic flyover update feature with automatic error entry (available only in this mode) provides additional assistance in target acquisition and identification. If flyover update is to be used, the coordinates of the geographic position must be recorded under a separate destination number.

DEST 0/MARK 0 is used to attack targets of opportunity which are radar reflective or for which a laser designator is available to provide illumination.

Initiation (FLY TO DEST 1–9/MARK 1–9 Selected).

Initiation is accomplished by selecting a station with a computed bomb or bomb type CBU ASCU code, depressing the BOC master function switch, and selecting the target's DEST/MARK number on the FLY TO controls. At mode entry, the target is defined to the NAV WD Computer by the coordinates previously entered under the selected DEST/MARK number. If the FLR signal data converter (SDC) is on and reliable at mode selection, autodesignation occurs at a range of up to 80 nmi. If the FLR SDC is off or failed at mode selection, autodesignation occurs at 30 nmi.

When the target is more than 80 nmi in front of the aircraft, or is behind the aircraft, and the FLR SDC is on and reliable, the azimuth steering line (ASL) replaces the flight director on the HUD and provides azimuth steering to the selected target. The HUD aiming symbol (AS) is not displayed during this phase, radar cursors are not present, and the FLR will continue to function in the mode previously selected. When within 80 nmi of a target in front of the aircraft, and with the FLR SDC on and reliable, the FLR will automatically switch to Ground Map Pencil (GMP) mode, unless already in the Ground Map Spoiled (GMS) mode, the HUD AS is displayed over the computed target location (if within the HUD field-of-view), and the target is automatically designated. At this time, the ASL is positioned midway between the target (HUD AS) and the flightpath marker (FPM) to indicate azimuth steering error. The FLR range and azimuth cursors are enabled and ground stabilized on the computed target location and slewing is allowed. The pullup anticipation cue is also present in the HUD FOV. However, the HUD solution cues are not displayed until the target slant range is less than 60,000 feet.

When the target is beyond 30 nmi or behind the aircraft and the FLR SDC is off or failed, the HUD ASL indicates azimuth steering to the target but the HUD AS is not displayed. Inside 30 nmi, the HUD AS will overlie the target when the target is inside the HUD FOV. Radar cursors are not present and slewing is not allowed. Inside 20 nmi, depending on the exact FLR problem being encountered, radar cursors may be present and slewing allowed.

See figure 1-26 for a view of the HUD and radar displays.

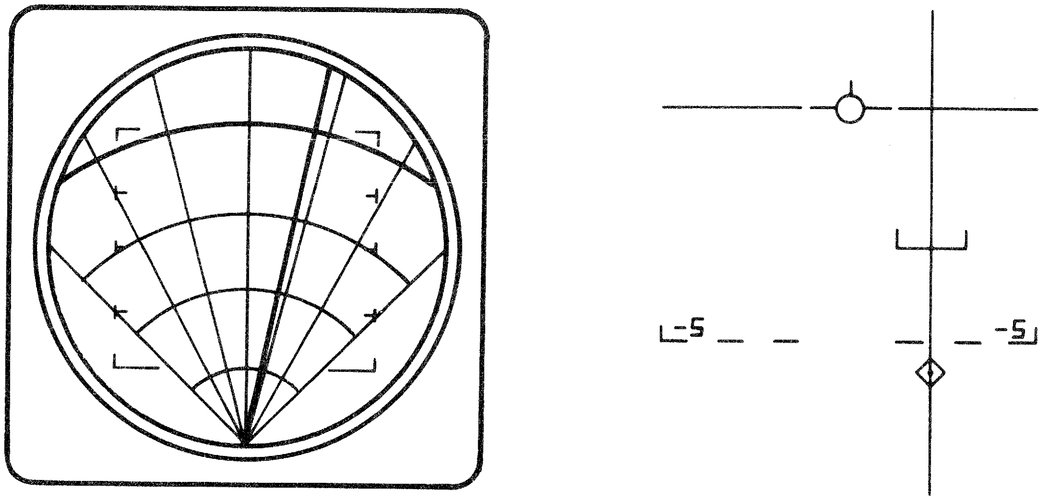
The aiming symbol and the radar cursor intersection indicate the same ground location, but the aiming symbol may not appear to be precisely on the point overlayed by the cursors because of altitude or boresight errors. If HUD and IMS boresight and platform alignment are correct, the aiming symbol position indicates LOS to the location actually designated. Apparent errors in azimuth result from incorrect cursor placement or bias in azimuth cursor boresight. Apparent errors in range result from incorrect range cursor placement or incorrect altitude solution by the computer.

Video positioning has no effect on weapon delivery accuracy; it only applies to video and cursor positioning relative to the scope face scribe marks. A video positioning error means that the horizontal distance of a particular return is not the same distance indicated by the range lines etched on the scope face. The cursors are subject to the same positioning error as video; therefore, there is no error between the cursors and the displayed video. The distance above the ground is subtracted from the scope presentation at the scope vertex by radar hardware. The video display is moved in closer to the aircraft by an amount equal to the distance above the ground. The distance above the ground is determined from the radar altimeter if it is locked on or from the air data computer (ADC). When the radar altimeter is not locked on, the radar receives altitude information from the ADC and assumes the ground is at sea level/29.92 inHg. When performing BOC attack with barometric altitude ranging, no bombing errors will result due to video positioning errors since the system is using inserted target altitude to determine height-above-target for the weapon. See figure 1-27.

Initiation (FLY TO DEST 0/MARK 0 Selected).

In BOC mode with DEST 0/MARK 0 selected on the fly to controls, the FLR will automatically switch to Ground Map Pencil (GMP) mode unless already in the Ground Map Spoiled (GMS) mode. The FLR range cursor appears at a fixed range of 8 nmi and the FLR azimuth cursor and HSI azimuth bearing pointer at 0° relative azimuth at mode entry. Slewing is enabled and the FLR cursors and HUD AS can be slewed out to 80 nmi (FLR SDC reliable) or 20 nmi (FLR SDC failed) and to ±45° in azimuth. Slewing the FLR cursors prior

SYMBOLOGY AND PPI DISPLAY AT SELECTION OF BOC



Forward Looking Radar in ground map mode.

Cursors appear ground stabilized over destination or mark position selected on FLY TO thumbwheel. Range cursor limited to 80 nautical miles by PPI display. If DEST 0/MARK 0 is selected on FLY TO switches, range cursor appears at eight nautical miles and azimuth cursor appears along the ground track. Cursors are not ground stabilized.

Azimuth steering line appears on HUD and is slaved to aiming symbol.

Aiming symbol (flashing) appears over target location defined by cursor position.

Solution cues do not appear.

Pullup anticipation cue is positioned on azimuth steering line.

78K035—08—80

Figure 1-26

to target designation causes the cursors to freeze to the new location (not ground stabilized) at each slew termination. Target designation is accomplished manually (no autodesignate) using either the target designate button or armament release button. The FLR cursors and HUD AS are ground stabilized at this point and start tracking the designated target. Pressing the target designate button a second time, undesignates the target and returns the FLR azimuth cursor to 0° relative bearing. However, the FLR range cursor remains fixed at the undesignation range. Once undesignation has occurred, either the BOC MFS must be deselected and reselected or the selection on the FLY TO thumbwheel must be changed momentarily to regain the mode initial cursor positions (0° and 8 nmi).

Target altitude and MSLP data can be entered for fly to DEST/MARK 0 (memory destinations 00 and 10). The values entered for one destination (00 or 10) also apply to the other destination. (It is not possible to store two different sets of values at the same time for these two destinations.) The correct altitude and MSLP values for the target area must be manually entered under DEST/MARK 0 to ensure accurate barometric ranging.

At predesignate and preslew, the HSI and PMDS range and bearing displays and time-on-target (Data Address 31) display operate as follows:

1. The HSI range display is 1048 (48,000 feet) and the PMDS range display is 048 (48,000 feet).

2. The bearing pointers display 0°. groundspeed.

3. The time-on-target value displayed in the upper window of Data Address 31 will differ from the clock time displayed in the lower window by the time required to fly 48,000 feet at the current

At postdesignate or postslew, the HSI and PMDS range displays always indicate the distance to the FLR range cursor. (Display is in 1,000-foot increments if range is less than 10 nmi.) The HSI and PMDS bearing pointers display the same relative bearing as the FLR azimuth cursor. The Data Address 31 time-on-target value now displays time to go to the current target (FLR cursor intersection).

PRESENTATION OF FLR VIDEO

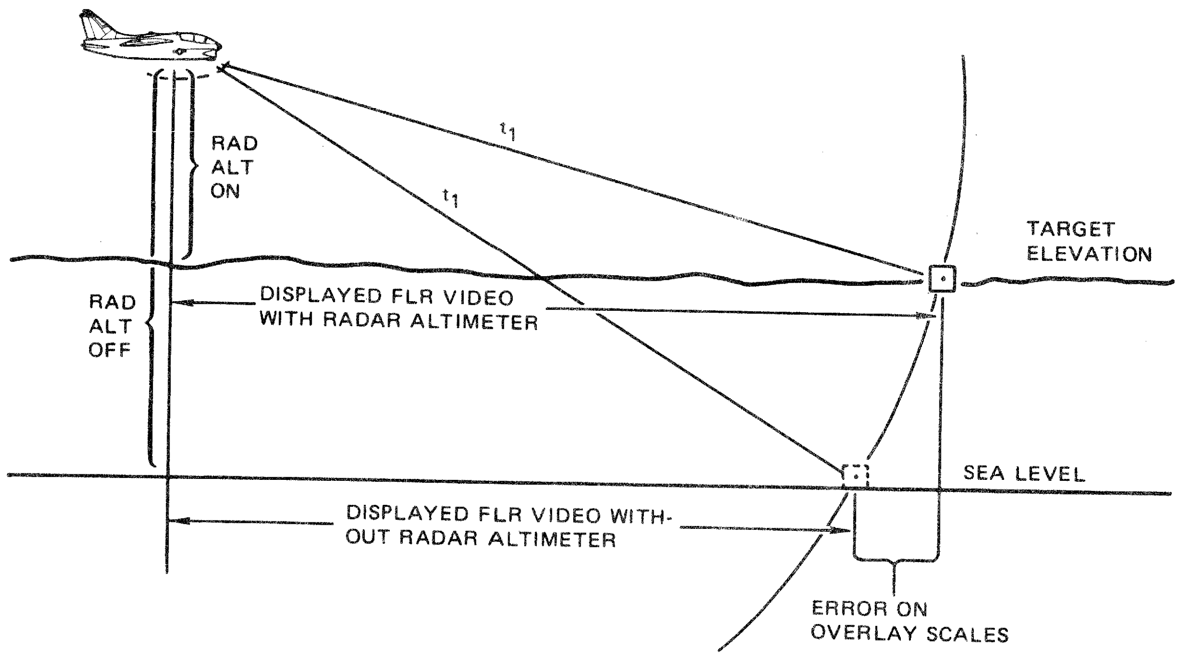


Figure 1-27

With TISL selected, designation occurs automatically upon receipt of a valid track signal from the TISL system, and the radar cursors and aiming symbol will move to overlay the position of the laser signal, provided target designation has not been previously performed.

Aiming.

In BOC, aiming (figure 1-28) should be performed with the FLR cursors and not the HUD aiming symbol as the slew control sensitivity is scaled for cursor movement. The cursors are moved by the Bullpup controller over 45° of sweep on the scope much faster than the slew rate of the aiming symbol across the 11° field of view of the HUD. Thus, it is difficult to position the aiming symbol precisely in azimuth while in BOC. Also, if there is an error from the altitude sensor in priority, the error will be magnified when aiming is performed using the HUD aiming symbol.

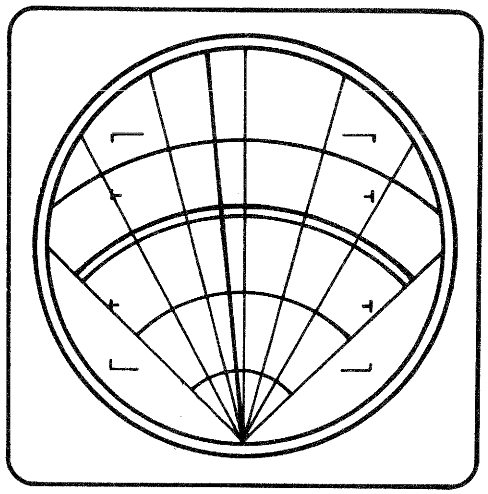
WARNING

Do not depress master function attack mode switches with the armament release button depressed. Unintentional release may occur if the armament release button is depressed while switching from one mode to another.

If unexpected visual-contact with the target is established, VISUAL ATTACK may be selected to permit visual aim refinement (this will not require redesignation of the target). If this mode change is made, it should be made directly by depressing the VISUAL ATTACK master function switch. This will cause the BOC master function switch light to go out and cause

SYMBOLOGY AND PPI DISPLAY FOR BOC – AIMING

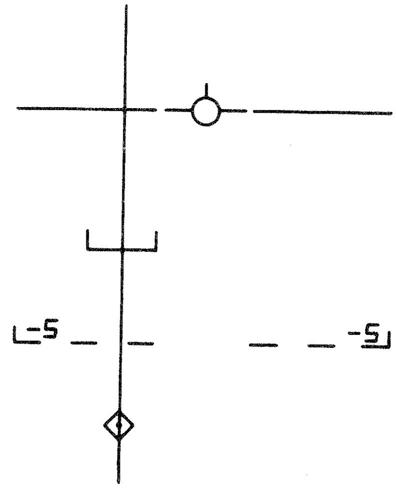
CURSOR AND AIMING SYMBOL SLEWING



Forward Looking Radar remains in ground map mode.

Bullpup controller moves radar cursor intersection.

After designation, cursors are ground stabilized.



Flashing aiming symbol moves with cursors and is ground stabilized.

Azimuth steering line moves with aiming symbol.

Solution cues do not appear.

78K036–08–80

Figure 1-28

immediate mode changeover, including FLR mode change to slaved AGR.

The FLR cursors indicate the computed target location and the radar should be tuned to optimize the returns in that area. Slewing should not be performed until the target return has been identified. When the exact target position has been located on the scope, the cursors should be slewed to precisely overlay the target. Proper cursor placement for best accuracy against a small hard target return is with the near (bottom) edge of the range cursor overlaying the near (bottom) edge of the target return and the center of the azimuth cursor overlaying the center of the near edge of the target return.

With TISL selected, the laser seeker will search in a ± 10° azimuth, ±4° elevation search pattern about the cursor intersection. Upon receipt of a properly coded laser signal, the seeker will lock on to the laser designated target and display the location of the target on the HUD. If target designation has not previously occurred, it will occur automatically at this time and the aiming symbol and cursor intersection will move to overlay the laser signal's ground location.

If target designation has occurred previously, the laser symbol will appear, but the aiming symbol and cursor intersection will not automatically move to the laser symbol location; the pilot must manually slew them there. This allows rejection of the laser information by continuing the attack on the previously computed target location. If the cursor intersection is slewed to the laser symbol location and locked on the symbol, the computer will use the coordinates established by the laser symbol position. From this point, the computer will dead reckon the computed target position.

If the aiming symbol moves away from the laser symbol due to drift or system errors, the pilot may redesignate and force the aiming symbol back to the laser symbol without slewing. However, this requires that the TISL equipment maintain a good track and lock-on. If the laser signal is lost and the pilot redesignates, the NAV WD Computer will revert to its original computed target location, and all inputs from the TISL are lost.

If the target location passes out of the HUD field of view (FOV), the laser symbol will move to the edge of the FOV and flash, indicating continuing lock and tracking by the laser system. If the laser symbol disappears from the HUD, the laser signal has been lost and the NAV WD Computer has reverted to the basic BOC mode, using the last designated position as the computed target location.

Automatic Flyover Update Entry.

The designate button can be used in the BOC mode (DEST 1–9/MARK 1–9) if the flyover update with automatic error entry capability is to be used. This capability is designed to be used over a preprogrammed update point before beginning the final attack. To use the flyover update with automatic error entry function, proceed as follows:

NOTE

Automatic flyover update cannot be used with DEST 0/MARK 0 selected on FLY TO thumbwheel or when the TISL system is selected and has achieved a lock-on (laser symbol present on HUD).

1. Update thumbwheel — FLYOVER
2. Present position toggle switch — UPDATE
3. Rotary mode selector switch — PRES POS
4. Keyboard panel — recall previously recorded destination number for the geographic position
5. When over the geographic position — DESIGNATE

It is not necessary to enter the error; update is automatic with designation. (If the pilot does not desire to update over the geographic position, proceed to the target, using HUD or ADI steering commands, but do not designate.) A quick check can be made to determine if the update error has been accepted by observing the blink of the ASL and aiming symbol at designation. Present position will also integrate on the NAV WD Computer control panel.

The computer retains the destination selected by the FLY TO switches as the BOC target and uses the preprogrammed update destination only for update purposes. Once the target coordinates have been identified to the computer, only deselecting the attack mode, usage of a laser signal, or changing the position of the FLY TO switches will change the designated target.

Deselecting the attack mode reverts the system to navigation computation. Usage of a laser signal for target location information is within the parameters of the NAV WD Computer program and has the effect of changing the coordinates entered under the destination/MARK number selected on the FLY TO switches. Changing the position of the FLY TO switches (either switch) reidentifies the target location to the computer and the computer will direct attack to the new target location.

Delivery.

When in a designated condition, the ASL is between the FPM and the aiming symbol and indicates azimuth steering error. The vertical pointer on the ADI also indicates steering error if the HDG MODE switch is in AUTO NAV. The HSI No. 1 pointer and mileage indicator will indicate the relative position and range of the target. The azimuth error should be zeroed out by steering the aircraft to place the FPM on the ASL or to center the bank steering bar on the ADI. Any apparent error in cursor placement should be corrected with the Bullpup controller.

If the target cannot be identified or no apparent error in cursor placement can be determined, the cursor should not be slewed and the delivery may be completed on the computed target coordinates. When the target is in range, the solution cues appear and delivery is completed as in the VISUAL ATTACK bomb mode.

If the target becomes visible, attack mode change to VISUAL ATTACK will allow visual aiming refinement. This mode change should be made directly by depressing the VISUAL ATTACK master function switch. This will cause the BOC function switch light to go out and effect immediate mode changeover. Sufficient time should be allowed (approximately 2 seconds) after mode change for FLR shifting from ground map mode to AGR mode and aim refinement.

WARNING

Do not depress master function attack mode switches with the armament release button depressed. Unintentional release may occur if the armament release button is depressed while switching from one mode to another.

NOTE

If the mode change is not made directly as described previously but is made instead by deselecting the BOC master function switch and then selecting VISUAL ATTACK, a maximum of 1.6 seconds is allowable between deselection and selection before target designation is lost.

Backup Mode for HUD Failure.

The only effects HUD failure has when using the BOC mode are the use of the ADI bank steering bar instead of the HUD azimuth steering line to indicate azimuth steering error and the lack of solution cues to indicate impending release. Aiming, designation, and weapon delivery are otherwise not affected by lack of HUD symbology.

BOC OFFSET MODE.

BOC OFFSET mode should be used against targets whose location is known in relation to some prominent radar reflective point which is used as an offset aimpoint (OAP). The data to be inserted consists of OAP coordinates, offset range and true bearing from the OAP to the target, and the Δ height between the OAP and target. OAP altitude and MSLP should be inserted, using the OAP data destination number, in the event of reversion to the barometric altitude ranging mode.

Initiation (FLY TO DEST 1–9/MARK 1–8 Selected).

Initiation is accomplished by selecting a station with a computed bomb type or CBU type ASCU code, depressing the BOC and OFFSET master function switches and selecting the OAP destination number (DEST 1–9/MARK 1–8) on the FLY TO controls. (The BOC OFFSET mode is not legal with DEST 0 or MARK 0 or 9 selected on the FLY TO controls.) At mode entry, the OAP is defined to the NAV WD Computer by the data previously entered under the selected DEST/MARK number.

The in-range point in the BOC OFFSET mode is controlled by the condition of the FLR signal data converter (SDC). With the FLR SDC on and reliable, in-range transition occurs at 80 nmi. If the FLR SDC is off or failed, the in-range transition point is 30 nmi.

When the OAP is more than 80 nmi in front of the aircraft (with the FLR SDC on and reliable) or the OAP is behind the aircraft, the azimuth steering line (ASL) replaces the flight director in the HUD field-of-view (FOV) and indicates azimuth steering to the selected OAP. The HUD aiming symbol (AS) is not displayed, radar cursors do not appear, and the FLR continues to function in the mode previously selected.

When within 80 nmi of an OAP in front of the aircraft (with FLR SDC on and reliable), the FLR will automatically switch to ground map pencil (GMP) mode, unless already in ground map spoiled (GMS) mode, the radar azimuth and range cursors are enabled and ground stabilized on the OAP location, and slewing is enabled. The HUD AS is displayed over the computed OAP location and the ASL continues to provide steering information to the OAP. The pullup anticipation cue (PUAC) is also displayed in the HUD FOV; however, the solution cues do not appear until the target slant range is less than 60,000 feet.

When the OAP is more than 30 nmi in front of the aircraft (with FLR SDC off or failed) or behind the aircraft, the ASL indicates azimuth steering to the OAP but the HUD AS is not displayed. Inside 30 nmi, the AS will appear in the HUD FOV over the computed location of the OAP and the ASL will continue to provide azimuth steering to the OAP. At target designation (by use of target designate button or armament release button), the AS will move to overlie the target and the ASL will display steering to the target rather than the OAP. Radar cursors are not present and slewing is not allowed. Inside 20 nmi, depending on the exact FLR problem being encountered, radar cursors may be present and slewing allowed.

NOTE

In the BOC OFFSET mode, the offset aimpoint must be designated for the NAV WD Computer to provide steering commands to the target.

Target designation is accomplished manually via the target designate button or armament release button (no autodesignate). At designate, the HUD AS moves from the OAP to the target and the HUD ASL indicates azimuth steering to the target. The radar GMP/GMS display is retained subsequent to designate and the azimuth and range cursors remain on the OAP. This allows for continuous monitoring of the relationship between the cursor intersection and the OAP and permits refinement of the cursor position if necessary.

The aiming symbol and the radar cursor intersection indicate the same ground location, but the aiming symbol may not appear to be precisely on the point overlayed by the cursors because of altitude or boresight errors. If HUD and IMS boresight and platform alignment are correct, the aiming symbol position indicates LOS to the location actually designated to the NAV WD Computer. Apparent errors in azimuth result from incorrect cursor placement or bias in azimuth cursor boresight. Apparent errors in range result from incorrect range cursor placement or incorrect altitude solution by the computer.

Video positioning has no effect on weapon delivery accuracy; it only applies to video and cursor positioning relative to the scope face scribe marks. A video positioning error means that the horizontal distance of a particular return is not the same distance indicated by the range lines etched on the scope face. The cursors are subject to the same positioning error as video; therefore, there is no error between the cursors and the displayed video. The distance above the ground is subtracted from the scope presentation at the scope vertex by radar hardware. The video display is moved in closer to the aircraft by an amount equal to the distance above the ground. The distance above the ground is determined from the radar altimeter if it is locked on. When the radar altimeter is not locked on, the radar receives altitude information from the ADC and assumes the ground is at sea level/29.92 inHg. When performing a BOC OFFSET attack with barometric altitude ranging, no bombing errors will result due to video positioning errors since the system is using inserted target altitude to determine height-above-target for the weapon.

Aiming.

In BOC OFFSET, aiming should be performed with the radar cursors and not the HUD aiming symbol, as the slew control sensitivity is scaled for cursor movement. The cursors are moved (by the Bullpup controller) over 45° of sweep on the scope much faster than the slew rate of the aiming symbol across the 11° of the HUD. Thus, it is difficult to position the aiming symbol precisely in azimuth in the BOC OFFSET mode.

The radar cursors indicate the computed OAP location and the radar should be tuned to optimize the return in that area. Slewing should not be performed until the OAP return has been identified. When the exact OAP position has been located the cursors should be slewed to precisely overlay the OAP. Proper cursor placement for best accuracy against a small hard OAP return is with the near (bottom) edge of the range cursor overlaying the near (bottom) edge of the OAP return and the center of the azimuth cursor overlaying the center of the near edge of the OAP return.

If slewing is attempted after the OAP is overflown and the target is behind the aircraft, the slewing commands are reversed (i.e., moving the BPC right moves the AS left). When the OAP is behind the aircraft (OAP relative bearing equal to or greater than 90°), the range cursor and azimuth cursor are removed from the FLR indicator display.

Designation.

If the OAP cannot be identified or no apparent error in cursor placement can be determined, the cursors should not be slewed and designation can be completed on the computer OAP location. At OAP designation, the HUD aiming symbol moves to the computed target position, ground mapping is continued, and the FLR cursors remain stabilized on the OAP. The ASL is slaved to the aiming symbol and indicates azimuth steering error to the target. If the HDG MODE switch is in AUTO NAV, the ADI bank steering bar will indicate azimuth steering error to the target. The HSI will display range and relative bearing (No. 1 pointer) to the target.

Delivery.

Radar cursor position refinement on the OAP can be accomplished right up to weapon release. Release is inhibited during cursor slewing to allow the computer time to reposition the target. If the target becomes visible, attack mode change to VISUAL ATTACK will allow visual aiming refinement. This mode change should be made directly by depressing the VISUAL ATTACK master function switch. This will cause the BOC and OFFSET function switch lights to go out and effect immediate mode changeover. Sufficient time should be allowed (approximately 2 seconds) after mode change for FLR shifting from ground map mode to AGR mode and aim refinement.

WARNING

Do not depress master function attack mode switches with the armament release button depressed. Unintentional release may occur if the armament release button is depressed while switching from one mode to another.

NOTE

If the mode change is not made directly as described previously but is made instead by deselecting the two master function switches and then selecting VISUAL ATTACK, a maximum of 1.6 seconds is allowable between deselection and selection before target designation is lost.

Reattack and Delivery Variations.

Reattack capability, HUD symbology, and delivery variations are identical to VISUAL ATTACK mode. If redesignation is required, redesignation must be on the OAP and not the target, even though the target may be visible. If the target has become visible, change to VISUAL ATTACK may be accomplished, if desired.

Backup Mode for HUD Failure.

The only effects HUD failure has when using the BOC OFFSET mode are the use of the ADI bank steering bar instead of the HUD azimuth steering line to indicate azimuth steering error, the lack of solution cues to indicate impending release, and the inability to refine aiming after designation. Aiming, designation, and weapon delivery are otherwise not effected by lack of HUD symbology.

CONTINUOUSLY COMPUTED IMPACT POINT MODE.

The continuously computed impact point (CCIP) mode is selected to display the instantaneous impact point on the ground where a single bomb or the center of a stick of bombs will impact if the bomb(s) was released manually. In the CCIP mode, the aiming symbol is not displayed; the impact point is the intersection of the lower solution cue and the continuously computed impact point steering line (CCIPSL). The pilot depresses the armament release button when the impact point is over the desired target. Figure 1-29 depicts the CCIP mode HUD attack symbology.

WARNING

In CCIP mode, the armament release button is hot. Weapon release will occur any time the armament release button is depressed with master arm selected.

If the computed impact point is greater than 20° below the HUD FOV in elevation or is outside the FOV more than 16° in azimuth, the CCIPSL is centered in the FPM and is parallel to earth vertical and perpendicular to the HUD pitch lines. When the computed impact point is between 11° and 16° in azimuth or 16° and 20° in elevation, the CCIPSL jumps down (extending from +4° above the FPM to −12°below the FPM) to indicate the computed impact is about to enter the HUD FOV. The CCIPSL remains parallel to earth vertical and perpendicular to the HUD pitch lines. The aircraft should then be flown to place the CCIPSL over the intended target. When the computed impact point is less than 11° in azimuth and 16° in elevation, the lower solution cue is displayed and the CCIPSL shifts from the FPM to a position through the solution cue. At this time, the CCIPSL is positioned +12° above and −4° below the solution cue. The CCIPSL is now displayed parallel to the side of the HUD combiner and perpendicular to the solution cue. This feature precludes obscuration of the solution cue in the CCIPSL at bank angles near 90°. The solution cue will move up the CCIPSL as the computed impact point moves toward the center of the HUD FOV. The intersection of the CCIPSL and the solution cue represents the single bomb or the center of a bomb stick if the bombs were released that instant.

The aiming symbol is not displayed in CCIP unless air-to-ground gunnery or rockets is selected. The HUD symbology for guns or rockets in CCIP is the same as the display for VISUAL ATTACK guns or rockets (figure 1-39).

On CCIP mode selection, continuous FLR AGR ranging is requested. If FLR ranging data are invalid, the solution cue does not flash; backup ranging will be controlled by Data 24. The ALT/MSLP data used for backup ranging is the data entered for the destination shown on the FLY TO thumbwheel.

When using the flexible fuze capability of the NAV WD computer program with GP bombs, destructors, and fire bombs, the pullup anticipation cue (PUAC) is used to provide the pilot with fuze arming time/safe escape information. The pilot has only to keep the PUAC below the FPM until weapon release occurs to ensure sufficient fuze arming time or safe escape altitude is available.

For bomb type CBU dispensers with time fuzes installed, the NAV WD computer moves the PUAC based on entries made under Data Addresses 28 and 29. The desired fuze function altitude (Data 29) tells the computer at what point the dispenser is to open. The fuze function time (Data 28) tells the computer how long the dispenser is to fall prior to opening. The computer uses these inputs along with current time of fall calculations to provide steering information by positioning the PUAC relative to the FPM. The fuzing conditions stored in Data Addresses 28 and 29 are satisfied when the PUAC is through the FPM (figure 1-29). Blast and ground avoidance cueing have priority over flexible fuze cueing for PUAC positioning and the pullup command (PUC) is reserved for blast and ground avoidance commands only.

The following are additional characteristics of the CCIP mode:

1. The pullup anticipation cue is displayed directly below the FPM, not on the CCIPSL. Pullup anticipation cue functions are the same as in VISUAL ATTACK.
2. The laser target symbol (LTS) will be present on the HUD display if the TISL is tracking; however, the LTS display is for visual reference only.
3. The CCIP mode cannot be used with GBU-8 series guided (EO) bombs, or AGM-65 missiles.
4. Bomb burst height, if entered for a destination, is ignored.

DELIVERY SYSTEM MANAGEMENT.

The aircraft velocity vector and position relative to the target are the fundamental quantities used to solve for weapon delivery. The NAV WD Computer automatically selects inputs from valid subsystems in accordance with a programmed order of precedence. From these inputs it continuously computes aircraft velocity in three dimensions and position relative to the target. Consistent accuracy can be obtained only by sound management of the weapon system. The accuracy of the computed weapon delivery solution will vary with the accuracy of the velocity and ranging sensor inputs. Various errors may be caused by malfunctions or unfavorable operating conditions. With thorough planning and careful monitoring of subsystem performance, the pilot may eliminate or minimize the effects of these errors.

When all subsystems are operating normally and providing valid data, the computer bases its velocity and ranging solutions on those sensors' first in priority. If the first priority input becomes invalid due to operating conditions or malfunctions, the computer automatically uses the sensor input next in priority in computing the weapon delivery solution. A computed solution may be obtained as long as the NAV WD Computer is operating and receives both of the following minimum inputs:

1. Valid attitude and heading from the IMS.
2. Valid velocity from either the IMS or ADC.

Without these minimum requirements, only a noncomputed delivery is possible. A flow diagram of backup modes is presented in figure 1-30.

In addition to the above requirements, the HUD must be operational in order to perform gun and rocket attacks in the computed mode.

RADAR SCOPE INTERPRETATION.

The pilot must know and understand the factors which will affect the radar presentation in order to make a valid scope interpretation and analysis. In general, light/mirror characteristics are analogous to reflected radar energy. For example, a shiny reflective surface, perpendicular to the flightpath, will reflect the maximum amount of the radar energy and display it on the scope as a bright blip. If this reflective surface is turned either to the side or backward, it will reach an angle where no radar energy will be reflected back toward the aircraft. This causes no-show areas such as water or dry lakes to be displayed on the scope. Radar energy can be absorbed (such as by vegetation) which will also cause a no-show display.

As with a beam of light, different types of surfaces and other variables affect the quantity and quality reflected radar energy and cause different types of displays on the scope. The factors which affect radar reflectivity can be divided into categories, controlled and uncontrolled.

Controlled Factors.

Controlled factors are those which the pilot can vary to adjust the scope presentation.

Receiver gain is probably the most important controllable factor. The ideal gain setting for most land navigation is one that is low enough to eliminate most of the ground clutter yet permits cultural and prominent terrain features to show clearly. To pick out and follow a prominent reflective-type target, the gain should be decreased until the target just starts to disappear, then increased just enough to adequately display the target. This will decrease scope clutter by eliminating all radar returns with reflective strength less than the target of interest. Conversely, when flying over areas of water, dry lakes or rivers a higher gain setting is required to contrast the normal ground clutter with the no-show areas. The latter technique is useful for obtaining mountain shadows at low altitude. Generally, the higher the reflectivity potential of a target or return area, the lower the receiver gain setting needed.

Aircraft altitude and antenna tilt are discussed together since they are interdependent. Altitude and tilt can be extremely significant factors, especially when using the GMP mode with its narrow vertical beam-width. At

CCIP HUD SYMBOLOGY

COMPUTED IMPACT POINT OUTSIDE 16° IN AZIMUTH OR 20° IN ELEVATION

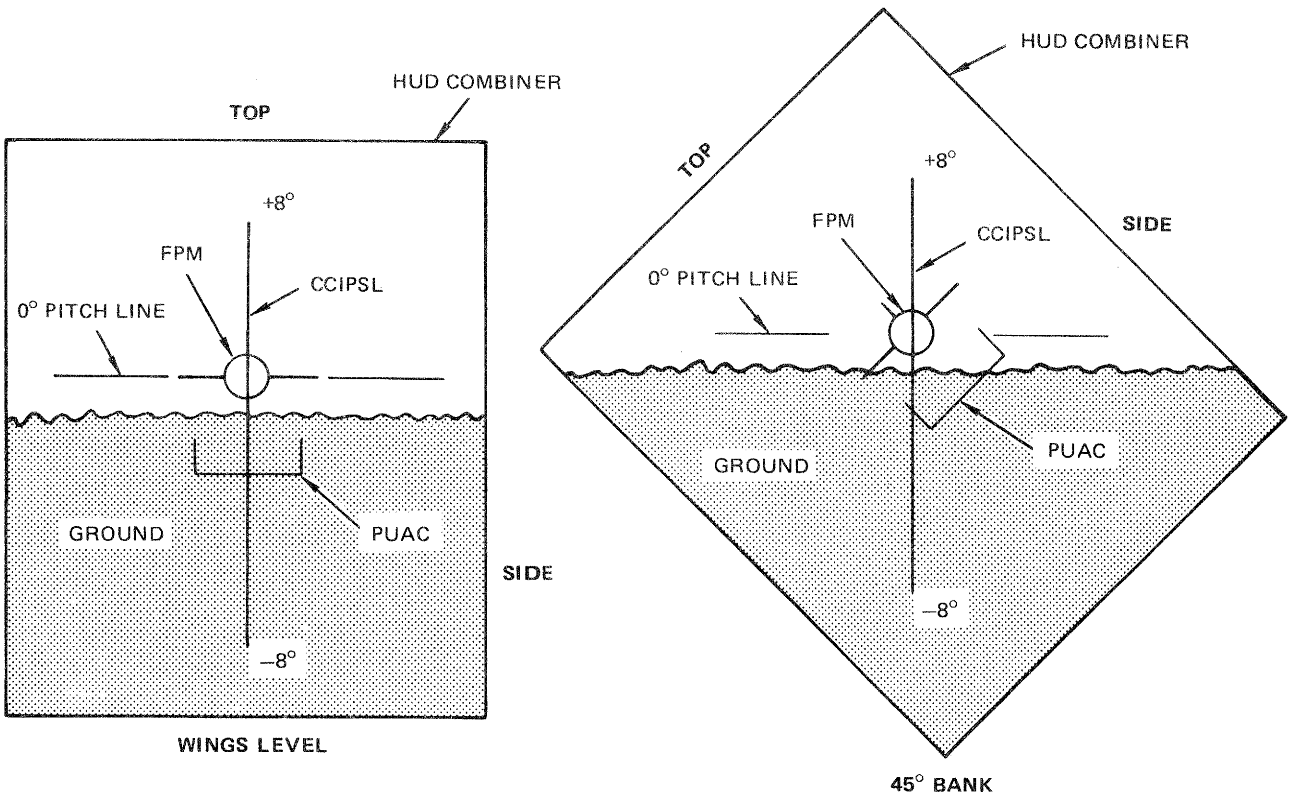


Figure 1-29 (Sheet 1)

CCIP HUD SYMBOLOGY

COMPUTED IMPACT POINT BETWEEN 11° AND 16° IN AZIMUTH OR 16° AND 20° IN ELEVATION

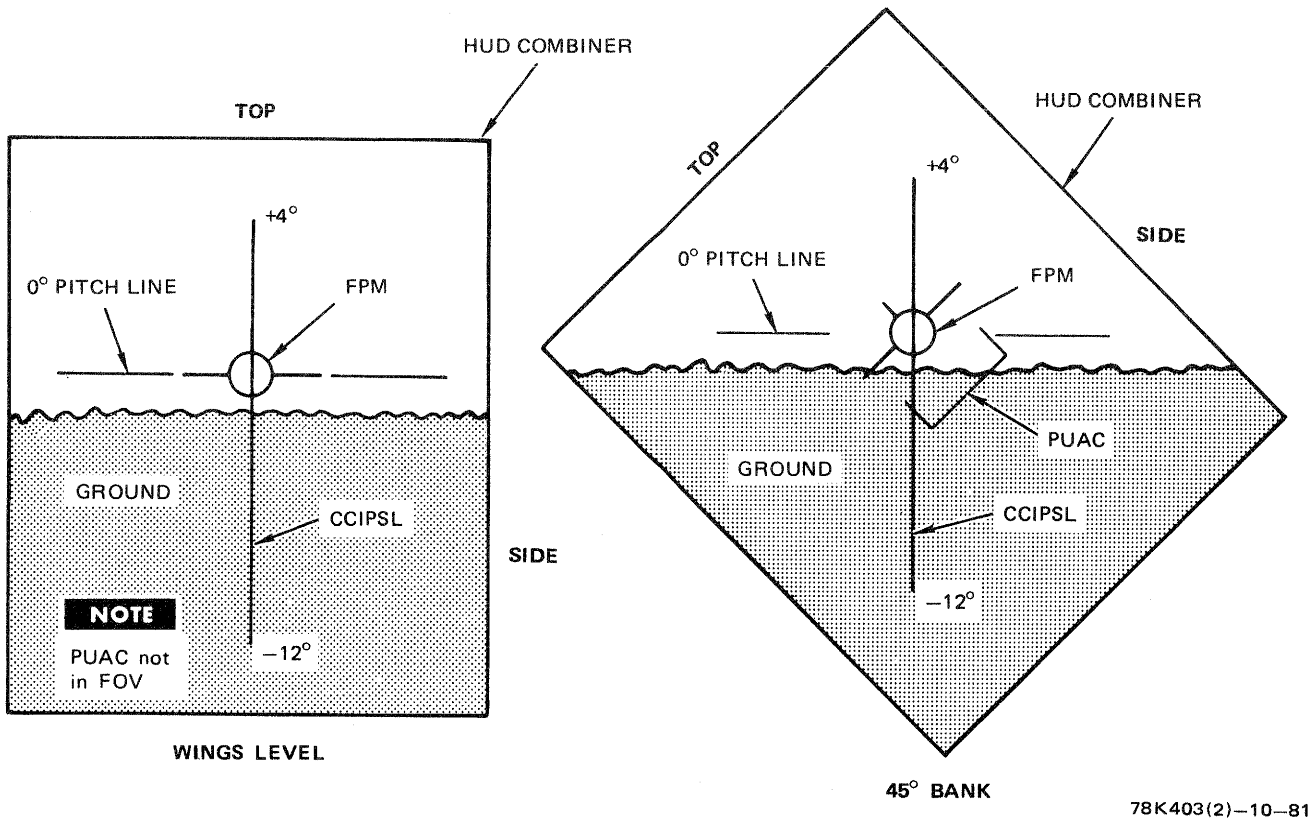


Figure 1-29 (Sheet 2)

CCIP HUD SYMBOLOGY

COMPUTED IMPACT POINT LESS THAN 11° IN AZIMUTH AND 16° IN ELEVATION

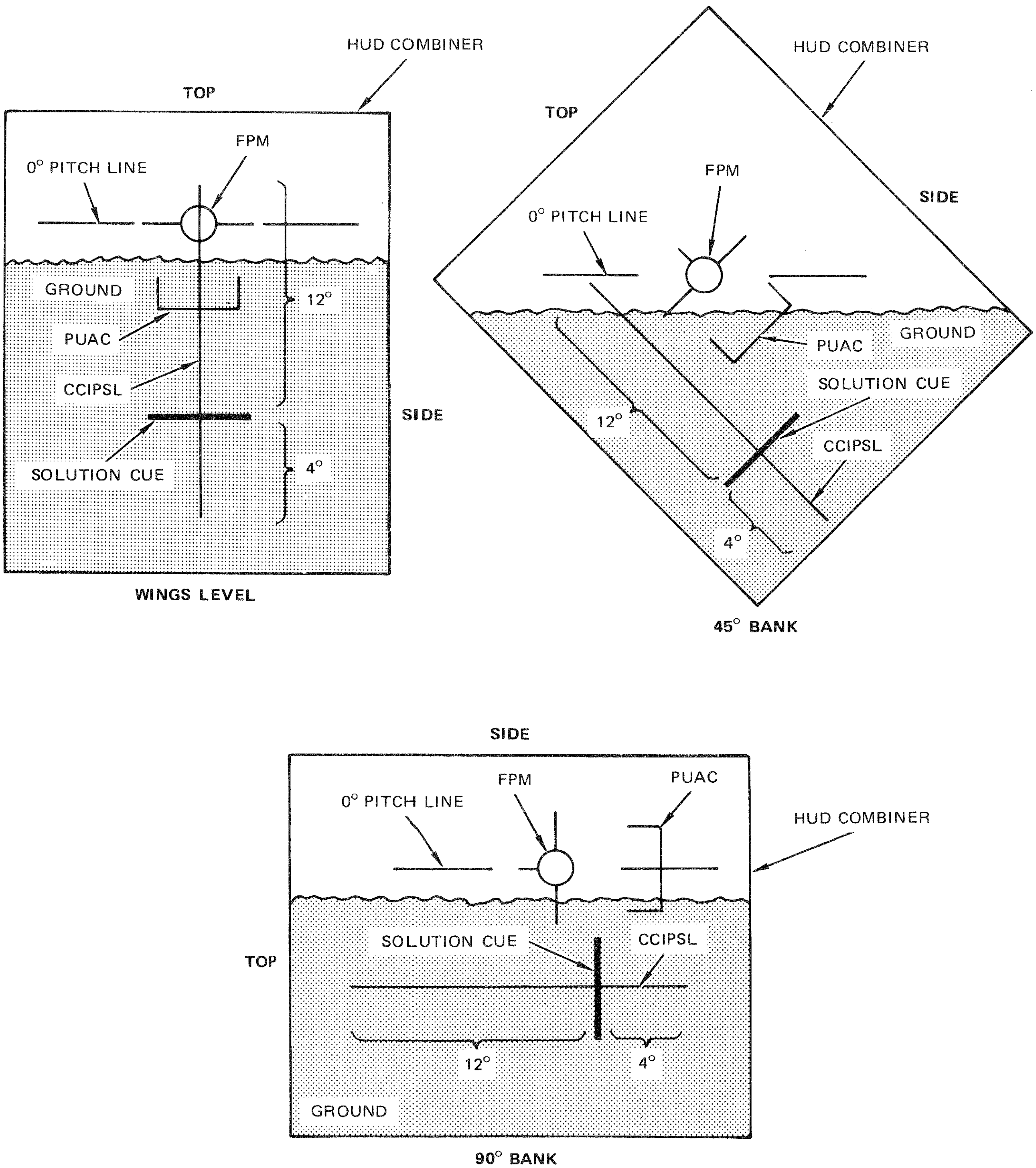


Figure 1-29 (Sheet 3)

CCIP HUD SYMBOLOGY

FLEXIBLE FUZE MODING

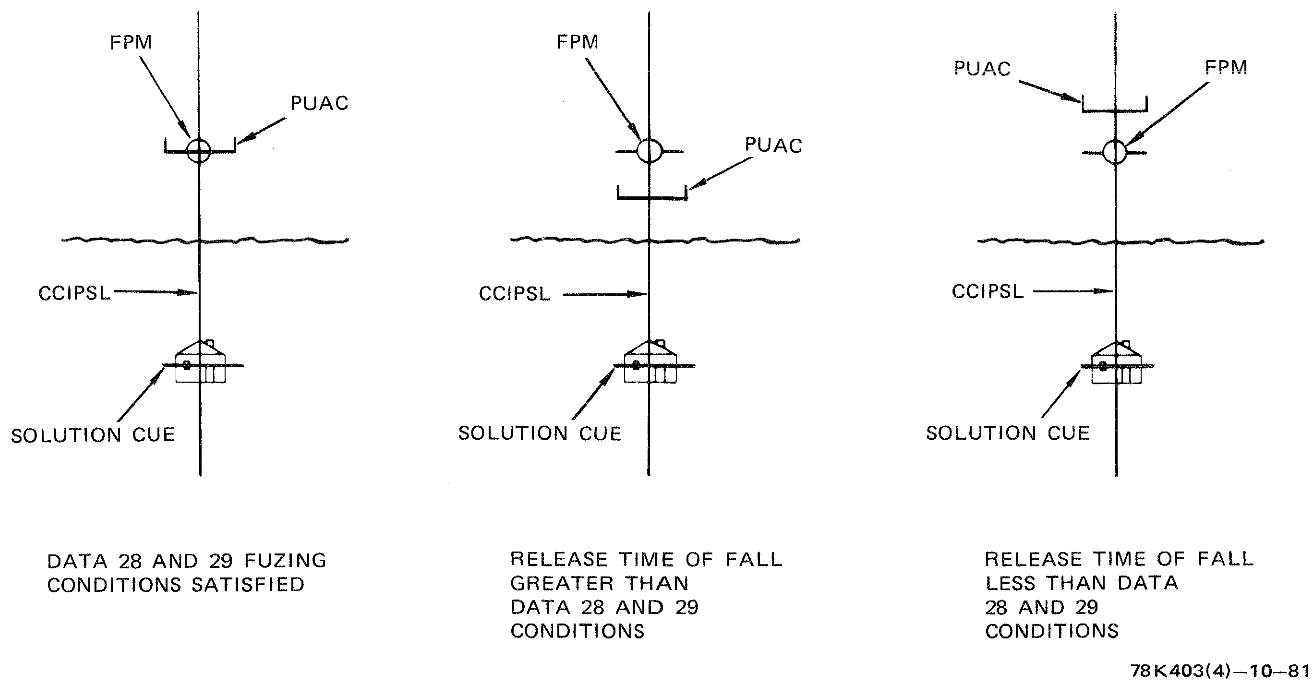
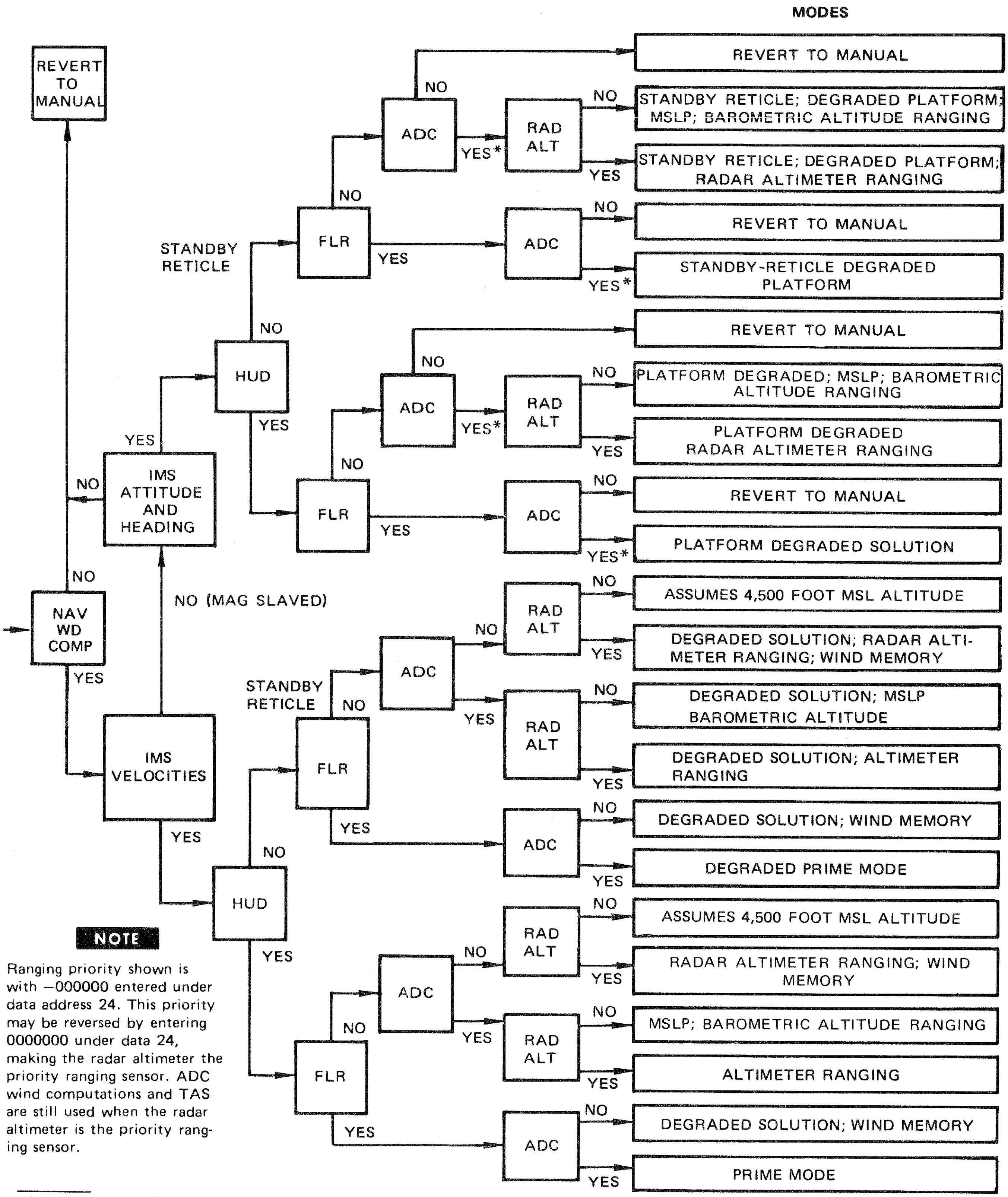


Figure 1-29 (Sheet 4)

WEAPON DELIVERY BACKUP MODES FLOW DIAGRAM



NOTE

Ranging priority shown is with −000000 entered under data address 24. This priority may be reversed by entering 0000000 under data 24, making the radar altimeter the priority ranging sensor. ADC wind computations and TAS are still used when the radar altimeter is the priority ranging sensor.

* If Doppler fails or judged unreasonable, reverts to wind memory mode

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Figure 1-30

lower altitudes, with optimum tilt, the scope should have usable returns over the entire range selected. However, due to line-of-sight limitations at low altitudes, usable ranges will naturally be shorter. As altitude increases, the required increase in antenna down-tilt causes the beam to subtend a smaller area on the ground. In GMP at high altitudes and larger ranges, the return will show as a narrow band on the scope. As the range decreases the pilot workload increases due to continual tilt and receiver gain changes. To ease the workload the GMS mode can be used with some degradation of maximum range.

The axis of attack can affect the type and size of radar returns. For example, the attack heading for a bridge over a river should be nearly parallel to the river for optimum radar acquisition. This provides optimum water and target breakout (especially at low altitude), as the maximum width of the river is available for a no-show return and the largest portion of the bridge will be presented perpendicular to the flightpath for maximum reflected energy. Weapon effect considerations may dictate a compromise in run-in heading. A phenomenon known as the cardinal heading effect may give a target return on a cardinal heading (north, south, east, or west), but not on a 45° subcardinal heading. This is caused by the north/south orientation of many targets, particularly towns.

Aspect angle is defined as the angle between the centerline of the radar sweep and the major axis of a target and is one of the factors which determines radar reflectivity. This effect might cause the whole town to disappear if the approach is made at a heading 45° to all the buildings. This effect may be useful in a complex target area if particular targets are oriented differently than other returns.

Radar range includes both range to target and the range scale used. If the target is properly "spotlighted" with radar energy from the antenna, a change in range scale will not change the amount of energy transmitted to and from the target. A decrease in the range scale increases the scale of the area being observed (i.e., target gets bigger) with a corresponding shift of the target to the top portion of the scope. Receiver gain may require minor initial adjustments after a range scale change, especially when switching from the 20 to the 10 nm scale, due to the increase in sweep rate.

When using a 40 or 80 nm range scale, the amount of video depends on altitude, radar mode (GMP or GMS), tilt, and receiver gain. Large targets are displayed as small returns and multiple targets in close proximity are displayed as one target. Also, given two targets of equal reflectivity, one near and one far away, the return signal strength from the near target is greater than the far target. This causes flooding of the lower portion of the scope when adjusting the gain to observe the far target. Decreasing slant range may change the aspect angle and required tilt, thus changing the amount of reflected energy and requiring reduced receiver gain to keep the target visible.

Linear polarization is used during normal operation as it provides better target resolution. Circular polarization provides an increased capability to penetrate light-to-moderate precipitation with a slight decrease in resolution. Circular polarization can be selected in all modes except GMS and AGR.

Circular polarization responds to asymmetrical targets and cancels the returns of small symmetrical targets such as raindrops. The radar's integrated cancellation ratio allows for the display of large symmetrical returns such as a spherical water tank on top of a tower. If painting a thunderstorm cell in the GMP mode with linear polarization, selecting circular polarization will reduce the apparent cell size since it will display the more dense portion of the cell. At greater ranges (depending on amount of precipitation), circular polarization should eliminate rainfall returns. As range decreases, rainfall returns can cause radar energy saturation and create scope clutter. Once inside the rain shower, ground mapping can be seriously degraded by scope clutter saturation. Circular polarization will usually not cancel hail returns. Generally speaking, if you cannot see through it in circular polarization, you probably should not fly through it. Circular polarization will not help in situations of reduced visibility due to haze, dust, blowing sand, etc.

Uncontrolled Factors.

Factors over which the pilot has no control are target size, shape, and composition. A large target will generally give a larger return. Returned energy from a V-type target will be highest if approached from the open end. Denser material targets will give the best returns. Although uncontrollable, a thorough knowledge of these factors and their effects will permit the pilot to optimize his approach heading and altitude.

Civilian and military airfields are usually excellent radar targets due to the large concentration of metals and concrete used in their construction. At long ranges, building concentrations associated with airfields will probably provide the first radar returns since the runway no-show areas will be lost in the ground clutter. At low altitudes and close ranges the airfield layout should be visible, with the runway producing a no-show return using high receiver gain. Buildings should break out when the receiver gain is decreased.

Large and medium cities produce excellent radar returns. Receiver gain settings are critical in breaking out individual areas within a large city complex. Industrial areas have a high return potential and require a low receiver gain setting to make them stand out from the surrounding return. Increasing the receiver gain slightly will bring in the commercial areas. Radar return for residential areas varies greatly in different parts of the world due to differing climates and building construction. The amount of foliage and vegetation in a residential area will also vary the strength of the return.

In open terrain away from cities, railroads and highways usually do not show up on radar unless the run-in heading is favorable. Railroad marshalling yards have a high signal potential depending on the number of tracks in the yard, but the cardinal heading effect must be considered. The marshalling yard return can also change drastically depending on the rolling stock population at the time. Some large power lines may produce returns if the aspect angle is favorable; however, they should not be relied upon. Large bridges are good radar reflectors, especially when seen against a water background. As previously indicated, a bridge will show best when approached at right angles. Small bridges may not show regardless of axis of attack. Wharves, piers, and breakwaters will generally show against a water background regardless of the type of construction. These returns make excellent checkpoints for updates, OAP's, and cross-checks of navigation accuracy. Power distribution substations in open terrain provide good returns from any direction due to their construction.

Mountains are good reflectors of radar energy. The steeper the slopes of the mountain, the greater the return. The near side of a mountain range produces a bright return with a shadow area of no return behind it. When flying above the mountain the shadow becomes shorter as altitude increases or as the range to the mountain decreases. The distinctive shadows cast by mountain peaks are significant reference points when navigating at low altitude. If using a mountain shadow for orientation increase the receiver gain to provide a distinct no return shadow on the scope. Rolling or flat terrain yields little return. When tuning the scope in this environment, adjust the receiver gain until the scope starts to flood, then back off the receiver gain until the desired cultural returns are visible.

Ground vegetation, such as trees, will absorb radar energy and can serve as an effective shield for targets which normally are reflective. Generally, towns or a large group of structures in the open are quite easy to find on radar. However, if the towns are surrounded by trees or have tree-lined streets, they may be virtually invisible on radar. Vegetation can also hide no-show returns such as small rivers, etc.

Large rivers will show as depicted on the map. The water area will be black in contrast to the surrounding ground return. If approached at a right angle, at low altitude, and a low grazing angle, even a large river or other no-show area may be reduced in apparent size so it is lost in the ground clutter. Many times when approaching a river at right angles, most of the river will be masked, but if the opposite shore has any reflectivity, the radar will present that opposite side as a very bright return.

Lakes usually appear as a no-show area with the same shape depicted on the map. In mountainous areas, the shape of a lake is often obscured by mountain shadow and the two types of no-show returns can be confus d. With a reduced gain setting, the lake can sometimes be distinguished by the bright return from its far side. The bright return from a mountain range will be from the near slope. As range decreases, a lake no-show will retain its shape while a mountain shadow will become smaller.

Anything with a water background should produce excellent navigational information. However, small lakes, rivers, reservoirs, and other similar checkpoints should be used with caution as they may not always show as depicted on the map or, if dry, may not show at all.

Unusual radar returns may occasionally be seen on the scope and may be caused by weather, climatic conditions, radar interference, and/or jamming. Weather may look like mountains and confuse the navigation problem. Switching to circular polarization in GMP should help eliminate all but the heaviest weather returns. Raising the tilt (in the GMP mode) above the land return will also show only the weather. In northern areas, a situation may occur where land appears as water and vice versa due to the smooth, level, inland snow reflecting the radar signal away from the aircraft. The jagged edges of pack-ice or frozen choppy lakes may also produce returns in the no-show areas of the snow covered land mass. Caution must be used when operating in this environment.

RANGE SENSOR MANAGEMENT.

The aircraft position relative to the target is derived by solving the range triangle as shown in figure 1-31. The NAV WD Computer accepts the priority range sensor which defines two of the parameters of the triangle, with the remaining parameters computed as needed for the weapon delivery problem. Figure 1-31 defines the ranging triangle and shows which parameters are sensor inputs and which are computed, depending on attack mode selection and sensor input availability.

If more than one range sensor input is available, the computer will select one for use according to a programmed order of precedence. This order of precedence for the different attack modes is shown in figure 1-32. The relative priority of the radar altimeter and the barometric altimeter is pilot selectable via an entry in the NAV WD Computer under Data Address 24. If −000000 (minus six zeros) is entered in Data 24, the ADC (barometric) altitude will have precedence over the radar altimeter input. If 0000000 (seven zeros) is entered in Data 24, the radar altimeter will have precedence over ADC altitude (after seven zeros are entered, the display will contain six zeros). Turning the Computer on, entry of present position or performing Computer self-test will cause −000000 to be automatically entered under Data 24, making the ADC altitude the priority altitude measurement. Regardless of what is entered in Data 24, the Forward-Looking Radar (FLR) range input will have precedence if it is available and the selected attack mode utilizes FLR ranging data.

NOTE

> Data Address 24 is not automatically set to −000000 at powerup if the computer is turned on after completion of IMS coarse alignment. Therefore, if entry of present position or computer self-test is not performed, it is recommended that the pilot verify that Data 24 is in the desired state.

Forward-Looking Radar Ranging Mode.

The FLR will be used to measure the slant range side of the ranging triangle if the selected attack mode requests FLR ranging data and certain conditions are met. The modes that utilize FLR ranging data are VISUAL ATTACK, VISUAL ATTACK OFFSET, and CCIP. The conditions that must be met before FLR ranging data will be used are:

1. FLR range valid
2. FLR grazing (line of sight) angle greater than 4°
3. Aircraft roll angle less than 40°
4. Aiming symbol in HUD field of view
5. FLR range between 1,344 and 52,672 feet

If FLR ranging data is requested by the computer but is not available because one of the above conditions is not met, the HUD solution cues will be flashed and the computer will automatically use the ranging sensor next in priority. If FLR AGR was not used because it was not available, its range input will be used to update the computed solution at the time it becomes available.

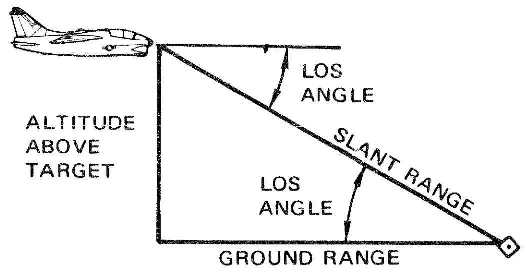
Radar Altimeter Ranging Mode.

This mode is the backup for FLR AGR in attack modes for which FLR AGR is first in priority. Reversion to radar altimeter ranging is automatic if 0000000 (seven zeros) is entered under Data 24 and FLR AGR is not valid or if the FLR is in the STBY or OFF position. This mode will be used by the NAV WD Computer only between 50 feet and 5,000 feet AGL, at bank angles less than 30°, with the radar altimeter locked on. Errors in ranging will be introduced over sloping or irregular terrain. If the radar altimeter is inoperative or its limits are being exceeded, the computer uses barometric altitude from the ADC. If −000000 is entered under Data 24, radar altimeter inputs will not be used unless both FLR and ADC ranging inpu· ecome invalid.

NOTE

> The ranging inputs used by the NAV WD Computer are in no way affected by the position of the BARO ALT/RDR ALT switch on the HUD. This switch selects only the source of altitude displayed on the HUD.

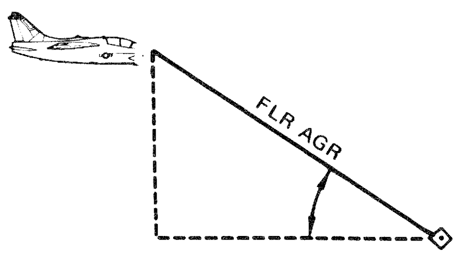
TARGET POSITION COMPUTATION



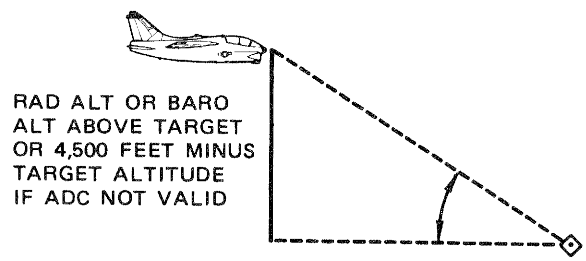
FUNDAMENTAL QUANTITIES RELATED TO TARGET POSITION

Using two inputs from valid sensor data, the NAV WD Computer derives the remaining two fundamental quantities for use in solving the weapon delivery problem; i.e., the ranging triangle. Methods for ranging solution, modes, and phase of attack in which they are used are as follows:

LINE OF SIGHT (VISUAL) AIMING

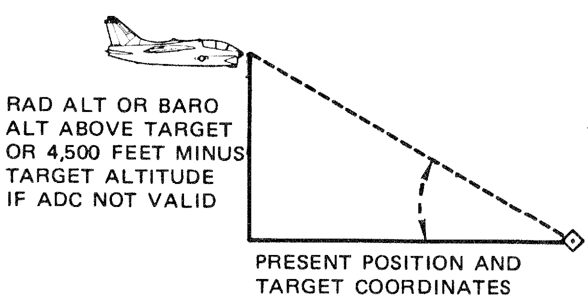


VISUAL ATTACK
VISUAL ATTACK OFFSET
CCIP BOMB

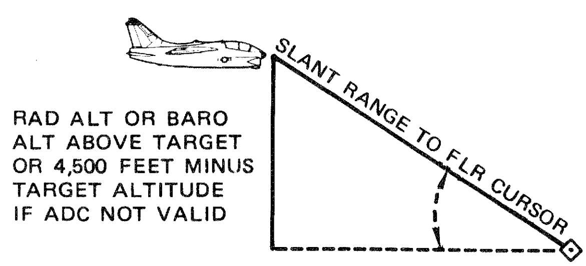


VISUAL ATTACK (FLR AGR not valid)
VISUAL ATTACK OFFSET
(FLR AGR not valid)
CCIP BOMB (FLR AGR not valid)

NONVISUAL AND COMPUTED AIMING



BOC BOMB
BOC BOMB OFFSET



BOC BOMB
BOC BOMB OFFSET

LEGEND

Inputs From Sensors ————
Computed Quantities - - - - - -

78K086–08–80

Figure 1-31

RANGING SENSOR ORDER OF PRECEDENCE

ATTACK MODE AND PHASE	1st	2nd	3rd	4th
VISUAL ATTACK (1) (2) (3c) (4)	FLR AGR	BARO ALT	RAD ALT	4,500 FT
VISUAL ATTACK OFFSET (1)	FLR AGR	BARO ALT	RAD ALT	4,500 FT (MSL)
CCIP BOMB (1) (3a)	FLR AGR	BARO ALT	RAD ALT	4,500 FT (MSL)
BOC BOMB (1) (3b)	BARO ALT	RAD ALT	4,500 FT (MSL)	
BOC BOMB OFFSET (1) (3b)	BARO ALT	RAD ALT	4,500 FT (MSL)	

NOTE

1. Data address 24 can be used to reverse the priority between baro altitude and radar altitude. This table is applicable with −000000 entered in Data 24.
2. Ranging sensor inputs are used to update the weapon delivery computations only at designate and at slew.
3. Ranging sensor inputs are used continuously:
   a. In CCIP
   b. In BOC and BOC OFFSET
   c. In computed guns and rockets mode.
4. If FLR AGR was first priority at the last update but was not used because it was not available, its range input will be used to update the computed solution at the time it becomes available.
5. If ADC and radar altimeter data are both invalid, determine desired release altitude AGL, subtract this from 4,500 feet, and enter the result as target altitude entry. This will provide reasonable delivery accuracy at the final pre-determined release altitude (AGL).

78K087–08–80

Figure 1-32

Barometric Altitude Ranging Mode.

The barometric altitude ranging mode is basically the same as the radar altimeter mode except that barometric altitude minus target altitude is automatically used when no FLR AGR inputs are available and −000000 (minus six zeros) is entered under Data 24. Using the normal procedures contained in the Before Taxi Check in T.O. 1A-7K-1, −000000 is automatically entered under Data 24, making the ADC altitude the priority altitude measurement. Deviations from standard atmospheric conditions must be compensated for, when known, to ensure the NAV WD Computer is using the proper values to compute the altitude difference. Two methods for adjusting the altitude difference are available, the D-value method and the Mean Sea Level Pressure (MSLP) method. The D-value method is determined from deviations in atmospheric pressure and pressure lapse rate from standard atmospheric conditions. Forecast D-values are obtainable directly from meteorology or may be computed from pressure differentials as shown in figure 1-33. The D-value method results in a correction to target altitude and is always utilized with a standard atmospheric pressure setting of 29.92.

The MSLP method compensates only for deviations from standard atmospheric pressure at the surface. It entails obtaining the forecast altimeter setting for the target area at the planned time of arrival and inserting it, along with other target data, into the NAV WD Computer. One advantage of the MSLP method is that current and forecast altimeter settings are usually updated more frequently than D-values. A discussion with the meteorologists will usually determine which method would be the most reliable and accurate at the time and place in question.

Another source of error when using the barometric altitude ranging mode is the tolerances of the air data computer (ADC). This source of error may be minimized on an individual aircraft basis by applying a correction factor to the target altitude data entry. The correction factor is determined by making a low-level flight (500 feet AGL or less) over level terrain or water of known elevation and comparing the HUD barometric altitude with the radar altitude. The check should be made at the Mach number planned for the actual weapon delivery and the altimeter setting of the checkpoint must be entered as MSLP into the computer. The correction factor is computed using the table in figure 1-34 and is applied algebraically to the elevation of the intended target prior to entry of target data into the computer.

NOTE

> When the D-value method is used to correct for deviations from standard atmospheric conditions, there will be two corrections to be applied to the target altitude prior to computer data entry. In this case, the target altitude entered into the computer must reflect both a D-value correction and an ADC correction.

The destination selected on the FLY TO thumbwheel determines the data to be used by the NAV WD Computer.

The NAV WD Computer program contains two sets of correction factors to ADC true airspeed and pressure altitude. Data Address 23 controls the application of these factors. The address is set to minus six zeros (−000000) during loading of the OFP into the aircraft. It is recommended that the address be checked periodically to ensure that the proper correction factors are being used by the computer. The Data 23 entry does not effect the data entries for MSLP or D-value or for target altitude correction factor. These entries are still required and use of the incorrect entry in Data 23 will require an unusually large altitude correction.

Range Measurement Errors.

Range (or altitude) measurement error is a major source of weapon impact error but proper system management and planning can minimize miss distances due to range measurement errors. Miss sensitivity to range (or altitude) measurement error depends on the following:

1. Line of sight (LOS) angle at target designate or last slew, whichever is last.
2. Weapon trajectory impact angle (a function of weapon ballistics and release altitude, airspeed, and dive angle).
3. The attack mode selected and ranging sensor used.

BAROMETRIC ALTITUDE RANGING MODE CORRECTION TABLE

1 RELEASE ALTITUDE (FT/MSL)	2 TARGET AREA PRESSURE (MB)	3 STANDARD PRESSURE (MB)	4 PRESSURE DIFFERENTIAL (MB)	5 D-FACTOR (FT/MB)	6 D-VALUE (FT)	7 WIND DIR/VEL
SL		1,013		27		/
1,000		979		28		/
2,000		942		29		/
3,000		908		30		/
4,000		875		31		/
5,000		843		32		/
6,000		812		33		/
7,000		782		34		/
8,000		753		35		/
9,000		724		36		/
10,000		697		38		/
11,000		670		39		/
12,000		644		40		/
13,000		619		42		/
14,000		595		43		/
15,000		572		44		/
16,000		549		45		/
17,000		527		47		/
18,000		506		48		/
19,000		485		50		/
20,000		466		51		/

To determine d-value:

1. Get target area atmospheric pressure in millibars for planned release altitude.
2. Insert target area atmospheric pressure in column 2 opposite the planned release altitude in column 1.
3. Subtract standard atmospheric pressure shown in column 3 from target area atmospheric pressure.
4. Insert the pressure difference from step 3 into column 4 as the pressure differential. This can be a plus or minus value.
5. Multiply the pressure differential (plus or minus) in column 4 by the D-factor shown in column 5.
6. Insert the product obtained in step 5 into column 6 as the D-value (feet).
7. Record wind direction and velocity for appropriate altitudes in column 7 for planning purposes.

To determine adjusted target altitude for increased accuracy in the Baro Altitude Ranging mode the target altitude can be adjusted by using the following procedures:

H_T – D = ADJUSTED TARGET ALTITUDE

H_T = Actual target height above sea level

D = D-value

Example

H_T = 2,000 feet

D = 155 feet

2,000 – 155 = 1,845 feet adjusted altitude

Use following steps to enter target altitude into the NAV WD computer:

a. Turn mode selector knob – ALT–MSLP.

b. Press appropriate 00 through 19 keyboard pushbuttons, for target designation.

c. Press the KEYBD selector.

d. Insert the adjusted target altitude in feet in the upper display. If the altitude is a minus value, press the E pushbutton before inserting the adjusted altitude. Read and verify.

e. Insert MSLP of 29.92 for display in the lower display. Read and verify.

f. Press the ENT pushbutton.

78K130–08–80

Figure 1-33

ADC ERROR CORRECTION

1. Enter __________ elevation (and __________ altimeter setting) of intended checkpoint.
2. Add __________ radar altimeter reading from HUD to elevation of checkpoint.
3. Sum __________ is actual MSLP altitude above checkpoint.
4. Subtract __________ barometric altitude reading from HUD.
5. Obtain __________ ADC correction factor for the airspeed being flown which is subtracted algebraically from target altitude.

NOTE

The above technique should supply an ADC error correction factor for as long as the same ADC is installed in the aircraft and the ADC static port is not damaged or obstructed. However, it should be performed whenever practical to verify the correction factor.

ADC ERROR CORRECTION APPLICATION

sample

1. Enter 617 elevation (and 30.02 altimeter setting) of intended checkpoint.
2. Add 400 radar altimeter reading from HUD to elevation of checkpoint.
3. Sum 1,017 is actual MSLP altitude above checkpoint.
4. Subtract 1,140 barometric altitude reading from HUD.
5. Obtain -123 ADC correction factor for the airspeed being flown which is subtracted algebraically from target altitude.

With a target altitude of 852 feet above sea level, the ADC error correction is applied as follows:

852 – (–123) = X;
852 + 123 = 975;
Adjusted Target Altitude = 975

A minus ADC error correction is always added to the target altitude and a plus ADC error correction is always subtracted from the target altitude.

78K109–08–80

Figure 1-34

There are two types of aiming performed with the computed weapon delivery system, visual and nonvisual. Visual aiming is performed by visually placing the aiming symbol on the target/OAP. Nonvisual aiming is performed by the NAV WD Computer placing the aiming symbol or the radar cursors on the target/OAP or by the pilot slewing the radar cursors to the target/OAP. Figure 1-31 shows the computed delivery modes under which each type of aiming is performed.

In a visual aiming computed mode, a short range (or high target altitude) error will produce short hits and a long range (or low target altitude) error will produce long hits (figure 1-35). Sensitivity of weapon delivery accuracy to range or altitude errors is a function of LOS angle at target designation or the last slew after target designation. The miss sensitivity of low-drag bombs to FLR ranging error while in VISUAL ATTACK is depicted in figure 1-36. A given range or altitude error will produce its maximum miss distance in a level delivery, which produces the lowest LOS angle for a given release altitude. Level run-in to the target also produces rapidly changing LOS angles which make precise aiming most difficult. Level visual deliveries should be avoided, if possible, since a 10° dive attack can be used more accurately to obtain very low altitude releases with higher and less rapidly changing LOS angles, facilitating precise aimpoint refinement.

In a nonvisual aiming computed mode, a high target altitude error will produce long hits and a low target altitude error will produce short hits. This is depicted in figure 1-37.

VELOCITY SENSOR MANAGEMENT.

The NAV WD Computer derives the aircraft velocity vector and present position from pilot inserted position data and from velocity sensor inputs. The pilot inserted data consists of present position, entered prior to takeoff, and navigational update coordinates, which are used en route to correct errors built up in the navigation computations. From the velocity sensor inputs, the computer continuously computes the aircraft velocity vector, current present position, and current position relative to the destination (or MARK) selected on the control panel FLY TO controls.

The Inertial Measurement Set (IMS) furnishes heading, attitude, and primary velocity inputs which are crucial to accurate navigation and weapon delivery solutions. Any velocity error causes computed weapon delivery error. Groundspeed error multiplied by weapon time of fall gives the miss distance. For example, a 5-knot ground speed error is equal to 8.4 ft/second error and if time of fall is 8 seconds, miss distance is 67 feet.

Management of the IMS begins with alignment before flight. Refer to T.O. 1A-7K-1 for complete procedures for IMS alignment.

The most accurate source of velocity data is a precisely aligned IMS; therefore, the IMS is the preferred velocity sensor, when available. With the IMS operating properly in NORM or INERTIAL modes, the NAV WD Computer derives the aircraft's velocity by integrating incremental velocities in the north, east, and vertical axes which are provided by the IMS. Doppler velocity (ground speed and drift angle) is used when available and coupled (INERTIAL mode) as a reference from which the computer performs three functions:

1. Long term damping of horizontal velocity (ground speed and drift angle) derived from IMS inputs.

2. Torquing of the IMS to maintain level alignment.

3. Torquing of the IMS for gyrocompassing to maintain azimuth alignment (IMS in NORM).

With the IMS in the INERTIAL mode, the Doppler can be coupled to or decoupled from the IMS via an entry in the NAV WD Computer under Data Address 25. When 0000000 (seven zeros) are entered under Data 25, the Doppler is coupled and the Doppler inputs are used. When −000000 (minus six zeros) are entered under Data 25, the Doppler is decoupled and Doppler inputs are only monitored and not used. Turning the Computer on, entry of present position or performing Computer self-test will cause −000000 to be automatically entered under Data 25, decoupling the Doppler. The entry under Data 25 has no effect on Doppler operation. When turned on, the Doppler will operate and provide inputs to the computer, whether coupled or decoupled. The computer will display these inputs when requested but will not use them to damp the IMS velocities unless directed to do so via Data 25.

NOTE

Data Address 25 is not automatically set to −000000 at powerup if the computer is turned on after completion of IMS coarse alignment. Therefore, if entry of present position or computer self-test is not performed, it is recommended that the pilot verify that Data 25 is in the desired state.

ALTITUDE ERROR EFFECT IN VISUAL MODES

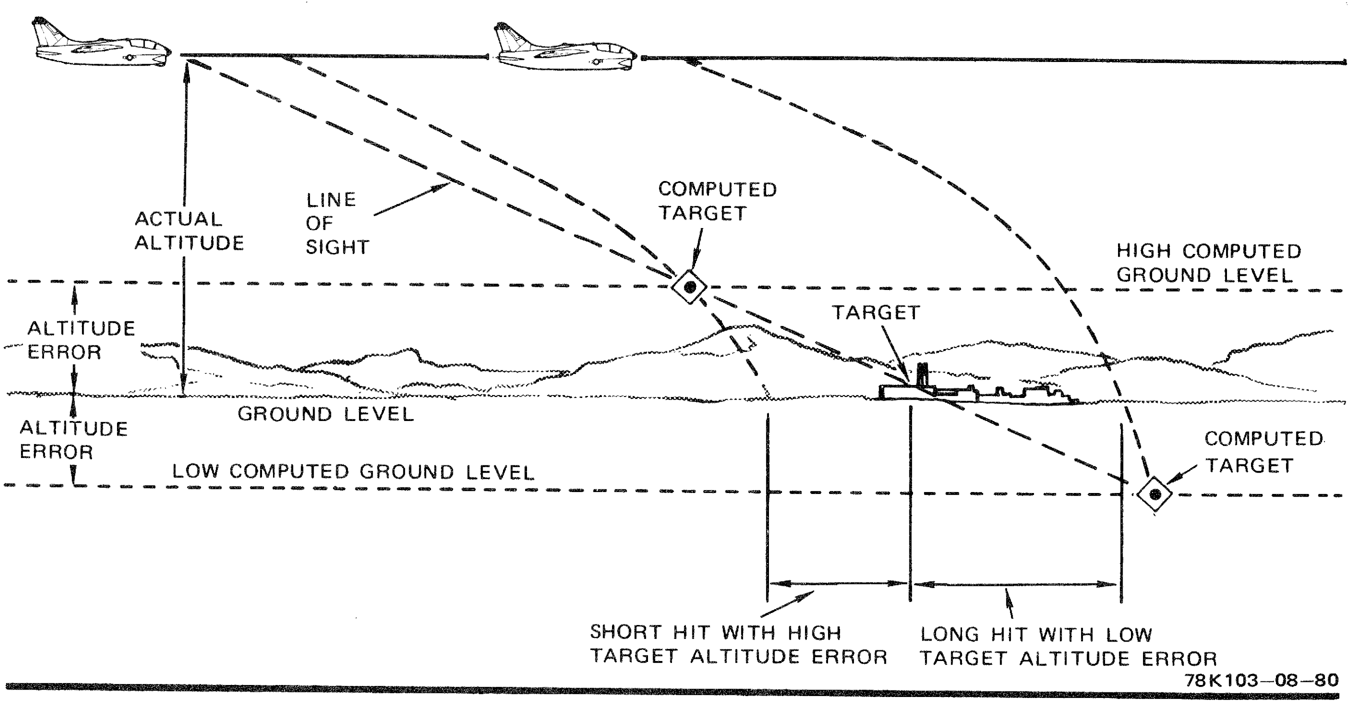


Figure 1-35

RANGE ERROR EFFECT IN VISUAL MODES

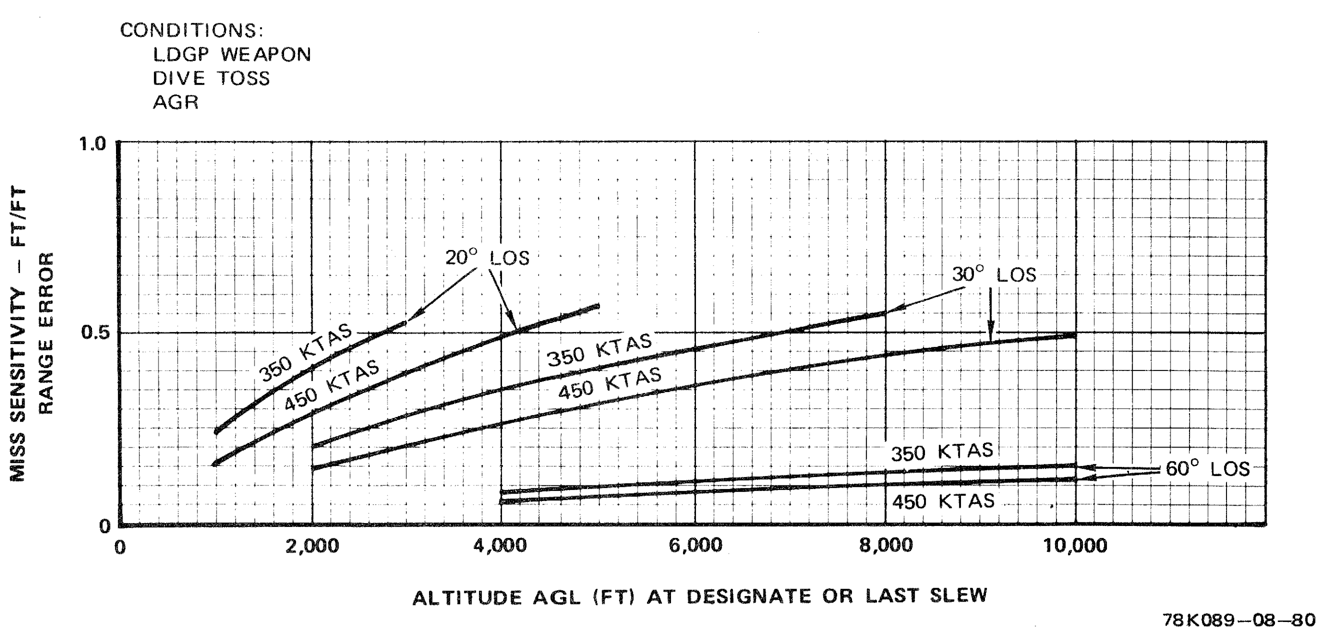


Figure 1-36

ALTITUDE ERROR EFFECT IN NONVISUAL MODES

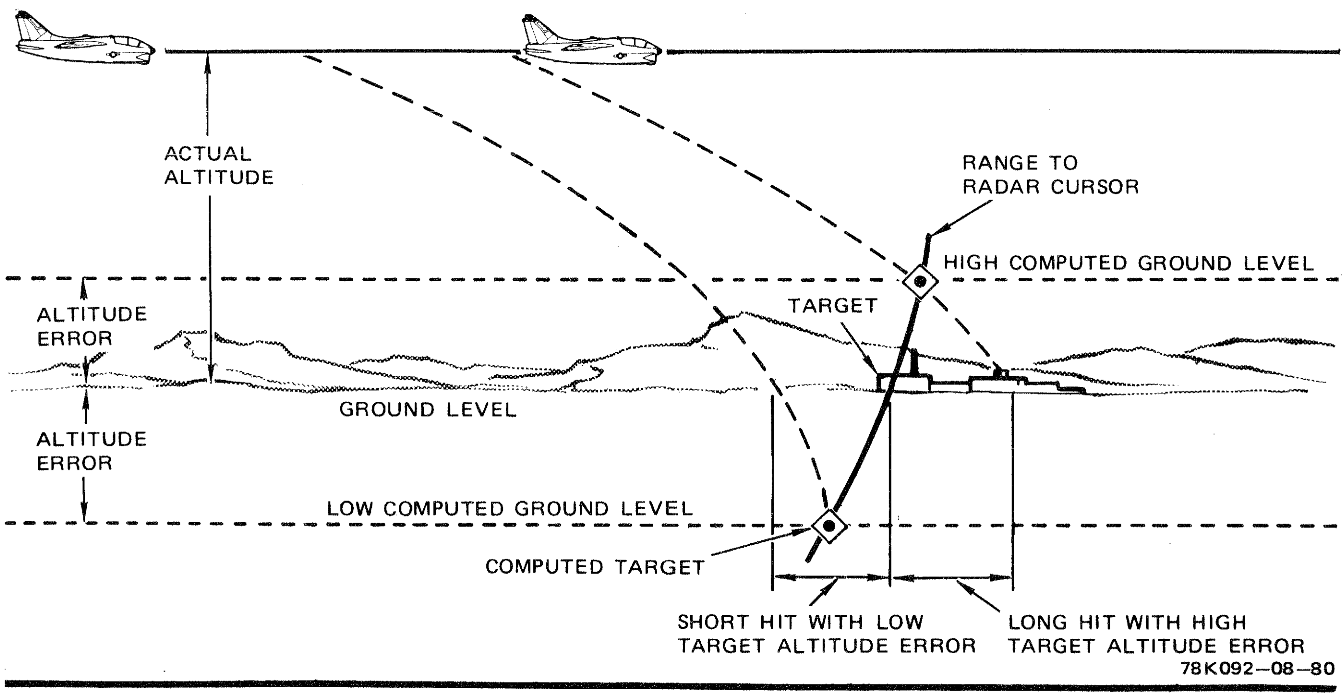


Figure 1-37

When the IMS is in the NORM mode, Data Address 25 has no effect on Doppler and IMS coupling, and reliable and reasonable Doppler inputs are always used by the NAV WD Computer to damp the IMS velocities and provide torquing signals for IMS leveling and gyrocompassing.

Proper management of both the IMS and Doppler is essential in achieving the most accurate possible velocity and attitude inputs for use in the weapon delivery solution.

WEAPON DELIVERY WITHOUT COMPLETE GROUND ALIGNMENT.

T.O. 1A-7K-1 provides the procedures for performing a complete airborne alignment in the event ground alignment cannot be completed. If airborne alignment cannot be completed, the following will assist in performing weapon delivery with an unaligned system.

1. Check the computer wind readout. Computed wind is generally more accurate than forecast wind but the forecast, together with visual clues (smoke, apparent drift, or white caps when over water), may be useful to determine if a gross error exists. Errors in computed wind may be due to errors in true airspeed, IMS heading and velocity, Doppler velocity, or a combination of errors. Doppler and/or ADC true airspeed errors will cause computed wind to vary with heading (maximum difference occurs between headings 180° apart). Errors in IMS heading or velocity will produce wind error which may fluctuate but will not be dependent on heading if Doppler is not being used. Unless the IMS is in a backup mode, a wind error produced by ADC TAS error will not be used for

navigation nor significantly affect weapon delivery accuracy with low drag bombs.

2. If the Doppler functions properly but there is less than 6 minutes remaining before arrival in the target area, a fast magnetic heading update (FMHU) can be performed. This is accomplished by momentarily switching the IMS to either GRID or MAG SL, and then to INERTIAL; subsequently entering seven zeros (0000000) in Data Address 25. Data Address 98 will display a 1 in window 3 for a period of 11 seconds or until the heading slew is completed. Level flight (within 5° of roll) must be maintained while the FMHU is in process. If roll exceeds 5°, the FMHU is terminated and the display in window 3 is set to 0 until the aircraft roll returns to a value of 5° or less. Bomb with the IMS in INERTIAL, with Doppler on, and use a dive angle less than 20°, if feasible, to ensure use of Doppler velocities at release altitudes instead of ADC velocities and memory winds.

3. If unable to initiate an airborne alignment due to mission requirements or lack of a reasonable and reliable Doppler, navigate with the IMS in MAG SL and enter forecast wind. When in the target area, initiate an FMHU by switching the IMS to INERTIAL and enter a minus six zeros (−000000) in Data Address 25 to decouple the Doppler. Data Address 98 will display a 1 in window 3 for a period of 11 seconds or until the heading slew is completed. Level flight (within 5° of roll) must be maintained while the FMHU is in progress. If roll exceeds 5°, the FMHU is terminated and the display in window 3 is set to 0 until aircraft roll returns to a value of 5° or less. Bomb with the IMS in INERTIAL with the Doppler decoupled and insert the best estimate of wind value at release altitude.

A backup mode of velocity computation is used automatically whenever:

1. The NAV WD Computer judges the IMS velocities to be unreasonable with NORM or INERTIAL selected on the IMS panel.

2. MAG SL or GRID is selected on the IMS panel.

3. NORM is selected on the IMS panel and the IMS has not completed coarse alignment and coarse level (50 seconds of fine alignment).

4. INERTIAL is selected on the IMS panel with the Doppler either unreliable or unreasonable and the IMS has not completed coarse alignment and coarse level (50 seconds of fine alignment).

In this event, IMS attitudes are used in weapon delivery computations, but IMS velocities are not. True airspeed from the ADC, angle of attack, Doppler velocity, and Doppler drift angle (or their backups) are still used by the computer.

Wind Computations.

If the NAV WD Computer receives both a valid airspeed from the ADC and a groundspeed input from either the IMS or the Doppler, wind speed and direction will be automatically computed for use in the weapon delivery problem and for pilot display. If either airspeed or groundspeed is not available, wind calculations are not performed and the last computed (memory) or pilot entered wind will be displayed and used as required. When wind computation is not being performed, the pilot should insert estimated wind at release altitude. If the Doppler is decoupled but valid and INERTIAL mode is selected with not fine alignment having been done, wind computations will be performed.

If the IMS is reasonable and reliable and the ADC fails, wind computation stops and the memory wind will be constant in the NAV WD Computer display; however, in this case the wind is not used in velocity computation. An erroneous wind will cause small errors in computing ballistic trajectory of low drag weapons and larger errors in computed trajectory of high drag weapons. The best estimate of wind at release attitude should be inserted by the pilot.

NOTE

If the ADC is not failed and the IMS or Doppler is reasonable, the wind will be continuously computed and the pilot will be unable to insert wind manually while airborne.

Refer to T.O. 1A-7K-1 for discussions on the computation of the aircraft velocity vector and directions for proper management of the aircraft velocity sensors.

ACQUIRING OPTIMUM PERFORMANCE.

Basic System Accuracy Considerations.

The contributions of velocity error and range (or altitude) measurement error to miss distance have been described in detail. Recommended procedures for management of velocity and range sensors to minimize errors have been described. Other sources of system error generally make very small contributions to miss distance and, except in the case of gross malfunction, these errors cannot be detected by the pilot. These sources of error are:

1. HUD boresight tolerances
2. Bomb dispersion
3. Weapon release delay and ejection velocity tolerances
4. IMS boresight, heading, and attitude measurement tolerances
5. True airspeed tolerance
6. Angle of attack tolerance
7. Azimuth cursor alignment tolerance

All of the error sources combine to cause weapon impact to miss the aimpoint which the pilot has designated to the NAV WD Computer. Pilot aiming uncertainty, or failure to have the aiming symbol (or radar cursors) precisely on the desired impact point is frequently one of the largest contributions to miss distance. Aiming error is dependent on pilot planning, acquisition of the desired impact point, and pilot concentration on precise aiming.

Visual target identification and aiming, using the HUD at slant ranges less than 15,000 feet and LOS angles greater than 10°, result in best accuracy for weapon delivery. The VISUAL ATTACK and VISUAL ATTACK OFFSET modes provide identical visual slew rates and ranging priorities after slewing postdesignate.

A critical factor affecting weapon delivery accuracy is the slant range at the last aim refinement. The miss distance contributions from most error sources, including aiming error, increase directly as the slant range increases. For this reason the final aim refinement before release, to obtain best accuracy, must be performed at the shortest range compatible with target defenses and blast/fragmentation clearance considerations.

Analysis of probable magnitude of errors from all sources and combined miss sensitivities throughout the weapon delivery envelope leads to several theoretical rules of thumb for planning most accurate employment of the A-7. These rules of thumb are:

1. Visual delivery accuracy is always best with the shortest slant range at last aimpoint refinement.
2. Visual delivery accuracy for a given slant range is always best for the highest LOS angle at last aimpoint refinement.
3. Visual delivery accuracy for a given slant range and LOS angle is better for low drag bombs than high drag bombs.
4. For visual deliveries of high drag bombs the accuracy improvement to be obtained by increasing LOS angles with steeper dive angles is modified by increased effect of velocity and wind errors due to higher release altitudes. Generally, a 10° to 15° dive is recommended for high drag weapons.

If careful planning and sound management of IMS and Doppler are used, excessive drift or a runaway aiming symbol should only be encountered due to a false short or long range AGR lock-on. In that event, rejecting the lock-on and slewing back to the target should be attempted to correct the ranging. If this fails and time permits, the FLR may be placed in STBY or the run must be aborted.

Preattack Checks.

In order to obtain the best possible inputs to the NAV WD Computer, the sources of these inputs should be checked to verify their accuracy. The following procedures are provided to enable checking of various components of the system prior to reaching the target area. Performance of these procedures will enable the pilot to select alternatives which minimize errors in weapon delivery. These procedures also minimize the possibility of component malfunctions going undetected and adversely affecting a subsequent mission.

NOTE

Performance of the following procedures is recommended prior to each weapon delivery mission, but is not mandatory.

NAV WD System Ground Checks.

During IMS coarse alignment, perform the following procedures in addition to those prescribed in T.O. 1A-7K-1:

1. AOA — Check (Check can be accomplished only before IMS completes 2-minute self-contained alignment.)

   Manually position the AOA vane so that the HUD zero pitch (flightpath angle) line overlays the zero mil standby reticle pipper. The cockpit AOA indicator should indicate 8.3 (±0.5) units AOA and the HUD pitch lines should move smoothly with changes in AOA vane position. Position the HUD zero pitch line to 100 mils. The AOA indicator should indicate 13.3 (±0.5) units. This check verifies that AOA input to the NAV WD Computer agrees with AOA vane position. One unit error in AOA input would produce 2 to 4 mils error in computed air to ground gunnery and 13 to 15 mils error in computed rocket delivery.

2. NAV WD Computer switch — TEST (If not accomplished before IMS coarse alignment has been completed, this test delays the start of computer controlled ground alignment.)

   In addition to the usual observations during this test (as described in T.O. 1A-7K-1), note the comparative boresight of the aiming symbol and the standby reticle pipper with zero mils depression. They should be within 3 mils of coincidence. (The standby reticle pipper is two mils in diameter.) If there is a difference, assume the standby reticle pipper to be correct. Remember its location in relation to the aiming symbol and use that point of the aiming symbol for subsequent aiming, rather than the aiming symbol itself.

Before taxi, accomplish the following in addition to the normal procedures prescribed in T.O. 1A-7K-1:

3. ADC Self-Test — On request, the ground crew will initiate the test. Cockpit indications should be as follows:

   a. HUD: 349 (±10) KIAS
      4,500 (±50) feet

   b. TAS: 400 (±5)KIAS

   c. ADC advisory light is on.

   d. AAU-19/A altimeter reverts to STBY.

4. Data 97 and Data 95 — Check.

   Data 97 indicates taxi speed in upper window if IMS is aligned and operating correctly in INERTIAL Mode with vertical velocity damped to zero. If Data 97 indicates more than one knot within 15 minutes of ground alignment while parked, inertial navigation may degrade early in flight. Eight knots while parked indicates a bad alignment or malfunction of IMS or NAV WD Computer. Any difference between Data 97 and Data 95 upper window during taxi is due to vertical velocity error which would degrade computed weapon delivery.

5. HUD — Check that the Zero Pitch Line is properly positioned on all aircraft headings.

   This check proves HUD and IMS pitch and roll boresight are good if IMS has good alignment. Normal tolerance for line is within 3 mils of the local horizontal in pitch and within 1° in roll. Roll tilt of 1° would appear as a 3-mil vertical difference between outer ends of the Zero Pitch Line.

6. Runway True Heading Check — Position the aircraft precisely on runway centerline before takeoff and align HUD standby reticle dot or the heading scale index mark precisely on the centerline stripe at the far end of the runway.

   Select IMS-HUD and mentally average the maximum and minimum heading indications (normally ±3 minute fluctuation). Record the average as indicated runway true heading. An indicated runway true heading within ±10′ of the actual value proves valid HUD and IMS azimuth boresight and good IMS azimuth alignment.

Ranging Sensor Evaluation.

If the NAV WD Computer and HUD are operating correctly with the IMS accurately aligned, the following procedure can be used to determine FLR ranging accuracy in computer controlled AGR mode:

HUD Versus FLYOVER Check.

1. Select a destination with a precisely defined aimpoint surrounded by level terrain, and approach on a cardinal true heading.

2. Maneuver to place the aimpoint at the −10° pitch line of the HUD, and then maintain −10° line of sight by keeping the flightpath marker on the aimpoint.

3. Select HUD update, slew to the aimpoint, designate, check for steady AGR lock-on and refine aim.

4. Make a last small slew at exactly 1,050 feet altitude above the aimpoint (ensure constant attitude during slew and, if possible, make the last slew in azimuth only).

5. Read and remember the along-track component of the HUD Δ, quickly flip thumbwheel 2 notches aft to the FLYOVER position; wait for numbers to reappear; and then press the keyboard button to call up the destination for update.

6. Level off to fly over the aimpoint and designate precisely over the aimpoint, still keeping the HUD Δ firmly in mind.

7. Record HUD Δ and heading and then read and record the Flyover Δ.

8. The along-track component of the HUD Δ and Flyover Δ should be no more than 3″ apart. If along-track difference exceeds 3″, repeat the check several times on opposite heading to verify results.

9. Do a postflight analysis of each HUD vs Flyover check to determine the direction and amount of error by the following procedure:

   a. Plot the update point and draw a ground track arrow through it.

   b. Plot the along-track component of the HUD Δ and Flyover Δ in relation to the update point on the shaft of the arrow.

   c. Note which Δ is closer to the head of the ground track arrow.

      If HUD Δ is closer to arrowhead (i.e., HUD Δ long along track), it means that the radar ranged short or was pointed down.

      If the Flyover Δ is closer to the arrowhead (i.e., HUD Δ short along track), it means that the radar ranged long or was pointed up.

   d. Multiply the difference, in seconds, between along-track Δ's by the following factors to determine approximate angular FLR elevation pointing error in mils:

      If HUD Δ long; 1 second = 3.1 mils

      If HUD Δ short; 1 second = 2.7 mils
      (If east or west heading was used, the result must also be multiplied by the cosine of the latitude of the aimpoint.)

   e. Write the system up if average result shows pointing error greater than 10 mils.

For example:
Steps a and b of analysis gives these plots for two runs:

```
N
↑                                   HUD Δ      F.O. Δ
:  HUD Δ N 13″    Aimpoint   E 40″      E 47″
:  F.O. Δ N 7″   W←—x—————————•—————————•——
x  Aimpoint
```

Step c:
The plots show that in the north run the HUD Δ was long on track by 6″ of latitude and on the west run, the HUD Δ was long on track by 7″ of longitude.

Step d:
North run: 3.1 mils x 6 s = 18.6 mils
West run: At 35° north latitude, use Cos 35° = .82 so 3.1 mils/s x 7 s x .82 = 17.8 mils

If a consistent ranging error is detected en route to the target, accurate weapon delivery using AGR can be achieved by adjusting aimpoint long or short using a rule of thumb for the planned delivery maneuver. The along track difference between HUD Δ and FLYOVER Δ indicates ranging error equivalent to radar elevation pointing error of approximately 3 mils/second of difference if the check is performed as described above. The bomb miss distance per mil of FLR elevation pointing error can be determined from figure 1-38 for any desired Line-of-Sight angle and altitude combination at last aim point refinement. The miss sensitivity for the planned delivery maneuver multiplied by 3 mils/second gives an approximate amount of aim adjustment required for each second of along track

MISS SENSITIVITY TO RADAR ELEVATION POINTING ERROR

CONDITIONS:
VISUAL ATTACK
LDGP Weapon
AGR
4g DIVE TOSS

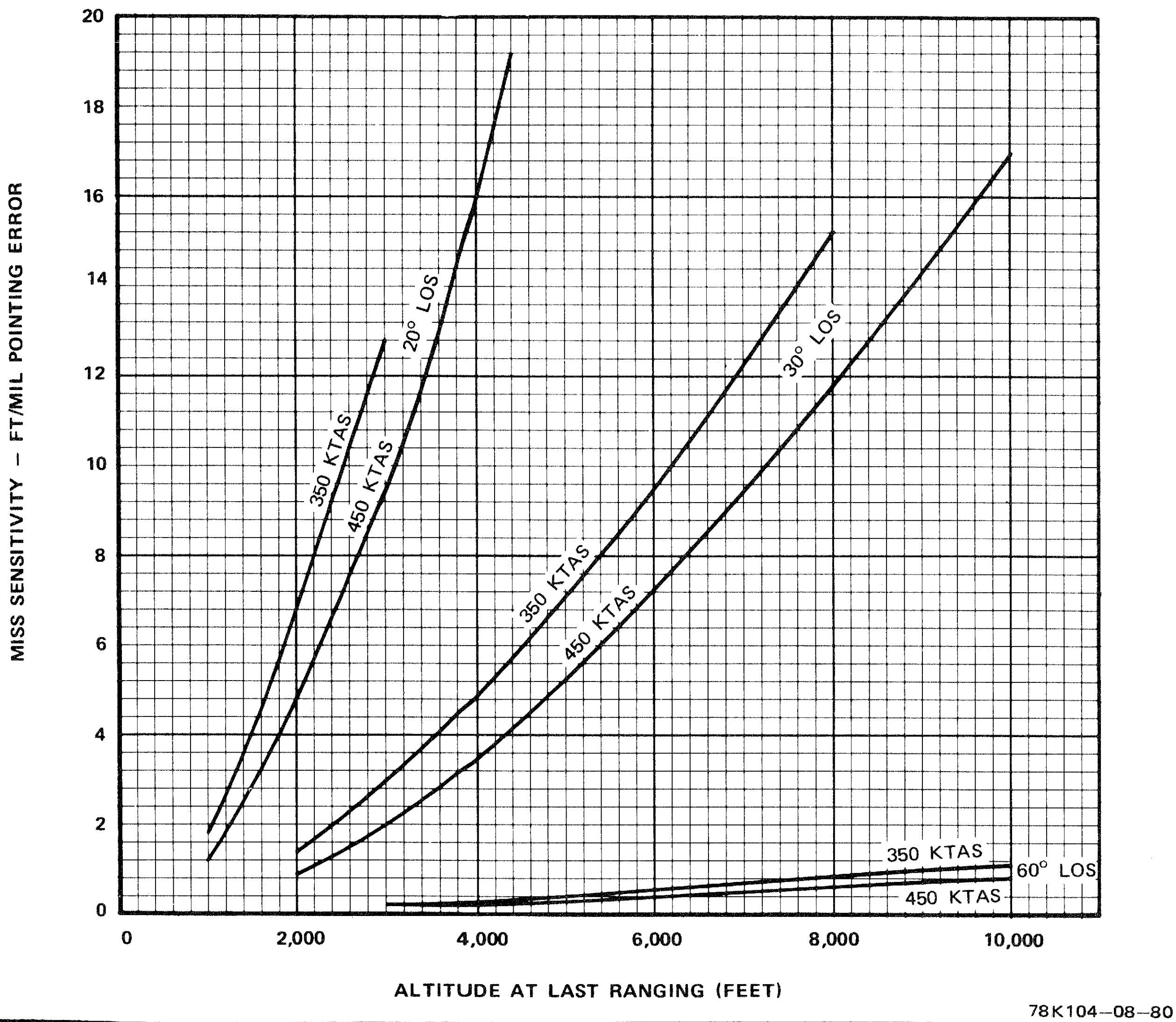


Figure 1-38

HUD vs FLYOVER difference. The direction of aim adjustment must be determined by steps 1, 2 and 3 of the HUD vs FLYOVER analysis procedure. If HUD Δ is long along track — aim long. If HUD Δ is short along track — aim short.

For example:

1. Assume preplanned deliveries on the range of 20° LOS angle at 450 KTAS with the last slew planned for 1,000 feet and 30° LOS angle at 450 KTAS with the last slew planned for 4,000 feet.

2. Then from figure 1-35, miss sensitivities are determined to be:

   20° LOS — 1 foot/mil

   30° LOS — 3.5 feet/mil

3. The aimpoint adjustment rule of thumb gives:

   20° LOS — 3 mils/second x 1 foot/mil = 3 feet/second

   30° LOS — 3 mils/second x 3.5 feet/mil = 10.5 feet/second

   These numbers can be written down and taken with the pilot for inflight computations for his planned delivery parameters.

4. Assume HUD vs FLYOVER checks reveals HUD Δ was long along track by 6 seconds (short ranging error).

5. Then in using AGR, pilot would aim long as follows:

   20° LOS — 3 feet/second x 6 seconds = 18 feet long

   30° LOS — 10.5 feet/second x 6 seconds = 63 feet long

ADC Altitude Calibration.

The ADC altitude, indicated on the AAU-19/A altimeter in the RESET mode, normally decreases as speed increases. During acceleration from 250 KIAS to 0.75 MN at low altitude, the normal decrease in indicated altitude is approximately 100 feet. The NAV WD Computer makes a Mach number correction to ADC altitude to compensate for this phenomenon. The HUD baro altitude scale indicates the corrected altitude, and this is the same altitude used by the computer for baro bombing. Any residual error in the HUD indicated baro altitude may be used as an ADC correction to adjust target altitude.

The accuracy of the HUD baro altitude indication can be measured with the RADAR Altimeter over flat, level terrain or water of known elevation, if an accurate existing altimeter setting can be obtained from a nearby facility. After an ADC correction has been determined, it does not normally change for a given Mach number. However, if the ADC, static lines or static port are altered or damaged, a new ADC correction should be measured. It is important to remember that accurate ADC altitude depends on balanced flight (no sideslip). Any sideslip may induce errors in baro bombing or in attempts to measure ADC corrections.

Select a flat surface of known elevation where flight at 500 feet AGL is approved and where existing altimeter setting can be obtained, and perform the following procedures:

1. Enter existing altimeter setting as MSLP for destination to be selected on FLY TO thumbwheel for ADC check.

2. At constant radar altitude in balanced flight, record the following at a low speed (200 to 300 KIAS) and also at the planned Mach number (0.75 to 0.85) of the last slew before weapon release.

Airspeed/IMN		
Checkpoint Elevation		
Radar Altitude		
HUD Baro Altitude		

3. Determine ADC correction for each IMN with this algebraic formula:

(ADC Correction) = (Checkpoint Elevation) + (Radar Altitude) − (HUD Baro Altitude)

NOTE

If HUD baro altitude indicates higher than the sum of checkpoint elevation and radar altitude, then add the difference (ADC correction) to target alt tude or subtract the difference (10 feet = .01 inHg) from target MSLP. If HUD baro altitude indicates lower than the sum of checkpoint elevation and radar altitude, then subtract the difference (ADC correction) from target altitude or add the difference (10 feet = .01 inHg) to target MSLP.

4. Use ADC correction in this formula to obtain adjusted target altitude for the last slew Mach number:

(Adjusted Target Altitude) = (Target Elevation) − (ADC Correction) − (D-Value)

NOTE

See figure 1-34 for example calculation without a D-Value correction.

5. If possible, obtain the existing altimeter setting at the target. Compare existing setting to forecast altimeter setting. If the forecast altimeter setting is in error, expect the D-Value to be in error by the same amount. Use the following formulas and adjust target altitude as a backup, even if planning to use AGR:

$$\begin{pmatrix}\text{Existing}\\\text{D-Value}\end{pmatrix} = \begin{pmatrix}\text{Forecast}\\\text{D-Value}\end{pmatrix} + \left[\begin{pmatrix}\text{Existing}\\\text{Altimeter}\end{pmatrix} \begin{pmatrix}\text{Forecast}\\\text{Altimeter}\end{pmatrix}\right] \times 1{,}000$$

$$\begin{pmatrix}\text{First Run}\\\text{Target}\\\text{Altitude}\end{pmatrix} = \begin{pmatrix}\text{Target}\\\text{Elevation}\end{pmatrix} - \begin{pmatrix}\text{ADC Correction}\\\text{at Release Mach}\end{pmatrix} - \begin{pmatrix}\text{Existing}\\\text{D-Value}\end{pmatrix}$$

NOTE

Set target MSLP at 29.92 when using D-Value.

Data 94 ADC Check.

An alternate method of performing an ADC calibration may be accomplished using the NAV WD Computer. Select a flat surface of known elevation where flight at 500 feet AGL is approved and the existing altimeter setting can be obtained, and perform the following procedures:

1. Ensure Data Address 24 is set to −000000 (barometric altimeter ranging in priority) and the FLR is in STBY.

2. Enter existing altimeter setting and elevation for destination to be selected on the FLY TO thumbwheel.

3. With VISUAL ATTACK selected and a free fall bomb station in priority, designate a target while in a slight dive and descend to a constant radar altitude, radar altimeter selected on the HUD scales (BARO ALT/RDR ALT switch in RDR ALT). Fly at this altitude until solution cue intersects the flightpath marker. This should be in balanced flight at the planned Mach number for weapons release.

4. As the solution cue approaches the FPM, attempt to maintain a constant radar altitude. Compare this altitude to the altitude generated by the NAV WD Computer and displayed in Data 94.

5. Use the following formula to obtain adjusted target altitude: (Target adjustment) = (Data 94 altitude) − (Radar Altitude).

Velocity Sensor Evaluation.

The following procedures should be used to check Doppler functions early in the flight while IMS alignment and INERTIAL navigation are most accurate:

1. Monitor the Data 95 Doppler readout for several seconds at constant airspeed to achieve an average speed. The average Doppler groundspeed should agree with the Data 95 inertial groundspeed, within ±5 knots with wings level and aircraft not accelerating or decelerating.

2. Check Data 96 for Doppler drift angle. When stabilized, Doppler drift angle should agree with Data 96 inertial drift angle within ±1°.

3. Check Data 98 for Doppler reliable cutout at 22° (±2°) noseup and nosedown, and 32° (±2°) left and right bank angle.

The following checks should be made en route to or from the target.

4. Data 95, 96, and 97 readouts should be compared with other aircraft stabilized in wings level information at a constant speed to detect possible erroneous INERTIAL, Doppler, or ADC velocities. An accurate update at the first check point will verify whether or not the average INERTIAL velocity error is excessive.

   A completely valid check of Inertial navigation accuracy requires a complete ground alignment of the IMS and an accurate update after 30 to 60 minutes of flight with IMS in INERTIAL and Doppler "decoupled." Updates at 15-minute intervals are desirable to monitor progress of the check. Navigation errors obtained at updates should be recorded but should not be entered in the computer until the Inertial navigation accuracy check has been completed. Elapsed time of Inertial navigation begins when the IMS is first switched to INERTIAL. Inertial navigation error in excess of 8 nmi/hour rate is unsatisfactory. Inertial navigation error in excess of 3 nmi/hour rate should be noted to indicate that auto cal may be needed.

5. INERTIAL velocity error will cause the ground stabilized position of the aiming symbol to drift away from the designated point during computed bomb attacks and HUD updates. This aiming symbol drift is not normally detectable unless velocity error is greater than 3 nmi/hour rate. It should be determined at least 10 minutes before arrival at the target whether Doppler is needed to improve navigation or to stop aiming symbol drift. If the Doppler has checked satisfactorily and it is needed, switch the IMS to NORMAL.

6. If the Doppler has checked satisfactorily but was not needed before weapon delivery, the NORMAL (Doppler Inertial Gyrocompassing — DIG) mode of navigation should be checked during return to base. A completely valid check of DIG navigation accuracy requires accurate updates at two points at least 100 nautical miles apart.

NOTE

The IMS NOT ALIGNED light should be OFF and an accurate update should be entered to begin the DIG navigation accuracy check. Updates at 15-minute intervals are desirable to monitor progress of the check. Navigation errors obtained at update should be recorded but should not be entered in the computer until the DIG navigation accuracy check has been completed. DIG navigation error in excess of 5 nm/hour rate is unsatisfactory. Frequent IMS NOT ALIGNED advisory light illumination is also a discrepancy if INERTIAL navigation accuracy was satisfactory.

Practice Attack.

The probability of a successful attack on the first pass is enhanced greatly if a practice attack is done before reaching the target. The planned weapon selection, delivery mode, and tactics should be checked as closely as possible, but with the MASTER ARM switch in OFF.

Azimuth Cursor Alignment Check.

A BOC Bombing Mission should not be attempted with an aircraft which has not had azimuth cursor alignment verified in visual conditions by the following procedure:

1. A small, well defined radar target that can be positively identified visually must be used to check azimuth cursor alignment. A radar reflector, a boat or ship on a straight course, or a straight bridge or causeway are suitable and should be approached at approximately 2,500 feet and 250 KIAS on a heading that minimizes azimuth beam width distortion (e.g., lined up precisely on the long axis of the bridge).

2. Carefully tune the radar GMS display on 10-mile range scale and reduce receiver gain to the very lowest setting which still paints the target. In BOC mode, slew the azimuth cursor to precisely bisect this very small radar return and then visually observe the aiming symbol position in azimuth. Change to the 5-mile scale and recheck cursor position.

3. The limit of accuracy of azimuth cursor placement on the target on the 5-mile scale is near ±5 mils. Also a ±5 mil tolerance on azimuth cursor alignment with the aiming symbol is reasonable. Therefore, a maintenance adjustment should be made if aiming symbol location is more than one aiming symbol width from the target, in azimuth, when the cursor is on the target.

Target Area Procedures.

In order to obtain an accurate hit, the aiming symbol should be precisely positioned on the intended bomb impact point and must be precisely tracking that point automatically. If the aiming symbol is not precisely tracking and appears to drift away from the exact point, it is certain that the solution is not exact and the bomb will not impact at the position of the aiming symbol at the time of release. In fact, it should hit nearer to the projected position of the aiming at the time of impact. That position may be estimated by projecting the apparent speed and direction of drift through the time of flight of the bomb. Therefore, it is recommended that small amounts of drift detected after designation be compensated by leading the drift (i.e., by slewing the aiming symbol to a position where drift is estimated to bring it to the desired impact point after time of fall).

Leading the drift as described provides a very precise correction for velocity errors in azimuth. It also corrects precisely for velocity errors in range if altimetric ranging is being used.

If using AGR, a long or short aim to lead range drift also causes a bias in the ranging solution which reduces miss due to velocity error. Therefore, if using AGR, it is recommended that the pilot lead range drift by only half the amount he would use for the same rate of azimuth drift.

The following weapon delivery techniques improve accuracy on target.

1. Visual Attack Bomb.

   Designate as soon as possible; then slew precisely to exact aimpoint. Note AGR lock-on and tracking; check for aiming symbol drift; refine aim, if necessary; if aiming symbol drifts, lead the drift; and center steering after slew. Use care not to have a pitch rate at termination of last slew which should be very small.

   If reattack of a stationary target is possible, do not undesignate and use reattack aiming symbol location to analyze possible drift on next run. The location of the aiming symbol at roll-in shows what the average velocity error has been since the previous release.

   For Example: If 2 minutes (120 seconds) elapsed from release to roll-in and the aiming symbol has drifted to 1,200 feet at 3 o'clock, the average velocity error has been 1,200 feet divided by 120 seconds which equals 10 feet-per-second toward 3 o'clock. The pilot should be alert for a similar direction and rate of drift.

2. BOC Mode.

   Obtain a good update before approaching target; use AFCS altitude hold and heading select; enter mode and find target as soon as possible; do not slew until target is identified; obtain perfect cursor placement on 10-mile scale and designate (designate for BOC DEST/MARK 0 and BOC OFFSET only); attempt to obtain target on 5-mile scale for most accurate cursor position refinement; have cursors in desired position before 3 miles; check for solution cues and center steering.

3. Manual Bomb.

   Use HUD scales.

GUIDED WEAPON DELIVERY.

There are five guided weapons capable of carriage and delivery on the A-7K: the AIM-9 Sidewinder air-to-air missile, the GBU-10 series laser guided bomb, the GBU-12 series laser guided bomb, the GBU-8 series guided bomb, and the AGM-65 Maverick air-to-ground missile. Refer to (Confidential) T.O. 1A-7K-34-1-1-1 for a description of AIM-9 missile delivery procedures and GBU-8, GBU-10, and GBU-12 series mission planning data. Refer to Computed Bombing Modes and Manual Bombing and Flare Delivery discussions, this section, for computed and manual delivery descriptions for GBU-10 series and GBU-12 series laser guided bombs and AGM-65 operating restrictions.

AGM-65 MAVERICK MISSILE DELIVERY.

The AGM-65 Maverick missile is only delivered singly; rapid delivery is accomplished by repeating the applicable portions of the single missile launch procedure.

Single Missile Launch.

Initiation is accomplished by selecting a station loaded with Maverick missiles, placing the radar switch to STBY or POWER, selecting 01 on QUANTITY thumbwheel, and depressing the VISUAL ATTACK master function switch. On the HUD, the aiming symbol replaces the flight director, fixed at 0° depression and 0° azimuth to align with the missle seeker head. Station selection applies gyro turnup power to all missiles on the selected station. At the expiration of 3 minutes, the missile gyros are up to operating speed and the radar set and display are ready for complete operation. The MASTER ARM switch may be placed in the ARM position any time after entering the target area.

The following operational limitations apply to AGM-65A and AGM-65B carriage en route to the target area:

1. The missile shall not be maintained in the ready mode in excess of 33 minutes on any single mission.

2. The missile shall not be maintained in the full power mode (electrical alignment, slew, and track) in excess of 3 minutes on any single mission if the missile is to be launched and shall not be maintained in the full power mode in excess of 5 minutes on any single mission if the missile is not to be launched on that mission.

3. The missile operational limits stated in step 2 represent contractual missile capability in the worst case of mission environment. As a general rule, the missile may be operated for longer time periods in the full power mode if allowances are made for the thermal environment and if full power on time is kept to that specified in step 2 for any single launch attempt. A missile shall be momentarily deselected and a 5-second wait before uncaging (air ignite) shall occur each time the single pass time limits of step 2 are exceeded, prior to additional full power operation, to reset the autopilot roll null circuitry.

The missile shall not be launched under conditions which violate the following restraints:

1. Minimum speed of Mach 0.5; maximum speed of Mach 1.02.

2. Maximum gimbal offset angle of 15° for AGM-65A and 10° for AGM-65B; limited to 5° below line of sight for short ranges and low altitudes.

3. Maximum dive angle of 60°.

4. Maximum roll angle of 30°; maximum roll rate of 30° per second.

5. Maximum lateral load factor of 0.5 and longitudinal load factors of −0.5 to +0.9.

6. **Maximum vertical load factor upward of 0.5 and downward of 3.0.**

CAUTION

Do not exceed missile operating time limits.

To prevent vidicon sunburns, do not point the missile seeker head toward the sun while operating in the track mode.

Before selecting Maverick loaded stations on the ground, ensure that the throttle is inboard to the IDLE position to prevent inadvertent uncage of missiles by the ignite circuit.

If desired, the standby reticle may be turned on and adjusted to the missile boresight position (zero depression).

When in the target area, the air ignite button (located on the throttle) is momentarily actuated and the target contrast switch is positioned as desired. When pressed and released, the air ignite button provides signals to accomplish the following: mechanically uncage the missile seeker head; electrically drive and hold the missile seeker head to electrical boresight; jettison the missile dome cover; and provide seeker head video, including gate crosshairs, to the TV display until the missile is launched, jettisoned, rejected, or deselected. Early dome cover jettison will allow the pilot to optimize the video display prior to attack if a suitable target/background is available.

CAUTION

Premature uncage of the missile prior to expiration of the 3-minute gyro turnup each time the station is selected may result in guidance unit damage due to gyro tumbling, or if launched, the missile guidance may be subnormal. A momentary deselection of the station after gyro is up to speed will not result in appreciable slowdown of the seeker head gyro. A rapidly changing picture generally indicates gyro tumbling.

NOTE

Redundance in the air ignition system fires both ignitors simultaneously any time the air ignite button is pressed. An air restart attempt also completes the Maverick uncage function if the air ignite button is pressed and released when a station loaded with a Maverick missile is selected.

Premature air ignite button actuation may occur during internal gun firing. Should this occur after a Maverick station has been selected but prior to target lock-on, the radar may be reset to the normal mode by cycling the STATION SELECT switch off and back to RDY. Should an inadvertent air ignite button actuation occur after missile seeker head lock-on, the missile seeker must be locked on again by operation of the target designate button.

For the Maverick TV display to be available, the forward-looking radar must be turned on (STBY or any operating mode) prior to target acquisition with the NORM-OVERRIDE switch on the radar display in NORM. Three minutes are required for full radar power warmup. When the NORM-OVERRIDE switch is placed in OVERRIDE, the selected radar mode display replaces the TV display, provided the VISUAL ATTACK mode is not selected.

NOTE

If an operating mode is selected and interference is encountered on the TV display, the radar can be placed in STBY to eliminate the interference.

The three-position target contrast switch (located on the Generator Control panel) causes the selected missile to track a dark-on-light target or a light-on-dark target or to automatically select a tracking mode. When the switch is placed in the AUTO position, the missile seeker head determines from the overall brightness of the view which tracking mode to use. If the image within the crosshairs at target designation is not of the proper polarity (dark-on-light or light-on-dark), the seeker will search until an object with the proper polarity is found. It is therefore very important to ensure the target contrast switch is in the proper position prior to target designation. Target tracking capability is a function of target contrast. The switch does not affect the quality of the picture on the TV display.

The missile seeker head may be slewed using the Bullpup controller to provide azimuth and elevation commands. This slewing capability is enabled by pressing and holding the target designate button on the pilot's stick grip. When the target designate button is released, the slewing capability is interrupted and the seeker head is stabilized (locked on) on the selected aimpoint. If the target is in the gate when the target designate button is pressed, the pilot releases the button immediately and the seeker head locks on to the target. When the initial presentation on the TV display does not place the target within the gates, the pilot holds the target designate button and uses the Bullpup controller to refine aim. Seeker head lock-on is automatic when the button is released. Further aiming refinement during the attack profile is accomplished in the same manner. Once the missile seeker head is locked on a target, it will remain locked-on until the missile is deselected, rejected, or loses the target due to the target passing out of the seeker head field of view (over fly) or something coming between the target and the seeker head. The target can be rejected by depressing the air ignite button to electrically cage and boresight the seeker head. Slewing commands cause the seeker head to slew at a rate proportional to signal magnitude and in a direction corresponding to Bullpup controller movement (figure 1-39).

BULLPUP CONTROLLER MOVEMENT

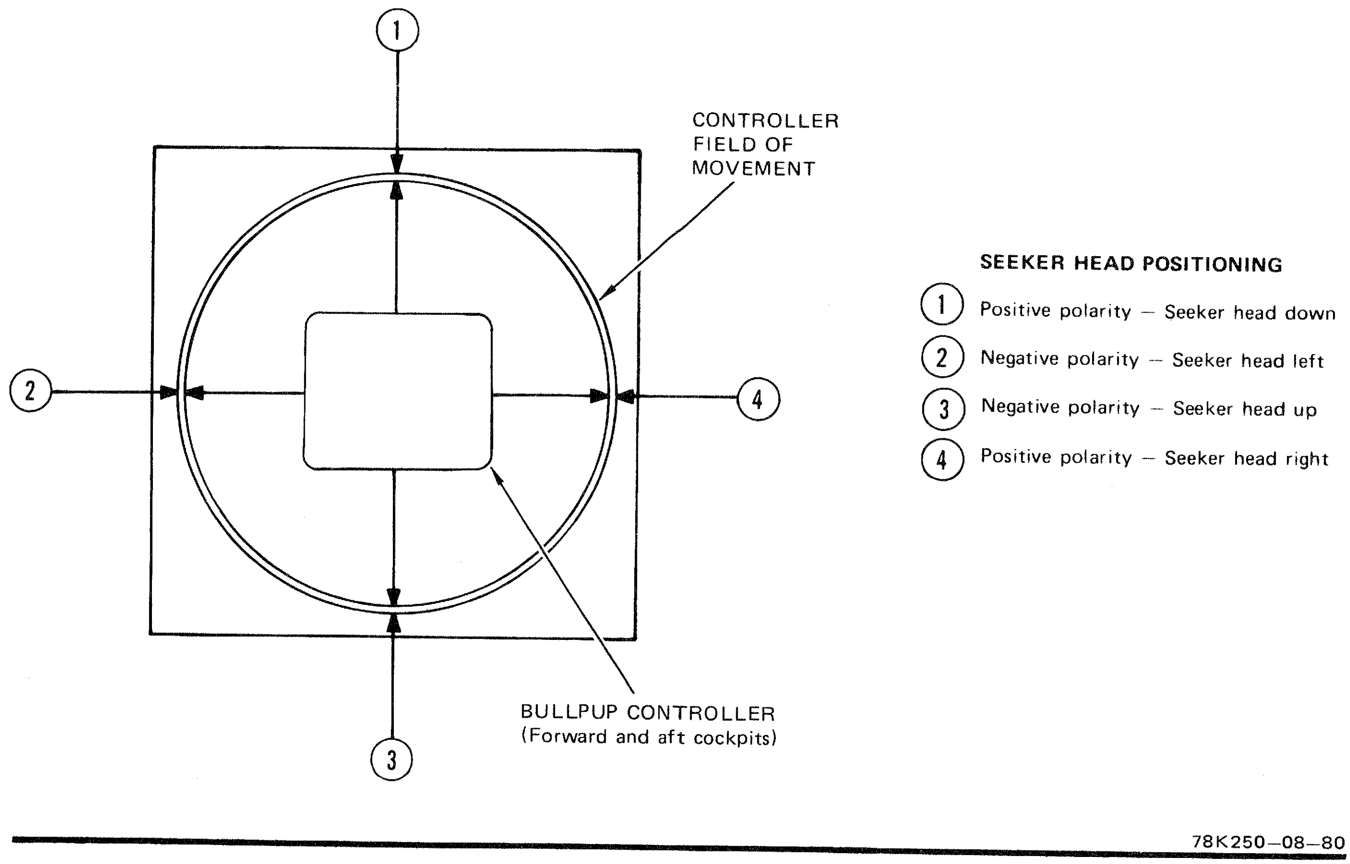


Figure 1-39

The uncage function takes priority over slew-enable and lock-on signals. This allows the pilot to return the seeker head to a boresight position at any time during the delivery profile.

A missile may be rejected by depressing the radar range/target reject switch on the throttle. The radar system is disconnected from the range/target reject switch when the ASCU switches from radar to TV mode. When a missile is rejected, the next priority missile on the same station is selected. A rejected missile may be reselected by momentarily interrupting the station select signal (cycling the station select switch to OFF then RDY).

NOTE

The ASCU does not have provisions to transfer to the next priority station on the opposite side of the aircraft following a reject signal. The next station will come into priority only by firing a missile or deselecting the station.

With the VISUAL ATTACK master function switch depressed or with the standby reticle turned on and set at zero depression, the pilot is provided with an aiming reference. Use of the HUD aiming symbol or the standby reticle as an aiming reference entails pressing and releasing the air ignite button to uncage and boresight the missile seeker head, selecting the desired target polarity, and flying the aircraft to overlay the target with the symbol/reticle. Pressing and releasing the target designate switch locks the missile seeker on the target. This procedure should provide target lock-on with minimal slewing (as fine adjustment) required prior to missile launch.

When a missile is launched, no further pilot action is required. The trailing edge of the launch signal (release of the armament release button) resets the uncage logic and the next station comes into priority. Figure 1-40 depicts the launch sequence with the maximum number of missiles loaded. Stations 2 and 7 can both be selected and will follow the release sequence shown. When an individual station is selected, missiles on that station will come into priority and be fired as shown by station 2 for the left wing and station 7 for the right wing.

CAUTION

The armament release button should be held depressed for approximately 2 seconds to assure missile launch. If the button is released prematurely, the missile batteries will be actuated, but the missile will not be launched.

The armament release button or air ignite button must be actuated prior to pulling off the target during simulated or actual missile attack. If the air ignite button is actuated, the station should be deselected momentarily. Actuation of the armament release button puts the TGM through a shutdown cycle, protects the vidicon from sun burns, and reduces the amount of heating due to full power mode (video on). Actuation of the air ignite button in lieu of a simulated or actual launch will protect the vidicon from sun burns, but leaves the missile/TGM in full power mode. Momentary deselection of the station will return the missile TGM to the ready condition (no video) and reduces the time the missile is operating in full power.

NOTE

A launched missile must physically separate from the launcher to enable the launcher to step to the next missile on the launcher. The armament release button must be held depressed until missile launch is confirmed.

During the missile attack, the NAV WD Computer continues making ground avoidance calculations to ensure the pilot has adequate notice of a pullup requirement. The TV display will start flashing on and off at two cycles per second approximately 2 seconds prior to the appearance of the pullup command on the HUD and will continue as long as the pullup command remains on the HUD. Ground avoidance calculations are performed only when VISUAL ATTACK is selected.

System Operation with Training Guided Missile.

The aircraft system is operated identically with both the live and training guided missile (TGM) with one major exception. The TGM has either ballast or a film recorder in place of a rocket motor and cannot be launched. Station selection, uncage, target designation, and seeker head slewing with the TGM loaded are performed in the same manner as with a live missile, and performance of these operations has the same results. When the pilot is tracking the selected target on the TV display, the TGM is recording on film the same picture the pilot is viewing. The film starts recording upon actuation of the air ignite button and ceases recording 1 second after actuation of the armament release button.

CAUTION

The TGM shall not be maintained in the full power mode (station selected, air ignite button actuated) in excess of 30 minutes on any single mission, and the sum of the ready mode (station selected, gyros running) and the full power mode periods on any single mission shall not exceed 40 minutes. No single simulated attack (start to stop of camera operation) shall be in excess of 3 minutes. Rest time of 3 minutes is recommended between simulated attacks.

NORMAL LAUNCH SEQUENCE

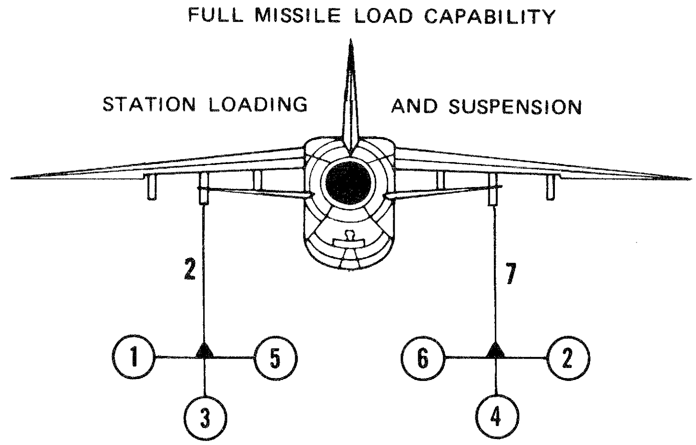


Figure 1-40

AGM-65 Delivery System Characteristics.

In addition to the requirements listed in Part 3 of this section, the weapon release system and weapon delivery system have characteristics which are peculiar to delivery of the AGM-65 Maverick missile. The following paragraphs discuss these characteristics, using the combined aircraft system and missile cluster as a complete system.

The Forward Looking Radar (FLR), which functions as a closed circuit television set, must be complete and functional to enable Maverick video display. The characteristics of the FLR during Maverick delivery are as follows:

1. All FLR modes are disabled when VISUAL ATTACK is selected.
2. With BOC selected, the FLR modes are not disabled. Upon depressing the air ignite button, missle TV video will be displayed on the FLR indicator.
3. The radar range switch is disconnected from the FLR when a Maverick station is selected, in release priority, and the air ignite button has been actuated (the missile is providing video to the FLR). In this case, the radar range switch functions as a missile reject switch with the following characteristics:

    a. The switch is not enabled until the air ignite button has been actuated.

    b. All missiles on a station may be rejected sequentially after one actuation of the air ignite button.

    c. Rejection of all (or the last) missiles on a station will not result in aircraft station transfer. In this case, only deselection of the station will allow aircraft station transfer.

    d. Rejection of the last missile on a station will not result in the first missile coming back into priority. After the launcher has stepped through all stations, it will return to the first loaded station only after the STATION SELECT switch is cycled.

e. Actuation of radar range switch does not result in boresighting of the rejected missile seeker. The seeker will be mechanically caged in the position it was in at switch actuation.

4. No cockpit controls have any effect on the quality or contrast of the video display except the FLR contrast and brilliance controls.

5. The TV light (indicating TV available from the launcher) is independent of the NORM-OVERRIDE switch and will be on whenever video is available.

6. The FLR will continue operating in the preset mode after Maverick station selection and radar will be displayed until air ignite button actuation.

The air ignite button functions to turn on the video display from the selected missile and has the following characteristics:

1. The air ignite button will not function unless the missile is on the highest priority station selected.

2. The automatic air ignite system is not connected to the air ignite button and has no effect on the missiles.

3. Attempted air restarts of the engine with the air ignite button will complete the Maverick video function, provided engine rpm is above approximately 44% (main generator still operating).

The switches on the Armament Release panel have the following characteristics:

1. A QUANTITY switch selection of 00 inhibits all releases; selection of 01 or higher enables one release per actuation of the armament release button.

2. A SINGLE/PAIRS/SIMULT switch position of SIMULT inhibits release; PAIRS position inhibits release if only one station or priority asymmetrical stations are selected; PAIRS position reverts to single release sequence if priority symmetrical stations are selected; SINGLE position allows release (firing) of selected missiles in single release sequence shown in figure 1-40.

3. The INTERVAL-FT switch has no application in Maverick missile delivery.

The switches on the ARMT panel have the following characteristics and functions:

1. The MASTER ARM switch enables missile firing only and has no effect on the presence or absence of video, or the functioning of the radar range switch, Bullpup controller, or target designate button.

2. The STATION SELECT switches establish release priority and apply gyro turnup power to all missiles on selected stations. If nonmissile stations of a higher priority are selected, the Maverick function of the air ignite button is disabled and video display is not available. If a fuselage station is selected after a missile has been selected, all Maverick functions are inhibited, the video display is lost, and the FLR will revert to the AGR mode.

The HUD has the following characteristics and functions:

1. Only VISUAL ATTACK and BOC mode selection will provide Maverick symbology. Selection of other attack modes causes the HUD to retain en route symbology.

2. Selection of a fuselage station and a Maverick station with VISUAL ATTACK selected causes the HUD to revert to air-to-ground guns symbology. If guns (internal or pods) are also selected, the symbology will be air-to-air guns.

The missile cluster (launcher and AGM-65 missiles) has the following characteristics and functions:

1. The launcher contains a launch interlock circuit which requires that the priority missile be commanded to track (i.e., the designate button has to be pressed and released) before missile launch (armed and guided) can be performed. The interlock circuit is bypassed when auxiliary jettison (unarmed and unguided launch) of the missile is performed.

2. The launcher contains internal circuitry which controls the firing sequence, depending on which side of the aircraft the launcher is on (firing sequence is always outboard to inboard).

3. Empty launcher positions are automatically bypassed.

4. Once the launcher has sequenced through all positions, it goes to a home position and will not begin the cycle again until the STATION SELECT switch is cycled.

5. Station selection causes the launcher to seek the first loaded station in firing priority. If no missiles are loaded, the launcher provides a launcher empty signal to the aircraft which results in aircraft station transfer.

6. The position of the MASTER ARM switch has no effect on launcher or missile operation. The MASTER ARM signal is used internally within the ASCU to enable missile launch.

7. Transfer from one launcher rail to another requires a missile reject signal (radar range switch) or missile umbilical separation and armament release switch release (trailing edge of firing pulse). During missile launch attempt, if armament release button is released prior to missile motor ignition or if the motor fails to fire, the launcher will not transfer to the next loaded rail. Aircraft station transfer (rapid launch procedure) is independent of launcher rail transfer and will occur upon release of the armament release button. After the armament release signal has been completed, the ASCU reestablishes priority of stations according to its internal priority logic.

8. Each missile is equipped with a sun shutter to protect the camera system from direct exposure to sunlight. The shutter is normally closed, will open upon missile selection, close when the missile is within approximately 20° of the sun, and close when the missile is rejected or deselected. The sun shutter logic is inoperative in the track mode and will not protect the vidicon from burns.

9. The missile gyros require a minimum of 2 minutes and a maximum of 3 minutes after station selection to reach operating speed. Premature actuation of the air ignite button (uncage signal) could result in gyro tumbling and missile seeker damage.

10. The TGM functions identically to the AGM, except that it simulates launch by starting a shutdown sequence at armament release button depression. Video is lost 1 second later. Video is reacquired by depressing air ignite, and another simulated launch sequence may be performed.

The armament advisory lights function as follows:

1. Station selected lights come on when a station is selected, a quantity of 00 is not selected, and SINGLE or PAIRS (with symmetrical stations selected) is selected.

2. Station ready lights come on under the same conditions as station selected lights with the additional requirement that MASTER ARM switch must be in ARM.

3. The station selected and station ready lights will come on as outlined in the preceding paragraphs, regardless of the readiness of the missile(s).

4. The GUIDED WEAPON light comes on when a station is selected for which the ASCU is set on BT (Maverick).

5. The above advisory lights will go out when the station(s) is deselected, select or salvo jettisoned, or all missiles on station are launched.

GBU-8 SERIES GUIDED BOMB DELIVERY.

The GBU-8 series guided bomb is a video (television) guided glide bomb. The A-7K has the capability to carry and deliver a total of four bombs per mission. The aircraft also has the capability of boresighting the HUD aiming symbol with the seeker head of bombs on individual stations. This boresighting is conducted while airborne en route to the target area and is performed on the individual bombs in any order. However, only the priority selected station can be boresighted at any one time.

Airborne Alignment.

Alignment is performed by selecting all stations to be boresighted and depressing the VISUAL ATTACK master function switch. On the HUD the aiming symbol replaces the flight director and is fixed in position on the zero sight line or at a location corresponding to boresight from a previous flight. The priority bomb must remain selected at least 5 minutes before any further control operations. Additionally, the radar must be in the STBY or any operating mode for at least 3 minutes before attempting to obtain a video display and the NORM-OVERRIDE switch must be in the NORM position.

CAUTION

The air ignite button must not be actuated to uncage the bomb seeker head prior to the completion of the 5-minute bomb warmup time. The gyros must be allowed to turn up for this period to reach full speed before mechanical uncage or damage to bomb seeker head may occur.

Before selecting GBU-8 series loaded stations on the ground, ensure that the throttle is inboard to the IDLE position to prevent inadvertent uncage of the bomb seeker head by the air ignite circuit.

NOTE

Premature air ignite button actuation may occur during internal gun firing. Should this occur after a GBU-8 loaded station has been selected but prior to planned weapon uncaged, the radar may be reset to the normal mode by cycling the station select switch OFF and back to RDY.

At the expiration of the 5-minutes bomb warmup time and after deselecting any bomb station higher in priority than the bomb to be boresighted, the air ignite button (located on the throttle) is actuated, applying station select power to the selected bomb to mechanically uncage the bomb seeker head. On the radar scope, the radar display is replaced by the video display as seen by the selected bomb. The pilot must select an easily discernible distant object and fly the aircraft so as to place the object within the video crosshairs. The aiming symbol is then slewed with the Bullpup controller to overlay the same object. When the aiming symbol overlies the object within the video crosshairs, the target designate button is actuated to enter the aiming symbol offset into the NAV WD Computer. Target designate button is actuated again to return the bomb seeker head to the boresight position and the station is deselected. Then the next station to be boresighted is selected and the procedure repeated. In order to minimize parallax error, the boresight may be accomplished on another aircraft flying in front of the GBU-8 loaded aircraft at a distance approximately equal to the slant range to be encountered during weapon delivery. The boresight may be expedited by accomplishing the procedure in release priority sequence so that lower priority stations will be at full speed when placed in priority.

Bomb Delivery.

Prior to entry into target area:

At least 5 minutes prior to entry into the target area, the bomb station(s) to be delivered is selected and the radar is placed in STBY or any operating mode. The FUZE switch is positioned to TAIL or NOSE/TAIL to enable power to be applied to the bomb guidance unit batteries and to energize the appropriate bomb rack arming solenoids. The NORM-OVERRIDE switch is placed in the NORM position to enable the TV display and the QUANTITY switch is positioned to 01.

NOTE

If an operating mode is selected and interference is encountered on the TV display, the radar can be placed in STBY to eliminate the interference.

Five minutes after station selection, the bomb batteries and video are checked and readied as follows:

1. Position the MASTER ARM switch to ARM. All station selected lights will go off.
2. Deselect all stations except the lowest priority station (station priority is 1, 8, 2, 7, 3, 6).
3. Momentarily depress the air ignite button. The radar scope will display the video as seen by the selected bomb. The video display should be clear and stable.
4. Momentarily actuate the radar range/target reject switch to fire the bomb batteries. Verify that the green station ready light comes on within 5 seconds.

5. Momentarily actuate the radar range/target reject switch to return the bomb to aircraft power. Verify that the green station ready light goes off.

6. Select the next highest priority station and allow at least 2 minutes for the bomb gyro to return to operating speed.

7. Repeat steps 3 through 6 for each bomb to be delivered within 1 hour.

NOTE

This procedure is performed at least 5 minutes prior to target area entry with one bomb. Add 2 minutes to the 5 minutes for each additional bomb to be delivered.

Maximum accumulated time for bomb operation on aircraft power after the battery is activated is 1 hour after which time weapon must be considered inoperative.

After all bomb batteries and video are checked, position the MASTER ARM switch to OFF until ready to begin the attack run. The station(s) to be delivered will remain selected to maintain the bomb gyros at operating speed and reduce the time required during the attack run. The bomb batteries will last a maximum of 1 hour operating on aircraft power after being activated. The guidance unit vidicon is temperature-sensitive and operating life can be reduced to as little as 35 minutes while operating at low altitudes on hot days. The mission briefing should include vidicon operating limits to be expected in the target area and mission profile to be flown.

If use of the radar display is desired upon completion of the above procedures, position the NORM-OVERRIDE switch to OVERRIDE. This will cause the selected radar operating mode to be displayed on the radar scope, replacing the video display.

If VISUAL ATTACK was selected during the above procedures (this is optional), en route HUD displays (flight director, etc) can be regained only by deselecting the attack mode.

Upon entry into target area:

Upon entry into the target area but before beginning the final attack run, position the NORM-OVERRIDE switch to NORM. Depress the VISUAL ATTACK master function switch or turn on the standby reticle and set to zero depression to obtain an aiming reference. Position the MASTER ARM switch to ARM to enable the bomb arming and release circuits.

Just prior to roll-in, momentarily depress the radar range/target reject switch to put the bomb on internal power (PCO) and verify that the green station ready light comes on. The bomb must impact the target within 5 minutes of PCO in order for the batteries to last through the bomb time of fall.

Having performed all of the above procedures prior to roll-in on the target, the bomb is ready for target designation and armed release. If VISUAL ATTACK is selected, the HUD aiming symbol will supply an aiming reference to place the target within the video display. If VISUAL ATTACK is not selected, the standby reticle may be used as an aiming reference. Pilot action required is to fly the aircraft to place the aiming symbol/standby reticle over the target, refer to the video display, and fly the aircraft to place the target within the video crosshairs. With the target within the crosshairs, momentarily actuating the target designate button will cause the bomb seeker head to lock on to the target. After verifying seeker head lock-on, the bomb is released with the armament release button. The video display of the next bomb in priority will appear on the radar scope upon release of the armament release button with the bomb ready for PCO and target designation. However, the previously released station must be deselected to cause the aiming symbol to move to the seeker boresight position of the next bomb.

CAUTION

If PCO was accomplished and the weapon was not released, aircraft power must be maintained on the weapon to prevent vidicon damage until the weapon battery is removed or the weapon is returned to internal power for a subsequent release within the 1-hour time limit. Do not deselect the station with the unreleased weapon except when necessary to move the aiming symbol to seeker boresight position for release of bombs on lower priority stations. Total cumulative time of station deselection should not exceed 5 minutes.

During the bomb attack with VISUAL ATTACK selected, the NAV WD Computer makes ground avoidance calculations before designation and blast and ground avoidance calculations after designation to ensure the pilot has adequate notice of a pullup requirement. The TV display will start flashing on and off at two cycles per second approximately 2 seconds prior to the appearance of the pullup command on the HUD and will continue as long as the pullup command remains on the HUD. The ground and blast avoidance calculations are not made and the pullup command will not appear if VISUAL ATTACK is not selected.

GBU-8 Delivery System Characteristics.

In addition to the requirements listed in Part 3 of this section, the weapon release system and the weapon delivery system have characteristics which are peculiar to delivery of the GBU-8 guided bomb. The following paragraphs discuss these characteristics, using the combined aircraft system and guided bomb as a complete system.

The Forward-Looking Radar (FLR), which functions as a closed circuit television set, must be complete and functional to enable GBU-8 video display. The characteristics of the FLR during GBU-8 delivery are as follows:

1. All FLR modes are disabled when VISUAL ATTACK is selected.
2. The radar range switch will not perform its usual FLR functions when a GBU-8 station is selected, in release priority, and the air ignite button has been actuated; i.e., the bomb is providing video to the FLR. In this case, the radar range switch functions as a power change over (PCO) switch with the following characteristics:
   a. The switch is not enabled until the air ignite button has been actuated once.
   b. STATION SELECT, FUZE (TAIL or NOSE/TAIL), and MASTER ARM switches must be selected to allow PCO.
   c. The first actuation of the switch effects a change of power supply from aircraft power to bomb power by firing two internal bomb thermal batteries. When the bomb senses correct battery voltage, internal bomb logic allows the ASCU to cause the appropriate station ready light to come on.
3. No cockpit controls have any effect on the quality or contrast of the video display except the FLR contrast and brilliance controls.
4. The TV light (indicating TV signal available from bomb) is independent of the NORM-OVERRIDE switch and will be on whenever video is available.
5. The FLR will continue operating in the preset mode after GBU-8 station selection and radar will be displayed until air ignite button actuation.

The air ignite button functions to turn on the video display and mechanically uncage the highest priority bomb selected and has the following characteristics:

1. The air ignite button will not function unless the bomb is on the highest priority station selected. Once actuated, video from that bomb is continuously available until the bomb is released or the station deselected; the button does not have to be reactivated to obtain video display following release of a bomb from a higher priority station.
2. The automatic air ignite system is not connected to the air ignite button and has no effect on the bombs.
3. Attempted air restarts of the engine with the air ignite button will complete the GBU-8 video function, provided engine rpm is above approximately 44% (main generator still operating).
4. The air ignite button will not electrically cage the bomb vidicon.

The switches on the Armament Release panel have the following characteristics:

1. A QUANTITY switch selection of 00 inhibits release.
2. A SINGLE/PAIRS/SIMULT switch position of SIMULT inhibits release; PAIRS position inhibits release if only one station or priority asymmetrical stations are selected; PAIRS position reverts to single release sequence if priority symmetrical stations are selected; and SINGLE position allows release of selected bombs in single release sequence.
3. The INTERVAL-FT switch has no application in GBU-8 bomb delivery.

The switches on the ARMT panel have the following characteristics and functions:

1. The MASTER ARM switch enables bomb release only and has no effect on the presence or absence of video or the functioning of the air ignite button or target designate button.

2. The STATION SELECT switches establish release priority and apply gyro turnup power to the bombs on selected stations. If higher priority stations, loaded with other than GBU-8 bombs, are selected, all GBU-8 functions (excluding gyro spinup) are inhibited, video display is lost, and the FLR will revert to the AGR mode.

The HUD has the following characteristics and functions:

1. Only VISUAL ATTACK mode selection will provide GBU-8 symbology. Selection of other attack modes causes the HUD to retain en route symbology.

2. Selection of a fuselage station and a GBU-8 station with VISUAL ATTACK selected causes the HUD to revert to air-to-ground guns symbology. If guns (internal or pods) are also selected, symbology will be air-to-air guns.

The TARGET CONTRAST switch has no application in GBU-8 bomb delivery.

The armament advisory lights function as follows:

1. Station selected (STA #) lights come on when a station is selected, a quantity of 00 is not selected, and SINGLE or PAIRS (with symmetrical stations) is selected.

2. Station ready (# RDY) come on after the following switches are actuated: STATION SELECT to RDY, FUZE to TAIL or NOSE/TAIL, MASTER ARM to ARM, and radar range switch actuated and correct battery voltage sensed by bomb.

3. The GUIDED WEAPON light comes on when a station is selected for which the ASCU is set to BK (GBU-8).

4. The above advisory lights will go out when the station(s) is deselected, select or salvo jettisoned, or the bomb on the station(s) is released. Additionally, the station ready (# RDY) light will go out when the radar range switch is pressed a second time (and subsequently every other time) transferring the bomb back to aircraft power.

NOTE

Turning the MASTER ARM switch to OFF or the FUZE switch to SAFE will also transfer the bomb back to aircraft power.

MANUAL BOMBING AND FLARE DELIVERY.

There are two manual modes, manual and manual ripple. Manual modes may be used for the delivery of weapons when an electronic failure in the NAV WD system precludes the use of a computed mode, or when a noncomputed weapon is selected. Manual modes also may be selected by the pilot at any time a manual delivery is desired.

The manual mode is initiated by nonselection or deselection of any computed attack mode. The standby reticle on the HUD is used for aiming. Standby reticle depression angles from applicable bomb tables are used for the desired type of manual delivery. Selection of weapon quantity and either single or pairs delivery is made through the ARMAMENT RELEASE panel. If a quantity of one is selected, a single fire pulse is transmitted immediately upon depression of the armament release button, independent of the status of the NAV WD Computer.

For a manual ripple delivery, the NAV WD Computer must be operating. The standby reticle is used to determine release point and bomb release begins when the armament release button is pressed and held. The spacing set in the INTERVAL/FT thumbwheel is available only when the aircraft is in straight and level flight. If a dive delivery is used, the interval will be less than that selected. To determine bomb spacing in manual ripple for dive attacks, refer to Section VI.

NOTE

When calculating the spacing between impact points for manual ripple release, ensure that the release interval obtained is equal to, or greater than, the MRI for the weapon and release mode to be used.

Ripple release of flares or target markers using the NAV WD Computer as an intervalometer is not possible. When releasing flares from a dispenser, the dispenser intervalometer can be used; however, the interval must be set prior to takeoff and cannot be changed. Also, there is no way of setting the number of flares to be released and the pilot must count the flares as they are dispensed. Refer to Part 6 in this section for description and intervalometer settings of each flare dispenser.

GUN AND ROCKET ATTACKS.

COMPUTED AIR-TO-AIR GUNNERY.

Initiation.

Initiation is accomplished by selection of the HIGH or LOW position of the GUN switch or selection of a wing station loaded with SUU-23/A gun pod and ensuring that no master function switch (attack or TF) is depressed. The NAV WD Computer positions the aiming symbol on the HUD to indicate required target tracking position at a nominal 1,600 feet of range. The lead angle computation is based on angular rate assuming a co-speed target and 0.56-second projectile time of flight. Airspeed differences between the aircraft and the target up to 50 KTAS have negligible effect on accuracy. At airspeed differentials of 100 KTAS or more, the pilot should correct by 1 mil per 100 knots difference. Target pullaway requires more lead and overtake requires less lead. With the current OFP, the NAV WD Computer does not correct aiming symbol placement for the effects of angle of attack or air density; however, the NAV WD Computer does correct aiming symbol placement for parallax and gravity drop. Gravity drop is computed for a maximum range of 1,600 feet with a 0.56-second projectile time of flight. The flight director remains displayed on the HUD indicating steering error to the destination (or MARK) selected on the NAV WD Computer control panel FLY TO switches.

Air-to-air gunnery symbology is also obtained by selecting either of the two fuselage stations, any computed attack mode, and either the internal gun or a gun pod station. The HUD symbology will be as previously described, except the flight director will not be displayed.

Aiming and Gun Firing.

The NAV WD Computer solution and the pilot's corrections described below are all based on 0.56-second projectile time of flight. Therefore, the pilot must maneuver to achieve a firing position which results in a 0.56-second time of flight, nominally 1,600 feet behind the target. The known wingspan (feet) of the target divided by 1.6 (feet per mil) determines the number of mils on the HUD which the wingspan will cover at 1,600 feet. For example, a target with a wingspan of 40 feet is at correct firing range when the target wingspan fills exactly 25 mils on the HUD (40 ft ÷ 1.6 ft/mil = 25 mils). The standby reticle rings are 25 mils apart and provide a convenient reference.

When at the correct range, the pilot must determine the required corrections to the NAV WD Computer's tracking solution, and then he must fly to establish and hold the correct tracking relationship between the aiming symbol and the target.

Figure 1-41 illustrates a sight picture for firing at the proper range with pilot corrections for a typical air combat situation. During training with a dart or banner, careful use of the preceding techniques will improve the percentage of hits achieved. Considering rate of fire, target size, and bullet dispersion, chances are good for a lethal hit. Use of a tracer mix will greatly enhance fine aim adjustments.

Gun firing is the same in all gun modes, whether computed or manual. The pilot exercises complete control over the time and length of each firing burst and the rate of fire during each burst. Although the length of each burst is unrestricted, short bursts (1 to 3 seconds) are recommended.

TYPICAL AIR-TO-AIR GUNNERY AIMING CORRECTIONS

CONDITIONS:
- 1600 FT FIRING RANGE
- 5000 FT MSL, 400 KIAS
- TRACKING WITH 4G AND 14 UNITS AOA
- TARGET 30 FT WING SPAN

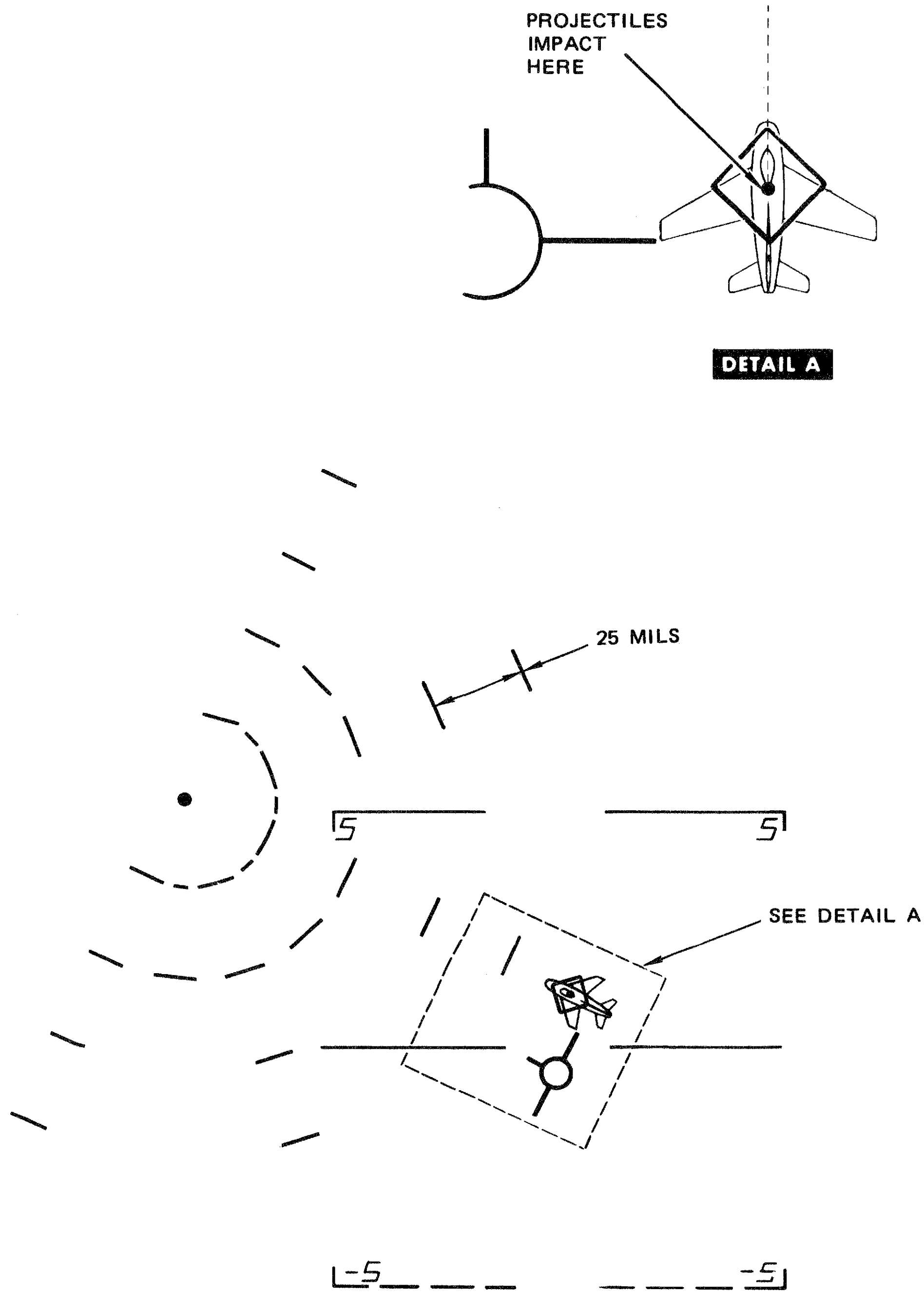


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Figure 1-41

MANUAL AIR-TO-AIR GUNNERY.

Initiation, Aiming, Gun Firing.

Initiation is accomplished by turning on the standby reticle, setting the MILS DEPR knob to the trajectory shift correction value listed in the following table and selecting the HIGH or LOW position of the GUN switch or selecting a wing station loaded with a gun pod. Aiming is done by pilot's eye, with the pilot estimating the amount of firing lead required. The standby reticle indicates approximately where the rounds will go when in straight and level flight and gives a gage of known size to aid the pilot in estimating range to the target. The pilot must estimate firing lead and projectile gravity drop by flying the aircraft to place the center of the standby reticle ahead of and above the target in its flightpath.

TRAJECTORY SHIFT CORRECTIONS

Angle of Attack	*Trajectory Shift*	
	350 KTAS	*500 KTAS*
8.5 units	0	0
10.0 units	5 mils	7 mils
12.0 units	11 mils	15 mils
14.0 units	17 mils	23 mils
16.0 units	23 mils	31 mils
18.0 units	29 mils	39 mils
20.0 units	35 mils	47 mils

COMPUTED AIR-TO-GROUND GUNNERY.

Initiation.

Initiation is accomplished by selection of the HIGH or LOW position of the GUN switch or selection of a wing station loaded with SUU-23/A gun pod and depression of any attack mode master function switch with no rocket or computed bomb loaded station selected. On the HUD, the pullup anticipation cue appears and the flight director is replaced by the aiming symbol, which indicates computed projectile impact point on the ground (figure 1-42). The Forward-Looking Radar (FLR) automatically enters the Air-to-Ground Ranging (AGR) mode, slaved to the aiming symbol position, and begins radiating. Target designation is not applicable in the computed air-to-ground gunnery mode and the Bullpup controller is inoperative.

The computation for aiming symbol positioning accounts for airspeed, g load, dive angle, and projectile velocity, ballistics, and gravity drop. The computation does not account for the horizontal offset of the gun pods from the internal gun (approximately 4 feet for station 3 and 6 feet for station 6).

Aiming and Gun Firing.

Aiming is accomplished by flying the aircraft to place and hold the aiming symbol on the target. The same is accomplished when placing the aiming symbol below and tracking through the target. Refer to Computed Air-to-Air Gunnery description in this section for a discussion on SUU-23/A gun pod boresight and its effect on gun pod firing and aiming symbol placement. When within 8,192 feet slant range of the ground position under the aiming symbol, an in-range cue appears atop the aiming symbol. Gun firing should be delayed until the in-range cue appears. The in-range cue will blink at a rate of five times per second when FLR range information is requested by the NAV WD Computer and the AGR data are not valid. The time, rate, and length of gun firing bursts is controlled by the pilot through the trigger without regard to aiming symbol location or presence of in-range cue.

The movement of the pullup anticipation cue and the appearance of the pullup command are a function of altitude, airspeed, and dive angle. The pullup command will appear when an immediate 4g pullup is required for ground avoidance. Blast avoidance is not computed for air-to-ground gunnery.

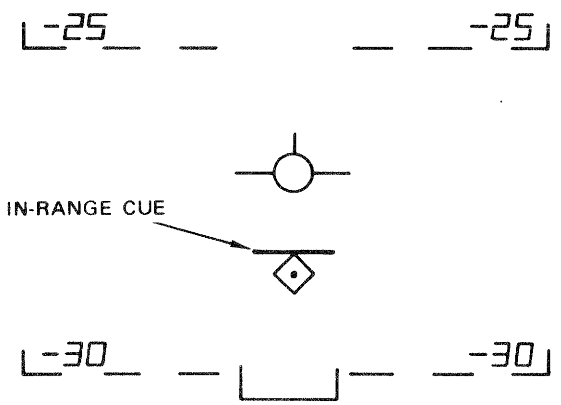
The laser target symbol (LTS) will be present on the HUD display if the TISL is tracking; however, the LTS display is for visual reference only.

MANUAL AIR-TO-GROUND GUNNERY.

Initiation, Aiming, and Gun Firing.

Initiation is accomplished by selecting the HIGH or LOW position of the GUN switch or selecting a wing station loaded with a gun pod, turning on the standby reticle, and rotating the MILS DEPR knob to the

HUD SYMBOLOGY FOR ROCKETS AND AIR-TO-GROUND GUNNERY



Bullpup controller commands not applicable.

Bomb fall line/azimuth steering line not displayed.

Aiming symbol indicates computed impact point.

An in-range cue is displayed atop the aiming symbol when slant range to the computed impact point is less than a preset value (8,192 feet for guns, 14,366 feet for rockets).

Target designation not applicable.

Pullup cue positioned on imaginary line through flightpath marker, parallel to the HUD vertical axis.

NAV WD Computer initiates air-to-ground ranging mode for Forward Looking Radar slaved to impact point.

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Figure 1-42

depression determined by the flight parameters planned. The standby reticle depression is determined using the sight depression tables in T.O. 1A-7K-34-1-2. Refer to Section V for directions and examples of determining standby reticle depression. Pullup must be estimated if the HUD or NAV WD Computer is not operational as the pullup command will not appear.

COMPUTED ROCKET ATTACKS.

NOTE

Rocket ballistics included in the OFP are based on the Mk 1 warhead/Mk 4 motor. Rocket firing using other warhead/motor combinations must be made in the manual mode.

Initiation.

Initiation is accomplished by selecting a station loaded with rockets (except TDU-11/B) and depressing any attack mode master function switch. On the HUD, the pullup anticipation cue appears and the flight director is replaced with the aiming symbol, which indicates computed rocket impact point on the ground (figure 1-42). The Forward-Looking Radar (FLR) automatically enters the Air-to-Ground Ranging (AGR) mode, slaved to the aiming symbol position, and begins radiating. Target designation is not applicable in the computed rocket attack mode and the Bullpup controller is inoperative.

The computation for aiming symbol positioning accounts for aircraft airspeed, g load and dive angle and rocket velocity, ballistics, and gravity drop.

Aiming and Firing.

Aiming is accomplished by flying the aircraft to place and hold the aiming symbol on the target. When within 14,366 feet slant range of the ground position under the aiming symbol, an in-range cue appears atop the aiming symbol. If possible under the attack conditions, rocket firing should be delayed until the in-range cue appears. The in-range cue will blink at a rate of five times per second when FLR range information is requested by the NAV WD Computer and the AGR data are not valid. The rockets are fired using the armament release switch at any time during the attack regardless of slant range to the target.

Although the in-range cue appears at 14,366 feet slant range and the aiming symbol positioning accounts for rocket ballistics, serious degradation of rocket accuracy can be expected at ranges in excess of 10,000 feet AGL. This is due to many factors, such as age of the rocket motor, wind effect at lower altitudes, and the accuracy tolerances of the system itself. Due to this degradation of accuracy, rocket firing should be performed at the shortest slant ranges possible consistent with safety and target area considerations, such as ground fire.

The movement of the pullup anticipation cue and the appearance of the pullup command are a function of altitude, airspeed, dive angle, and a 1,500-foot blast radius around the computed impact point. The pullup command will appear when an immediate 4g pullup is required for blast avoidance.

MANUAL ROCKET ATTACKS.

Initiation, Aiming, and Firing.

Initiation is accomplished by selecting a station loaded with rockets, turning on the standby reticle, and rotating the MILS DEPR knob to the depression determined by the flight parameters planned. The standby reticle depression is determined using the rocket ballistic tables, zero sight line angle-of-attack chart, sight setting tables, range tables, and wind correction tables in T.O. 1A-7K-34-1-2. Refer to Section V for directions and examples of determining standby reticle depression. Pullup must also be preplanned. If the HUD or NAV WD Computer are not operational, the pullup command will not appear.

PART 3 – AIRCRAFT WEAPON RELEASE SYSTEM

GENERAL.

The weapon release system consists of all equipment required to arm and release or fire munitions mounted on wing and fuselage stations, and to arm and fire the M61A1 20mm gun. In itself, the system provides for manually sighted delivery with single release of bomb-type munitions, manually sighted air-to-ground gunnery and rocket attacks, and manually sighted air-to-air gunnery. When interfaced with the NAV WD Computer, the two systems provide five fully computed bombing modes with either single or multiple weapon releases per pass, one manually sighted bombing mode with multiple weapon releases, computed sight air-to-ground gunnery and rocket attacks, and computed sight air-to-air gunnery. For detailed description of the computed modes and the NAV WD Computer, refer to Part 2, Navigation/Weapon Delivery System.

The weapon release system consists of cockpit mounted controls and indicators, Armament Station Control Unit (ASCU), and weapon suspension equipment. The aircraft weapon suspension equipment is discussed in Part 5.

SAFETY SWITCHES.

The weapon release system incorporates the following safety switches. These switches are designed to prevent hazardous conditions occurring from component malfunctions or erroneous switch settings.

LANDING GEAR HANDLE SWITCH.

The landing gear handle switch is located beneath the left console at the left forward end of the gear handle channel. It is a momentary type switch and is always depressed when the gear handle is in the WHLS UP position. This switch must be depressed to complete circuitry for master arm power and gun operation. When unactuated (landing gear handle in WHLS DOWN) the switch may be bypassed with the armament safety disable (ARM SAFETY DISABLE) or the gear handle simulator (GR HANDLE SIM) switch for ground checkout of the aircraft weapon release system.

GEAR UP AND LOCKED SWITCH.

The gear up and locked switch is located in the left main wheel well. Jettison from stations 3 and 6 is dependent on the switch being in the gear up and locked position. Interruption of stations 3 and 6 jettison circuitry, until the gear is up and locked, is necessary because the gear is in the path of stores dropped from these stations. If this switch malfunctions in the gear down position, stores on stations 3 and 6 cannot be jettisoned.

GUN GAS PURGE SYSTEM SAFETY DEVICES.

A switch, located in the gun gas purge door combing, is actuated by the gun gas purge door opening. If for any reason, the door fails to open, this switch inhibits gun firing. Also, if there is insufficient engine bleed air passing over a sensor to purge the gun compartment, gun firing is inhibited. These inhibitions on gun firing will also prevent the gun system (barrels, drum, and feed and return chutes) from rotating.

COCKPIT CONTROLS AND INDICATORS.

The cockpit controls consists of the armament (ARMT) panel, armament release (ARMAMENT RELEASE) panel, and pilot's stick grip. When the AIM-9 air-to-air missile is being used, the audio control (AUDIO) panel is added to the above. The armament panel contains all switches necessary to select and arm all wing and fuselage stations and the switches necessary to select the rate of fire for and to arm the M61A1 gun. The panel also contains the select jettison (SEL JETT) and auxiliary jettison (AUX JETT) switches discussed in Part 4, Jettison Controls.

The armament release panel contains switches for selecting the sequence of release, the number of release pulses, and the spacing between releases. This panel is used primarily in the five computed or the manual ripple bombing mode. The switches on this panel have no effect on the operation of the fuselage stations or the gun.

The pilot's stick grip contains the target designation and armament release buttons and trigger switch. For detailed description of the target designate button and its functions, refer to Part 2, Navigation/Weapon Delivery System. The audio control panel is used when launching the AIM-9 air-to-air missile.

The armament advisory light panel contains placarded lights which advise the pilot which stations are selected, the munitions on those stations, the munition's fuzing requirements, if any, and the ready status of each selected station.

Cockpit controls and indicators are illustrated in figure 1-43.

ARMAMENT STATION CONTROL UNIT (ASCU).

The Armament Station Control Unit (ASCU), located in the left avionic bay, provides the necessary control and release or jettison functions for all weapons and external stores, with the exception of ECM pods and fuel tanks. Jettison capability only is provided for ECM pods and fuel tanks.

When two or more stations are selected for release of stores, the control logic section of the ASCU determines, by a built-in station priority system, what the exact sequence of release will be from the stations selected. The point in the release sequence where transfer occurs from an empty station to the next station in priority is also determined in the control logic section.

Three types of release are provided for in the ASCU. These are determined by the SINGLE/PAIRS/SIMULT switch on the armament release panel. When in SINGLE sequence, one weapon is released from a selected station with each release pulse with wing station priority being 1, 8, 2, 7, 3, 6. When in P AIRS sequence, two weapons are released at a time, one each from a symmetrical pair of stations with each release pulse. Station priority is 1 and 8, 2 and 7, 3 and 6. Stations 4 and 5, when selected, always have priority over wing stations, but are independent of the SINGLE/PAIRS/SIMULT switch. The SIMULT sequence provides for the simultaneous release of only rockets or vertical dispensers with one release pulse from all selected wing stations.

The ASCU panel provides two store type pushbutton switches for each wing station. Each switch provides positions marked with letters corresponding to the code which is assigned to each individual store. Before flight, each station store type switch is set with the code which identifies the store carried on that station. See figure 1-44 for a summary of ASCU store codes. When a station is selected and in priority, the weapon type for that station is transmitted to the NAV WD Computer. The two digit code for the weapon enables the computer to determine ballistics, retardation delay times, ejection velocity, and use of the 1,500-foot blast radius limitation. The ASCU supplies the electrical outputs necessary to arm and release or jettison the specific external store present and selected. Computed release will be impossible if a code is selected for which ballistics are not available. If the pilot sets the switches for a computed release, the BFL will not be displayed on the HUD. In addition, the ASCU completes circuitry for armament advisory light indications when stations (stores) are selected.

The ASCU contains built-in equipment (BITE) for detecting faults within the ASCU. BITE is initiated by placing the BITE switch in TEST. After approximately 20 seconds, while the ASCU cycles through the release sequence for all weapon types, either a GO or NO GO light on the front of the ASCU indicates that the ASCU is functioning properly or that a malfunction exists.

WARNING

Before operating BITE, all stores and racks must be electrically disconnected since the weapon release circuits are energized during the BITE test.

When ECM stores are carried, the ASCU is bypassed by ECM wiring and the ECM stores are controlled by the ECM panel in the cockpit. ASCU controls are shown in figure 1-45.

WEAPON RELEASE SYSTEM—CONTROLS, INDICATOR LIGHTS, AND FUNCTIONS

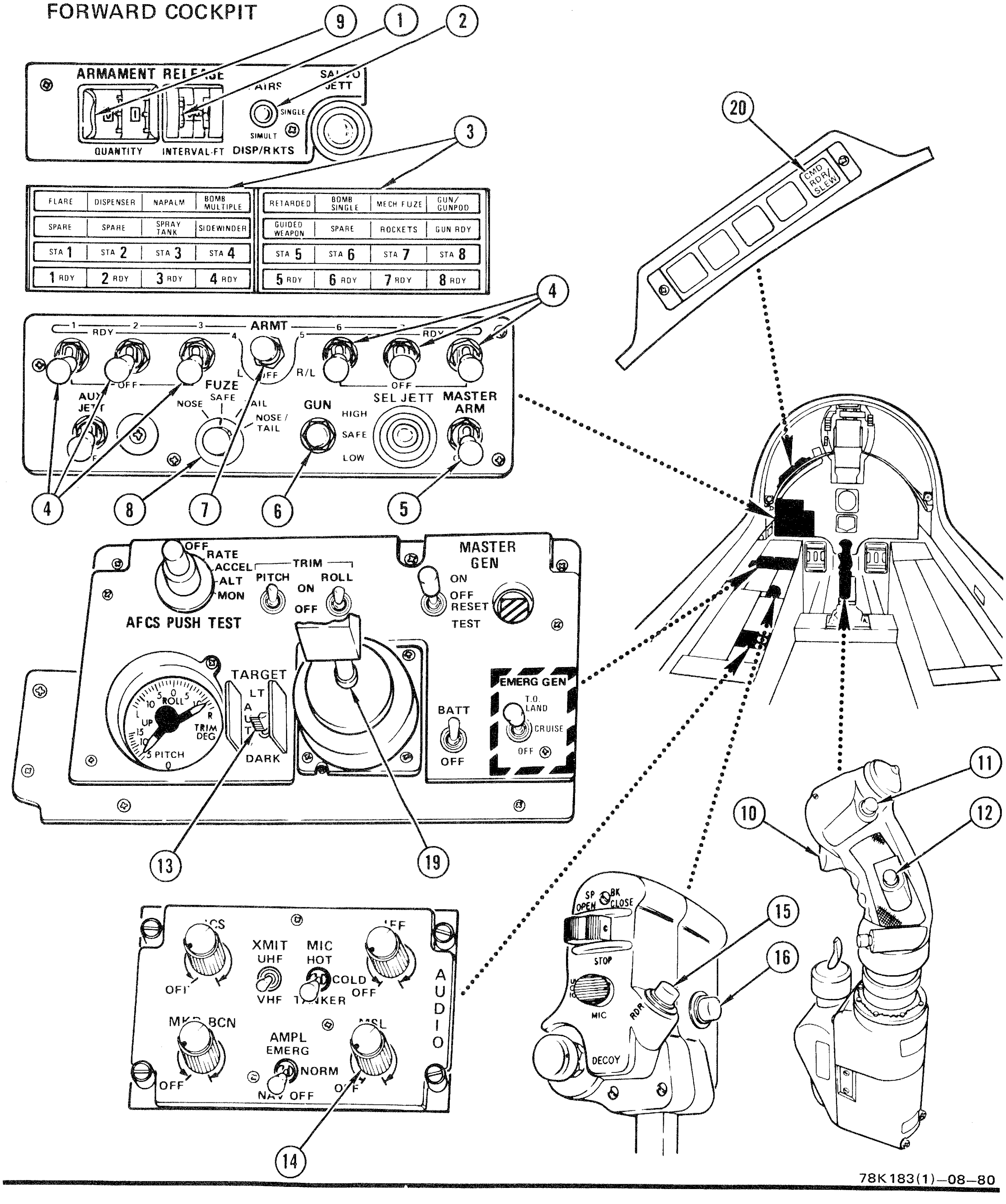

Figure 1-43 (Sheet 1)

WEAPON RELEASE SYSTEM—CONTROLS, INDICATOR LIGHTS, AND FUNCTIONS

AFT COCKPIT

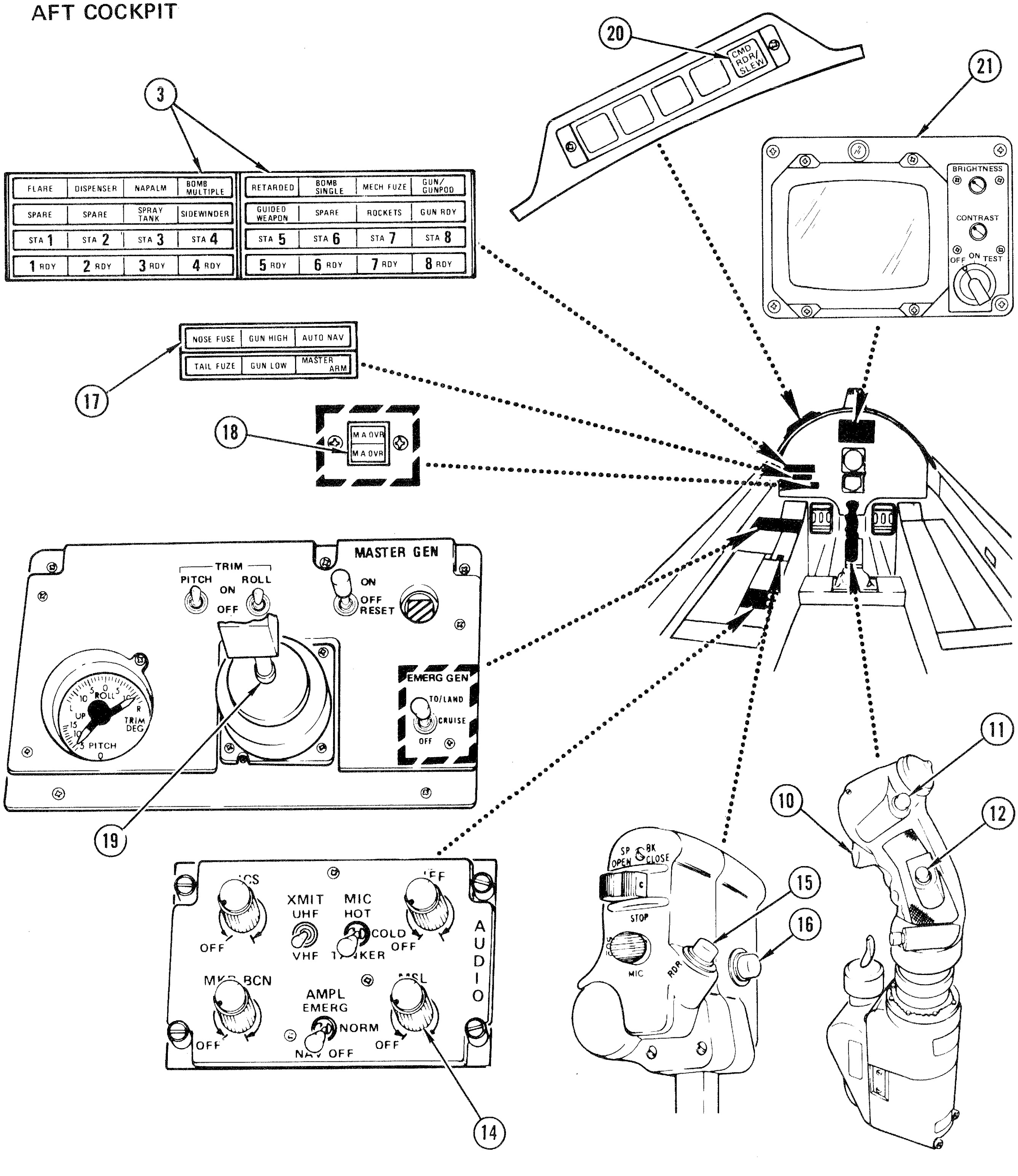

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Figure 1-43 (Sheet 2)

WEAPON RELEASE SYSTEM – CONTROLS, INDICATOR LIGHTS, AND FUNCTIONS

Nomenclature	Function
1. INTERVAL-FT thumbwheel (forward cockpit)	Two rotary switches with numbers from 0 through 9 on one and 10 through 90 on the other. Has no function unless QUANTITY switch is set on 02 or more. Not applicable to firing or release of guided weapons, internal gun, flares, rocket launchers, tow target, or any fuselage mounted munition. Not applicable to SUU-20 series dispenser in bombs mode when a computed attack mode is selected. 010 through 990 – permits pilot to select, in 10-foot increments, the spacing between munition impact points for computed delivery, or distance flown over the ground between munition releases for manual delivery. The number of fire pulses selected on the QUANTITY thumbwheel occur at a rate determined by the setting on the INTERVAL-FT thumbwheel or the computer minimum release interval inhibit, whichever is larger.
2. SINGLE/PAIRS/SIMULT switch (forward cockpit)	Three-position toggle switch which provides the pilot with the capability of selecting the order of munition releases from aircraft wing stations. Not applicable to the tow target, M61A1 gun, gun pods, spray tanks, or any fuselage mounted munition. SINGLE – permits fire pulses to be delivered to one station at a time. Single mounted bomb type munitions are released one at a time from highest priority wing station selected (normal station priority is 1, 8, 2, 7, 3, 6 with all wing stations selected). Multiple mounted munitions are released alternately from most outboard pair of symmetrical stations selected until empty, then transfer to the next highest priority station or pairs of stations occurs. Single mounted rocket launchers receive one fire pulse each with station priority and station transfer occurring the same as single mounted bomb type munitions. Multiple mounted rocket launchers receive one fire pulse with station priority and station transfer occuring the same as other multiple mounted munitions. If unsymmetrical stations are selected, the highest priority single station is released with station transfer occurring when station is empty. PAIRS – permits fire pulses to be delivered to two symmetrically selected stations simultaneously. Transfer to next priority stations occurs automatically when stations are emptied. PAIRS sequence reverts to SINGLE sequence if highest priority stations selected are symmetrical but one station is empty. If selected stations are not symmetrical or only one station is selected, weapon release/firing and station ready lights are inhibited. With AGM-65 missile or GBU-8/B bomb loaded on symmetrically selected stations, system reverts to SINGLE sequence. Symmetrical stations with different munitions release in pairs. When single mounted dispensers are selected, both fire simultaneously with each fire pulse and station transfer occurs when both are empty. One rocket launcher on each symmetrically selected station in priority fires with each fire pulse. Station transfer occurs after each launcher on selected stations receives one fire pulse.

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Figure 1-43 (Sheet 3)

WEAPON RELEASE SYSTEM – CONTROLS, INDICATOR LIGHTS, AND FUNCTIONS

Nomenclature	Function
2. SINGLE/PAIRS/SIMULT switch (forward cockpit – continued)	SIMULT – each fire pulse is delivered simultaneously to all selected wing stations with rocket launchers and/or vertical dispensers loaded. If stations loaded with other munitions types are selected, those stations are not readied, do not come into priority, and do not receive fire pulse(s) except for fuselage stores, tow target, internal gun, and gun pods. Station transfer does not occur.
3. Armament advisory lights (Both cockpits)	General Description: Four rows of lights provide armament system information to the pilot. The top two rows of yellow lights (except the GUN RDY green light), provide an indication of ASCU store type switch setting for selected station(s) including the requirement for mechanical fuzing. The lower two rows of lights provide an indication of the ready status of the station(s) selected. Individual advisory light functions follows: FLARE – indicates a station is selected for flare dispenser. Light goes off only when station is deselected or select or salvo jettisoned. DISPENSER – indicates a station is selected for which the ASCU is set for aircraft retained CBU dispensers. Light goes off when station is deselected or when an empty signal is received from all dispensers on all applicable stations. NAPALM – indicates a station is selected for which the ASCU is set for fire bombs. Light goes off when (a) station is deselected, or (b) MER/TER on all applicable stations have completed one release cycle, or (c) all applicable single-loaded stations have received one fire pulse. BOMB MULTIPLE – indicates a station is selected for which the ASCU is set for SUU-20 training dispenser in bombs mode or a bomb type munition and the munition is loaded on a MER or TER. For MER/TER loaded munitions, light goes off when all applicable stations have been deselected or when all applicable MER/TER's have completed one release cycle. For SUU-20 training dispenser, light goes off only when all applicable stations are deselected or select or salvo jettisoned. When SUU-20 is in bombs mode and rockets mode is desired, cycle applicable station select switch to change the mode. This causes the BOMB MULTIPLE light to go off and the ROCKETS light to come on. **CAUTION** If BOMB SINGLE light comes on when a MER/TER station is selected, the station is improperly loaded. Do not attempt release as the MER/TER will be released instead of the munitions. If BOMB SINGLE light comes or when SUU-20 loaded station is selected, ASCU has malfunctioned. Do not attempt release. RETARDED – indicates a station is selected for which the ASCU is set for (a) a munition with HD/LD inflight option and FUZE switch in NOSE/TAIL or TAIL position, or (b) munition which is fixed high-drag, or (c) SUU-20 with Mk 106 practice bombs. For bomb type munitions, light goes off (a) when FUZE switch is placed in NOSE or SAFE position for munitions with HD/LD inflight

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Figure 1-43 (Sheet 4)

WEAPON RELEASE SYSTEM – CONTROLS, INDICATOR LIGHTS, AND FUNCTIONS

Nomenclature	Function
3. Armament advisory lights (both cockpits – continued)	option, or (b) when all applicable MER/TER's have completed one release cycle, or (c) when all applicable single loaded stations have received one fire pulse, or (d) when all applicable stations have been deselected. For SUU-20 with Mk 106 practice bombs, light goes off only after all applicable stations have been deselected or select or salvo jettisoned. BOMB SINGLE – indicates a station is selected for which the ASCU is set for a bomb type munition. Light goes off when all applicable stations have been deselected or when all applicable stations have received one fire pulse. MECH FUZE – indicates a station is selected for which the ASCU is set for a munition requiring mechanical fuzing, the store present signal is actuated and the FUZE switch is in SAFE. FUZE switch must be set to any position other than SAFE to ready stations. Light goes off when (a) FUZE switch is placed to any position other than SAFE, or (b) when all applicable stations are deselected. GUN/GUN POD – indicates GUN switch is set to either HIGH or LOW position or that a station is selected for which the ASCU is set for a gun pod and the MASTER ARM switch is in OFF. The light will go off when the GUN switch is placed in SAFE, the gun pod station is deselected, or in internal gun mode only, when the MASTER ARM switch is placed in ARM. SPRAY TANK – has no present application. SIDEWINDER – indicates a fuselage station (4 or 5) is selected and an AIM-9 missile or a TDU-11/B target rocket (with shorting plug) is loaded on the selected station. Light goes off when AIM-9 has left the launcher or when station is deselected. For TDU-11/B, light goes off only when station is deselected. **NOTE** If TDU-11/B shorting plug is not installed on AERO 3B launcher, the ROCKETS light illuminates and the target rocket cannot be fired. If ROCKETS advisory light comes on when a fuselage (STA 4/STA 5) station is selected, neither the AIM-9 missile nor the TDU-11/B target rocket can be fired. GUIDED WEAPON – indicates a station is selected for which the ASCU is set for a GBU-10C/B or -12B/B laser guided bomb. GBU-8/B electro-optical guided bomb, or AGM-65 guided missile. Light goes off when all applicable single loaded stations have received one fire pulse, or AGM-65 loaded stations are empty, or all applicable stations are deselected. ROCKETS – indicates a station is selected for which the ASCU is set for rocket launcher or SUU-20 training dispenser is in rockets mode. For rocket launcher, light goes off when (a) TERs on all applicable multiple loaded stations have completed one firing cycle, or (b) all

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Figure 1-43 (Sheet 5)

WEAPON RELEASE SYSTEM – CONTROLS, INDICATOR LIGHTS, AND FUNCTIONS

Nomenclature	Function
3. Armament advisory lights (both cockpits – continued)	applicable single-loaded stations have received one fire pulse, or (c) all applicable stations are deselected. For SUU-20 light goes out only when all applicable stations have been deselected or select or salvo jettisoned. When SUU-20 is in rockets mode and bombs is desired, cycle applicable station select switch to change the aircraft and weapon modes. This causes the ROCKETS light to go off and the BOMB MULTIPLE light to come on.

GUN RDY – indicates internal gun and/or selected gun pod(s) are ready for firing. Light comes on when GUN switch is in HIGH or LOW or gun pod station(s) is selected and MASTER ARM switch is placed in ARM. Light goes off when MASTER ARM switch is placed in OFF, GUN switch is placed in SAFE, or gun pod station(s) is deselected.

NOTE

GUN RDY light does not indicate whether gun/gun pod is loaded or empty, only that gun/gun pod is electrically ready to fire.

STA 1 through STA 8 (station selected) – one light (yellow) for each station. The light for a particular station comes on when the station is selected, fuzed if required, MASTER ARM switch OFF, and station(s) selected satisfy ARMAMENT RELEASE panel switch position requirements. If the ARMAMENT RELEASE panel switches have not been set so that munition release/fire is fully enabled, the lights will not come on. If SINGLE/PAIRS/SIMULT switch is in SIMULT position, lights come on only for those stations loaded with rocket launcher, vertical dispensers, gun pods, or tow target (station 1 only). Lights go out when (a) MASTER ARM switch is placed in ARM position, or (b) FUZE switch (if fuzing is required) is placed in SAFE position, or (c) station(s) selected has been fired or released, or (d) station(s) is deselected. For flares and SUU-20 training dispenser, lights go off only when applicable stations are deselected or MASTER ARM is placed in ARM position.

NOTE

Fuselage stations (4 and 5) take precedence over all other stations, regardless of any switch settings or computer modes and will be in priority whenever selected. Station selected lights for those stations will come on provided station is loaded and MASTER ARM switch is in OFF position.

1 RDY through 8 RDY (station ready) – one light (green) for each station. The light for a station comes on when the station is selected, fuzed if required, MASTER ARM switch is placed in ARM, and station(s) selected satisfy ARMAMENT RELEASE panel switch position requirements. If the ARMAMENT RELEASE panel switches have not been set so that munitions release/fire is fully enabled, the lights will not come on. If SINGLE/PAIRS/SIMULT switch is in SIMULT position, lights come on only for those stations loaded with rocket launchers, vertical dispensers, gun pods, or tow target (station 1 only). When station selected is loaded with GBU-8/B bomb, light will come on only after PCO indication is received from bomb. Lights go out when (a) MASTER ARM switch is placed in OFF, or (b) FUZE switch (if fuzing is required) is placed in SAFE position, or (c)

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Figure 1-43 (Sheet 6)

WEAPON RELEASE SYSTEM – CONTROLS, INDICATOR LIGHTS, AND FUNCTIONS

Nomenclature	Function
3. Armament advisory lights (both cockpits – continued)	MER/TER on applicable station(s) has completed one release cycle, or (d) one fire pulse has been delivered to applicable stations with single mounted bombs or rocket launchers, or (e) CBU dispensers on applicable stations are empty, or (f) applicable stations are deselected. For rocket launchers or vertical dispensers with the SINGLE/PAIRS/SIMULT switch in SIMULT, lights go off only when applicable stations are deselected, MASTER ARM is placed in OFF, QUANTITY SELECT switch is set to zero, AUX JETT switch is actuated, or fuselage stations are selected. For flares and SUU-20 training dispenser, lights go off only when applicable stations are deselected or MASTER ARM is placed in OFF position. **NOTE** Fuselage stations (4 and 5) take precedence over all other stations regardless of any switch settings or computer modes and will be in priority whenever selected. Station ready lights for those stations will come on provided station is loaded and MASTER ARM switch is in ARM position.
4. Wing station select switches (forward cockpit)	RDY – permits pilot to select and ready any combination of wing (1, 2, 3, 6, 7, 8) stations, provided store priority, fuzing, and SINGLE/PAIRS/SIMULT switch requirements are satisfied and MASTER ARM switch is in ARM. Completes circuit to station and store armament advisory lights. OFF – interrupts firing circuit to wing stations. Removes ready signals from stores. Removes power from store and station armament advisory lights.
5. MASTER ARM switch (forward cockpit)	ARM – permits operation of weapons release and firing circuits. Provides power to station ready armament advisory lights for selected stations and to GUN RDY light when GUN switch is in any position other than SAFE. Provides power to MASTER ARM armament monitor light. Completes circuit for camera operation when trigger or armament release button is depressed. Provides power to mechanical arming solenoids of selected stations if fuzing has been selected. Provides power to armament system after landing gear is retracted, or ARM SAFETY DISABLE switch is actuated with aircraft on the ground. **NOTE** With landing gear handle micro-switch in up position, MASTER ARM power is available regardless of landing gear position. OFF – interrupts power to armament system release and firing circuits. Removes power from station ready and GUN RDY armament advisory lights. Removes power from MASTER ARM armament monitor light. Applies reset power to GBU-8/B bomb and changes bomb from operation on internal power to operation on aircraft power.

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Figure 1-43 (Sheet 7)

WEAPON RELEASE SYSTEM – CONTROLS, INDICATOR LIGHTS, AND FUNCTIONS

Nomenclature	Function
6. GUN switch (forward cockpit)	HIGH – selects and enables M61A1 gun for firing at a rate of 6,000 rounds per minute. Provides power to GUN/GUN POD armament advisory light. Provides power to GUN HIGH armament monitor light. Completes circuit between trigger and gun control box. LOW – selects and enables M61A1 gun for firing at a rate of 4,000 rounds per minute. Provides power to GUN/GUN POD armament advisory light. Provides power to GUN LOW armament monitor light. Completes circuit between trigger and gun control box. SAFE – deselects M61A1 gun and opens circuit between trigger and gun control box. Removes power from GUN/GUN POD armament advisory light. Removes power from GUN HIGH and GUN LOW armament monitor lights. ASCU actuates clearing sector lever to put gun bolts in clear position so no rounds are in chambers. **NOTE** GUN switch has no effect on gun pod operation.
7. Fuselage station select switch (forward cockpit)	L (4) – permits pilot to select and ready left fuselage (4) station. Completes circuit to SIDEWINDER and STA 4/4 RDY armament advisory lights. Inhibits wing station (except gun pod) release/firing. Provides air-to-air gunnery symbology on HUD if gun/gun pod and computed attack mode selected. **NOTE** If ROCKETS light comes on when fuselage station is selected and loaded, the store has been improperly loaded or has malfunctioned and cannot be fired. R/L (5) – permits pilot to select and ready right and left fuselage (5 and 4) stations, provided either or both are loaded. Automatic station transfer from 5 to 4 is provided upon release of armament release button following application of fire pulse to station 5. Completes circuits to SIDEWINDER and STA 4/4 RDY and STA 5/5 RDY armament advisory lights. Inhibits wing station (except gun pod) release/firing. Provides air-to-air gunnery symbology on HUD if gun/gun pod and computed attack mode selected. **NOTE** Fuselage station select switch position of other than OFF will prevent any other station (except gun pod stations) from coming into priority for release/firing. OFF – interrupts firing circuit to fuselage stations. Removes ready signals from stores. Removes power from store and station armament advisory lights. Allows selected wing stations to come into priority for release/firing.

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Figure 1-43 (Sheet 8)

WEAPON RELEASE SYSTEM – CONTROLS, INDICATOR LIGHTS, AND FUNCTIONS

Nomenclature	Function
8. FUZE switch (forward cockpit)	NOSE/TAIL – with MASTER ARM switch in ARM, provides power to all mechanical arming solenoids (MAU-12, MER, TER) on selected stations and enables guidance unit battery of GBU-8/B bomb on priority station selected. Enables application of auto-clearing cutout power to SUU-23/A gun pods on selected stations. Notifies computer to compute high-drag ballistics for inflight option retarded munitions. Interrupts power to MECH FUZE armament advisory light. Provides power to NOSE FUZE and TAIL FUZE armament monitor lights. Switch must be pulled out to select this position. **CAUTION** NOSE/TAIL position is an improper selection for inflight option retarded munitions. This position provides no safety in case of retarder fin failure. TAIL – with MASTER ARM switch in ARM, provides power to tail mechanical arming solenoids on selected stations and enables guidance unit battery of GBU-8/B bomb on priority selected station. Enables application of auto-clearing cutout power to SUU-23/A gun pod on selected stations. Notifies computer to compute high-drag ballistics for inflight option retarded munitions. Interrupts power to MECH FUZE armament advisory light. Provides power to TAIL FUZE armament monitor light. NOSE – with MASTER ARM switch in ARM, provides power to nose mechanical arming solenoids on selected stations. Enables application of auto-clearing cutout power to SUU-23/A gun pod on selected stations. Notifies computer to compute low-drag ballistics for inflight option retarded munitions. Interrupts power to MECH FUZE armament advisory light. Provides power to NOSE FUZE armament monitor light. **NOTE** Center arming solenoids of right wing MAU-12 are energized by FUZE switch TAIL position and MASTER ARM switch. Center arming solenoids of left wing MAU-12 are energized by FUZE switch NOSE position and MASTER ARM switch. FUZE switch NOSE/TAIL position must be selected to ensure all MAU-12 center arming solenoids are energized when required. SAFE – interrupts power to all mechanical arming solenoids and disables guidance unit battery of GBU-8/B bomb. Normal release circuits are inhibited. Permits auxiliary jettison of unarmed munitions from MER and TER. Inhibits auto-clearing cutout power to SUU-23/A gun pods. Interrupts power to NOSE FUZE and TAIL FUZE armament monitor lights. Closes circuit for power to MECH FUZE armament advisory light. Applies reset power to GBU-8/B bomb and changes bomb from operation on internal power to operation on aircraft power.

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Figure 1-43 (Sheet 9)

WEAPON RELEASE SYSTEM – CONTROLS, INDICATOR LIGHTS, AND FUNCTIONS

Nomenclature	Function
9. QUANTITY thumbwheel (forward cockpit)	Two rotary switches with selections from 0 through 9 on each. Permits the pilot to control the number of releases to be made with each actuation of the armament release button. Not applicable to firing or release of internal gun, gun pods, or any fuselage mounted munition. While a specific numerical setting is not required for guided weapons, flares, rocket launchers or tow targets, the ASCU logic does require a selection of 01 or higher to allow release. Not applicable to SUU-20 series dispensers in bombs mode when a quantity greater than 01 is selected. 00 – safe position. Does not allow firing or release of any munition for which a setting is required in either manual or computed modes. Has no effect on firing or release of internal gun, gun pods or fuselage mounted munitions. 01 – a single fire pulse is delivered by the computer in computed modes or with each actuation of the armament release button in manual modes. 02 through 99 – selects number of fire pulses generated by computer in both manual ripple and computed modes. If an even number is selected, the munitions bracket the target at the spacing selected on the INTERVAL-FT thumbwheel. If an odd number is selected the center munition impacts on target and the remaining munitions bracket the target at the spacing selected on the INTERVAL-FT thumbwheel.
10. Trigger switch (both cockpits)	Fires gun/gun pods when pressed to second detent. Provides automatic camera operation when pressed to first or second detent. MASTER ARM switch must be in ARM.
11. Armament release button (both cockpits)	Provides for release of selected fuselage and wing-mounted munitions in computed or manual modes. Designates target in computed attack mode if not previously designated by target designate button. Provides automatic camera operation when MASTER ARM switch is in ARM.
12. Target designate button (both cockpits)	First depression designates target or OAP in computed attack mode and second depression undesignates target or OAP. Only one depression required in update modes. When AGM-65 missile is loaded on selected priority station, depressing button allows slewing of missile seeker. Releasing button provides lock-on signal to seeker, commanding seeker to track target within the tracking gate. When GBU-8/B bomb is loaded on selected priority station, first actuation of button commands bomb seeker to track target within the crosshairs and, if Bullpup controller is actuated, enters aiming symbol offset into computer memory. Second actuation of button applies caging power to bomb seeker, returning seeker to electrical cage position.

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Figure 1-43 (Sheet 10)

WEAPON RELEASE SYSTEM – CONTROLS, INDICATOR LIGHTS, AND FUNCTIONS

Nomenclature	Function
12. Target designate button (both cockpits)	When an AIM-9E or AIM-9J missile is loaded on selected priority station, first actuation of button applies manual uncage signal to missile seeker, allowing seeker to track a target (within gimbal travel limits) prior to missile launch. Second actuation of button removes manual uncage signal, causing missile seeker to return to electrical cage position.
13. Target contrast switch (forward cockpit)	DARK – commands AGM-65 missile seeker to track a target seen as dark against a light background. AUTO – commands AGM-65 missile seeker to pick the optimum tracking mode for the designated target. LIGHT – commands AGM-65 missile seeker to track a target seen as light against a dark background.
14. MISSILE switch (both cockpits)	Provides and controls volume of AIM-9 missile audio tone when turned clockwise. Interrupts electrical power to AIM-9 missile audio tone circuit when turned fully counterclockwise.
15. Radar range/target reject switch (both cockpits)	When an AGM-65 missile is loaded on the priority station, actuation of switch will reject the selected missile and select the next priority missile on the same station. When a GBU-8/B bomb is loaded on the priority station, first actuation of switch removes reset power from the bomb and with fuzing and MASTER ARM on, fires the bomb guidance unit battery, causing the bomb to change to operation on internal power. Second actuation of switch applies reset power to the bomb and changes bomb from operating on internal power to operation on aircraft power.
16. Air ignite button (both cockpits)	When AGM-65 missile is loaded on selected priority station, actuation of button jettisons dome cover on priority missile and drives missile seeker to electrical boresight position. If radar is operating in NORMAL mode, radar display switches to TV display with tracking gate superimposed over image seen by missile seeker. When GBU-8/B bomb is loaded on selected priority station, actuation of button applies mechanical uncage power to bomb seeker. If radar is operating in NORMAL mode, radar display switches to TV display with crosshairs superimposed over image seen by bomb seeker.

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Figure 1-43 (Sheet 11)

WEAPON RELEASE SYSTEM – CONTROLS, INDICATOR LIGHTS, AND FUNCTIONS

Nomenclature	Function
17. Armament monitor lights (aft cockpit)	General Description: Two rows of lights that provide specific forward cockpit armament select switch positioning information to the aft cockpit pilot. Individual armament monitor lights function as follows: NOSE FUZE – Indicates the FUZE switch has been positioned to NOSE or NOSE/TAIL. Light goes off when FUZE switch is positioned to TAIL or SAFE. TAIL FUZE – Indicates the FUZE switch has been positioned to TAIL or NOSE/TAIL. Light goes off when FUZE switch is positioned to NOSE or SAFE. GUN HIGH – Indicates the GUN switch has been positioned to HIGH. Light goes off when GUN switch is positioned to LOW or SAFE. GUN LOW – Indicates the GUN switch has been positioned to LOW. Light goes off when GUN switch is positioned to HIGH or SAFE. MASTER ARM – Indicates the MASTER ARM switch has been positioned to ARM with MA OVR (master arm override) switch not actuated. Light goes off when MASTER ARM switch is positioned to OFF or when MA OVR switch is actuated (MA OVR light on).
18. MA OVR switch	Permits the aft cockpit pilot to override the ARM position of the MASTER ARM switch by interrupting the master arm input signal to the ASCU. Initiated by momentarily depressing MA OVR switch. MA OVR light in switch comes on when switch is initiated. MASTER ARM monitor light and 1 RDY through 8 RDY and GUN RDY armament advisory lights go off and STA 1 through 8 and GUN/GUN POD armament advisory lights come on at switch initiation. Deselected by pressing MA OVR switch second time or cycling MASTER ARM switch to OFF and back to ARM. When deselected, master arm signal path to ASCU is reestablished, the MA OVR light goes off, and all appropriate armament advisory light indications return to the ready state.
19. Bullpup controller (both cockpits)	AGM/TGM-65 – Provides azimuth and elevation slew commands to the missile seeker head when an AGM/TGM-65 missile is loaded on the priority selected station and the target designate button is pressed and held in the cockpit having radar/slew command control (cockpit CMD RDR/SLEW light on). GBU-8/B – Provides azimuth and elevation slew commands to the HUD aiming symbol during airborne alignment of the GBU-8/B guided bomb.
20. Radar/Slew command transfer switch (both cockpits)	When pressed – Transfers control of radar set gain control and Bullpup controller between cockpits. Controlling cockpit CMB RDR/SLEW light comes on when switch is pressed.
21. Television monitor (aft cockpit)	Displays HUD video presentations in the aft cockpit. The display contains HUD symbology superimposed over a real world background during daylight operations.

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Figure 1-43 (Sheet 12)

ASCU STORE CODE SUMMARY

ASCU CODE	STORE (See note 1)	COMPUTED DELIVERY POSSIBLE
AK	No wing store loaded — OFF	N/A
AK	ECM AND TRANSPONDER PODS	N/A
AK	FUEL STORES	N/A
	BOMB TYPES	
BK	GBU-8/B	See note 2
FT	GBU-10B and -10A/B	Yes
DK	GBU-10C/B	Yes
GK	GBU-12/B and -12A/B	Yes
DL	GBU-12B/B	Yes
GO	Mk 82 External Fuze	See note 3
JQ	Mk 82 Internal Fuze	Yes
GQ	Mk 82 SE HD	Yes
GR	Mk 82 SE HD/LD	Yes
GT	Mk 84	Yes
*FK	M117A1 with MAU-103 A/B fin	Yes
*FL	MC-1	See note 4
GQ	Mk 36 DESTRUCTOR (HD)	Yes
GP	Mk 36 DESTRUCTOR (LD)	Yes
JN	Mk 20 ROCKEYE	Yes
JK	CBU-24, CBU-49	Yes
JL	CBU-52B/B	Yes
JM	CBU-58, CBU-71	Yes
HK	MATRA 250 KG BOMB	No
JO	BL-755 BOMB CLUSTER	No
IK	BLU-1 finned	Yes
IL	BLU-1 unfinned	Yes
IM	BLU-27 finned	Yes
IN	BLU-27 unfinned	Yes
IQ	BLU-52	Yes

ASCU CODE	STORE (See note 1)	COMPUTED DELIVERY POSSIBLE
	DISPENSER TYPES	
CL	CBU-12	Yes
CQ	CBU-30	See note 8
CP	CBU-38	See note 8
CM	CBU-46	See note 7
	FLARES	
BO	SUU-25/SUU-42 flare launcher	No
	MISSILES	
BT	AGM-65 Maverick	See note 2
	ROCKETS	
AM	LAU-3, LAU-68 launchers	See note 5
	GUN PODS	
BN	SUU-23	See note 6
BP	GPU-5/A 30 mm gun pod	Yes
	TRAINING MUNITIONS	
DR	SUU-20 RKTS with BDU-33 bombs	See note 7
DT	SUU-20 RKTS with Mk-106 bombs	See note 7
HR	BDU-33 bombs on MER/TER	Yes
HS	BDU-33 on MAU-12	Yes
BT	A/A 37A-T series TGM (Maverick)	See note 2

*ASCU codes FK and FL are interchangeable and may be used for either munition.

NOTE

1. Inert versions of WR munitions will use the ASCU code of the parent munition.
2. Computed for HUD aiming symbol positioning only. Ballistics not included in computer.
3. Refer to restrictions on delivery when using M1/M1A1 fuze extenders. Otherwise computed delivery is possible.
4. Yes. However, ballistics are for the M117. Aiming corrections may be necessary for MC-1.
5. Yes. Ripple delivery not applicable.
6. Yes. Computed for HUD aiming symbol position only. Ballistics are for internal gun.
7. Yes. However, only one release pulse per solution. Ripple release not possible.
8. Yes. However, length of fire pulse is pilot-controlled and ballistic solution is for beginning of drop. Therefore, aiming symbol or CCIP impact point must be positioned over desired starting point of area to be covered.

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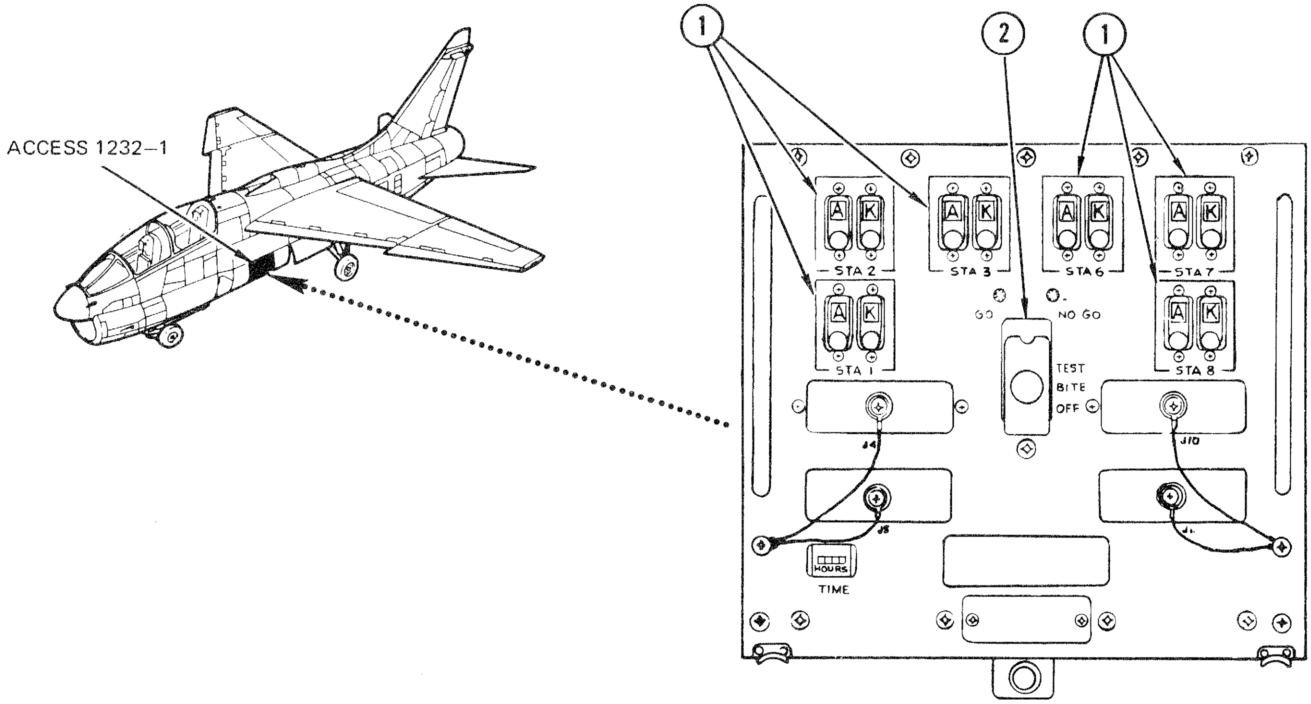
Figure 1-44

ARMAMENT STATION CONTROL UNIT (ASCU) CONTROLS, INDICATORS AND FUNCTIONS



ARMAMENT STATION
CONTROL UNIT (ASCU)

Nomenclature	Function
1. Store type switches and code setting windows	Two pushbutton switches for each wing station. One switch has letters A through J. The other switch has letters K through T. The letters are used in combination to code the ASCU for the munition loaded on the corresponding wing station. The codes must be set prior to aircraft engine turnup prior to flight.
2. BITE switch	A covered, spring-loaded switch used to activate the ASCU built in test equipment (BITE) circuits. ASCU serviceability is indicated by GO-NO GO lights right above the switch. **WARNING** This switch must never be activated with stores loaded on the aircraft. During BITE tests, the ASCU supplies release pulses to all munitions stations.

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Figure 1-45

WEAPON RELEASE SYSTEM OPERATION.

The complexity of the aircraft weapon release system requires a thorough knowledge of the system's operating characteristics if the system is to be properly used, especially when used in conjunction with the NAV WD Computer. The following discussions are intended to provide the background knowledge necessary to enable proper usage of the weapon release system.

SYSTEM REQUIREMENTS.

The following list of requirements must be met in order for the weapon release system to operate. Some of the requirements are semirestrictive in nature and some are dependent upon the conditions under which the system is used.

1. An operational computer is required whenever a computed attack mode is selected or when a quantity of 02 or more is selected on the armament release panel.

2. Computed attack or manual ripple delivery is possible only when an ASCU setting is used which has accompanying ballistic data in the computer. However, there are cases in which computer-stored ballistic data closely approximates that of munitions which do not have ballistics in the computer. In these cases, it is permissible to use the ASCU setting for the munition which has its ballistics in the computer. Refer to Weapon Delivery Parameters discussion, Part 1 this section, for munitions which fall in this category. When ASCU settings are used which do not have accompanying ballistic data in the computer, manual single delivery is required.

3. With both computed and noncomputed weapon types selected and a computed attack mode or manual ripple mode selected, the following applies:

   a. When the highest priority station selected has a computed weapon type, release will occur normally and, if a computed attack mode is selected, HUD symbology, solution cue movement, and minimum release interval (MRI) computations will be based on the weapon type in priority. The noncomputed weapon type(s) will be released/fired in station priority sequence based on the ballistics and MRI of the computed weapon type.

   b. When the highest priority station selected has a noncomputed weapon type, release will not occur. If a computed attack mode is selected, HUD symbology will be air-to-ground gunnery. If no computed attack mode is selected (including terrain following and landing), HUD symbology will be air-to-air gunnery.

   c. With either rocket launchers or flare/marker dispensers loaded on the highest priority station, the ASCU will revert to the manual single mode regardless of computed attack mode selection or the setting on the QUANTITY thumbwheel. With these stores in priority, release/fire will occur upon depression of the armament release switch and only one fire pulse is delivered to the ASCU.

4. The NAV WD Computer will only solve one weapon delivery solution at a time. Therefore, with guns selected and no computed attack mode selected (air-to-air gunnery mode), manual ripple of other weapon types is not possible, and release is inhibited with quantity of 02 or more selected.

5. Manual ripple is not possible with the Terrain Following (TF) or Landing (LDG) master function switches depressed.

6. Simultaneous firing of guns (internal or gun pods) and release/firing of other weapon types is possible if both the armament release button and trigger switch are actuated.

7. Manual single release (quantity of 01 selected) is not inhibited in any mode and release will occur upon depression of the armament release button.

OPERATIONAL USAGE.

Rocket Firing System.

The rocket firing system is based on the assumption that all launchers will be in the ripple fire mode, i.e., all rockets in a launcher will be fired upon application of a single fire pulse. With SINGLE or PAIRS selected on the armament release panel, fire pulses are routed to the wing stations in the same priority sequence as for bombs. With SIMULT selected on the armament release panel, a fire pulse will be sent to all wing stations which have rockets selected on the ASCU. The STA RDY lights will stay on until all launchers on a station have received one fire pulse and the ROCKETS advisory light will remain on until all rocket launchers on the selected stations receive one fire pulse. With SIMULT selected, the STA RDY lights go out only after all stations are deselected or MASTER ARM is turned off.

When rocket launchers are operated in the single fire mode, the switchology becomes involved, especially when the launchers are loaded on TERs and it is desired to retain as many launcher nose cones as possible to reduce drag.

A knowledge of how the TER works is essential to understanding system operation. With rocket launchers loaded and the proper ASCU code (AM) set, the TER will home to its first loaded station when the STATION SELECT switch for that station is positioned to RDY or cycled from RDY to OFF and back to RDY. It will advance to the next loaded station at the end of each fire pulse or Auxiliary Jettison pulse.

The ASCU monitors the Ground Interlock Signal (GIS) from the TER to determine if stores are still loaded on that aircraft station. The GIS signal is present any time the TER is ready to fire a rocket launcher, but is momentarily interrupted as the TER steps past station 3 on its way to the first loaded launcher. Any interrupt in the GIS signal after the first fire pulse has been sent to that aircraft station will cause the ASCU to think that station is empty, the STA RDY light will go out, and no more fire pulses can be sent to that station until the ASCU logic is reset. Cycling the STATION SELECT switch after the first fire pulse, with the station indicating not empty (STA RDY light on), will result in an interruption of the GIS signal. The ASCU store present signal and station ready indications can be regained by cycling the STATION SELECT switch a second time.

The ASCU will assume that all stations with MAU-12 mounted launchers are loaded if there have been no fire pulses sent to the stations since they were selected. Aircraft stations with launchers on TERs will be considered loaded if the ASCU has not recognized a GIS interrupt since station selection. The ASCU will only send fire pulses to stations that it considers loaded (unless SIMULT is selected). The STA RDY lights will be on during the first sequence for each station. After that, the ASCU release logic can be reset by cycling STATION SELECT, which resets ASCU logic for that station back to its original (loaded) condition, even though the station may be physically empty. The weapon code being sent to the NAV WD Computer is indicated by the weapon advisory lights. If no weapon advisory light is on, the HUD will display air-to-ground guns symbology if an attack mode is selected. If the quantity selection is zero, no rockets can be fired.

The following paragraphs use an example rocket launcher configuration to establish system operation. The load will consist of LAU-3 rocket launchers on TER shoulder stations (TER stations 2 and 3) on aircraft stations 1 and 8 and single-mounted LAU-3 rocket launchers on aircraft stations 2 and 7. Aircraft stations 3 and 6 will be empty or loaded with fuel tanks. The rocket launchers will be set to SINGLE mode. Each firing pulse sent to a launcher will cause two of the 19 rockets to be fired.

SINGLE Mode Selected on Armament Release Panel.

If SINGLE mode and all stations are selected, the fire pulses will be directed as follows:

Rocket Launcher

Fire Pulse	*A/C Station*	*TER Station*	*Comments*
1	1	2	
2	8	2	
3	1	3	Station 1 Ready Out
4	8	3	Station 8 Ready Out
5	2		Station 2 Ready Out
6	7		Station 7 Ready Out ROCKETS Advisory Out
7	None		

If all STATION SELECT switches are cycled, the above sequence can be repeated or restarted. The ROCKETS advisory light will come on as soon as one station has been cycled so that it is ready to receive a fire pulse and remain on until the last ready station has been sent a pulse (or two pulses for stations with TERs).

If it is desired to keep the nose cones intact on the launchers on TER station 3 and aircraft stations 2 and 7, it is necessary to restart the above sequence before fire pulse three is issued. The STATION SELECT switches must be cycled twice to home the TER to the first launcher. Lights will come back on after STATION SELECT switches are cycled a second time. Now it is possible to apply two more fire pulses, still firing the same launchers. After firing these same launchers 10 times, they are finally empty, with the last firing consisting of only one rocket per launcher. This is when it is recommended that AUX JETT be used to get rid of the drag imposed by the empty launcher.

Care must be exercised to jettison only the empty launchers. The following steps provide the recommended procedure to auxiliary jettison stores from TERs (or MERs):

1. Cycle STATION SELECT switches.
2. Deselect all stations except station 1.
3. Actuate AUX JETT switch one time for each store to be released.
4. Deselect station 1 and select station 8.
5. Repeat steps 3 and 4 for each station.

The above procedure will work with either SINGLE or SIMULT selected on the ARMAMENT RELEASE panel. With PAIRS selected, symmetrically paired stations (1 and 8, 2 and 7, 3 and 6) will be selected in steps 2 and 4 and stores will be released in steps 3 and 5.

Now that empty launchers have been jettisoned and only one launcher per TER is left, the switchology requirements are different. Since the GIS signal will be interrupted each time a fire pulse is sent to the launcher on the TER, it will be necessary to cycle STATION SELECT before more fire pulses can be sent to that station. Note that the switchology for a station with a TER with one launcher is the same as for a station with a parent rack launcher.

PAIRS Mode Selected On Armament Release Panel.

If the PAIRS mode and all stations are selected, the firing pulses will be directed as follows:

	A/C Station 1		*A/C*	*A/C*	A/C Station 8	
Fire Pulse	*TER STA 2*	*TER STA 3*	*Station 2*	*Station 7*	*TER STA 2*	*TER STA 3*
1	X				X	
2		X				X
3			X	X		
4		No rockets fired				

After the above sequence, the ROCKETS advisory light and all STA RDY lights will be out. Just as in SINGLES modes, the STATION SELECT switches can be cycled to get the ROCKETS advisory light back on and the sequence can be repeated. If the priority station selected is not symmetrically paired with another rocket station, no rockets will be fired.

If STATION SELECT is cycled twice between each fire pulse, all firing pulses will be sent to the launchers on TER station 2. Transfer to aircraft stations 2 and 7 will not occur until the TER GIS signal has been momentarily interrupted after the first fire pulse to the launcher on TER station 3, causing station 1 and 8 ready lights to go out. After loss of STA RDY lights, transfer to aircraft stations 2 and 7 can be prevented by cycling STATION SELECT switches between firing pass. STA RDY lights are regained each time the applicable STATION SELECT switch is cycled OFF then RDY.

After the launchers on TER station 2 on aircraft stations 1 and 8 are empty, they can be dropped by use of Auxiliary Jettison. With symmetrical stations selected, depressing AUX JETT will cause jettison pulses to be sent to both TERs. As with SINGLES mode, ensure that the empty launcher is dropped by cycling the appropriate STATION SELECT switches to rehome the TER. If the ROCKETS advisory light was off due to having sent a fire pulse to TER station 3, activating AUX JETT will cause it to come back on. This is true regardless of the mode selected on the ARMAMENT RELEASE panel. However, sending another fire pulse to the launcher on TER station 3 will cause the ROCKETS advisory light to go out again.

SIMULT Mode Selected on Armament Release Panel.

If the SIMULT mode and all stations are selected, fire pulses will be directed as follows:

Fire Pulse	A/C Station 1 TER STA 2	A/C Station 1 TER STA 3	A/C Station 2	A/C Station 7	A/C Station 8 TER STA 2	A/C Station 8 TER STA 3
1	X		X	X	X	
2		X	X	X		X
3	X		X	X	X	
4		X	X	X		X
20		X				X

Just as with the other modes, the launcher nose cones on TER station 3 can be retained by cycling STATION SELECT switches twice between each firing pass. Auxiliary Jettison operation will be as if SINGLE mode were selected on the armament release panel. It will be necessary to deselect station 1 before the empty launcher on station 8 can be jettisoned unless both launchers are jettisoned from station 1.

This discussion has assumed that all rocket stations are selected. The chances of switchology problems will be reduced by selecting only those rocket stations to be fired.

CBU Dispensing Circuits.

CBU dispensers are divided into two separate types: aft dispensers (Type I) and vertical dispensers (Type II). The aircraft dispenser circuits, unlike the rocket circuits, monitor the individual stores for an empty indication. All dispensers provide a CBU empty signal but the signal is applied in different ways, depending on the dispenser being monitored.

SUU-7 series (CBU-12/46) dispensers (Type I) indicate an empty condition by applying a sequence of signals to the CBU monitor circuits. An open indicates the CBU is loaded. When a ground is applied by the dispenser, it indicates that one more fire pulse application is required to empty the dispenser. After the next fire pulse, the dispenser removes the ground, indicating it is empty.

SUU-13 series (CBU-30/38 dispensers (Type II) indicate an empty condition simply by applying a ground to the CBU monitor circuits when empty.

Aft (Type I) Dispensers.

With aft dispensers loaded on a TER, the dispensers are fired in TER station priority. The TER dispenser monitor circuits normally apply a CBU empty signal to the aircraft when the dispensers are empty but the TER monitor circuits are based on the dispensers applying a ground when empty. Since the SUU-7 series dispenser applies a ground before being empty and an open when empty, the TER CBU empty signal is applied too early. Therefore when SUU-7 series dispensers are loaded on a TER, the aircraft ignores the CBU empty signal, never transfers off the aircraft station, and never turns off the STA RDY and DISPENSER advisory lights unless the station(s) is deselected.

As an example, consider the following load and the switchology involved under different circumstances. The load consists of TERs on stations 1 and 8 with CBU-46/A dispensers loaded on the TER center and outboard stations. The CBU-46/A dispensers will be set to dispense four tubes with each fire pulse, requiring five fire pulses to empty each dispenser. The stores on the other aircraft stations do not matter.

With SINGLE mode and both stations selected, the system will operate as follows:

Fire Pulse	Aircraft Station	TER Station
1	1	1
2	8	1
3	1	2
4	8	3
5	1	1
6	8	1
7	1	2
8	8	3
9	1	1
10	8	1
11	1	2
12	8	3
13	1	1
14	8	1
15	1	2
16	8	3
17	1	1
18	8	1
19	1	2
20	8	3

If the stations remain selected and the MASTER ARM switch is cycled between passes for safety, the dispensers will fire as shown in the above sequence. However, if it is desired to empty the dispensers on TER station 1 before firing the other dispensers, the STATION SELECT switches must be cycled after each second fire pulse. This will cause the TERs to rehome to station 1 each time, preventing the other dispensers from receiving fire pulses. If this method of control is used, two fire pulses may be applied during each pass with the STATION SELECT switches cycled during the go-around. The TER station 1 dispensers will be empty after the fifth pass and may be released on the fifth go-around with the Auxiliary Jettison system.

NOTE

Always cycle STATION SELECT switches before activating the AUX JETT switch. This will ensure the first loaded MER/TER station is released first.

If the STA RDY light goes off after cycling the STATION SELECT switch, cycling the switch a second time will turn light back on.

With PAIRS mode and both stations selected, the system will operate as follows:

Fire Pulse	Aircraft Station	TER Station
1	1 and 8	1
2	1 and 8	2/3
3	1 and 8	1
4	1 and 8	2/3
5	1 and 8	1
6	1 and 8	2/3
7	1 and 8	1
8	1 and 8	2/3
9	1 and 8	1
10	1 and 8	2/3

If the stations remain selected and the MASTER ARM switch is cycled between passes for safety, the dispensers will fire as shown in the above sequence. However, if it is desired to empty the dispensers on TER station 1 before firing the other dispensers, the STATION SELECT switches must be cycled after each fire pulse. This will cause the TERs to rehome to station 1 each time, preventing the other dispensers from receiving fire pulses. This makes firing a dispenser more than once on the same pass difficult, but it can be accomplished. The dispenser tubes do not release all of their load simultaneously but leave a trail of bomblets behind the aircraft. Speedy cycling of the STATION SELECT switches immediately upon sending the first fire pulse should result in the second fire pulse being sent before the first set of tubes is empty. Do not hold the armament release button depressed while cycling the STATION SELECT switch or a fire pulse will be transmitted immediately to the stations as they are reselected. The TER station 1 dispensers will be empty after the fifth fire pulse is applied and may be released with the Auxiliary Jettison system.

The SIMULT position of the SINGLE/PAIRS/SIMULT switch does not function for aft dispensers.

The following discussion is based on the same dispensers loaded on the MAU-12 bomb rack and compares the differences between single and multiple carriage dispensing.

With SINGLE mode and both stations selected, the system will operate as follows:

Fire Pulse	*Aircraft Station*
1	1
2	8
3	1
4	8
5	1
6	8
7	1
8	8
9	1
10	8

At the end of the ninth fire pulse, the STA RDY light for station 1 goes out, and at the end of the tenth fire pulse, the STA RDY light for station 8 and the DISPENSER advisory light goes out. If in a computed attack mode, the HUD symbology will change to the air-to-ground gunnery mode when the DISPENSER advisory light goes out. Cycling the STATION SELECT switches will have no effect on the firing sequence shown above as there is no homing capability in the dispensers.

With the PAIRS mode and both stations selected, the system will operate as follows:

Fire Pulse	*Aircraft Station*
1	1 and 8
2	1 and 8
3	1 and 8
4	1 and 8
5	1 and 8

At the end of the fifth fire pulse, both STA RDY lights and the DISPENSER advisory light go out.

Vertical (Type II) Dispensers.

Vertical dispensers may be carried on any wing station but are not authorized for MER/TER carriage. For discussion purposes, an example load of one CBU-30/A dispenser on wing stations 1, 2, 3, 6, 7, and 8 will be used to illustrate the armament system's characteristics. With ASCU code CQ (CBU-30) set on a priority station(s), the NAV WD Computer will issue a solid fire pulse at ballistic solution in all computed attack modes, including CCIP and manual ripple deliveries. The fire pulse will continue as long as the armament release button is depressed. The CBU-30/A has an integral intervalometer which will route the fire pulse to the dispenser tubes as long as the fire pulse is present, so that the number of tubes dispensed cannot be accurately predicted. For the purposes of this discussion, assume that half (20) of the 40 tubes are fired from each dispenser with each aircraft fire pulse application.

With the SINGLE mode and all stations selected, the system will operate as follows:

Fire Pulse	*Aircraft Station*	*Advisory Lights*
1	1	
2	8	
3	1	Station 1 RDY Out
4	8	Station 8 RDY Out
5	2	
6	7	
7	2	Station 2 RDY Out
8	7	Station 7 RDY Out
9	3	
10	6	
11	3	Station 3 RDY Out
12	6	Station 6 RDY Out and DISPENSER Advisory Out

With the PAIRS mode and all stations selected, the system will operate as follows:

Fire Pulse	*Aircraft Stations*	*Advisory Lights*
1	1 and 8	
2	1 and 8	Stations 1 and 8 RDY Out
3	2 and 7	
4	2 and 7	Stations 2 and 7 RDY Out
5	3 and 6	
6	3 and 6	Stations 3 and 6 RDY Out and DISPENSER Advisory Out

With the SIMULT (simultaneous) mode and all stations selected, the system will operate as follows:

Fire Pulse	*Aircraft Stations*	*Advisory Lights*
1	1, 2, 3, 6, 7, 8	
2	1, 2, 3, 6, 7, 8	All STA RDY and DISPENSER Advisory Out

NOTE

With SIMULT selected, the STA RDY lights do not go out after the fire pulses are delivered. See figure 1-41 for circumstances which cause these lights to go out.

If the armament release button is held depressed long enough to completely empty a dispenser, the sequences shown above will be halved. Holding the armament release button depressed will prevent station transfer when in the SINGLE or PAIRS mode. As the Auxiliary Jettison system does not function for single carriage munitions, the Select or Salvo Jettison systems must be used to release the dispensers.

COMBAT SUPPORT EQUIPMENT.

KB-18A STRIKE CAMERA SYSTEM.

A KB-18A strike camera system is provided to record weapon effectiveness and to aid in bomb damage assessment. The system consists of a KB-18A camera and magazine, camera control unit, support mounts, and electrical power and control system. The camera is located on the lower right side of the forward section of the engine compartment and is positioned to provide 70-millimeter panoramic fore and aft photographic coverage of 180° along the line of flight, and 20° to each side of the flightpath.

Preflight camera settings that must be made include F-stop, overrun time from 0 to 32 seconds, and a cycling rate of 1, 2, or 4 frames per second.

The automatic exposure control system of the camera is activated when the MASTER ARM switch is placed in ARM.

Camera operation is automatic when the trigger switch is pressed to the first detent or when the armament release button is pressed to release stores from readied stations. Film capacity provides for approximately 300 exposures. The preset overrun time and frame cycle rate will determine the number of times the camera can be operated. The pilot must estimate the amount of remaining film as no film counter is installed in the cockpit. At end of film switch in the camera stops camera operation when film is expended.

PART 4 – JETTISON CONTROLS

Aircraft jettison controls give the pilot the capability to jettison all or any part of the external stores carried on the aircraft. Jettison controls are illustrated in figure 1-46. Jettisoning procedures are discussed in Emergency Aircrew Procedures, Section III.

SALVO JETTISON.

The salvo jettison circuits are normally used only in an emergency situation, and are activated by depressing the SALVO JETT button. Depression of the SALVO JETT button in either cockpit releases all stores, including MER's, TER's, and missile launchers, from the MAU-12 ejector rack on all wing stations (fuselage stations excluded), and disables the mechanical fuzing circuits so all mechanically armed munitions are released in a safe condition. A 2.1-second holding circuit is energized when the SALVO JETT button is depressed to ensure all stores will receive a release pulse, even if the SALVO JETT button is released before completion of the jettison cycle. 0.2 second after depression of the SALVO JETT button, stations 1 and 8 receive a release pulse. 0.5 second later, or 0.7 second after button depression, stations 2 and 7 receive a release pulse. If the main landing gear is in the up-and-locked position, stations 3 and 6 receive a release pulse 0.5 second after stations 2 and 7, or 1.2 seconds after button depression. If the landing gear is not in the up-and-locked position but reaches it before deactivation of the 2.1-second holding circuit, stations 3 and 6 receive a release pulse when the gear up-and-locked switch is actuated. If the main landing gear is not in and does not reach the up-and-locked position during the jettison cycle, stations 3 and 6 do not receive a release pulse and the SALVO JETT button must be depressed again, after the gear is up and locked, to jettison stations 3 and 6. The position of the MASTER ARM switch has no effect on salvo jettison. Salvo jettison does not jettison munitions on fuselage stations.

SELECT JETTISON.

The select jettison circuits are activated by depressing the SEL JETT button in the forward cockpit and are identical in operation to the salvo jettison circuit with the following exception: the pilot must select (with the appropriate station select switch) the station to receive a release pulse; the SEL JETT switch must be held depressed until the jettison cycle for the selected station is completed. The same time sequencing used in the salvo jettison circuitry is also used in the select jettison circuitry, i.e., in order to select jettison stores from stations 1 or 8, the SEL JETT switch must be held for 0.2 second, 0.7 second for station 2 or 7, and 1.2 seconds for 3 or 6.

If the SEL JETT switch is released before completion of the jettison cycle, the cycle ceases and remaining stations selected will not receive a release pulse. The position of the MASTER ARM switch has no affect on select jettison.

Since the select jettison circuitry also disables all the mechanical fuzing circuits, all mechanically armed munitions will be released in a safe condition.

NOTE

> On all aircraft after completion of T.O. 11L1-3-15-510 on AERO 3B missile launchers, the select jettison circuit for fuselage stations 4 and 5 is deactivated.

AUXILIARY JETTISON.

Unlike the salvo or select jettison circuits where jettison always occurs at the MAU-12, the auxiliary jettison circuit permits the pilot to release munitions from MER's and TER's while retaining the MER's and TER's. The auxiliary jettison circuits also permit the firing, unarmed and unguided, of AGM-65 Maverick missiles from LAU-88/A launchers. The auxiliary jettison circuits utilize the normal release circuits within the ASCU. Therefore, in addition to the desired stations being selected, the MASTER ARM switch must be in the ARM position.

The AUX JETT switch is a spring-loaded switch and generates one release signal each time it is actuated. Auxiliary jettisoning will follow the priority order established by the sequence switch. When the AUX JETT switch is actuated, only the highest priority station selected receives a release pulse. With multiple stations selected and the sequence switch in SINGLE, all

JETTISON CONTROLS

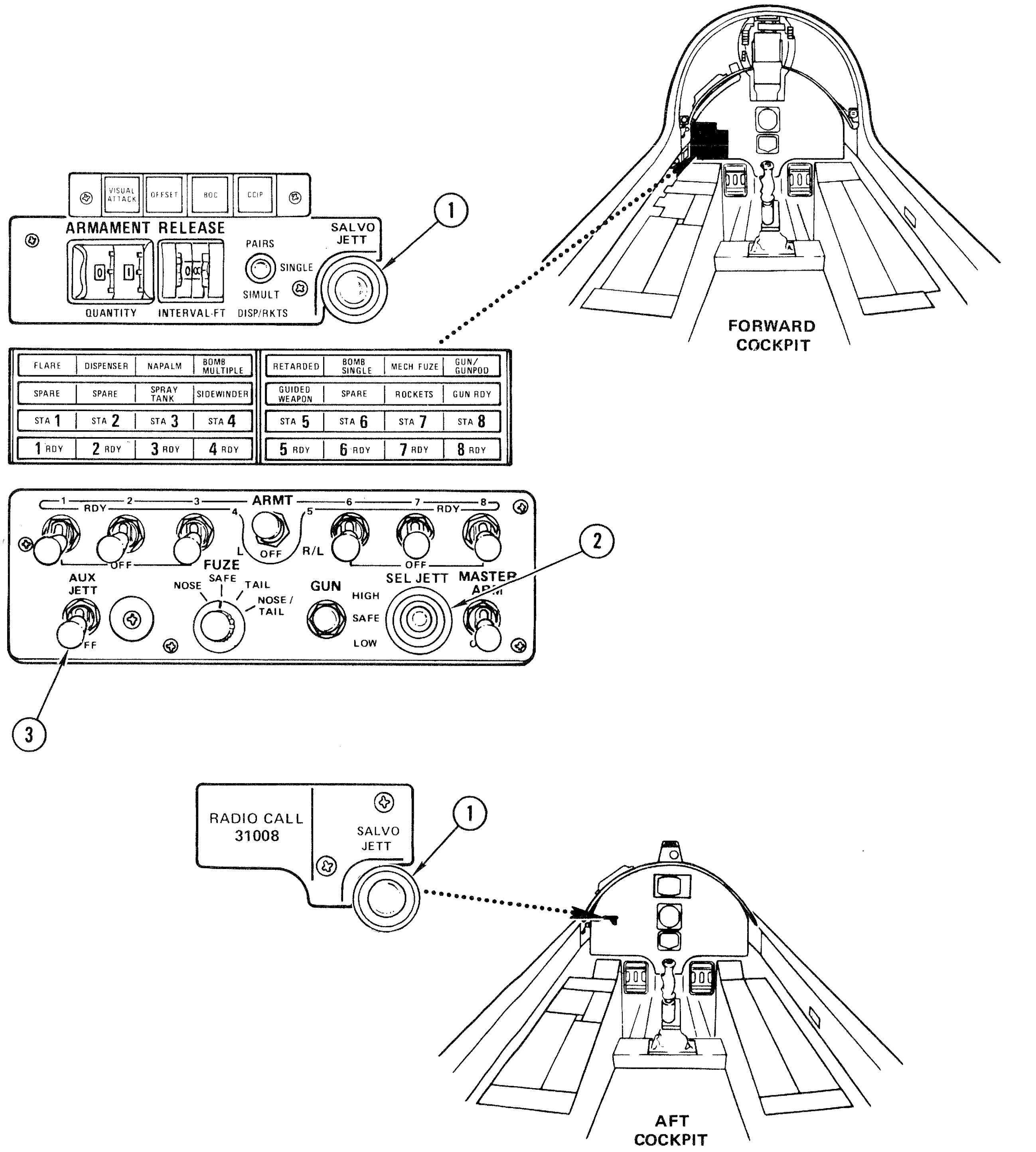

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Figure 1-46 (Sheet 1)

JETTISON CONTROLS

Nomenclature	Function
1. SALVO JETT button (both cockpits)	Depression of button in either the forward or aft cockpit initiates jettison cycle. Does not have to be held depressed. Disables mechanical fuzing. Does not jettison fuselage stations. MASTER ARM and station select switch positions have no effect on jettison cycle.
2. SEL JETT button (forward cockpit)	Depression of button initiates jettison cycle. Button must be held depressed until completion of cycle. Jettisons only those wing stations selected by station select switches. Disables mechanical fuzing. MASTER ARM switch position has no effect on jettison cycle.
3. AUX JETT switch (forward cockpit)	Actuation of switch releases/fires one store from highest priority single or pair of MER/TER(s)/LAU-88 selected, in single-pairs priority. SINGLE/PAIRS/SIMULT switch must be in PAIRS for two stores to be released. Rocket launchers are released in SINGLE sequence if SIMULT is selected. Switch is momentary and must be actuated once for each store or pair of stores released. Does not disable mechanical fuzing. Does not jettison fuselage stations. MASTER ARM and station select switches must be in on position.

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Figure 1-46 (Sheet 2)

ordnance on the MER, TER or LAU-88/A of the highest priority station selected will be jettisoned before station transfer will occur.

NOTE

Alternating release from paired stations is not performed when auxiliary jettisoning stores with the sequence switch in SINGLE. Only stores on the highest priority station will be released. When that station is empty, station transfer to the paired station on the opposite wing will occur. This could produce an undesirable asymmetrical load. When auxiliary jettisoning from paired stations, the sequence switch should be in PAIRS.

If the sequence switch is in PAIRS, the symmetrical pair of stations with the highest priority receives release pulses. If the sequence switch is in SIMULT, only rocket launchers on the TER of the highest priority selected station are jettisoned. No other store types can be released while the sequence switch remains in SIMULT. If a store is hung on the highest priority selected station, transfer will not occur until that station is deselected.

Unlike the salvo jettison and select jettison modes, ordnance may be dropped armed in the auxiliary jettison mode. Since activation of the AUX JETT switch does not disable mechanical firing, the FUZE switch determines whether the ordnance is jettisoned safe or armed. The fuzing options available in the normal release sequence are available in the auxiliary jettison mode.

NOTE

Auxiliary jettison does not function for fuselage stations (4 and 5) or for any store mounted singly on MAU-12 ejector rack.

PART 5 – WEAPON SUSPENSION SYSTEMS

FUSELAGE PYLONS.

There are two fuselage pylons (figure 1-47): one on the left side of the fuselage, aircraft armament station 4; and one on the right side, aircraft armament station 5. An AERO 3B missile launcher attaches to each pylon.

AERO 3B MISSILE LAUNCHERS.

AERO 3B missile launchers (figure 1-48) are used to carry and fire AIM-9 Sidewinder missiles or TDU-11/B target rockets. The launchers are secured to the fuselage pylons with two bolts which are held captive in the launcher. The AERO 3B provides launching rails for the missiles and rockets and secures them during takeoff, flight, and landing. Major components are a power supply, a detent and snubber assembly, and a rail assembly.

The power supply, located in the center of the launcher, provides missile power for the AIM-9 during captive flight as well as power for missile and rocket firing.

The detent and snubber assembly consists of three functional units. A detent extending through the rail restrains the missile in vertical and lateral directions. Snubber cams extending through slots in the rail engage the forward and aft missile lugs to prevent movement of the missile until fired. Guides provide for locking of the forward cams upon firing to clear the rail for passage of the missile lugs. The detent also contains two contact points for the missile motor fire pulse. The detent and snubber assembly performs the same functions for the target rocket as it does for the missle except for the motor fire pulse. A detent locking pin, which remains installed during flight, insures positive locking of the detent block in the store loaded position.

A nose assembly consists of a cover housing, a cover latch mechanism, a safety switch (normally closed), and an umbilical block breakaway hook for retraction of the severed umbilical cable upon firing of the AIM-9 missiles. When the target rocket is carried, a shorting plug is connected to the nose connector to reroute the missile firing pulse. A receptacle is provided on the aft end of the launcher for the target rocket, and this receptacle receives the firing pulse from the shorting plug.

FUSELAGE PYLON

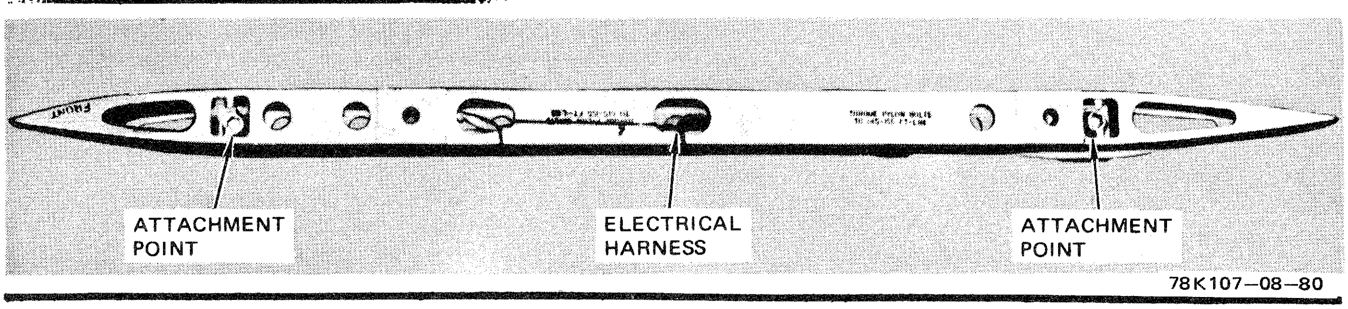

Figure 1-47

AERO 3B MISSILE LAUNCHER

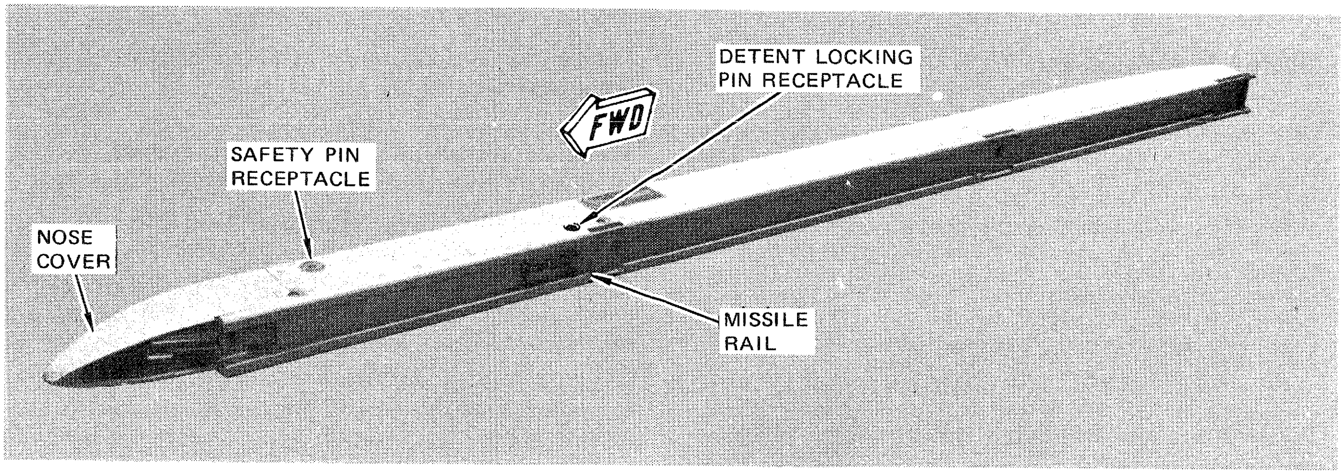

Figure 1-48

WING PYLONS.

Six pylons (figure 1-49) are provided for external stores carriage on the wings. From left to right the pylons are numbered 1, 2, and 3 on the left wing and 6, 7, and 8 on the right wing. Each pylon has a MAU-12 bomb ejector rack installed, and has a forward and aft electrical access. All stores are suspended from the MAU-12 rack, and all stores requiring electrical power connect into one or both of the electrical accesses.

PYLON CABLE ASSEMBLIES.

Each aircraft is equipped with a set of pylon cable assemblies. These cable assemblies are used to connect the aircraft circuitry to those stores requiring electrical power. Figure 1-50 provides a list of pylon cable assemblies by part number, identifying the store to which they connect.

MAU-12 BOMB EJECTOR RACK.

One MAU-12 (MAU-12B/A or MAU-12C/A) bomb ejector rack (figure 1-51) is installed in each wing pylon. The rack is designed to carry and forcibly eject rack-mounted stores and auxiliary suspension equipment. The rack is equipped with three mechanical arming solenoids, a gas ejection system, four sway braces, and two sets of suspension hooks, one set spaced 30 inches apart and one set spaced 14 inches apart. The arming solenoids are used to retain the arming wire/lanyard swivel and loops/links of munitions released armed. On the A-7K, the NOSE position of the FUZE switch arms the nose solenoids on both wings and the center solenoids on stations 1, 2, and 3 (left wing). The TAIL position of the FUZE switch arms the tail solenoids on both wings and the center solenoids on stations 6, 7, and 8 (right wing). The NOSE/TAIL position of the FUZE switch arms all solenoids on both wings, and must be used when arming wire/lanyard swivel and loops/links are installed in MAU-12 center solenoids.

The gas ejection system consists of a forward and aft ejector foot, mechanical linkage, and gas pressure lines. Two ARD 863-1 electrical impulse cartridges provide the gas pressure through a metering orifice above each ejector foot to eject the store. The orifices control the amount of ejection force applied by each ejector foot. The ejection forces can be raised or lowered to control the pitch of the store being ejected by changing the orifice size.

NOTE

Orifice numbers are dash numbers of part number 64D13176- . An orifice installed with no number visible and no port drilled through its length should be removed from the rack and the side of the orifice inspected to ascertain its proper dash number.

WING PYLON (TYPICAL)

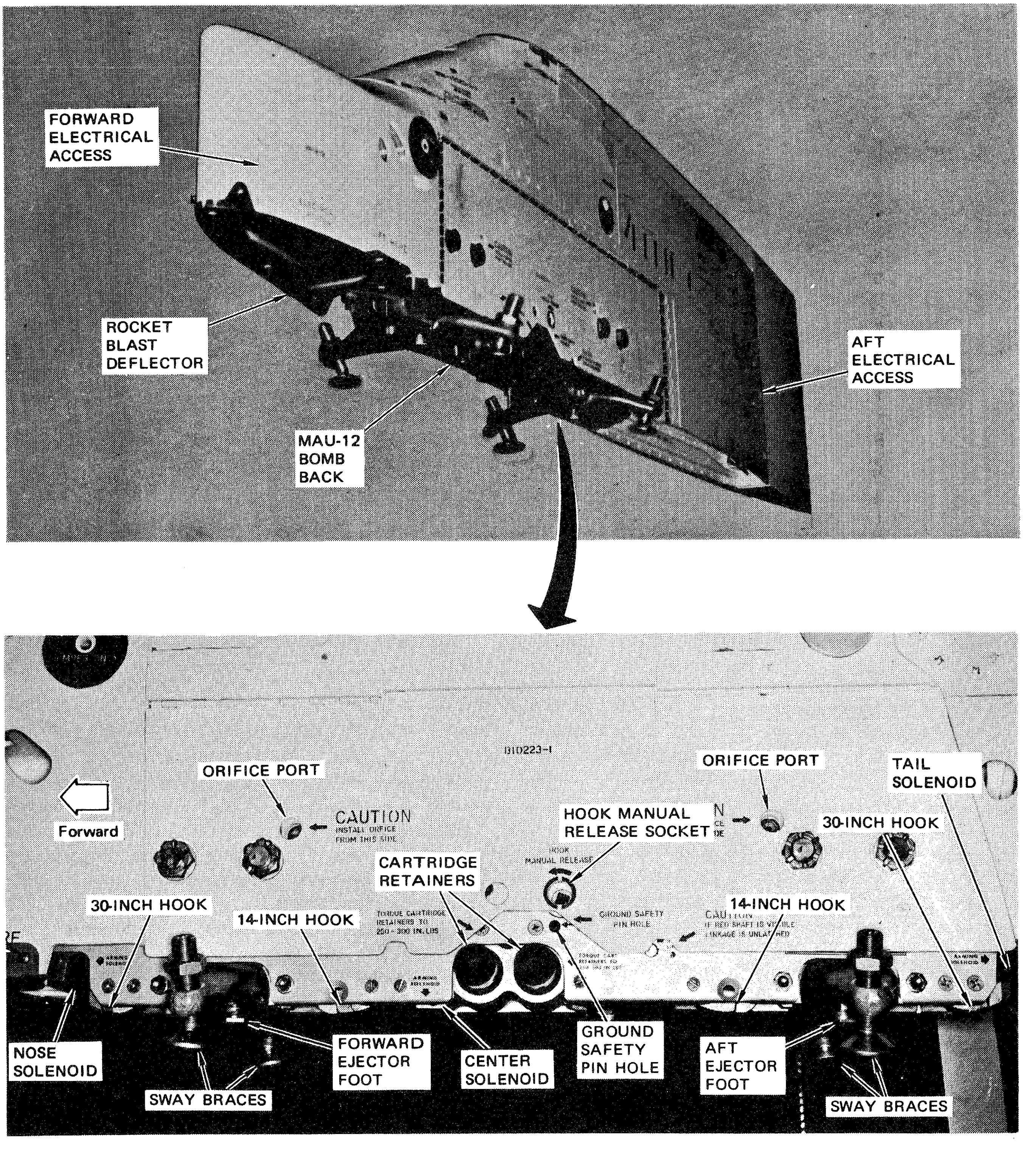

Figure 1-49

PYLON CABLE ASSEMBLY APPLICATION

MUNITION/ACCESSORY	CABLE ASSEMBLY
MER-10N and TER-9A	216-97335-101 or 216-97403 and 216-97402-6
SUU-20 series dispenser	216-97735-101 or 216-97403 and 216-97402-6
Rocket launchers (2.75-inch FFAR)	216-97403 and 216-97402-2
CBU-12 series, CBU-30 series, CBU-38 series, and CBU-46/A dispensers	216-97403 and 216-97402-3
SUU-25 series dispenser	216-97403 and 216-97402-2
SUU-42 series dispenser	216-97403 and 216-97402-13
LAU-88/A missile launcher	216-97403 and 216-97730-101
GBU-8/B guided bomb	216-97731-101
SUU-23/A gun pod	216-97732-101
Fuel tank (300-gallon)	216-97403 and 216-97402-9

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Figure 1-50

The sway braces and suspension hooks support and brace stores with diameters from 9.0 to 30.5 inches. Ground safety is provided by a safety pin installed in the mechanical linkage of the suspension hooks. This pin will not prevent the impulse cartridges from firing but it will prevent the store from being released by the hooks. The only difference between the MAU-12B/A and the MAU-12C/A is in the side plates. The MAU-12B/A side plates are made of one-fourth-inch aluminum alloy and the MAU-12C/A side plates are made of 0.188-inch steel.

MULTIPLE EJECTOR RACK, TYPE 10N (MER-10N) AND TRIPLE EJECTOR RACK, TYPE 9A (TER-9A).

The MER-10N and TER-9A (figure 1-52) are auxiliary suspension racks used to increase the number of munitions the MAU-12 rack can carry. A MER/TER can be suspended from the MAU-12 rack of each wing pylon and can increase the MAU-12 rack carriage capabilities to six (MER) or three (TER) munitions.

A MER consists of a strongback with a cluster of three ejector units at each end and interconnecting wiring. A TER consists of a strongback with one cluster of three ejector units and interconnecting wiring. Each ejector unit has provisions for suspension, sway bracing, sensing, mechanical arming, and ejection of munitions. The strongback has two suspension lugs with 30-inch spacing and four sway brace pads for suspension from and sway bracing by the MAU-12 rack. A fairing around the strongback encloses the interconnecting wiring. A control panel at the aft end of the MER/TER has an electrical safety pin receptacle, a manual stepper switch, and a ROCKET/CBU selector switch. The manual stepper switch is used only during maintenance. Ground safety is provided by an electrical safety pin, one mechanical safety pin in each loaded ejector unit, and the MAU-12 mechanical safety pin.

MAU-12 BOMB EJECTOR RACK

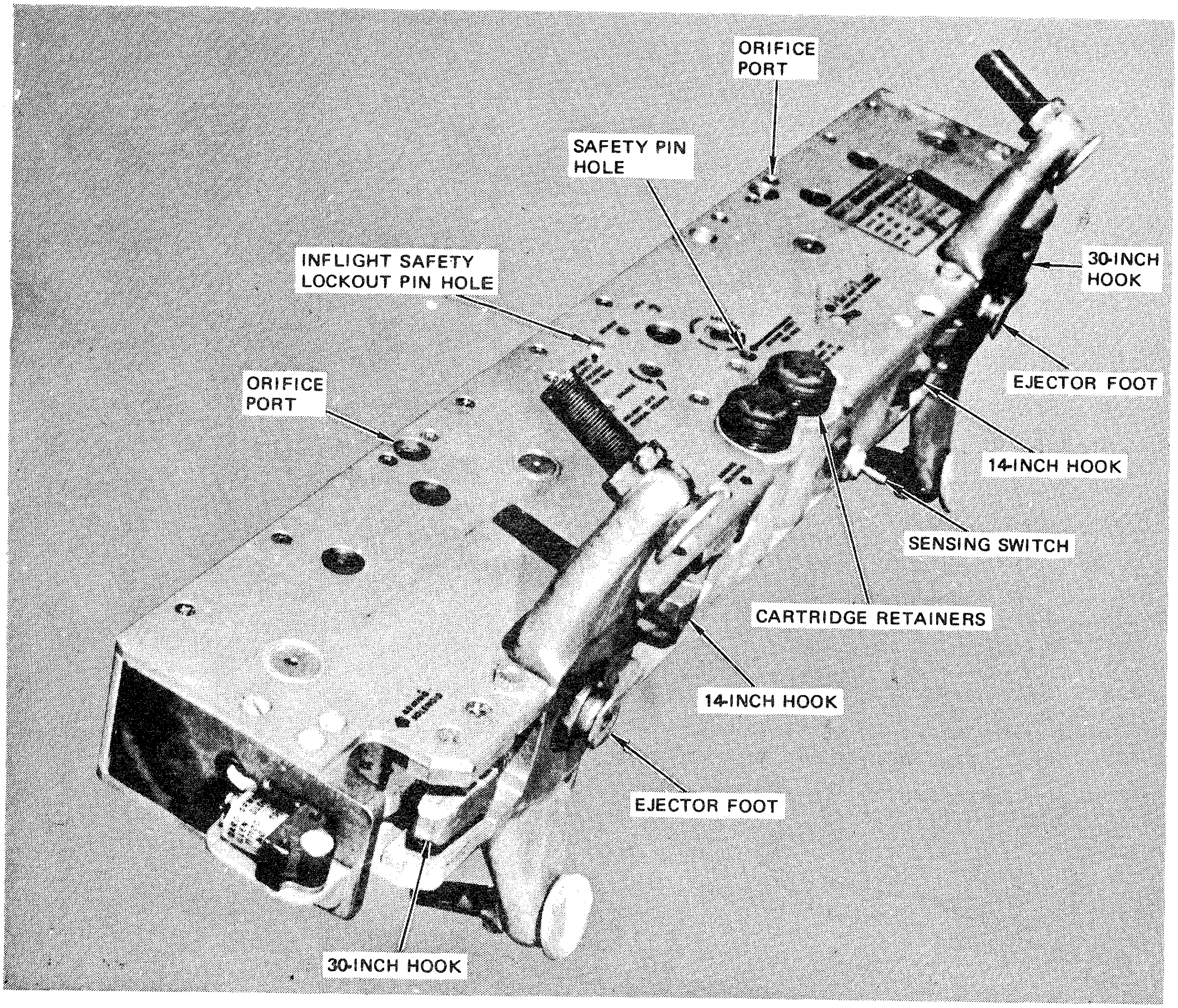

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Figure 1-51

MULTIPLE EJECTOR RACK, TYPE 10N (MER-10N) AND TRIPLE EJECTOR RACK, TYPE 9A (TER-9A)

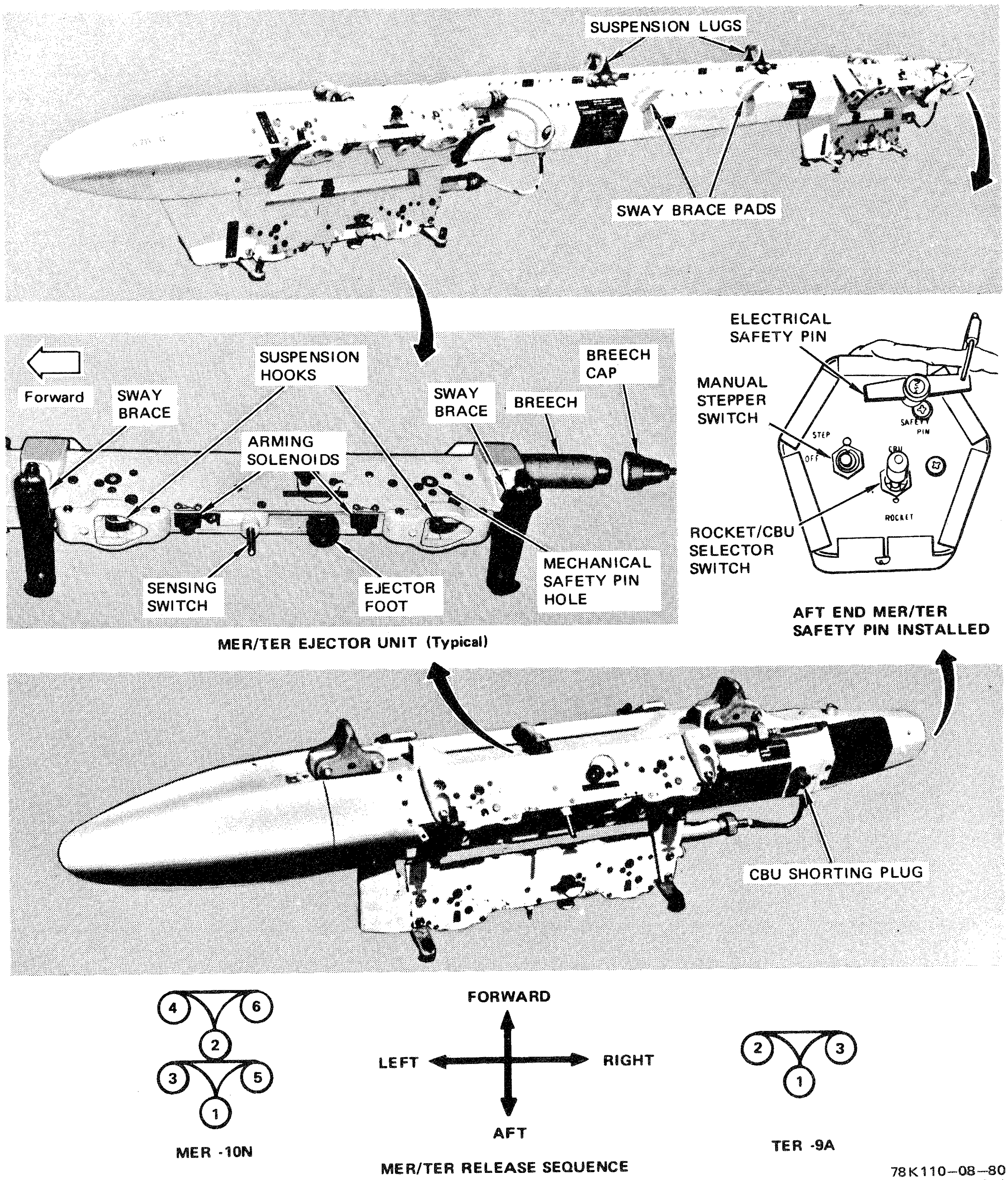


Figure 1-52

The MER-10N is used to carry and release only bomb type munitions on the A-7K. The TER-9A is used to carry bomb type munitions, rocket launchers, and CBU dispensers, and has two modes of operation, bomb release and rocket/CBU select. A seven-level, 11-position, solenoid-operated stepper switch controls sequential operation of the MER/TER. Positions 1 through 7 are used for the MER and positions 1 through 4 are used for the TER. Application or cycling of aircraft Master Arm power causes the stepper switch to home to the position of the lowest number loaded ejector unit. Master Arm power is controlled by the STATION SELECT switches. The MER/TER determines which ejector units are loaded by the position of the store sensing switch plunger on each ejector unit. Each application of a fire pulse causes the switch to step to the next loaded ejector unit, automatically bypassing empty ejector units. The stepper switch takes approximately 30 milliseconds to step from one ejector unit to the next unit in order, and an additional 15 milliseconds is required to step past each empty ejector unit. MER switch positions 1 through 6 and TER switch positions 1 through 3 provide a Ground Interlock Signal (GIS) to the aircraft ASCU. The ASCU interprets the GIS as meaning the MER/TER is loaded.

NOTE

Cycling the STATION SELECT switch any time after the first fire pulse with the MER/TER not empty (STA RDY light on) will result in loss of store present indication because of interruption of the GIS. Station ready indications will not be available and store release is not possible. The ASCU store present signal and STA RDY light can be regained by cycling the STATION SELECT switch a second time.

In the bomb release mode, power for the mechanical arming solenoids is routed to the appropriate solenoid(s) in each ejector unit. Fire pulses are routed by the stepper switch to the breech cap firing pins of loaded ejector units. When the last loaded ejector unit is fired, the switch steps to position 7 (MER) or 4 (TER), interrupting the GIS, which the ASCU interprets as MER/TER empty, resulting in aircraft station transfer. The ROCKET/CBU selector switch has no effect in the bomb release mode as the aircraft fire pulses are automatically routed to the breech caps of loaded ejector units.

When rocket launchers are loaded on a TER, a 28-volt dc rocket select signal is applied to the TER by the ASCU, closing the rocket select relay in the TER and applying 28 volts to positions 4 through 7 of the stepper switch auto-step level. With the rocket select relay energized, firing pulses are routed through a 5-ohm resistor (ROCKETS position of TER ROCKETS/CBU switch) to the rocket harness of each loaded ejector unit (empty ejector units are bypassed). When the stepper switch gets to position 4, the 28-volt rocket select voltage causes the switch to step back to the first loaded ejector unit. The GIS signal is also interrupted, applying a TER empty signal to the aircraft even though the launchers are still present on the TER.

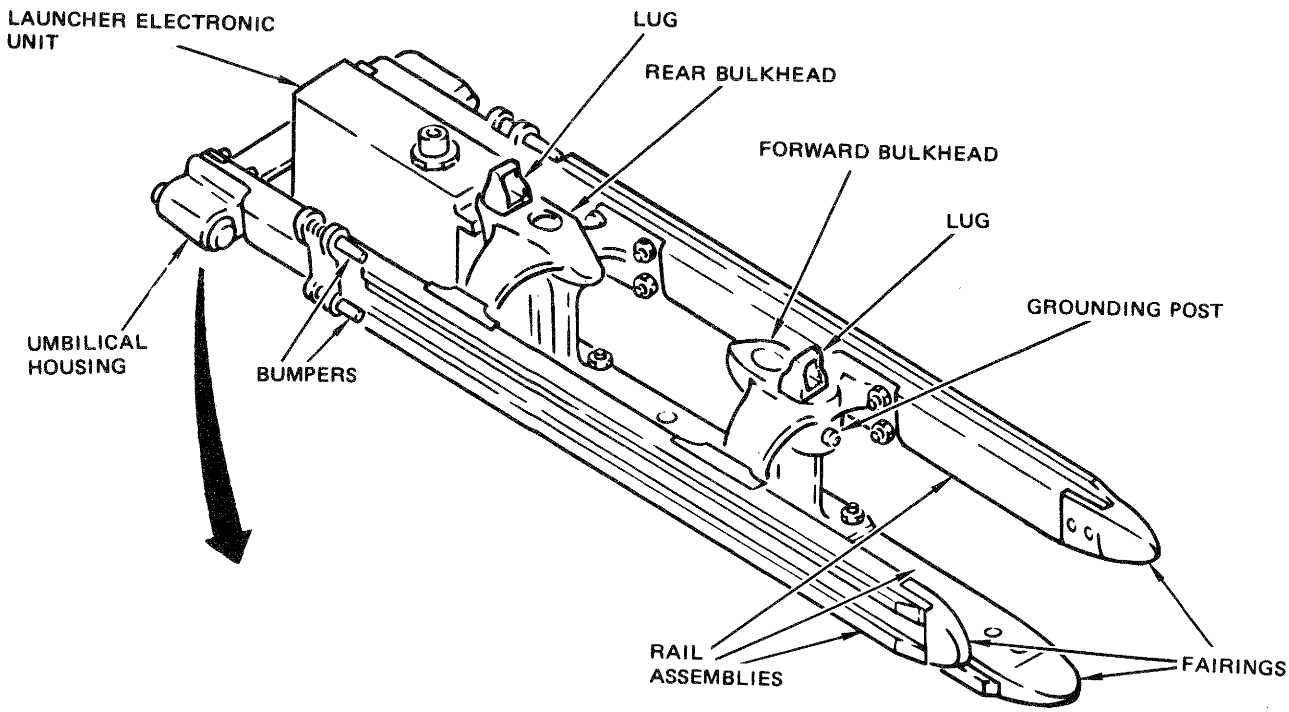
Actuation of the aircraft Auxiliary Jettison system turns off the rocket select signal and applies a fire pulse to the TER. Loss of the rocket select signal allows the rocket select relay to open and routes the fire pulses to the ejector unit breech caps, jettisoning the launchers.

When CBU dispensers are loaded on a TER, the TER operates identically to the rocket select mode with the following exceptions: the TER selector switch is in the CBU position, bypassing the 5-ohm resistor, and the GIS signal is not used to identify the TER empty condition. The aircraft ignores the CBU empty signal, never transfers off the aircraft station, and never turns off the STA RDY and DISPENSER advisory lights unless the station(s) is deselected.

LAU-88/A MISSILE LAUNCHER.

The LAU-88/A launcher (figure 1-53) consists of three missile rails, a strongback, and an electronics unit. The launcher is designed to carry and control three AGM-65 Maverick guided missiles or A/A 37A-T1 Training Guided Missiles (TGMs). The rails are positioned at 90° angles from each other with the strongback and the electronics unit located between the two shoulder rails. The strongback has two suspension lugs spaced 30 inches apart and provisions for swaybracing. The strongback supports all three missile rails. The electronics unit is mounted behind the strongback and contains all the control and switching circuits for the launcher and missiles. Aircraft power is routed through the electronics unit to all loaded missiles to provide missile heating and, when selected, missile gyro turnup. The unit establishes the order of release for the loaded missiles and provides a station empty signal when all missiles have been fired. Each launcher rail is a T shaped single piece of metal. At the rear of each rail, two bumpers are provided to prevent aft movement of the missiles. A retractable electrical connector is located between the bumpers. A retractable electrical connector is located between the bumpers. After the missile is loaded, the connector is rotated forward to connect with the missile. Approximately midway on each rail is a shear pin housing. After the missile is loaded, the shear pin is installed to prevent missile movement during aircraft flight and maneuvers.

LAU-88/A MISSILE LAUNCHER



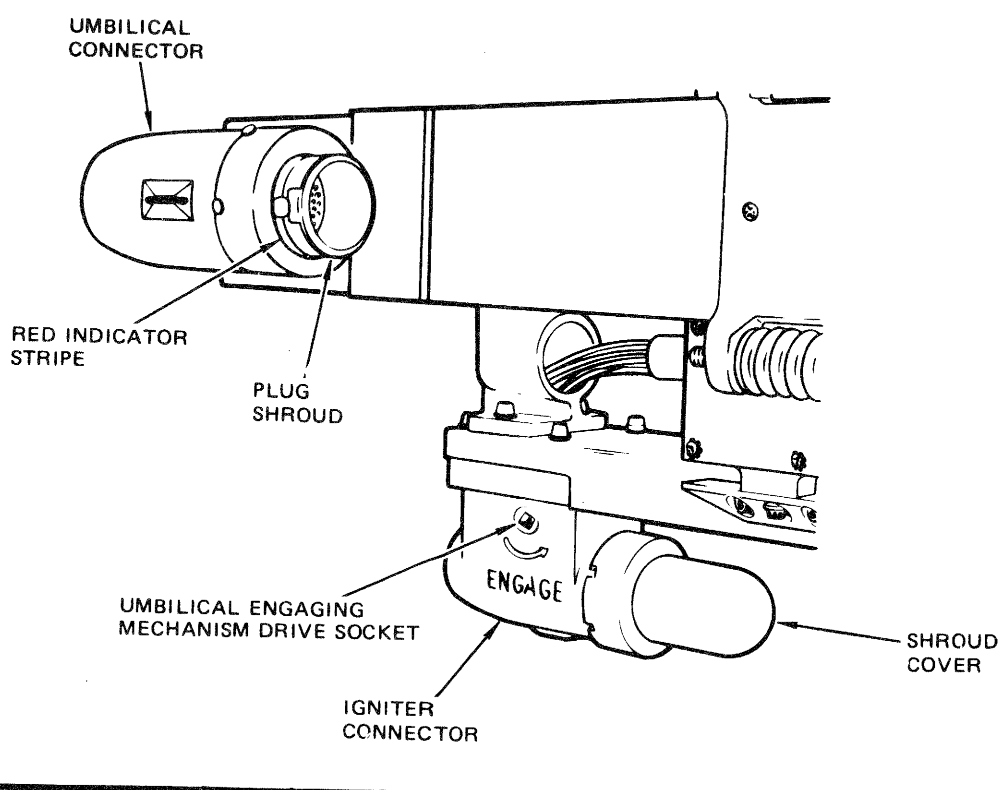


Figure 1-53

PART 6 – NONNUCLEAR WEAPONS (COMBAT)

AIRCRAFT GUNNERY SYSTEM.

M61A1 20MM GUN SYSTEM.

The M61A1 20-millimeter gun system consists of the gun, a linkless ammunition handling system, a hydraulic gun drive system, a gun gas purge system, and an electrical control system. Most gun system components are installed in the left forward fuselage section.

WARNING

The gun blast port must be plugged if the aircraft is to be flown without the gun installed. Flight without the M61A1 gun or a blast port plug installed will allow pressurization of the gun and ammunition drum compartments and may cause failure of gun gas shroud components. This will, in turn, allow gun gas seepage into other aircraft compartments upon reinstallation and firing of the gun. Also, when the aircraft is flown without the gun or blast port plug installed, airframe buffet is noticeable and common. If the gun, ammunition drum, and FLR are all removed, the aircraft will not be flown because of the adverse cg effect.

The gun works on the Gatling gun principle and fires electrically primed M50 series 20-millimeter ammunition. The gun consists of six barrels, each with its own bolt, a gun rotor, and a gun housing. The barrels are mounted in a circular pattern on the gun rotor, which is inside the gun housing. The gun housing has two cam grooves or paths, one elliptical and one circular, on the inside of the housing. A cam is located on top of each barrel bolt and, as the gun rotor revolves inside the housing, rides around these paths. During gun firing, the elliptical cam path is used and it causes the bolts to move forward and aft on the barrels. As a bolt moves forward, a round is fed, chambered, and fired in that barrel. As the bolt moves aft, the round is extracted and ejected from the barrel. Firing voltage is not applied to a round until the round is chambered and locked. As deceleration begins at the end of gun firing, an electrical solenoid activates the gun clearing mechanism. The solenoid pulls the clearing sector lever which forces the gun bolt cams into the circular path. The bolts are retained in the circular path, which is around the back of the gun housing, as the gun comes to a stop. This prevents the rounds from being chambered and fired, thus safing the gun.

The ammunition handling system consists of the ammunition drum, ammunition chutes, conveyor belts, and the transfer unit. The ammunition drum stores the live ammunition and expended cases. The ammunition chutes and conveyor belts transport the live rounds from the ammunition drum to the transfer unit, receives expended cases and cleared (live) rounds from the transfer unit, and transports them to the drum. The transfer unit transfers live rounds from the conveyor belt to the gun and expended cases and cleared rounds from the gun to the conveyor belt. The transfer unit also functions as the entrance and exit point into the gun system during loading and unloading.

The M61A1 gun and the ammunition handling system hold a maximum of 500 rounds of 20-millimeter ammunition, some of which cannot be fired. If the full load is fired in one continuous burst, a maximum of 18 rounds will be lost during system deceleration, which starts as soon as the last unfired round passes the last round switch. If the gun is fired in short bursts, 4 to 9 rounds will be lost (unfired) at the end of each burst due to deceleration, which begins immediately upon release of the trigger. No rounds are lost during system acceleration as rounds are fired as soon as the system begins to accelerate.

The hydraulic gun drive system, powered by PC 2 pressure, supplies the power to operate the gun system at the rate selected on the GUN switch in the cockpit. The gun rate is controlled through a flow control valve in the hydraulic system. The gun rotor, transfer unit, conveyor belt, and drum are powered by means of a drive shaft (torque tube) to the gun and a flexible shaft to the drum, at rates of 4,000 (LOW position of GUN switch) and 6,000 (HIGH position of GUN switch) rounds per minute. The hydraulic system also opens the gun gas purge door.

The gun gas purge system, using low-pressure bleed air in conjunction with a hydraulically actuated purge door adjacent to the gun, forces explosive gases from the gun compartment and the ammunition drum compartment. The purge air system operates during gunfiring. The gun gas purge door starts to close 30 seconds after gunfiring ceases and will be closed in approximately 60 seconds, or approximately 80 seconds after gunfiring ceases.

The gun electrical control system (figure 1-54) provides power and sensing for all other components of the gun system. The system consists of the ARMT panel, armament advisory light panel, the Armament Station Control Unit (ASCU), the gun control unit, and sensing elements. With MASTER ARM power available (wheels up and MASTER ARM switch in ARM) and the gun selected (HIGH or LOW position of GUN switch), the gun can be fired at the selected rate using the trigger switch in either cockpit. The ASCU takes inputs from the ARMT panel and provides MASTER ARM power, GUN/GUN POD advisory light, and the GUN RDY light. The ASCU also provides rate control commands to the gun hydraulic system, operating commands to the gun gas purge system, and fire commands to the gun control unit. The gun control unit provides gun drive commands to the hydraulic system and firing voltage to the gun. A safety feature of the gun control system prevents gun firing when insufficient bleed air is available to the purge system and/or when the purge door or the purge air valve fails to open. A last round switch, located in the drum exit unit, provides a signal to the gun control unit to cease gun system operation when expended cases (or empty elements) pass the switch. A last round bypass switch, located in the gun bay, allows ground checkout of the empty gun system.

In addition to pure gun control functions, the ASCU advises the NAV WD Computer when the gun has been selected. If other requirements have been met, the computer then displays Air-to-Air or Air-to-Ground computed attack symbology on the Head-Up Display (HUD). For additional information related to computed gun modes, refer to Gun and Rocket Attack descriptions in Part 1 and Part 2. For operating limitations of the gun system, refer to T.O. 1A-7K-1, Section V.

SUU-23/A 20MM GUN POD.

The SUU-23/A gun pod (figure 1-55) consists of the GAU-4/A 20-millimeter automatic gun, a linkless ammunition feed and storage system, and inertia gun starter, brake assembly, and a control panel assembly. The pod is constructed in five readily detachable sections: nose fairing, forward fairing, gun support section, drum assembly, and aft fairing. The nose fairing provides an opening for protrusion of the gun barrels and diffuser assembly and, when used in conjunction with the diffuser, is designed to divert gun blast pressures away from the aircraft. The forward fairing functions as an aerodynamic cover for the gun barrels with the top forward air scoop and rear louvers on each side providing gun gas purging. The gun support section houses the gun (except for the barrels), the inertia gun starter, the brake assembly, and the linkless conveyor feed system, and has cutouts provided for the loading chute, link ejection chute, and case/round ejection. The right side of the support section has a large removable cowling for access to the internal components and one of the pod suspension lugs is mounted in the top of the section. The drum assembly houses the linkless feed drum and mounts one of the pod suspension lugs. The control panel assembly is mounted on the rear bulkhead of the drum assembly with the pod electrical receptacle mounted on the top centerline behind the suspension lug. The aft fairing completes the pod aerodynamic shape and houses a handcrank used in manual loading and unloading of the pod.

The GAU-4/A gun works on the Gatling gun principle and fires electrically primed M50 series 20-millimeter ammunition. The gun consists of six barrels, each with its own bolt, a gun rotor, and a gun housing. The barrels are mounted in a circular pattern on the gun rotor, which is inside the gun housing. The gun housing has two cam grooves or paths, one elliptical and one circular, on the inside of the housing. A cam is located on top of each bolt assembly and, as the gun rotor revolves inside the housing, rides around these paths. During gun firing, the elliptical cam path is used and it causes the bolts to move forward and aft in relation to the barrel chambers. As a bolt moves forward, a round is fed, chambered, and fired in that barrel. As the bolt moves aft, the round is extracted and ejected from the barrel. Firing voltage is not applied to a round until the round is chambered and locked. As deceleration begins at the end of gun firing, an electrical solenoid activates the gun clearing mechanism. The solenoid pulls the clearing sector lever which forces the gun bolt cams into the circular path. The bolts are retained in the circular path, which is around the back of the gun housing, as the gun comes to a stop. This prevents the rounds from being chambered as the gun comes to rest, thus safing the gun.

The ammunition handling system, holding approximately 1,200 rounds, consists of the ammunition drum, conveyor feed system, and transfer unit. The drum stores the live ammunition and transfers the ammunition to the conveyor feed system. The conveyor feed system transfers the ammunition from the drum to the transfer unit, which feeds the ammunition into the gun. The transfer unit also functions as the entrance point into the gun system during pod loading.

GUN CONTROL SYSTEM

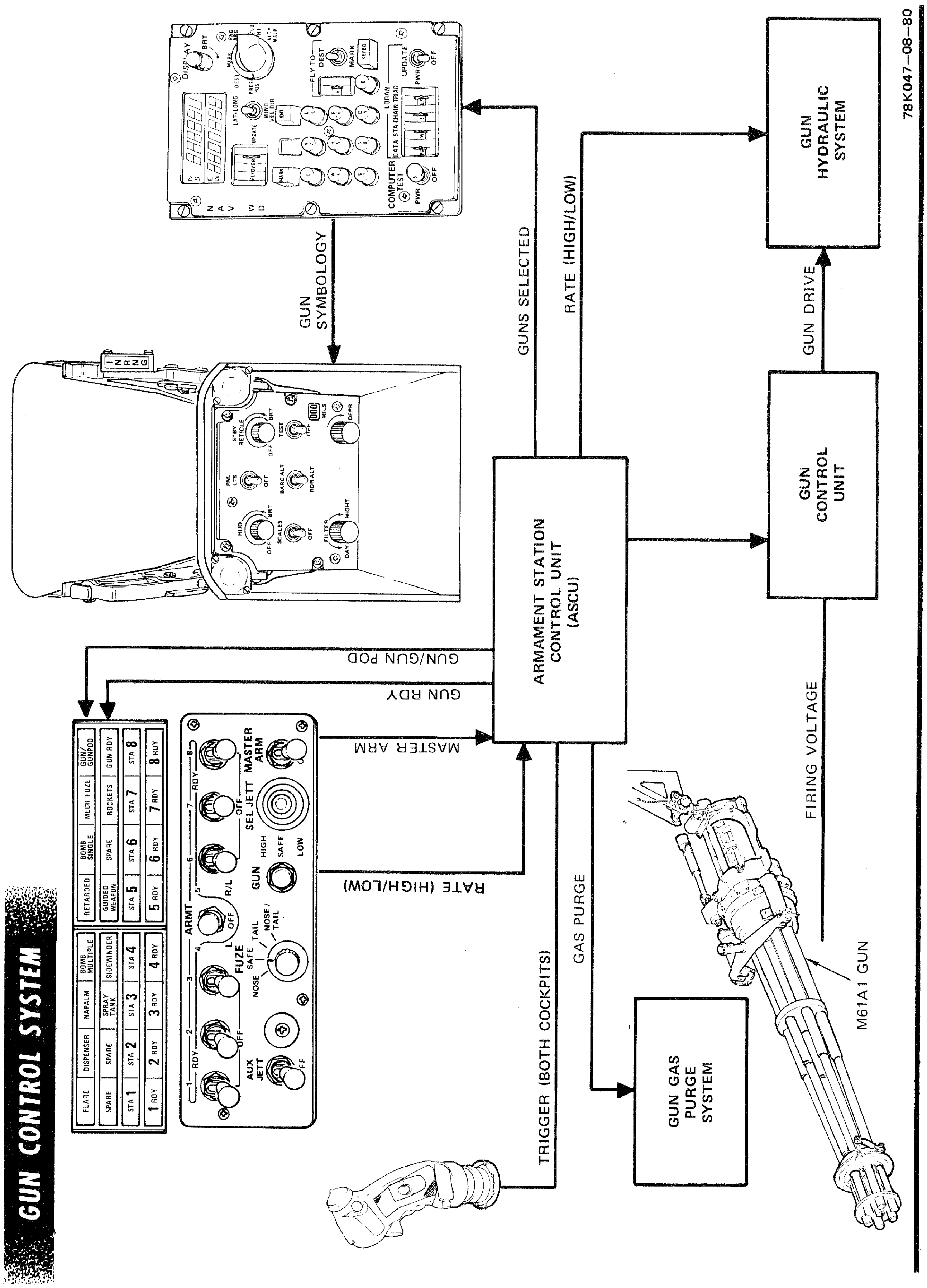


Figure 1-54

SUU-23/A GUN POD

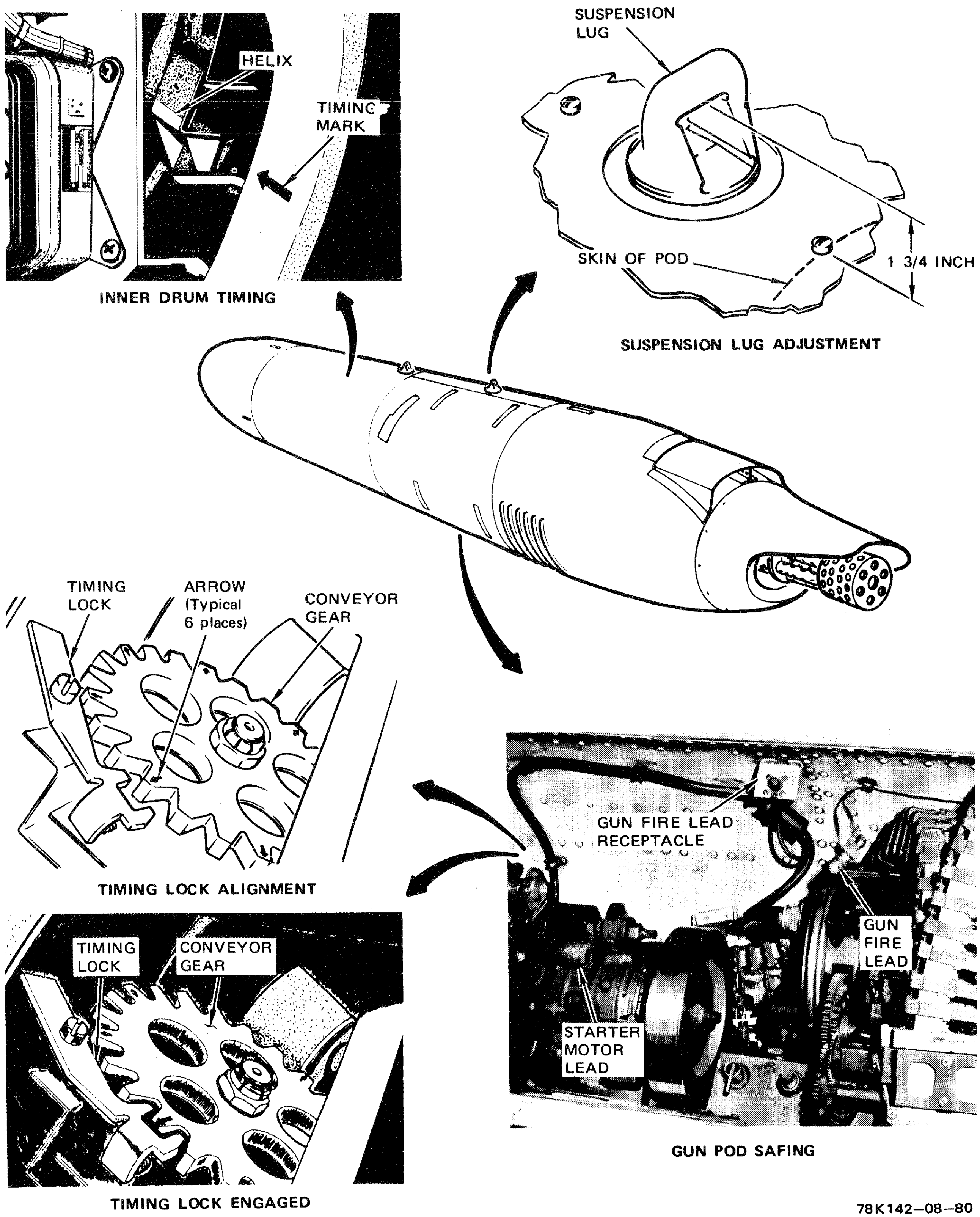


Figure 1-55

When the ARMT panel MASTER switch is positioned to ARM, the inertia starter motor of all gun pods begin to accelerate the starter, which takes a maximum of 40 seconds to accelerate to operating speed. When the gun pod station(s) is selected and the trigger switch in either cockpit is depressed to the second detent, the inertia starter engages and accelerates the gun system (gun, drum, conveyor system, and transfer unit) to 5,400 shots per minute (spm). At 5,400 spm, the inertia starter disengages and a gas drive system uses gun gas from four of the six GAU-4/A gun barrels to further accelerate to the maximum firing rate of 6,000 spm. With the inertia starter operating at rated speed, maximum gun firing rate is achieved 0.2 to 0.4 second after trigger depression. The gas drive system sustains the driving rate of the gun system and the inertia starter is disengaged but continues to run. If a malfunction occurs (such as misfire of four or more consecutive rounds) or the driving rate fails below 5,400 spm, the inertia starter engages and returns the rate to 5,400 spm and again disengages. The expended cases (fired rounds) are extracted from the gun and ejected from the lower left side of the pod by the case ejector with sufficient velocity to clear the aircraft.

Complete fire-out of all ammunition is not possible. A last round switch in the ammunition drum stops the feed system before the last round in the drum reaches the feed system. Firing voltage is removed and the clearing action is initiated by the last round switch, resulting in all cartridges being removed from the gun breech. A last round switch bypass button is provided to enable ground checkout of an empty pod.

A burst limiter is a device used to limit the number of rounds fired each mission. It is attached to the right side of the gun and is driven mechanically by the rear gear of the rotor body. The limiter may be set for a desired number of rounds to be fired in one burst. When the set number of rounds have been fired, a cam operated switch in the burst limiter opens, interrupting the trigger circuit. When the burst limiter is removed from the pod, the attaching connectors must be connected together to complete the trigger circuit.

The burst limiter will normally be installed on training flights. The use of the burst limiter will be at the using commander's discretion.

The gun pod also has a cutout circuit which prevents the automatic clearing action from occurring at the end of a firing burst. When the cutout circuit is energized, the clearing solenoid is not energized when the trigger is released and rounds continue to be chambered as the gun barrels slow to a stop. This enables the pod to start firing immediately upon the next depression of the trigger. The pod last rounds switch opens the cutout circuit and causes the clearing action to be performed when the switch is actuated. This feature is controlled by the armament panel FUZE switch in the NOSE or NOSE/TAIL position.

The gun pod electrical control system consists of the ARMT panel, armament advisory light panel, and Armament Station Controll Unit (ASCU). MASTER ARM power is interlocked through the STATION SELECT switches. Individual station control is provided by the STATION SELECT switches, which are positioned to RDY to select and enable gun pod stations. The ASCU takes all of the above inputs and provides MASTER ARM power, GUN/GUN POD advisory light, station selected/ready lights and the GUN RDY light. Upon depression of the trigger to the second detent, the ASCU provides the gun firing command to the gun pod. The pod is jettisoned using the select or salvo jettison circuits.

In addition to gun pod control functions, the ASCU advises the NAV WD Computer when the pod has been selected. If other requirements have been met, the computer then displays Air-to-Air or Air-to-Ground computed attack symbology on the Head-Up Display (HUD). For additional information related to computed gunnery modes, refer to Gun and Rocket Attacks descriptions in Part 1 and Part 2.

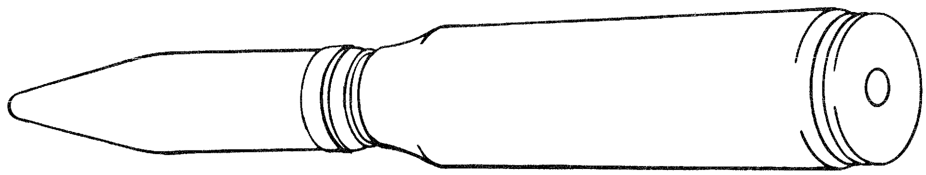
M50 SERIES 20MM AMMUNITION.

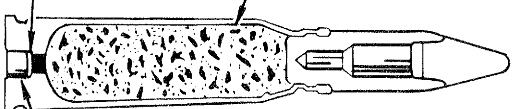
A 20-millimeter round consists of a brass cartridge case, an electrical primer, propellant powder, and a projectile. Electrical power from the gun system firing pin ignites the cartridge primer which in turn ignites the propellant powder. Gas formed by the burning propellant forces the projectile from the cartridge case and through the gun barrel. The only difference in M50 series ammunition types (figure 1-56) is in the projectile.

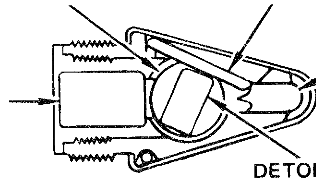
The M53 armor piercing incendiary (API) steel projectile has an aluminum nose which is charged with an incendiary compound. The projectile has no fuze.

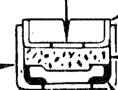
The M56A3 high-explosive incendiary (HEI) projectile contains an incendiary compound, an explosive compound, and a fuze. The fuze is armed by the inertial forces imparted when the round is fired and functions on impact.

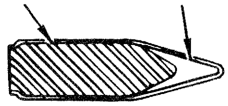
20MM AMMUNITION

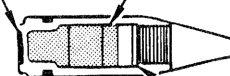












20MM ROUNDS FOR M61A1 GUN

ROUND	APPROXIMATE MUZZLE VELOCITY IN M61A1 (FT/SEC)	AVERAGE WEIGHT (LBS)			IMPULSE (LB-SEC)
		PROJECTILE	PROPELLANT	COMPLETE ROUND	
M53 Armor Piercing Incendiary	3380±50	0.22	0.081	0.57	31.6
M55A2 Ball	3380±50	0.22	0.084	0.56	31.9
M56A3 High Explosive Incendiary	3320±50	0.22	0.088	0.56	32.3

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Figure 1-56

The M55A2 ball projectile (TP) is used for target practice. The hollow steel projectile does not contain a filler.

Tracer ammunition is also available in 20-millimeter. Tracer is usually linked in a 1:5 ratio with other 20-millimeter projectiles.

BOMB TYPE MUNITIONS.

MK 82, MK 83, AND MK 84 LDGP.

The Mk 82, Mk 83, and Mk 84 low-drag general purpose bombs (figure 1-57) are designed to produce blast, fragmentation, and deep cratering effects. The bombs are similar in shape, explosive used, and construction. The explosive filler used is Tritonal 80-20 or Minol 40-40-20. These bombs normally use a nose fuze and a tail fuze to increase functioning reliability, however, either type fuze may be used singly if desired. Two conduits within the bomb body connect the nose and tail fuze wells to a charging well between the suspension lugs. These conduits are used for FMU type (internal) fuze arming lanyards. The fin has attachment points for the ATU-35 drive assembly (required for M905 tail fuze).

The munition velocity at impact must not exceed 900 feet/second to enable the fuzing to withstand the forces of impact. The tables in Section VI list the maximum release airspeeds for various dive angles and altitudes that must be observed to avoid exceeding this impact velocity. The munition trajectory angle of impact is also provided for use in ricochet or burial depth computation. These values are precisely computed numbers and have not been padded to provide a degree of conservatism.

Ricochet and Burial Depth.

With this type low-drag munition shape, ricochet is almost certain to occur at impact angles less that 30°. Between 30° and 40° impact angles, some ricochet and/or broaching may be expected. For impact angles greater than 40°, the bomb should bury with burial depth increasing as trajectory angle at impact increases. Too deep penetration may result in partial or total camouflage. Release conditions which result in trajectory angles at impact of approximately 40° are recommended to minimize the possibility of too deep penetration and also minimize the possibility of ricochet and broaching.

GBU-8 SERIES GUIDED BOMB.

Refer to (Confidential) T.O. 1A-7K-34-1-1-1 for information on this weapon system.

GBU-10 (MK 84) AND GBU-12 (MK 82) SERIES LASER GUIDED BOMBS.

The GBU-12 series weapon system (figure 1-58) components consist of the Mk 82 GP bomb and the KMU-388 series bomb guidance kit. the GBU-10 series weapon system (figure 1-56) consists of the Mk 84 GP bomb and the KMU-351 series bomb guidance kit. The bomb guidance kits and associated attaching hardware provide a laser, terminal guidance capability for the Mk 82 and Mk 84. No specific carriage equipment or weapon fire control system is necessary; the weapon is mounted directly on the wing station armament pylons and released through the conventional weapons controls. No electrical connectors exist between aircraft and weapon. Hence, weapon monitoring or controlling functions are not required from the cockpit.

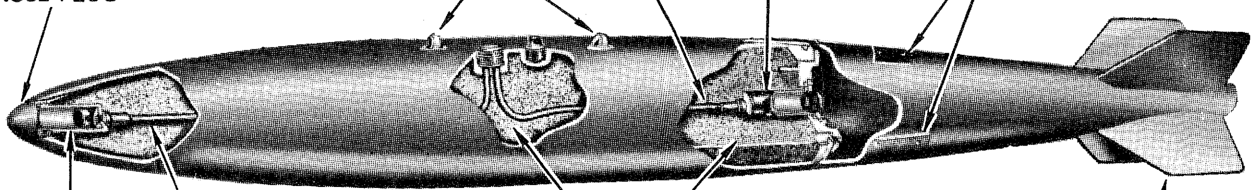
NOTE

Ballistics and weapon envelope/profile data is available for the laser weapons in this manual.

Mission.

The delivery aircraft uses the laser guided bomb in much the same manner as conventional unguided bombs in support of air operations including air superiority, interdiction, and close air support missions. Targets illuminated by a laser are attacked using this system. The bomb guidance system, sensing the laser energy, derives azimuth and elevation steering commands for the movable canards to provide steering to the illuminated target.

MK 82, MK 83, AND MK 84 LDGP BOMBS



	Mk 82	Mk 83	Mk 84
Weight	531.0 pounds	985.0 pounds	1970.0 pounds
Length	7.0 feet, 3.0 inches	9 feet, 9.7 inches	12.0 feet, 7.5 inches
Diameter	10.8 inches	14.0 inches	18.0 inches
Fin span	15.0 inches	19.6 inches	25.3 inches
Suspension lug distance	14.0 inches	14.0 inches	30.0 inches
Fuze	Refer to Bomb-Fuze Compatibility Chart	Refer to Bomb-Fuze Compatibility Chart	Refer to Bomb-Fuze Compatibility Chart

78K077—08—80

Figure 1-57

Mission planning data is presented for the level and dive bombing modes. The mission may therefore be conducted against targets of opportunity or against preplanned targets of known location. The ballistic tables, for all modes, assume that the weapon flies an unguided (ballistic) path toward the target. Thus, the weapon guidance system must accomplish only final course corrections. By this procedure, the weapon should impact close to the target if the guidance system malfunctions. Guidance system acquisition of the target prior to release is unnecessary. The weapon flies ballistically until the illuminated target is within the detector field of view and until the reflected energy is strong enough to activate the guidance system.

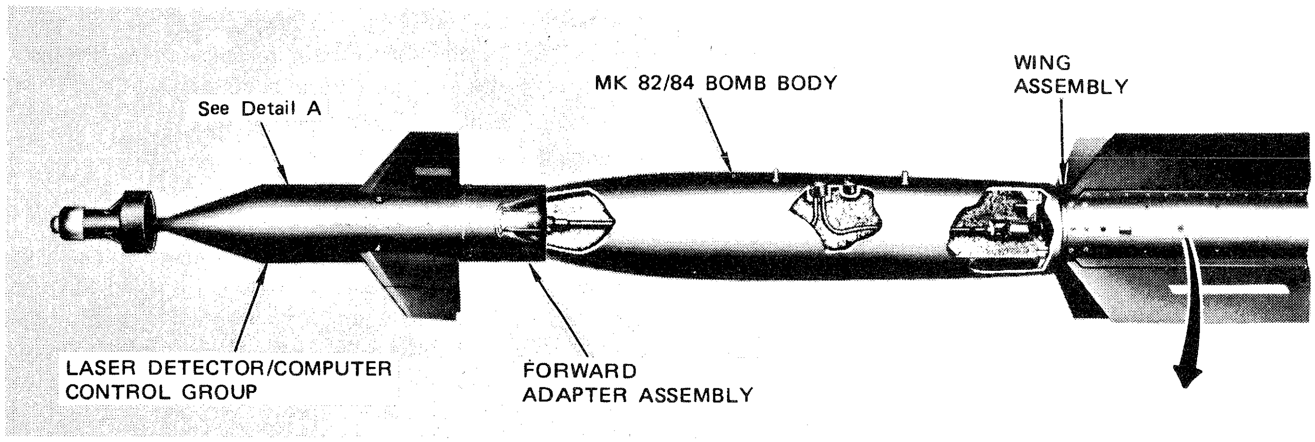
Laser Guided Bomb.

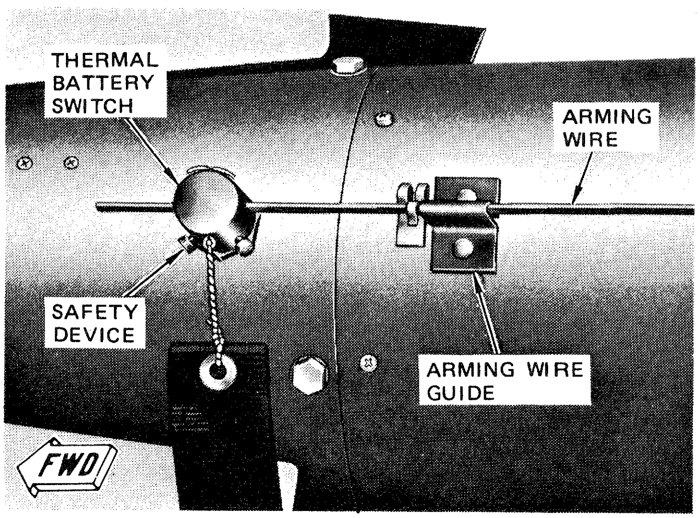
The guidance systems are mounted on the weapon to become the extreme forward and rear sections. The major components of the guidance kits are the laser illumination detector, the bomb guidance control, and the wing assembly.

Laser Illumination Detector.

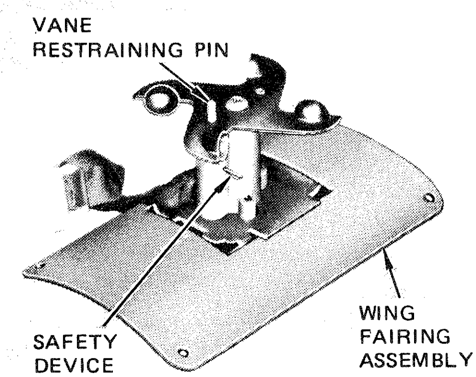
This section consists of an IR dome, the optical equipment, an infrared detector, and the signal mixer and preamplifier networks. The detector housing is

GBU-10 SERIES AND GBU-12 SERIES LASER GUIDED BOMBS

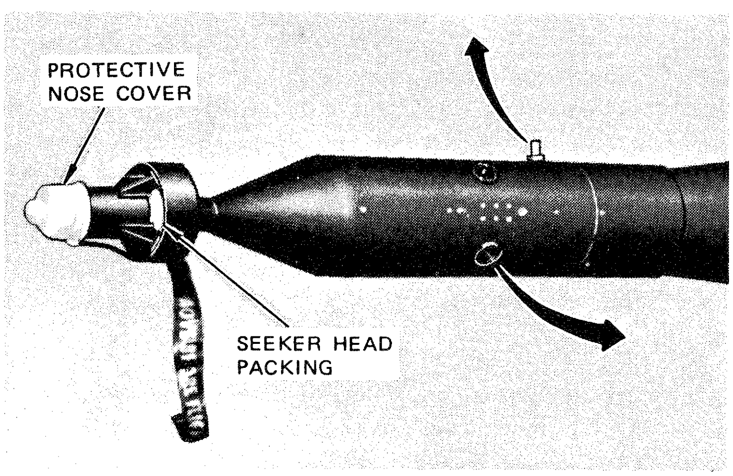




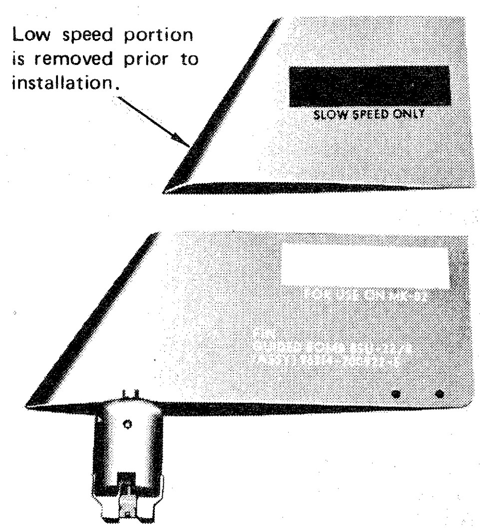
KMU-388/B AND KMU-351A/B SHOWN
(TOP VIEW)



ATU-35 DRIVE ASSEMBLY
(Mounted on Wing Fairing)



DETAIL A



KMU-388 SERIES AND KMU-351B/B
FIN ASSEMBLY

78K182–08–80

Figure 1-58

gimbal-mounted by a universal joint assembly. During bomb flight, the detector boresight axis is maintained along the bomb velocity vector by the ring stabilizer. The four-quadrant detector receives invisible laser energy in the near infrared spectrum. This in turn generates signals with characteristics that are a function of the detector quadrant or quadrants receiving the energy. These signals, which eventually become both pitch and yaw commands, are directed to the guidance computer.

Guidance Computer.

The computer receives the detector signals and performs the electronic processes which develop the command signals and operate the guidance control unit. Some of the computer components include the log amplifier, comparator logic, and the control logic circuits. The amplifier video processing circuits amplify the weak (long range) video signals and attenuate the strong (close range) ones in direct proportion to the strength of the signals. This enables the continuous detection of both weak and then very strong signals by the same system. The comparator network, receiving the output of the amplifier, develops the error signals which represent the direction (left or right, up or down) to be taken to correct weapon flight. Then the control logic converts these error signals into solenoid drive signals, which in turn operate the proper set of steering solenoids. The control logic also contains circuits which place the commands in a fin trial status if guidance signals are lost or if signal inputs are of insufficient strength.

Bomb Guidance Control.

This section of the KMU system consists of the four movable canards, four solenoids, the thermal battery, and a gas generator. These units provide the drive force which moves the canards in accordance with the commands generated by the computer. Each canard pair, which shares a common shaft, is driven in a bang-bang manner to a total of 5.5° movement in either direction. In the absence of any command, the canards are maintained in the trial position by the airstream.

The thermal battery firing device in the top of the control unit receives the battery arming wire/arming cable. The wire is routed through the forward bomb lug and tied to the forward rack sway brace. One end of the arming cable is secured to a bracket in front of the thermal battery switch. The other end is routed through a pull pin in the switch and tied off to a forward sway brace. Guidance is always activated at release. As the weapon separates from the rack, the arming wire is pulled activating the thermal battery. Battery voltage is applied to a 3-second delay squib relay; when the relay fires, the bomb power systems are activated. The 3-second delay allows the bomb and aircraft to separate sufficiently before any guidance commands can begin.

Forward Fairing Assembly.

The forward fairing assembly provides the mounting and interfacing structure between KMU guidance kit and the bomb. The FMU-26 electrical fuze is installed through the adapter fairing and into the nose fuze well of the bomb. This is an electrical fuze with a self-contained thermal battery. A fuze arming lanyard is routed internally through the bomb, extended through a lanyard access between the bomb lugs, then installed in the forward arming solenoids. At bomb release, pulling the lanyard initiates battery operation. (FMU-26 fuzes are further described in Part 7 of this section.)

Guided Bomb Wing Assembly.

The KMU wing assembly provides the necessary lift for bomb maneuvering flight. Access ports in the wing fairing provide mounting points for ATU-35 drive assembly, which drives the M905 bomb tail fuze. The ATU-35 drive receives a branched arming wire which is installed in the aft arming solenoids. Both the fuze and the drive unit are described in Part 7 of this section.

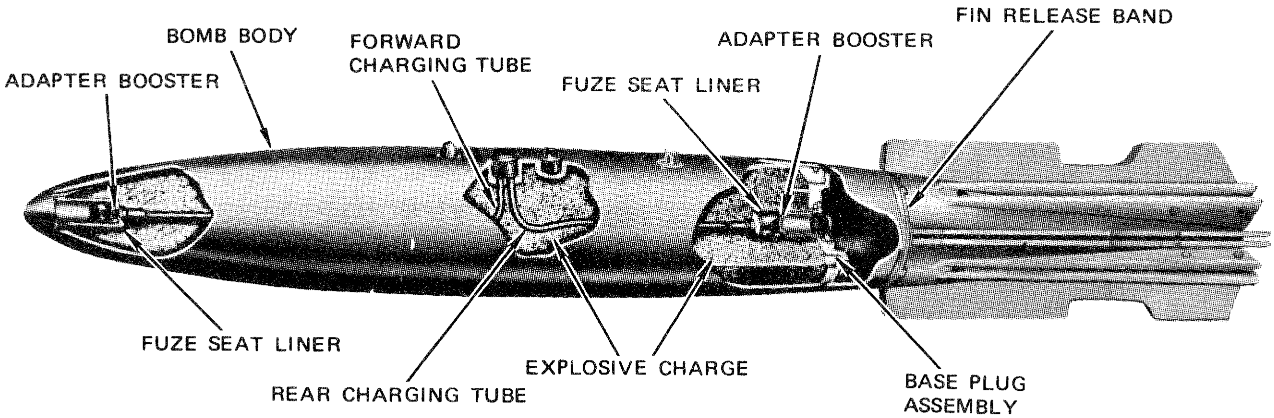
Refer to (Confidential) T.O. 1A-7K-34-1-1-1 for additional information on this weapon system.

MK 82 SNAKEYE I.

Mk 82 Snakeye I bomb (figure 1-59) consists of a basic Mk 82 LDGP bomb body with Mk 15 Mod 3, 3A, or 4 retardation fins. Addition of the Mk 15 fin to the Mk 82 bomb allows use of additional weapon delivery capabilities. The bomb can be delivered as a low-drag Mk 82 or as a high-drag Mk 82 Snakeye. The high-drag configuration permits low angle and/or low altitude delivery by eliminating the danger of aircraft damage due to ricocheting bombs or fragments from detonating bombs.

The bomb is carried in the low-drag configuration with the fins held closed by a release band with an arming wire running through a trunk latch type band fastener. The swivel and link of this wire is installed in the rack

MK 82 SNAKEYE I BOMB



Weight	572.0 pounds
Length	7.0 feet, 5.5 inches
Diameter	10.8 inches
Fin span	
Closed	15.1 inches
Open	5.0 feet, 5.3 inches
Suspension lug distance	14.0 inches
Fuze	Refer to Bomb-Fuze Compatibility Chart

78K076—08—80

Figure 1-59

tail arming solenoid. When the bomb is released low-drag, the swivel and link is pulled from the deenergized solenoid. When the bomb is released high-drag, the energized solenoid pulls the fin release wire from the release band latch. This latch pops open, releasing the fin drag plates. A leaf spring under each drag plate and the force of the airstream open the plates to approximately perpendicular to the airstream. The open fins provide maximum drag area and stability. The nose fuze aiming wire is withdrawn from the fuze as the fins open, allowing the fuze to arm.

MK 36 MODS 1, 2, AND 3 DESTRUCTOR.

This munition is the same as the Mk 82 Snakeye I bomb (figure 1-59) except the fuze components are those of the Mk 75 destructor kit. The mod number of the kit determines the mod number of the Mk 36 Destructor. the weapon is deployed high-drag only for ground implant and subsequent land mine operations. Ballistic data is the same for both the Mk 82 Snakeye and Mk 36 bombs.

When the destructor is released, the fin release band wire is withdrawn, allowing the fin to open. Opening of the fin withdraws the nose-fin wire from the arming device vane. This leaves the vane free to turn the drive train for a period of time which is set on the arming device. This time is adjustable from 2 to 18 seconds in 2-second increments; normally, 2 seconds is set for use with the Mk 36 Destructor. At the end of the set time, the drive train in the arming device aligns the explosive train. In a similar manner, the arming wire is withdrawn from the firing mechanism as the fins open, initiating the firing mechanism timer.

No function is initiated at water or land entry. Upon impact, the fin assembly is severely damaged, usually tearing the four fins off the fin support. After impact, the destructor sinks to the bottom or buries in the ground where it remains inactive until termination of the timer operation. After a delay of 30 minutes, actuation of the destructor is possible, making it a land or water mine.

Hazardous Release Conditions.

When deploying the Mk 82 Snakeye or Mk 36 Destructor, a hazardous condition exists if a retarder failure occurs. This applies to both H-6 and tritonal filled munitions. With a retarder failure and resultant low-drag trajectory, the munition impact forces may be sufficiently high to cause a high order detonation. In such a situation, a delivery aircraft engaged in low altitude, high-drag deployment may receive serious damage from bomb fragments. This could occur even though the fuze has not had time to arm.

Recommendations.

Test data to date indicates that the H-6 explosive is slightly more impact sensitive than the tritonal filled. Therefore, to reduce the hazard, the H-6 filled bombs should not be used for the high-drag, low altitude release situation if tritonal filled bombs are available. To provide an additional safety margin against a retarder failure, the pilot should execute a 4g military power pullup or banked escape maneuver after release of these munitions.

MK 75 MODS 1, 2, AND 3 MODIFICATION KITS.

The Mk 75 Mods 1, 2, and 3 modification kits are very similar. The Mk 75 Mod 1 is described here. The Mk 75 Mod 1 kit contains the Mk 30 arming device, the Mk 42 firing mechanism, the Mk 95 battery, and the Mk 59 booster along with a variety of other tools necessary to convert the Mk 82 Snakeye to the Mk 36 Destructor.

Instead of utilizing a fuze in the nose and tail of the bomb, an arming device and a magnetic firing mechanism are used. The firing mechanism responds to changes in the component of the magnetic field along the axis of the destructor. The firing mechanism battery provides self-destruction for the destructor should actuation fail to occur before the battery depletes itself.

The Mk 32 arming device, used in Mk 75 Mods 2 and 3 kits, provides safety and arming features for the Mk 36 Destructor. The arming device ensures an out-of-line condition of the weapon's explosive train until after the weapon has been released from the aircraft. The Mk 32 requires vane rotation through air travel and impact force, in that order, to complete its arming cycle. It is an improved version of the Mk 30, which requires vane rotation only for arming. The arming device will maintain a constant rotational speed from 150 knots; however, a minimum of 175 knots is required to shear a pin, permitting the device to arm.

M117 SERIES GP.

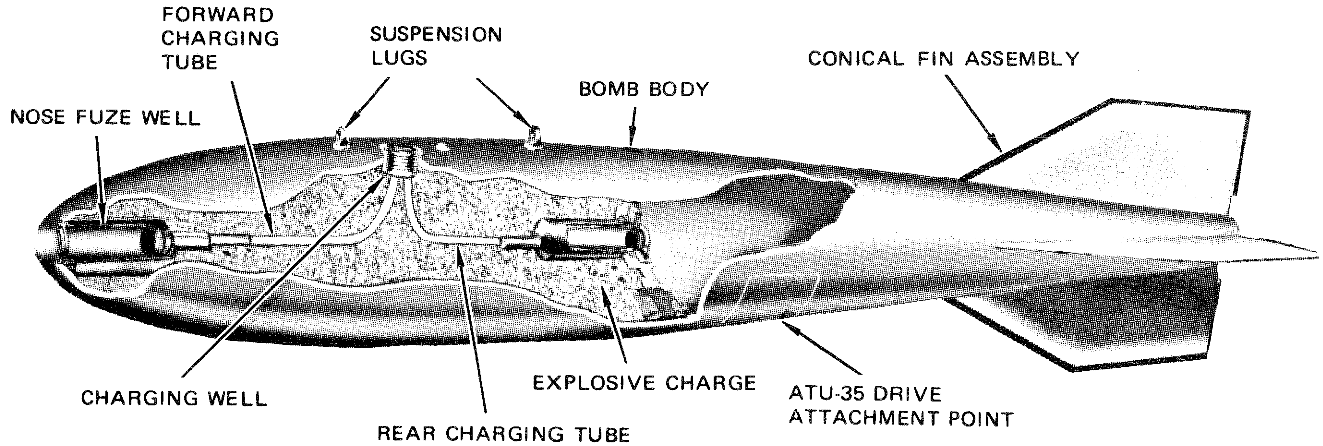
The M117 (figure 1-60) is a general purpose demolition bomb designed to produce blast, fragmentation, and deep cratering effects. The explosive filler used is Tritonal 80-20 or Minol 40-40-20. The bomb normally uses a nose fuze and a tail fuze to increase functioning reliability, however, either type fuze may be used singly if desired. Two conduits within the bomb body connect the nose and tail fuze wells to a charging well between the suspension lugs. These conduits are used for FMU type (internal) fuze arming lanyards. The bomb is compatible with a MAU-103A/B fin, which has attachment points for the ATU-35 drive assembly (required for M905 tail fuze).

MC-1 GAS BOMB.

The MC-1 is a nonpersistent gas bomb designed by conversion and modification of the M117 general purpose bomb. The bomb has a cylindrical metal body with an ogival nose and a tapered aft section to which a conical fin assembly is attached. The basic structural material of the bomb is steel. The bomb body is filled with 24 gallons (220 pounds) of GB agent. The filler tube is permanently welded shut at the time filling is accomplished. The bomb is designed for use with both a nose fuze and a tail fuze. A hollow burster tube runs through the center of the bomb and connects the nose and tail cavities. Fuze wells are installed at both ends of the tube to accommodate nose and tail fuzes. Prior to loading, an M32 burster charge containing an explosive is installed in the tube.

Other components used are arming wires and adapter-booster. The arming wires are threaded through safety devices in the fuze, thus maintaining the fuze in a safe (unarmed) condition until release. The adapter-boosters serve to accommodate the body of the fuzes and to contain a booster charge which insures proper operation of the burster charge. Operation of the bomb commences when it is released from the aircraft and the arming wires are withdrawn. This permits the fuze arming vanes to rotate in the airstream. After the required number of revolutions or time lapse, the fuzes

M117 SERIES GP BOMB



Weight, full	823.0 pounds
Length	7.0 feet, 3.4 inches
Diameter	16.0 inches
Fin span	22.38 inches
Suspension lug distance	14.0 inches
Fuze	Refer to Bomb-Fuze Compatibility Chart

78K080—08—80

Figure 1-60

are armed. When the bomb impacts, the fuzes function, causing the burster to detonate. The detonation of the burster ruptures the bomb body and disperses the filling as tiny droplets of liquid which quickly evaporate to a gas.

NOTE

Regardless of the fuze used, all will be set for instantaneous or nondelay functioning.

The fins used on the MC-1 gas bomb are conical, low-drag assemblies consisting of an elongated cone and four identical streamlined blades assembled perpendicular to the cone. All fins used on the MC-1 gas bombs will accept the ATU-35 series drive for use with the M905 tail fuze.

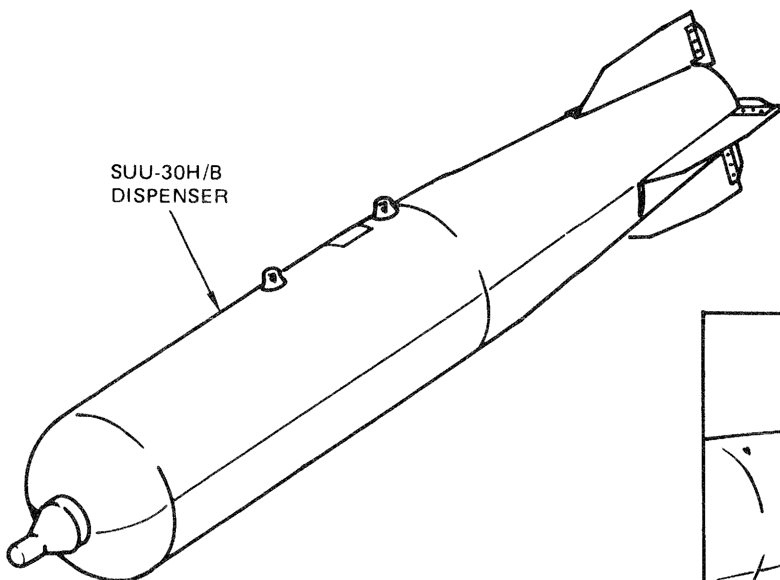
Physical characteristics of the MC-1 gas bomb are identical to those of the M117 bomb except for total weight, full, which is 720 pounds for the MC-1.

BOMB TYPE (SUU-30 DISPENSER) CBU MUNITIONS.

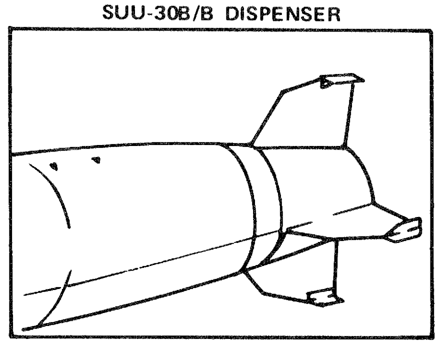
The complete bomb type CBU munition consists of an SUU-30 dispenser loaded with bomblets and fuzed with a nose fuze (figure 1-61). The cylindrically shaped dispenser consists of two half shells locked together by a nose locking cap and a baseplate. The upper half contains a strong back section for forced ejection; the lower half provides a hard shell area for chocking purposes. A dual set of external arming wire/lanyard guides is positioned along the upper half of the dispenser for routing arming wire/lanyards. Four fins are attached to the aft end of the dispenser body.

When the dispenser is ejected from the aircraft, the fuze arming time begins. When the fuze functions, it blows the nose locking cap from the dispenser. The explosive force of the fuze and air pressure force the two halves apart, releasing the bomblet payload. Refer to Section I,

SUU-30 DISPENSER CBU MUNITIONS



SUU-30B/B DISPENSER



Length	7.5 feet
Diameter	16.0 inches
Fin span	23.0 inches
Suspension lug distance	14.0 inches

MUNITION	DISPENSER	SUBMUNITION	WEIGHT (LBS)
CBU-24B/B	SUU-30B/B	BLU-26/B	832
CBU-49B/B	SUU-30B/B	BLU-59/B	832
CBU-52A/B	SUU-30B/B	BLU-61A/B	785
CBU-52B/B	SUU-30H/B	BLU-61A/B	785
CBU-58/B	SUU-30H/B	BLU-63/B	810
CBU-58A/B	SUU-30H/B	BLU-63A/B	820
CBU-71/B	SUU-30H/B	BLU-86/B	810
CBU-71A/B	SUU-30H/B	BLU-86A/B	820

NOTE

Refer to Bomb/Fuze Compatibility Chart for list of authorized fuzes.

78K105—08—80

Figure 1-61

Part 7 for fuze data and to T.O. 1A-7K-34-1-2 for fuze settings, sight depression settings, and impact pattern data.

SUU-30B/B Dispenser.

The SUU-30B/B dispenser nose locking cap consists of a nose plug and adapter, a nose coupling, a breech cap, and a lanyard tube. A retention post between the aft suspension lug and the tail fin provides an attachment point for lanyards used with nose fuzes. The dispenser fins have a stabilizing plate attached to the outside edge of each fin.

NOTE

The M907E1/E2 fuze is compatible with the SUU-30B/B and SUU-30H/B dispensers but is not reliable.

SUU-30H/B Dispenser.

The SUU-30H/B dispenser is identical to the SUU-30B/B dispenser with one exception: the stabilizing plates on the outside edge of the SUU-30B/B have been shortened by 1.5 inches and moved to the trailing edge of the SUU-30H/B dispenser, becoming miniature drag plates.

Submunitions.

The BLU-26/B bomblet (figure 1-62) is a spin-armed, self-dispersing, fragmentation submunition that detonates upon impact. When the bomblet is released into the airstream, the bomblet flutes produce a high rate of spin. Spinning induces dispersion and initiates arming of the M219 fuze. Weights holding the rotor in the unarmed position are released by centrifugal force caused by spinning. The hammer weights move back, releasing the firing pin from the rotor. Weights which hold the rotor in the unarmed position disengage, allowing the rotor to arm. The M219 fuze is sensitive to impact from any direction. Impact with a target detonates the high-explosive filler which bursts the bomblet case and propels the steel balls at high velocity in a radial direction.

The BLU-59/B bomb used in the CBU-49B/B is identical to the BLU-26/B except it is equipped with the M224 time delay fuze which detonates randomly after impact.

BLU-26/B BOMBLET

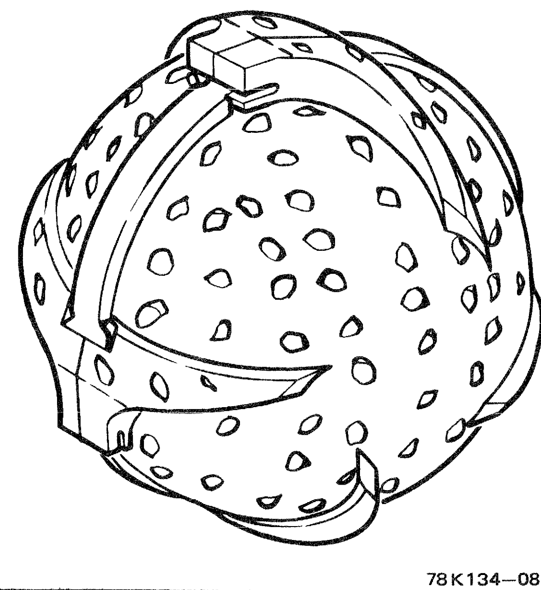


Figure 1-62

The BLU-61A/B bomblet used in the CBU-52A/B and CBU-52B/B is externally identical to the BLU-26/B except that the BLU-61A/B is about 50 percent larger. Internally, the bomblets have a serrated mild steel fragmenting shell instead of steel balls. The bomblets contain the M219 fuze and function identically to the BLU-26/B bomblet. The BLU-61A/B has a zirconium incendiary liner insert.

The BLU-63/B bomblet used in the CBU-58/B is identical to the BLU-26/B except that the BLU-63/B has no steel balls and only provides high-explosive detonation effects. The BLU-86/B bomblet used in the CBU-71/B is identical to the BLU-63/B except it is equipped with the M224 time delay fuze which detonates randomly after impact. The BLU-63A/B bomblet used in the CBU-58A/B is similar to the BLU-63/B except it also contains incendiary briquets (two 5-gram titanium pellets). The BLU-86A/B used in the CBU-71A/B is identical to the BLU-63A/B except it is equipped with the M224 time delay fuze which detonates randomly after impact.

MK 1, NO. 1 MK 2, AND NO. 1A MK 2 BL-755 BOMB CLUSTERS.

The BL-755 (figure 1-63) is a British bomb cluster munition (similar to the Mk 20 Rockeye) composed of a bomb body, nose fairing, and tail unit. The bomb cluster contains 147 armor-piercing bomblets. The nose fairing contains the safety, arming and functioning unit (SAFU) which is a factory installed, impeller-driven mechanical nose fuze. A minimum airspeed of 270 knots must be sensed for proper operation of the arming vane. The bomb body consists of two main bulkheads spanned by a suspension beam (hardback) and enclosed by an upper and lower type clamshell which houses the armor-piercing bomblets. The tail unit, attached to the aft bulkhead of the bomb body, consists of a truncated cone with attached fin boxes which contain four spring-loaded extendible fins. Two lanyards are used: One for the SAFU and one for the tail unit. Both lanyards are equipped with shear links. The lanyard for the tail unit is secured to the bomb rack sway brace so that the fins will extend under any drop condition for safe separation of the bomb from the aircraft. The lanyard for the SAFU and time delay unit is installed in the bomb rack tail arming solenoid. At bomb release, the tail fins extend, the lock pin is removed from the arming impeller, and the time delay starts. At a present time, the primary cartridge fires to open the clamshell type upper and lower skins; then, the secondary cartridge fires and ejects the bomblets. All components, except the lanyards, are installed during manufacture to make a complete munition. Two suspension lugs, spaced 14 inches apart, are installed in the bomb cluster.

The Mk 1 was built for British use and has four fuze time settings.

Setting	*Fuze Function Time-Seconds*
A	1.13
B	1.38
C	1.64
D	2.00

The Mk 2 was built for German use and has a longer hard back than the Mk 1 for use on German bomb racks. The Mk 2 has four fuze time settings.

Setting	*Fuze Function Time-Seconds*
E	0.68
F	0.80
G	0.94
H	1.13

The desired time delay is set prior to takeoff by removal of the arming vane to gain access to the fuze time setting selection lever. Premature operation of the SAFU timer is indicated by red in the arm/safe indicator on the face of the SAFU adjacent to the time selector mechanism.

The No. 1 and No. 1A Mk 2 bomb clusters are the same, except for the connector on the electrical lead. However, the electrical lead is not used on USAF aircraft. During bomb buildup, 28 V dc is applied to the electrical lead to operate the gas motor detent pin. The electrical lead is then removed.

Safety Considerations.

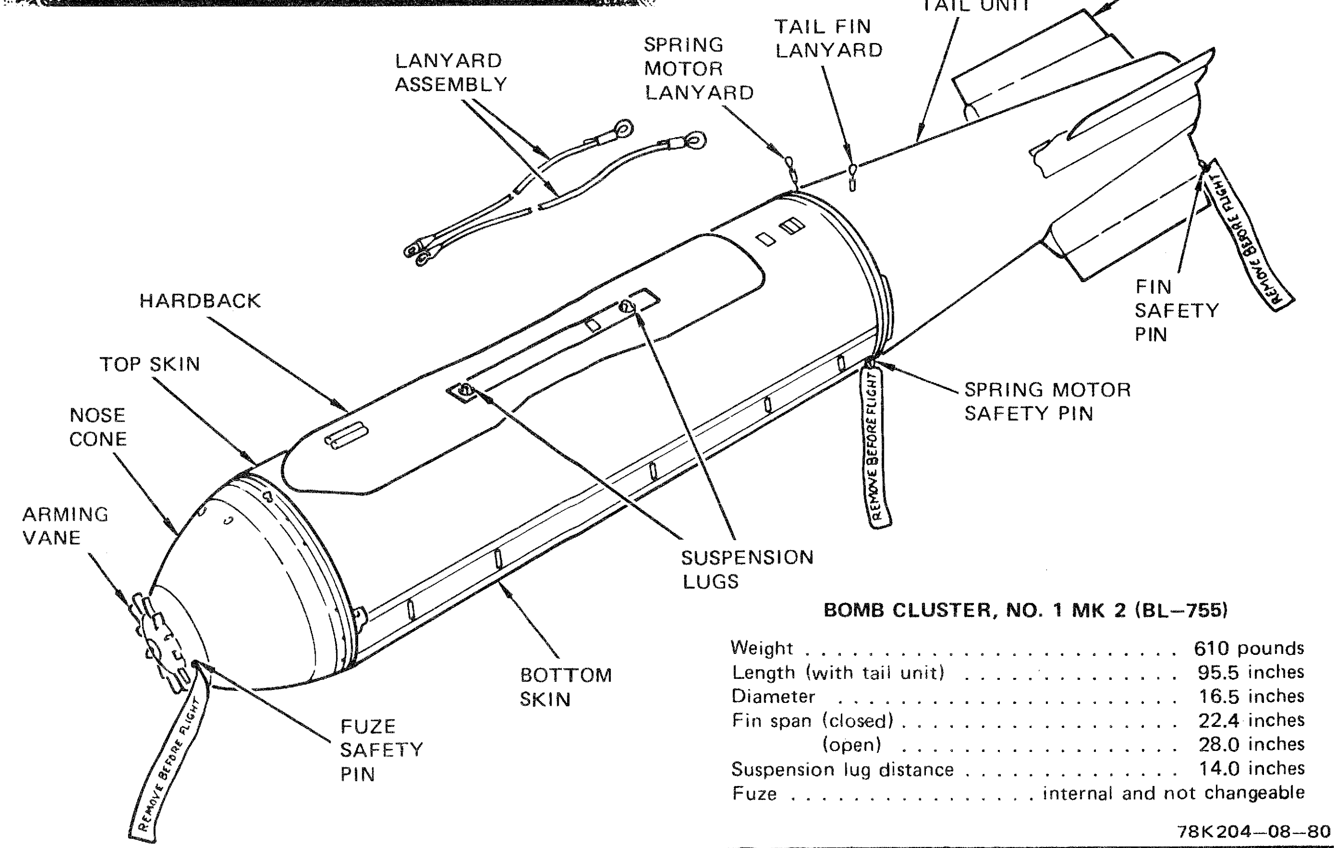
The BL-755 bomb cluster, Mk 1, No. 1 Mk 2, and No. 1A Mk 2 has not received safety certification by the USAF nonnuclear munitions safety board (NNMSB).

The BL-755 munition is certified only for the contingency rearming of USAF aircraft at allied bases with BL-755 munitions from their inventories.

The electrical detent, a primary safety feature, must be negated before flight. The remaining safety features, which prevent dispenser functioning and submunition dispersal while carried on the aircraft, do not meet USAF design safety criteria.

The BL-755 is authorized for manual single delivery only. Do not attempt delivery in computed attack

BL-755 BOMB CLUSTER



BOMB CLUSTER, NO. 1 MK 2 (BL–755)

Weight	610 pounds
Length (with tail unit)	95.5 inches
Diameter	16.5 inches
Fin span (closed)	22.4 inches
(open)	28.0 inches
Suspension lug distance	14.0 inches
Fuze	internal and not changeable

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Figure 1-63

modes, in manual ripple, or with the SINGLE/PAIRS/SIMULT switch in any position other than SINGLE.

Ballistic Data.

Ballistic data are provided for the 1.13-second fuze time (H Setting) on the Mk 2 version of the BL-755 and for the 1.64-second fuze time (C Setting) on the Mk 1 in T.O. 1A-7K-34-1-2.

WARNING

Analysis to date of safe delivery of the BL-755 cluster munition from USAF aircraft indicates that safe escape from one's own weapon effects cannot be assured when using the 1.13-second fuze setting and no postrelease escape maneuver is attempted. Therefore, for added safety, a 4g pull-up escape should be initiated immediately after release whenever mission conditions permit.

BL-755 Bomblet.

The BL-755 submunition (figure 1-64) is designed to be compressed when loaded in the bomb cluster by telescoping the probe and tail assemblies over the bomblet body. Upon ejection from the bomb cluster, the probe and tail extend and the arming cycle begins. The probe gives the bomblet standoff distance required to achieve maximum effectiveness from the shaped charge.

BL-755 BOMBLET

Length (stowed)	5.9 inches
(deployed)	14.0 inches
Diameter	2.7 inches
Weight	2.5 pounds
Number of bomblets per cluster	147
Nominal arming time	0.7 seconds

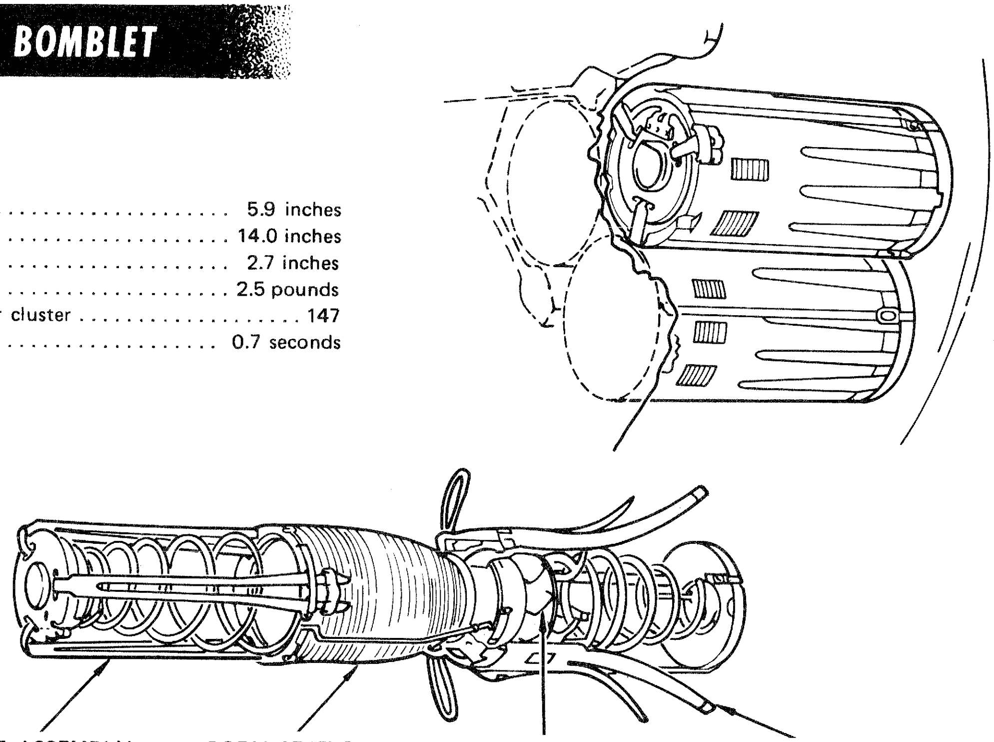


Figure 1-64

MK 20 ANTITANK CLUSTER BOMB (ROCKEYE II).

The Mk 20 is an unguided cluster bomb designed for employment against trucks, tanks, and other point targets.

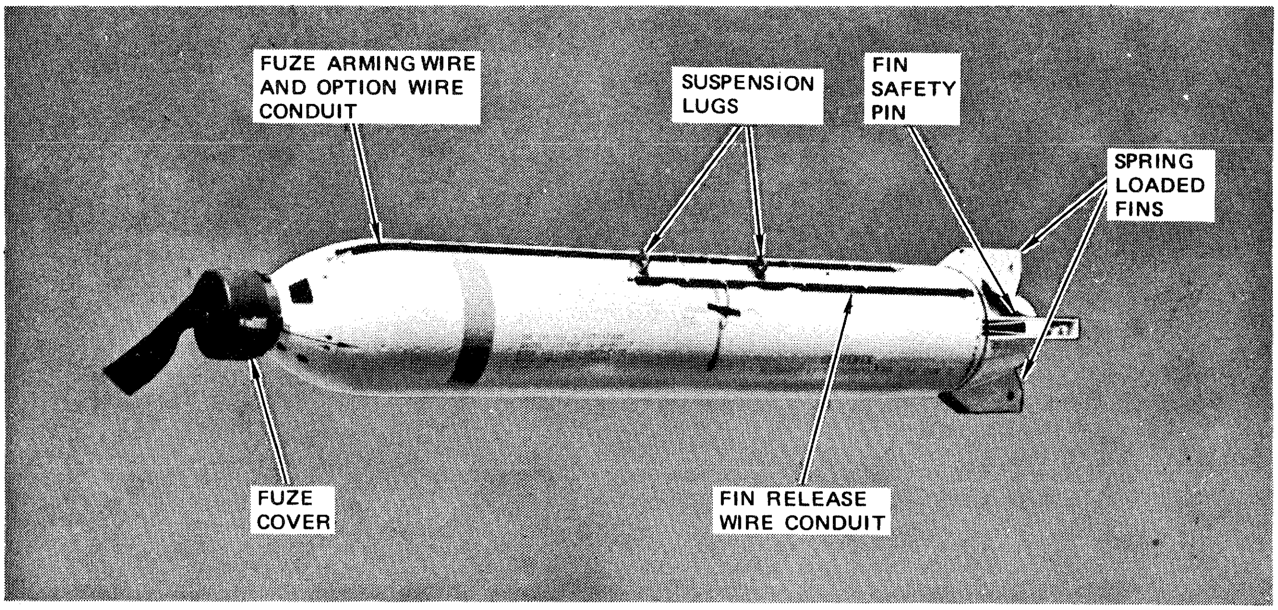
The Mk 20 Mod 2 consists of the Mk 7 Mod 2 bomb dispenser and Mk 118 antitank bomblets. The Mk 20 Mod 3 consists of the Mk 7 Mod 3 bomb dispenser and Mk 118 antitank bomblets. The Mk 20 Mod 4 consists of the Mk 7 Mod 4 bomb dispenser and Mk 118 antitank bomblets. Refer to Section I, Part 7 for fuze data. Refer to T.O. 1A-7K-34-1-2 for fuze settings, sight depression, and impact pattern data.

Mk 7 Bomb Dispenser. (See figure 1-65.)

The Mk 7 Mod 2 bomb dispenser consists of a nose fairing, a cargo section, and a tail section. The nose fairing houses the Mk 339 Mod 0 mechanical time fuze. During ground handling, a fuze cover is installed over the fuze impeller and the fuze safety wire for protection. The 0.125-inch aluminum skinned cargo section houses the Mk 118 Mod 0 antitank bomblets which are secured and protected by dunnage. A linear-shaped charge is secured to the inner wall of the cargo section. This shaped charge is used to cut the dispenser in half longitudinally when the fuze functions after release. The tail section consists of a conical body equipped with four foldable spring-loaded fins. Until weapon release, these fins are held in the folded position by a fin release band, which in turn is held closed by a fin release wire and, for ground safety, a fin safety pin. Two conduits are provided along the top of the dispenser for routing of the fuze arming wire and the fin release wire. Both the fuze arming wire and the fin release wires are secured to the bomb dispenser with anchor screws at the end of their respective conduit. All components, including fuze and fuze arming wires, are installed in or on the bomb dispenser during manufacture to make a complete munition.

The Mk 7 Mod 3 bomb dispenser is identical to the Mk 7 Mod 2 bomb dispenser with one exception. On the Mk 7 Mod 3, a pilot option wire has been added to allow the

MK 7 BOMB DISPENSER (MOD 3 SHOWN)



Weight (loaded)	490 pounds
Length	92 inches
Diameter	13 inches
Fin Span (open)	35 inches
(closed)	17 inches
Suspension lug distance	14.0 inches
Fuze	Refer to Bomb-Fuze Compatibility Chart

78K015–08–80

Figure 1-65

pilot to select, in the air, one of the two fuze function times set on the Mk 339 Mod 0 fuze. The conduit for the fuze wire was modified to allow for routing of the pilot option wire. The pilot option wire is secured to the bomb dispenser with an anchor screw at the end of the conduit. All components are installed in or on the bomb dispenser during manufacture to make a complete munition.

The Mk 7 Mod 4 bomb dispenser is identical to the Mk 7 Mod 3 bomb dispenser with two exceptions. The Mk 7 Mod 4 bomb dispenser has an extra set of suspension lug wells to allow use of the dispenser in the GBU-3/B configuration (not currently authorized for carriage on the A-7K) and extra conduit breaks are provided in the conduits for extractor attachment.

Event Sequence, Mk 7 Dispenser.

1. 0.0 seconds — the dispenser is released from aircraft.

   a. Fuze arming and fin release wires strip from conduit.

   b. The fuze band falls away and the impeller is actuated by the air stream.

   c. The Mk 339 Mod 0 fuze timer initiates.

   d. The fin release band is released.

e. The folding fins open.

f. The dispenser free-falls for the preset time.

2. Preset Fuze Function Time — Mk 339 Mod 0 functions and initiates the linear-shaped charge.

a. The linear-shaped charge cuts the dispenser longitudinally.

b. The dispenser opens.

c. The Mk 118 bombs disperse.

Dispenser Fuze Function Settings.

During the selection of release conditions and fuze settings for this type munition, care should be taken to ensure that:

1. After dispenser opening, the submunitions must have adequate time to arm before impact. To satisfy this requirement, the fuze setting for the selected release condition should provide a submunition time of flight in excess of 1.2 seconds.

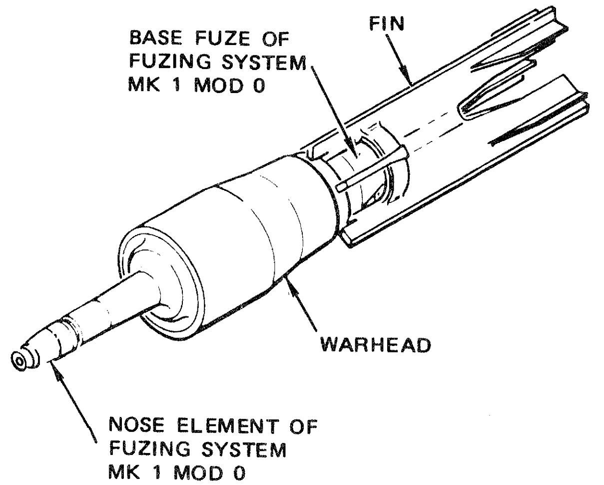
2. Munition delivery accuracy should not be significantly degraded by the effect of unknown winds on the high-drag submunitions after cluster opening. To ensure this objective, the fuze setting selected for the planned release condition should keep the cluster intact until the minimum practical height-of-burst (HOB) above ground. HOB no higher than 2,000 feet AGL are recommended to minimize wind effects on the submunition trajectory.

3. When using the Mk 20 Mod 4, ensure that the aircraft is clear of the Mk 118 submunition fragment envelope at fuze arming. The Mk 118 submunition fuze will arm 0.5 second after dispenser opening. Refer to T.O. 1A-7K-34-1-1, Section I, for the unsafe release conditions when using 1.2-second fuze function setting.

Mk 118 Mod 0 Antitank Bomblet.

The Mk 118 Mod 0 antitank bomblet (figure 1-66) consists of the Mk 1 Mod 0 bomb fuzing system, a shaped charge warhead, and fixed stabilizing fins. When the dispenser splits at fuze functioning, the Mk 1 Mod 0 bomb fuzing system arms the bomblet and the same system detonates the bomb on impact. The shaped charge warhead causes the explosive force of the detonation to be directed forward into the impact point.

MK 118 MOD 0 ANTITANK BOMBLET



78K016—08—80

Figure 1-66

The Mk 118 bomb has a shaped charge warhead capable of penetrating 7.5 inches of 450 Brinell steel or 9.0 inches of cold rolled steel. The bomb is fuzed by the Mk 1 Bomb Fuzing System, which consists of a target discriminating nose element and an arming vane operated base fuze. The purpose of the dual mode fuzing system (Impact Sequence) is to defeat countermeasures such as sandbags or wooden platforms over armored surfaces. The bomblet will also penetrate light structures or foliage before activation, thus providing better effectiveness against this type of target.

Event Sequence, Mk 118 Bomblet.

1. After release from the dispenser, the arming vane reacts to air stream velocity (at least 200 knots) and reaches 15,000 rpm is 0.1 second.

2. At 15,000 rpm, the base fuze rotor is allowed to turn.

3. For Mk 20 Mods 2 and 3, the rotor is driven 90° placing the detonator in line in 1.1 seconds. For Mk 20 Mod 4, the rotor is driven 90° placing the detonator in line in 0.4 second.

4. The nose and base fuzes are now armed. The total elapsed time between bomb separation from the dispenser and bomb arming in approximately 1.2 seconds for Mk 20 Mods 2 and 3 and 0.5 second for Mk 20 Mod 4.

Impact Sequence — Hard Target.

1. If the bomblet strikes a target with a hardness equivalent to a 1/16-inch mild steel plate at 250 feet/second, a shear washer in the nose fuze will shear.

2. The nose element firing pin is then driven into the detonator, initiating detonation.

3. The detonator crushes a piezoelectric crystal which generates an electrical signal. This signal is conductively coupled to the electric detonator in the base fuze.

4. The detonator initiates the firing train that fires the Octol shape charge in the warhead.

5. The time between impact and initiation is 35 to 76 microseconds.

Impact Sequence — Soft Target.

1. If the bomblet strikes a soft target with a hardness less than equivalent to 0.25-inch plywood at 1,000 feet/second, the shear washer does not function.

2. Instead, the inertial firing pin in the base fuze comes forward, due to bomb deceleration, and initiates the detonator.

3. The detonator initiates the firing train which fires the Octol shape charge warhead.

4. Elapsed time between impact and warhead detonation is 445 to 1,825 microseconds, depending on impact angle.

BLU-1C/B, BLU-27B/B, AND BLU-27C/B FIRE BOMBS.

BLU-1C/B Fire Bomb.

The BLU-1C/B fire bomb (figure 1-67) is a tank designed for external carriage and ejection from aircraft. The bomb body consists of the nose, center, and tail sections, assembled with supplemental components. Reinforced areas along the top provide for suspension, sway bracing, and forced ejection from aircraft. Electrical cables run internally from an initiator cavity between the suspension lugs to the forward and aft bomb bulkheads. Each bulkhead has a receptacle for the FMU-7 fuze and AN-M23A1 igniter assembly. The bomb is fitted with removable nose and tail end caps or nose end cap and either the MXU-393/B or the MXU-469/B tail fin assembly. The end caps, when installed, function as protective covers for the fuze-igniter assemblies and provide aerodynamic shape to the bomb. The bomb is filled locally with incendiary gel.

BLU-27B/B and BLU-27C/B Fire Bombs.

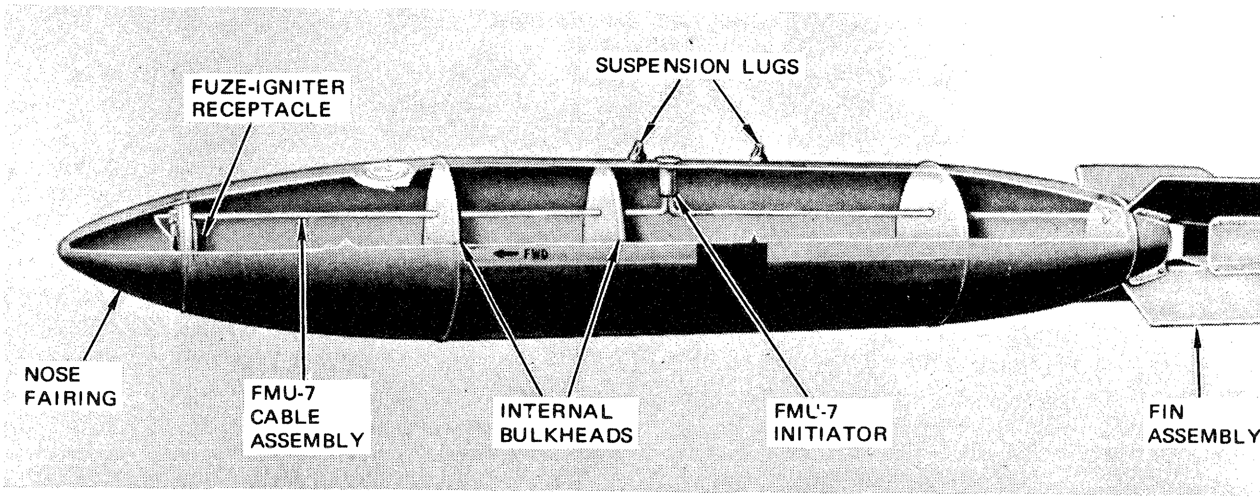
The BLU-27B/B fire bomb is identical in shape and characteristics to the BLU-1C/B fire bomb with the following exceptions: the BLU-27B/B is a welded one-piece bomb body and is prefilled during manufacture with Napalm B. The BLU-27B/B also has external arming wire guides installed during manufacture. The bomb can be fitted with the MXU-393/B or the MXU-469/B fin assembly.

The BLU-27C/B fire bomb is identical to the BLU-27B/B fire bomb except that the BLU-27C/B will accommodate MS 3314 or MAU-129/B T-lug suspension lugs (which are not used on the A-7K).

BLU-27 fire bombs which have failed a continuity test on one end are serviceable and may be used. The electrical cable will be cut and removed from the end which failed the continuity test.

Some BLU-27 fire bombs which have failed a continuity test (on one or both ends) may be repaired for use during close air support firepower demonstrations. The repair

BLU-1C/B AND BLU-27 SERIES FIRE BOMBS



	BLU-1C/B	BLU-27 SERIES
Weight (finned)	715.0 pounds	819.0 pounds
(unfinned)	700.0 pounds	804.0 pounds
Length (finned)	144.0 inches	144.0 inches
(unfinned)	130.0 inches	130.0 inches
Diameter	19.0 inches	19.0 inches
Fin Span	24.0 inches	24.0 inches
Suspension Lug Distance	14.0 inches	14.0 inches
Fuze	Refer to Bomb-Fuze Compatability Chart	

78K091—08—80

Figure 1-67

procedure consists of installing a FMU-7C/B initiator in the end on the damaged end of the bomb. The initiator will be equipped with a short FMU-7 series cable (for connection to the fuze) and an initiator lanyard extending through the end cap. This lanyard is attached to an arming wire which is used to fire the initiator upon armed weapon release.

MXU-393/B and MXU-469/B Fins.

The MXU-393/B fin is designed to stabilize the fire bombs in flight. The fin is of aluminum construction and consists of four fin blades and a square supporting structure bolted together. The MXU-469/B fin is identical to the MXU-393/B fin except that the MXU-469/B is riveted together and the supporting structure is round rather than square.

AN-M23A1 Igniter.

The AN-M23A1 igniter is issued separately from the fire bomb. The igniter body is in the form of a short cylinder rounded at one end with an internally threaded fuze well on the rounded end. The other end of the igniter is flat and threaded externally for installation in BLU-1C/B and BLU-27 fire bombs. The flat end also contains a filler plug which is used during manufacture. The igniter is installed in the bomb after the bomb is loaded on the aircraft. The igniter contains 1.20 pounds of white phosphorus which is initiated by the fuze detonation and which, in turn, ignites the bomb filler.

BLU-52/B and BLU-52A/B Chemical Bombs.

The BLU-52/B and BLU-52A/B chemical bombs (figure 1-68) are tanks filled with an incapacitating agent. The bomb body consists of nose, center, and tail sections. Reinforced areas along the top of the center section provide for suspension, sway bracing, and forced ejection from aircraft. The tanks are designed to break up on impact, dispersing the chemical agent. The nose section is fitted with an aerodynamic fairing and the tail section with an MXU-393/B or MXU-469/B fin. The BLU-52/B is filled with CS-1 chemical agent and the BLU-52A/B is filled with CS-2 chemical agent. Both CS-1 and CS-2 are white micropulverized powders which are highly irritating to the eyes, skin, and respiratory system.

MXU-393/B and MXU-469/B Fins.

The MXU-393/B fin is designed to stabilize the bombs in flight. The fin is of aluminum construction and consists of four fin blades and a square supporting structure bolted together. The MXU-469/B fin is identical to the MXU-393/B fin except that the MXU-469/B is riveted together and the supporting structure is round rather than square.

ROCKETS AND ROCKET LAUNCHERS.

2.75-INCH FOLDING FIN AIRCRAFT ROCKET (FFAR).

The 2.75-inch FFAR (figure 1-69) is an air-launched rocket used to deliver high explosive (HE), high explosive antitank (HEAT), flechette, and white phosphorous (WP) warheads. FFAR's are effective against personnel, tanks, shipping, vehicles, fortifications, and other equipment. Warheads are selected to best satisfy operational requirements. The 2.75-inch FFAR also has a plaster loaded inert head for target practice. A rocket complete round consists of a motor, warhead, and fuze. The 2.75-inch FFAR's are fired from the LAU-3 series and LAU-68 series launchers or the SUU-20 series practice bomb and rocket dispenser.

2.75-Inch Rocket Motor.

The 2.75-inch FFAR uses Mk 4 and Mk 40 rocket motors (figure 1-70). The motor tube is made of aluminum, weighs 11.4 pounds, and is 39.4 inches long. Both motors include the following components: an igniter, a propellant grain, a stabilizing rod, and a nozzle and fin assembly.

The rocket is ignited by aircraft electrical power. When a firing impulse is applied to the igniter contact disk, electric current passes through the igniter circuit, heats the squib bridge wire, and ignites the squib. The squib then ignites the main igniter charge. The salt covered stabilizing rod prevents unstable burning and reduces flash and afterburning of the propellant grain.

Gas pressure resulting from the burning igniter charge ruptures the igniter case and burning particles of the igniter charge ignite the propellant charge. Burning propellant blows or burns away the nozzle seals and fin retainer and provides propulsion gasses for the rocket. After the rocket leaves the launcher, gas pressure on a piston and crosshead in the nozzle and fin assembly forces the fins open. The opened fins stabilize the rocket in flight.

The Mk 40 rocket motor uses scarfed nozzles which impart a spin to the rocket for additional stabilization while in flight. A rocket equipped with the Mk 40 motor is designated LOW SPIN FOLDING FIN AIRCRAFT ROCKET (LSFFAR). Figure 1-70 depicts a comparison between standard nozzles and scarfed nozzles.

WARNING

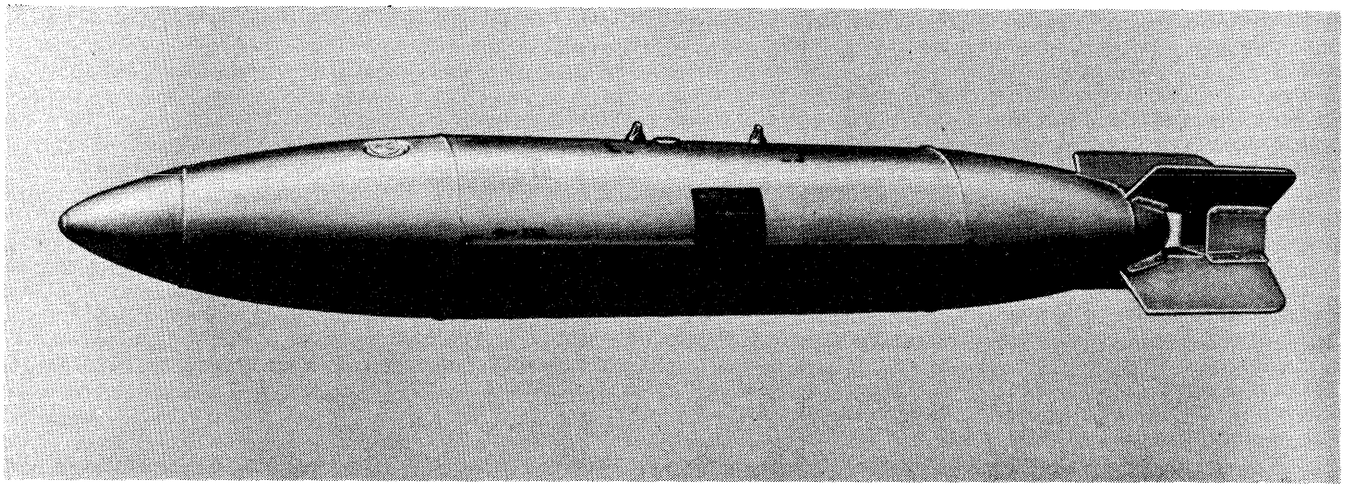
2.75-inch rockets equipped with Mk 40 rocket motors are authorized for use only in the LAU-68 series rocket launchers. Use of other rocket launchers may result in serious damage or loss of the aircraft due to possible fin entanglement resulting from rocket spin.

2.75-Inch Rocket Warheads.

Mk 1 Warhead (HE).

The Mk 1 (HE) warhead (figure 1-71) has a ste.! case and an explosive charge of 1.4 pounds of HBX-1 and uses the Mk 176 or Mk 178 fuze. With the Mk 178 fuze installed, the warhead is 11 inches long and weighs 6.5 pounds. The primary effect of the Mk 1 warhead is blast and fragmentation.

BLU-52 SERIES CHEMICAL BOMB

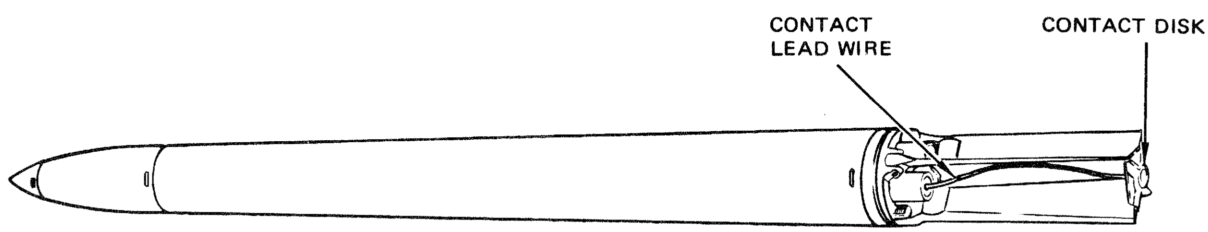


Weight	350 pounds
Length	148 inches
Diameter.	19 inches
Fin Span.	24 inches
Suspension Lug Distance	14 inches
Fuze	None

78K019—08—80

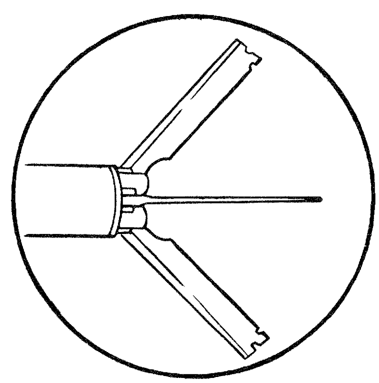
Figure 1-68

2.75-INCH FFAR ROCKET



FOLDING FIN AIRCRAFT ROCKET (FFAR)

Weight:	18.5 pounds
Length: . . . . 48 inches	(fins folded)
Diameter:.	2.75 inches



78K115—08—80

Figure 1-69

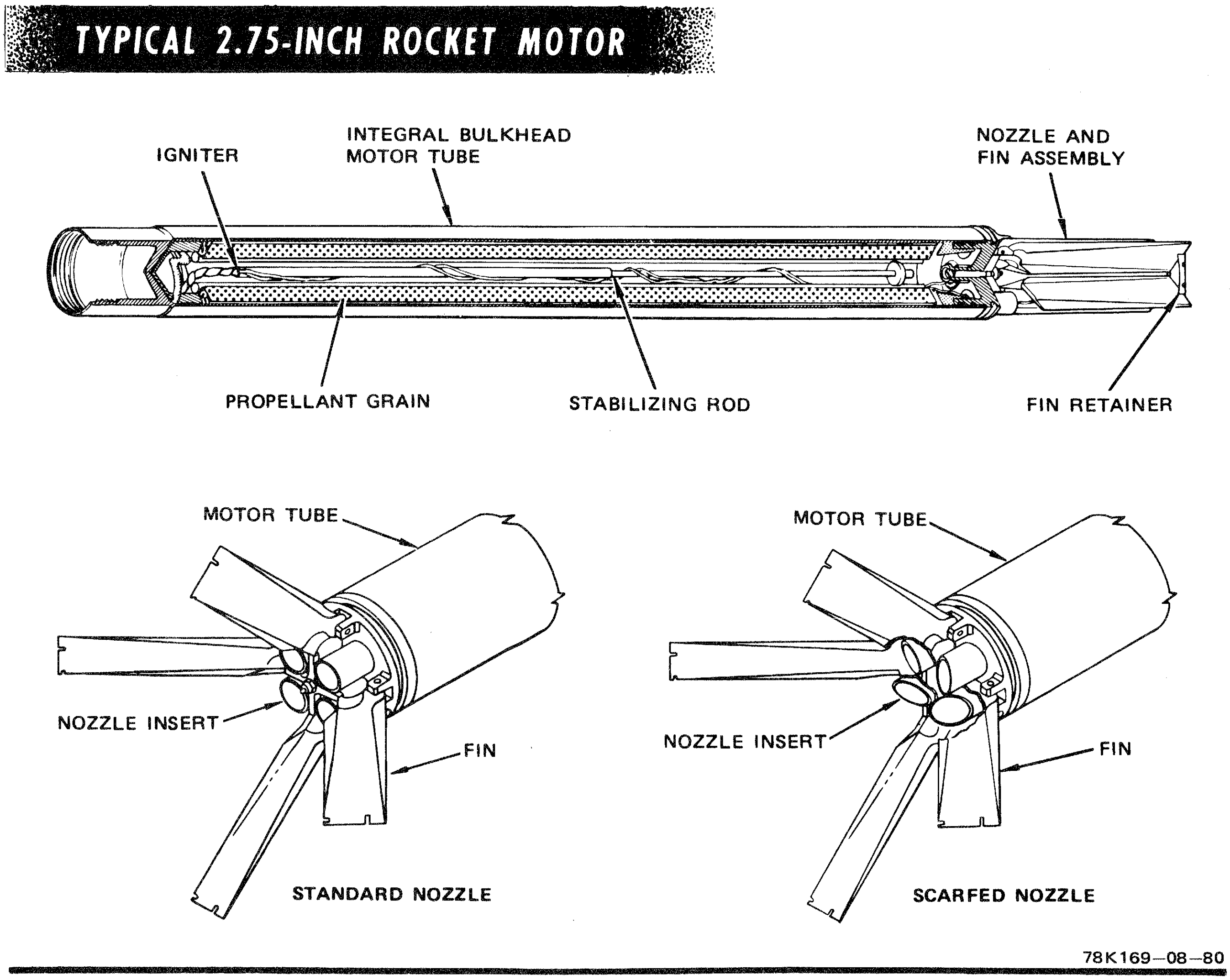


Figure 1-70

M151 Warhead.

The M151 warhead (figure 1-71) has a pearlite malleable iron (PMI) case filled with 2.32 pounds of composition B4 and uses the M427 fuze. With the M427 fuze installed, the warhead is 16.01 inches long and weighs 9.6 pounds. The primary effect of the M151 warhead is blast and fragmentation.

Mk 5 High Explosive Antitank Warhead (HEAT).

The Mk 5 warhead (figure 1-71) is similar in external configuration to the Mk 1 warhead. The filler is 0.92 pound of Composition B in the form of a shaped charge. A booster pellet is located at the base of the shaped charge. With the Mk 181 fuze installed, the warhead is 11.08 inches long and weighs 6.6 pounds. The warhead is intended for use against tanks and armor.

When the Mk 5 warhead impacts and the fuze functions, a shaped charge booster in the fuze projects a shock wave through the cone and flash tube of the warhead to the warhead booster pellet. The warhead booster pellet detonates and ignites the warhead shaped charge, which is designed to focus all the energy from the detonation into a narrow, high velocity jet. Pressures up to 250,000 psi are produced on the point of impact. Depth of penetration is a function of target density. Since all energy is directed forward, there is little appreciable lateral blast effect from the Mk 5 warhead.

2.75-INCH ROCKET WARHEADS

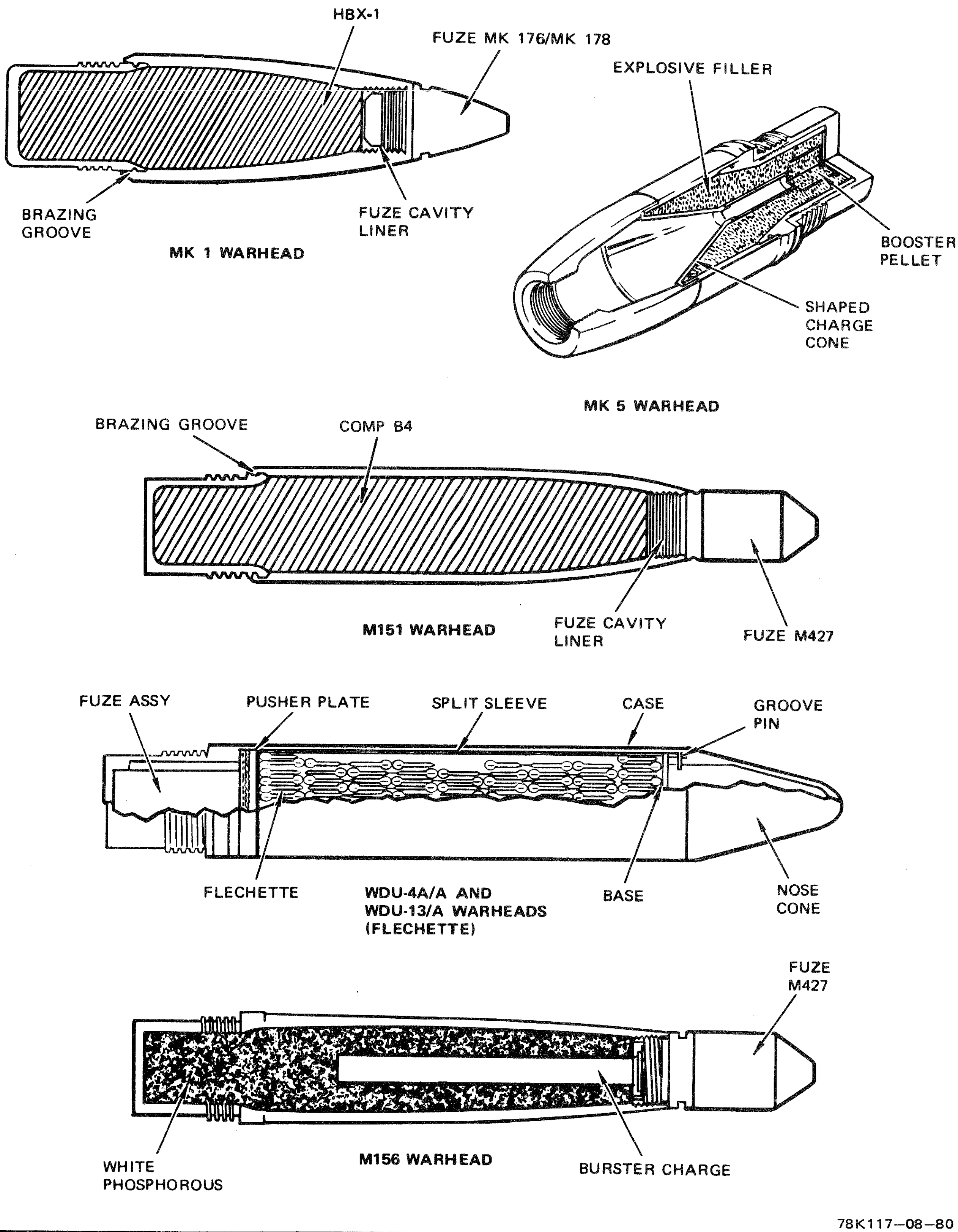


Figure 1-71

WDU-4A/A and WDU-13/A Warheads (FLECHETTE).

The WDU-4A/A antipersonnel flechette warhead (figure 1-71) weighs 9.1 pounds and contains 5.5 grams of explosive. The warhead is 17.25 inches long and contains 2,200 twenty-grain flechettes. The warhead has a base fuze, ejecting charge, piston, and an aerodynamic nose cone, and contains a red dye marker to provide visual identification of warhead functioning.

The WDU-13/A warhead is identical to the WDU-4A/A warhead except that the WDU-13/A has approximately 720 sixty-grain flechettes.

The fuze is installed during assembly and is an integral part of the warhead. At launch, acceleration forces arm the fuze. At 1.6 seconds after launch, an airburst is initiated by deceleration forces which allow the spring-loaded firing pin to ignite the ejecting charge. The ejecting charge generates gas pressure against the pusher plate which transmits the pressure through the flechettes and to the shear pins on the nose cone. The shear pins break, the nose cone is ejected, and the flechettes follow the nose cone. The flechettes are packed with alternating flechettes pointing fore and aft. Aerodynamic force causes the tail-forward flechettes to tumble and streamline after ejection. This weather cocking causes dispersion.

Slant range at launch is the critical factor in determining slant range at warhead function. Slant range at function must be known to determine dispersion and weapon effectiveness. Refer to Section II, ROCKET AND GUN BALLISTIC TABLES, T.O. 1A-7K-34-1-2 for tables used to determine optimum launch conditions.

M156 Rocket Smoke (WP) Warhead.

The M156 (figure 1-71) is a target spotting warhead. The external appearance of the M156 is identical to that of the M151 HE warhead. Because of this similarity in appearance, markings must be carefully observed and maintained. With the M427 fuze installed, the warhead is 16.01 inches long, weighs 10.75 pounds and contains 0.125 pounds of Composition B4 and 2.3 pounds of white phosphorus.

When the warhead impacts and the fuze functions, the fuze booster initiates the warhead burster charge. The burster charge ruptures the warhead case and scatters the phosphorus which ignites spontaneously to provide dense smoke. Incendiary effect is minor.

WTU-1/B Warhead (Practice).

The WTU-1/B practice warhead (inert) is a one-piece cast warhead that simulates the ballistic characteristics of the M151 warhead. The WTU-1/B is approximately 15 inches long and weighs 9.4 pounds. It is used for practice.

Mk 61 Warhead (Practice).

The Mk 61 practice warhead (inert) has a solid iron head and simulates the ballistic characteristics of the Mk 1 warhead. It has the same appearance as the Mk 1 warhead except that it is painted blue with white markings. The Mk 61 is approximately 11 inches long and weighs 6.5 pounds. It is used for practice.

2.75-Inch Rocket Fuzes.

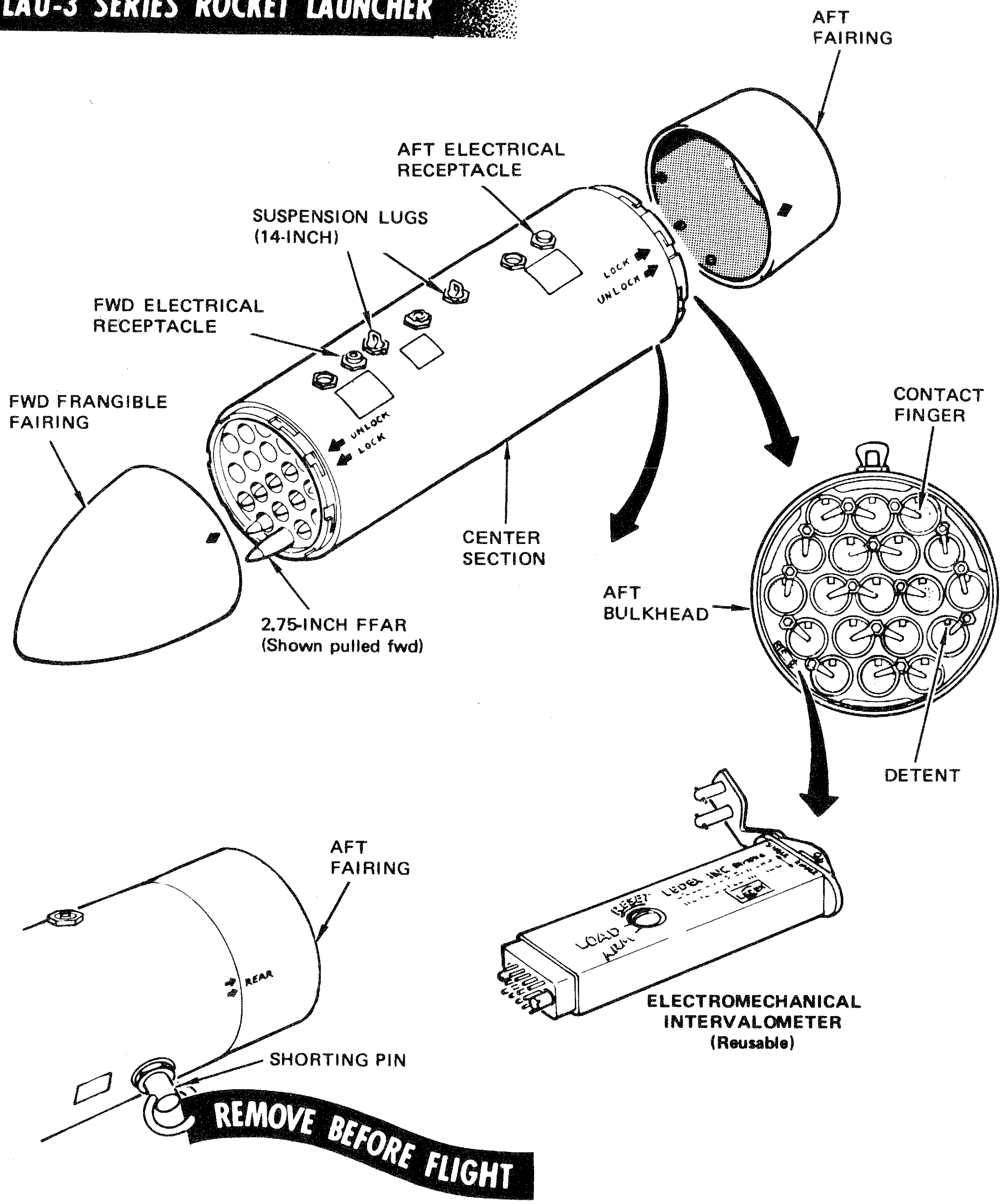
Refer to Section I, Part 7, NONNUCLEAR WEAPONS FUZES.

LAU-3 SERIES ROCKET LAUNCHER.

The LAU-3 series (figure 1-72) is an expendable 19-round launcher designed for air-to-air or air-to-surface use. The complete launcher consists of the center section, nose fairing, tail fairing, and 19 2.75-inch FFARs. The center section consists of 19 treated paper tubes clustered and bonded together and enclosed in a thin aluminum skin. Detent devices within each tube restrain the rockets during takeoff and flight and provide a ground for the fire signal during rocket launching. Spring-loaded fingers on the aft bulkhead provide a contact to complete the circuit for rocket launching. Two electrical receptacles, wired in parallel, forward and aft of the suspension lugs provide connection to the aircraft. An electrical shorting pin on the side of the launcher provides ground safety during handling and loading.

The LAU-3C/A launcher is equipped with 7027240-50 fairing set. The LAU-3D/A launcher is equipped with 7027240-70 fairing set. These fairing sets constitute the only difference between the launchers. The nose fairings are constructed of treated fiber and are designed to shatter during rocket firing. The tail fairings are constructed of metal with an open aft end like a funnel to channel rocket debris away from the underside of the aircraft wing.

LAU-3 SERIES ROCKET LAUNCHER



Weight (loaded)	415 pounds
Length (with fairings)	53 inches
Diameter	16 inches
Suspension lug distance	14 inches

78K097–08–80

Figure 1-72

The launcher utilizes a selectable, reusable, electromechanical intervalometer to route the fire pulse to the different rocket tubes. The intervalometer is mounted on the launcher aft bulkhead and has a SINGLE/RIPPLE switch and a RESET switch. With the SINGLE/RIPPLE switch in SINGLE, two tubes are fired with each fire pulse received by the launcher. With the switch in RIPPLE, all tubes are fired in sequential paired order upon receipt of the first fire pulse, with a preset interval dependent on the intervalometer installed between tubes. Authorized intervalometers are available with preset intervals between tubes of 17, 20 and 60 milliseconds. The RESET switch has a LOAD position for ground safety, an ARM position, and positions 1 through 10 for paired rocket tubes.

LAU-68A/A AND LAU-68B/A ROCKET LAUNCHER.

The LAU-68A/A and LAU-68B/A (figure 1-73) are reusable seven-round launchers designed for air-to-air or air-to-surface use. The complete launcher consists of the center section, nose fairing, tail fairing, and seven 2.75-inch FFARs. The center section consists of seven metal tubes clustered and bonded together and enclosed within a thin aluminum skin. Detent devices within each tube restrain the rockets during takeoff and flight and provide a ground for the fire signal during rocket launching. Spring-loaded fingers on the aft bulkhead provide a contact to complete the circuit for rocket launching. An electrical shorting pin on the top of the launcher provides ground safety during handling and loading.

The LAU-68A/A has a 26-pin electrical receptacle forward and a 5-pin electrical receptacle aft. The LAU-68B/A has a 5-pin electrical receptacle forward and aft. On the A-7K aircraft, only the aft receptacle is used.

The nose fairing is constructed of treated paper and, during rocket launching, shatters from rocket impact. The tail fairing is constructed of metal and shaped like a funnel, with a hole on the aft end. During rocket launching, the tail fairing functions to channel rocket debris away from the underside of the aircraft wing.

The launchers utilize a reusable electromechanical intervalometer to route the fire pulse to the different rocket tubes. A SINGLE/RIPPLE switch and intervalometer controls, which must be positioned during aircraft loading, are located on the aft end of the launcher. With the SINGLE/RIPPLE switch in SINGLE, one tube is fired with each fire pulse received by the launcher. With the switch in RIPPLE, all tubes are fired in sequential order with a 60-millisecond interval between tubes. The intervalometer control has a LOAD position for ground safety, an ARM position, and firing positions 1 through 7.

DISPENSER TYPE MUNITIONS.

CBU-30/A AND CBU-38 SERIES DISPENSER AND BOMB.

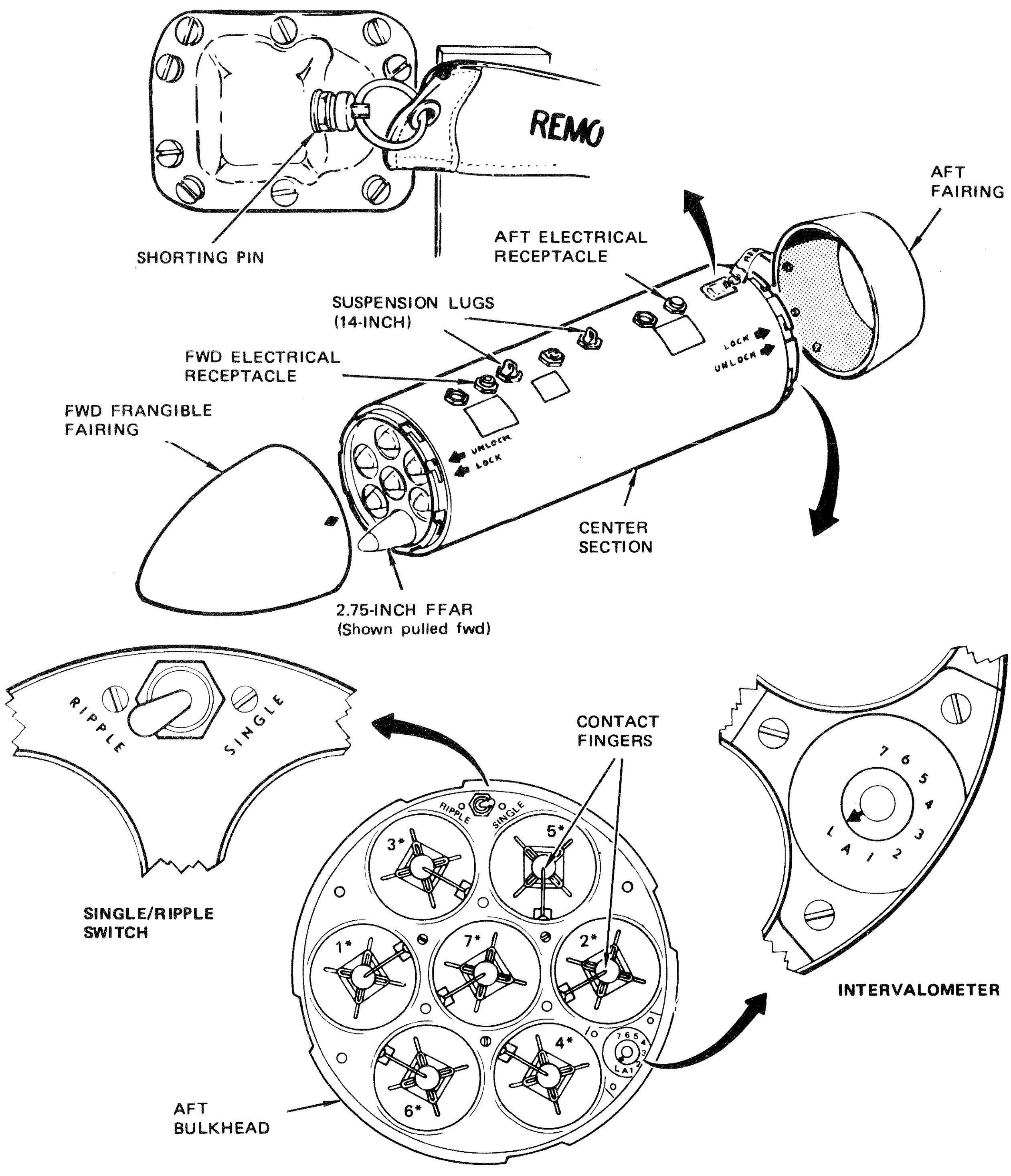
The CBU-30/A and CBU-38 series dispensers are comprised of components as follows:

CBU	*Dispenser*	*Bomb*	*Use*
CBU-30/A	SUU-13/A	BLU-39/B23	Antipersonnel
CBU-38/A	SUU-13A/A	BLU-49/B	Antimaterial
CBU-38A/A	SUU-13B/A	BLU-49A/B	Antimaterial
CBU-38B/A	SUU-13C/A	BLU-49A/B	Antimaterial
CBU-38C/A	SUU-13C/A	BLU-49B/B	Antimaterial

SUU-13 Series Dispenser.

The SUU-13/A dispenser (figure 1-74) is an externally mounted pod designed to dispense downward various types of submunitions. The dispenser consists of a strongback enclosed within an aerodynamically shaped skin and fairings front and rear. The strongback provides for suspension and sway bracing of the dispenser and supports the dispenser. An electrical receptacle is located on a movable plate on top of the dispenser behind the aft suspension lug. For A-7K application, this plate is placed in the NAVY position. The dispenser is equipped with 40 tube assemblies enclosed within a recessed open-bottomed bomb bay. The top of each tube assembly has an impulse cartridge breech assembly used to eject the submunition loaded into the tube. A removable wooden safety pallet is attached to the bottom of the dispenser covering the bomb bay during ground handling and loading to prevent inadvertent releasing of the submunitions. Ground safety is provided by the safety pallet and a safety pin which is installed through a pin actuated ARM/SAFE switch.

LAU-68 SERIES ROCKET LAUNCHER

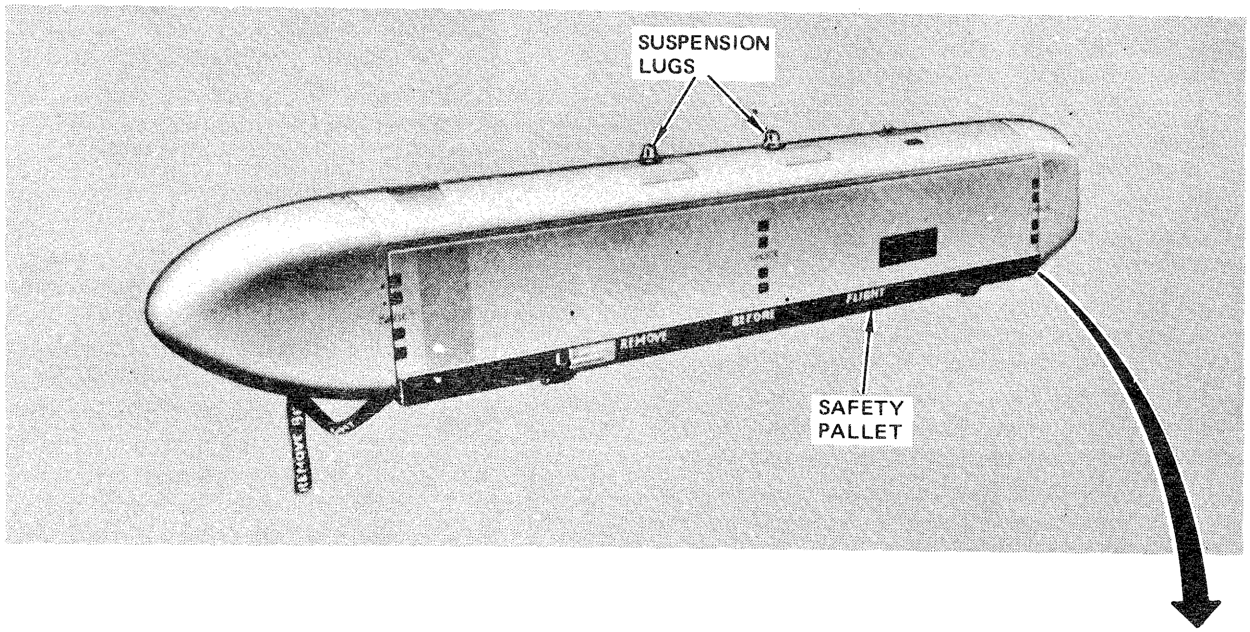


	Weight (loaded)	211 pounds
	Length (with fairings)	73 inches
	Diameter	10 inches
*TUBE NUMBERS	Suspension lug distance	14 inches

78K148—08—80

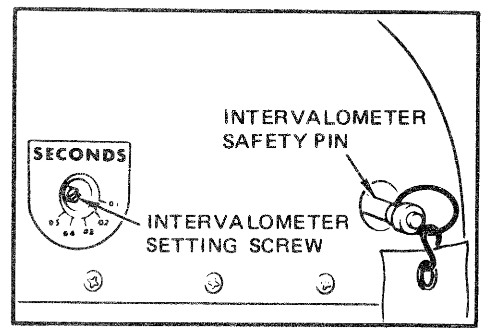
Figure 1-73

SUU-13 SERIES DISPENSERS

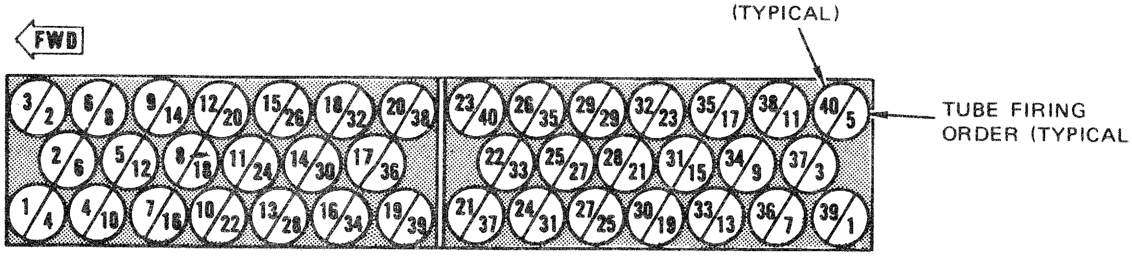


	CBU-30/A	CBU-38/A	CBU-38A/A	CBU-38B/A	CBU-38C/A
Dispenser	SUU-13/A	SUU-13A/A	SUU-13B/A	SUU-13C/A	SUU-13C/A
*Weight	385	790	790	790	790
Bomb	BLU-39/B23	BLU-49/B	BLU-49A/B	BLU-49A/B	BLU-49B/B

Empty weight	157 pounds
Width and height	14.7 x 14.4 inches
Length w/rear fairing	8 feet, 5.2 inches
Length w/o rear fairing	7 feet, 8.8 inches
Length w/bobtail fairing	7 feet, 6.3 inches
Number of tubes	40



SUU-13 DISPENSER CHECK



BOTTOM VIEW

*Listed weights are without safety pallet.

78K141–08–80

Figure 1-74

Depressing the armament, release button supplies power to fire an electrically primed cartridge of one tube assembly and activates a stepping mechanism and a control intervalometer which continues to stepfire one tube at a time until the armament release button is released. The pulse rate (time spacing between tube firings) is controlled by a timing circuit. The rate of stepping is preset on the ground by a selector switch in the dispenser control box. The available pulse rates are 0.1, 0.2, 0.3, 0.4 and 0.5 second. The release signal must be continuously applied to the SUU-13/A timing circuit for a time duration (4 to 19 seconds) determined by the dispenser pulse rate setting: multiply the pulse rate setting by 39.

The SUU-13A/A dispenser is identical to the SUU-13/A dispenser with the following exceptions: the SUU-13A/A intervalometer has settings of 0.05, 0.1, 0.2, 0.3, and 0.4 second, and the SUU-13A/A safety pallet is secured to the dispenser with quick-release fasteners in lieu of the internal wrenching bolts used on the SUU-13/A safety pallet. Some models of the SUU-13/A have an aerodynamic aft fairing and some models have a flat (bobtail) aft fairing. All models of the SUU-13A/A have a flat (bobtail) aft fairing.

The SUU-13B/A dispenser is identical to the SUU-13A/A dispenser except that the method of attaching the safety pallet to the dispenser has been changed.

The SUU-13C/A dispenser is identical to the SUU-13B/A dispenser except that the dispenser intervalometer settings have been changed to 0.025, 0.05, 0.1, 0.2, and 0.3 second.

NOTE

Ballistic equations for ASCU codes CP (CBU-38) and CQ (CBU-30) are included in the NAV WD Computer program. With green ready lights on CBU-30/38 stations, the NAV WD Computer will issue a continuous solid fire pulse, starting at the computed release point (intersection of lower solution cue and flightpath marker for dead-reckoned targets and when the armament release button is depressed in CCIP or Manual Ripple bombing modes). The solid fire pulse will continue until the armament release button is released. Since the length of the fire pulse is pilot controlled, bomb stick length is set to zero and the solution is given for the beginning of the drop. Therefore, the aiming symbol or CCIP impact point must be placed over the beginning of the area to be covered. Because of the solid fire pulse, the FPM will not flash and the release freeze data will not be calculated.

BLU-39/B23 Chemical Bomblets.

In the CBU-30/A configuration, each SUU-13/A tube assembly is loaded with a CDU-12/B bomb cluster (canister), containing 32 BLU-39/B23 antipersonnel chemical bomblets. The canister is retained in the dispenser tube by four screws, which are sheared when the canister is ejected by the tube impulse ejection cartridge. Ejection velocity of the canister from the dispenser is approximately 90 fps downward. Figure 1-75

CDU-12/B CANISTER ASSEMBLY

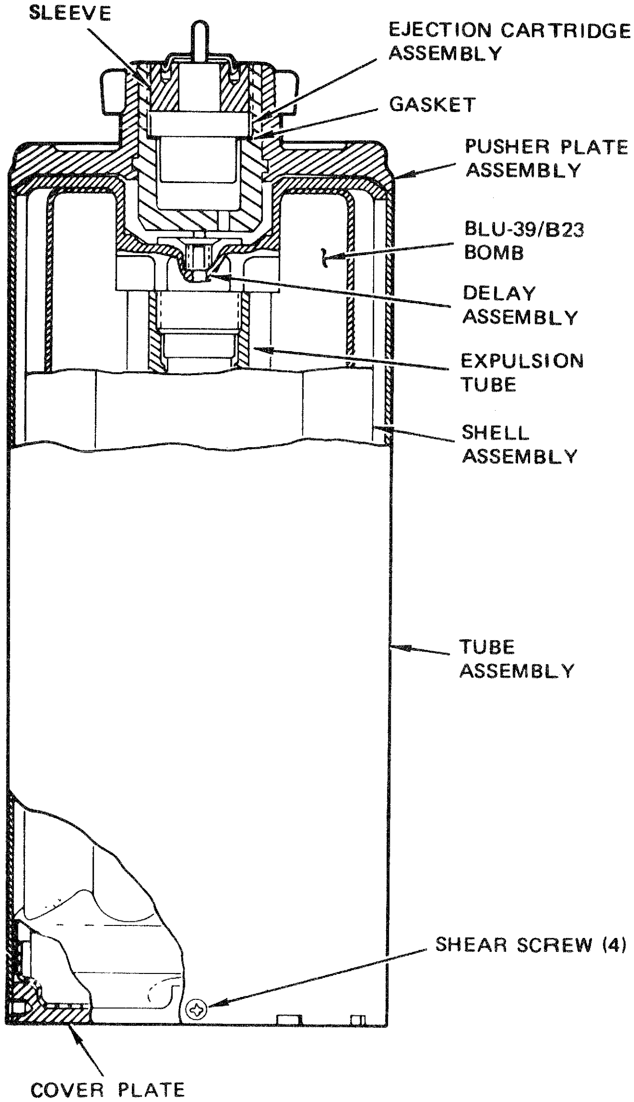


Figure 1-75

depicts a typical SUU-13/A tube assembly with a CDU-12/B canister installed. Each canister contains, in addition to the 32 BLU-39 bomblets, a delay assembly and an expulsion tube. When the tube assembly cartridge is fired, the hot gasses created are vented to the canister delay assembly while creating sufficient pressure on the canister to shear the tube's four canister retaining screws. After 0.3 to 0.5 second, the delay assembly ignites black powder contained in the canister expulsion tube and ignites the fuze igniter of each BLU-39 bomblet. The burning black powder in the canister expulsion tube forces the bomblets through the thin, fiber glass walls of the canister.

The BLU-39/B23 bomblet (figure 1-76) has a cylindrical shape and looks very much like a flashlight battery. It has an aluminum case and contains 40 grams of material (60% pyrotechnic and 40% CS). The bomblet has a delay element so that it does not start dispensing CS (smoke)

BLU-39/B23 CS BOMBLET

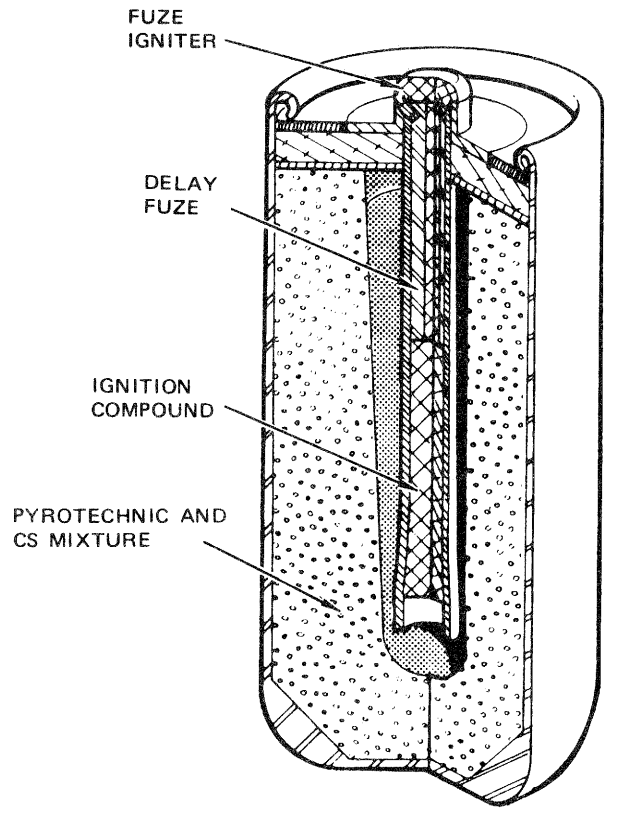


Figure 1-76

until 5 to 6 seconds after it leaves the bomb package. The bomblet dispenses CS for approximately 10 to 15 seconds. When the bomblet impacts on a cleared surface, the escape of the pressurized CS smoke from an orifice at one end of the bomblet causes it to skitter about the surface. The bomblet is unstabilized in flight. The bomblet is 1.25 inches in diameter, 2.5 inches long and weighs 0.13 pound.

NOTE

Since the bomblet will start to dispense smoke 5 to 6 seconds after release, release conditions which provide a time of flight of less than 6 seconds should be selected.

BLU-49/B (HE) Bombs.

A single BLU-49/B antimaterial high explosive (HE) bomb (figure 1-77) is carried in each of the SUU-13A/A dispenser's 40 ejection tubes to make up the CBU-38/A. The bombs are 4.6 inches in diameter, 10.25 inches long when installed in the SUU-13A/A cylinder, 14 inches long with ringtail extended, and have a nominal weight of 13 pounds. The bombs are ejected downward from the dispenser at approximately 62 fps. Ejection forces imparted by the dispenser tube ejection cartridges shear six pins which hold the bomb in the tube. As the bomb emerges from the tube, three wind tabs within the bomb tail assembly force the stabilizer ring tail into the extended position. Extension of the ringtail actuates the fuze system. The bomb arms in 5.5 (±1) seconds and detonates on impact.

NOTE

For CBU-38/A, release conditions must be selected which provide a BLU-49/B bomb time of flight greater than 6.5 seconds for all bombs to assure adequate time for the fuzes to arm prior to impact.

The BLU-49A/B is identical to the BLU-49/B except for the fuzing. The arming time for the BLU-49A/B was reduced to a minimum of 2.25 seconds and a maximum of 3.50 seconds. The BLU-49A/B has a safety device that prevents the bombs from arming when it senses an impact greater than 25g after the ring tail has been extended and before the arming time (2.25 to 3.50 seconds) is reached. The weight lock was redesigned to prevent it from being misassembled.

The BLU-49B/B is identical to the BLU-49A/B except that some of the explosive filler is replaced with a zirconium liner to provide an incendiary effect.

NOTE

For the CBU-38A/A, CBU-38B/A, and CBU-38C/A release conditions must be selected which provide a BLU-49A/B and BLU-49B/B bomb time of flight greater than 3.5 seconds for all bombs to assure adequate time for the fuzes to arm prior to impact.

If the bomb must penetrate jungle canopy, the resultant deceleration should not be sufficient to cause the inertial weights to fire the detonator. The bomb then will penetrate and explode following final impact with the ground. Upon water or mud impact (which does not provide sufficient deceleration to fire the detonator by the action of the inertial weights), another means is provided to fire the detonator. Openings in the face of the fuze will allow the fluid media to enter and push a piston against the firing pin. The firing pin then fires the detonator and ignites the explosive train.

CBU-12 SERIES AND CBU-46/A DISPENSER AND BOMB.

The CBU-12/A consists of a SUU-7B/A dispenser loaded with 213 BLU-17/B smoke bomblets. The CBU-12A/A consists of a SUU-7C/A dispenser loaded with 213 BLU-17/B smoke bomblets. The CBU-46/A consists of a SUU-7C/A dispenser loaded with 444 BLU-66/B antipersonnel fragmentation bomblets.

CBU-46/A Impact Pattern Data.

The impact pattern dimensional information for a munition of this type varies with the number of tubes released and delivery airspeed. The typical impact patterns (for one CBU-46 dispenser release pulse) can be approximately 1,300 to 1,900 feet long and 50 to 100 feet wide.

BLU-49/B HE BOMB

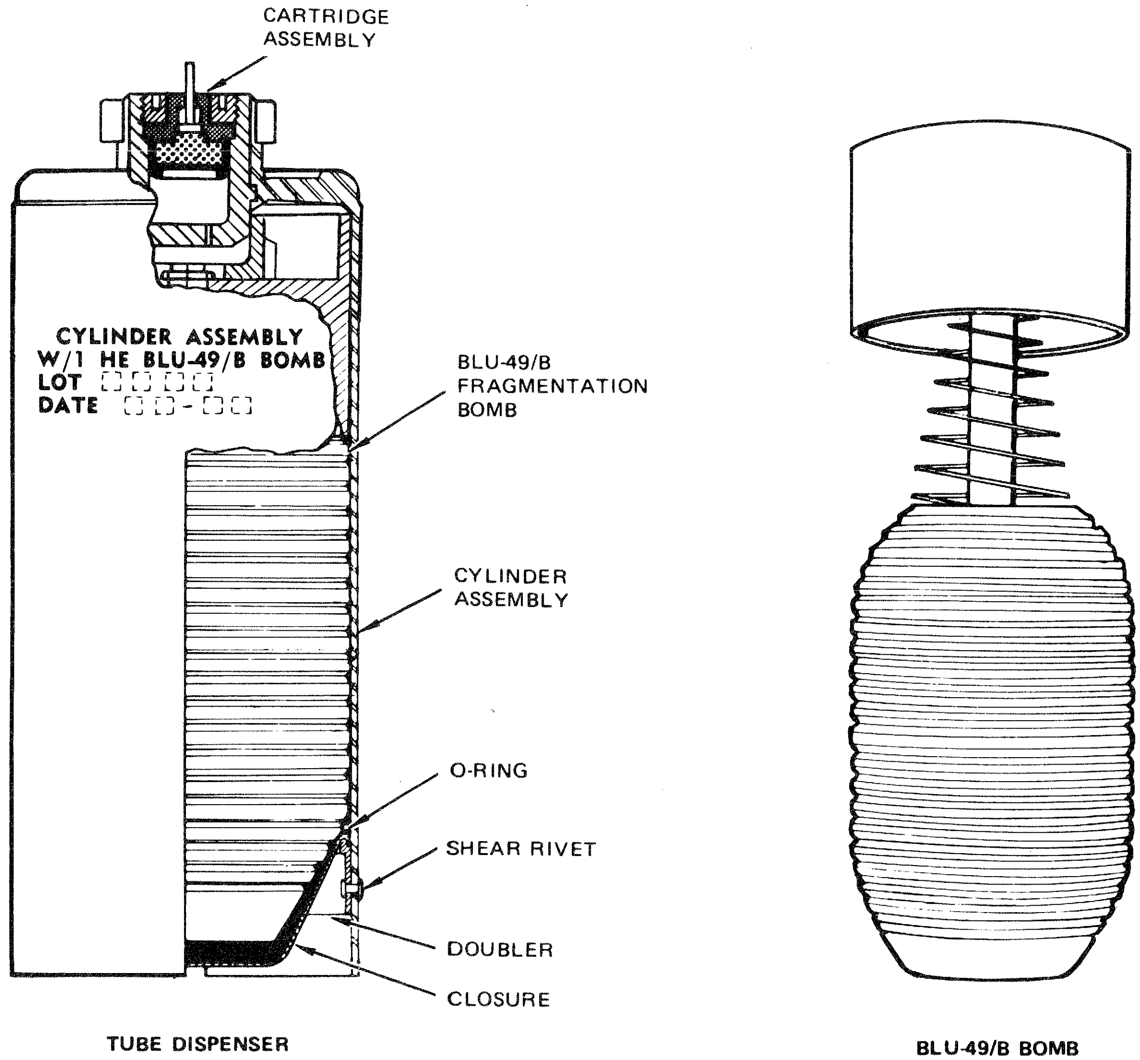


Figure 1-77

The time required for the tubes to empty varies with release airspeed as follows:

Release True Airspeed Knots	*Dispensing Time Seconds*
400	2.8
450	2.4
500	1.9
550	1.5

These dispensing times should be observed if a long impact pattern is desired and successive releases are employed. For example, if the release airspeed is 500 KTAS, successive releases at 1.5 to 1.8 seconds after initial release should assure impact pattern overlap and provide a continuous pattern. Three successive six-tube releases, accomplished at 500 KTAS and release intervals between 1.5 and 1.8 seconds, should provide a total impact pattern length between 4,000 and 4,600 feet long.

SUU-7C/A Bomb Dispenser.

The SUU-7C/A (figure 1-78) is an expendable, 19-tube, rearward ejecting dispenser designed to deliver various types of submunitions. The dispenser consists of a nose cone, a center section, and tail cone. The nose cone is a rounded aluminum fairing with an air intake hole in the front similar to a jet engine intake. The center section encloses the 19 thin-walled anodized aluminum tubes and the dispenser wiring. The center section also contains a strongback which provides for suspension and sway bracing of the dispenser and supports the dispenser. An electrical receptacle is located on a movable plate on the top center line of the dispenser behind the aft suspension lug. For A-7K application, this plate is placed in the NAVY position. The aluminum tail cone is formed to protect the exterior sides of the outer tubes. Internal ballast is provided under the skin at the rear of the center section to prevent damage to the aircraft when the dispenser is jettisoned.

Five components are necessary in a loaded tube to provide proper release of the submunitions. These are a helical compression spring; an ejection piston assembly, an adapter, the submunitions, a retaining plug, and an explosive detent assembly. The spring is placed in the tube first (from the rear) followed by the ejection piston assembly, adapter, submunitions, retaining plug, and explosive detent assembly. The spring becomes compressed when the tube is loaded to capacity. A slot in the sidewall of the retaining plug accommodates the explosive detent assembly which prevents ejection of the submunitions until the dispenser electrical circuit is energized. Receipt of the aircraft fire pulse initiates a small explosive detent assembly which projects the detent stop pin into the interior of the retaining plug. The stop pin strikes the opposite wall of the retaining plug, preventing damage to the tube sidewall and the aircraft. Ejection of the stop pin frees the inner face of the tube of all restrictions, permitting the combination of spring action and ram air pressure to eject the bomblets from the rear of the tube. When in the CBU-12 configuration, 16 of the dispenser's 19 tubes are loaded. In the CBU-46 configuration, 18 of the 19 tubes are loaded.

The SUU-7C/A is equipped with a removable bomb safety retainer attached to the dispenser rear bulkhead, a removable nose cone plug, and a tail cone protector. All of these items are tagged with a red flag and removed during loading or before flight. Dispenser electrical safety is provided by a safe-arm switch which is actuated by a tagged, removable pip pin. The dispenser has a manual selector switch which permits selection of two, four, six, or all (salvo) tubes to be released with each fire pulse received by the dispenser. The manual selector switch position must be selected before flight and is rotated using a blade screwdriver. The ROCKET-CBU switch on the TER's must be on CBU when SUU-7 series dispensers are loaded on them.

SUU-7B/A Bomb Dispenser.

The SUU-7B/A dispenser is identical to the SUU-7C/A dispenser with three exceptions: there is no internal ballast and, for A-7K application, a ballast ring is attached externally to aid in dispenser separation from the aircraft; the SUU-7B/A does not have a salvo release capability, the SUU-7B/A does not have a safe-arm switch.

SUU-7C/A DISPENSER

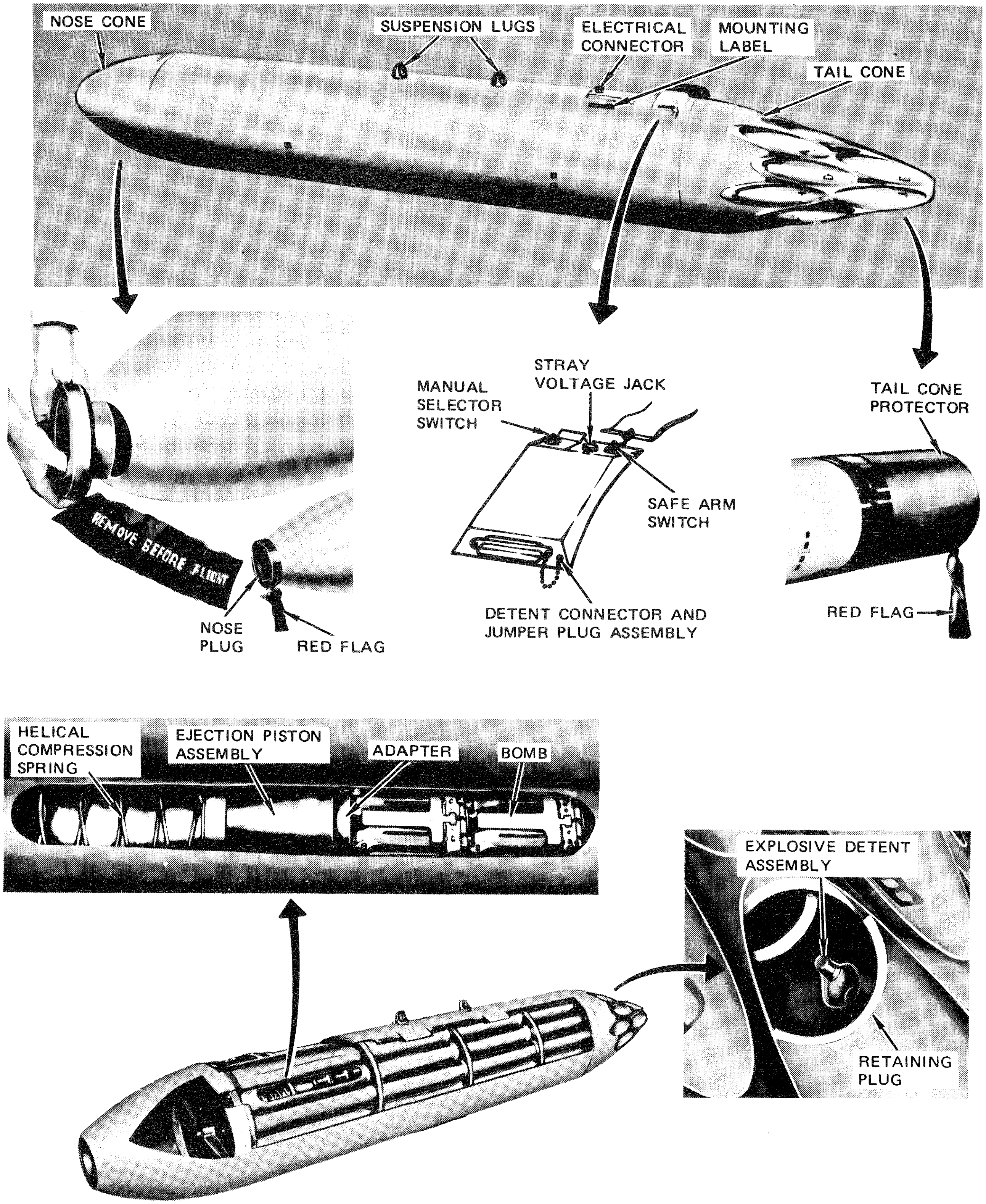
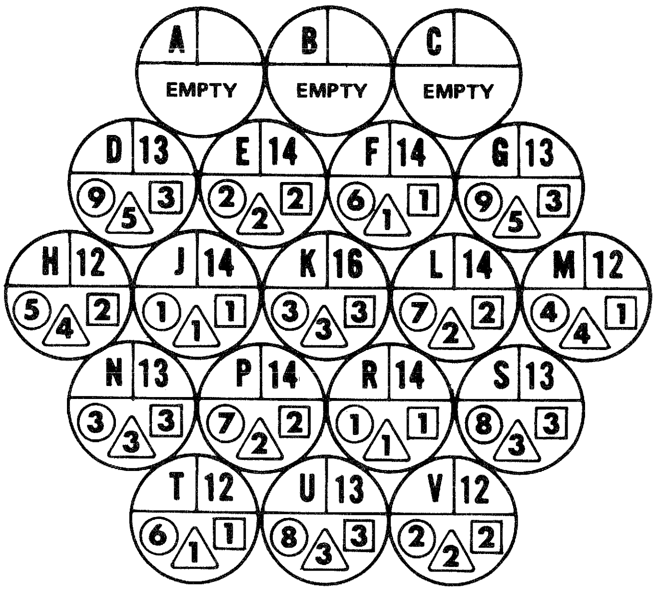


Figure 1-78 (Sheet 1)

SUU-7C/A DISPENSER

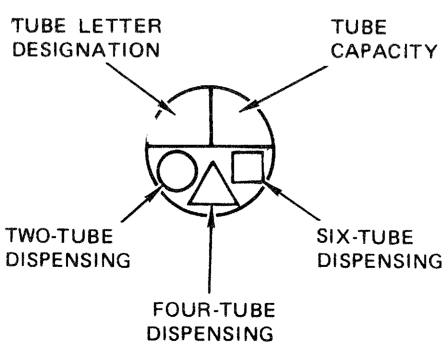


CBU-12A/A TUBE IDENTIFICATION, CAPACITIES, AND FIRING SEQUENCE

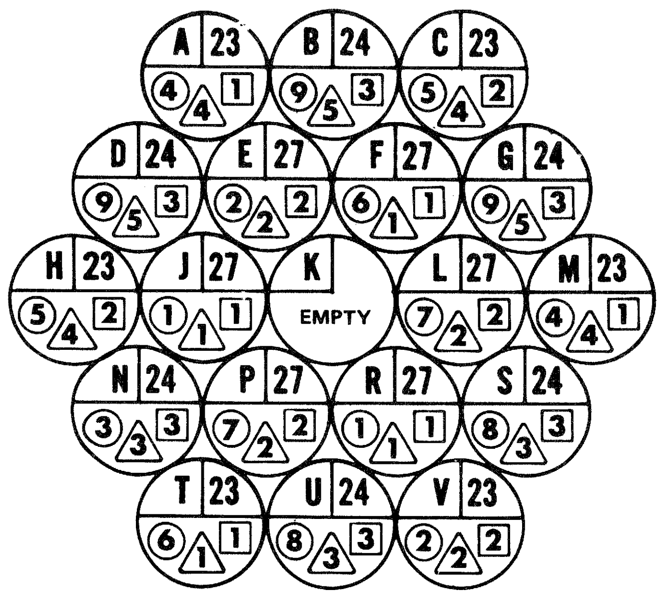
NOTE

CBU-12/A uses SUU-7B/A Dispenser. Tube identification, capacities and firing sequence are same as CBU-12A/A but SUU-7B/A does not have salvo release capability.

SUU-7C/A DISPENSER SYMBOL EXPLANATION



Also Salvo Release



CBU-46/A TUBE IDENTIFICATION, CAPACITIES, AND FIRING SEQUENCE

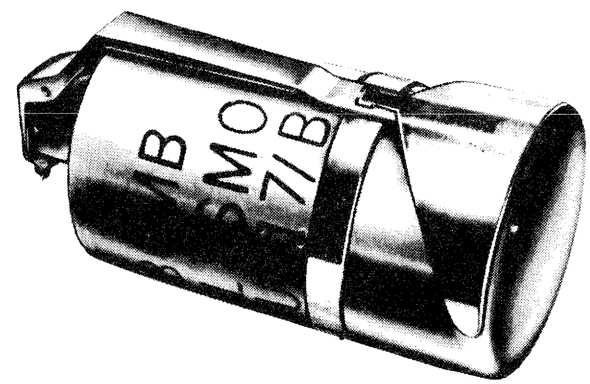
78K139(2)–08–80

Figure 1-78 (Sheet 2)

BLU-17/B Smoke Bomb.

The BLU-17/B bomb (figure 1-79) consists of a M206A2E2 fuze and approximately 1.0 pound of white phosphorus contained within a steel cylinder. The fuze is a bursting type fuze containing a primer, a delay charge, and a high-explosive burster. The fuze lever is secured to the bomb body by a spring tab which in turn is secured by a safety strap. Upon ejection from the dispenser, air pressure lifts off the spring tab which releases the safety strap securing the fuze lever to the bomb body. As the lever moves outward, it releases pressure on the spring actuated striker which strikes the primer. The primer ignites the delay charge which, after a delay of 4 to 5 seconds, explodes the burster. The burster shatters the bomb body and scatters particles of steel and white phosphorus over a 35-yard radius. The white phosphorus ignites spontaneously on exposure to air, producing a yellow-white flame and dense white smoke.

BLU-17/B SMOKE BOMBLET



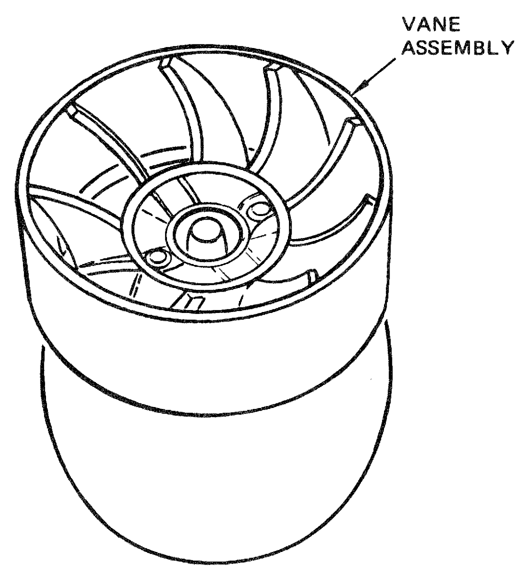
78K140—08—80

Figure 1-79

BLU-66/B Bomb.

The BLU-66/B (figure 1-80) is an antipersonnel bomb, 2.8 inches in diameter, 3.7 inches long, weighs 1.5 pounds, and contains 0.26 pound of cyclotol. The bomb consists of a spherical fragmenting case, a plastic impeller vane with a 2.2-inch diameter obturating disk, and a spin arm/spin decay fuze that allows the bomb to penetrate a jungle canopy prior to detonation. Upon ejection from the dispenser, the vane induces spin about the central axis of the bomb. At approximately 3,500 rpm the fuze will arm. After arming, the bomb will detonate when the spin has been reduced below 2,000 rpm. The arming sequence of the fuze is as follows: at 2,500 rpm, two spring loaded centrifugal locks are disengaged from the slide-detonator assembly; at approximately 3,500 rpm, centrifugal force acting on three symmetrical weights lifts the spring-loaded firing pin from a recess in the top of the slider-detonator assembly. This action frees the unbalanced slider-detonator assembly which centrifugally moves the detonator in line. The detonator is locked in line with a spring detent. When the spin rate has decayed to approximately 2,000 rpm, the spring load on the firing pin exceeds the centrifugal force of the weights, and the firing pin is released causing the bomb to detonate.

BLU-66/B BOMB



78K121—08—80

Figure 1-80

SUU-25 SERIES FLARE DISPENSER.

The SUU-25C/A flare dispenser (figure 1-81) is capable of dispensing eight Mk 24 or LUU-2 series flares or eight LUU-1/B or LUU-5/B markers. Single flare dispensing capability is the primary feature over earlier models.

The equipment is designed to be returned and ·sed for more than one mission. The dispenser consists of a center section constructed of four metal tubes enclosed by an outer skin with metal bulkheads on each end. A suspension lug reinforcement plate (strong back) is installed at the top of the center section. Two electrical receptacles, on top of the center section, permit electrical connection of the dispenser to the aircraft. However, only one receptacle is connected for dispenser operation. On the right side of the dispenser is a jack in which a shorting pin, with a red streamer attached, can be inserted to interrupt the electrical circuit between the electrical receptacles and the breeches. This pin electrically safes the dispenser.

Flares/markers are loaded against a compression cushion and are retained by eight shear pins, four located in the center section and four in the aft end. Each of the four tubes has two breech assemblies loaded with impulse cartridges. One breech is routed to a chamber between the forward and aft flares. The aft flare is dispensed first by cartridge gases creating a temporary compression chamber between the flares. Single flare dispensing is effected through the dispenser intervalometer which causes one flare to be dispensed with each release pulse.

The SUU-25E/A flare dispenser is identical to the SUU-25C/A dispenser with one exception: the SUU-25E/A forward shear pins (retaining links) are visible and accessible from outside the dispenser. This allows visual confirmation that the forward flares are properly secured.

SUU-42/A AND SUU-42A/A FLARE DISPENSER.

The SUU-42 flare dispenser (figure 1-82) is a single-carriage munition suspended directly from the MAU-12 bomb rack. The dispenser consists of eight launch tubes, a fire control system, and the supporting structure assembly. Each launch tube consists of a 5-inch diameter tube, two separate impulse cartridge ejection systems, two detent assemblies, an extractor assembly, and a safety lockout switch. The fire control system consists of an intervalometer, a MANUAL/RIPPLE selector switch, a pin actuated ARM/SAFE switch, and the interconnecting wiring. The structure assembly consists of four internal bulkheads, the removable nose cone, a two-piece riveted skin section, and four stabilizing fins on the dispenser aft periphery. The SUU-42/A and the SUU-42A/A are identical except that fiber glass tubes in the SUU-42/A are replaced by aluminum tubes in the SUU-42A/A. The fiber glass and aluminum tubes are interchangeable and the fiber glass model is being replaced by attrition.

Each dispenser tube can carry and dispense two flares or markers the same size as the Mk 24 Mod 4 flare. The flares are loaded end-to-end with the aft flare depressing the safety lockout switch. With the dispenser electrical safety pin removed, energizing the aircraft weapons release system applies voltage to the dispenser intervalometer.

The intervalometer routes the power to the dispenser tube ejection cartridge. When the cartridge fires, the resultant gas forces the flare from the tube. As the flare leaves the tube, the tube extractor assembly catches the flare arming mechanism, starting the flare arming cycle. When the aft flare has been ejected, the safety lockout switch opens, closing the circuit to the breech cap for that tube's forward flare.

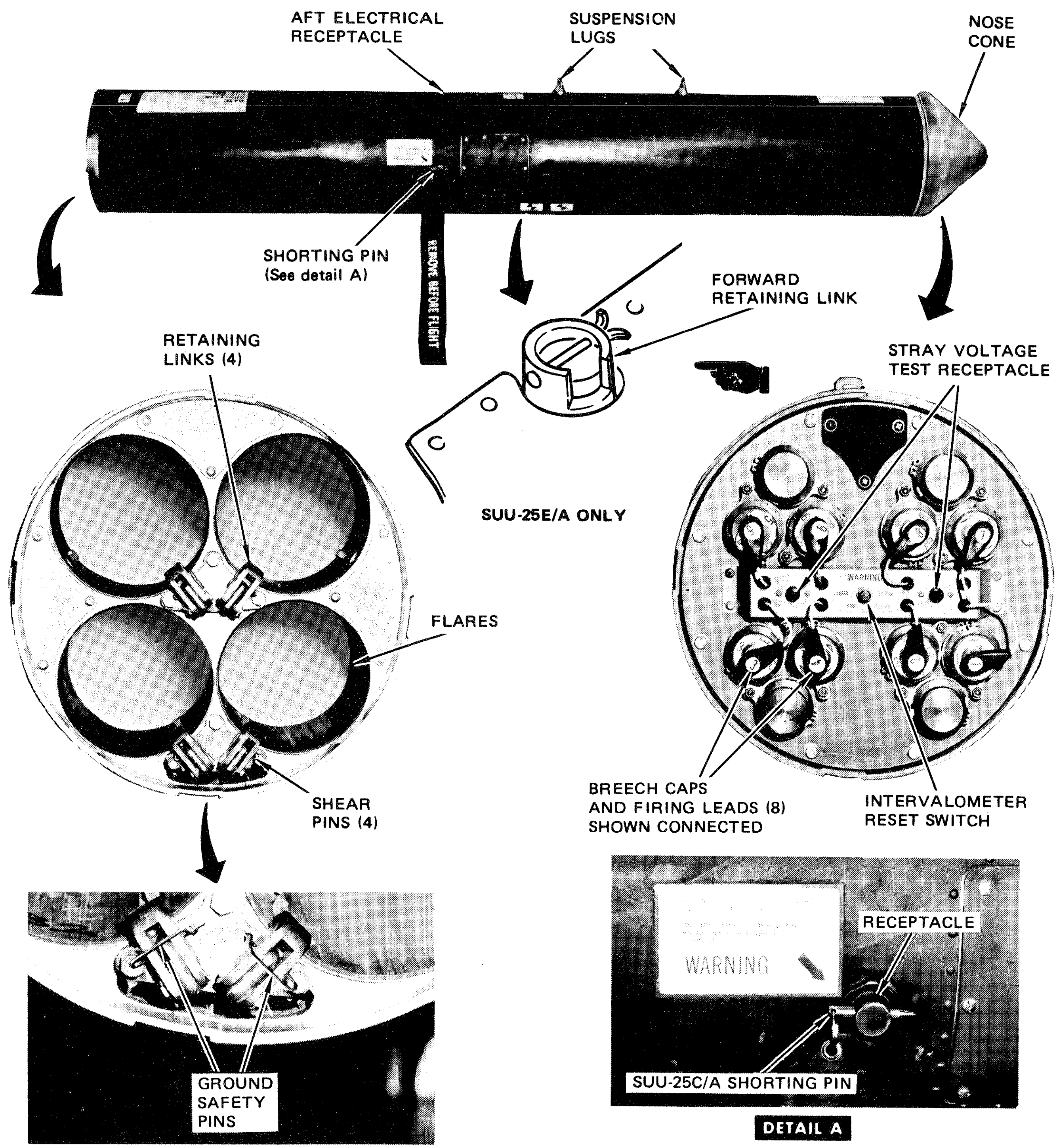
The dispenser intervalometer is set on the ground from 0.01 to 9.99 seconds. The intervalometer has three selector knobs, one knob for hundredths of a second, one knob for tenths of a second, and one knob for seconds, with ten increments on each knob. The MANUAL/RIPPLE switch allows one flare release per fire pulse delivered in the MANUAL position and allows train (sequential) release of flares as set on the intervalometer switches in the RIPPLE position. The train release will continue until the dispenser is empty or the fire pulse stops. The dispenser intervalometer is unreliable at settings below 0.10 second.

PYROTECHNICS.

MK 24 MOD 4 FLARE.

The Mk 24 Mod 4 flare (figure 1-83) consists of an aluminum case enclosing an ejection fuze, an ignition fuze, an arming lanyard, a parachute, and a candle. The arming lanyard and fuze setting dials are located on one end of the flare. Both fuzes are variable mechanical time delay fuzes. The ejection fuze is adjustable from 5 to 30 seconds in 5-second increments and allows the flare to fall 25 to 6,634 feet before ejection and suspension of the candle. The ignition fuze is adjustable from 10 to 30 seconds in 5-second increments and allows the

SUU-25 SERIES FLARE DISPENSER



NOTE

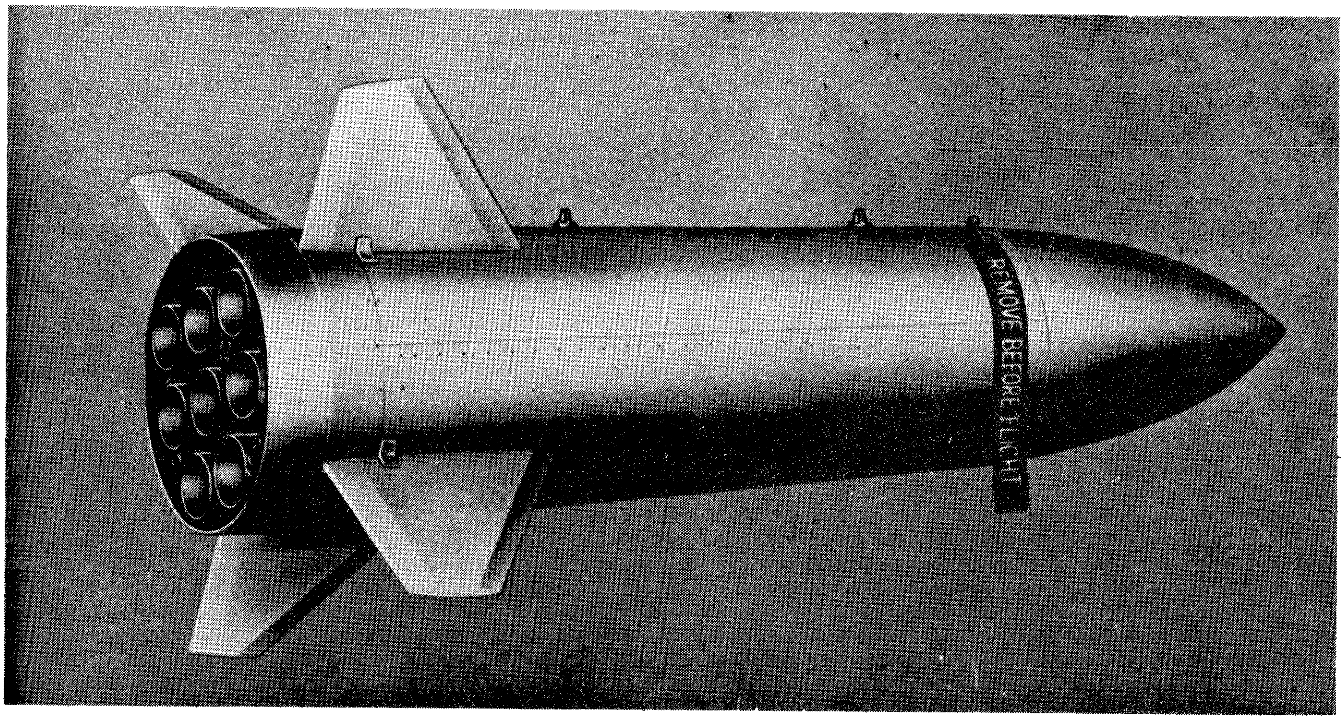
Ground safety pins are installed after landing

Weight (loaded)	360 pounds
Length (with nose cone)	96 inches
Diameter	14 inches
Suspension lug distance	14 inches

78K144–08–80

Figure 1-81

SUU-42/A AND SUU-42A/A FLARE DISPENSER



Weight, Empty	390.0 pounds
Length	11.0 feet, 8.0 inches
Diameter	22.75 inches
Suspension Lug Distance	30.0 inches
Number of Tubes	8 Tubes (2 flares per tube)
Payload	Mk 24 Mod 4 Flare

78K090–08–80

Figure 1-82

suspended candle to fall 45 to 525 feet before igniting. A safety pin with a key ring is installed in the fuze dials to prevent inadvertent initiation of the flare.

When the flare is loaded in the SUU-25 or SUU-42 series dispensers, a KMU-361 adapter kit is installed in both ends of the flare. An adapter arming lanyard and the flare arming lanyard are both attached to the flare safety pin key ring. Ejection of the flare from the dispenser pulls the adapter free of the flare, which in turn pulls the flare safety pin and the flare arming lanyard, arming the ejection fuze.

When the ejection fuze functions, it ejects the parachute, candle, and ignition fuze from the flare case, arming the ignition fuze and allowing the parachute to open. When the ignition fuze functions, it ignites the suspended candle and separates itself from the candle. The suspended candle falls at approximately 7.5 feet per second and burns for a minimum of 2 minutes with 2 million candlepower.

MK 24 FLARE AND LUU-1/B AND LUU-5/B TARGET MARKER FLARE

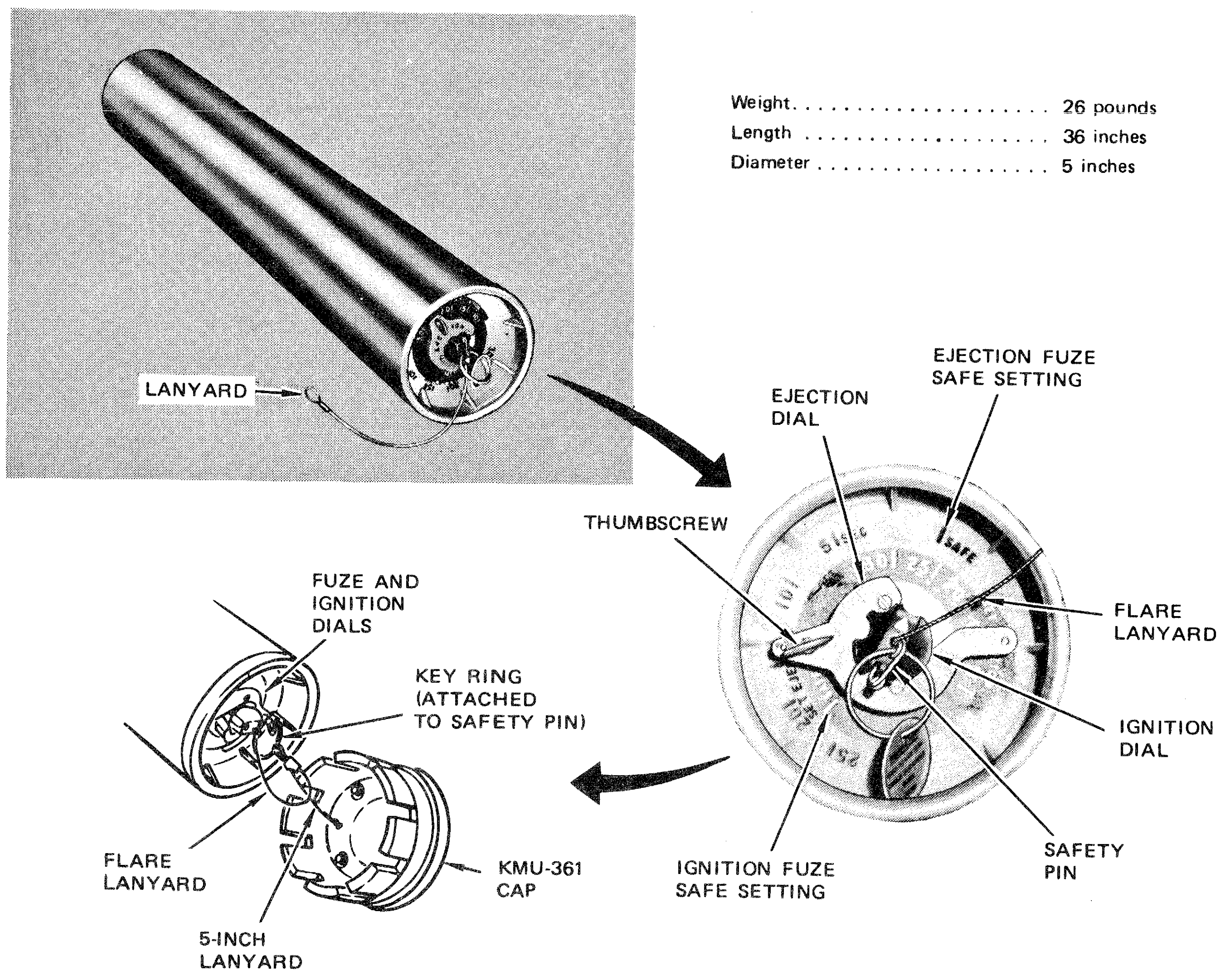


Figure 1-83

LUU-1/B AND LUU-5/B TARGET MARKER FLARES.

The LUU-1/B and LUU-5/B target marker flares (figure 1-83) are 4.87 inches in diameter, 36 inches long, and weigh 26 pounds. Both are Mk 24 Mod 4 illumination flares with a different candle/parachute assembly installed. The candle is designed to burn for 30 minutes on the ground, providing an easily distinguished colored flame. It is intended that the color be distinguishable in the presence of burning illumination flares. The LUU-1/B burns with a red flame; the LUU-5/B, green. The candle is inverted (the burning surface on the end connected with the parachute) to reduce the chances of snuffing out the flame on ground impact. The cast candle is 27 inches long, 4 inches in diameter, and weighs 19 pounds, with 16 pounds of flare composition. A steel suspension cable links the parachute and the wooden suspension block located on the bottom of the candle. The suspension cable passes through a 2.75-inch diameter protective core in the center of the candle and extends 6 feet from the top of the candle to a point where the cable is connected to eight 6-foot shroud lines. The parachute for the target marker flare is a cruciform design, which uses 7.5- by 2-foot panels sewn together in the form of a plus (+) sign. The parachute is designed to provide a 30-foot per second rate of descent and to snag in the top of heavy foliage, making it useful in jungle areas. After flare ignition, the flare has a rate of descent of approximately 15 feet per second.

The 5- to 30-second delay ejection fuze and the 10- to 30-second delay ignition fuze from the Mk 24 illuminating flare are used for the target marker flares. Since the ignition of the candle takes place at the end opposite to the ignition fuze, a double-ply quickmatch train is coiled inside the ignition fuze cavity and threaded through the protective center core of the candle. The quickmatch is extended into the cavity and is coiled over a hot-burning material called the first fire mixture. The candle has a 1/8 inch coating of the first fire mixture. Formed in the candles are two holes 1/2 inch in diameter by 3 inches long, filled with a first fire mixture having a 2-minute burn time, which increases the capability of the burning candle to withstand ground impact and continue burning.

When the marker is loaded in the SUU-42 series and SUU-25 series dispensers, the arming lanyard extension is removed and a KMU-361 adapter kit is installed on the marker. An adapter arming lanyard and the marker arming lanyard are both attached to the marker safety pin key ring. Ejection of the marker from the dispenser pulls the adapter free of the marker, which in turn pulls the marker safety pin and the marker arming lanyard, arming the ejection fuze.

Standard Mk 24 procedures are used to release the target marker flares. The ejection and ignition fuzes must be set before flight. Upon release, the pull on the lanyard ignites the ejection fuze. At the conclusion of the ejection fuze delay, an ejection charge expels the candle and parachute from the outer case. The ejection charge also ignites the ignition fuze delay element, which in turn ignites the candle.

LUU-2 SERIES FLARE.

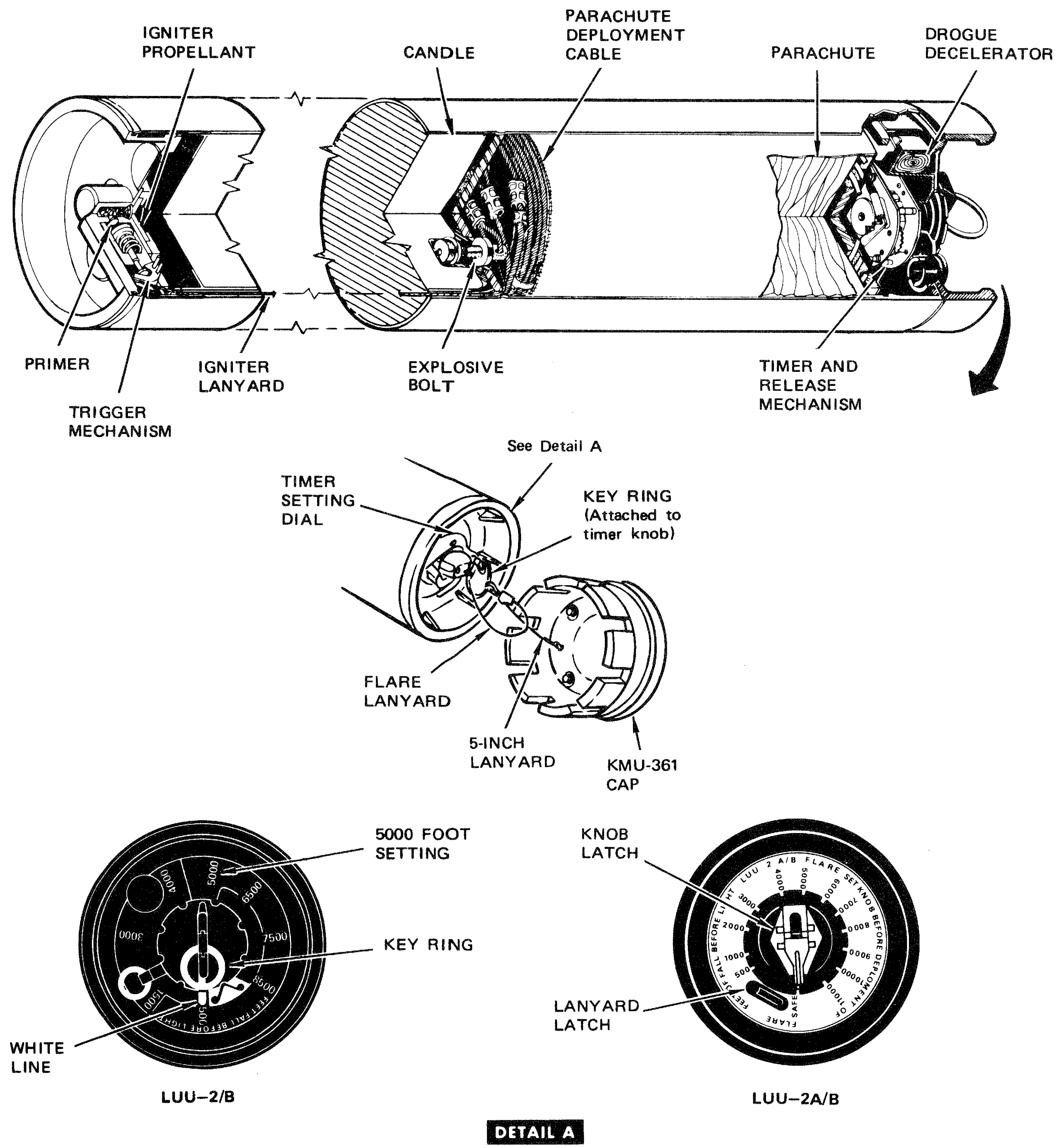
The LUU-2/B flare (figure 1-84) is a pyrotechnic illuminating device with an approximate 5-minute burn time. The flare burns at an average of 2 million candle-power. The flare weighs approximately 30 pounds and is identical to the Mk 24 flare in external dimensions.

The desired freefall distance in feet (delay time) must be set into the timer before flight. This is done by turning the knob in the center of the timer cover clockwise until the pointer is opposite the number of feet desired. The available settings are 500, 1,500, 3,000, 4,000, 5,000, 6,500, 7,500, and 8,500 feet.

The timer knob is removed as the flare is ejected from the aircraft, which starts the timer. After the selected delay time, the release mechanism is tripped, allowing the timer and cover to be ejected from the flare case by a spring. As the timer is ejected, it pulls the parachute with it. Deployment of the main parachute produces a shock force on the support cables through the ignition lanyard to rotate a bellcrank in the ignition system, shearing a safety pin and cocking and releasing a firing pin. The firing pin strikes and initiates a primer, which ignites boron pellets. The boron pellets ignite a wafer of propellant, which ignites the flare candle. Pressure buildup on flare ignition blows out pressure relief plugs in the igniter housing after which the flare case burns through and the ignition housing falls free.

The flare burns for approximately 300 seconds. The average rate of descent of the flare after parachute deployment is 8 feet per second and the flare descends

LUU-2 SERIES AND MJU-3/B FLARES (LUU-2 SERIES SHOWN)



Weight	29 pounds
Length	36 inches
Diameter	5 inches

78K198–08–80

Figure 1-84

approximately 2,500 feet during the 5-minute burn time. Because the pyrotechnic candle consumes the flare housing, the flare tends to hover during the last two minutes of burn time. At candle burnout, an explosive bolt is initiated which releases one parachute support cable, causing the parachute to collapse.

The LUU-2A/B flare incorporates an improved timer assembly for higher reliability and increased flexibility. The timer has a SAFE position and feet-of-fall settings of 500 and 1,000 to 11,000 in 1,000-foot increments. The timer knob has a quick attach-detach feature allowing the lanyard loop to be attached directly to the knob instead of a keyring. An auxiliary lanyard attachment device with the same quick attach-detach feature is provided for double lanyard hookup. A pawl release mechanism retains the timer in the flare case until expiration of the preset time delay (feet-of-fall setting) at which time the timer assembly is ejected, pulling the 18-foot diameter parachute from the flare case. Deployment of the parachute fires the flare ignition system.

When the flare is installed in the SUU-42 series and SUU-25 series dispensers, a KMU-361 adapter kit is installed on the flare. A 6-inch lanyard is attached from the adapter kit to the flare timer knob keyring. Ejection of the flare from the dispenser pulls the adapter free of the flare, which in turn pulls the flare timer knob from the flare.

MJU-3/B COUNTERMEASURES FLARE.

The MJU-3/B countermeasures flare (figure 1-84) is a LUU-2/B flare modified for special use. The modification consists of locking the time setting knob at the 8,500-foot setting and changing the flare functioning mechanism so that the flare ignites within approximately 0.5 second of withdrawal of the timer knob. All functions of the MJU-3/B flare after ignition are identical to the LUU-2/B except that when the parachute deploys it becomes a streamer immediately, causing the flare to fall away from the aircraft line of flight. This feature makes the MJU-3/B useful as a decoy for heatseeking antiaircraft missiles. The physical characteristics and carriage capabilities of the MJU-3/B flare are identical to those of the LUU-2/B flare.

MISSILES.

AIM-9B, AIM-9E, AIM-9J, AND AIM-9P (SIDEWINDER) MISSILES.

Refer to (Confidential) T.O. 1A-7K-34-1-1-1.

AGM-65A AND AGM-65B AIR-TO-GROUND MISSILE SYSTEM.

Missile Description.

The AGM-65A and AGM-65B missiles and associated data are shown in figure 1-85. The missiles can be separated into two sections: the forward section containing the seeker and electronics circuitry and the aft section containing the warhead, rocket motor, battery, hydraulic system for control surface positioning, and electrical connectors for connection to the launcher. However, operation of the missiles is more easily understood in terms of functional operations of missile component groups without regard to their physical location. The functional groups are: power supply, propulsion, hydraulic actuation system, guidance, and armament.

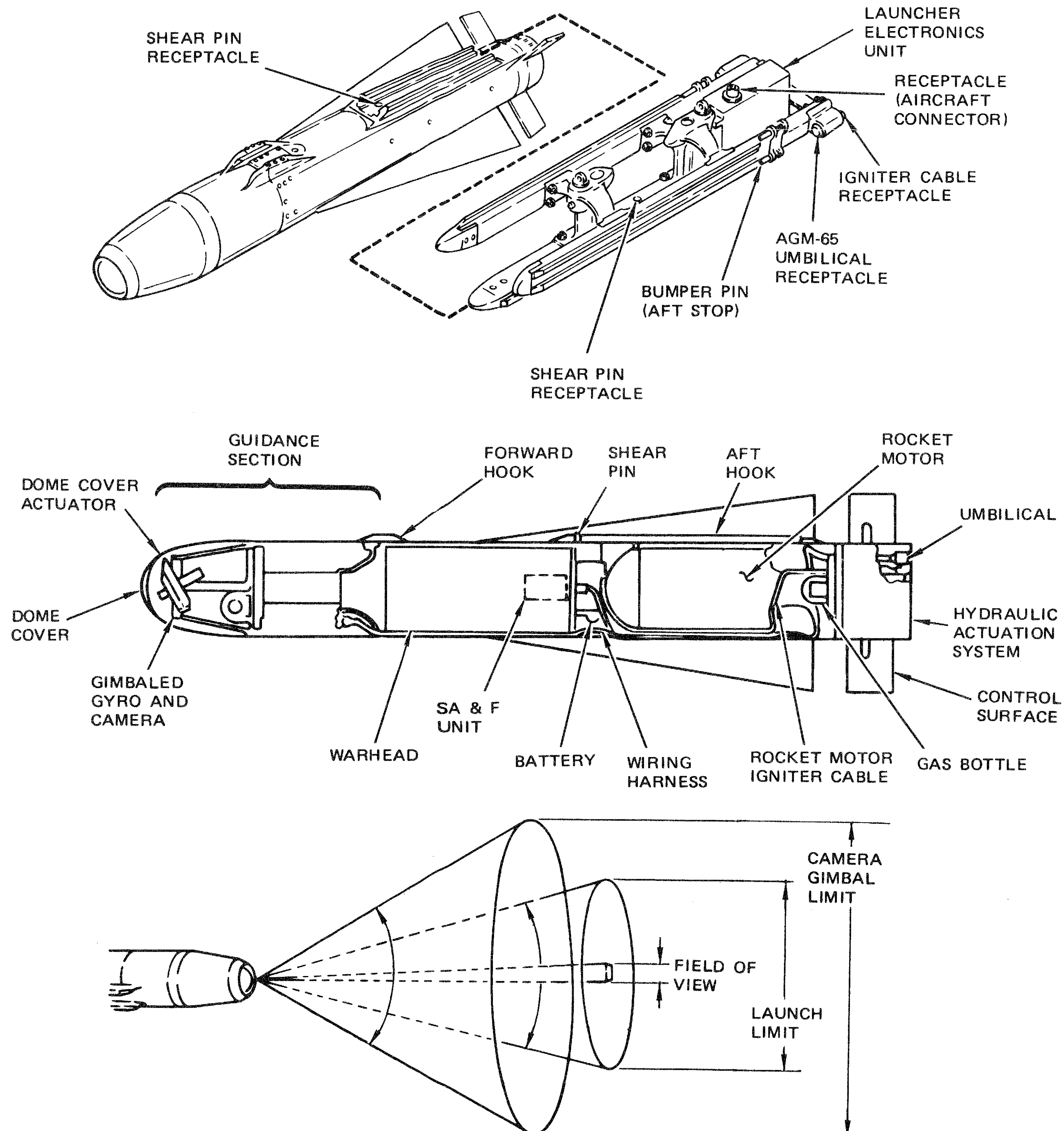
Power Supply.

The missile uses aircraft electrical power until just before it is launched. When the launch command is received, the battery is activated and its voltage is almost instantly raised from zero to rated value. After the battery comes up to rated voltage, the missile is switched over to battery power and uses this power for the remainder of the launch sequence and flight.

Propulsion.

The missile is propelled by a solid propellant rocket motor of the boost-sustain type. Boost phase produces approximately 10,000 pounds of thrust and lasts approximately 1/2 second; sustain phase produces approximately 2,000 pounds of thrust and lasts approximately 3 1/2 seconds. After rocket motor burnout, the remainder of the flight is unpowered.

AGM-65A AND AGM-65B MISSILE AND LAU-88/A LAUNCHER



	AGM-65A	AGM-65B
CAMERA GIMBAL LIMIT	60°	50°
LAUNCH LIMIT	30°	20°
FIELD OF VIEW	5°	2.5°

PHYSICAL CHARACTERISTICS	
WEIGHT	464 Pounds
LENGTH	8 Feet, 1.7 Inches
DIAMETER	12 Inches
WING SPAN	28.5 Inches

78K224–08–80

Figure 1-85

Hydraulic Actuation System.

The hydraulic actuation system derives its power from compressed helium gas. The compressed gas is contained in a bottle and is not released to pressurize the system until after the missile is launched and leaves the rail. The gas pressure drives the hydraulic pump. Before the system is pressurized, the control surfaces are held in a centered position by spring-loaded pins. After pressurization, hydraulic fluid forces the pins to retract, releasing the control surfaces. The hydraulic fluid is fed to torque motors which maneuver the control surfaces. Flow of the hydraulic fluid into the torque motors is controlled by valves which open and close to position the control surfaces proportional to signals from the missile guidance unit. Control surface deflections are thus proportional to the amount of flightpath correction required by the guidance unit.

Guidance.

Missile guidance is controlled by the guidance unit which is the portion of the missile in front of the forward hook. Light from the target scene enters through a window in the nose of the missile and is converted to an electrical charge pattern on a plate in the television camera. The charge pattern varies in intensity corresponding to variations in brightness in the target scene. Electrical signals representing this target scene are sent to the cockpit along with electronically generated reference symbols for display on the radar scope. These signals are also sampled to determine the scene brightness at particular points. Points inside the target area (defined by the opening at the intersection of crosshairs for the AGM-65A or within the area bounded by the background gates for the AGM-65B) are compared with points just outside this area (background). The guidance unit chooses the target area and the average brightness level about halfway between the lightest (or darkest) part of the target area and the average brightness of the background. This level is established as the threshold between target and background at the time of target lock-on.

Choice of target area as an area darker or lighter than the background is controlled by the setting of the target contrast switch in the cockpit. If the automatic mode is used, the guidance unit defines the target as being dark or light by the scene in the tracking window (gate) at the time lock-on is commanded. If the light-on-dark mode is chosen, the target area is defined as an area lighter than the background. In this mode, the missile will not lock on to a dark target. The opposite is true of the dark-on-light mode.

The missile is equipped with a sun shutter to protect the seeker from extreme intensity light sources. In the event that the seeker is pointed toward the sun, the shutter will close to prevent the vidicon from being damaged. The shutter will remain closed until the seeker is directed away from the sun. During the tracking phase of missile operation, the sun shutter circuitry is deactivated, thus the shutter will remain open. If the missile is deselected, the sun shutter will again close.

After lock-on, the target area and the background area are continually sampled to determine if the target is still in the center of the scene. If the target moves or if the missile line of sight begins to drift off of the target, the camera is slewed to realign it with the target. The resulting misalignment between the camera and the missile line of flight is detected by the guidance unit which, during missile flight, sends correction signals to the control surface servo valves. The control surfaces deflect, steering the missile back into alignment with camera.

As the missile flies toward the target, the target grows in apparent size. This change is detected by the missile guidane unit, which continually redefines the target boundaries to include a constantly increasing area. However, when the target size increases to fill a predetermined portion of the field of view, approximately 70%, the guidance unit stops increasing the defined target area, and any correction signals are held constant for the remainder of the flight to the target.

The AGM-65B has a modified version of the AGM-65A guidance unit that improves target acquisition range for small tactical targets, thereby providing increased standoff capability against a given target. This is accomplished by doubling the size of the tracking image by magnification (field of view is reduced from 5° to 2.5°). This modification includes a larger lens assembly and several additional refinements to the video display to further enhance human factors. There are no changes to the center and aft sections of the missile, the launcher, or aircraft subsystems. Initially, the dimension within the tracking gate is approximately 0.5 milliradian. The TV display represents a 2.5° field of view within a 50° camera gimbal limit. The seeker head must be within 10° (20° conical limit) from weapon boresight at launch in order to retain successful track after launch. Figure 1-85 shows the camera gimbal and launch limits with the 2.5° field of view.

The pointing cross provided in the AGM-65B video display performs two functions: it indicates the relative bearing between the missile boresight line and the line of sight (LOS) of the missile optics (seeker) and it indicates the quality of the lock-on after target designation. When the seeker LOS is aligned with the missile boresight line, the pointing cross is centered and blanked out within the tracking gate. As the seeker moves in azimuth (either by slewing or self-tracking), the pointing cross moves in the same direction. As the seeker moves in elevation, the pointing cross also moves in the same direction. The optimum indication at launch is with the bars centered. At target designation, if any combination of target size and LOS angle is such that the lock-on does not have a good probability of surviving launch transients, the AGM-65B identifier and the pointing cross will flash on and off at an approximate 4-hertz rate.

Armament.

The missile warhead uses a conical shaped charge to penetrate hard targets and blast for additional effectiveness. The safety, arming, and fuzing device in the warhead arms as a result of the acceleration forces produced by the thrust of the rocket motor. Detonation is triggered by contact sensors in the front portion of the missile or by deceleration of the missile on impact.

AGM-65A AND AGM-65B LAUNCH ENVELOPES.

Figures 1-86 and 1-87 show missile launch limits in horizontal range versus launch altitude for three Mach numbers. The minimum launch range for any altitude is represented by the left boundary of the envelope; the maximum launch range and time of flight is represented by the right boundaries. The minimum launch range is limited by a maximum line-of-sight depression of 60°. The line-of-sight depression is equal to flightpath dive angle plus seeker head displacement from radar boresight line. The maximum and minimum launch altitudes are 33,000 feet and 300 feet (terrain clearance), respectively.

Minimum Launch Slant Ranges to Avoid Fragment Envelope.

The following minimum launch slant ranges should be observed to avoid the fragment envelope:

Launch Velocity (KTAS)	*Slant Range (Feet)* Safe Escape (PH 0.001)	System Arming Capability
300	2,800	2,900
350	3,100	3,100
400	3,500	3,400
450	3,800	3,600
500	4,200	3,800
550	4,500	4,000
600	4,900	4,100

The safe escape slant ranges listed above are based on a 4g wings-level pullout escape maneuver. For this type escape maneuver, the probability that the launch aircraft will encounter a fragment from its own missile detonation is less than 0.001. The system arming capability data listed above provide information concerning the slant range required for full fuze arming at the specified launch airspeeds.

WARNING

When the system arming slant range is less than the launch slant range required for safe escape, the aircrew should take every precaution to be sure that the launch slant range is greater than the value required to clear the fragmentation envelope.

Terrain avoidance during recovery is not considered in these minimum launch slant ranges. Refer to Dive Recovery Charts, Section VI, to establish the altitude lost during a 4g recovery for various dive angles and airspeeds. Terrain avoidance and fragment envelopes are not considered in the launch envelopes shown in figures 1-86 and 1-87.

AGM-65A LAUNCH ENVELOPES

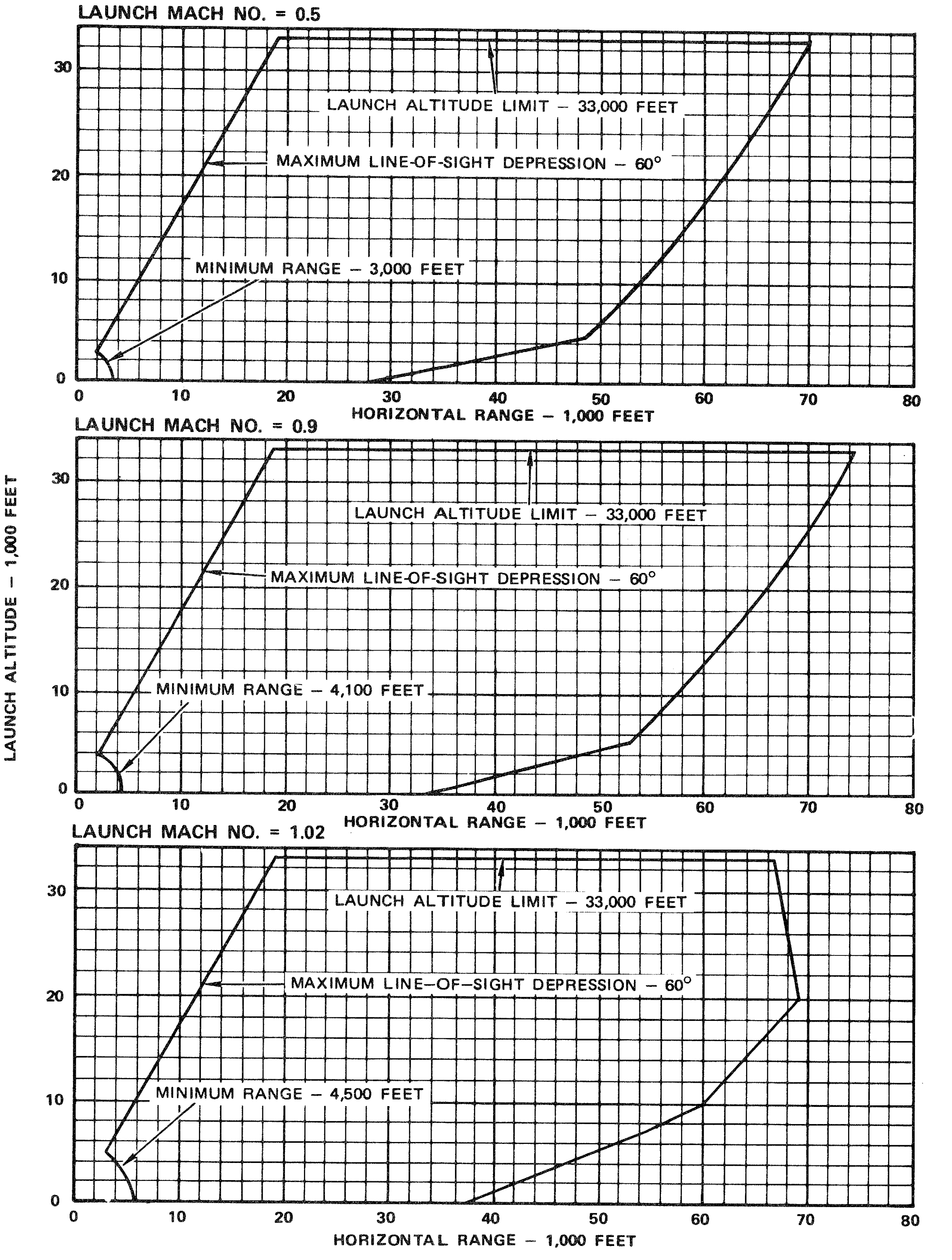


Figure 1-86

AGM-65B LAUNCH ENVELOPES

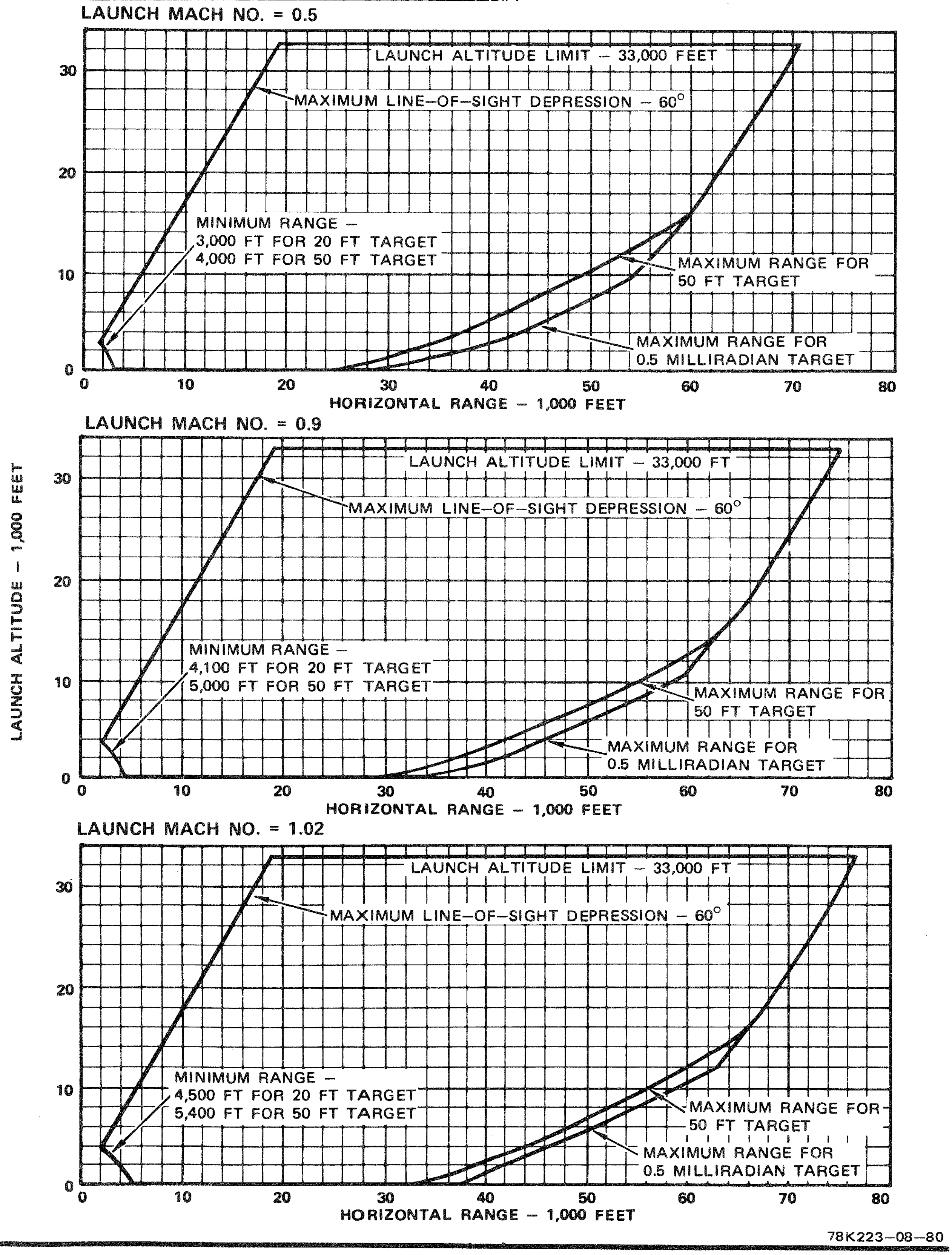


Figure 1-87

PART 7 – NONNUCLEAR WEAPONS FUZES

BOMB FUZES.

WARNING

Improper employment of a weapon fuze combination may result in serious damage to the aircraft or injury to the aircrew.

Refer to T.O. 11A-1-1, Ammunition Restricted or Suspended, for current information regarding restricted use of models or specific lots of fuzes whose performance or safety for use is questionable.

For fuze safe arming times, refer to Sections V and VI. For bomb/fuze compatibility, refer to figure 1-88.

A fuze is a device used to initiate bomb detonation at a predetermined time and under the desired circumstances. Since targets are usually selected in advance of a mission and the structure of the target indicates the type of fuzing which would produce the best results, it is imperative that the correct fuzing system be installed in the weapon. Additionally, many weapons can accommodate a large variety of fuzes which can drastically change the weapon effects. Pilots must be familiar with the classification and operation of fuzes to effectively plan the mode of delivery and ensure safe escape from the contemplated weapon effects.

CLASSIFICATION OF BOMB FUZES.

Bomb fuzes are separated into two groups, nose and tail (figure 1-89). Fuzes are further separated by functions as follows:

Impact — This type of fuze is designed to function upon impact with the target or with a short delay. The time delay (if any) is measured from the instant of impact.

Proximity — The proximity fuze is a miniature Doppler radar set. The fuze transmits radar waves which are reflected back to the fuze by the target. When the lag time between transmission and reception reaches a set value, the fuze functions. The lag time between transmission and reception has been precomputed and translated into selectable burst height values in altitude above the target. These burst height values vary between different fuzes.

Time — In a time fuze, the delay is initiated at bomb release from the aircraft and not at the instant of impact. The time element is obtained by a mechanical or electrical device.

Hydrostatic — This type of fuze is employed in depth bombs for underwater demolition work. The fuzes operate on the principle of a bellows or diaphragm which expands with an increase in water pressure as the bomb sinks to counteract the force exerted by a spring. When the spring force is overcome, the firing pin is released and driven against the primer by spring action.

METHODS OF ARMING.

Fuzes are armed in one or a combination of the following four methods:

Vane — The arming vane is a small propeller which is rotated after weapon release by airflow as the bomb falls. When the vane rotates the required number of times, the fuze is armed.

Pin — The arming pin is ejected or withdrawn by spring action when the bomb is released. The ejection of the pin releases the arming mechanism and allows the fuze to arm.

Inertia — Abrupt changes in the velocity of the falling bomb arms the fuze.

Electric — The fuze is armed by a thermal battery which is activated at bomb release by the extraction of the arming lanyard.

BOMB/FUZE COMPATIBILITY CHART

FUZE	TYPE		FUNCTIONAL DELAY	BOMB	ARMING (AIR TRAVEL) DELAY
	NOSE	TAIL			
FMU-7/B FMU-7A/B FMU-7B/B FMU-7C/B Internal	X	X	Electrical impact instantaneous	BLU-1C/B BLU-27B/B BLU-27C/B	50 feet
FMU-26A/B FMU-26B/B Internal	X X		Airburst occurs 0.1 second after arming	CBU-24B/B CBU-49B/B CBU-52 series CBU-58 series CBU-71 series	Airburst – Selectable; 1.9 to 99.9 seconds in 0.5-second increments (±0.3-second tolerance)
FMU-26B/B Internal	X	X	Impact short delay; selectable, non-delay, 0.01, 0.02, 0.05, 0.10, 0.25 sec	Mk 82 Mk 83 Mk 84 M117 GBU-10 LGB GBU-12 LGB GBU-8 EOB	Impact short delay – Selectable; 2.0 to 20.0 seconds in 2.0-sec increments (±10% or 0.002 whichever is greater tolerance)
FMU-54/B Internal		X	Instantaneous only	Mk 82 Snakeye	Selectable; 0.75 to 3.5 seconds in 0.25-second increments
FMU-54A/B Internal		X	Instantaneous only	Mk 82 Snakeye	Selectable; 2.5 to 6.0 seconds in 0.25-second increments
with					
Mk 43TDD External	X		N/A (Firing signal transmitter to FMU-54A/B at 16 feet AGL)		N/A
FMU-56B/B FMU-56D/B External	X X		250, 500, 800, 1100, 1500, 1800, 2000, 2200, 2500, 3000 ft AGL.	CBU-24B/B CBU-49B/B CBU-52 series CBU-58 series CBU-71 series	Selectable; Safe, 3, 4, 5, 6, 7, 8, 9, 10,18 seconds.
FMU-72/B Internal	X	X	Selectable in 20-min increments from 20 minutes to 5 hours; 1-hour increments from 5 to 16 hours; 2-hour increments from 16 to 30 hours; 3-hour increments from 30 to 36 hours	Mk 82 Mk 83 Mk 84 GBU-10 LGB	Arming time 6 seconds with tolerance of +1.5 to –1.0 seconds
FMU-81/B Internal	X	X	Electrical selectable impact delay: .00, .01, .02, .05, .10, or .25 second	GBU-10 LGB GBU-12 LGB	Selectable; Safe, 4, 5, 6, 7, 8, 10, 12, 14 or 20 seconds
FMU-110/B External	X		Electrical proximity-airburst – 300, 500, 700, 900, 1200, 1500, 1800, 2200, 2600, 3000 ft AGL	CBU-24B/B CBU-49B/B CBU-52 series CBU-58 series CBU-71 series	Selectable: 3, 4, 5, 6, 7, 8, 9, 10 or 18 seconds

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Figure 1-88 (Sheet 1)

BOMB/FUZE COMPATIBILITY CHART

FUZE	TYPE		FUNCTIONAL DELAY	BOMB	ARMING (AIR TRAVEL) DELAY
	NOSE	TAIL			
Mk 339 External	X		Airburst selectable; 1.2 to 50.0 seconds in 0.1 sec increments		Delay time of 1.1 ±0.1 seconds (±0.1 second up to 10 seconds, 1% of settings above 10 seconds)
M904E2 M904E3 External	X X		Selectable with M9 delay element; 0.00, 0.01, 0.025 0.05, 0.10, 0.25 second	MC-1 M117 Mk 82 Mk 83 Mk 84 Mk 82 Snakeye	Selectable; 2, 4, 6, 8, 10, 12, 14, 16, 18 seconds (±10%)
M905 External		X	Selectable with M9 delay element 0.00, 0.01, 0.025, 0.05, 0.10, 0.25 second	MC-1 M117 Mk 82 Mk 83 Mk 84 GBU-8 EOB GBU-10 LGB GBU-12 LGB	Selectable; 4, 6, 8, 12, 16, 20 seconds (±20%)
M907* External	X		Airburst selectable; 4 to 92 seconds in 0.5-second increments	CBU-24B/B CBU-49B/B CBU-52 series CBU-58 series CBU-71 series	Half of setting when setting is less than 10 seconds. 60% of all settings over 10 seconds.

*Physically compatible but not reliable with the SUU-30B/B or SUU-30H/B dispenser

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Figure 1-88 (Sheet 2)

ARMING TIME INTERVAL.

Direct arming fuzes are armed immediately when the arming pin is ejected or when the arming vane has rotated the required number of revolutions.

Delay arming fuzes have an arming pin or vane which initiates a time delay mechanism (clockwork) which arms the fuze after a predetermined time elapse.

EXPLOSIVE TRAIN.

The explosive train (figure 1-90) controls the detonation of the bomb. The train is a sequence of explosions in which a small quantity of very sensitive explosive sets off a large quantity of much less sensitive explosive.

The type of explosive used in large quantities in bombs must be relatively insensitive to shock and heat to provide a reasonable degree of safety in storing, shipping, and handling. It must also permit the bomb to be used to penetrate a resistant target such as armor plate, earth, or concrete, before exploding. Conversely, the type of explosive used in the fuze must be very sensitive so that it explodes when impacted by the firing pin. Such an explosive is not safe to handle except in minute quantities and, therefore, is strongly compressed into a metal capsule called a detonator which is built into the fuze. The shock generated by the explosion of a detonator is not of sufficient strength to be reliable as a means of exploding the large amount of insensitive explosive which makes up the main charge of the bomb. To accomplish main charge explosion, a small quantity of explosive more sensitive to the main charge is placed

BOMB FUZE CLASSIFICATION

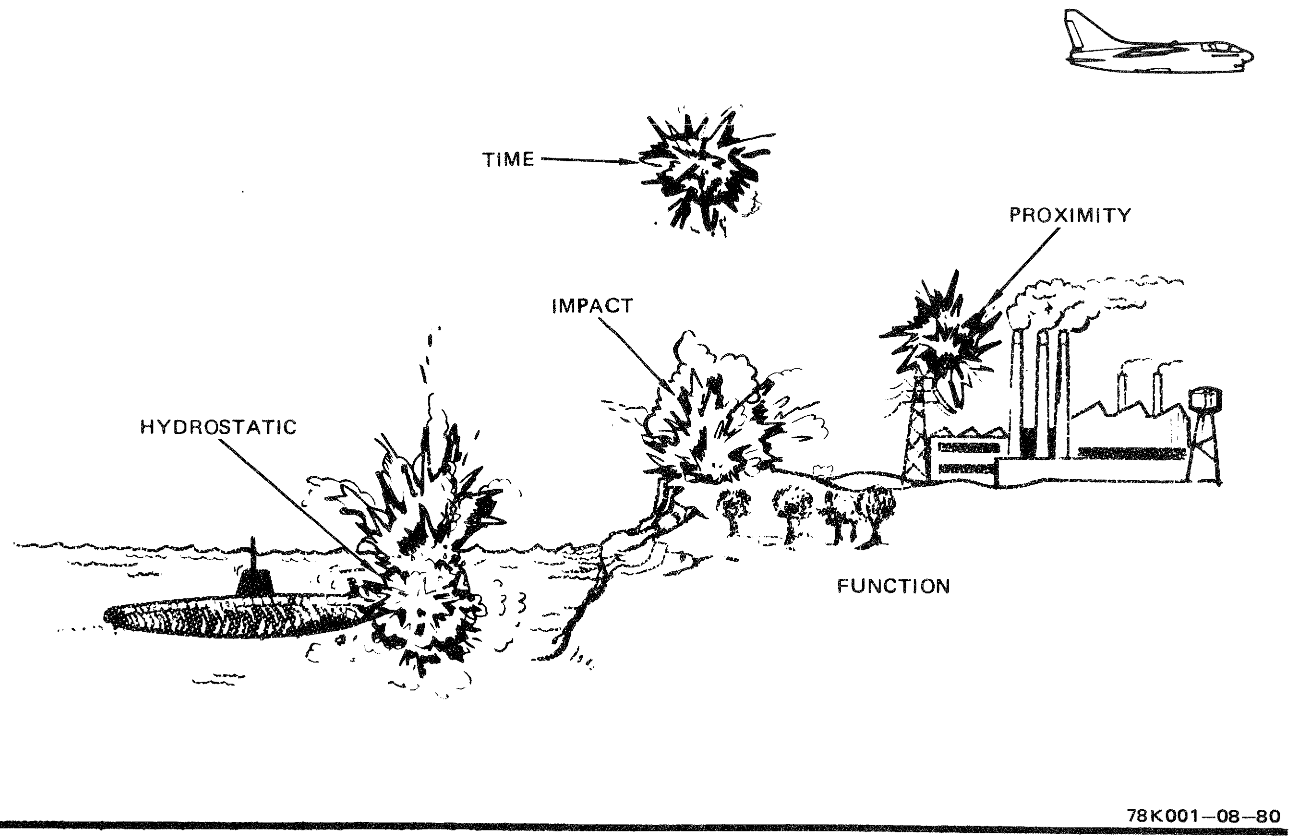


Figure 1-89

FUZE EXPLOSIVE TRAIN

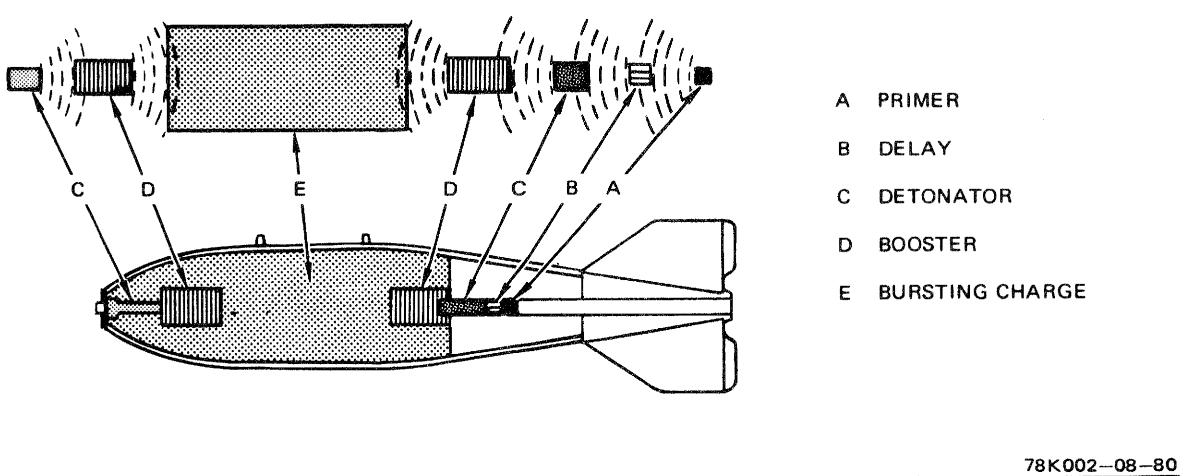


Figure 1-90

next to the detonator. This element is called the booster. The booster is sensitive enough to be exploded by the detonator and large enough so that the shock of boosted explosion detonates the bursting charge (main charge) of the bomb. Such an arrangement of elements is basic to all explosive ammunition.

Types of Explosive Trains.

The explosive train sequence, in both nose and tail fuzes, may be instantaneous or delayed action. The instantaneous sequence begins immediately upon weapon impact when the firing pin is driven into the detonator. The blast from the detonator explodes the booster, which relays and amplifies the blast causing the main charge to explode. A delayed action train allows bomb penetration of a target and permits low flying aircraft to escape bomb fragments and target debris. The delay action requires two additional components, a primer and a delay element, which are placed ahead of the detonator, booster, and main charge. The action is started as a detonation but is converted into a delaying flame by the delay element. The detonator changes the process back into a detonation which continues through the booster into the main charge.

SAFETY FEATURES.

For safety reasons, a bomb must be incapable of explosion through fuze action before it is clear of the aircraft. Fuzes are so constructed that they cannot function while unarmed. To prevent premature or accidental functioning of a fuze, a safety feature is incorporated during manufacture. The most common safety features in fuzes are detonator out-of-line and arming-stem-safe.

Detonator Out-of-Line.

A detonator out-of-line arrangement (figure 1-91) in a fuze holds one of the explosive train elements out of alignment with the other elements. For example, the detonator may be held out of line with the firing pin until the fuze is armed.

Arming Stem Safe.

A safety feature commonly found in tail fuzes is an arming stem which is screwed into the firing pin plunger. The detonator in this type of fuze is located immediately beneath the firing pin. Vane rotation during arming unscrews the arming stem from the firing pin plunger, thus freeing the plunger; an anticreep spring prevents premature movement of the plunger and firing pin due to velocity changes of the bomb during free fall.

M904 SERIES NOSE FUZE.

The M904 (figure 1-92) is a mechanical impact nose fuze commonly used with GP bombs. All fuzes in this series are similar in appearance. The desired arming time is set on a calibrated dial. The selective arming delay times for the M904E1 are 4, 6, 8, 12, 16 or 20 seconds. For the M904E2 and M904E3, selective arming delay times range from 2 to 18 seconds in 2-second increments. The fuze employs an arming vane to effect arming. The arming time is independent of release airspeed and is accomplished by the nose vane, a mechanical governor, and a constant-speed rotating gear train. Firing delay times are provided by inserting a delay element in the cavity beyond the firing pin. The delay elements are available in the following delay increments: instantaneous, 0.010, 0.025, 0.05, 0.10, and 0.25 seconds.

Safety Features.

Safety features of the fuzes include a rotor containing the detonator, which is locked out of line with the rest of the explosive train until air arming is completed, and the delay element cavity, which acts as an interrupter to the explosive train when the delay element is not installed. Fuze arm-safe indications are visible in two windows. One window is located in the fuze body and the other window is located just above the booster. In M904E1 and M904E2 fuzes, full red visible in the fuze body window indicates the striker body has moved into firing position and the fuze is armed. In M904E3 fuzes, a black A on a red background in the fuze body window gives the same indication. The other window, just above the booster, is not visible when the fuze is installed.

WARNING

If the window in the fuze body shows red (M904E1/E2) or a black A on a red background (M904E3), the fuze is unsafe and should not be touched. Call explosive ordnance disposal personnel immediately.

TYPICAL FUZE SAFETY FEATURES

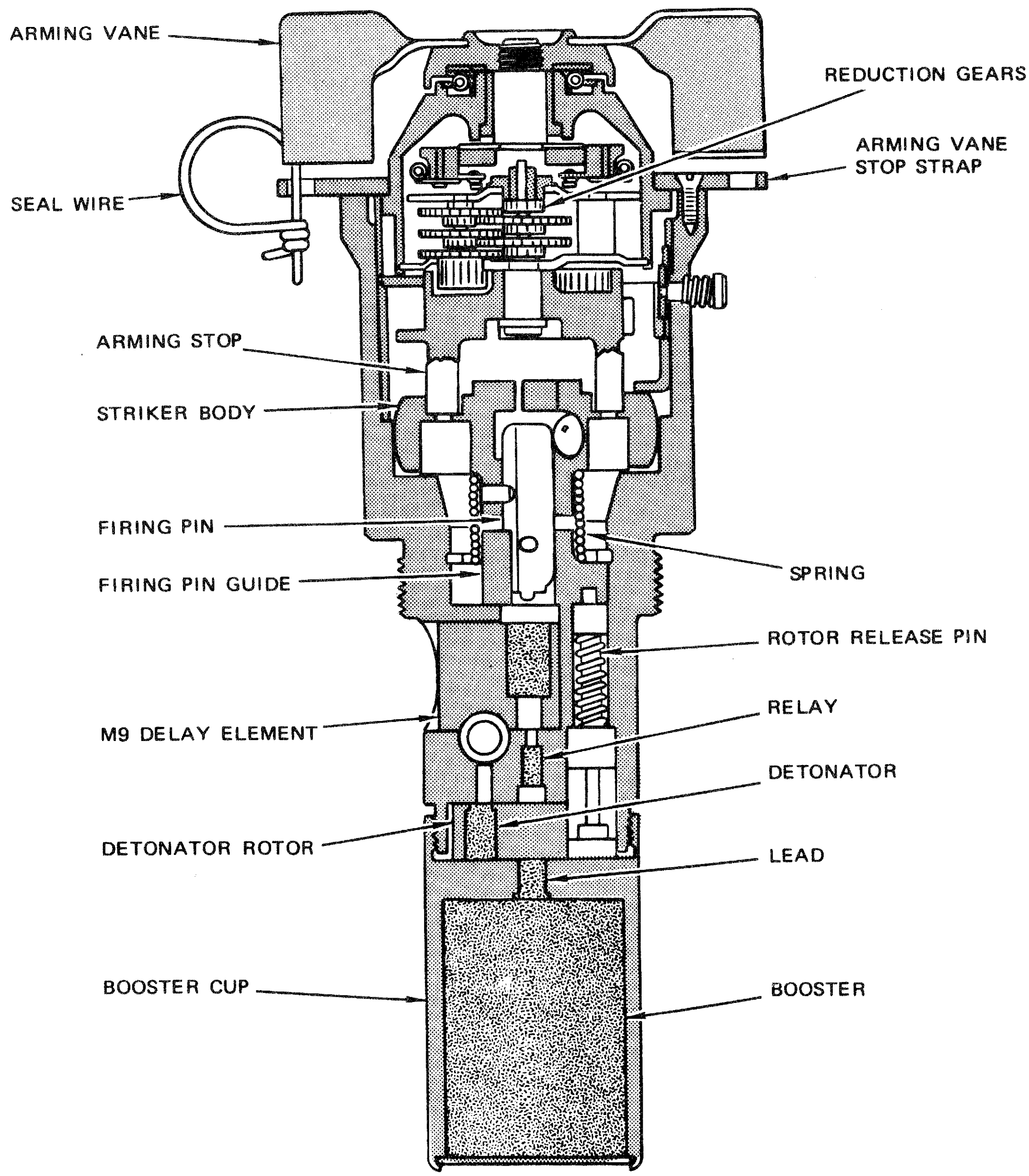


Figure 1-91

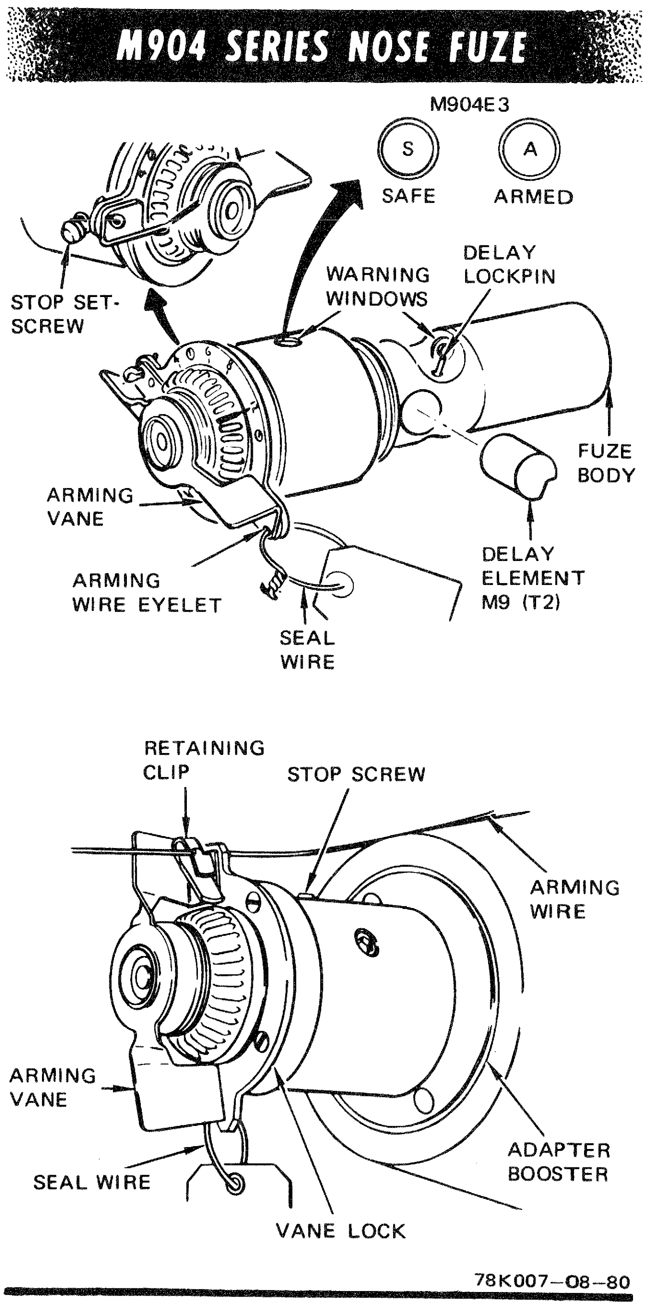


Figure 1-92

Fuze Arming.

Fuze arming begins when the bomb is released from the aircraft. The arming wire is withdrawn from the vane and the vane spins in the airstream. (Operating range is 150 to 600 knots.) Thirty revolutions equals 1 second of selected arming time. After the selected arming time has expired, the spring-loaded rotor is permitted to rotate and align the detonator with the rest of the explosive train. The rotor is locked in position and the fuze is fully armed. When the bomb impacts, the fuze nose assembly moves rearward causing the firing pin to strike the detonator, which initiates the explosive train.

WARNING

The M904E1 fuze has a manufacturing arming time tolerance of ±20%; the M904E2 and M904E3 tolerances are ±10%. The negative tolerance of the fuze must be used when determining the minimum arming separation between weapon and aircraft. The positive tolerance must be used to determine the minimum release altitude to ensure arming before impact.

M1 AND M1A1 FUZE EXTENDERS.

The fuze extension devices (figure 1-93) are physically compatible with T45 series nose adapter booster and any bomb which will accept the M904E1, E2, and E3 nose fuzes. The device consists of a burster support and a burster assembly. The burster support is a steel tube, 2.375 inches outside diameter, which has a male thread at one end for attaching to the bomb and a T45 series nose adapter booster and a female thread at the other end to receive the nose fuze. The burster assembly consists of an asphalt impregnated chipboard which has a recessed metal cap crimped to one end and a plain metal cap cemented to the other. The tube of the M1 is filled with cast tetrytol and the tube of the M1A1 is filled

M1A1 FUZE EXTENDERS

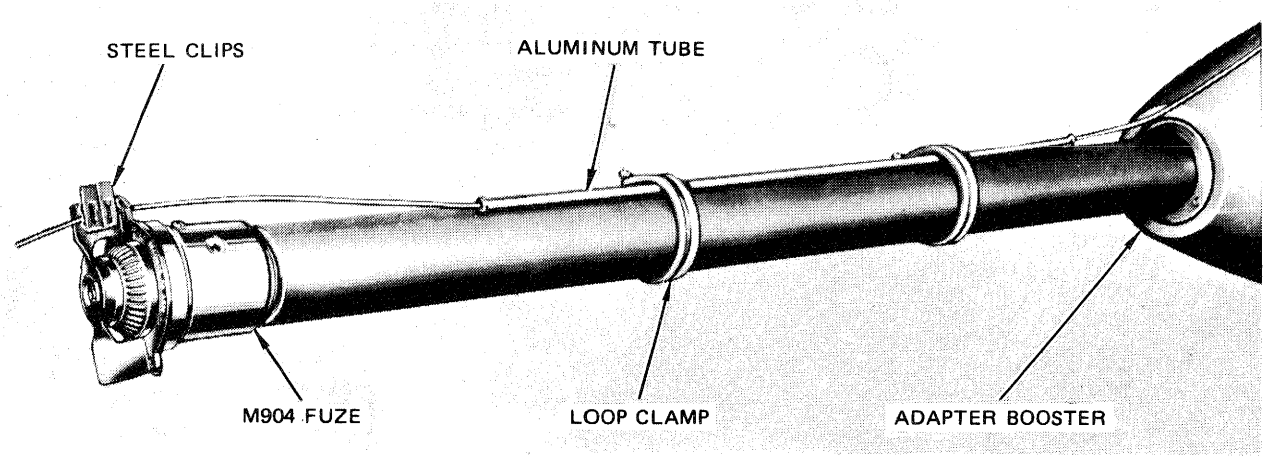


Figure 1-93

with Composition B. The overall length of the burster support is 36.72 inches, the burster assembly is 35.96 inches, and the designated size is 36 inches. The fuze extenders are authorized for use with the Mk 82, Mk 83, and Mk 84 LDGP bombs. Only the M904 fuze is recommended for use with the extenders. Fuze extenders are also available in 18-inch and 24-inch lengths.

Existing bombing table, fuze arming data and safe escape data should be used for bombs on which the fuze extenders are used. Refer to T.O. 1A-7K-1 for approved load configurations and External Store Limitations on the bombs authorized to use the fuze extenders.

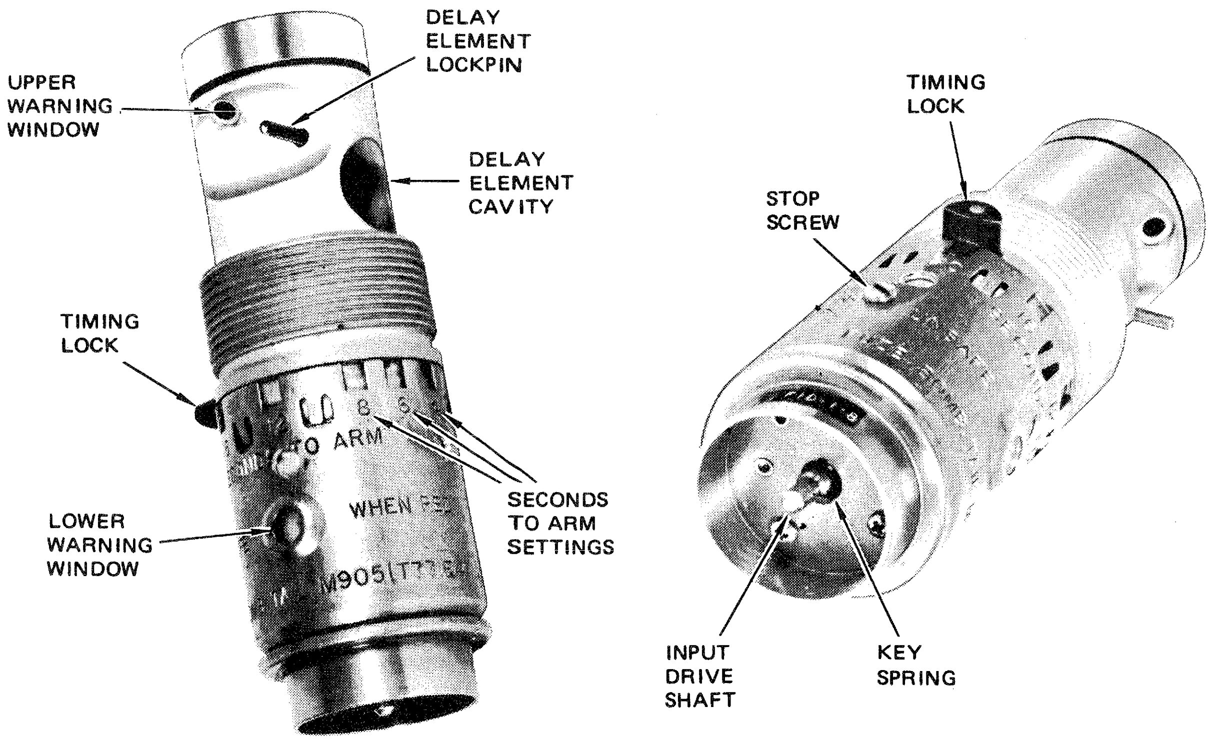
M905 TAIL FUZE.

The M905 (figure 1-94) is a mechanical impact tail fuze commonly used with GP bombs. Arming is effected by an ATU-35 arming drive assembly through a flexible shaft. Arming time is independent of release airspeed and is accomplished by the arming drive assembly, flexible shaft, mechanical governor, and constant-speed rotating gear train. The desired arming time is set on a calibrated dial with selective delay times of 4, 6, 8, 12, 16, and 20 seconds. Impact detonation delay times are provided by inserting a delay element in the cavity just beyond the firing pin. The delay elements are available in the following delay increments: instantaneous, 0.01, 0.025, 0.05, 0.10 and 0.25 second.

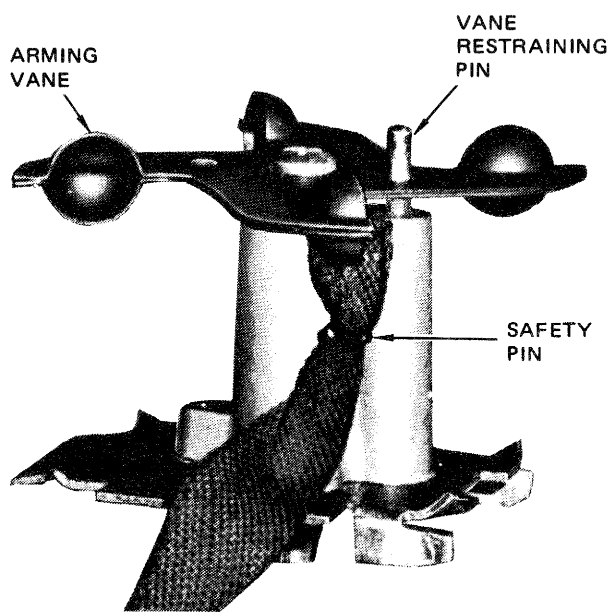
The ATU-35A/B or ATU-35B/B drive assembly is issued separately from the M905 tail fuze and is installed on the bomb during buildup or loading. The drive assembly is mounted on the tail fin assembly of Mk 82, Mk 83, Mk 84, M117, GBU-8, GBU-10, and GBU-12 bombs and comes equipped with a MAU-87/B governed coupler and a variety of flexible shafts. During loading and flight,, the drive arming vane is prevented from rotating by the vane restraining pin, which is held in place by the tail arming wire. Upon armed release, the arming wire is pulled, allowing the vane restraining pin to retract. Restraining pin retraction allows the drive arming vane to rotate, which results in arming of the M905 fuze. Flexible shaft requirements for the various bombs are as follows:

Bomb	*Shaft*
Mk 82 LDGP	MAU-86/B-5 (4 1/2-inch)
Mk 83 LDGP	MAU-86/B-6 (7 1/4-inch)
Mk 84 LDGP	MAU-86/B-3 (8 1/4-inch)
M117 Series GP	MAU-86/B-6 (7 1/4-inch)
GBU-8/B EO	MAU-86/B-3 (8 1/4-inch)
GBU-10 Series LG	MAU-86/B-3 (8 1/4-inch)
GBU-12 Series LG	MAU-86/B-5 (4 1/2 inch)
MC-1 GB	MAU-86/B-6 (7 1/4-inch)

M905 TAIL FUZE AND ATU-35 DRIVE ASSEMBLY



M905 TAIL FUZE



ATU-35 DRIVE ASSEMBLY

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Figure 1-94

Safety Features.

Safety features include a rotor containing the detonator, which is locked out of line with the rest of the explosive train until air arming is complete, and two warning windows. One window is located in the fuze body and one is just above the booster. If the fuze should accidentally become armed, the warning window in the body shows a red flag. The other window, above the booster, is not visible.

WARNING

If the window in the fuze body shows red, the fuze is unsafe and should not be touched. Call explosive ordnance disposal personnel immediately.

Fuze Arming.

Fuze arming starts when the bomb is released from the aircraft and the arming wire is withdrawn from the vane tab of the arming drive assembly. This action permits the vane tab to rotate the inner parts of the fuze (operating range of the fuze is 150 to 600 knots). After the selected arming time has expired, the firing pin is free to move in the direction of flight upon sufficient deceleration of the fuze. An anticreep spring prevents premature movement of the firing pin due to velocity changes of the bomb during freefall. At approximately the same time the firing pin arms, the rotor containing the detonator is released so that it may rotate by spring action, bringing the detonator in line with the rest of the explosive train. A detent locks the rotor in the armed position and the fuze is then armed. When the bomb impacts on target, the inertia generated by the bomb impact causes the firing pin assembly to move forward and strike the primer in the delay element, thus initiating the explosive train.

WARNING

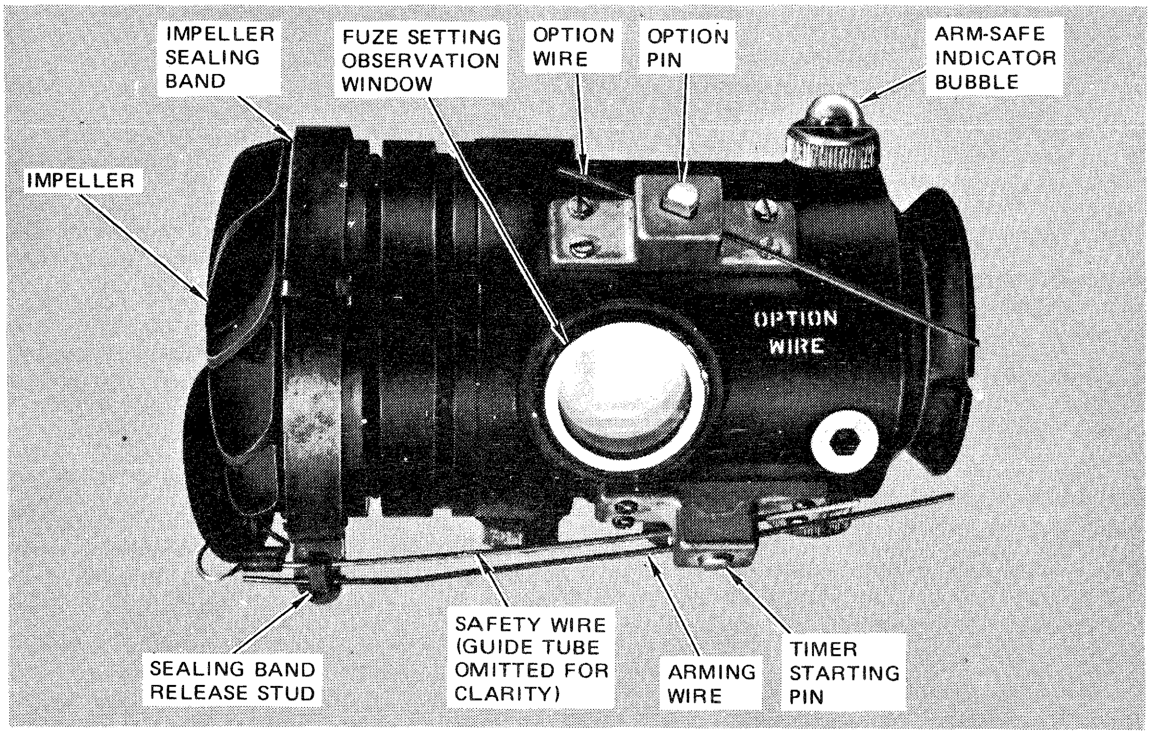
The M905 fuze has a manufacturing arming time tolerance of ±20%. The negative tolerance of the fuze must be used when determining the minimum arming separation between weapon and aircraft. The positive tolerance must be used to determine the minimum release altitude to ensure arming before impact.

MK 339 MOD 0 NOSE FUZE.

The Mk 339 Mod 0 nose fuze (figure 1-95) is an air armed mechanical time fuze designed for use with bomb type dispenser munitions, and installed in the Mk 20 Rockeye II munition during manufacture. The fuze has a fixed arming time of 1.1 (±0.1) seconds which starts upon removal of the fuze arming wire. The fuze arming wire passes through a timer starting pin and impeller sealing band release stud. With the arming wire installed, the timer starting pin prevents timer rundown and the sealing band prevents impeller (arming vane) rotation. The fuze incorporates a SAFE/ARM indicator, which is visible through a window in the upper half of the Rockeye nose fairing. This indicator is a clear plastic bubble which extends from the case of the fuze. On later models of the fuze, the base of the bubble is covered by a green foil disc. When the fuze is safe, the bubble is empty and, on later models, the green foil is visible and intact. When the fuze is armed, an indicator pin with a black tip and a red flat surface extends from the fuze into the bubble.

The fuze has two selectable functioning times, primary and option, with a setting range of 1.2 to 50 seconds in 0.1-second increments for each functioning time. The function timers are accurate to within ±0.1 seconds for settings from 1.2 to 10.0 seconds and 1% of all settings above 10.0 seconds. Any setting within the above range may be selected for either functioning time with no restrictions. The time used by the fuze is determined by the position of the fuze option pin. The option pin is normally held depressed by an option wire which is installed at the time of manufacture. With the option wire installed and the option pin depressed, the fuze will function at the expiration of the selected primary time. When the option wire is pulled, allowing the option pin to extend, the fuze will function at the expiration of the selected option time. Once the option wire has been removed, it cannot be reinstalled and the fuze is committed to the option time setting. The fuze settings are preset at the time of manufacture to 1.2 seconds for primary and 4.0 seconds for option.

MK 339 MOD 0 NOSE FUZE



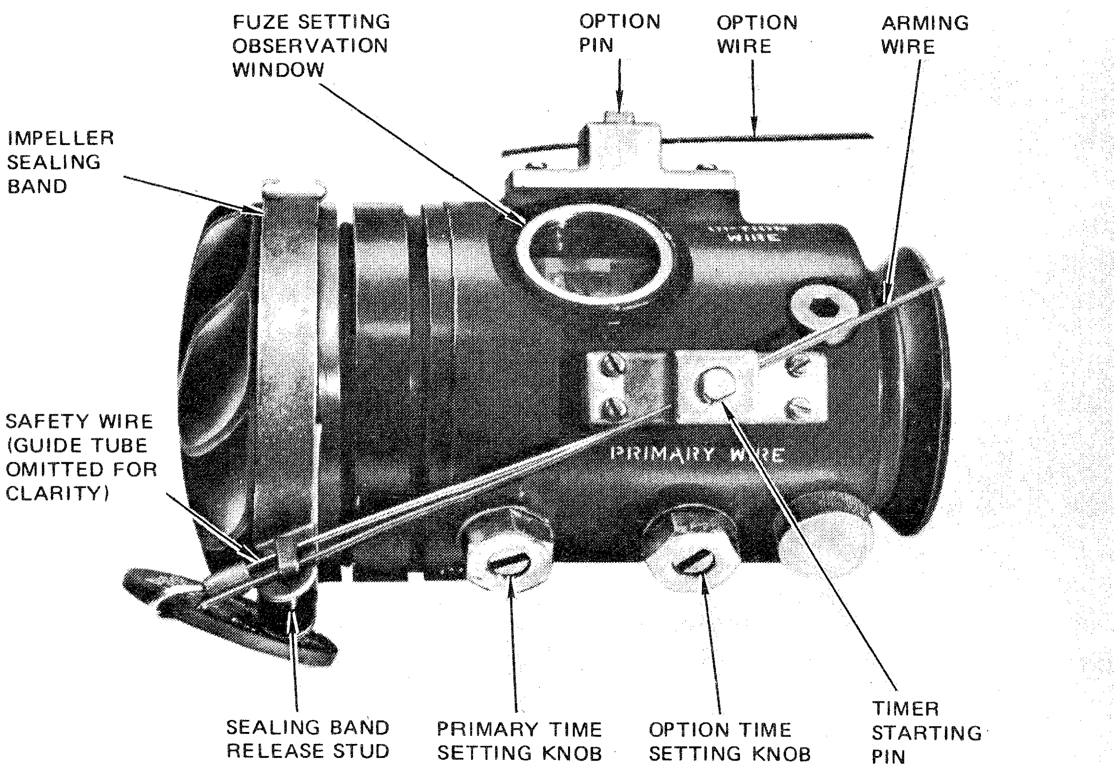


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Figure 1-95

At the time of installation into the Mk 20 Mod 2 Rockeye II, the Mk 339 fuze option wire is removed, disabling the fuze primary time capability. However, the fuze option time capability and settings are not affected. When installed in the Mk 20 Mod 3 and Mk 20 Mod 4 Rockeye II, the munition is configured with an option wire for the fuze, allowing utilization of either the primary or option time setting, at the pilot's discretion. The pilot selects the time to be used by pulling or not pulling the option wire at weapon release.

The Mk 20 Mod 4 munition differs from the Mod 3 in that the submunition will arm 0.5 second after cluster opening. Rockeye ballistic tables currently published in T.O. 1A-7K-34-1-2 are applicable to Mk 20 Mod 2, Mod 3, and Mod 4 munitions. For some of the slower release speed conditions, the aircraft will not be clear of the submunition fragmentation envelope (at submunition fuze arming) when the Mk 20 Mod 4 is released with a 1.2-second function time setting. The following table lists the release conditions where Mk 339 fuze function time settings greater than 1.2 seconds are required to assure that the aircraft is clear of the submunition fragmentation envelope at fuze arming. These values assume that, for the 1.2-second cluster opening time, the submunition could arm 1.5 seconds after Mk 20 Mod 4 separation from the aircraft.

Release KTAS	*Mk 339 Function Time Setting (sec)*
Level Release — Straight and Level Escape Maneuver	
350	2.6
400	2.0
450	1.5
500 and Above	1.2 minimum
Dive Release — 4G Recovery Escape Maneuver	
350	1.8
400	1.8
450 and Above	1.2 minimum

M907E1/E2 MECHANICAL TIME FUZE.

NOTE

The M907E1/E2 fuze is compatible with the SUU-30B/B and SUU-30H/B dispensers but is not reliable.

The M907E1/E2 mechanical time fuze (figure 1-96) is commonly used for airburst functioning of SUU-30 series bomb type clamshell dispensers. The desired function time is set on a calibrated dial on the fuze body. The M907E1 may be set from 4 to 92 seconds at 1/2-second intervals. The M907E2 may be set from 3 to 92 seconds at 1/2-second intervals. There is a functioning tolerance of ±1 second when the function time is set below 45 seconds. At settings above 45 seconds the tolerance is ±1.5 seconds.

The fuze employs a four-bladed vane to effect arming. The arming time is independent of release airspeed and is accomplished by the arming vane, a mechanical governor, and a constant speed rotating gear train. Arming time is automatically determined as one-half the function time when the function time is greater than 10 seconds. For function times less than 10 seconds but not the minimum, arming time is at least one-half the function time. For M907E1, with 4-second function time selected, the arming time is 1.5 seconds after release. For M907E2 with 3-second function time selected, arming time is 1 second after release. Delivery airspeeds encompass a range of 100 to 600 KTAS; however, the fuze is more reliable at speeds above 175 KTAS.

Safety Features.

Safety features include a slider detonator block containing the detonator, which is locked out of line with the rest of the explosive train until arming time is complete, and an arming pin, which prevents functioning of the timing mechanism and locks the firing pin in position, blocking movement of the slider detonator block. The arming pin is spring ejected when the arming wire is pulled during weapon release. The fuze has two visual safety indicators. The aluminum foil disk in the fuze body indicates the fuze is safe if the disk is intact and the brass slider assembly is not visible. A warning window above the foil disk indicates the fuze is safe when the head of the arming stem is positioned under the arming disk.

M907E1/E2 NOSE FUZE

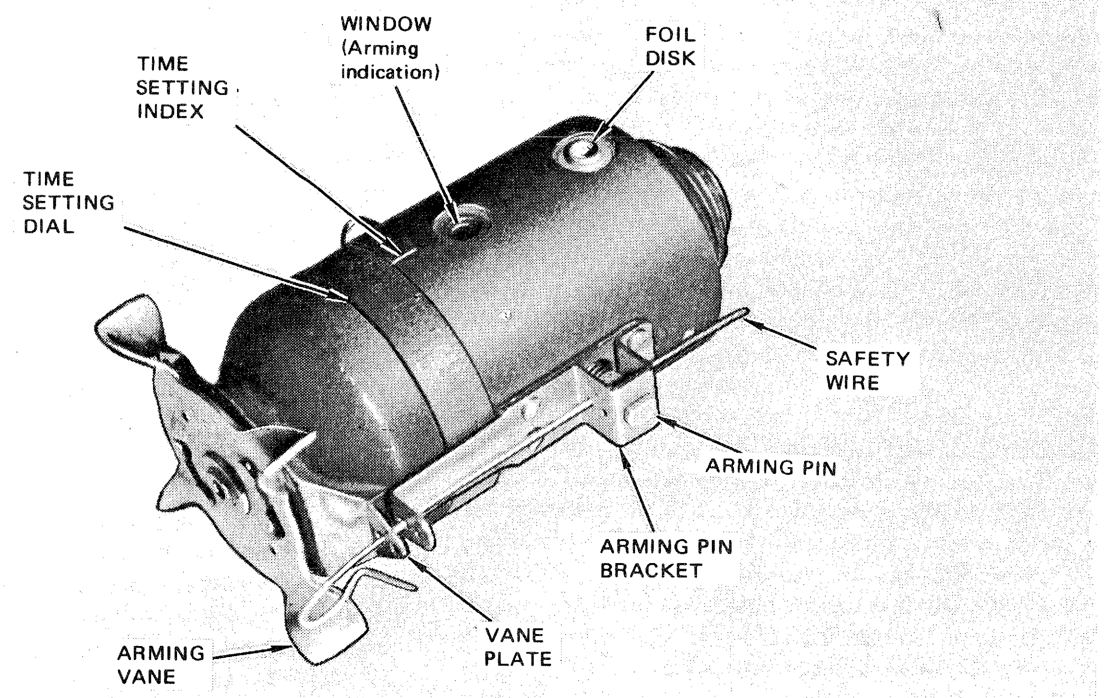


Figure 1-96

FMU-26A/B FUZE.

The FMU-26A/B fuze (figure 1-97) is an electric fuze powered by an internal thermal battery. The fuze is used as a nose fuze in bomb type dispensers and provides an airburst to open the dispenser. The fuze is cylindrically shaped and is approximately 3 inches in diameter and 6.5 inches in length.

The thermal battery is initiated by a Battery Firing Device (BFD) which runs from the fuze well, through a swivel and link, and is secured to the dispenser. During loading, the swivel and link is installed in the bomb rack arming solenoid.

When a dispenser containing an FMU-26A/B fuze is released armed, the arming solenoid holds the swivel and link which remains with the bomb rack as the BFD is withdrawn through the swivel and link. The BFD remains attached to the dispenser. This action cocks and releases the firing pin, which initiates the thermal battery in the fuze.

The thermal battery provides the electrical power for fuze operation. The fuze timing circuitry provides an arming signal at the preset arming time. This arming signal is used to arm the fuze, that is to rotate the detonator from the out-of-line position to the in-line or firing position. The fuze timing circuitry then provides the firing (final event) signal at the preset time for airburst function.

The event and arm times are set into the fuze with an Allen wrench and are displayed in the windows on the face of the fuze. The safe pin locks the fuze rotor in the out-of-line position until after the fuze is installed in the bomb. Before departure of the loaded aircraft from the loading area, the safe pin is removed from the fuze and replaced with the seal pin. The seal pin prevents entry of moisture into the fuze.

The aft end of the fuze (the booster end) has a pie-shaped section to accept a booster. Two kinds of boosters are available: a 5-gram M5 propellant booster (FZU-1/B booster) which is secured to the fuze by a metal bracket, and a 45-gram RDX booster (FZU-2/B) which is not used with the FMU-26A/B. The bracket is also used to activate the airburst mode. The aft end of the fuze also has a safe plug and a safety switch. The safe plug is in the fuze only during shipping and handling, and is removed prior to installation of the fuze into the dispenser. The battery firing device is installed in the cavity vacated by the safe plug.

The fuze safety switch has three positions: RED, GREEN (normal), and BLUE (airburst). The BLUE position can be selected only when the FZU-1/B (airburst) booster is installed. The FZU-1/B booster has a metal bracket which holds the spring-loaded safety switch in the BLUE position. When the FZU-1/B booster and its bracket are removed, the safety switch will spring to the GREEN position. The airburst mode is inoperative when the safety switch is not in the BLUE position. If the fuze selector switch is set in the airburst mode, but the safety switch is not set in the BLUE position, the fuze will not detonate airburst, but will detonate at impact through the airburst backup circuit.

FMU-26B/B FUZE.

The FMU-26B/B fuze (figure 1-97) is an electric fuze powered by an internal thermal battery. It is used as a nose or tail fuze and provides airburst or impact initiated burst. The airburst mode is intended for use only with bomb type dispensers. This fuze is cylindrically shaped and is approximately 3 inches in diameter and 6.5 inches in length. It is compatible with bombs that have internal plumbing (required to route the arming lanyard) and the standard 3-inch fuze wells (nose and tail) which include the M117, Mk82, Mk83, and Mk 84 LDGP bombs.

For bombs, the arming lanyard is routed from the charging well of the bomb through the internal plumbing of the bomb to a battery firing device which is attached to the fuze in the nose or tail fuze well. The free end of the arming lanyard, which is protruding from the charging well of the bomb, is routed through a swivel and link and then into a lanyard lock which is installed in the charging well and secured by a lanyard locknut. When the bomb is loaded on the bomb rack, the swivel and link is installed in the bomb rack arming solenoid.

When a bomb containing an FMU-26B/B fuze is released armed, the arming solenoid holds the swivel and link which remains with the bomb rack as the arming lanyard is withdrawn through the swivel and link. The arming lanyard remains attached to the bomb by the lanyard lock. This action cocks and releases the firing pin, which initiates the thermal battery in the fuze.

The thermal battery provides the electrical power for fuze operation. The fuze timing circuitry provides an arming signal at the preset arming time. This arming signal is used to arm the fuze, that is, to rotate the detonator from the out-of-line position to the in-line or firing position. The fuze timing circuitry then provides the firing (final event) signal at impact or the preset time for airburst function.

The event and arm times are set into the fuze with an Allen wrench and are displayed in the windows on the face of the fuze. The safe pin locks the fuze rotor in the out-of-line position until after the fuze is installed in the bomb. Before departure of the loaded aircraft from the loading area, the safe pin is removed from the fuze and replaced with the seal pin. The seal pin prevents entry of moisture into the fuze.

The aft end of the fuze (the booster end) has a pie-shaped section to accept a booster. Two kinds of boosters are used: a 45-gram RDX booster (FZU-2/B booster) which is secured to the fuze by tape, and a 5-gram M5 propellant booster (FZU-1/B booster) which is secured to the fuze by a metal bracket. The bracket is also used to activate the airburst mode. The aft end of the fuze also has a safe plug and a safety switch. The safe plug is in the fuze only during shipping and handling, and is removed prior to installation of the fuze into the bomb. The battery firing device is installed in the cavity vacated by the safe plug.

When the fuze is used with bomb type dispensers, the FZU-1/B (airburst) booster is used. The lanyard lock, the lanyard locknut, and the FZU-2/B booster are not used in dispensers. When the fuze is used in high explosive bombs, the FZU-2/B booster, lanyard lock, and lanyard locknut are used.

The fuze safety switch has three positions: RED, GREEN (normal), and BLUE (airburst). The GREEN (normal) position keeps the firing circuit to the detonator disabled for approximately 6.6 seconds after bomb release. The safety switch should be kept in the GREEN position for all short delay (dive mode) settings except when operational delivery conditions are such that the

FMU-26A/B AND FMU-26B/B FUZES

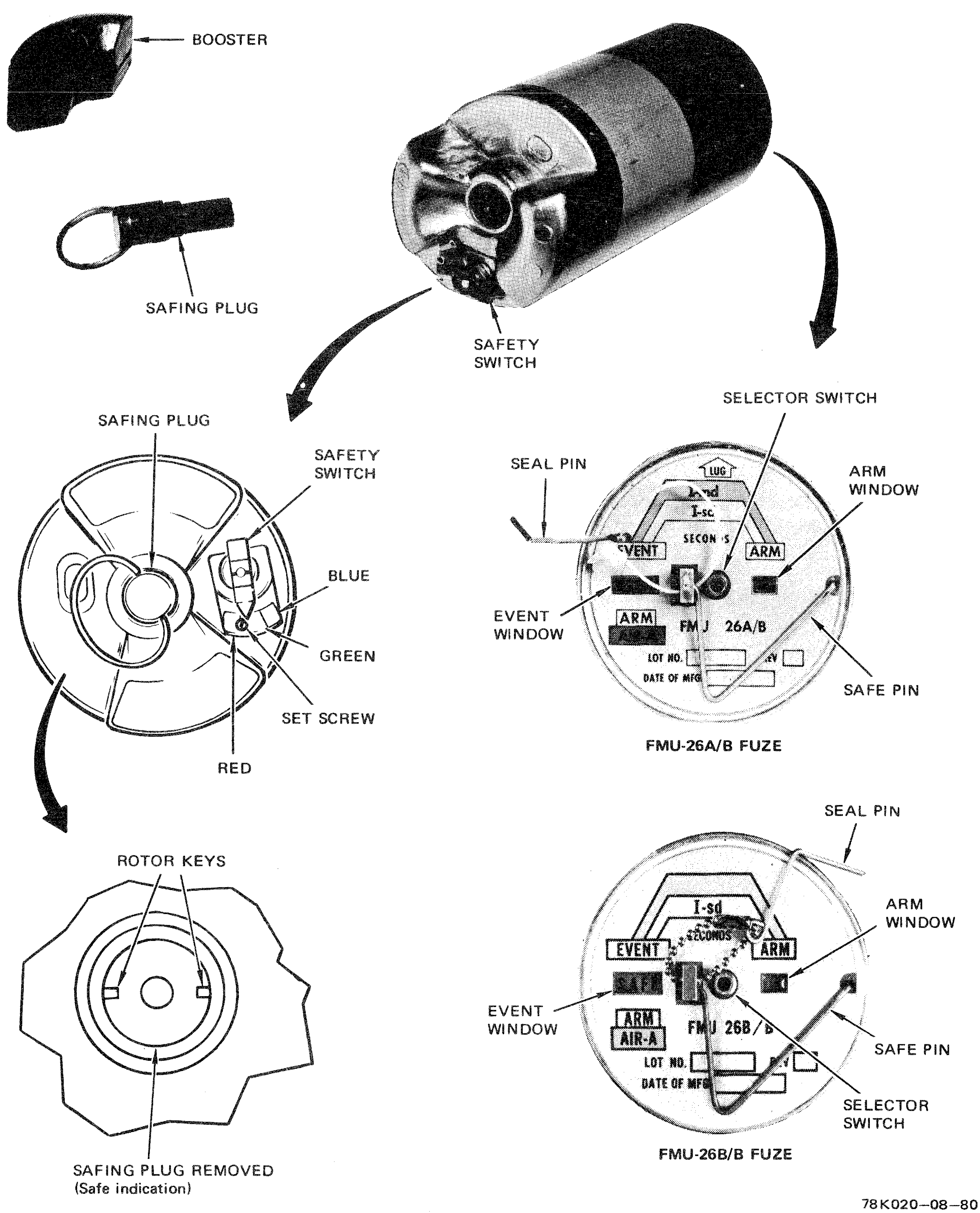


Figure 1-97

time from bomb release to impact will be less than 6.6 seconds. For release conditions where the bomb time of fall is less than 6.6 seconds, the safety switch must be set in the RED position to ensure the fuze is armed at impact. The BLUE position can be selected only when the FZU-1/B (airburst) booster is installed. The FZU-1/B booster has a metal bracket which holds the spring-loaded safety switch in the BLUE position. When the FZU-1/B booster and its bracket are removed, the safety switch will spring to the GREEN position. The airburst mode is inoperative when the safety switch is not in the BLUE position. If the fuze selector switch is set in the airburst mode, but the safety switch is not set in the BLUE position, the fuze will not detonate airburst, but will detonate at impact through the airburst backup circuit.

CAUTION

Whether the fuze safety switch is set in the RED position or the GREEN position, the minimum release altitude, or vertical drop required for safe escape, must be carefully observed as specified in the appropriate minimum release altitude/fuze arming time tables.

NOTE

The arming time tolerance for the short delay mode is ±0.300 second. With this mode, the minimum allowable bomb time of flight (to prevent duds) will be the arming delay setting plus 0.300 second. The fuze contains a safing device which duds the fuze if impact occurs prior to arming.

When used in high explosive bombs, the fuze can be used more advantageously in the nose fuze well. Nose installation permits easier access for inspection by the aircrew and for changes of arming and event time settings if such changes are required after initial loading. The inspection and changes can be done if the nose plug is removed. If the tail fuze well is used, the initial fuze settings are most easily accomplished before the fuze is installed in the bomb. After fuze installation, settings are most easily accomplished with the bomb tail fin removed. Changes in tail fuze settings require removal of the fuze from the bomb, or removal of the tail fin and fuze nose plug.

FMU-54/B TAIL FUZE.

The FMU-54/B fuze (figure 1-98) is a mechanically-operated retardation sensing device with a predetermined arming delay of 0.75 to 3.50 seconds, selectable in 0.25-second intervals. The fuze is only for the tail fuze well of bombs equipped with high-drag (retardation) fins and is not visible when installed.

Fuze Arming.

Upon retarded bomb release, the opened fin causes rapid deceleration of the bomb, initiates the fuze arming cycle, and provides a safe escape distance from delivery aircraft. In the event of fin malfunction, the fuze is not armed. A properly armed fuze detonates upon impact when a g force releases the spring-loaded firing pin. The fuze is mechanically initiated by a lanyard connected to the rack. As the bomb falls away, the lanyard pulls the fuze lanyard engaging shaft, thus releasing the fuze components to operate if proper retardation is experienced. The lanyard assembly is routed so that the lanyard goes with the bomb after performing its designed function.

Safe Escape Criteria.

Safe escape criteria must be observed in the selection of FMU-54/B arming delay settings. Even though the fuze arming delay can be set to a value as low as 0.75 second, a minimum setting of 2.5 seconds is recommended to assure safe escape during low level operations. Considering the Snakeye I opening time, this would require the selection of release conditions to provide a minimum bomb time of flight of 2.8 seconds.

NOTE

The fuze type and arming delay setting should be recorded on the side of the bomb or on a red warning tag attached to the bomb. This should be checked during pilot preflight of the aircraft.

Since the fuze settings are not visible to the pilot for inspection, the munitions handling and loading personnel must be carefully briefed on recording the required data.

FMU-54/B TAIL FUZE

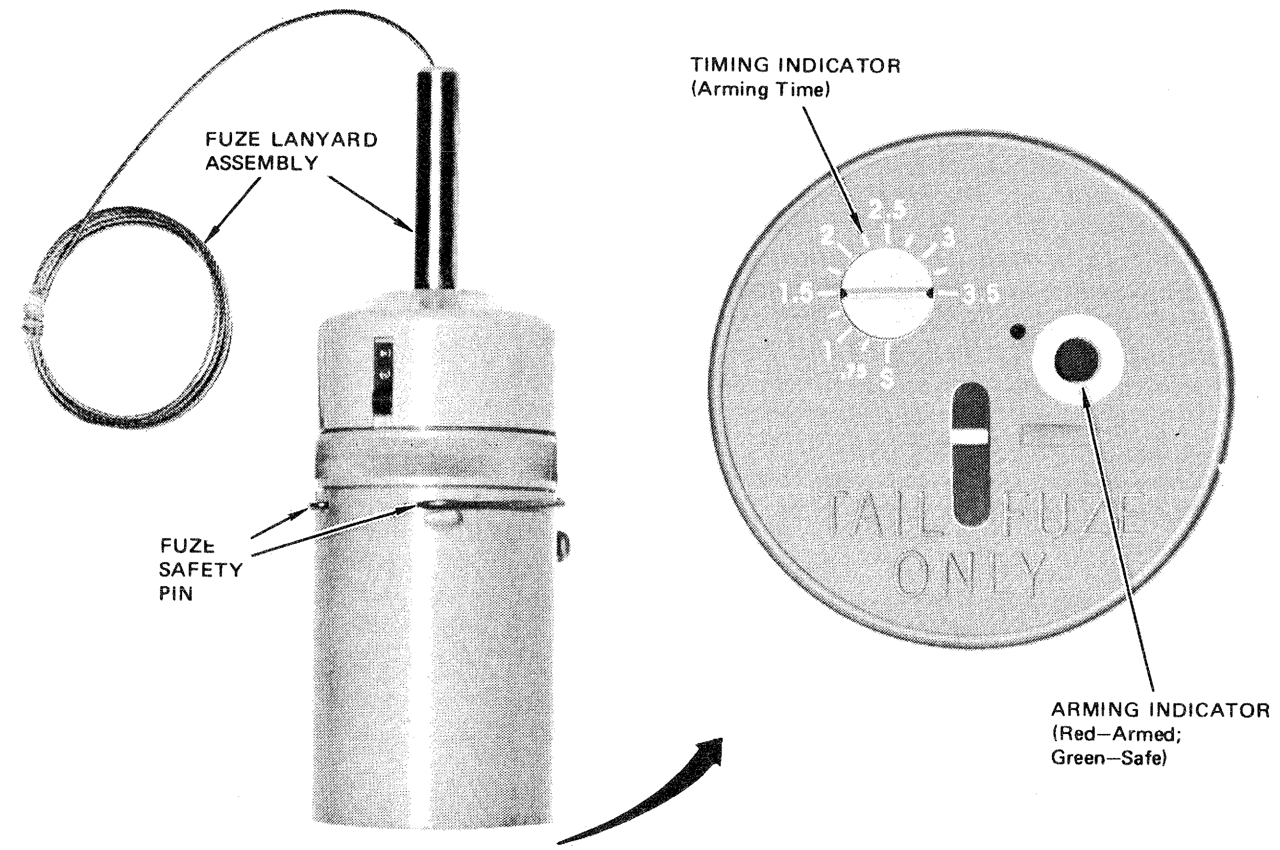


Figure 1-98

FMU-54A/B TAIL FUZE.

The FMU-54A/B is a modified version of the FMU-54/B. The major differences between the FMU-54/B and FMU-54A/B fuzes are in the selectable safe separation times and in the provisions in the FMU-54A/B to be used in conjunction with a Mk 43 Target Detecting Device (TDD).

The fuze fits into the tail fuze well of a Mk 82 bomb equipped with a high-drag (retardation) fin. A safe-separation timer provides ground-settable delays of from 2.50 to 6.00 seconds, settable in 0.25-second intervals.

The FMU-54A/B fuze can be used either alone or in conjunction with a Mk 43 (TDD). The primary function of the FMU-54A/B fuze and TDD is to detonate the bomb, upon receipt of a firing signal from the TDD, prior to ground impact, but after safe separation of the bomb from the releasing aircraft. However, if the TDD is not used or does not provide a firing signal, the fuze will detonate the bomb upon ground impact.

A bomb fuzed with the FMU-54A/B will function as follows upon armed release from an aircraft:

When the cord assembly that is attached to the arming solenoid stretches to its elastic limit the swivel and link assembly fails, allowing the lanyard to retract into the internal plumbing and fall with the bomb, thus initiating the fuze arming cycle. The D ring of the swivel and link assembly remains with the aircraft.

The fin release pin is then withdrawn from the fin retaining band latch.

When the fin drag plates open, an arming wire attached to one drag plate is withdrawn from the striker rod in the Mk 43 TDD. The fin drag plates provide stability and deceleration during bomb descent.

Sustained retardation of 4 g's for 0.6 second causes the retardation sensor in the fuze to complete the sensing cycle and start mechanical timing sequence of 2.5 to 6.0 seconds arming time. At the end of the preset arming delay, the rotor release shaft permits the spring-loaded rotor to move so that the detonator in the rotor is in line with the firing pin and the explosive lead in the fuze housing. The electrical detonator in the rotor is also in contact with the electrical leads to the Mk 43 TDD. When the rotor is in line, the fuze is fully armed.

The Mk 43 TDD is initiated by withdrawal of the arming wire from the striker rod. The spring-loaded striker rod ignites the thermal battery through an electric pyrotechnic match. The thermal battery reaches its operating voltage in approximately 2 seconds. As the bomb approaches the target, the interaction between the emitted and reflected radio frequency energy causes a doppler signal to appear at the oscillator detector. This signal is then applied to the target signal amplifier to be amplified sufficiently to trigger the thyratron in the firing circuit. Energy is thus applied to the electric detonator in the FMU-54A/B fuze and the bomb detonates.

If the FMU-54A/B fuze is used alone or the Mk 43 TDD fails to function, upon ground impact the spring-loaded firing pin initiates the detonator, which causes bomb detonation.

MK 43 TARGET DETECTING DEVICE.

The Mk 43 Target Detecting Device (TDD) is an electronic proximity sensor that provides an electrical signal to detonate a FMU-54A/B fuze. The TDD fits into the nose fuze well of the Mk 82 series bomb. The TDD contains no explosive components. The nominal function height for the Mk 43 TDD is 16 feet. The Mk 43 TDD cannot be used with any fuze other than the FMU-54A/B.

The Mk 43 TDD consists of a cylindrical metal body with a dark green plastic nose cone attached to the forward end. The battery initiating striker rod protrudes from the nose cone. This spring-loaded striker rod is held in place by a safety clip. A receptacle for an electrical connection is located at the rear of the cylindrical body.

The Mk 43 TDD is initiated by withdrawal of the arming wire from the striker rod. This occurs when the high drag fin is deployed shortly after release of bomb from aircraft. The spring-loaded striker rod ignites the thermal battery through an electric pyrotechnic match. The thermal battery reaches its operating voltage in approximately 2 seconds. The target signal amplifier output is fed to the radio frequency oscillator detector where pulsed radio frequency energy is radiated outward in a lobol pattern. As the bomb approaches the target, the interaction between the emitted and reflected radio frequency energy causes a Doppler signal to appear at the oscillator detector. This signal is then applied to the target signal amplifier to be amplified sufficiently to trigger the thyratron in the firing circuit. Energy is then applied to the electric detonator in the bomb fuze which detonates the bomb.

FMU-56 SERIES PROXIMITY FUZES.

The FMU-56 series fuzes (figure 1-99) are self-powered Doppler radar proximity fuzes used to open SUU-30 series bomb type clamshell dispensers. The fuze has provisions for selection of fuze arming time and height above the ground for fuze functioning (height of burst) and for selecting an electronic countermeasures mode.

ECM Mode of Operation.

The ECM mode of operation is incorporated into the FMU-56A/B, FMU-56B/B, and FMU-56D/B proximity fuzes to provide a backup function 2.0 (±0.5) seconds after expiration of the safe arming time (SST). This mode provides fuze function if the fuze sees an electromagnetic environment sufficient to mask the radar return.

The ECM mode of operation is selectable at the antenna support collar by the ECM switch with positions ON and OFF. This switch is set during manufacture in the ECM ON position and is restrained in that position by a spring lever. The SST tolerance is the same for all FMU-56 fuzes (±10% of the preset value or ±0.5 second,

FMU-56B/B AND FMU-56D/B FUZE

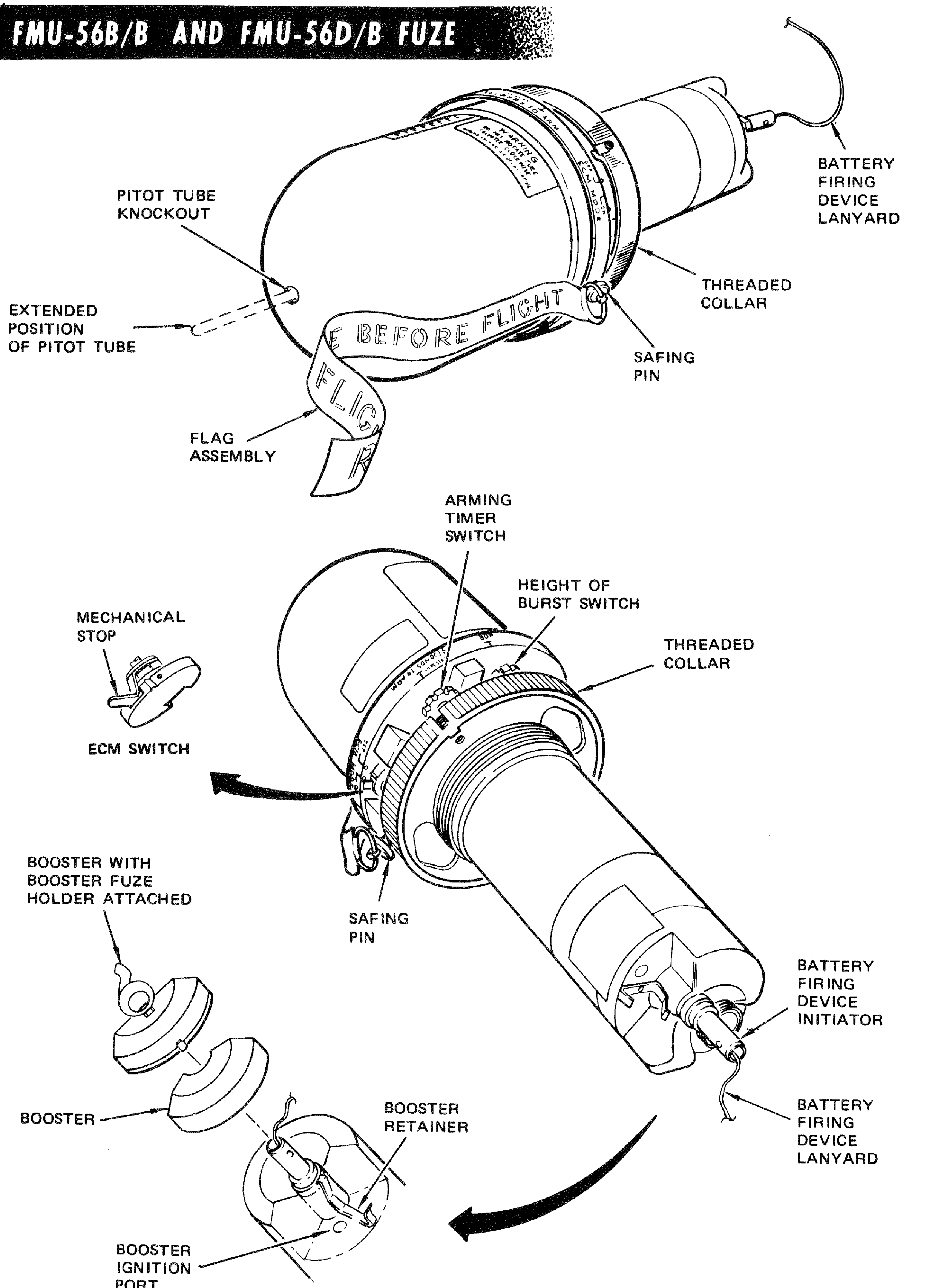


Figure 1-99

whichever is greater). For mission planning purposes where FMU-56A/B, FMU-56B/B or FMU-56D/B fuzed munitions are involved, the SST plus ECM tolerances should be considered cumulative. For example:

1. SST 3.0 (±0.5) seconds
2. ECM 2.0 (±0.5) seconds
3. Function 5.0 (± 1.0) seconds

In this case, if the fuze senses an ECM environment, the fuze would be expected to function between 4.0 and 6.0 seconds after release. In this type environment, function somewhere near the desired time/altitude might be obtained if the fuze SST were set at a value approximately 2 seconds less than the time of flight from release to function.

NOTE

If this procedure is used, the preplanned attack conditions must be closely executed to assure that the SST expires not only prior to, but near, the selected function altitude.

FMU-56B/B PROXIMITY FUZE.

The FMU-56B/B has ten settings for height of burst and ten settings for arming time. Refer to the following table for height-of-burst (HOB) settings. Each fuze has height of burst and arming time codes painted on the fuze. The fuze has a pitot tube which extends after weapons release for velocity sensing.

FMU-56B/B Height-of-Burst (HOB) Settings

HOB Switch Position	*Altitude Setting (Feet)*
A	250
B	500
C	800
D	1,100
E	1,500
F	1,800

FMU-56B/B Height-of-Burst (HOB) Settings (continued)

HOB Switch Position	*Altitude Setting (Feet)*
G	2,000
H	2,200
J	2,500
K	3,000

The FMU-56B/B fuze assembly consists of the fuze subassembly and the fuze booster. The fuze subassembly is constructed in two cylindrically shaped sections. The smaller section fits into the fuze well of the dispenser. The fuze subassembly contains the Doppler ranging radar, thermal battery, and safing and arming device. The fuze subassembly is equipped with a safing pin which is removed before flight. The safing plug found in earlier models of the fuze has been replaced with an integral battery firing device which cannot be removed and replaced in the field. The rear end of the small section has a pie-shaped cutout with a metal retainer clip which holds the fuze booster.

The fuze booster contains 5 grams of M5 propellant in a metal container topped by a foam filler. Detonation of the booster causes the nose cap of the cluster bomb to separate.

Fuze Arming.

After the CBU is released from the aircraft, the battery firing device is activated when the lanyard is pulled. The firing pin of the battery firing device initiator strikes the battery primer, igniting the battery which applies power to the fuze circuitry and starts the arming timer. The arming timer runs for the preset time. At the end of the preset time the fuze arms, provided the velocity sensor switch is closed.

When energized, the radar circuitry of the fuze is continually checking the CBU's height above the ground and the vertical component of its velocity with respect to the ground. The height above the ground is measured by determining the time required for the radar pulse to reach the ground and return to the fuze. The closing velocity of the CBU is determined from the amount of Doppler shift in the returned signal with respect to the internal reference oscillator in the fuze. When the height above ground, as measured by the fuze, is the same as the preset height of burst, and the closing velocity of the munition is greater than a predetermined minimum value, the detonator fires through the booster ignition port of the fuze housing to detonate the booster. Detonation of the booster pushes the FMU-56 series fuze and the CBU nose cap out of the CBU cannister, allowing the CBU to separate into two pieces and disperse the payload.

Safety Features.

To arm the FMU-56B/B fuze, the following sequence of events must occur:

The battery must be ignited.

The safing pin which disconnects the timer from the battery and shorts the battery output must be removed.

The arming timer selector switch must be set to a position other than 0.

Airflow sensed by the pitot tube at the expiration of safe separation time must exceed 150 knots.

If the battery is ignited while the safing pin is installed, the battery is shorted to ground, causing discharge.

When the arming timer switch is set to 0, the safe separation timer does not run and the safing and arming device cannot receive an ARM signal and remains in the SAFE position. When the velocity of air sensed at the pitot tube is less than 150 knots, the switch remains open, breaking the arm circuit to the safing and arming device.

NOTE

Since the fuze height of burst and arming time selector switch positions are set by the load crew, the munitions handling and loading personnel must be carefully briefed on the required settings.

FMU-56D/B PROXIMITY FUZE.

The FMU-56D/B fuze (figure 1-99) is a self-powered Doppler radar proximity fuze used to open SUU-30 series bomb type clamshell dispensers. The fuze has provisions for selection of fuze arming time, height above the ground for fuze functioning (height of burst), and electronic countermeasures mode. Refer to the following table for the coded height of burst settings. These coded settings, along with the arming time coded settings, are also painted on each fuze.

FMU-56D/B Height-of-Burst (HOB) Settings

HOB Switch Position	*Altitude Setting (Feet)*
A	250
B	500
C	800
D	1,100
E	1,500
F	1,800
G	2,000
H	2,200
J	2,500
K	3,000

The fuze assembly consists of the fuze subassembly and the fuze booster. The fuze subassembly is constructed in two cylindrically shaped sections. The forward and larger section contains the Doppler ranging radar and the safing and arming device. The aft and smaller section contains the battery firing device (BFD) and the thermal battery. The rear end of the small section has a pie-shaped cutout with a metal retainer clip which holds the fuze booster. The fuze subassembly is equipped with a safing pin which is removed before flight.

The fuze booster contains 5 grams of M5 propellant in a metal container topped by a foam filler. Detonation of the booster causes the nose cap of the cluster bomb to separate.

The BFD consists of a lanyard, which is made of steel cable, and a steel initiator, which is within the small section of the fuze subassembly. During fuze installation, the BFD lanyard is routed through the dispenser lanyard tube and through a swivel and link and is secured to a retention post on the dispenser aft body. During loading, the BFD swivel and link is installed in a bomb rack arming solenoid.

Fuze Arming.

After the CBU is released from the aircraft, the BFD is activated when the lanyard is pulled. The firing pin of the BFD initiator strikes the battery primer, igniting the battery which applies power to the fuze circuitry and starts the arming timer. The arming timer runs for the preset time. At the end of the preset time, the fuze arms, provided the velocity sensor switch is closed.

All proximity data processing begins 3.7 seconds after release regardless of fuze arm time setting. The arming and functioning criteria are:

1. Fuze must be armed prior to reaching the preset height of burst (HOB).

2. Fuze must sense 200 ft/s downward vertical velocity (minimum) after 3.7 seconds and as it passes through the range gates and HOB.

3. Fuze must sense passing through outer and middle gates after 3.7 seconds and prior to HOB (outer gate is HOB + 600 feet (including tolerance); middle gate is HOB + 250 feet). The fuze will sense and remember the range gates if they occur after 3.7 seconds and prior to or after arm time setting. If all other criteria are satisfied and the munition passes through both range gates and HOB before arming, the munition will function immediately upon expiration of arming time.

NOTE

FMU-56D/B fuzed cluster munitions will dud if, during flight, the munition is flown in medium rain at 550 KCAS in excess of 8 minutes, or at 450 KCAS in excess of 30 minutes. Under these flight conditions, radome erosion will cause the pitot tube to sense a pressure differential which is premature in the FMU-56D/B arming sequence and cause a dud fuze.

When energized, the radar circuitry of the fuze is continually checking the CBU's height above the ground and the vertical component of its velocity with respect to the ground. The height above the ground is measured by determining the time required for the radar pulse to reach the ground and return to the fuze. The closing velocity of the CBU is determined from the amount of Doppler shift in the returned signal with respect to the internal reference oscillator in the fuze. When the height above ground, as measured by the fuze, is the same as the preset height of burst and the closing velocity of the munition is greater than 200 feet-per-second, the detonator fires through the booster ignition port of the fuze housing to detonate the booster. Detonation of the booster pushes the fuze and the CBU nose cap out of the CBU cannister, allowing the CBU to separate into two pieces and disperse the payload.

Safety Features.

To arm the FMU-56D/B fuze, the following sequence of events must occur:

The battery must be ignited.

The safing pin which disconnects the timer from the battery and shorts the battery output must be removed.

The arming timer selector switch must be set to a position other than 0.

Airflow sensed by the pitot tube at the expiration of safe separation time must exceed 200 feet-per-second.

If the battery is ignited while the safing pin is installed in the proper receptacle, the battery is shorted to ground, causing discharge.

When the arming timer switch is set to 0, the safe separation timer does not run and the safing and arming device cannot receive an ARM signal and remains in the SAFE position. When the velocity of air sensed at the pitot tube is less than 200 feet-per-second, the switch remains open, breaking the arm circuit to the safing and arming device.

NOTE

Since the fuze height of burst and arming time selector switch positions are set by the load crew, the munitions handling and loading personnel must be carefully briefed on the required settings.

Delivery Considerations.

Ripple release of CBU-52B/B, CBU-58 series, and CBU-71 series munitions with FMU-56D/B fuzes installed must be planned with a spatial separation around each dispenser. Refer to Section V for directions on planning a ripple release with FMU-56D/B fuzed dispensers. Refer to Section VI for ripple release envelopes for these munitions with FMU-56D/B fuzes installed.

FMU-72/B LONG DELAY FUZE.

The FMU-72/B fuze (figure 1-100) is compatible with the nose and/or tail fuze wells of all bombs with internal plumbing and the standard 3-inch fuze well, which include the M117 750-pound GP bomb and the Mk 82, Mk 83, and Mk 84 GP bombs.

Fuze settings must be made before installing the fuze in the fuze well. If a change in a setting is required after installing the fuze, it must be removed from the bomb to make the change.

NOTE

The fuze type and arming delay setting should be recorded on the side of the bomb or on a red warning tag attached to the bomb. This should be checked during pilot preflight check of the aircraft.

Since the fuze settings are not visible to the pilot for inspection, the munitions handling and loading personnel must be carefully briefed on recording the required data.

The FMU-72/B fuze is activated upon armed release. The swivel and link assembly is held by the arming solenoid and stays with the aircraft. When the bomb is released the lanyard is pulled. This pull (greater than 15 pounds) cocks and releases the firing pin which initiates the liquid ammonia battery in the fuze. The battery provides electrical power for fuse operation. The arming circuitry provides a fixed delay for the signal for arming. The arming signal is used to arm the fuze, that is, rotate the detonator from the out-of-line position to the in-line or firing position. To assure that the detonator does not fire at arming, it is grounded until impact occurs, and the power source which fires the detonator is not charged until 33 seconds after impact. The fuse timing and counting circuitry provide the firing or final event signal at the set event time after impact. The arming time and selectable event times are listed below:

Arming time — fixed at 6.0 (+1.5, −1.0) seconds

Event times — selectable in 20-minute increments for 20 minutes to 5 hours, 1-hour increments from 5 hours to 16 hours, 2-hour increments from 16 hours to 30 hours, and 3-hour increments from 30 hours to 36 hours.

WARNING

When the FMU-72/B fuze is used in GP bombs, select a minimum release altitude which provides safe escape from bomb fragments for instantaneous or contact bursts. This is required to protect the aircraft and pilot in the event of a premature bomb detonation at initial impact. To preclude ricochet, release conditions for GP bombs should provide a trajectory angle at impact in excess of 44° for M117 and 42° for Mk 82 and Mk 84.

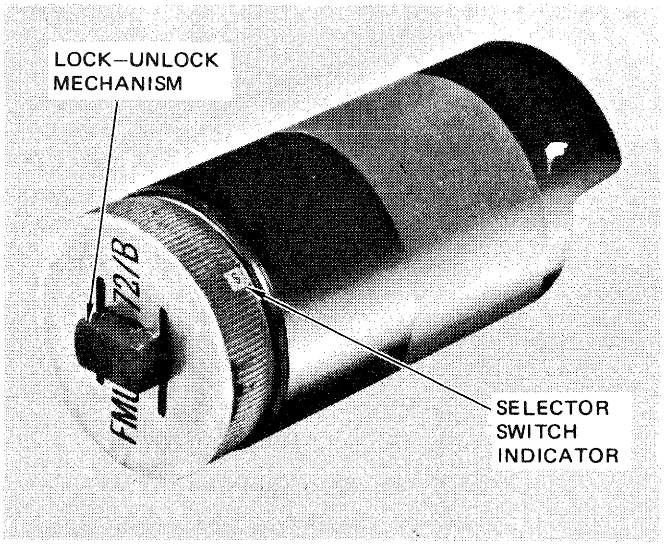
Anti-Disturbance Activation Time.

The activation time of the anti-disturbance feature is 33.0 (±10.0) seconds. Delivery techniques should be conducted to prevent bomb release in close proximity of previously dropped bombs after the activation time has elapsed.

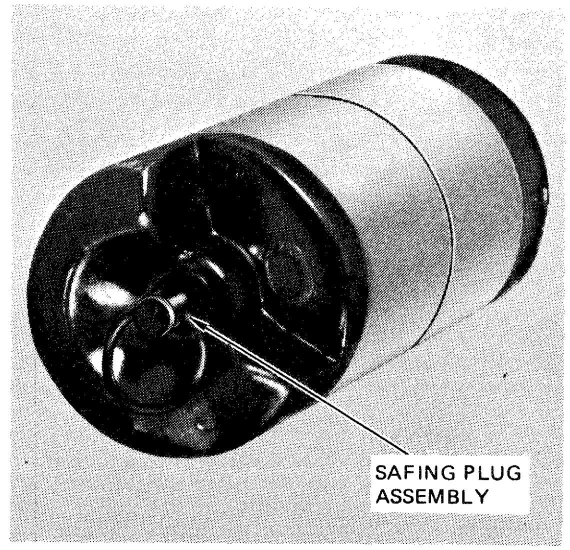
Required Impact Spacing Data.

To prevent sympathetic detonation, bombs should be delivered so the distance between individual bombs at impact is in excess of 75 feet. If sympathetic detonation is desired, the spacing between individual bombs should be 30 feet or less.

FMU-72/B LONG DELAY FUZE



VIEW OF SELECTOR-SWITCH END



VIEW OF EXPLOSIVE-TRAIN END

78K062–08–80

Figure 1-100

The fuze contains a safing switch which duds the fuze in the event impact occurs prior to arming.

CAUTION

Rough handling of the fuze after it is removed from the shipping container and especially during the installation when the safe plug is removed, could result in a dud fuze. The munitions handling and loading personnel must be cautioned not to mishandle the fuze or install a fuze which has been inadvertently dropped.

NOTE

To ensure adequate time for the FMU-72/B fuze to arm prior to impact, ensure that the last FMU-72/B fuzed munition to leave the aircraft has a minimum time of flight of 7.5 seconds.

FMU-81/B SHORT DELAY FUZE.

The FMU-81/B short delay fuze (figure 1-101) is compatible with the nose and tail fuze wells of all low-drag bombs with internal plumbing and the standard 3-inch fuze well. The FMU-81/B fuze is intended for use primarily with guided bombs. Any of nine arming-delay settings (4, 5, 6, 7, 8, 10, 12, 14, or 20 seconds) or a SAFE setting can be selected by means of the thumbwheel setting knob of the arming-delay selector switch. The tolerance on the arming delay is ±5%. The arming-delay settings may be made before or after installation of the fuze in the bomb. Any of six impact-delay settings (.00, .01, .02, .05, .10, or .25 second) can be selected by means of the thumbwheel setting knob of the impact-delay selector switch. The impact-delay settings may be made before or after installation of the fuze in the bomb.

The FMU-81/B consists of three major assemblies: fuze, FZU-2/B fuze booster, and MAU-162/A firing lanyard adjuster. An auxiliary booster clip is provided as an accessory for guided bomb applications.

FMU-81/B FUZE

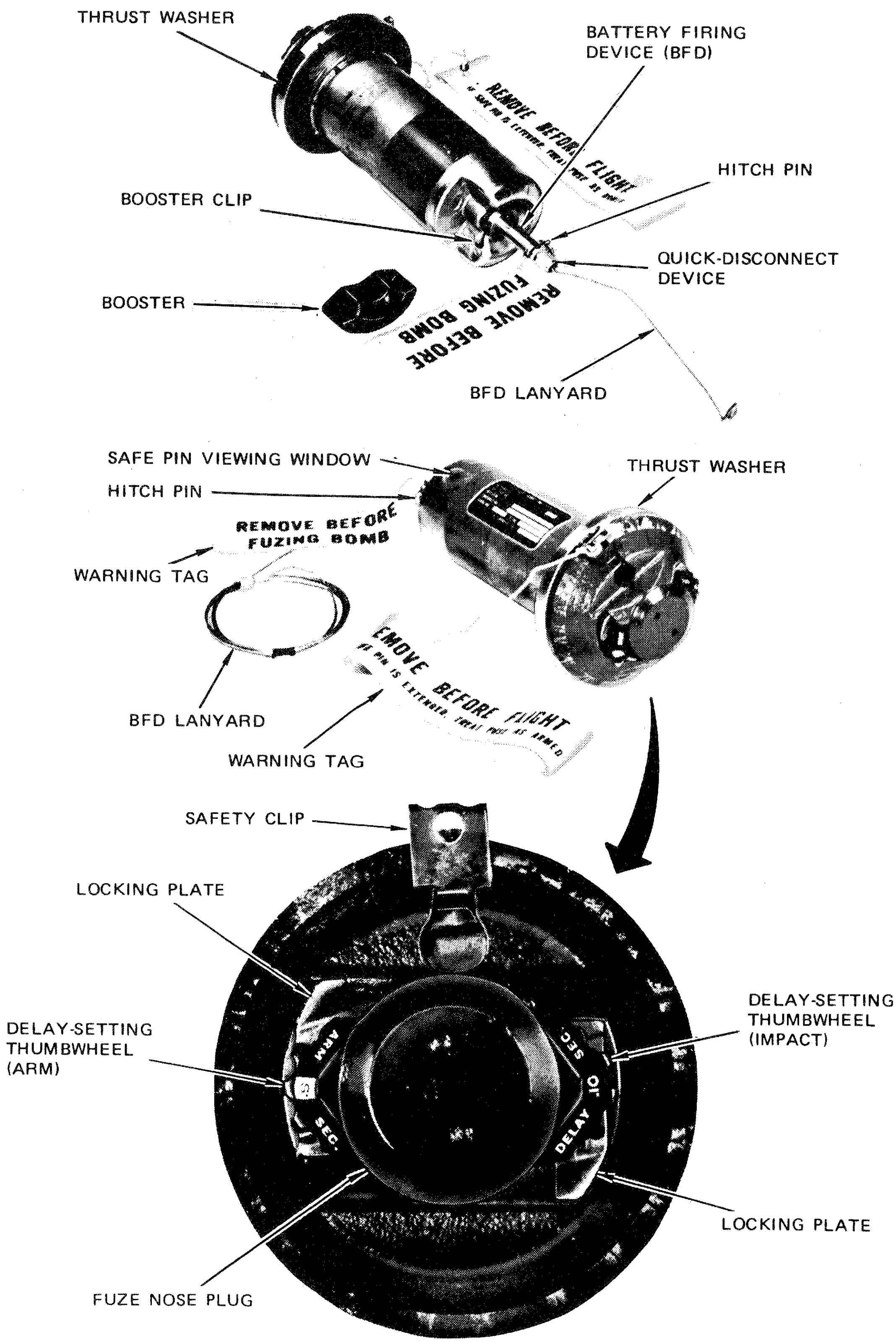


Figure 1-101

The body of the fuze is a steel cylinder with a window near the end opposite the nose. Contained within the body are a battery, a safing and arming (S and A) mechanism, and an electronics assembly. The nose contains two thumbwheel setting knobs, one for arming and one for impact delay, held in place by a fuze nose plug and connected to selector switches in the electronics assembly by two mating shafts. The battery firing device (BFD) is a steel cylinder integral with the fuze body that protrudes from the recessed end of the body. It contains a firing pin held in restraint by a shear wire until initiated by a pull from the lanyard. The lanyard assembly is a braided steel cable connected to the BFD by a ball and shank. The hitch pin is a safety pin inserted in a hole in the BFD housing and lanyard rod. This pin is removed before fuzing the bomb. The safe pin is a slender steel rod that is visible through the window in the fuze body and extends through the body and nose to the seal plug.

The fuze booster is shaped to fit the contour of the fuze booster cavity and to be snapped into position under the booster clip. The auxiliary booster clip is a spring steel holder that holds three supplementary boosters in place around the BFD when the fuze is used in a guided bomb.

The MAU-162/A lanyard adjuster consists of a swivel and link assembly attached to a lanyard securing block. The swivel and link assembly is installed in the appropriate bomb rack arming solenoid, and the BFD lanyard is secured to the block. Upon armed weapon release, the lanyard is pulled from the BFD and then the MAU-162/A securing block separates from the swivel and link, leaving the swivel and link in the solenoid.

Fuze Arming.

Upon bomb release, a lanyard pull of 20 pounds or more shears a pin in the BFD and releases the BFD firing pin. The firing pin initiates a primer cap, which in turn initiates heat paper within the battery. The heat paper raises the battery temperature to generate battery voltage. After a battery rise time of 0.4 ($\pm$0.125) second, the battery produces the 11 volts necessary to operate the timing and control circuitry in the fuze. At approximately 3/4 of the set arm time, the enable bellows motor is activated, removing the safe pin block on the S and A. At the set arm time, the arming bellows motor is activated, moving the detonator to the in-line position. On impact, the fuze functions after elapse of the preset impact delay.

Safety Features.

The SAFE position of the arming-delay-setting thumbwheel renders the arming circuit inoperable in this position.

Locking plates behind the arming-delay and impact-delay setting thumbwheels prevent accidental movement of the thumbwheels during ground handling of the fuze.

The safe pin reveals a potentially armed condition of the fuze by visibly protruding through a seal plug on the fuze nose. The safe pin holds the rotor out of line until the pin is driven through the plug by the arm-enable bellows.

WARNING

If the safe pin is protruding through the seal plug in the fuze nose, the fuze shall be considered armed. In this event, the fuze shall not be used. Do not touch fuze and notify explosive ordnance disposal (EOD) personnel immediately.

The safety clip on the fuze nose prevents the safe pin from releasing the rotor until the safety clip is manually removed during installation in a bomb. If the BFD is accidentally initiated during handling, the safe pin permanently locks the safety clip in place to reveal a defective fuze condition to the munition handler. A hitch pin prevents actuation of the BFD until manually removed during bomb installation.

The S and A mechanism provides out-of-line safety until the rotor is freed by movement of the safe pin and propelled in line by an arming bellows after BFD initiation. If an impact of greater than 250g should occur before arming, the safing switch and/or the detonator enable switch will function and prevent the fuze from arming. If an arming signal should be generated before arm-enable (removal of the safe pin), the rotor will attempt to rotate and will deform a locking tang, which then permanently locks the rotor out of line. The S and A mechanism also prevents battery voltage from reaching the event circuitry before mechanical arming occurs.

The arm-enable circuitry prevents premature actuation of the arm-enable bellows by means of a resistor-capacitor combination that limits the enable-bellows charging current until the preset timing circuit releases a voltage pulse and triggers the capacitor to discharge into the bellows.

FMU-110/B PROXIMITY FUZE.

The FMU-110/B fuze (figure 1-102) is a self-powered Doppler radar proximity fuze used to open SUU-30 series CBU munitions (bomb type clamshell dispensers). The fuze has provisions for presetting fuze safe separation time (arming time) and munitions dispenser height of burst (HOB). These settings may be made after the fuze is installed in the munition. An electronic countermeasures (ECM) selector switch is also provided. The selectable safe separation time positions on the SECONDS TO ARM switch are: X (SAFE), 3, 4, 5, 6, 7, 8, 9, 10, and 18 seconds. The following table shows the HOB settings, which are also painted on the side of the fuze.

FMU-110/B Height-of-Burst (HOB) Settings

HOB Switch Position	*Altitude Setting (Feet)*
A	300
B	500
C	700
D	900
E	1,200
F	1,500
G	1,800
H	2,200
J	2,600
K	3,000

The FMU-110/B fuze is basically cylindrical in shape: however, the radome is larger than the fuze housing subassembly. The fuze subassembly houses the Doppler ranging radar, the safing and arming (S and A) mechanism impulse cartridge, two mechanical safety locks and the velocity sensing system. A safing pin with a warning streamer, installed in the nose of the radome, retains the S and A locking rod in the retracted position. The SECONDS TO ARM, HOB, and ECM switches are located at the aft end of the radome. The battery firing device (BFD), firing lanyard, and booster retaining clip, installed in the rear of the fuze, form an integral part of the fuze.

Associated components of the fuze include the FZU-1/B booster and the MAU-166/B swivel and link assembly. The FZU-1/B booster consists of a urethane foam unit which serves as a spacer and a propellant can which contains 5 grams of M5 propellant. The spacer and propellant can are cemented together. The MAU-166/B swivel and link assembly is preformed from 0.08-inch diameter steel wire.

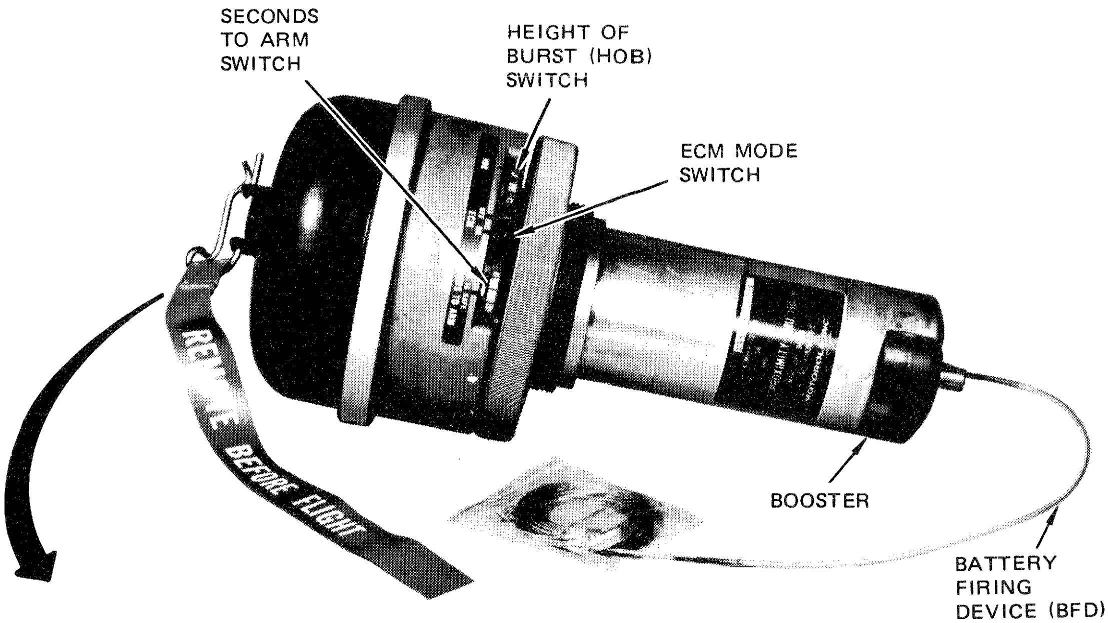
Fuze Arming.

Before munitions release, the BFD mechanically locks the S and A rotor in the safe position and prevents battery ignition and application of power to the fuze. After the CBU is released from the aircraft, the BFD is activated when the arming lanyard is pulled. When activated, the BFD removes one of the locks from the S and A rotor, and the BFD initiator strikes the battery primer which ignites the battery. Voltage from the battery provides power for the electronic circuitry. The safe separation timer starts on battery ignition and runs for the preselected time set on the SECONDS TO ARM switch. At the end of the preset time, the fuze will arm, provided the velocity sensing switch is closed.

When the munition reaches a velocity of 120 knots, the velocity sensing switch closes. One-half second before the preset arming time, the fuze generates a pulse which fires an impulse cartridge, releasing the S and A locking rod. At the preset arming time, the fuze generates an arm pulse which is applied through the velocity sensing switch (if the munition has reached a velocity of 120 knots) and fires an impulse cartridge rotating the S and A rotor to the armed position.

When energized, the radar circuitry of the fuze is continually checking the CBU's height above the ground and the vertical component of its velocity with respect to the ground. The height above the ground is measured by determining the time required for the radar pulse to reach the ground and return to the fuze. The closing velocity of the CBU is determined from the amount of Doppler shift in the returned signal with respect to the fuze's internal reference oscillator. When the height above ground (measured by the fuze) is the same as the

FMU-110/B NOSE FUZE



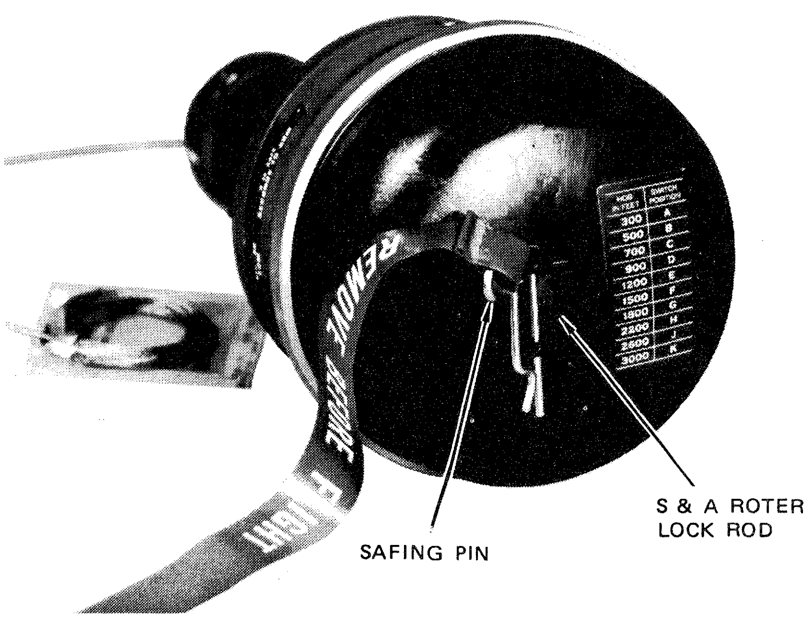


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Figure 1-102

height of burst and the closing velocity of the munition is greater than a minimum value, the detonator fires through the booster ignition port of the fuze housing to detonate the booster. Detonation of the booster pushes the FMU-110/B fuze and the CBU nose cap out of the CBU canister, allowing the CBU to separate into two pieces and disperse the payload.

Safety Features.

To arm the FMU-110/B fuze, the following sequence of events must occur:

The SECONDS TO ARM switch must be set to a position other than X (SAFE).

The safing pin must be removed. With the safing pin in place, the S and A rotor lock rod cannot be deployed, thus locking the S and A mechanism in the safe position.

A lanyard pull force in excess of approximately 15 pounds must be felt on the BFD lock. Until this force is felt, the BFD lock mechanically locks the S and A rotor in the safe position and prevents battery ignition and application of power to the fuze.

The velocity switch must sense a forward velocity in excess of approximately 120 knots at the expiration of the preset arm time.

The S and A rotor lock must be deployed by an impulse cartridge that is activated one-half second before the selected SECONDS TO ARM time. Until this time, the S and A rotor is mechanically locked in the safe position.

The FMU-110/B fuze has a visual arm indicator. When the velocity sensing system is activated (battery ignited and SECONDS TO ARM switch set to a position other than safe), a red indicator rod is extended approximately one inch in front of the radome, exposing a port of the velocity sensor. The extended indicator rod is an indication that the battery has been ignited and the fuze should be treated as armed.

NOTE

Since the fuze height of burst and SECONDS TO ARM switch positions are set by the load crew, the munitions handling and loading personnel must be carefully briefed on the required settings.

Delivery Considerations.

The arming timer tolerance for the FMU-110/B fuze is 10% of the selected value or ±0.5 second, whichever is greater. During mission planning when FMU-110/B fuzed munitions are involved, the munition time of flight from release to function altitude must be greater than the arming timer setting plus the tolerance. This procedure must be carefully observed. If the munition passes through the selected function height prior to the expiration of the preset arming time, the fuze function is uncertain and a dud round may result.

To assure adequate time for all fuze functional requirements to be met, the fuze should be fully armed no less than 2 seconds before it reaches the preset height of burst.

Alternate Height of Burst.

The FMU-110/B fuze incorporates an alternate HOB feature that allows a proximity function at a secondary HOB other than the ground selectable HOB. This alternate HOB is internal to the fuze and is preset by the manufacturer at 700 (±50) feet. For mission planning purposes where FMU-110/B are involved, the backup HOB function is operative whenever the munition is released below the preset HOB. The fuze may function any time after arming due to a radar return from a slant range corresponding to the preset HOB. If the fuze has not functioned when it reaches 700 feet, it will function there.

Since the fuze may function at either 700 (±50) feet above AGL or any time after expiration of the preselected arming delay, release conditions should be selected for which these two events are nearly coincident. In addition, the recommended release envelopes contained in the Tables of Release Envelopes should also be followed in mission planning. The following level release conditions satisfy these requirements for single and pair releases.

Arming Delay (Sec)	*Release Altitude (Ft)*	*KTAS*	*CBU-58B/B Sight Depression (Mils)*	*CBU-52B/B Sight Depression (Mils)*	*HOB (Ft)*
3	900	460	197	193	700
		500	184	181	
		540	174	170	
4	1,000	460	197	195	700
		500	184	182	
		540	174	171	
5	1,200	540	181	179	700

ECM Mode.

An ECM mode of operation is incorporated into the FMU-110/B fuze to provide a backup function after expiration of the safe separation time. This feature provides an option of fuze function if the fuze sees an electromagnetic environment sufficient to mask the radar return.

The ECM mode of operation is selectable at the antenna support collar by the ECM switch with positions of ON and OFF. Selection of the OFF position precludes a fuze function while selection of the ON position provides a fuze function if the fuze sees an electromagnetic environment sufficient to mask the radar return. In the latter case, if the FMU-110/B senses an ECM environment, the fuze would be expected to function between safe separation time and the selected height of burst. In this type of environment, function somewhere near the desired time/altitude may be obtained if the fuze safe separation time is set at a value approximately 2 seconds less than the expected time of flight from release to function altitude.

Release Envelopes.

Release envelopes for munitions with the FMU-110/B fuze are provided in Section VI with directions for their use contained in Section V. These envelopes can be used to determine minimum release altitudes and minimum release interval settings which will provide adequate munition separation distance for ripple releases. The envelopes will also provide the minimum altitudes that may be used for single releases and the maximum release altitude that may be used for either single or ripple release.

FIRE BOMB FUZING SYSTEM.

The fuzing system for BLU-1C/B and BLU-27 fire bombs (figure 1-103) consists of the AN-M23A1 igniter, the FMU-7 series fuze, the FMU-7 series cable assembly, and the FMU-7 series initiator. When the fire bomb is completely assembled, the only visible component of the fuzing system is the initiator.

AN-M23A1 Igniter.

The AN-M23A1 igniter is filled with 1 1/4 pounds of white phosphorus. It has a threaded fuze well in one end designed to receive the FMU-7 series fuze. The other end of the igniter is threaded and designed to fit the fuze well of the BLU-1C/B and BLU-27 fire bombs.

FMU-7 Series Fuze.

The FMU-7 series fuze is an electrically armed, impact-detonated fuze which will function on impact at any angle. The fuze consists of an electrically operated motor bellows, a striker assembly (firing pin), a primer-detonator, and a booster. Once armed, the fuze cannot be reset and it functions instantaneously on impact. The fuze incorporates the arming-stem-safe principle as its safety feature. The motor bellows holds the firing pin immobile until receipt of the electrical arming signal from the FMU-7 series initiator.

FMU-7 Series Cable Assembly.

The FMU-7 series cable assembly is a two-wire cable that runs from the initiator well (between the suspension lugs) to the forward and aft bulkheads of BLU-1C/B and BLU-27 fire bombs. The ends of the cable connect to the FMU-7 series fuze. The cable is used to transmit the electrical arming signal from the FMU-7 series initiator to the FMU-7 series fuze. BLU-27 fire bombs which have failed continuity tests on one end have the cable removed from that end. BLU-27 fire bombs which have failed continuity tests on both ends will have the cables removed from both ends. In either case, the fire bombs may be repaired for use in close air support firepower demonstrations.

FIRE BOMB FUZING SYSTEM

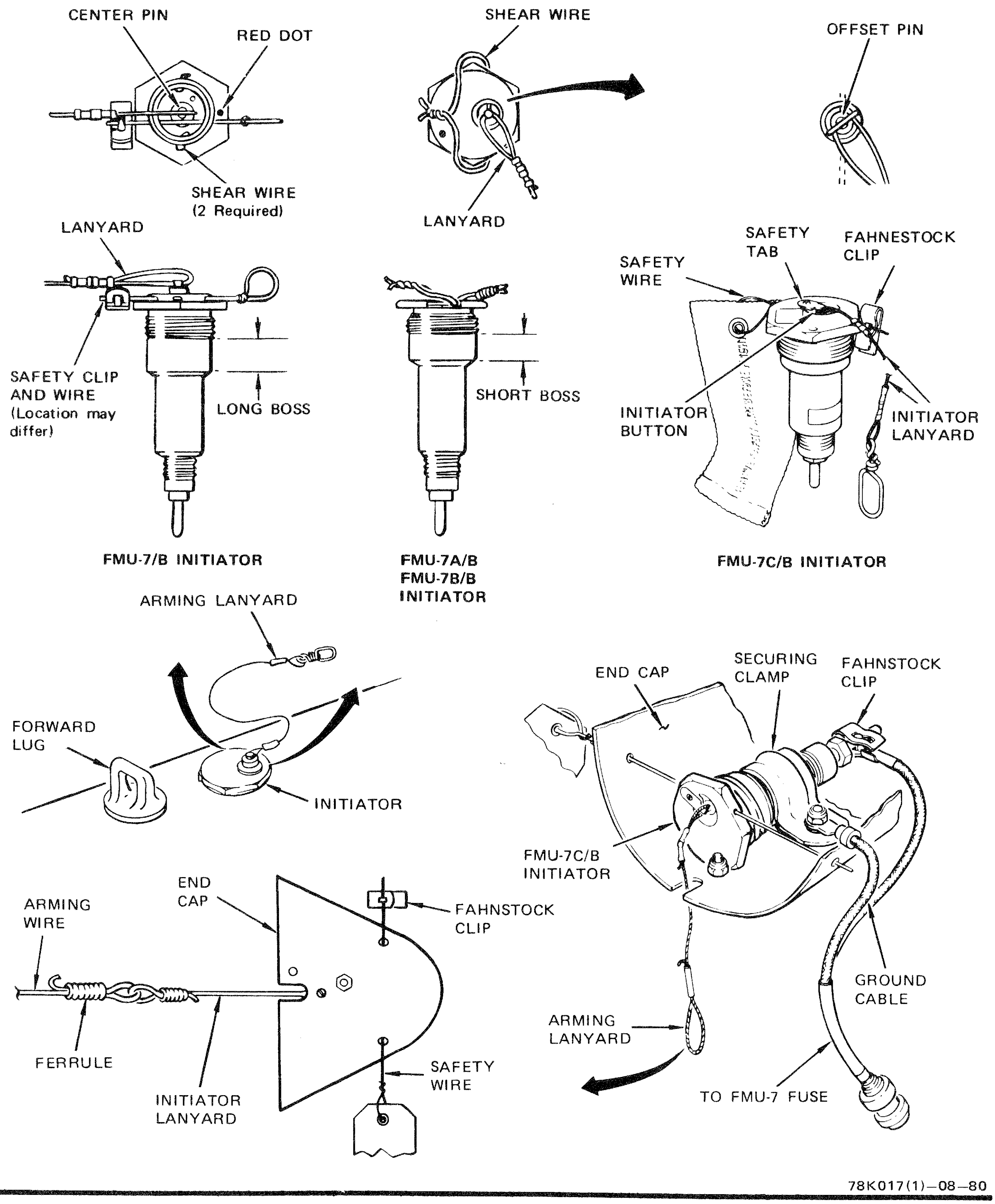


Figure 1-103 (Sheet 1)

FIRE BOMB FUZING SYSTEM

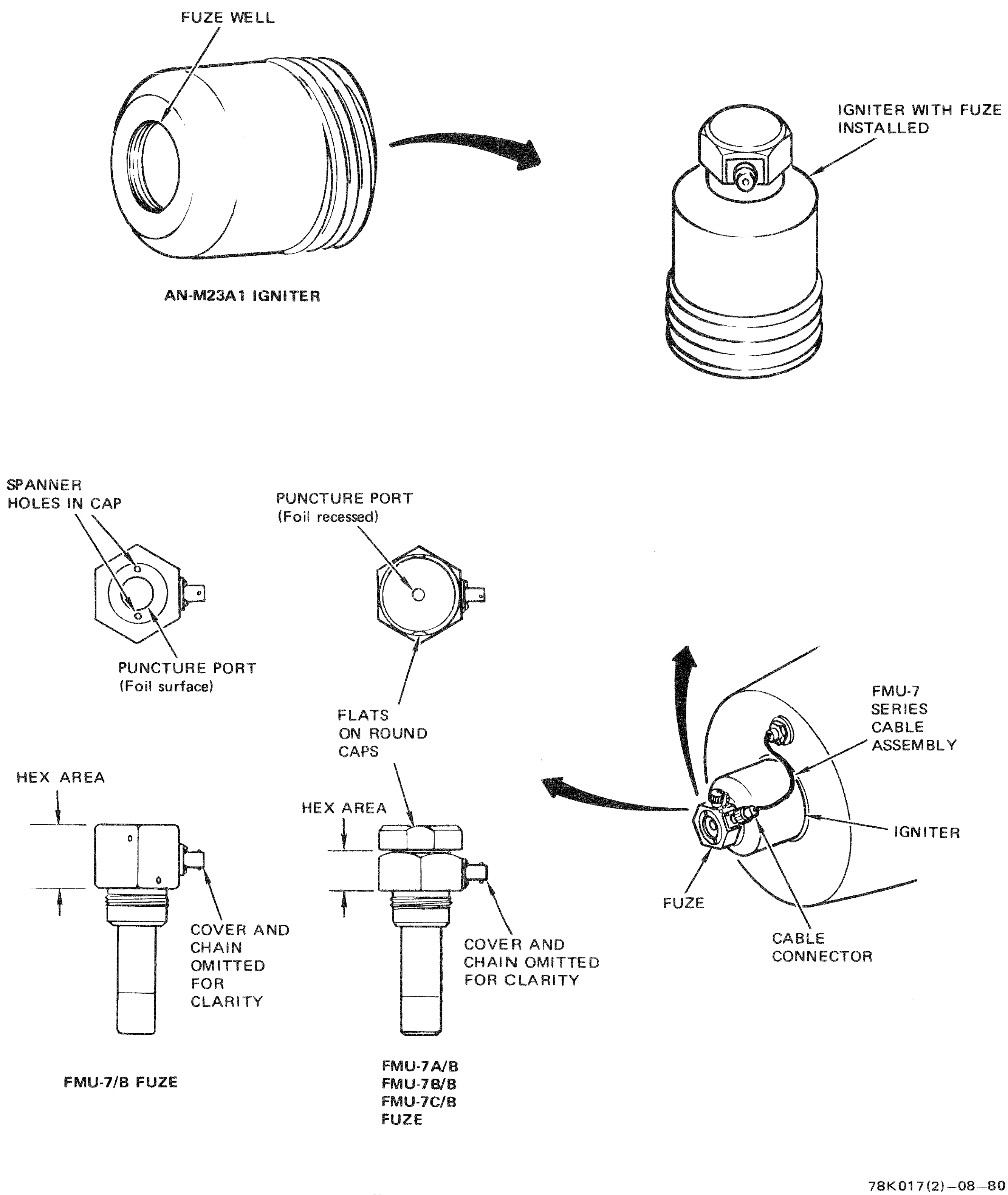


Figure 1-103 (Sheet 2)

FMU-7 Series Initiator.

The FMU-7 series initiator consists of an arming lanyard, a spring-loaded firing pin, and a 1.5-volt thermal battery. The initiator is normally installed in the initiator well between the suspension lugs and connected to the FMU-7 series cable assembly.

BLU-27 fire bombs which have failed continuity tests on one or both ends may be repaired to allow use in close air support firepower demonstrations. The repair procedure consists of mounting a FMU-7C/B initiator in the end cap with a short FMU-7 series cable attached. The initiator arming lanyard protrudes through the end cap. When the end cap is installed on the bomb, the FMU-7 series cable is attached to the fuze and the initiator arming lanyard is attached to an arming wire.

Fuzing System Functioning.

When the bomb is released from the aircraft, the arming lanyard pulls the initiator cap from the initiator. This releases the initiator firing pin, which strikes the thermal battery primer, activating the battery. After a 0.6-second delay, the battery produces a 1.5-volt pulse which is transmitted through the cable to the fuze. The 1.5-volt pulse operates the motor bellows which frees the fuze firing pin, thus arming the fuze. Upon impact of the bomb, the firing pin strikes the fuze primer, detonating the fuze. Fuze detonation bursts the igniter, scattering the igniter white phosphorus. The white phosphorus ignites spontanously upon exposure to the air and ignites the scattered filling of the bomb.

ARMING WIRE AND LANYARD RIGGING FOR BOMB TYPE MUNITIONS.

Arming wires and lanyards are installed on bomb type munitions to allow the pilot to release an armed bomb or a safe bomb, as he desires. Arming wires are used with mechanical fuzes and arming lanyards are used with FMU series fuzes.

Arming wires and lanyards are rigged to provide the highest possible probability that the munition will arm as desired. When loaded on MER/TER shoulder stations, the wires and lanyards are rigged so they are on the lower side of the ejector unit. When loaded on MER/TER center stations, the wires are rigged so they are on the same side of the ejector feet and sensing switch as the side of the suspension lug they are attached to. When loading is completed, arming wires (and Snakeye fin release wires) should not cross over the top of the munition or be supported by ejector feet or sensing switches. Lanyards also should not cross over the top of the munition and, when loaded on MAU-12 racks, should also go around the suspension lugs.

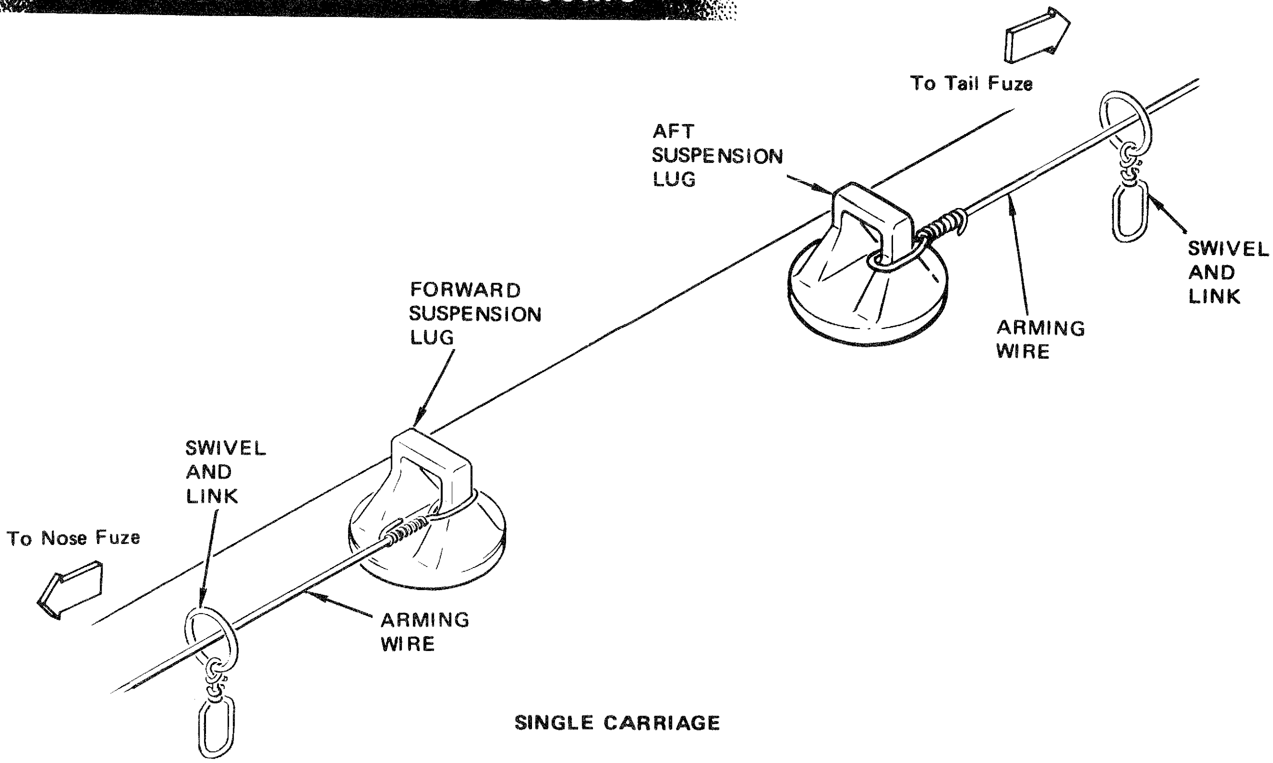
Retaining clips are used to hold fuze arming wires and fin release wires in place during flight and to retain the wires at bomb release when the arming solenoids are not energized (safe/low drag bombs). There are two different retaining clips authorized for use on the A-7 aircraft. Fahnestock clips are made from flat brass stock, exert 2 to 8 pounds of retention force on the wire, and are used on Mk 15 series fin release wires and Mk 43 TDD arming wires. The other type of retaining clip is made of flat beryllium copper stock, exerts a minimum of 15 pounds of retention force on the wire, and is used on arming wires of M series fuzes and ATU-35 series drive assemblies. Beryllium copper retaining clips are never used on fin release wires as they impose such a pull force that the fin release wire may fail before the clip is pulled from the wire.

Swivel and links are used on all arming wires and arming lanyards. MAU-78/B (62C11846) swivel and links are authorized in all swivel and link applications except for FMU-54 series fuzes and Mk 15 fin release wires. MAU-166/B (65C12057) swivel and links are authorized for use in any application. All swivel and links not associated with FMU-54/B series fuzes and not positively identified as MAU-166/B must be considered to be MAU-78/B and therefore restricted from use in FMU-54 series and Mk 15 fin release wire applications.

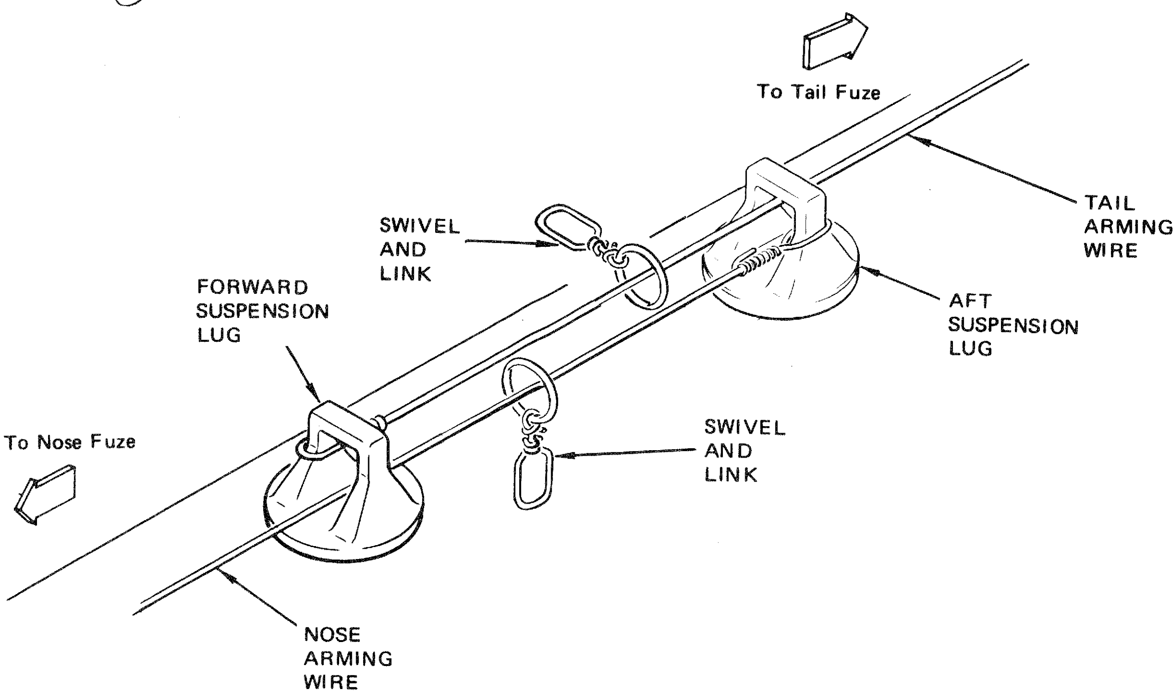
MK 82, MK 83, MK 84, M117 GP BOMBS, MC-1 GAS BOMB, AND GBU-10 SERIES AND GBU-12 SERIES LASER GUIDED BOMBS.

Arming wires on GP, MC-1 gas bombs, and laser guided bombs (figure 1-104) are rigged from one of the suspension lugs to the nose fuze or ATU-35 drive (tail fuze). The planned carriage of the bomb determines which suspension lug is to be used. For multiple carriage (MER/TER), the wires run from the aft lug to the nose fuze and from the forward lug to the ATU-35 drive. For single carriage (MAU-12), the wires run from the aft lug to the ATU-35 drive and from the forward lug to the nose fuze.

GP BOMBS ARMING WIRE RIGGING



SINGLE CARRIAGE



MULTIPLE CARRIAGE

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Figure 1-104

Arming lanyards on GP and laser guided bombs (figure 1-105) are tied off to the lanyard lock. The loop of the lanyard must be made long enough to reach the appropriate rack arming solenoid. The swivel and link of nose fuze lanyards must go to the nose solenoid, and for tail fuze lanyards, to the tail solenoid. The center solenoid of the MAU-12 bomb rack is not used for GP bombs as such use would remove the pilot's fuzing options.

MK 82 SNAKEYE I BOMB.

Mk 82 Snakeye bombs (figure 1-106) can be configured for either a fixed low-drag, fixed high-drag, or pilot option high- or low-drag delivery. For all of these configurations, the rigging of the arming wires, arming lanyards/cords, and fin release wires is essentially the same.

The nose arming wire is secured to the tail fin and routed forward to the bomb nose. For pilot option and fixed low-drag bombs, the arming wire is positioned on top of the bomb, routed through the suspension lugs, and has a swivel and link installed on the wire. For fixed high-drag bombs, the arming wire is positioned on the outboard side of the bomb with no swivel and link. Arming wires for Mk 43 TDD are secured to the forward edge of the Mk 15 fin (these bombs are restricted to fixed high-drag configuration). Arming wires for M904 fuzes are secured to the Mk 15 fin clevis bolt and routed under the fin link pin.

FMU-54 series fuzes are installed in the fixed high-drag and pilot option configuration Snakeye bombs only. The FMU-54/B has a BFD type arming lanyard which is routed through the round loop of a swivel and link and secured to a lanyard lock in the bomb charging well. The FMU-54A/B has a bungee type arming cord assembly.

Fin release wires are installed only on fixed high-drag and pilot option configuration Snakeye bombs. If a FMU-54/B fuze is installed in a pilot option bomb, the fin release wire is secured to the elongated loop of the FMU-54/B swivel and link. If a FMU-54A/B fuze is installed in a pilot option bomb, the fin release wire is secured to the elongated loop of a yellow or gold swivel and link, and a separate piece of arming wire is used to secure the FMU-54A/B arming cord swivel and link to the round loop of the fin release wire swivel and link. For fixed high-drag bombs, the fin release wire is attached to the elongated loop of a separate swivel and link which is installed in the bomb rack nose arming solenoid. The fin release wire is routed aft through the aft suspension lug, fin release band latch, and guide tube with a Fahnestock clip installed on the wire aft of the guide tube.

The nose arming wire swivel and link (fixed low-drag and pilot option bombs) is installed in the rack nose (MER/TER) or center (MAU-12) arming solenoid. The fin release wire swivel and link (pilot option bombs) is installed in the rack tail (MER/TER) or center (MAU-12) arming solenoid. Pilot option bombs are restricted to MER/TER carriage only so that when Snakeye bombs are loaded on MAU-12, the bomb is configured either fixed high-drag or fixed low-drag. The fixed low-drag has only one swivel and link, installed in the center arming solenoid. The fixed high-drag bomb will usually have two swivel and link assemblies; the fin release wire swivel and link, installed in the nose arming solenoid, and the FMU-54 fuze swivel and link, installed in the center arming solenoid.

MK 36 DESTRUCTOR.

Mk 36 Destructors (figure 1-107) are configured for either a fixed low-drag or a fixed high-drag delivery. For fixed low-drag destructors the arming device arming wire is secured to its own swivel and link and routed forward to the arming device with the swivel and link installed in the rack nose arming solenoid. A swivel and link is installed on the firing mechanism arming wire and in the rack tail arming solenoid. No fin release wire is installed.

For fixed high-drag destructors device arming wire is secured to the bottom fin clevis bolt and routed forward to the arming device. The firing mechanism arming wire is secured to the top fin link pin, routed through the hole in the top fin drag plate, through the firing mechanism popout pin, through the hole in the bottom fin drag plate, and cut flush with the bottom fin drag plate. The fin release wire is rigged to a swivel and link which is installed in the rack tail arming solenoid.

BLU-1C/B, BLU-27B/B AND BLU-27C/B FIRE BOMBS.

BLU-1C/B and BLU-27 series fire bombs have arming lanyards which are built into the FMU-7 series initiators. For multiple carriage of fire bombs, the initiator arming lanyard is installed in the ejector unit tail solenoid. For single carriage, the initiator arming lanyard is installed in the bomb rack center solenoid.

GP BOMBS ARMING LANYARD RIGGING

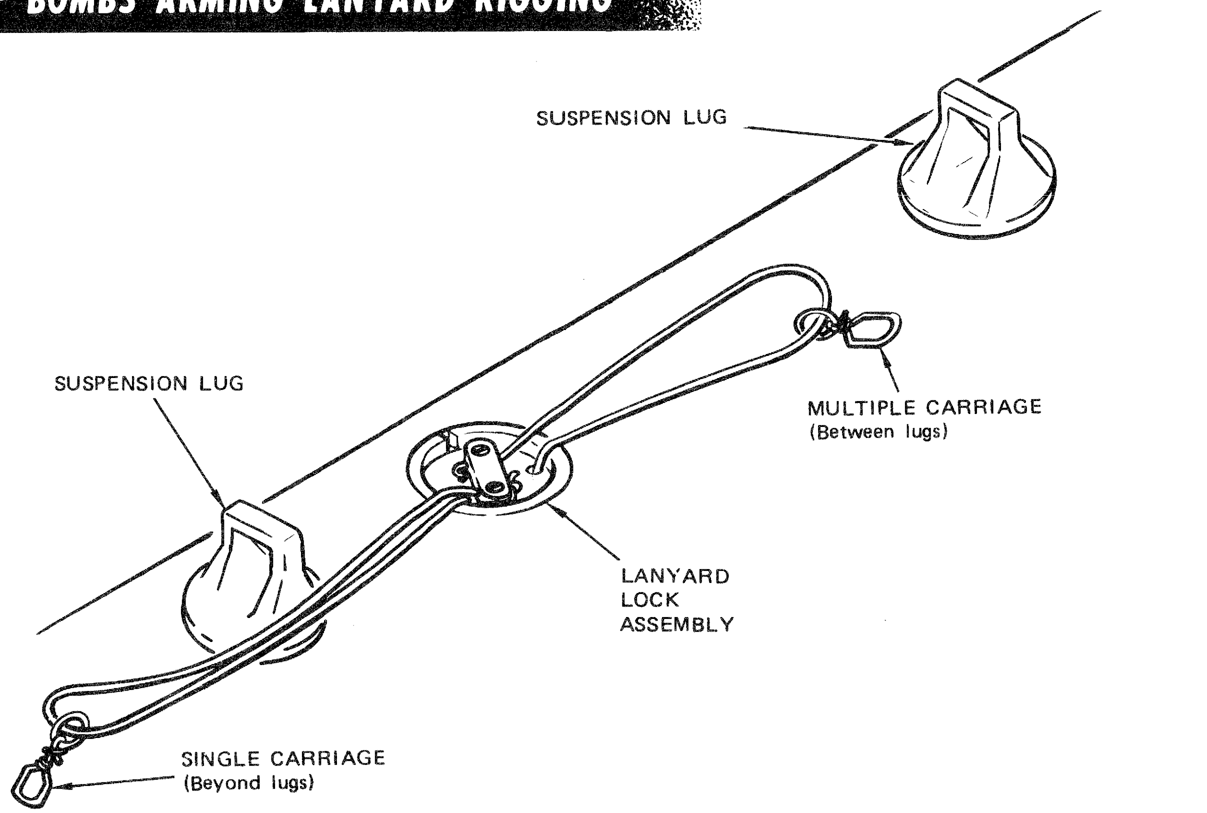
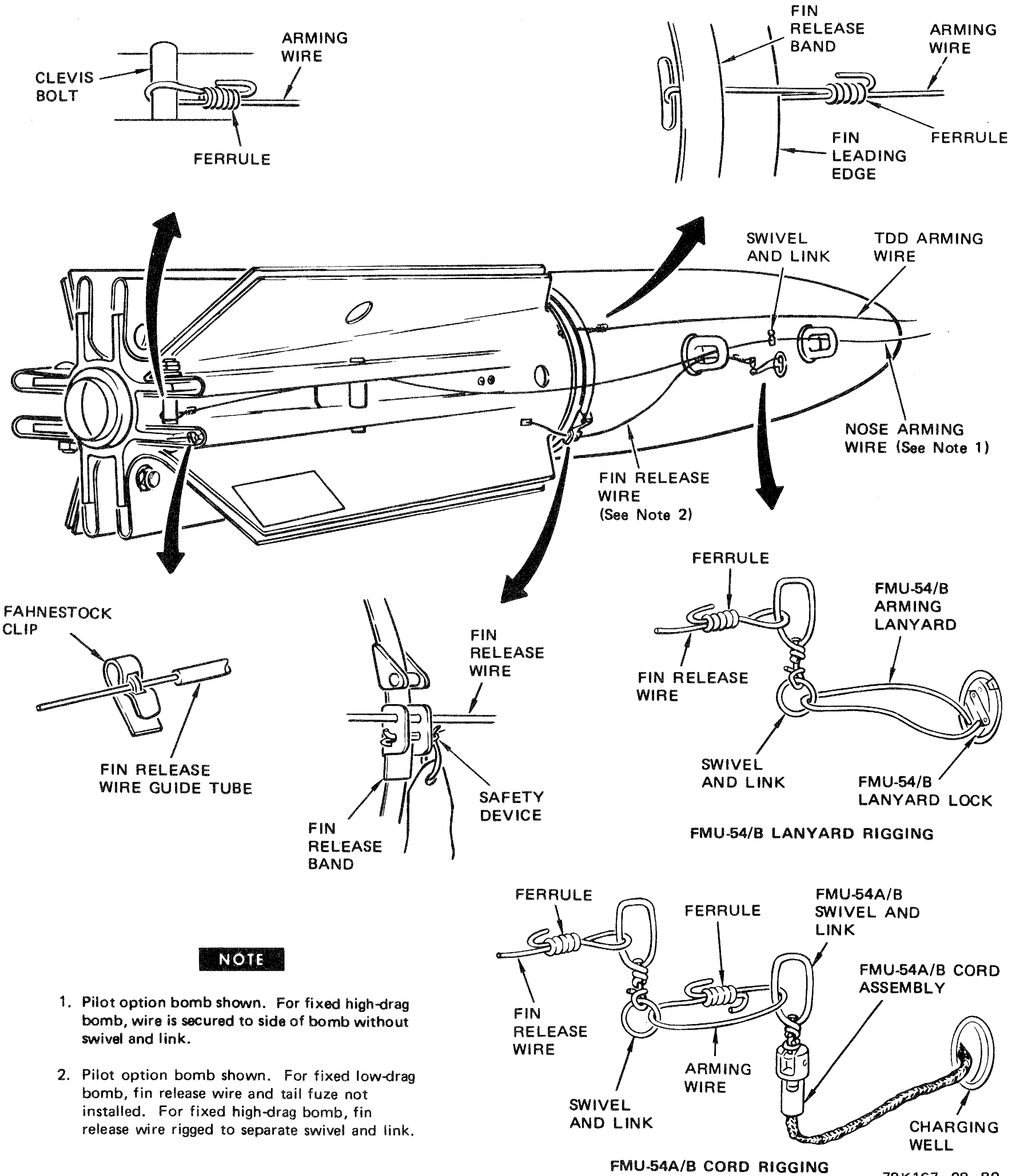


Figure 1-105

MK 82 SNAKEYE BOMB ARMING WIRE, ARMING LANYARD/CORD, AND FIN RELEASE WIRE RIGGING



NOTE

1. Pilot option bomb shown. For fixed high-drag bomb, wire is secured to side of bomb without swivel and link.
2. Pilot option bomb shown. For fixed low-drag bomb, fin release wire and tail fuze not installed. For fixed high-drag bomb, fin release wire rigged to separate swivel and link.

Figure 1-106

MK 36 DESTRUCTOR ARMING WIRE AND FIN RELEASE WIRE RIGGING

HIGH-DRAG CONFIGURATION

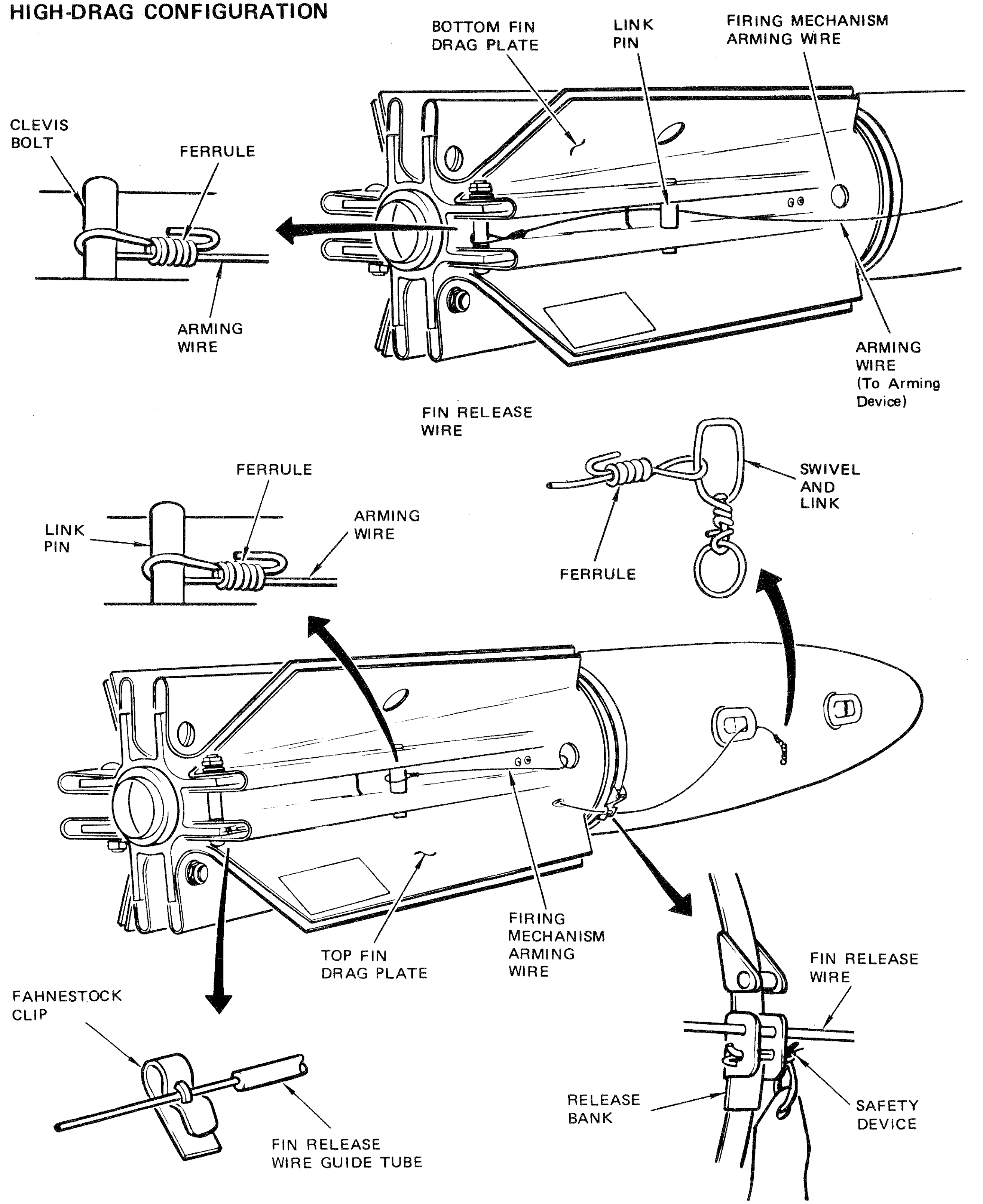


Figure 1-107 (Sheet 1)

MK 36 DESTRUCTOR ARMING WIRE AND FIN RELEASE WIRE RIGGING

LOW-DRAG CONFIGURATION

NOTE

Mk 15 fin shown. Conical fin wire rigging identical.

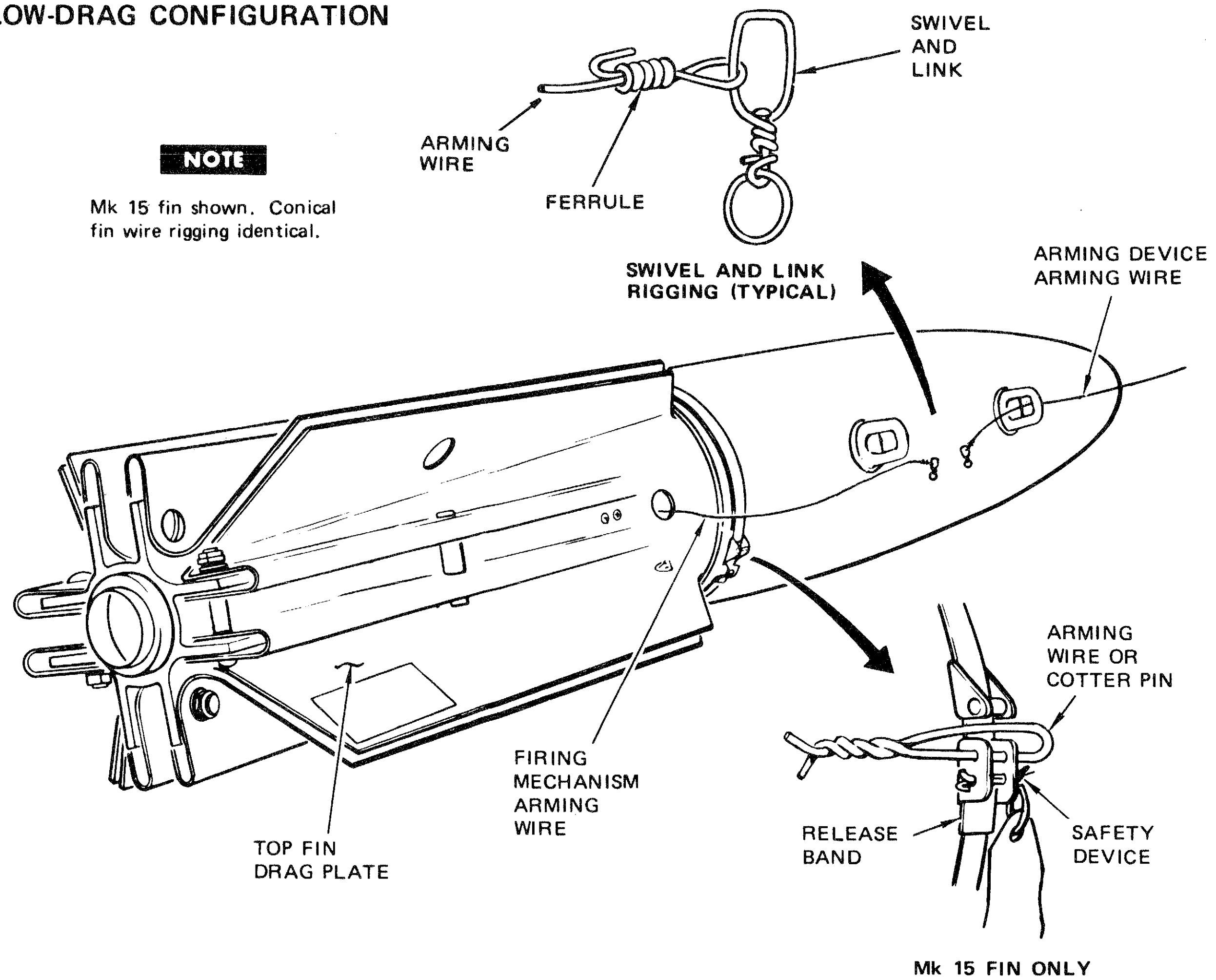


Figure 1-107 (Sheet 2)

BLU-27 series fire bombs which have been repaired have their initiator(s) installed in the end cap(s). An arming wire is attached to the initiator lanyard. The other end of the arming wire is secured to the nearest suspension lug for single carriage or the farthest lug for multiple carriage (identical to GP bombs arming wire rigging). The arming wire swivel and link is installed in the nearest arming solenoid (again identical to GP bombs).

BOMB TYPE (SUU-30 DISPENSER) CBU MUNITIONS.

The M907 fuze arming wire (figure 1-108) runs aft on the dispenser through the guides and is tied off to the retention post. The FMU-26/56/110 fuze arming lanyard runs aft on the dispenser from the lanyard tube through the guides, around the retention post, and is cut off beyond the retention post. Both the arming wire and the arming lanyard utilize a swivel and link assembly. The guides between the suspension lugs are skipped for positioning of the swivel and link.

For dispensers to be loaded on MER/TER shoulder ejector units, the arming wire/lanyard must be routed through the row of arming wire guides which will be closest to the MER/TER center ejector unit. This is to prevent the wire/lanyard from catching on the ejector foot during unarmed release. For dispensers loaded on MER/TER center station(s), the arming wire/lanyard swivel and link is installed in the ejector unit nose solenoid. For dispensers loaded on MAU-12 bomb rack, the swivel and link is installed in the bomb rack center solenoid.

MK 20 ROCKEYE II.

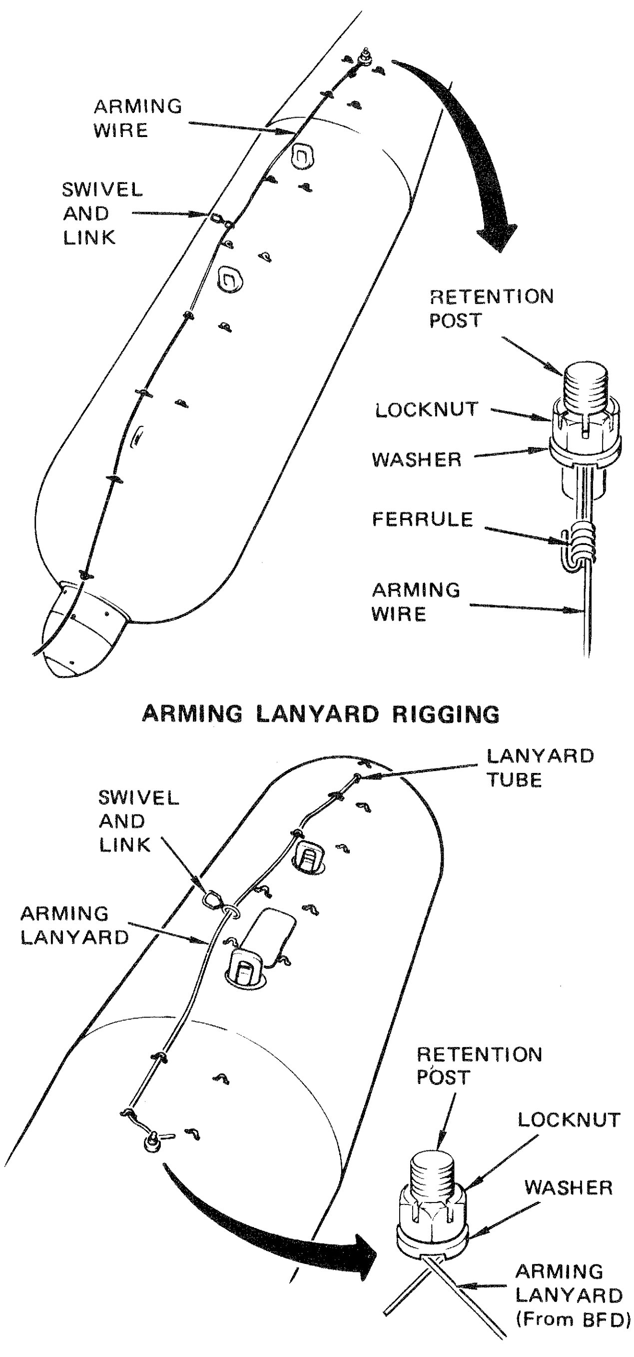
The arming and fin release wires of the Mk 20 Rockeye II are installed during manufacture. During preparation for munition loading, the extractor for each wire is positioned to place it near the solenoid to be used. The extractor for the fuze arming wire is installed in the bomb rack nose arming solenoid. The extractor for the Mk 20 Mod 3 and Mk 20 Mod 4 pilot option wire is installed in the bomb rack tail arming solenoid. The extractor for the fin release wire is secured to the ejector unit ejector gun removal pin (MER/TER) or bomb rack aft sway brace (MAU-12). Figure 1-109 depicts extractor positioning on the Rockeye II for multiple carriage.

FUZE SWITCH POSITIONING.

Due to the many different bomb type munitions carried, the different configurations of those munitions and the reversal of the MAU-12 bomb racks from the left wing

DISPENSER BOMB ARMING WIRE/LANYARD RIGGING

ARMING WIRE RIGGING



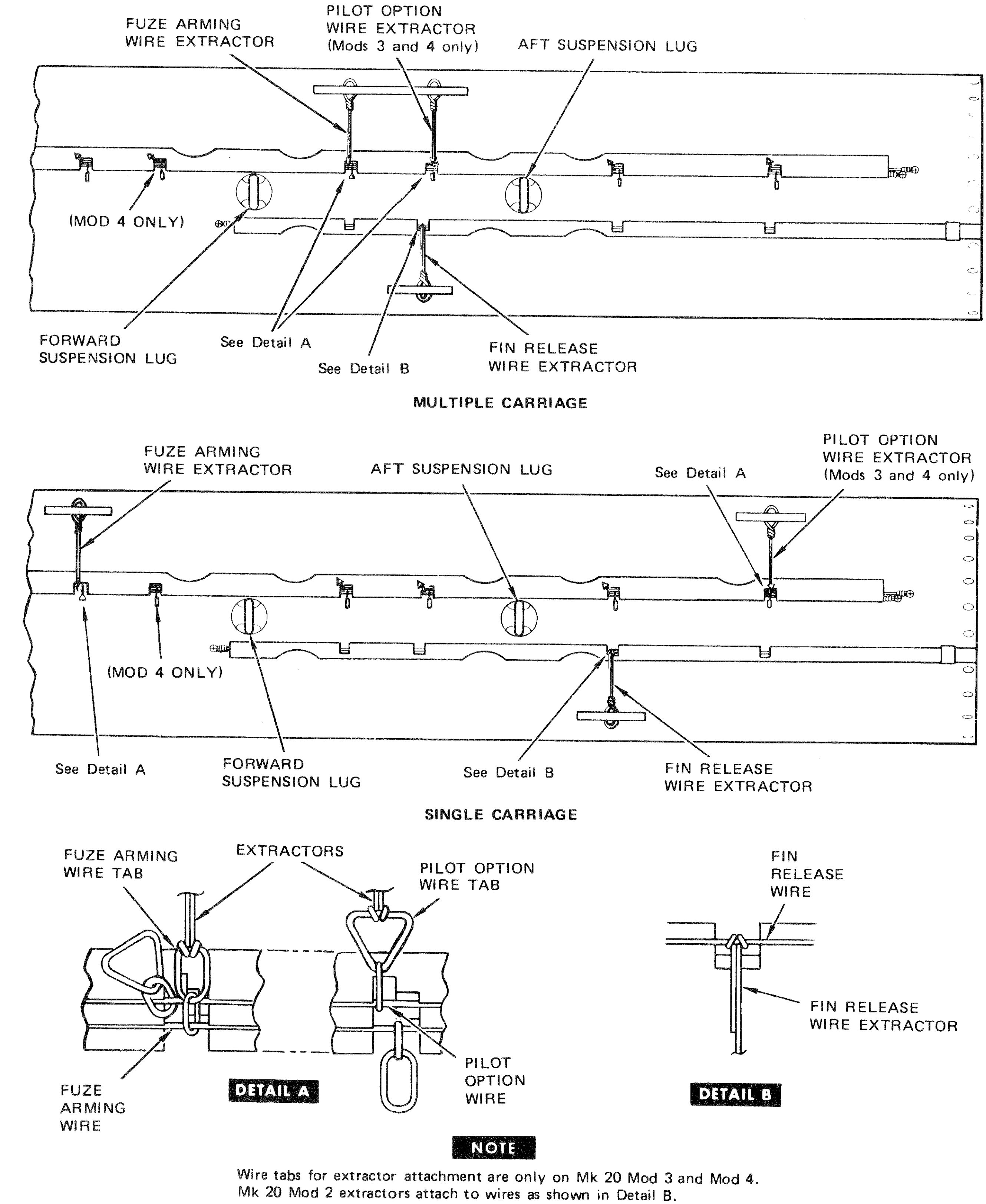
NOTE

Rigging shown applies to all bomb type (SUU-30 dispenser) CBU munitions.

78K176—08—80

Figure 1-108

ROCKEYE EXTRACTOR POSITIONING



NOTE

Wire tabs for extractor attachment are only on Mk 20 Mod 3 and Mod 4. Mk 20 Mod 2 extractors attach to wires as shown in Detail B.

78K006–08–80

Figure 1-109

to the right wing, FUZE switch positioning is critical if the munitions are to be released in the desired armed condition. Figure 1-110 depicts the results of FUZE switch positioning for each bomb type munition currently authorized.

MISSILE FUZES.

For information on the operation of AIM-9B, AIM-9E, and AIM-9J missile fuzes, refer to (Confidential) T.O. 1A-7K-34-1-1-1.

2.75-INCH ROCKET FUZES.

MK 176 AND MK 178 ROCKET WARHEAD FUZES.

The Mk 176 and Mk 178 point detonating fuzes (figure 1-111) have cone-shaped steel bodies that enclose an arming mechanism, firing mechanism, and an explosive train. The explosive train consists of a primer, detonator, booster, and, in the Mk 176 only, a 3-millisecond delay. In the unarmed condition, the arming mechanism is positioned and locked so that the primer, delay element, and detonator are out of alignment with the firing pin and booster lead-in. The fuze is armed by sustained acceleration. Once armed, the fuze remains armed until detonation. The Mk 176 and Mk 178 are used with the Mk 1 warhead.

When the rocket is launched, inertial forces resulting from acceleration cause the setback weights to move aft and free the rotor to turn. Sustained acceleration turns and locks the unbalanced rotor in the armed position and aligns the explosive train under the firing pin. On impact, the firing pin is driven against the primer and the exploding primer initiates the explosive train.

The Mk 178 is the same as the Mk 176 except that the delay element between the primer and the detonator has been removed and replaced by a flash tube to reduce fuze function time.

M427 ROCKET WARHEAD FUZE.

M427 fuze (figure 1-111) is a superquick action, impact-actuated rocket nose fuze. The fuze assembly consists of an inertial arming device, a mechanical firing mechanism, and an explosive train consisting of a primer, detonator, lead-in, and booster. The primer and booster are housed in an unbalanced arming rotor. In the unarmed condition, the rotor is locked in position so that the primer and detonator are out of line with the firing pin and the booster. Fuzing elements are housed in a conical aluminum case. The fuze is graze-sensitive with superquick action on impact and requires 20g for approximately 1 second to arm. M427 fuze is used on the M151 and M156 warheads.

When the rocket is launched, inertial forces resulting from acceleration move a setback weight aft and free the arming rotor to turn. Sustained acceleration causes the unbalanced arming rotor to turn and lock in the armed position. The explosive train is in line and the primer is aligned with the firing pin. The firing pin is driven against the primer on impact. The primer functions and initiates the explosive train.

MK 181 POINT DETONATING ROCKET WARHEAD FUZE.

The Mk 181 fuze assembly (figure 1-111) consists of an arming device, firing mechanism, and a shaped charge booster. The fuze contains an impact-sensitive primer and does not require a firing pin. Fuze arming is actuated by sustained rocket acceleration of approximately 20g. The Mk 181 fuze is used with the Mk 5 warhead.

When the rocket is launched, inertial acceleration forces free the rotor to turn. Sustained acceleration forces turn and lock the unbalanced rotor in the armed position. The explosive train is then in line. On impact, the primer functions and initiates the explosive train. The shaped charge booster detonates and projects a shock wave against a booster pellet at the base of the warhead. The booster pellet then ignites the warhead-shaped charge.

FUZE SWITCH POSITIONS AND RESULTS

WEAPON TYPE AND CONFIGURATION	SWITCH POSITION	RESULTS
Mk 82, Mk 83, Mk 84, M117 Series Low Drag GP Bombs MC-1 Gas Bomb	SAFE	Dud weapons
	NOSE	Nose fuze armed, tail fuze safe
	TAIL	Tail fuze armed, nose fuze safe
	NOSE/TAIL	Nose and tail fuzes armed
Mk 82 Snakeye Pilot Option	SAFE	Dud low-drag weapon
	NOSE	Low-drag, nose armed weapon
	TAIL	High-drag, nose and tail armed weapon
	NOSE/TAIL	UNSAFE. Improper switch setting. All weapons released high-drag, nose and tail armed. Snakeye fin failure may result in loss of aircraft and pilot.
Mk 82 Snakeye Fixed High-Drag and Mk 36 Destructor High-Drag	SAFE	Dud low-drag weapon
	NOSE	Improper switch setting. MER/TER and right wing MAU-12 weapons low-drag dud. Left wing MAU-12 weapons high-drag nose and tail armed.
	TAIL	Improper switch setting. MER/TER and right wing MAU-12 weapons high-drag nose and tail armed. Left wing MAU-12 weapons low-drag dud.
	NOSE/TAIL	All weapons high-drag nose and tail armed.
Mk 82 Snakeye Fixed Low-Drag and Mk 36 Destructor Low-Drag	SAFE	Dud weapons.
	NOSE	Improper switch setting. Dud destructors. Arming devices armed but firing mechanisms unarmed. MER/TER and left wing MAU-12 Snakeyes armed. Right wing MAU-12 Snakeyes dud.
	TAIL	Improper switch setting. Dud destructors. Firing mechanisms armed but arming devices unarmed. Right wing MAU-12 Snakeyes armed. MER/TER and left wing MAU-12 Snakeyes dud.
	NOSE/TAIL	All weapons released armed.
GBU-8 EOB GBU-10 LGB GBU-12 LGB	SAFE	Dud weapons.
	NOSE	Nose fuze armed, tail fuze safe
	TAIL	Tail fuze armed, nose fuze safe
	NOSE/TAIL	Nose and tail fuzes armed
BLU-1/27 Fire Bombs	SAFE	Dud weapons
	NOSE	Improper switch setting. MER/TER and right wing MAU-12 weapons dud. Left wing MAU-12 weapons armed.
	TAIL	Improper switch setting. MER/TER and right wing MAU-12 weapons armed. Left wing MAU-12 weapons dud.
	NOSE/TAIL	All weapons released armed.
Mk 20 Rockeye without Pilot Option Wire	SAFE	Dud weapons
	NOSE	All weapons released armed.
	TAIL	Improper switch setting. Dud weapons.
	NOSE/TAIL	All weapons released armed.

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Figure 1-110 (Sheet 1)

FUZE SWITCH POSITIONS AND RESULTS

WEAPON TYPE AND CONFIGURATION	SWITCH POSITION	RESULTS
Mk 20 Rockeye with Pilot Option Wire Installed	SAFE	Dud weapons.
	NOSE	All weapons released armed, primary fuze function time enabled.
	TAIL	Improper switch setting. Dud weapons.
	NOSE/TAIL	All weapons released armed, option fuze function time enabled.
CBU-24/49/ 52/58/71 Dispenser Bombs	SAFE	Dud weapons.
	NOSE	Improper switch setting. MER/TER and left wing MAU-12 weapons armed. Right wing MAU-12 weapons dud.
	TAIL	Improper switch setting. MER/TER and left wing MAU-12 weapons dud. Right wing MAU-12 weapons armed.
	NOSE/TAIL	All weapons released armed.
BDU-33 Practice Bombs on MER/TER	N/A	FUZE switch used only to enable release. Any position other than SAFE.
BLU-52 Chemical Bombs	N/A	FUZE switch not used as weapons contain no fuzes.

78K190(2)–08–80

Figure 1-110 (Sheet 2)

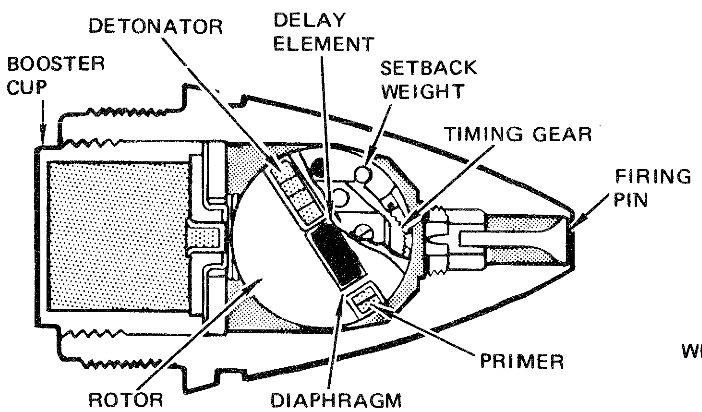
WDU-4A/A AND WDU-13/A FUZE.

The fuze used in the WDU-4A/A and WDU-13/A (figure 1-111) is an integral part of the warhead.

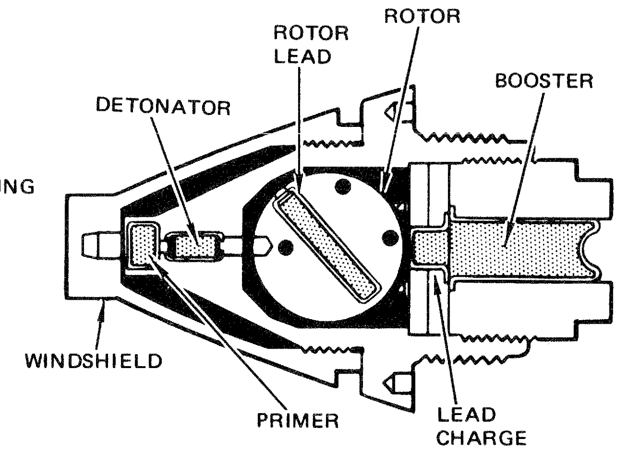
The fuzing element consists of an acceleration-actuated arming mechanism, a deceleration-actuated spring-loaded firing mechanism, a percussion primer, and an explosive charge. The primer is housed in an unbalanced arming rotor. In the unarmed condition, the rotor is locked in a position so that the primer is out of alignment with the firing mechanism and explosive charge. A pusher plate is installed between the explosive charge and the payload.

When the rocket is fired, inertial acceleration forces free the fuze arming rotor. The unbalanced rotor turns to the armed position and is locked in place. The primer is in line with the firing mechanism, and the fuzing mechanism is armed. At deceleration through 11g the firing pin strikes the primer. The primer initiates the explosive charge behind the pusher plate of the warhead. Pressure resulting from the exploding charge shears the warhead nose retaining pins and the flechettes are expelled.

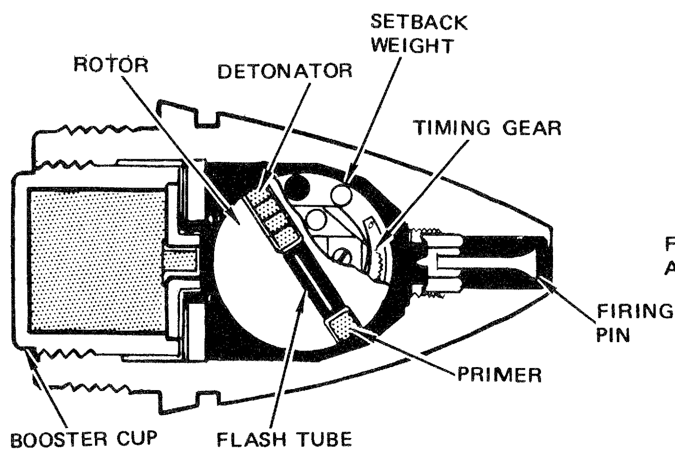
2.75-INCH ROCKET FUZES



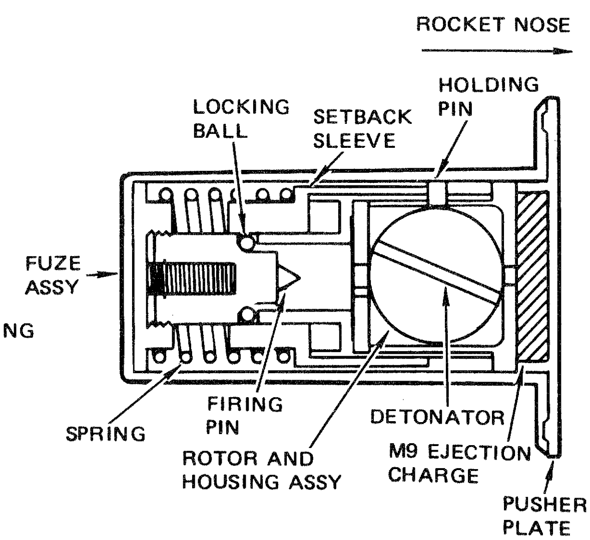
MK 176 FUZE
(Point Detonating)



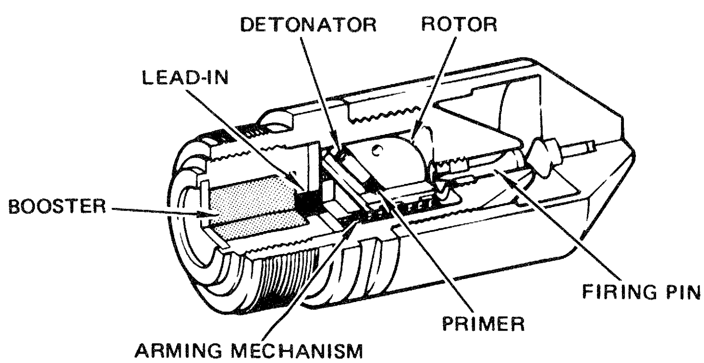
MK 181 FUZE
(Point Detonating)



MK 178 FUZE
(Point Detonating)



WDU-4A/A AND WDU-13/A
FUZING ELEMENT
(Inertia Detonating)



M427 FUZE
(Point or Graze
Detonating)

78K118-08-80

Figure 1-111

PART 8 – NONNUCLEAR TRAINING WEAPONS AND EQUIPMENT

SUU-20 SERIES BOMB AND ROCKET DISPENSER.

DESCRIPTION.

The SUU-20 series dispenser (figure 1-112) is an externally mounted pod which has both rocket launching and practice bomb ejection capabilities. The dispenser is designed to carry six BDU-33 series of Mk 106 practice bombs and four 2.75-inch FFAR rockets. The six practice bombs are carried in a recessed open bay and held in individual bomb ejector racks by retention arms, sway braces, and ejector pistons. The rockets are carried in four launch tubes, two on each side of the dispenser. The SUU-20/A-M and the SUU-20A/A are identical in external appearance with their most distinguishable feature being an externally mounted strongback running the length of the dispenser top surface. The SUU-20B/A is functionally identical to the SUU-20/A-M and SUU-20A/A. Physically, the SUU-20B/A differs in that the strongback is enclosed within the skin of the dispenser, the relative positions of the intervalometers have been reversed, and the method of sway bracing the practice bombs has been changed.

The practice bomb ejector racks consist of bomb retaining arms, sway braces, and an ejector piston assembly. The bomb retaining arms are adjustable for 3-inch or 4-inch bombs. The forward sway brace is a bolt with a metal inverted V on the lower end. On the SUU-20/A-M and SUU-20A/A, the aft sway brace is a spring-loaded wedge. The forward sway brace is screwed down to level the bomb horizontally and the aft sway brace is moved forward to wedge the bomb snugly in place. On the SUU-20B/A, one sway brace is a bolt with an inverted metal V on the lower end and the other sway brace is a bolt with a saddleback pad on the lower end. Both sway braces are screwed down until the bomb is horizontal and held snugly in place, with the legs of the inverted V and the legs of the saddleback pad straddling the bomb. The bomb ejector racks are rotated 180° from each other so that the cartridge holder will always be on the outboard side of the dispenser. This rotation places the saddleback sway brace pad aft on the right side and forward on the left side (aft looking forward) of the dispenser. The practice bomb ejector racks of the SUU-20B/A are replacing the racks of the SUU-20/A-M and SUU-20A/A by attrition. However, mixing of the two types of ejector racks on the same dispenser is not authorized. On both types of ejector racks, the ejector piston assembly operates within a breech housing and is driven by gas pressure generated when the impulse cartridge is electrically fired. Each ejector rack uses one ARD 863-1 impulse cartridge. An index pin on the ejector piston fits into a corresponding hole in the bomb to prevent the piston from sliding off the side of the bomb during ejection. Impulse cartridges are installed in the breech housing and retained by a cartridge holder. The cartridge holder is torqued and pinned in place to ensure it does not vibrate loose in flight.

The rocket tubes are 84 inches long and have spring-loaded rocket firing contacts at the rear of each tube. A detent assembly in each tube serves to restrain the rockets during takeoff and flight and provide a ground for the fire signal during rocket launching.

The dispenser has two intervalometers located forward in the recessed bomb bay in front of the practice bomb racks. On the SUU-20/A-M and SUU-20A/A, the bomb intervalometer is on the left and the rocket intervalometer is on the right. On the SUU-20B/A, the intervalometer positions are reversed. The bomb intervalometer has SINGLE, RIPPLE, and SALVO release modes with an ARM position and a SAFE position for each mode. The rocket intervalometer has SINGLE and RIPPLE firing modes with an ARM position and a SAFE position for each mode. Additionally, the rocket intervalometer has eight detented positions which are dead (empty) positions. Prior to loading, the intervalometers are placed in the SAFE position immediately in front of the release mode to be used; i.e., if the BOMB SINGLE release mode is to be used on the next flight, the bomb intervalometer is placed in the SALVO SAFE position. This ensures that

SUU-20 SERIES BOMB AND ROCKET DISPENSER

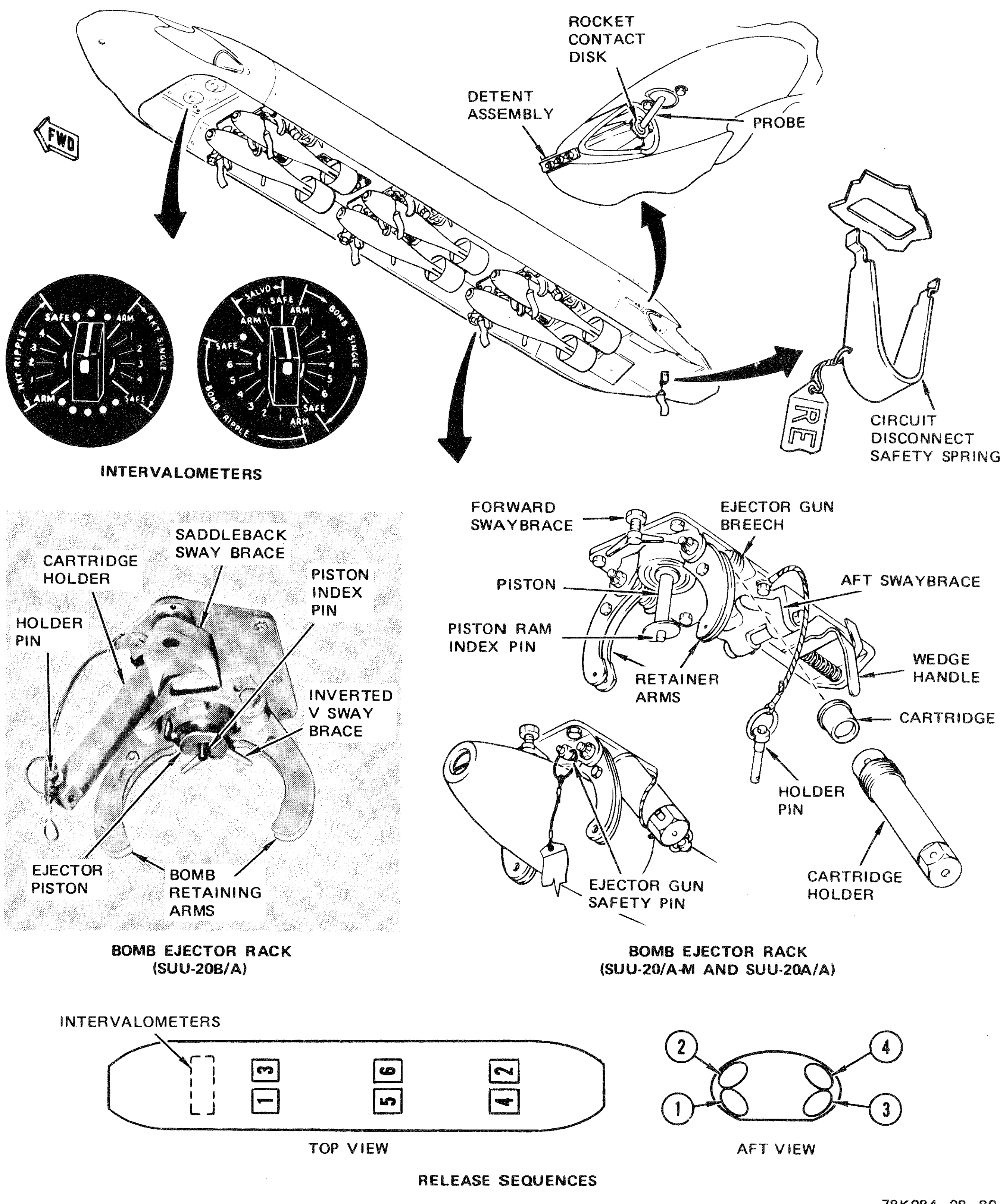


Figure 1-112

in setting the intervalometers during arming area checks, the intervalometer does not have to be cycled through any loaded stations.

CAUTION

The dispenser intervalometers use a step-and-fire sequence which means the release pulse to the dispenser is used to step the intervalometer before being applied to the rocket motor/impulse cartridge. This results in the leading edge of the fire pulse being applied to the switch position the intervalometer is in, prior to stepping to the next position. With a fully loaded dispenser, if the intervalometer(s) is set to position 1 instead of ARM, a double release (two practice bombs or two rockets) could occur upon application of the first fire pulse.

Ground safety is provided by a mechanical safety pin in each bomb rack, a circuit disconnect safety spring which opens the dispenser firing circuit, and the SAFE positions of the dispenser intervalometers. All safety pins and the safety spring are tagged with red caution flags.

OPERATION.

The 28-volt dc current required for dispenser operation is furnished through the MASTER ARM switch. When the MASTER ARM switch is placed in the ARM position, 28 volts activate a relay located within the dispenser. This relay eliminates the requirement that both bomb and rocket circuitry be available at the dispenser carrying station. This is accomplished by directing the firing pulses through this relay to the appropriate dispenser intervalometer. Bomb and rocket selection is accomplished by ASCU logic. When the appropriate station select switch (stations 2 and 7) is placed in RDY position, the BOMB MULTIPLE light or the ROCKETS light illuminates. If the mode indicated is not desired, cycling the station select switch to OFF and then back to RDY interrupts the ASCU circuit causing switchover to the other mode. For example, if moving the station select switch to RDY illuminates the ROCKETS light and bombs are desired, cycling that station select switch to OFF and then back to RDY deselects ROCKETS and selects BOMBS. The BOMB MULTIPLE light then illuminates.

For clarity of text the modes of operation are covered in a SINGLE, RIPPLE, and SALVO sequence. It will be assumed that the aircraft is configured with two dispensers.

NOTE

In the event a full bomb or rocket load is not carried, the bombs and rockets should be loaded in a manner that is compatible with the release sequence.

In addition to the release modes that may be selected within the SUU-20 series dispenser, aircraft cockpit selections are also available. To obtain this capability, set the bomb intervalometer in the SUU-20 dispenser to BOMB SINGLE.

SINGLE Mode Operation.

SINGLE mode operation allows the pilot to eject one bomb or fire one rocket at a time. The pilot has the option of selecting a single bomb release from the left dispenser and then the right dispenser with the sequence switch in SINGLE, or a simultaneous single release of like stores from both dispensers with the sequence switch in PAIRS.

RIPPLE Mode Operation.

The NAV WD computer is not compatible with the BOMB RIPPLE intervalometer selection in the SUU-20 series dispenser and a manual delivery is mandatory. With a quantity of 1 selected on the ARMAMENT RELEASE panel and the SINGLE/PAIRS/SIMULT switch set in SINGLE, all practice bombs release from the highest priority station selected at the fixed 100-millisecond dispenser interval. If stations 2 and 7 are selected, transfer to station 7 occurs with release of the ARMAMENT RELEASE button or by deselecting station 2. With the SINGLE/PAIRS/SIMULT switch set in PAIRS, all practice bombs release from both stations at the fixed 100-millisecond dispenser interval. Rockets may be fired in either VISUAL ATTACK or manual with the SUU-20 series rocket intervalometer set in RKT RIPPLE. Rockets fire at the fixed 100-millisecond dispenser interval.

NOTE

The pilot must hold the armament release button depressed for the duration of the RIPPLE sequence, which is approximately one-half second.

SALVO Mode Operation.

The NAV WD Computer is not compatible with the bomb SALVO intervalometer selection in the SUU-20 series dispenser and a manual delivery must be made. With a quantity of 1 selected on the ARMAMENT RELEASE panel and the SINGLE/PAIRS/SIMULT switch set in SINGLE, all practice bombs release simultaneously from the highest priority station selected. If stations 2 and 7 are selected, transfer to station 7 is obtained with release of the ARMAMENT RELEASE button or by deselecting station 2. With the SINGLE/PAIRS/SIMULT switch in PAIRS and stations 2 and 7 selected, all practice bombs release simultaneously from both stations.

PRACTICE BOMBS.

BDU-33 PRACTICE BOMB.

The BDU-33 (figure 1-113) is a 25-pound practice bomb designed for aircrew training in weapons delivery techniques. The teardrop shaped body is cast metal with a hollow round signal cavity running lengthwise through the center. A conical fin assembly, with a cruciform type fin, is roll-crimped into two grooves in the aft end of the bomb body. The fin assembly has a hollow tube which serves as an extension of the bomb signal cavity. A single suspension lug is installed in a lug well just forward of the center of gravity of the assembled bomb. For use in the SUU-20 series dispenser, this lug must be removed. For MER/TER carriage, this lug is replaced with a Mk 14 suspension lug.

BDU-33B/B Practice Bomb.

The signal cavity of an assembled bomb contains, from nose to tail, a firing pin assembly, a Mk 4 Mod 3 or Mod 4 signal cartridge or a CXU-2/B spotting charge, an inertia tube, and a cotter pin. When the Mk 4 cartridge is used, a safety (cotter) pin is installed between the signal cartridge and the firing pin assembly. Once the safety pin is removed, it cannot be reinstalled in the bomb until the bomb is disassembled. When the CXU-2/B is used, a safety clip is installed over the striker plate for ground safety. Impact of the bomb drives the signal cartridge, aided by the inertia tube, against the firing pin assembly, detonating the cartridge. The cartridge expels smoke and a flash from the tail of the bomb permitting visual observation of bombing accuracy.

BDU-33D/B Practice Bomb.

The BDU-33D/B practice bomb differs from the BDU-33B/B in that the spotting charge has been relocated from the tail to the nose of the bomb. Also, a new firing pin is used. A safety block prevents the firing pin from moving during ground handling operations. The ballistics characteristics are identical for both the BDU-33B/B and the BDU-33D/B.

MK 106 PRACTICE BOMB.

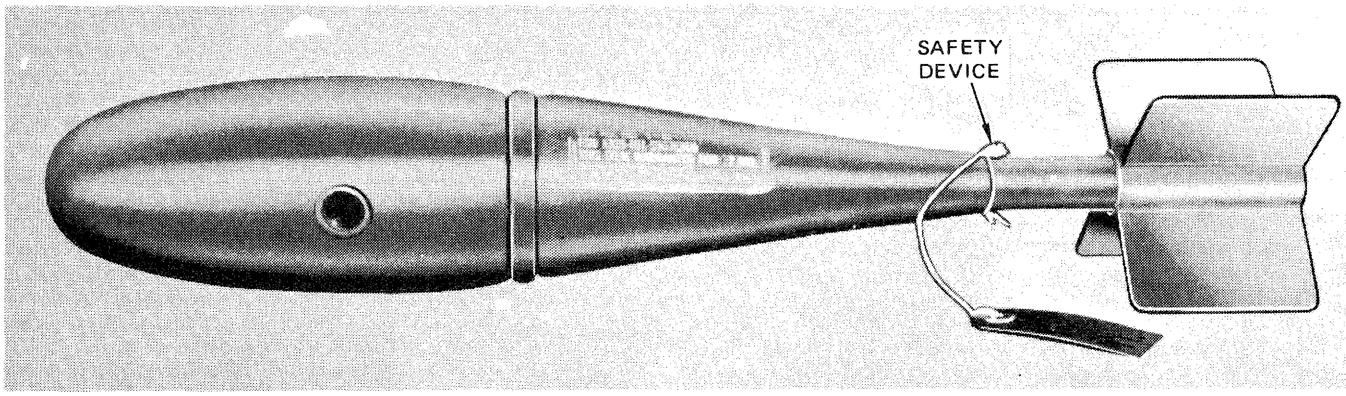
The Mk 106 (figure 1-113) is a 5-pound, thin-skinned practice bomb designed for aircrew training in retarded weapons delivery techniques. The bomb consists of an outer cylinder, an inner cylinder (sleeve), firing device, signal cartridge, and box fin assembly. The box fin assembly consists of four metal vanes welded to the aft end of the inner sleeve. On the Mk 106 Mod 4, the firing device was changed to a flat, circular nose plate the same diameter as the outer cylinder. The bomb has a retractable suspension lug which is not used on the A-7K.

The Mk 4 Mod 3 or Mod 4 signal cartridge or CXU-1/B spotting charge is installed in the sleeve with the primer toward the bomb nose. The firing device is installed and secured in the bomb nose. Impact of the bomb after release causes the spring-loaded firing device to collapse, detonating the signal cartridge spotting charge. Smoke from the cartridge permits visual observation of bombing accuracy.

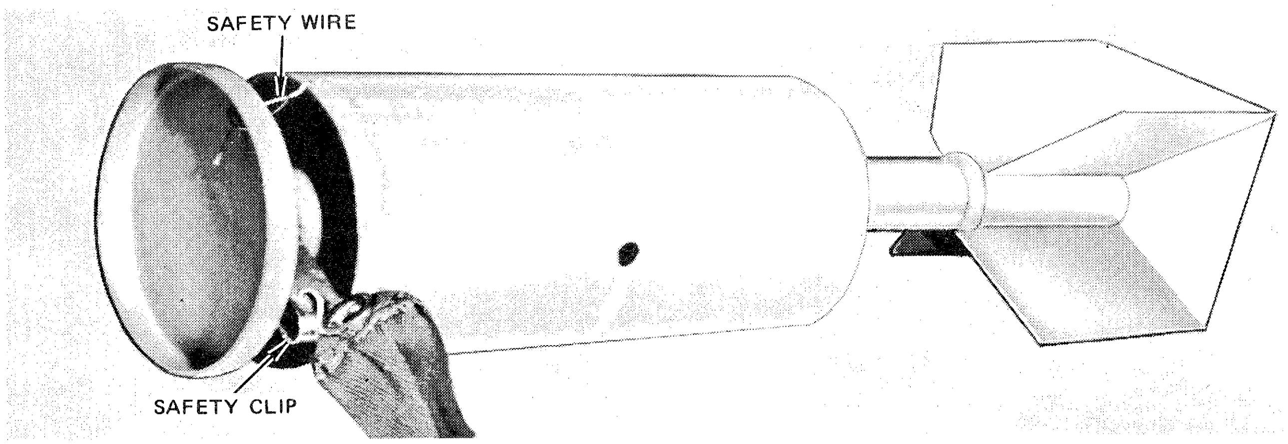
MK 4 MOD 3 AND MK 4 MOD 4 SIGNAL CARTRIDGE.

The Mk 4 Mod 3 signal cartridge (figure 1-114) closely resembles a 10-gage shotgun shell. The cartridge has an aluminum case with a commercial shotgun primer. The case is filled with an expelling charge of smokeless powder and a marker load of stabilized red phosphorus.

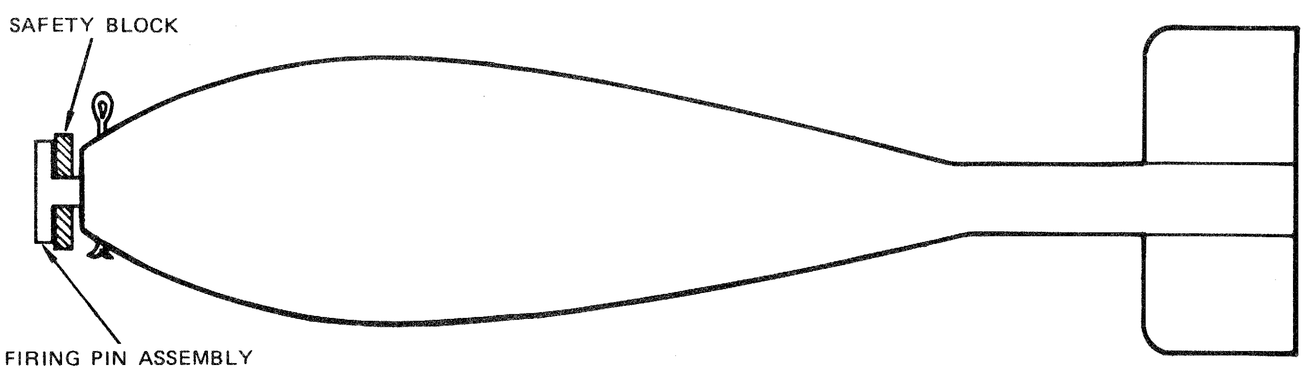
PRACTICE BOMBS



BDU-33B/B



MK 106 MOD 4



BDU-33 D/B

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Figure 1-113

MK 4 SIGNAL CARTRIDGES

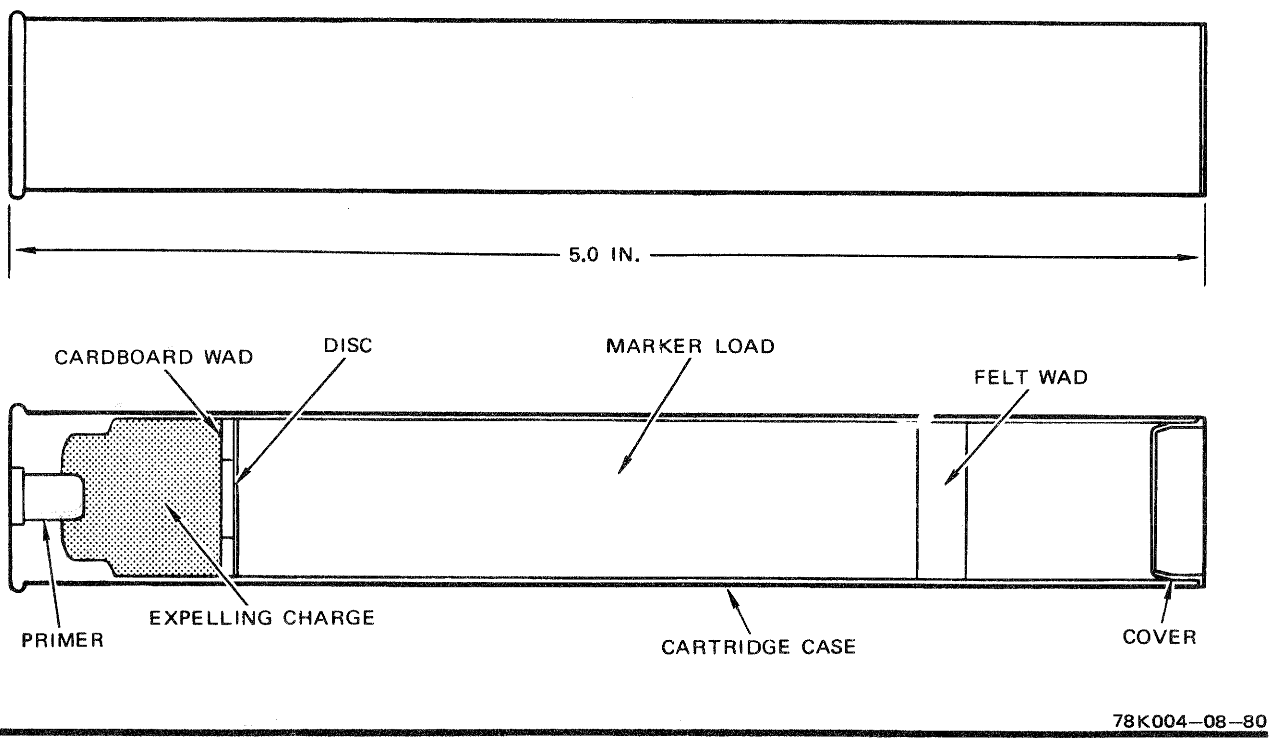


Figure 1-114

The Mk 4 Mod 4 signal cartridge is identical to the Mk 4 Mod 3 except that the red phosphorus has been replaced by colored (red) powder due to fire hazards encountered when phosphorus is used.

CXU-1/B BOMB SPOTTING CHARGE.

The CXU-1/B, used in the Mk 106 practice bomb, consists of a round tube with a firing pin assembly, shear pin primer, propellant charge, and marker load of titanium tetrachloride. When installed in the Mk 106, the forward end of the tube is attached to the bomb striker plate and extends from the rear of the bomb. A spring steel dish-shaped retaining ring at the bomb tail holds the tube in place.

CXU-2/B BOMB SPOTTING CHARGE.

The CXU-2/B, used in the BDU-33 practice bomb (figure 1-115) consists of a round tube with a striker plate, internal shear wire, firing pin, primer, propellant charge, and marker load of titanium tetrachloride. When installed in the BDU-33B/B, the flange on the forward end fits against the bomb nose and approximately 3/8 inch of the tube extends from the rear of the bomb. A horseshoe shaped safety clip fits around the striker plate, preventing plate movement. A retaining ring at the aft end of the tube holds the charge in place.

CXU-2/B INSTALLED IN BDU-33B/B

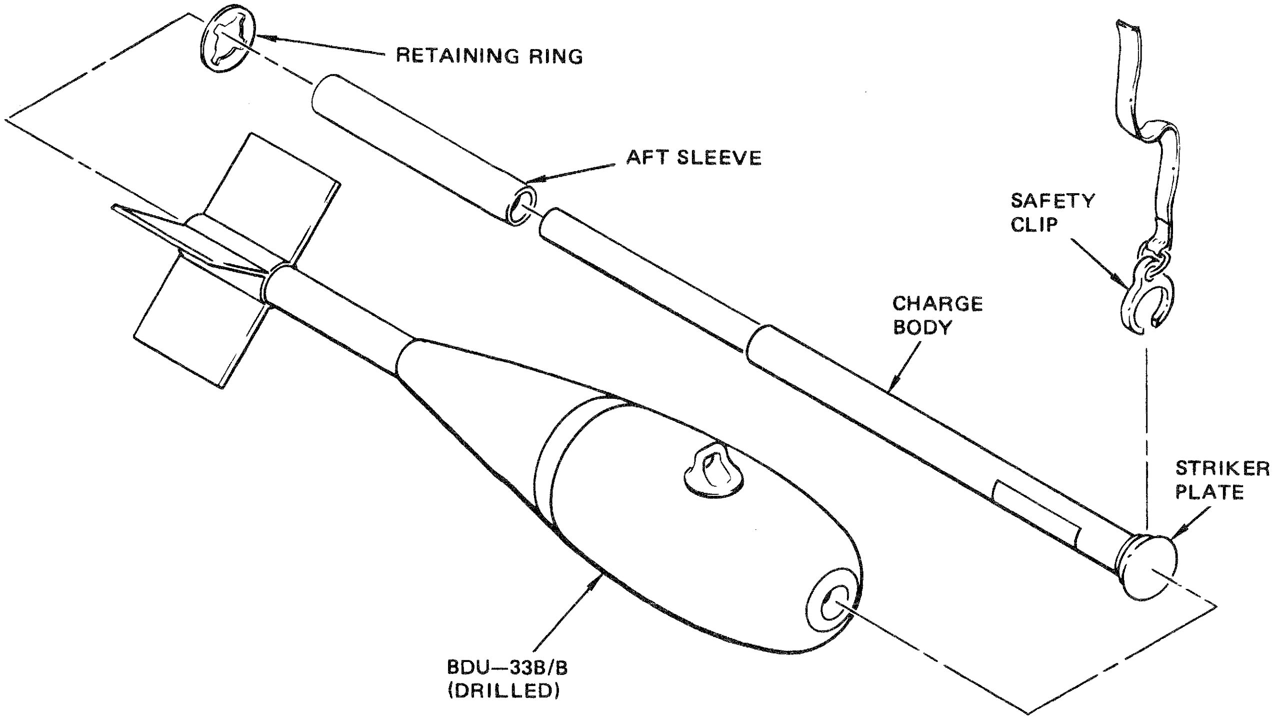


Figure 1-115

TDU-11/B TARGET ROCKET (5-INCH HVAR).

The TDU-11/B target rocket (figure 1-116) is a modified 5-inch HVAR (high velocity aircraft rocket). Four tracking flares have been added to the rocket tail fins to increase the emitted infrared energy to produce a stronger target for the AIM-9 Sidewinder missile. The rocket is carried and fired from the same launcher (AERO 3B) as the AIM-9 missile. The firing signal is received through an electrical cable (rocket pigtail) that is plugged into and taped to the AERO 3B launcher.

NOTE

A shorting plug must be used with the target rocket. If the shorting plug is not connected, the target rocket cannot be fired.

The TDU-11/B target rocket is selected and launched in the same manner as the AIM-9 missile. The target rocket is loaded on one fuselage station and the Sidewinder is loaded on the other fuselage station.

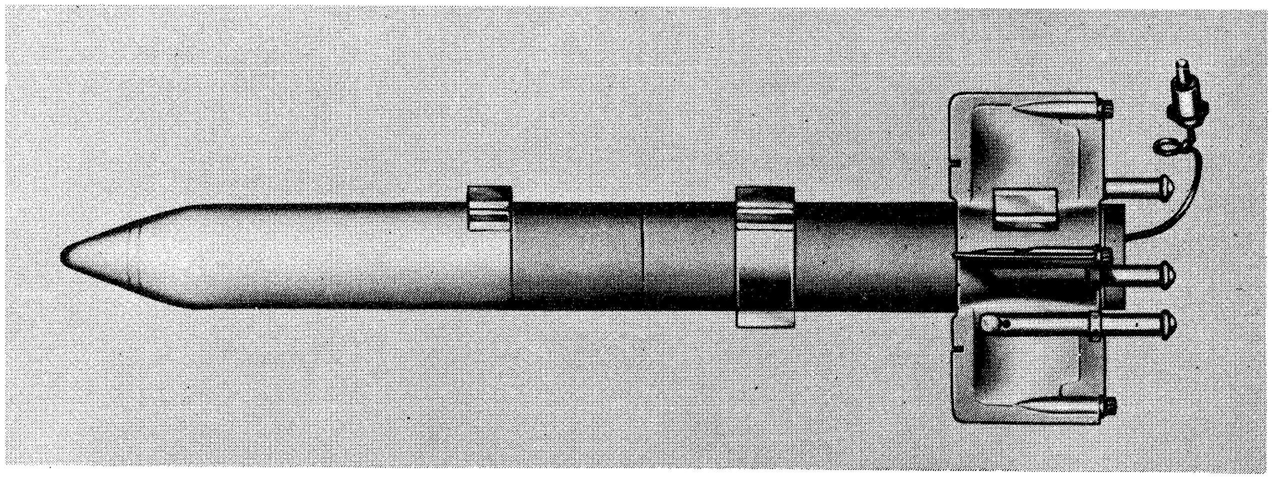
A/A 37A-T SERIES MAVERICK (AGM-65) TRAINING GUIDED MISSILE.

The Maverick training guided missile (TGM) (figure 1-117) is a captive training device used to train pilots in the use of the AGM-65A/B missile, in video target acquisition, and in tactics. The TGM is identical to the AGM-65A/B missile, except there are no external control surfaces, the warhead has been replaced by a signal processing unit and ballast, the rocket motor has been replaced by film recorder and/or ballast, and the guidance unit has no autopilot functions. The inflight switch position are the same for the TGM as for the live AGM-65A/B missile. The TGM can be suspended from any LAU-88/A launcher position. The TGM has no igniter cable to be connected.

The TGM is a modular training device made up of any one of three guidance units mated to any one of two center-aft sections. A/A37A-T3 and A/A37A-T4 guidance units provide the same cockpit display as the AGM-65A tactical missile. A/A37A-T5 guidance units provide the same cockpit display as AGM-65B tactical missiles. Differences between A/A37A-T3 and A/A37A-T4 guidance units are minimal, and with regard to aircrew procedures and cockpit displays, nonexistent. They differ from the tactical missile guidance unit only in their lack of autopilot functions. A/A37A-T5 guidance units are identical to AGM-65B guidance units in every respect except external markings. The A/A37A-T7 center-aft section is equipped with a film recorder. The film ceases to run upon actuation of the aircraft armament release button, simulating missile launch, or upon deselection of the station. The A/A37A-T6 center-aft section has ballast in the place of the recorder.

TDU-11/B TARGET ROCKET

5-INCH HVAR

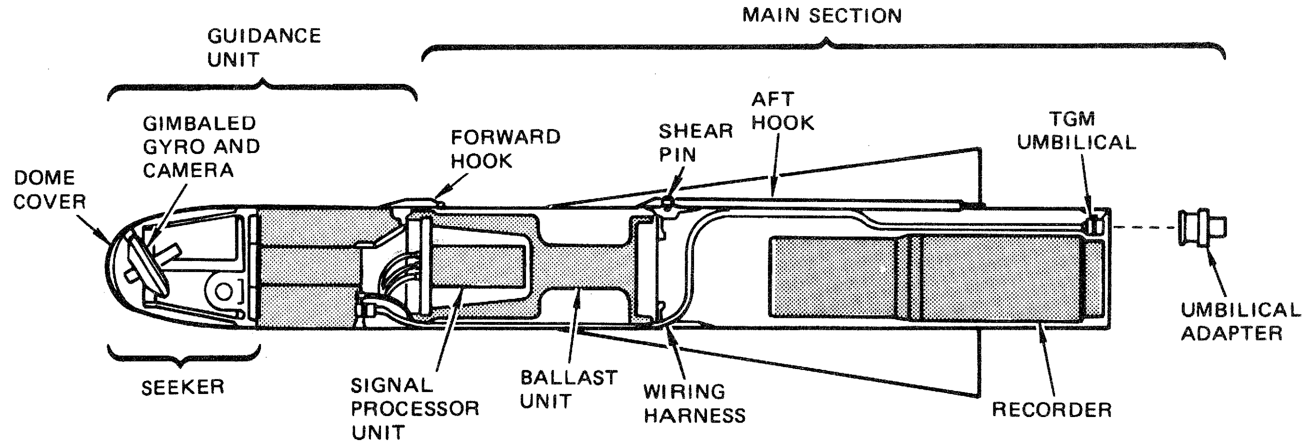


Weight	215.0 pounds
Length	6.0 feet, 6.0 inches
Diameter	5.0 inches
Rocket Head	Lead-Filled Mk 6, Mod 1

78K095–08–80

Figure 1-116

MAVERICK (AGM-65) TRAINING GUIDED MISSILE



Weight	475 pounds (approximate)
Length	97.7 Inches
Diameter	12.0 Inches
Stabilizer span	28.5 Inches
Recording time	30 Minutes @ 3.75 frames per second 15 Minutes @ 7.5 frames per second

78K186—08—80

Figure 1-117

SECTION II
NORMAL AIRCREW PROCEDURES

TABLE OF CONTENTS.

INTRODUCTION.

In accordance with AFR 60-9, the pilot is required to use these procedures when operating the aircraft with nonnuclear weapons. (The following pertains only to Weapon Preflight.) This section contains an exterior (preflight) inspection of suspension equipment and nonnuclear weapons that is considered mission essential. The pilot is not required to perform the mission essential checklist items; the correct installation of suspension equipment and nonnuclear weapons is the responsibility of certified load crews. However, the pilot may perform the mission-essential exterior checks if desired. The exterior (preflight) inspection items preceded by an asterisk (*) are considered safety of flight items which should be checked by the pilot if time permits.

NOTE

During Delayed Flight or Alert, certain safety pins may be removed and electrical cable plugs may be connected as directed by Major Command or as directed by Local Commander during combat conditions. Checklist items assigned to be performed in the arming area may be performed in any designated area when the aircraft is on delayed flight or alert status.

The procedures contained in this section are reproduced in checklist form and presented in T.O. 1A-7K-34-1-1CL-1. When this section is changed or revised, the checklist will be changed concurrently.

PREFLIGHT CHECKS.

PYLON AREA (GENERAL). (Figure 2-1.)

*1. MAU-12 cartridge retainers — Checked

NOTE

Local commanders have the option of installing and safety wiring empty MAU-12 cartridge retainers. MAU-12 cartridge retainers found in this condition may be assumed to be empty.

2. MAU-12 ground safety pin — Installed in rack

3. MAU-12 sway braces — Tight, locknuts tight

4. MAU-12 ejector feet — Lightly contacting munition

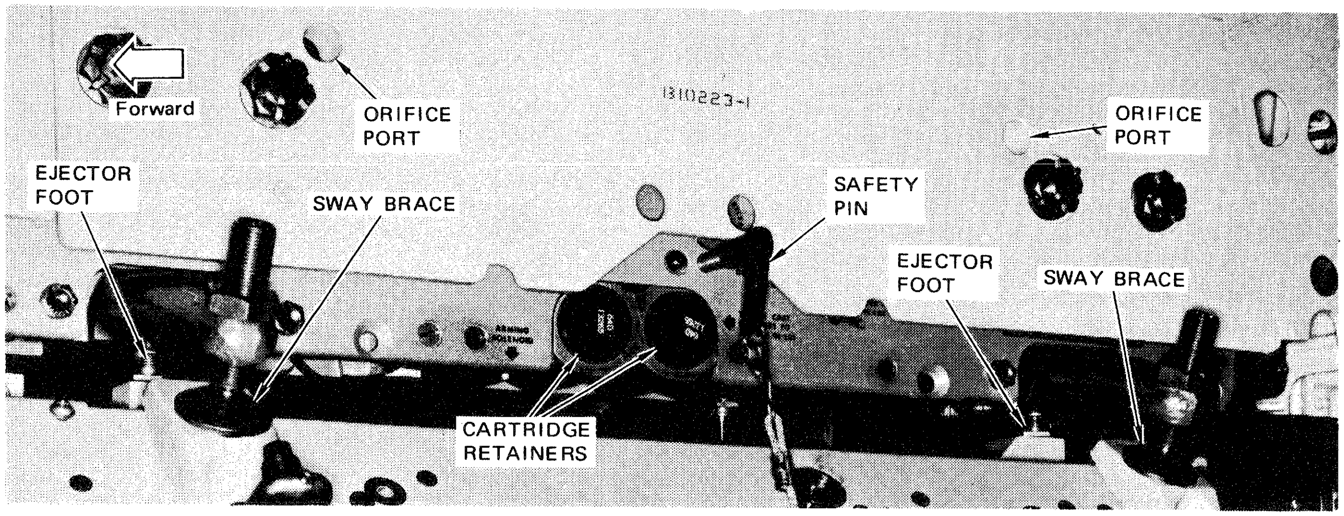
5. Weapons — Secure, proper station, condition

CAUTION

If bomb type munitions are loaded, ensure arming wires, fin release wires, and arming lanyards are routed so they will not hang on ejector feet, sensing switches, or sway brace pads. Improper routing may result in armed munitions when safe release is intended or undesirable arming combinations.

6. Orifice settings — Checked (figure 2-2)

WING PYLON AREA (GENERAL)



78K153–08–80

Figure 2-1

MAU-12 ORIFICE SETTINGS

MUNITION/ACCESSORY	ORIFICE NUMBER*	
	FORWARD	AFT
Mk 82/83/84 LDGP Bombs	7	5
Mk 82 Snakeye Bomb	7	5
GBU-12 LGB	7	5
GBU-8 EOB/GBU-10 LGB	6	7
M117 Series GP Bomb	7	5
MC-1 Gas Bomb	7	5
Mk 36 Destructo	7	5
BLU-1C/B Fire Bomb	5	5
BLU 27 Series Fire Bomb	5	5
BLU-52 Series Chemical Bomb	5	5
LAU-3 Series Launcher	7	5
LAU-68 Series Launcher	7	5
SUU-23/A Gun Pod	7	6
SUU-7 Series Dispenser	7	5
BL-755 Bomb Cluster	7	5

MUNITION/ACCESSORY	ORIFICE NUMBER*	
	FORWARD	AFT
SUU-13 Series Dispenser	7	5
SUU-20 Series Dispenser	7	5
SUU-25 Series Dispenser	5	7
SUU-42 Series Dispenser	7	5
CBU-24/49/52/58/71 Dispenser Bombs	7	5
Mk 20 Rockeye Cluster Bomb	7	5
AGM-65 Missile/TGM	7	4
MER-10N/TER-9A (with any store except AN/APX-95 loaded)	7	6
MER-10N/TER-9A (with AN/APX-95 installed)	7	5
ECM Pods**	7	5
300 Gallon Fuel Tank	7	7

*Orifice number is dash number of part number 64D13176–. An orifice installed with no number visible and a port drilled through the complete length of the orifice is a –6 orifice.
**AN/ALQ-71(V)-4 takes a –7 forward and a –7 aft; AN/ALQ-119(V)-2, –5, –8, and –13 pods take a –7 forward and a –6 aft. When ECM pods are loaded without jettison capability (no cartridges installed), the orifice installed is unimportant. Any orifice may be installed to keep contamination out of the MAU-12 system.

78K021–08–80

Figure 2-2

MER/TER.

1. Pylon aft electrical access door — Open; connections — mated; locking collar ball — locked; access door — secured (figure 2-3)

CAUTION

If the holes in the knurled ring on the master harness do not engage the protrusions on the pylon receptacle and if installed, the 90° adapter, loss of the MER/TER may occur.

NOTE

The pylon harness for the SUU-23/A gun pod and the pylon harness for MER/TER/SUU-20 are single electrical cables.

2. MER/TER selector switch — Set for munition type suspended

NOTE

When bomb type munitions are loaded on a MER/TER, the position of the MER/TER selector switch need not be checked. When CBU-12 or CBU-46 series munitions are loaded, switch must be in CBU position. When rocket launchers or SUU-25 series flare dispensers are loaded, switch must be in ROCKETS position.

3. Electrical safety pin — Installed

4. Mechanical safety pin — Installed (figure 2-4)

5. Sensing switch guard — Removed (figure 2-4)

The ejector unit sensing switch must be in contact with the munition suspended or be fully extended on empty ejector units for the MER/TER stepping circuits to function properly.

*6. Breech caps (3 for TER, 6 for MER) — Checked

BOMB TYPE MUNITIONS.

BDU-33 Practice Bombs.

1. Safety devices/clips/blocks — Removed (if applicable)

PYLON ELECTRICAL CONNECTION

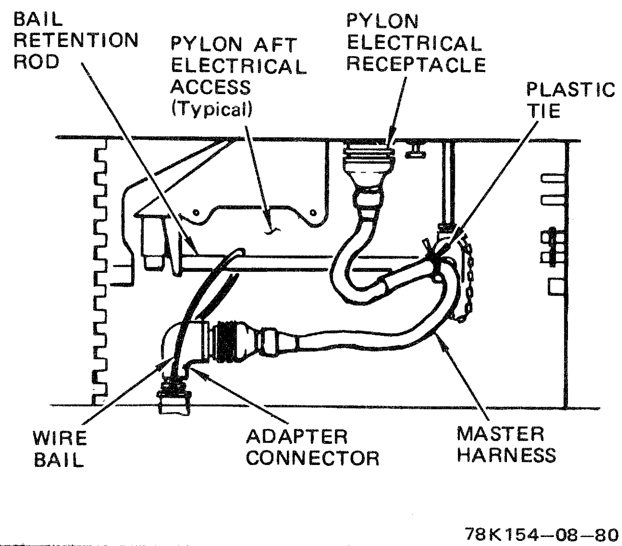


Figure 2-3

NOTE

Local commanders may authorize retention of safety device/clip/blocks in BDU-33B/B until immediately prior to launch.

2. Short piston — Installed, fully extended

3. Torsion spring — Installed, compressed

BLU-1C/B and BLU-27 Series Fire Bombs.

1. Initiator shear wire/safety pin (FMU-7A/B and FMU-7B/B) — Installed, wire twisted

   Ensure the shear wire is looped and twisted to prevent the wire from pulling out.

2. Arming lanyard swivel and link — Installed in solenoid (center solenoid on MAU-12, tail solenoid on MER/TER)

3. Nose cap — Secure

4. Tail fin/cap — Secure

MER/TER EJECTOR UNIT (TYPICAL)

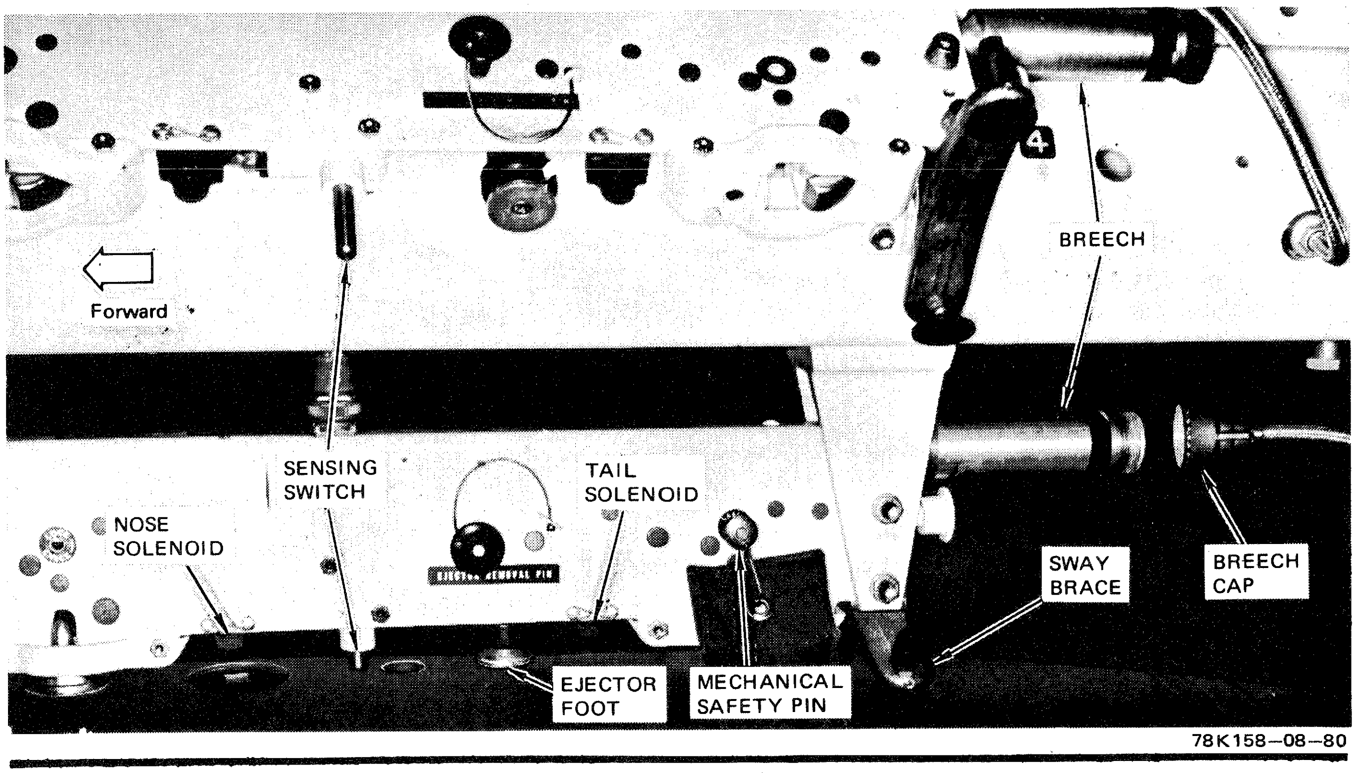


Figure 2-4

BLU-52 Series Chemical Bombs.

1. Nose cap — Secure
2. Tail fins — Secure

Mk 82, Mk 83, and Mk 84 LDGP, M117 GP, and MC-1 Gas Bombs.

1. Fuze safety devices/ATU-35 safety pins — Removed (figures 2-5 and 2-6)
2. Arming wire retaining clips — Installed, one per M-series fuze (figures 2-5 and 2-6)

*3. Fuze setting (marked on bomb) — Checked, matches mission requirements

4. Fin assembly — Checked, secure
5. ATU-35 restraining pin — Prevents drive from rotating (figure 2-6)
6. Arming wires/lanyards — Installed, secure (figure 2-7)
7. Arming wire/lanyard swivel and links — Installed in solenoids

Mk 82 Snakeye I with M904/FMU-54 Series.

1. Fuze safety device (M904) — Removed (figure 2-5)
2. Arming wire retaining clip (M904) — Installed, one per fuze (figure 2-5)

M904 SERIES FUZE INSTALLED

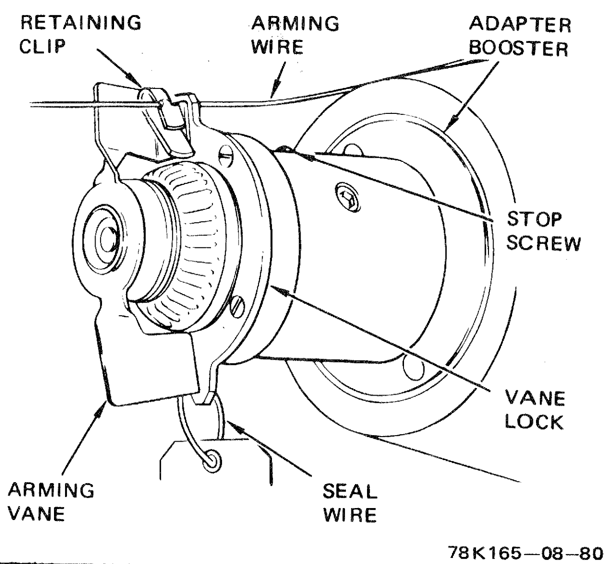


Figure 2-5

ATU-35 DRIVE INSTALLED

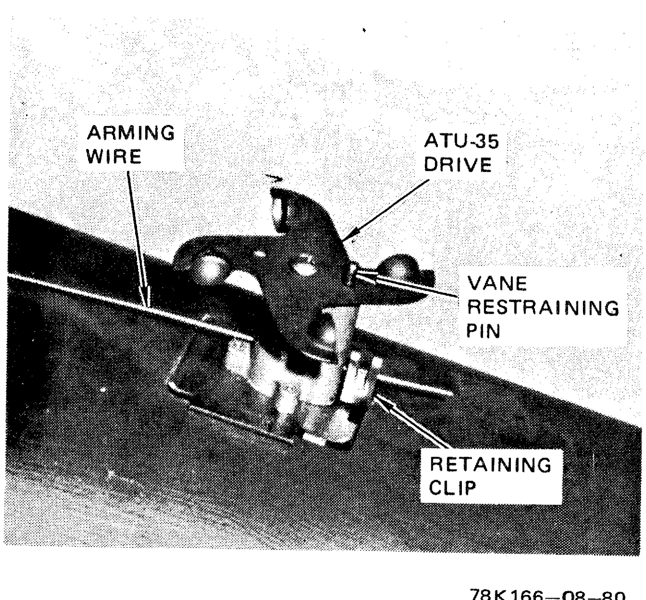


Figure 2-6

*3. Fuze setting — Checked, matches mission requirements

The fuze setting for M904 fuzes is visible on the fuze and the delay element time for the M904 is marked on the bomb by the load crew. The fuze setting for the FMU-54 series is marked on the bomb.

WARNING

For pilot option bombs, the M904 nose fuze shall have a minimum arming time setting of 6 seconds and the FMU-54 series tail fuze shall have a minimum arming time setting of 2.5 seconds.

4. Arming wire (M904) — Installed, secured to fin clevis bolt (figure 2-8)

5. Arming wire swivel and link (M904 pilot option/fixed low-drag) — Installed (nose solenoid for MER/TER, center solenoid for MAU-12)

6. Arming lanyard (FMU-54/B pilot option) — Installed through fin release wire swivel and link, secured to lanyard lock (figure 2-8)

7. Arming cord (FMU-54A/B pilot option) — Attached to fin release wire swivel and link (figure 2-8)

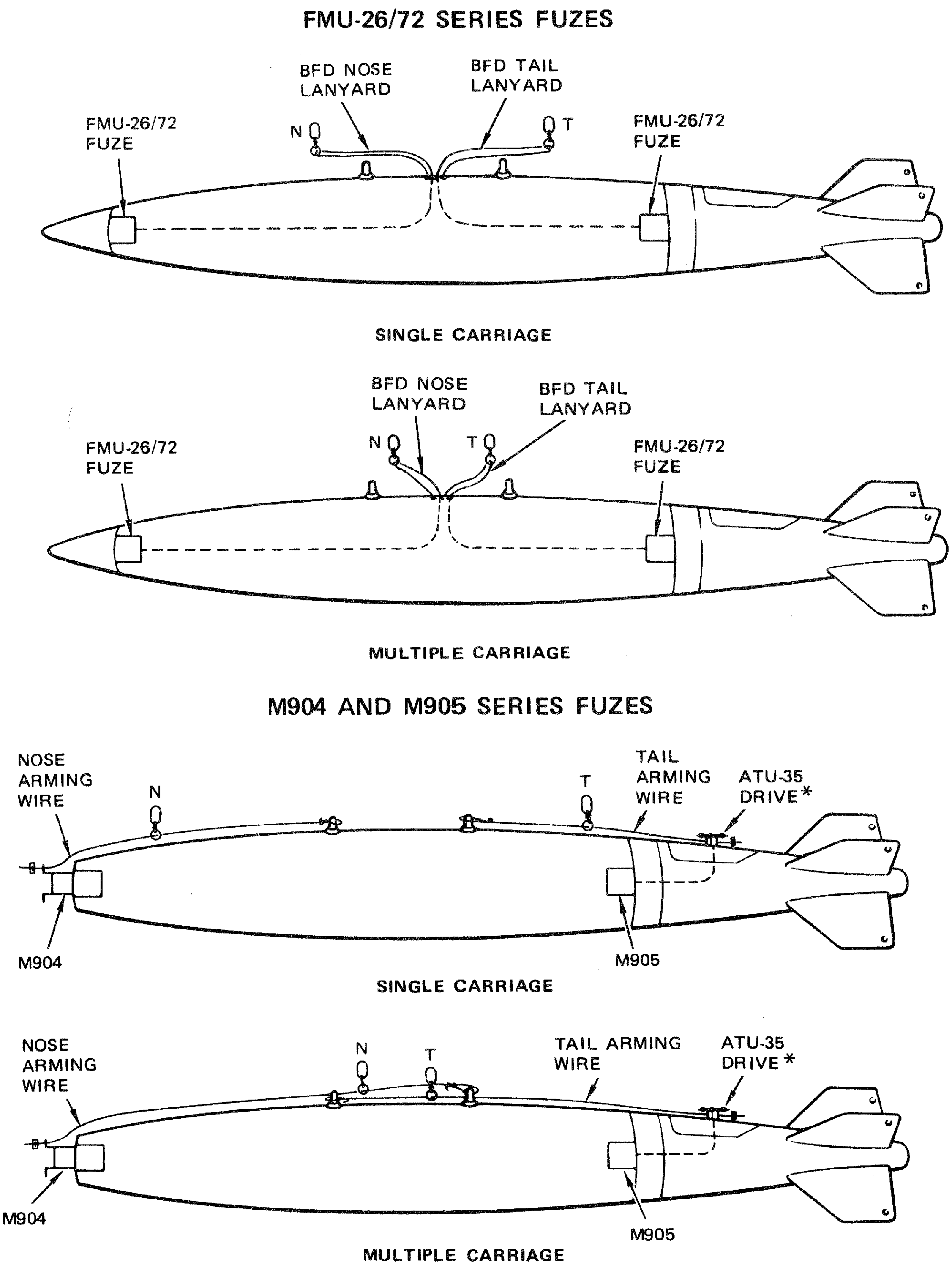
8. Arming lanyard/cord swivel and link (FMU-54 fixed high-drag) — Installed (nose solenoid for MER/TER, center solenoid for MAU-12)

*9. Fin release wire (except fixed low-drag) — Checked (figure 2-8)

The fin release wire must extend through the fin release band latch, guide tube, and 1/2 inch aft of end of tube. A Fahnestock clip must be installed on the fin release wire against the aft end of the guide tube.

10. Fin release band safety pin (except fixed low-drag) — Removed

GP BOMBS ARMING WIRE AND ARMING LANYARD RIGGING



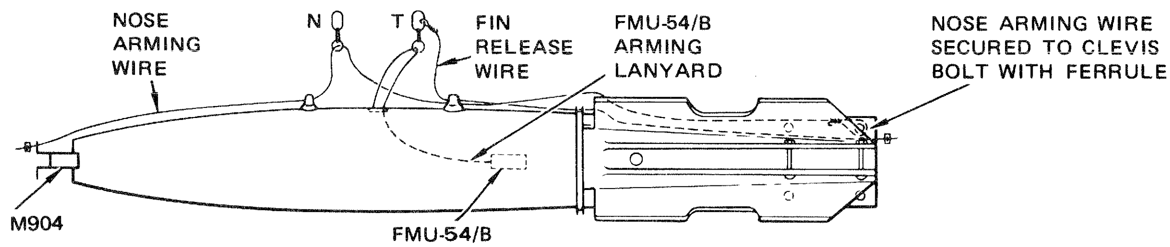
* Not intended to show actual location of ATU-35 drive. M117 uses cutout closest to lug; Mk 80 series uses cutout within 90° of top centerline of fin.

78K188—08—80

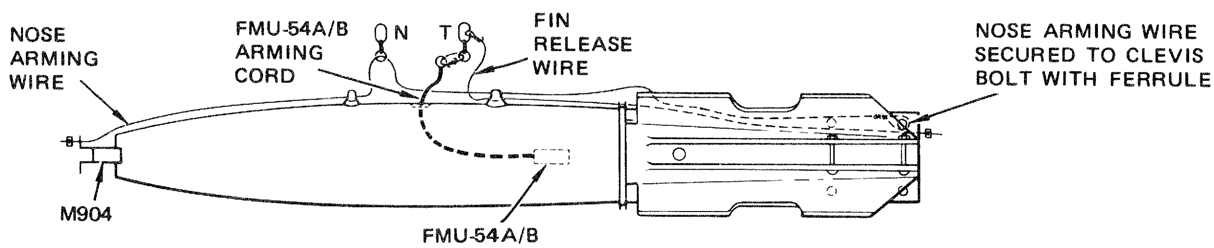
Figure 2-7

MK 82 SNAKEYE AND MK 36 DESTRUCTOR FIN RELEASE WIRE, ARMING WIRE, AND ARMING LANYARD RIGGING

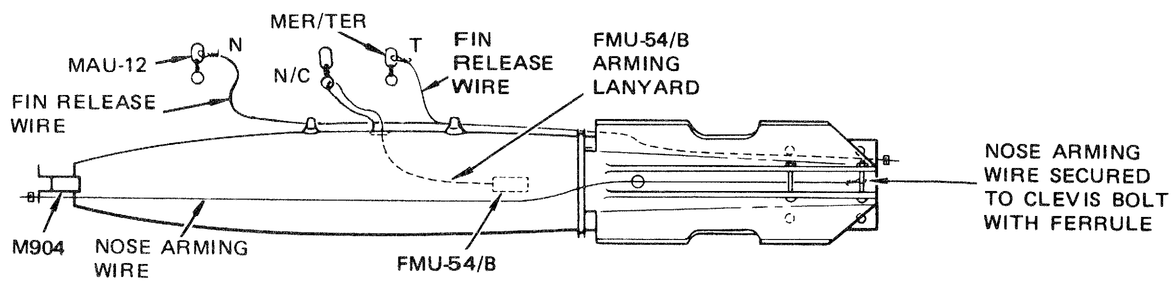
MK 82 SNAKEYE



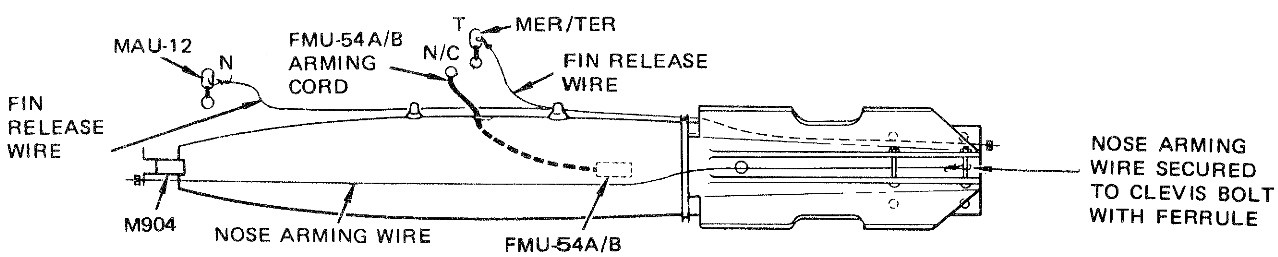
PILOT OPTION BOMB – MULTIPLE CARRIAGE (M904 AND FMU-54/B)



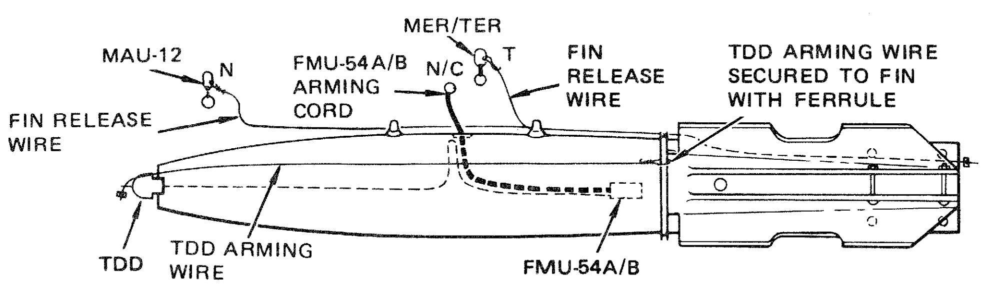
PILOT OPTION BOMB – MULTIPLE CARRIAGE (M904 AND FMU-54A/B)



FIXED HIGH-DRAG BOMB – MULTIPLE/SINGLE CARRIAGE (M904 AND FMU-54/B)



FIXED HIGH-DRAG BOMB – MULTIPLE/SINGLE CARRIAGE (M904 AND FMU-54A/B)



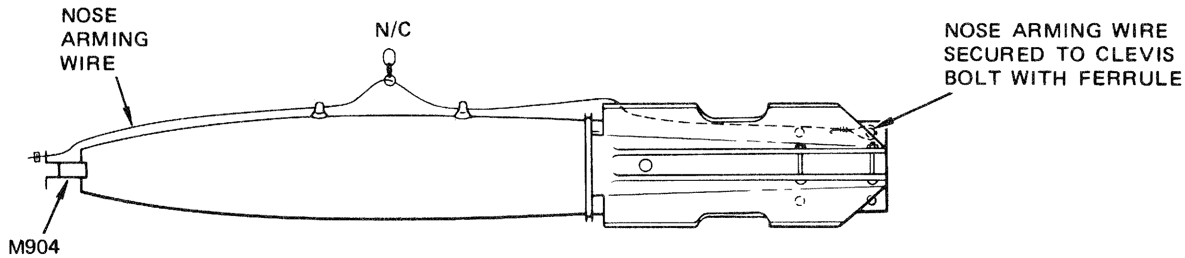
FIXED HIGH-DRAG BOMB – MULTIPLE/SINGLE CARRIAGE (MK 43 TDD AND FMU-54A/B)

78K187(1)–08–80

Figure 2-8 (Sheet 1)

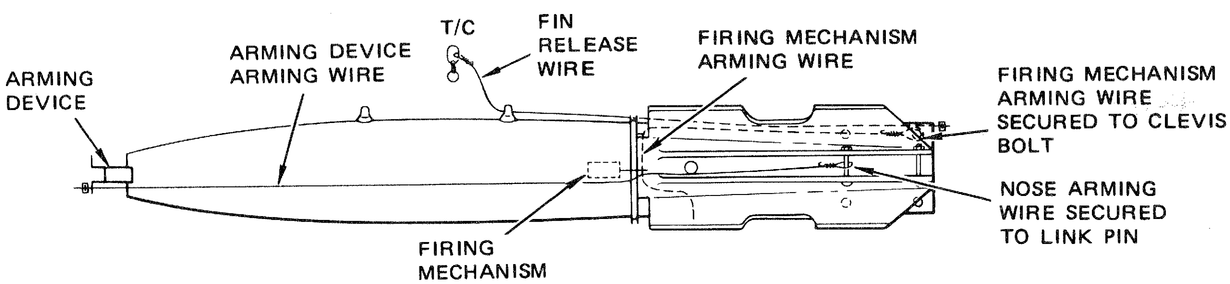
MK 82 SNAKEYE AND MK 36 DESTRUCTOR FIN RELEASE WIRE, ARMING WIRE, AND ARMING LANYARD RIGGING

MK 82 SNAKEYE

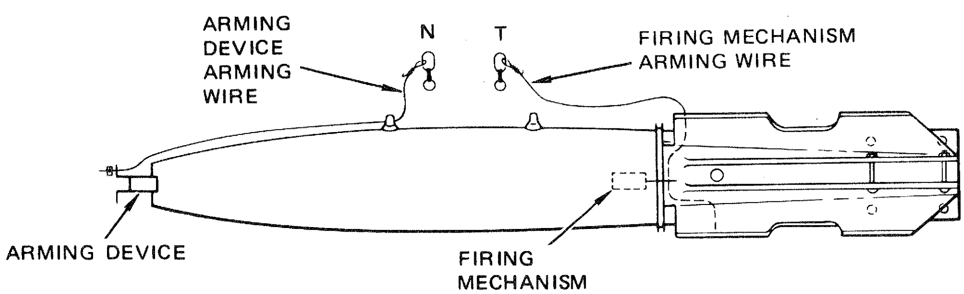


FIXED LOW-DRAG BOMB – MULTIPLE/SINGLE CARRIAGE (M904 ONLY)

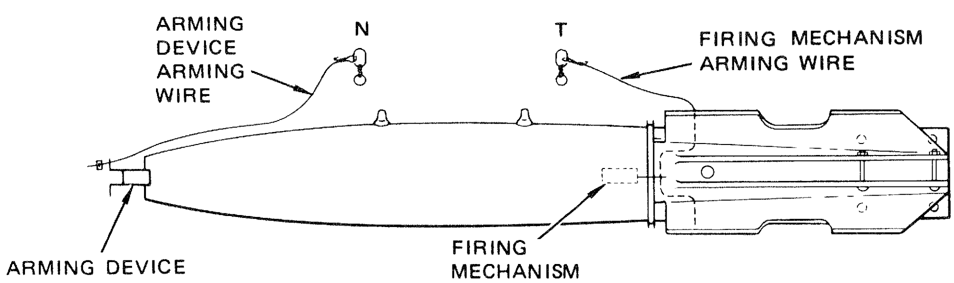
MK 36 DESTRUCTOR



FIXED HIGH-DRAG DESTRUCTOR – MULTIPLE/SINGLE CARRIAGE



FIXED LOW-DRAG DESTRUCTOR – MULTIPLE CARRIAGE



FIXED LOW-DRAG DESTRUCTOR – SINGLE CARRIAGE

78K187(2)–08–80

Figure 2-8 (Sheet 2)

*11. Fin release wire swivel and link (pilot option) — Installed (tail solenoid)

*12. Fin release wire swivel and link (fixed high-drag) — Installed (tail solenoid for MER/TER, nose solenoid for MAU-12)

13. Fin release band safety pin (fixed low-drag) — Installed with legs spread

14. Fin assembly — Checked secure

15. Safety pin lanyard (FMU-54A/B) — Removed

Mk 82 Snakeye I with Mk 43 TDD and FMU-54A/B Fuze.

1. TDD safety device — Removed

2. Arming wire retaining clip (TDD) — Installed, one per TDD

3. Arming wire (TDD) — Installed, secured to fin leading edge

4. Arming cord swivel and link (FMU-54A/B) — Installed (nose solenoid for MER/TER, center solenoid for MAU-12)

*5. Fin release wire swivel and link — Installed (tail solenoid for MER/TER, nose solenoid for MAU-12)

*6. Fin release wire — Checked (figure 2-8)

The fin release wire must extend through the fin release band latch, guide tube, and 1 1/2 to 2 inches aft of end of tube. A Fahnestock clip must be installed on the fin release wire against the aft end of the guide tube.

7. Fin release band safety pin — Removed

8. Fin assembly — Checked, secure

9. Safety pin lanyard (FMU-54A/B) — Removed

*10. Fuze setting (FMU-54A/B) — Checked, matches mission requirements

Mk 36 Destructor.

1. Arming device safety device — Removed (figure 2-5)

2. Arming wire retaining clip — Installed, one per arming device (figure 2-5)

*3. Arming device setting (except Mk 32) — Checked, matches mission requirements

The setting for the Mk 30 arming device is visible on the arming device. The Mk 32 arming device does not have adjustable settings.

4. Arming device arming wire (high-drag) — Installed, secured to side fin clevis bolt (figure 2-8)

5. Arming device arming wire (low-drag) — Swivel and link installed in nose solenoid (figure 2-8)

6. Firing mechanism arming wire (high-drag) — Installed, secured to top fin link pin, cut flush with bottom surface of fin (figure 2-8)

7. Firing mechanism arming wire (low-drag) — Swivel and link installed in tail solenoid, wire cut flush with bottom surface of fin (figure 2-8)

*8. Fin release wire (high-drag) — Checked (figure 2-8)

Fin release wire must extend through the fin release band latch, guide tube, and 1 to 1 1/2 inches aft of end of tube. A Fahnestock clip must be installed on the fin release wire against the aft end of the guide tube.

9. Fin release band safety pin (high-drag) — Removed

10. Fin release band safety pin (low-drag with Mk 15 fin) — Installed with legs spread

*11. Fin release wire swivel and link (high-drag) — Installed (tail solenoid for MER/TER, center solenoid for MAU-12)

GBU-10 Series and GBU-12 Series Laser Guided Bombs.

1. Protective nose cover, seeker head packing — Removed

2. Thermal battery arming wire/arming cable — Installed, secured to sway brace (figures 2-9 and 2-10)

3. Arming wire retaining clip — Installed on thermal battery arming wire (figure 2-9)

4. Thermal battery switch safety devices — Removed

*5. Fuze settings (marked on bomb) — Checked, matches mission requirements

6. ATU-35 safety pins (M905) — Removed (figure 2-6)

7. ATU-35 restraining pin (M905) — Prevents drive from rotating

8. Arming wire retaining clip (M905) — Installed

9. Fin assembly — Checked, secure

10. Wing and fin extenders — Installed (low speed version); not installed (high speed version)

11. Arming wires/lanyards — Installed, secure (figure 2-7)

12. Arming wire/lanyard swivel and links — Installed in solenoids

GBU-10C/B and GBU-12B/B Laser Guided Bombs.

WARNING

Make sure that thermal-battery firing-pin safety wire is properly installed and that firing pin is secured in place before performing the following steps. Personal injury may be caused by escaping hot gas if firing pin is released.

1. Protective detector cover and protective packing — Removed

2. Thermal-battery arming cable — Installed properly (figures 2-9 and 2-10)

3. Thermal-battery safety wire and attached safety streamer — Removed

WARNING

Ensure that folded-wing release latch safety wire and wing fairing safety pin are installed before performing following steps. Personal injury may occur if wings are accidentally released.

4. Folded-wing release lanyard and latch — Installed properly and latch securely locked in place

5. Wing assembly fairing safety pin and streamer — Installed

6. Folded-wing release safety pin and streamer — Removed

NOTE

When the aircraft is placed on alert status or when takeoff is delayed for an appreciable length of time, perform the following procedures.

Delayed Flight or Alert.

1. Wing assembly fairing safety pin and streamer — Installed

GBU-8 Series Guided Bomb.

1. Pylon cable assembly — Connected to bomb

2. Protective dome cover — Removed

3. Guidance section window — Free of damage

4. BIAS switch selection — 0 or DOWN (as required)

GBU-10/B AND GBU-12/B LGB THERMAL BATTERY ARMING WIRE RIGGING

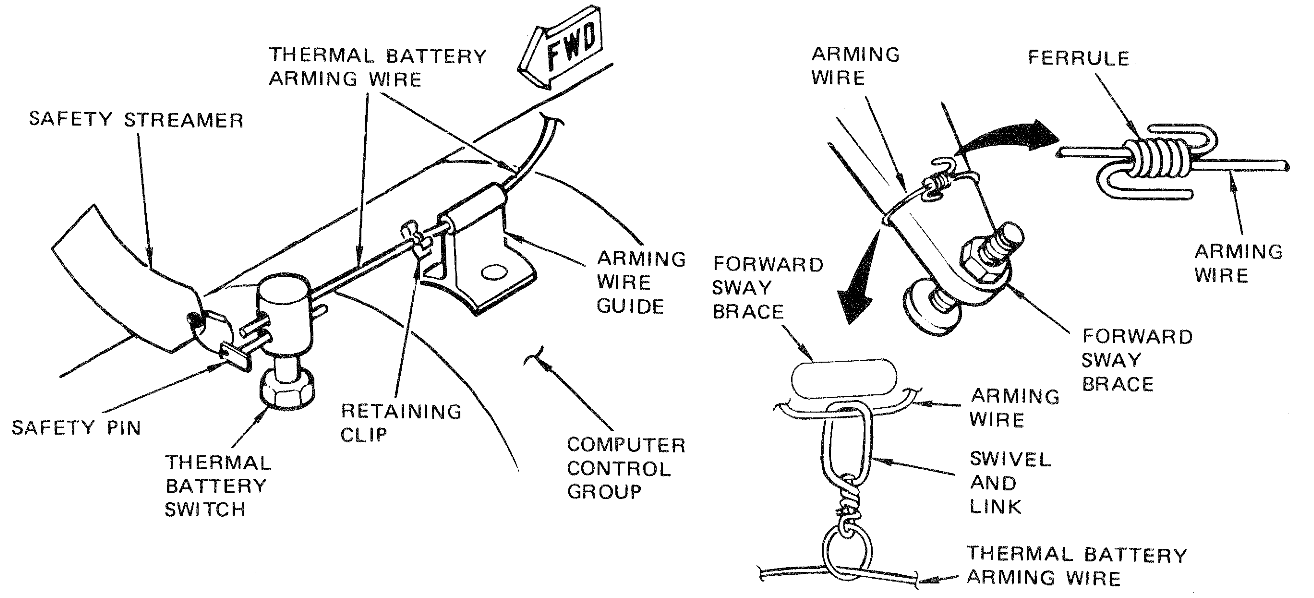


Figure 2-9

GBU-10A/B, -10C/B, -12A/B, AND -12B/B LGB THERMAL BATTERY ARMING CABLE RIGGING

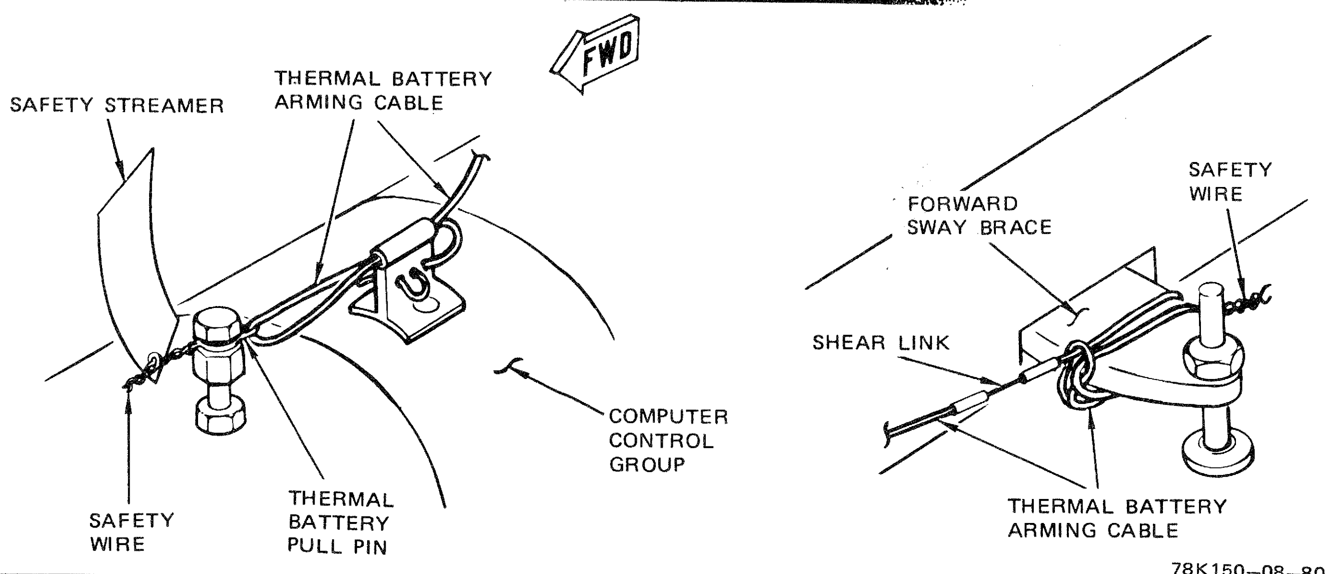


Figure 2-10

*5. Fuze settings (marked on bomb) — Checked, matches mission requirements

6. Control section safety pin — Installed

7. ATU-35 safety pins (M905) — Removed (figure 2-6)

8. ATU-35 restraining pin — Prevents drive from rotating (figure 2-6)

9. Arming wire retaining clip (M905) — Installed (figure 2-8)

10. Arming wires/lanyards — Installed, secure (figure 2-7)

11. Protective dome cover — Installed

Mk 20 Cluster Bomb.

1. Fuze arming wire — Installed (figure 2-11)

2. Fuze cover and fuze safety wire — Removed (figure 2-11)

3. (Mod 3 and Mod 4) Pilot option wire — Installed (figure 2-11)

If the pilot option wire is missing from the Mk 20 Mod 3 and Mk 20 Mod 4, the cluster bomb case should be marked PILOT OPTION INOPERABLE.

*4. Fuze settings — Checked, match mission requirements

For computed delivery, the option time may be set as desired between 1.2 and 10 seconds. On Mk 20 Mod 3 and Mk 20 Mod 4, the primary time may be set as desired between 1.2 and 50 seconds.

For manual delivery of Mk 20 Mod 2, the option time may be set as desired between 1.2 and 50 seconds. For manual delivery of Mk 20 Mod 3 and Mk 20 Mod 4, both times may be set as desired between 1.2 and 50 seconds and may have the same or different settings.

MK 20 FUZE INSPECTION

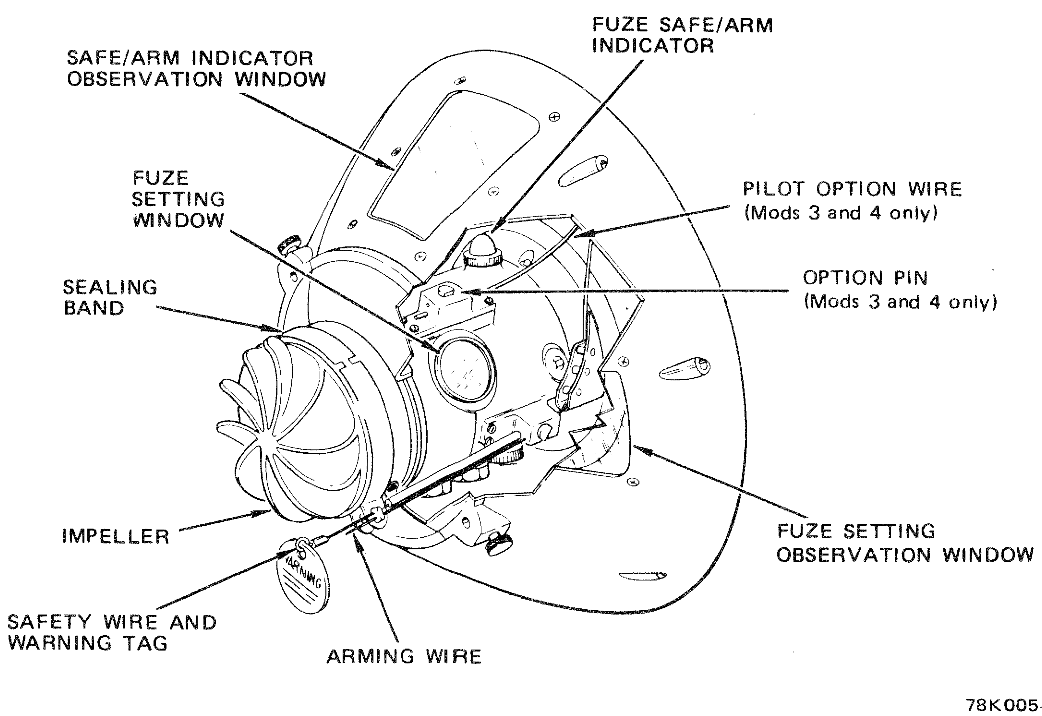


Figure 2-11

5. Arming wire extractor — Installed in nose solenoid

6. (Mod 3 and Mod 4) Pilot option wire extractor — Installed in tail solenoid

7. Fin release wire extractor — Installed over ejector unit ejector gun retaining pin (figure 2-12) (MER/TER) or secured to pylon aft sway brace (MAU-12)

8. Fin release band safety pin — Removed (figure 2-13)

Bomb Type (SUU-30 Dispenser) CBU Munitions.

1. Arming wire retaining clip (M907) — Installed, one per fuze

2. Fuze safing pins (FMU-56/110) — Installed

3. Pitot tubes (FMU-56) — Not extended

EXTRACTOR RIGGING – MULTIPLE CARRIAGE

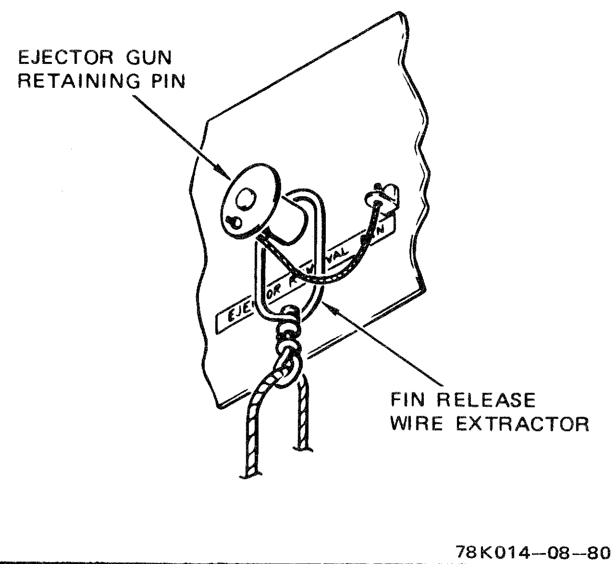


Figure 2-12

MK 20 FIN INSPECTION

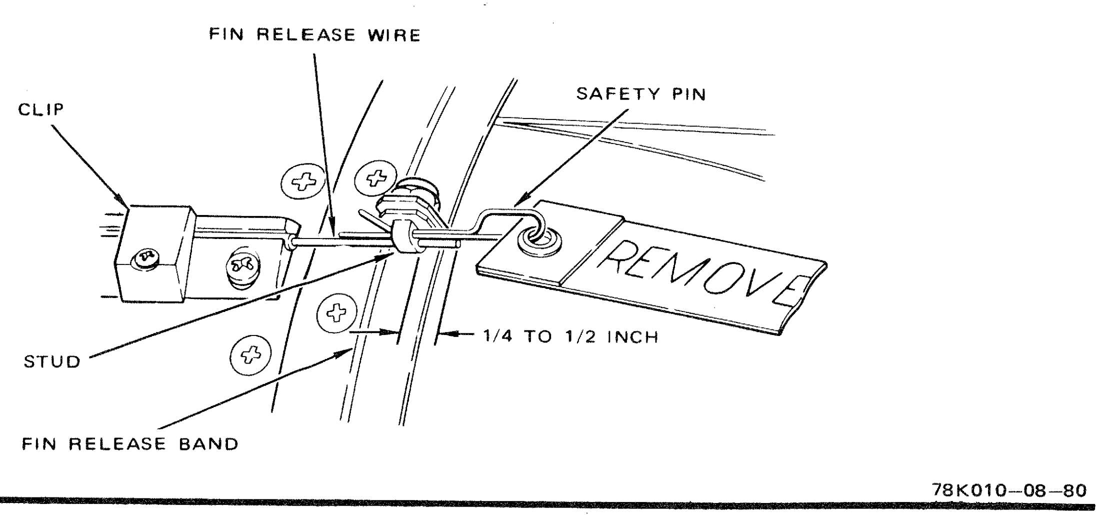


Figure 2-13

*4. Fuze settings — Checked, match mission requirements

The fuze settings for the M907, FMU-56B/B, FMU-56D/B, and FMU-110/B fuzes are visible on the fuze. The fuze settings for the FMU-26 series fuzes are marked on the dispenser case.

5. Arming wire (M907) — Installed, secured to retention post (figure 2-14)

6. Arming lanyard (FMU-26/56/110) — Installed, secured to retention post (figure 2-14)

7. Arming wire/lanyard swivel and link — Installed (nose solenoid for MER/TER, center solenoid for MAU-12)

BL-755 Bomb Cluster.

1. Fuze safety pin — Installed

*2. Fin release shear wire — Attached to aft sway brace

3. Spring motor shear wire — Installed in tail solenoid

4. Spring motor safety pin — Removed

5. Tail fin safety pin — Removed

*6. Fuze settings — Match mission requirements

DISPENSER BOMBS ARMING WIRE/LANYARD RIGGING

NOTE

Rigging procedures shown are applicable to all bomb type (SUU-30 Dispenser) CBU munitions.

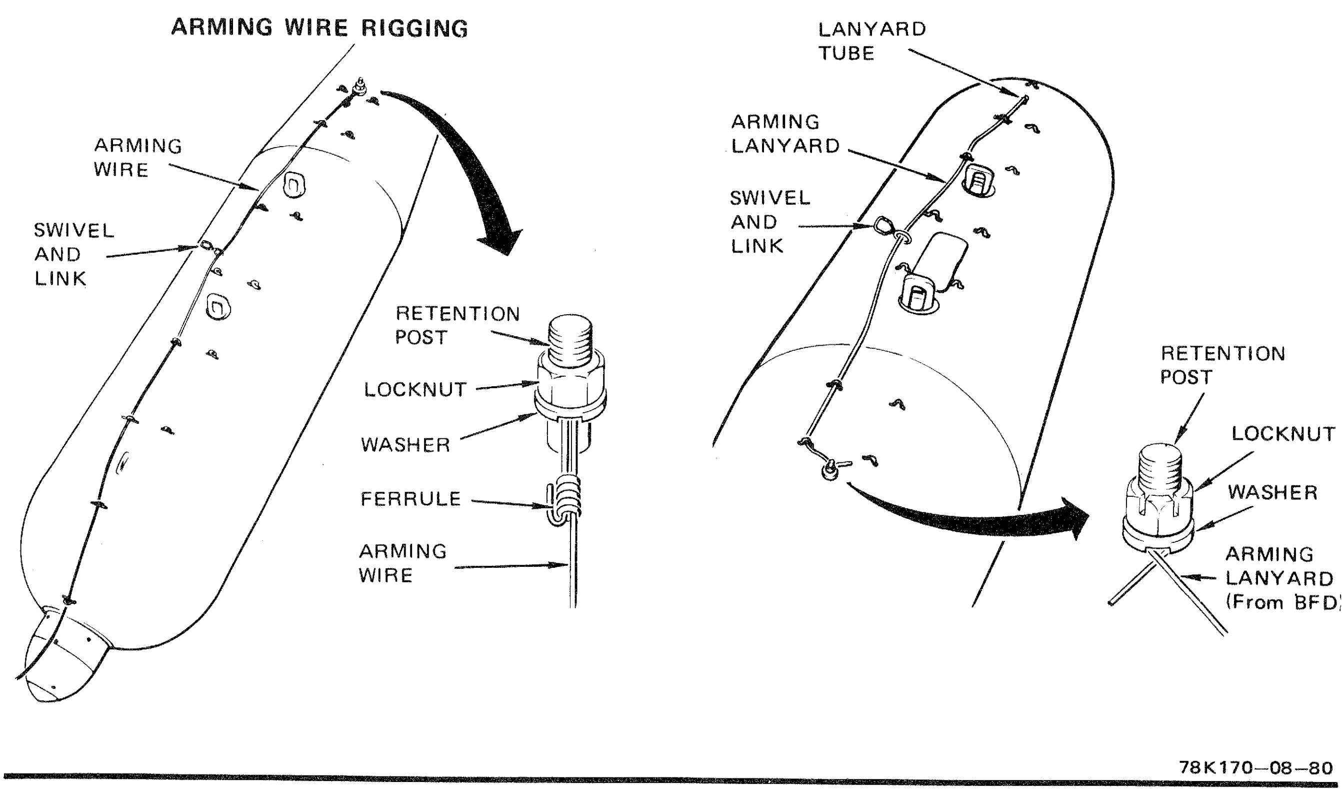


Figure 2-14

DISPENSER TYPE MUNITIONS.

SUU-20 Series Bomb and Rocket Dispenser.

1. Pylon aft electrical access door — Open; connections — mated; locking collar ball — locked; access door — secured (figure 2-3)

CAUTION

If the holes in the knurled ring on the master harness do not engage the protrusions on the pylon receptacle and, if installed, the 90° adapter, loss of the SUU-20 may occur.

2. Circuit disconnect safety spring — Installed (figure 2-15)
3. Bomb and rocket intervalometers — SAFE
4. Ejector gun safety pins — Installed in loaded racks
5. Safety devices/clips — Removed

CBU-12 Series and CBU-46/A Dispensers.

1. Pylon aft electrical access door (single carriage) — Open; connections — mated; locking collar ball — locked; access door — secured (figure 2-3)

CAUTION

If the holes in the knurled ring on the master harness do not engage the protrusions on the pylon receptacle and the 90° adapter, release may not occur.

2. TER CBU harnesses (multiple carriage) — Connected to dispensers
3. Dispenser safety pin (except CBU-12/A) — Installed (figure 2-16)
4. Jumper plug — Installed (figure 2-16)
5. Nose plug — Removed
6. Tail cone protectors/covers — Removed

*7. Tube release settings — Checked, match mission requirements

CBU-30/A and CBU-38 Series Dispensers.

1. Pylon aft electrical access door — Open; connections — mated; locking collar ball — locked; access door — secured (figure 2-3)

CAUTION

If the holes in the knurled ring on the master harness do not engage the protrusions on the pylon receptacle and the 90° adapter, release may not occur.

2. Intervalometer safety pin — Installed (figure 2-17)

*3. Intervalometer selector settings — Checked, match mission requirements (figure 2-17)

4. Safety pallet — Removed

SUU-25 Series Flare Dispenser.

1. Pylon aft electrical access door (single carriage) — Open; connections — mated; locking collar ball — locked; access door — secured (figure 2-3)

CAUTION

If the holes in the knurled ring on the master harness do not engage the protrusions on the pylon receptacle and the 90° adapter, release may not occur.

2. TER rocket harness (multiple carriage) — Connected to dispensers

*3. TER selector switch (multiple carriage) — ROCKETS

4. Dispenser safety pin — Installed

SUU-20 SAFETY DEVICES

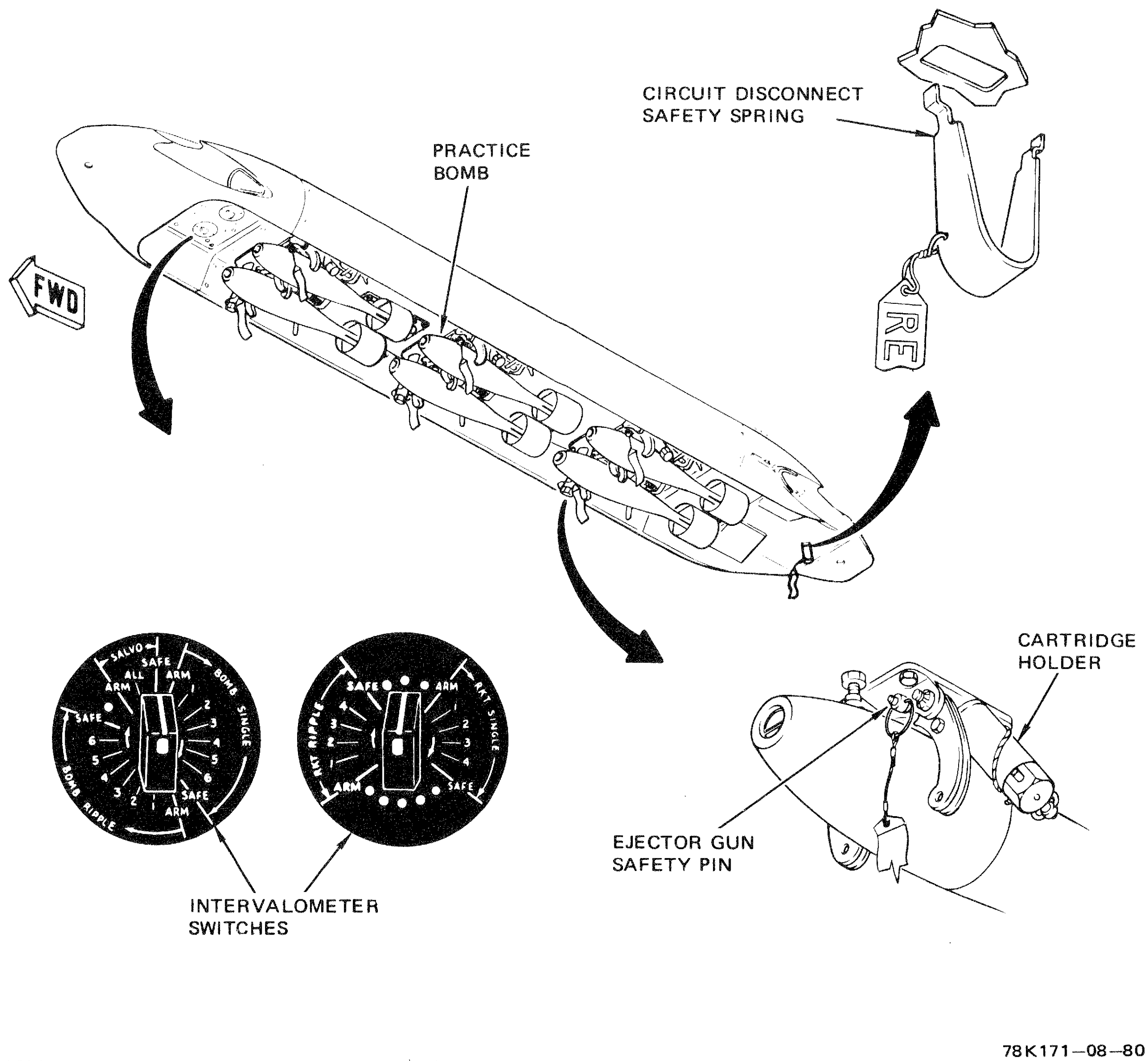


Figure 2-15

SUU-7 DISPENSER INSPECTION

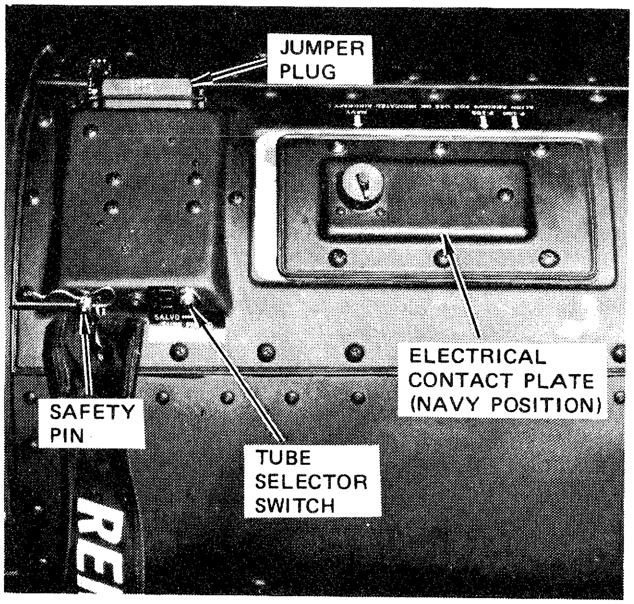


Figure 2-16

SUU-13 DISPENSER INSPECTION

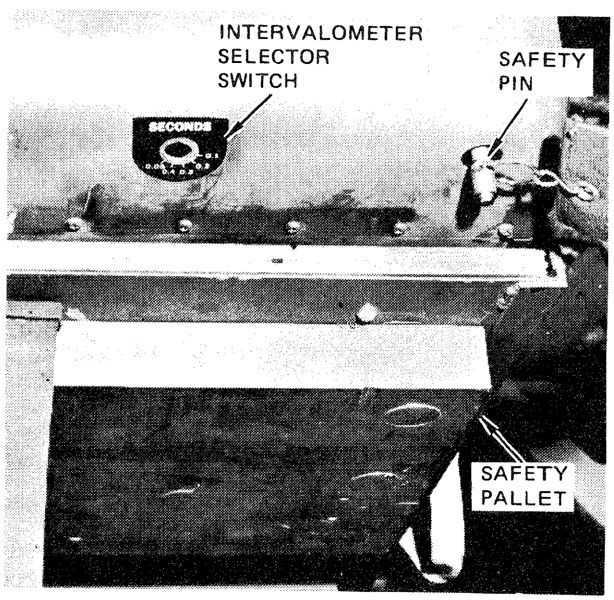


Figure 2-17

5. Dispenser aft shear pins — Installed

*6. Flare/marker ejection and ignition settings (marked on dispensers) — Checked, match mission requirements

SUU-42 Series Flare Dispenser.

1. Pylon aft electrical access door — Open; connections — mated; locking collar ball — locked; access door — secured (figure 2-3)

CAUTION

If the holes in the knurled ring on the master harness do not engage the protrusions on the pylon receptacle and the 90° adapter, release may not occur.

2. Dispenser safety pin — Installed

*3. Dispenser intervalometer settings (marked on dispenser) — Checked, match mission requirements

*4. Flare ejection and ignition settings (marked on dispenser) — Checked, match mission requirements

LAU-3 SERIES AND LAU-68 SERIES ROCKET LAUNCHERS.

1. Launcher shorting pin — Installed

2. Pylon aft electrical access door (single carriage) — Open; connections — mated; locking collar ball — locked; access door — secured (figure 2-3)

CAUTION

If the holes in the knurled ring on the master harness do not engage the protrusions on the pylon receptacle and the 90° adapter, release may not occur.

3. TER rocket harnesses (multiple carriage) — Connected to launchers

*4. Launcher fairings (if appl) — Secure

SUU-23/A GUN POD.

1. Pylon harness — Connected to gun pod receptacle

2. Pod gun fire lead and starter motor lead — Disconnected (figure 2-18)

3. Clearing cam holdback tool — Removed

*4. Burst limiter (if installed) — Set, matches mission requirements

AIM-9 GUIDED MISSILE.

1. AERO 3B launcher safety pin — Installed in top of launcher (figure 2-19)

*2. AERO 3B launcher detent locking pin — Installed in top of launcher (figure 2-19)

3. Missile influence fuze cover — Installed

4. Missile nose protective cover — Installed

5. Missile umbilical cable — Connected to launcher

NOTE

For captive flight, a captive missile adapter plug must be installed on the missile umbilical connector to prevent activation of the missile gas grain generator.

6. Launcher nose fairing — Closed, secure

*7. Missile — Checked, secure

Ensure that snubber cams engage the forward and aft missile lugs to prevent forward and aft movement of the missile during flight. Do not move the canard fins.

TDU-11/B TARGET ROCKET (5-INCH HVAR).

1. AERO 3B launcher safing pin — Installed in top of launcher (figure 2-20)

*2. AERO 3B launcher detent locking pin — Installed in top of launcher (figure 2-20)

SUU-23/A GUN POD SAFING

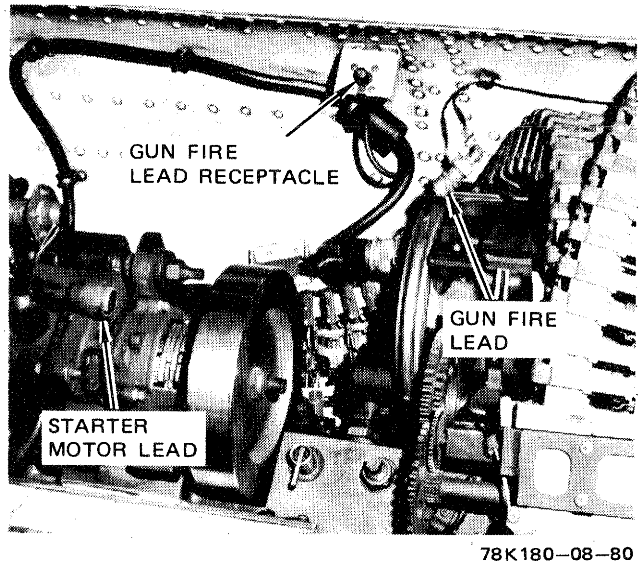


Figure 2-18

3. Rocket igniter cable — Connected to HVAR receptacle

4. HVAR shorting plug — Connected to launcher

5. Launcher nose fairing — Closed, secure

6. Rocket — Checked, secure

AGM-65 MAVERICK MISSILE AND TGM.

1. Pylon aft electrical access door — Open; connections — mated; locking collar ball — locked; access door — secured (figure 2-3)

CAUTION

If the holes in the knurled ring on the master harness do not engage the protrusions on the pylon receptacle, missile caging and launching may not be possible.

2. Missile igniter cables (AGM-65) — Not connected, self-shorting cover in shorting position

AIM-9 MISSILE SAFETY DEVICES

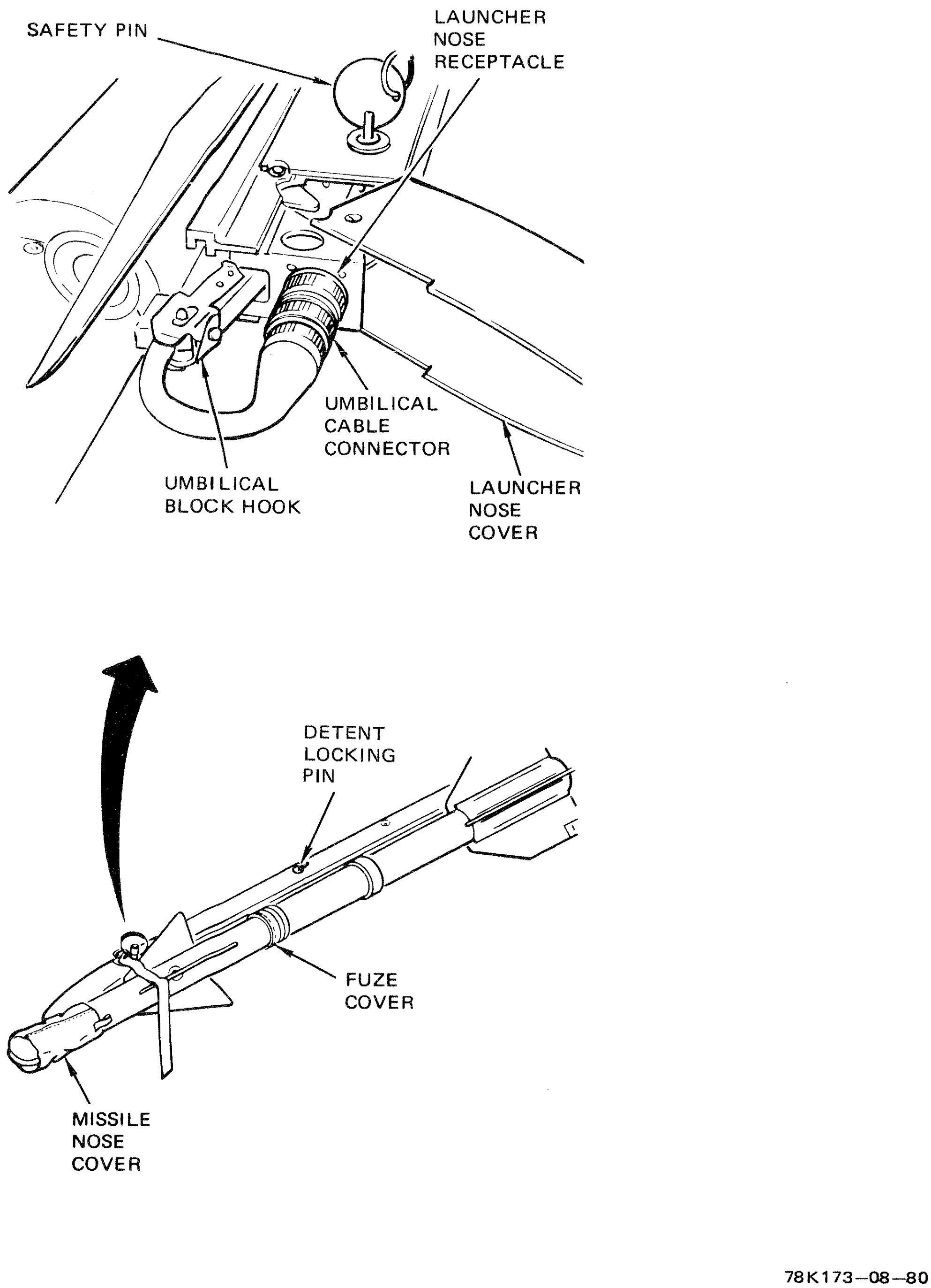


Figure 2-19

TDU-11/B INSPECTION

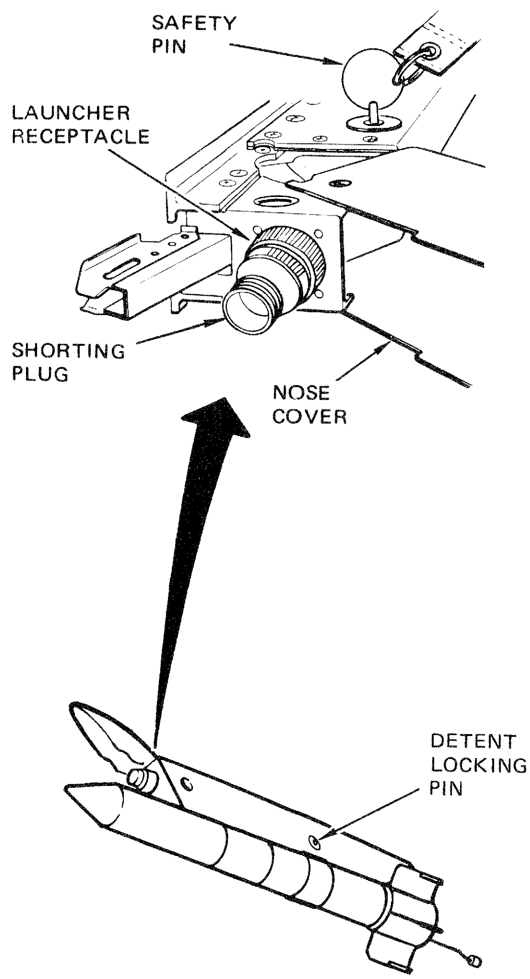


Figure 2-20

*3. Shear pins — Installed (loaded rails only)

4. Launcher umbilical adapter — Connected to missile

5. Dome covers (AGM-65) — Installed

6. Missile condition and security — Checked

ECM PODS.

1. Umbilical connections — Secure

2. Antennas — Condition checked

BEFORE TAXI CHECK.

GENERAL.

NOTE

All references to armament controls and indicators apply to forward cockpit.

1. ARMT station select switches — RDY for all MER/TER loaded stations with bomb type munitions and all SUU-20 loaded stations

2. Verify BOMB SINGLE light does not come on.

CAUTION

BOMB SINGLE light on indicates one or more MER/TERs are incorrectly loaded or the ASCU has malfunctioned. Subsequent attempts to deliver bombs will result in the release of the loaded MER/TER or SUU-20 dispenser from the parent rack.

3. ARMT station select switches — OFF

TARGET/DESTINATION DATA INSERTION IN NAV WD COMPUTER.

1. Rotary mode selector switch — Desired mode (DEST, RNG/BRG, ΔB HT, ALT/MSLP)

2. Keyboard panel — Identify target/destination number

3. KEYBD pushbutton — Press

4. Keyboard panel — Enter data

NOTE

The maximum allowable offset range from the OAP to the target is 131,068 feet.

Offset targets with elevation above the OAP are entered with plus values. Targets with elevation below the OAP are entered with minus values. If the Δ height is a minus value, press the keyboard E pushbutton before inserting the Δ height.

If the altitude to be entered is a minus value, press the keyboard E pushbutton before inserting the altitude figures.

MSLP shall be entered to the nearest 0.01 inch.

When values entered are to be used for offset attack, the altitude and MSLP should be that of the OAP, not the target.

5. Latitude and longitude window — Verify data. In latitude window read offset range, Δ height, and altitude. In longitude window read offset bearing, burst height, and MSLP

6. ENT pushbutton — Press to enter data

FLEXIBLE FUZE DATA ENTRY.

1. Rotary mode selector switch — PRES POS

2. Present position toggle switch — UPDATE

3. UPDATE thumbwheel — DATA

4. Keyboard panel — Identify data address

Data Address 28 is used for fuze time setting from 0000000 to 0001000 (zero to 10.00 seconds). Data Address 29 is used for fuze altitude setting from 0000000 to 0032000 (ground level to 32,000 feet AGL).

5. KEYBD pushbutton — Press

6. Keyboard panel — Enter data

7. Latitude and longitude windows — Verify data

   In latitude window read data address number. In longitude window read fuze time setting or fuze altitude setting.

8. ENT pushbutton — Press to enter data

ECM PODS.

1. ECM control switch — STBY

   STBY light(s) comes on after 3-minute warmup period.

2. ECM control switch — XMIT 1

   Proper indication of XMIT 1 light is obtained.

   NOTE

   Refer to (Confidential) T.O. 1A-7K-34-1-1-1 for information on the proper indication of lights on the ECM control panel for all authorized ECM pods.

3. ECM control switch — XMIT 2

   Proper indication of XMIT 2 light is obtained.

4. ECM control switch — BOTH

   Proper indication of XMIT 1 and XMIT 2 lights are obtained.

5. ECM control switch — STBY

   NOTE

   Do not leave pods in the transmit modes for extensive periods of time.

AGM-65 MAVERICK MISSILE AND TGM.

TGM Ground Check After Engine Start.

The A/A 37 A-T1 TGM may be operated on the ground after engine start if the following Warning, Caution, and Note are observed.

WARNING

Do not operate the TGM on the ground if the dome cover is installed. Flying glass could result in FOD or injury to ground personnel in the immediate vicinity.

CAUTION

Position aircraft so that the sun is not within 40° of TGM boresight.

Do not uncage the TGM until a full 3 minutes have elapsed after selecting the station on which the TGM is loaded.

Do not exceed 15 minutes with the TGM station selected.

Do not exceed 3 minutes in the slew plus track modes.

NOTE

The TGM recorder camera will begin operation at uncage. Film will be expended. In TGM serial No. 3185 and subsequent, the film recorder has been replaced with an aft ballast.

1. ARMT station select switch — RDY, GUIDED WEAPON and yellow station selected advisory lights on

   When a station loaded with a TGM is selected, the 3-minute warmup period starts.

2. Radar power switch — STBY

   Following a 3-minute delay after turnon, radar set and display are ready for complete operation.

3. Radar NORM-OVERRIDE switch — NORM

4. QUANTITY switch — 01

5. SINGLE/PAIRS/SIMULT switch — SINGLE

6. Target contrast switch — As required

   Select DARK or LIGHT depending on targets of opportunity. A command signal is provided to the TGM to track a dark-on-light or a light-on-dark target. Switch position has no affect on picture quality on the TV display.

7. VISUAL ATTACK master function switch — Depress

   CAUTION

   Do not press the air ignite button until a full 3 minutes have elapsed after selecting the TGM loaded station.

   If gyro tumbling is observed (scope display shows a continuous rapid rotation or is so blurred as to make any image indiscernible), immediately position the applicable ARMT station select switch to OFF and terminate check.

8. Air ignite button — Press and release

   Air ignite button removes mechanical cage, electrically aligns seeker head, and turns on TV display. For the TGM, pressing the button also begins camera operation for TGMs with film recorders.

9. TV display — Check and adjust

   The quality of the TV display directly affects the pilot's ability to successfully detect targets. TV display brightness and contrast should be adjusted for an optimum display. Optimum adjustment is normally near maximum contrast with brightness adjusted as necessary.

10. Target designate button — Press and hold

    The button enables the Bullpup controller and places the seeker in modified free gyro.

11. Bullpup controller — Move fore and aft, right and left while pressing the target designate button and observing the TV display

12. Observe radar scope. Tracking gate should move up and down, right and left with respect to TV scene.

13. Bullpup controller — Position tracking gate over target of opportunity while pressing the target designate button

    NOTE

    If lock-on is not achieved in the following step, recheck position of target contrast switch and repeat procedures from step 10.

14. Target designate button — Release

    Lock-on signal is provided to enable target tracking by seeker head.

15. Verify TGM is locked on target. Tracking gate remains on target with no tendency to drift.

16. Air ignite button — Press and release

    Returns seeker to head to align mode.

17. ARMT station select switch — OFF

18. Deselect attack mode

19. Radar — As required

ARMING AREA CHECKS.

GENERAL.

1. Armament switches — OFF, SAFE

2. Pilot — Hands in view

The following procedure will be performed by the arming area ground crew.

M61A1 GUN.

1. LOX compartment electrical harness — Connected to gun control unit

2. LOX compartment access door — Closed, secure

TDU-11/B TARGET ROCKET.

1. AERO 3B launcher safety pin — Removed

AIM-9 GUIDED MISSILE.

1. Missile nose and influence fuze covers — Removed
2. AERO 3B launcher safety pin — Removed

SUU-23/A GUN POD.

1. Starter motor lead — Connected
2. Gun fire lead — Connected
3. Pod side cowling — Installed, secure

DISPENSER TYPE MUNITIONS.

CBU-30/A and CBU-38 Series Dispensers.

1. Intervalometer safety pin — Removed

CBU-12 Series and CBU-46/A Dispensers.

1. Safety pin (except CBU-12/A) — Removed

SUU-25 Series Flare Dispenser.

1. Dispenser shorting pin — Removed

SUU-42 Series Flare Dispenser.

1. Dispenser safety pin — Removed

SUU-20 Series Bomb and Rocket Dispenser.

1. Bomb and rocket intervalometers — Set, match mission requirements

NOTE

Setting of intervalometers to position 1 with a full load of bombs and/or rockets will result in a dual release/firing on the first pass. Intervalometers on fully loaded dispensers shall be set to ARM.

2. Circuit disconnect safety spring — Removed
3. Ejector gun safety pins — Removed

LAU-3 SERIES AND LAU-68 SERIES ROCKET LAUNCHERS.

1. Launcher shorting pin — Removed

AGM-65 MAVERICK MISSILE.

NOTE

Steps 1 and 2 do not apply to the TGM.

1. Igniter cable stray voltage check — Performed
2. Igniter cable connector — Connected

BOMB TYPE MUNITIONS.

GBU-10 Series and GBU-12 Series Laser Guided Bomb.

1. Wing assembly fairing safety pin and streamer — Removed

Bomb Type (SUU-30 Dispenser) CBU Munitions.

1. Safing pins (FMU-56/110) — Removed
2. Armed indicators (FMU-110) — Not extended

BLU-1C/B and BLU-27 Series Fire Bombs.

1. Initiator arming lanyard tape (FMU-7/B) — Removed
2. Initiator safety wire (FMU-7/B) — Removed
3. End cap safety wire (repaired BLU-27) — Installed

GBU-8/B EO Guided Bomb.

1. Dome cover — Removed
2. Control section safety pin — Removed

BDU-33 Practice Bomb on MER/TER.

1. Safety device/clip — Removed

PYLON AREA (GENERAL).

1. MER/TER electrical and mechanical safety pins — Removed

2. MAU-12 ground safety pins — Removed

INFLIGHT PROCEDURES.

NOTE

All references to armament controls apply to the forward cockpit and all references to armament monitor lights apply to the aft cockpit unless otherwise specified in these procedures. Corresponding armament advisory lights in the forward and aft cockpits operate simultaneously.

Armament release button, target designate button, air ignite button, radar range reject switch, trigger switch, and Bullpup controller are operable in forward or aft cockpits.

Ballistic equations for the MC-1 gas bomb are not incuded in the NAV WD Computer program. Consequently, the MC-1 gas bomb uses ASCU code FL. This code provides ballistics for the M117 GP bomb which are not identical to those of the MC-1 gas bomb. Since the ballistics for the MC-1 are not identical to those of the M117, a comparison of their respective ballistic tables in T.O. 1A-7D-34-1-2 at the planned computed delivery point should be made to determine the amount of error to be expected and possible aiming corrections required to eliminate this error.

Ballistic equations for ASCU codes CP (CBU-38) and CQ (CBU-30) are included in the NAV WD Computer program. With green ready lights on CBU-30/38 stations, the NAV WD Computer will issue a continuous solid fire pulse, starting at the computed release point (intersection of lower solution cue and flightpath marker for dead-reckoned targets and when the armament release button is depressed in CCIP or Manual Ripple bombing modes). The solid fire pulse will continue until the armament release button is released. Since the length of the fire pulse is pilot controlled, bomb stick length is set to zero and the solution is given for the beginning of the drop. Therefore, the aiming symbol or CCIP impact point must be placed over the beginning of the area to be covered. Because of the solid fire pulse, the FPM will not flash and the release freeze data will not be calculated.

The FUZE switch selection for the MC-1 gas bomb in all bombing modes is identical to that for the M117; i.e., NOSE, TAIL, or NOSE/TAIL.

VISUAL ATTACK.

The following procedures apply to delivery of all bomb type munitions, practice bombs in the SUU-20 series dispenser or loaded on MER's/TER's, and CBU dispensers.

1. Target data — Checked

2. Radar Set — Operating Mode selected

3. Attack mode master function switch — VISUAL ATTACK

   Depressing the VISUAL ATTACK switch causes the Forward-Looking Radar to enter AGR Mode, radiating. Attack symbology appears on the HUD after a station with bombs is selected and in priority.

4. ARMAMENT RELEASE panel — Set

   a. QUANTITY thumbwheel — As desired

NOTE

A selection of 01 permits a single fire pulse. The 00 setting is a safe position and does not permit a fire pulse.

   b. SINGLE/PAIRS/SIMULT switch — SINGLE or PAIRS

   c. INTERVAL-FT thumbwheel — As desired

5. ARMT station select switches — RDY, armament advisory lights checked

The azimuth steering line and aiming symbol appear when a bomb station is selected and in priority.

With CBU dispensers loaded, the DISPENSER and station selected advisory lights illuminate.

With fixed high-drag bomb, RETARDED advisory light illuminates.

With GBU-10C/B and -12B/B LGB, GUIDED WEAPON and MECH FUZE advisory lights illuminate.

With fire bombs, the NAPALM and MECH FUZE advisory lights illuminate.

With other bomb type munitions, the BOMB SINGLE or BOMB MULTIPLE and MECH FUZE advisory lights illuminate.

With SUU-20 practice bombs, the BOMB MULTIPLE advisory light illuminates. If Mk 106 practice bombs are loaded, the RETARDED advisory light illuminates. Station selected advisory lights illuminate.

NOTE

If ROCKETS advisory light illuminates when SUU-20 station is selected, cycle applicable station select switch(es) to OFF then RDY.

6. FUZE switch — Set as applicable

MECH FUZE advisory light goes off and station selected advisory lights and appropriate NOSE/TAIL armament monitor lights illuminate.

   a. Mk 82, Mk 83, Mk 84, M117 GP, MC-1 GB — NOSE, TAIL, or NOSE/TAIL

   b. BLU-1C/B, BLU-27 fire bombs — NOSE/TAIL

   c. Bomb type (SUU-30 dispenser) CBU munitions — NOSE/TAIL

   d. Mk 20 cluster bomb — NOSE or NOSE/TAIL

   For Mk 20 Mod 2, place FUZE switch in NOSE.

   For Mk 20 Mods 3 and 4, if selected primary fuze functioning time is desired, place FUZE switch in NOSE.

   For Mk 20 Mods 3 and 4, if selected option fuze functioning time is desired, place FUZE switch in NOSE/TAIL.

   e. Mk 82 Snakeye pilot option — NOSE or TAIL

   If low-drag bomb option is desired, place FUZE switch in NOSE.

   If high-drag bomb option is desired, place FUZE switch in TAIL. RETARDED advisory light comes on.

WARNING

The Mk 82 Snakeye I pilot option bomb is rigged so that when the high-drag option (tail fuzing) is selected, the bomb fuzes will not arm unless the Mk 15 fin opens. Selection of NOSE/TAIL position on the FUZE switch will bypass this safety feature.

f. Mk 82 Snakeye fixed high-drag — NOSE/TAIL

g. Mk 82 Snakeye fixed low-drag — NOSE/TAIL

h. Mk 36 Destructor fixed high-drag — TAIL

i. Mk 36 Destructor fixed low-drag — NOSE/TAIL

j. GBU-10 and GBU-12 laser guided bombs — NOSE/TAIL

k. BDU-33 on MER's/TER's — NOSE, TAIL, or NOSE/TAIL

7. MASTER ARM switch — ARM, STA RDY lights checked

   a. Station selected lights go off.

   b. MASTER ARM armament monitor light illuminates.

8. Aiming symbol — Place on or near target

   a. By use of Bullpup controller to slew aiming symbol/azimuth steering line to overlay target

   b. By flying to place aiming symbol, stowed within flightpath marker, on the target (normal pointblank mode)

9. Target — Designate

   With the aiming symbol near or overlaying the target, designate target by pressing the target designate button or the armament release button. Hold target designate button depressed for at least 1 second.

   NOTE

   In all computed attack modes (except CCIP), pressing the armament release button will not cause weapon release until a valid release solution is present.

10. Aiming symbol — Refine position

    Aiming symbol must be slewed as necessary to place and retain symbol over target.

Before solution cue intersects flightpath marker:

11. Azimuth error — Corrected

12. Armament release button — Press and hold

    If using the flexible fuze capability, monitor pullup anticipation cue movement. For bombs and dispensers with altitude sensing fuzes, keep the pullup anticipation cue below the flightpath marker. For dispensers with time fuzes, fly the aircraft to achieve simultaneous intersection of the solution and pullup anticipation cues with the flightpath marker.

    Before reaching the target, a toss is executed by pulling up to intersect the lower solution cue; pullup to the upper cue effects a loft. Waiting until the lower cue comes down to intersect the flightpath marker results in a level or straight dive tactic. In a flyover situation, an over-the-shoulder delivery is made by executing a pullup before the upper solution cue intersects the flightpath marker. In any delivery tactic, the armament release button is pressed and held before the flightpath marker/solution cue intersection occurs. If use of the upper solution cue is desired, the armament release button must not be pressed until the lower cue has passed through the flightpath marker.

13. Execute pullup.

    The flightpath marker flashes for 2 seconds or more after the last weapon is released.

    For bomb type munitions, as the last weapon is released from each selected station, the STA RDY light for that station goes out. If all selected stations are emptied, all armament advisory lights go off.

    If CBU-12/46 dispensers are loaded on a TER, STA RDY lights do not go off. If CBU-12/46 disensers are loaded on the MAU-12, STA RDY lights go off when the dispensers are empty.

If reattack is desired:

14. MASTER ARM switch — OFF, any remaining STA RDY lights go off

    a. Station selected lights for remaining selected stations illuminate.

    b. MASTER ARM armament monitor light goes off.

15. ARMT panel — Checked, switches set

    Select any additional stations required and deselect all empty stations. Check mechanical fuzing requirements for weapons selected.

16. ARMAMENT RELEASE panel — Checked, switches set

    Check QUANTITY, INTERVAL-FT, and SINGLE/PAIRS/SIMULT switches for desired reattack release parameters.

17. MASTER ARM switch — ARM, STA RDY lights checked

    a. Station selected lights go off.

    b. MASTER ARM armament monitor light illuminates.

18. Aiming symbol — On target

    If aiming symbol does not appear on HUD, press and release designate button to reset the system, visually reacquire the target, and redesignate.

Before solution cue intersects flightpath marker:

19. Azimuth error — Corrected

20. Armament release button — Press and hold

21. Execute pullup.

If no reattack desired:

22. MASTER ARM switch — OFF, MASTER ARM armament monitor light goes off

23. FUZE switch — SAFE, appropriate NOSE/TAIL fuze armament monitor lights go off

24. ARMT station select switches — OFF

25. Armament advisory lights — Off

26. Designate button — Press or deselect attack mode

HUD Failure Before Designation — If the HUD fails before target designation, a computer solution is possible by use of the HUD standby reticle. Proceed as follows:

1. HUD — OFF

   This prevents an intermittent HUD fail signal from reaching the NAV WD Computer.

2. STBY RETICLE — On, set intensity as desired

3. MILS DEPR knob — First detent position (approx 0 mils)

4. Fly aircraft to overlay target with standby reticle.

5. Target — Designate

6. Fly out azimuth error using ADI bank steering bar.

7. Armament release button — Press and hold during target approach

   Weapons automatically release as the aircraft flies through the computed release point.

8. Execute pullup (no cues available).

WARNING

Pullup safety margin must be calculated since no computed cues are displayed.

NOTE

All other VISUAL ATTACK backup modes are entered automatically and require little or no pilot action. Refer to Delivery System Management discussion in the Navigation/Weapon Delivery System description, Section I, for detailed information.

VISUAL ATTACK OFFSET.

The following procedures apply to delivery of all bomb type munitions, practice bombs in SUU-20 dispenser or loaded on MER's/TER's, and CBU dispensers.

1. Target data — Checked

NOTE

Selection to FLY TO DEST 0 position or FLY TO MARK positions 0 or 9 prevents display of attack symbology. En route navigation computations continue, but the flight director is not displayed.

2. Radar set — Operating mode selected

3. Attack mode master function switches — VISUAL ATTACK and OFFSET

After mode initiation and before OAP designation, HUD symbology is identical to that of the VISUAL ATTACK mode except that solution cues do not appear.

4. ARMAMENT RELEASE panel — Set

   a. QUANTITY thumbwheel — As desired

NOTE

A selection of 01 permits a single fire pulse. The 00 setting is a safe position and does not permit a fire pulse.

   b. SINGLE/PAIRS/SIMULT switch — SINGLE or PAIRS

   c. INTERVAL-FT thumbwheel — As desired

5. ARMT station select switches — RDY, armament advisory lights checked

The azimuth steering line and aiming symbol appear when a bomb station is selected and in priority.

With CBU dispensers loaded, DISPENSER and station selected advisory lights illuminate.

With fixed high-drag bomb, RETARDED advisory light illuminates.

With GBU-10C/B and -12B/B LGB, GUIDED WEAPON and MECH FUZE advisory lights illuminate.

With fire bombs, the NAPALM and MECH FUZE advisory lights illuminate.

With other bomb type munitions, the BOMB SINGLE or BOMB MULTIPLE and MECH FUZE advisory lights illuminate.

With SUU-20 practice bombs, the BOMB MULTIPLE advisory light illuminates. If Mk 106 practice bombs are loaded, the RETARDED advisory lights illuminate. Station selected advisory lights illuminate.

NOTE

If ROCKETS advisory light illuminates when SUU-20 station is selected, cycle applicable station select switch(es) OFF then RDY.

6. FUZE switch — Set as applicable

MECH FUZE advisory light goes off and station selected advisory lights and appropriate NOSE/TAIL armament monitor lights illuminate.

   a. Mk 82, Mk 83, Mk 84, M117 GP, MC-1 GB — NOSE, TAIL, or NOSE/TAIL

   b. BLU-1C/B, BLU-27 series fire bombs — NOSE/TAIL

   c. Bomb type (SUU-30 dispenser) CBU munitions — NOSE/TAIL

d. Mk 20 cluster bomb — NOSE or NOSE/TAIL

For Mk 20 Mod 2, place FUZE switch in NOSE.

For Mk 20 Mods 3 and 4, if selected primary fuze functioning time is desired, place FUZE switch in NOSE.

For Mk 20 Mods 3 and 4, if selected option fuze functioning time is desired, place FUZE switch in NOSE/TAIL.

e. Mk 82 Snakeye pilot option — NOSE or TAIL

If low-drag bomb option is desired, place FUZE switch in NOSE.

If high-drag bomb option is desired, place FUZE switch in TAIL. RETARDED advisory light comes on.

WARNING

The Mk 82 Snakeye I pilot option bomb is rigged so that when the high-drag option (tail fuzing) is selected, the bomb fuzes will not arm unless the Mk 15 fin opens. Selection of NOSE/TAIL position on the FUZE switch will bypass this safety feature.

f. Mk 82 Snakeye fixed high-drag — NOSE/TAIL

g. Mk 82 Snakeye fixed low-drag — NOSE/TAIL

h. Mk 36 Destructor fixed high-drag — TAIL

i. Mk 36 Destructor fixed low-drag — NOSE/TAIL

j. GBU-10 and GBU-12 laser guided bombs — NOSE/TAIL

k. BDU-33B/B on MER's/TER's — NOSE, TAIL, or NOSE/TAIL

7. MASTER ARM switch — ARM, STA RDY lights checked

   a. Station selected lights go off.

   b. MASTER ARM armament monitor light illuminates.

8. Aiming symbol — Place on OAP

9. OAP — Designate

   The OAP is designated by pressing the target designate button or the armament release button. At designation, the aiming symbol and Forward-Looking Radar move to the computed target location. Solution cues appear when target is within maximum weapon delivery range. Hold target designate button depressed for at least 1 second.

If target becomes visible:

10. Aiming symbol — Refine position

Before solution cue intersects flightpath marker:

11. Azimuth error — Corrected

12. Armament release button — Press and hold

    Any of the delivery tactics described for VISUAL ATTACK mode can be used in VISUAL ATTACK OFFSET mode.

13. Execute pullup.

    The flightpath marker flashes for 2 seconds or more after the last weapon is released.

    For bomb type munitions, the last weapon is released from each selected station, the STA RDY advisory light for that station goes off. If all selected stations are emptied, all armament advisory lights go off.

    If CBU-12/46 dispensers are loaded on a TER, STA RDY, lights do not go off. If CBU-12/46 dispensers are loaded on the MAU-12, STA RDY lights go off when the dispensers are empty.

If reattack is desired:

14. MASTER ARM switch — OFF, any remaining STA RDY lights go off

    a. Station selected lights for remaining selected stations illuminate.

    b. MASTER ARM armament monitor light goes off.

15. ARMT panel — Checked, switches set

    Select any additional stations required and deselect all empty stations. Check mechanical fuzing requirements for weapons selected.

16. ARMAMENT RELEASE panel — Checked, switches set

    Check QUANTITY, INTERVAL-FT, and SINGLE/PAIRS/SIMULT switches for desired reattack release parameters.

17. MASTER ARM switch — ARM, STA RDY lights checked

    a. Station selected lights go off.

    b. MASTER ARM armament monitor light illuminates.

18. Aiming symbol — On target

    If aiming symbol does not appear on HUD, press and release designate button to reset the system, place the aiming symbol on the OAP, and redesignate. The aiming symbol and FLR will move to the computed target location. If the target becomes visible, refine the position of the aiming symbol visually.

Before solution cue intersects flightpath marker:

19. Azimuth error — Corrected

20. Armament release button — Press and hold

21. Execute pullup.

If no reattack desired:

22. MASTER ARM switch — OFF, MASTER ARM armament monitor light goes off

23. FUZE switch — SAFE, appropriate NOSE/TAIL fuze armament monitor lights go off

24. ARMT station select switches — OFF

25. Armament advisory lights — Off

26. Designate button — Press or deselect attack mode

HUD Failure Before Designation — Procedures for HUD failure before designation are the same as in the VISUAL ATTACK mode, except fly aircraft to overlay OAP and designate on OAP instead of target.

BOC.

The following procedures apply to delivery of all bomb type munitions, practice bombs in SUU-20 dispenser or loaded on MER's/MER's, and CBU dispensers.

1. Target data — Checked

2. Radar set — Operating mode selected

3. Attack mode master function switch — BOC

4. DEST/MARK — Selected

   When within radar mapping range or when desired, press the BOC master function switch. The Forward-Looking Radar enters the ground map pencil (GMP) mode or, if GMS is selected, remains in the GMS mode. Cursors appear on PPI ground-stabilized over the computed target location. The aiming symbol appears on the HUD, indicating the same ground location as the cursor intersection. The range cursor is not enabled beyond 80 nautical miles.

NOTE

If DEST 0/MARK 0 is selected, the range cursor is displayed at 8 nautical miles and is not ground-stabilized. The azimuth cursor is displayed along the ground track.

5. ARMAMENT RELEASE panel — Set

   a. QUANTITY thumbwheel — As desired

   NOTE

   A selection of 01 permits a single fire pulse. The 00 setting is a safe position and does not permit a fire pulse.

   b. SINGLE/PAIRS/SIMULT switch — SINGLE or PAIRS

   c. INTERVAL-FT thumbwheel — As desired

6. ARMT station select switches — RDY, armament advisory lights checked

   The azimuth steering line and aiming symbol appear when a bomb station is selected and in priority.

   With CBU dispensers loaded, the DISPENSER and station selected advisory lights illuminate.

   With fixed high-drag bombs, RETARDED advisory light illuminates.

   With GBU-10C/B and -12B/B LGB, GUIDED WEAPON and MECH FUZE advisory lights illuminate.

   With fire bombs, the NAPALM and MECH FUZE advisory lights illuminate.

   With other bomb type munitions, the BOMB SINGLE or BOMB MULTIPLE and MECH FUZE advisory lights illuminate.

   With SUU-20 practice bombs, the BOMB MULTIPLE advisory light illuminates. If Mk 106 practice bombs are loaded, the RETARDED advisory light illuminates. Station selected advisory lights illuminate.

   NOTE

   If ROCKETS advisory light illuminates when SUU-20 station is selected, cycle applicable station select switch(es) OFF then RDY.

7. FUZE switch — Set as applicable

   MECH FUZE advisory light goes off and station selected advisory lights and appropriate NOSE/TAIL armament monitor lights illuminate.

   a. Mk 82, Mk 83, Mk 84, M117 GP, MC-1 GB — NOSE, TAIL, or NOSE/TAIL

   b. BLU-1C/B, BLU-27 series fire bombs — NOSE/TAIL

   c. Bomb type (SUU-30 dispenser) CBU munitions — NOSE/TAIL

   d. Mk 20 cluster bomb — NOSE or NOSE/TAIL

      For Mk 20 Mod 2, place FUZE switch in NOSE.

      For Mk 20 Mods 3 and 4, if selected primary fuze functioning time is desired, place FUZE switch in NOSE.

      For Mk 20 Mods 3 and 4, if selected option fuze functioning time is desired, place FUZE switch in NOSE/TAIL.

   e. Mk 82 Snakeye pilot option — NOSE or TAIL

      If low-drag bomb option is desired, place FUZE switch in NOSE.

      If high-drag bomb option is desired, place FUZE switch in TAIL. RETARDED advisory light comes on.

WARNING

The Mk 82 Snakeye I pilot option bomb is rigged so that when the high-drag option (tail fuzing) is selected, the bomb fuzes will not arm unless the Mk 15 fin opens. Selection of NOSE/TAIL position on the FUZE switch will bypass this safety feature.

f. Mk 82 Snakeye fixed high-drag — NOSE/TAIL

g. Mk 82 Snakeye fixed low-drag — NOSE/TAIL

h. Mk 36 Destructor fixed high-drag — TAIL

i. Mk 36 Destructor fixed low-drag — NOSE/TAIL

j. GBU-10 and GBU-12 laser guided bombs — NOSE/TAIL

k. BDU-33 on MER's/TER's — NOSE, TAIL, or NOSE/TAIL

8. MASTER ARM switch — ARM, STA RDY lights checked

   a. Station selected lights go off.

   b. MASTER ARM armament monitor light illuminates.

When target is sighted on PPI:

9. Cursors — Slew to overlay target

   Use Bullpup controller to move cursor intersection in both range and azimuth.

10. Target — Designate

   The target is designated by pressing the target designate button or the armament release button. After designation, cursor and aiming symbol positions may be refined if target becomes visible. Hold target designate button depressed for at least 1 second.

If target becomes visible:

11. Select VISUAL ATTACK.

   Select VISUAL ATTACK mode and continue the attack, using the aiming symbol to refine aiming instead of the radar cursors.

WARNING

Do not depress master function attack mode switches with the armament release button depressed. Unintentional release may occur if the armament release button is depressed while switching from one mode to another.

Before solution cue intersects flightpath marker:

12. Azimuth error — Corrected

13. Armament release button — Press and hold

   Any of the delivery tactics described for VISUAL ATTACK mode can be used in BOC mode.

14. Execute pullup.

   The flightpath marker flashes for 2 seconds or more after the last weapon is released.

   For bomb type munitions as the last weapon is released from each selected station, the STA RDY advisory light for that station goes off. If all selected stations are emptied, all armament advisory lights go off.

   If CBU-12/46 dispensers are loaded on a TER STA RDY lights do not go off. If CBU-12/46 dispensers are loaded on the MAU-12, STA RDY lights go off when the dispensers are empty.

If reattack is desired:

15. MASTER ARM switch — OFF, any remaining STA RDY lights go off.

   a. Station selected advisory lights for remaining selected stations illuminate.

   b. MASTER ARM armament monitor light goes off.

16. ARMT panel — Checked, switches set

   Select any additional stations required and deselect all empty stations. Check mechanical fuzing requirements for weapons selected.

17. ARMAMENT RELEASE panel — Checked, switches set

    Check QUANTITY, INTERVAL-FT, and SINGLE/PAIRS/SIMULT switches for desired reattack release parameters.

18. MASTER ARM switch — ARM, STA RDY lights checked

    a. Station selected lights go off.

    b. MASTER ARM armament monitor light illuminates.

19. Aiming symbol — On target

    If aiming symbol does not appear on HUD, press and release designate button to reset the system. Reacquire the target on radar and redesignate.

Before solution cue intersects flightpath marker:

20. Azimuth error — Corrected

21. Armament release button — Press and hold

22. Execute pullup.

If no reattack desired:

23. MASTER ARM switch — OFF, MASTER ARM armament monitor light goes off

24. FUZE switch — SAFE, appropriate NOSE/TAIL armament monitor lights go off

25. ARMT station select switches — OFF

26. Armament advisory lights — Off

27. Designate button — Press and release, or deselect attack mode

HUD Failure After Designation — If HUD symbology is lost after target designation, proceed as follows:

1. ADI — Fly steering commands to target

2. Armament release button — Press and hold depressed until release occurs

WARNING

Pullup safety margin must be calculated since no computed cues are displayed.

NOTE

Other computed backup modes are described in Delivery System Management in the Navigation/Weapon Delivery System discussion, Section I. These modes are entered automatically and require little or no pilot action.

BOC OFFSET.

The following procedures apply to delivery of all bomb type munitions, practice bombs in the SUU-20 dispenser or loaded on MER's/TER's, and CBU dispensers.

1. Target data — Checked

   NOTE

   Use FLY TO DEST positions 1 through 9 or FLY TO MARK 1 through 8. Selection of FLY TO DEST 0 position or FLY TO MARK positions 0 or 9 prevents display of attack symbology. En route navigation computations continue, but the flight director is not displayed.

2. Radar set — Operating mode selected

3. Attack mode master function switches — BOC and OFFSET

   When within radar mapping range or when desired, press the BOC and OFFSET master function switches. The radar enters the ground map pencil (GMP) mode or, if GMS is selected, remains in the GMS mode. Cursors appear on the PPI ground-stabilized over the computed OAP location. The aiming symbol appears on the HUD, indicating the same ground location as the cursor intersection. The range cursor is not enabled beyond 80 nautical miles.

4. ARMAMENT RELEASE panel — Set

a. QUANTITY thumbwheel — As desired

NOTE

A selection of 01 permits a single fire pulse. The 00 setting is a safe position and does not permit a fire pulse.

b. SINGLE/PAIRS/SIMULT switch — SINGLE or PAIRS

c. INTERVAL-FT thumbwheel — As desired

5. ARMT station select switches — RDY, armament advisory lights checked

The azimuth steering line and aiming symbol appear when a bomb station is selected and in priority.

With CBU dispensers loaded, the DISPENSER and station selected advisory lights illuminate.

With fixed high-drag bombs, RETARDED advisory light illuminates.

With GBU-10C/B and -12B/B LGB, GUIDED WEAPON and MECH FUZE advisory lightS illuminate.

With fire bombs, the NAPALM and MECH FUZE advisory lights illuminate.

With other bomb type munitions, the BOMB SINGLE or BOMB MULTIPLE and MECH FUZE advisory lights illuminate.

With SUU-20 practice bombs, the BOMB MULTIPLE advisory light illuminates. If Mk 106 practice bombs are loaded, the RETARDED advisory light illuminates. Station selected advisory lights illuminate.

NOTE

If ROCKETS advisory light illuminates when SUU-20 station is selected, cycle applicable select switch(es) to OFF then RDY.

6. FUZE switch — Set as applicable

MECH FUZE advisory light goes off and station selected advisory lights and appropriate NOSE/TAIL fuze armament monitor lights illuminate.

a. Mk 82, Mk 83, Mk 84, M117 GP, MC-1 GB — NOSE, TAIL, or NOSE/TAIL

b. BLU-1C/B, BLU-27 series fire bombs — NOSE/TAIL

c. Bomb type (SUU-30 dispenser) CBU munitions — NOSE/TAIL

d. Mk 20 cluster bomb — NOSE or NOSE/TAIL

For Mk 20 Mod 2, place FUZE switch in NOSE.

For Mk 20 Mods 3 and 4, if selected primary fuze functioning time is desired, place FUZE switch in NOSE.

For Mk 20 Mods 3 and 4, if selected option fuze functioning time is desired, place FUZE switch in NOSE/TAIL.

e. Mk 82 Snakeye pilot option — NOSE or TAIL

If low-drag bomb option is desired, place FUZE switch in NOSE.

If high-drag bomb option is desired, place FUZE switch in TAIL. RETARDED advisory light comes on.

WARNING

The Mk 82 Snakeye I pilot option bomb is rigged so that when the high-drag option (tail fuzing) is selected, the bomb fuzes will not arm unless the Mk 15 fin opens. Selection of NOSE/TAIL position on the FUZE switch will bypass this safety feature.

f. Mk 82 Snakeye fixed high-drag — NOSE/TAIL

g. Mk 82 Snakeye fixed low-drag — NOSE/TAIL

h. Mk 36 Destructor fixed high-drag — TAIL

i. Mk 36 Destructor fixed low-drag — NOSE/TAIL

j. GBU-10, GBU-12 laser guided bombs — NOSE/TAIL

k. BDU-33 on MER's/TER's — NOSE, TAIL, or NOSE/TAIL

7. MASTER ARM switch — ARM, STA RDY lights checked

a. Station selected lights go off.

b. MASTER ARM armament monitor light illuminates.

When OAP sighted on PPI:

8. Cursors — Slew to overlay OAP

Use Bullpup controller to move cursor intersection in both range and azimuth.

9. OAP — Designate

The OAP is designated by pressing the target designate or armament release button. After designation, aiming symbol is ground-stabilized on computed target location, and radar cursors remain stabilized on the OAP. Cursor position on OAP can be refined right up to weapon release. Hold target designate button depressed for at least 1 second.

If target becomes visible:

10. Select VISUAL ATTACK.

Select VISUAL ATTACK mode and continue the attack, using the aiming symbol to refine aiming.

WARNING

Do not depress master function attack mode switches with the armament release button depressed. Unintentional release may occur if the armament release button is depressed while switching from one mode to another.

Before solution cue intersects flightpath marker:

11. Azimuth error — Corrected

12. Armament release button — Press and hold

Any of the delivery tactics described for VISUAL ATTACK mode can be used in BOC OFFSET mode.

13. Execute pullup.

The flightpath marker flashes for 2 seconds or more after last weapon is released.

For bomb type munitions as the last weapon is released from each selected station, the STA RDY advisory light for that station goes off. If all selected stations are emptied, all armament advisory lights go off.

If CBU-12/46 dispensers are loaded on a TER, STA RDY lights do not go off. If CBU-12/46 dispensers are loaded on the MAU-12, STA RDY lights go off when the dispensers are empty.

If reattack is desired:

14. MASTER ARM switch — OFF, any remaining STA RDY lights go off

a. Station selected advisory lights for remaining selected stations illuminate.

b. MASTER ARM armament monitor light goes off.

15. ARMT panel — Checked, switches set

Select any additional stations required and deselect all empty stations. Check mechanical fuzing requirements for weapons selected.

16. ARMAMENT RELEASE panel — Checked, switches set

    Check QUANTITY, INTERVAL-FT, and SINGLE/PAIRS/SIMULT switches for desired reattack release parameters.

17. MASTER ARM switch — ARM, STA RDY lights checked

    a. Station selected lights go off.

    b. MASTER ARM armament monitor light illuminates.

18. Aiming symbol — On target

    If aiming symbol does not appear on HUD, press and release designate button to reset the system. Reacquire the OAP on radar and redesignate. If the target becomes visible, refine the position of the aiming symbol visually.

Before solution cue intersects flightpath marker:

19. Azimuth error — Corrected

20. Armament release button — Press and hold

21. Execute pullup.

If no reattack desired:

22. MASTER ARM switch — OFF, MASTER ARM armament monitor light goes off

23. FUZE switch — SAFE, appropriate NOSE/TAIL fuze armament monitor lights go off

24. ARMT station select switches — OFF

25. Armament advisory lights — Off

26. Designate button — Press or deselect attack mode

HUD Failure After Designation — If HUD symbology is lost after OAP designation, proceed as follows:

1. ADI — Fly steering commands to target

2. Armament release button — Press and hold depressed until release occurs

WARNING

Pullup safety margin must be calculated since no computed cues are displayed.

NOTE

Other computed backup modes are described in Delivery System Management in the Navigation/Weapon Delivery System discussion, Section I. These modes are entered automatically and require little or no pilot action.

CCIP.

The following procedures apply to delivery of all bomb type weapons, except: GBU-8 series guided (EO) bombs and Maverick missiles. In the CCIP mode, the TISL symbol is displayed for information purposes only.

1. Radar set — Operating mode selected

2. Attack mode master function switch — CCIP

3. ARMAMENT RELEASE panel — Set

    a. QUANTITY thumbwheel — As desired

    NOTE

    A selection of 01 permits a single fire pulse. The 00 setting is a safe position and does not permit a fire pulse.

    b. SINGLE/PAIRS/SIMULT switch — SINGLE or PAIRS

    c. INTERVAL-FT thumbwheel — As desired

4. ARMT station select switches — RDY, armament advisory lights checked

    With CCIP selected and a bomb station selected and in priority, the bombfall line (BFL) will appear. When the impact angle reaches −20°, the BFL jumps down to indicate the impact point is about to enter the HUD field of view. When the impact angle reaches −16°, the solution cue becomes visible 4° below the BFL, moving up and along the BFL. The intersection of the solution cue and the BFL indicates bomb impact point or the center of a bomb stick.

With vertical CBU dispersers loaded, DISPENSER and station selected advisory lights illuminate.

With fixed high-drag bomb, RETARDED advisory light illuminates.

With fire bombs, the NAPALM and MECH FUZE advisory lights illuminate.

With SUU-20 practice bombs, the BOMB MULTIPLE advisory light illuminates.

If Mk 106 practice bombs are loaded, the RETARDED advisory light illuminates.

Station selected advisory lights illuminate.

NOTE

If ROCKETS advisory light illuminates when SUU-20 station is selected, cycle applicable station switch(es) to OFF and then RDY.

5. FUZE switch — Set, as applicable

MECH FUZE advisory light goes off and station selected advisory lights and appropriate NOSE/TAIL fuze armament monitor lights illuminate.

a. Mk 82, Mk 83, Mk 84, M117 GP, MC-1 GB — NOSE, TAIL, or NOSE/TAIL

b. BLU-1C/B, BLU-27 series fire bombs — NOSE/TAIL

c. Mk 20 cluster bomb — NOSE or NOSE/TAIL

d. For Mk 20 Mod 2, place FUZE switch in NOSE.

e. For Mk 20 Mods 3 and 4, if selected primary fuze functioning time is desired, place FUZE switch in NOSE.

f. For Mk 20 Mods 3 and 4, if selected option fuze functioning time is desired, place FUZE switch in NOSE/TAIL.

g. Mk 82 Snakeye fixed high-drag — NOSE/TAIL

h. Mk 82 Snakeye fixed low-drag — NOSE/TAIL

i. Mk 36 Destructor fixed high-drag — TAIL

j. Mk 36 Destructor fixed low-drag — NOSE/TAIL

k. BDU-33 on MER's/TER's — NOSE, TAIL, or NOSE/TAIL

6. MASTER ARM switch — ARM, STA RDY lights checked

a. Station selected lights go off.

b. MASTER ARM armament monitor light illuminates.

7. Intersection of BFL and solution cue — Over target

WARNING

In the CCIP mode, the armament release button is hot. Weapon release will occur any time the armament release button is pressed with a station enabled.

8. Armament release button — Press and hold

9. Execute pullup.

The flightpath marker flashes for 2 seconds or more after the last weapon is released.

For bomb type munitions, as the last weapon is released from each selected station, the STA RDY advisory light for that station goes off. If all selected stations are emptied, all armament advisory lights go off.

If CBU-12/46 dispensers are loaded on a TER, STA RDY lights do not go off. If CBU-12/46 dispensers are loaded on the MAU-12, STA RDY lights go off when the dispensers are empty.

NOTE

CCIP bombing mode does not have reattack capabilities. If a reattack of the target is desired, the procedures are the same as an initial CCIP attack (step 1). If a reattack is not desired, proceed to step 10.

10. MASTER ARM switch — OFF, MASTER ARM armament monitor light goes off
11. FUZE switch — SAFE, appropriate NOSE/TAIL fuze armament monitor lights go off
12. ARMT station select switches — OFF
13. Armament advisory lights — Off
14. Deselect attack mode

HUD Failure — Discontinue attack, deselect the CCIP bombing mode.

GUIDED WEAPON DELIVERY.

AGM-65 Maverick Missile.

Single Missile Launch.

Prior to attack:

1. Radar power switch — STBY or POWER

   Following a 3-minute delay after turnon, radar set and display are ready for complete operation.

   NOTE

   If an operating mode is selected and interference is encountered on the TV display, the radar can be placed in STBY to eliminate the interference.

2. Radar NORM-OVERRIDE switch — NORM

   Capability is provided for Maverick TV display.

3. QUANTITY switch — 01

   NOTE

   A single release occurs each time the armament release button is actuated with the QUANTITY switch set in any position other than 00.

4. ARMT station select switches — RDY, GUIDED WEAPON, and yellow station selected advisory lights on

   When a station loaded with Maverick is selected, the 3-minute missile warmup starts.

   CAUTION

   Premature use of the missile prior to expiration of the 3-minute gyro turnup, each time the station is selected, may result in guidance unit damage due to gyro tumbling or, if launched, the missile guidance may be subnormal. A momentary deselection of the station after gyro is up to speed will not result in appreciable slowdown of the seeker head gyro.

5. Target contrast switch — As desired

   A command signal is provided to the missile to track a dark-on-light or a light-on-dark target or to automatically select a tracking mode. Switch position has no affect on picture quality on the TV display.

6. SINGLE/PAIRS/SIMULT switch — SINGLE
7. VISUAL ATTACK master function switch — Depress

   Aiming symbol appears on HUD fixed at HUD boresight position.

8. STBY RETICLE (if desired) — On, set to missile boresight. Adjust brightness as desired.
9. Air ignite button — Press and release

   Air ignite button enables missile seeker boresight alignment, jettisons the missile dome cover, and turns on TV display and tracking gate. For TGM, the button also begins camera operation.

CAUTION

Do not use flightpaths where the sun is within 20° of missile boresight when seeker is uncaged.

If gyro tumbling is observed (TV display shows a continuous rapid rotation or is so blurred as to make any image indiscernible), immediately position applicable ARMT station select switch to OFF.

The TGM shall not be maintained in the full power mode (electrical alignment, slew and track) in excess of 30 minutes on any single mission, and the sum of the ready mode (station selected, gyros running) and the full power mode periods on any single mission shall not exceed 40 minutes. Do not exceed missile operating time limits as specified in Section I.

NOTE

Redundancy in the air ignition system fires both igniters simultaneously whenever the air ignite button is pressed. Air restart attempts also provide Maverick control functions if the air ignite button is pressed and a station loaded with Maverick is selected.

10. TV Display — Adjusted

    The quality of the TV display directly affects the pilot's ability to successfully detect targets and employ the missile. TV display brightness and contrast should be adjusted for an optimum display. Optimum adjustment is normally near maximum contrast with brightness adjusted as necessary.

11. MASTER ARM switch — ARM, STA RDY lights checked. MASTER ARM armament monitor light illuminates

    Firing circuits are enabled.

During attack run:

12. Maneuver aircraft to position aiming symbol/standby reticle on target.

13. Target designate button — Press and hold

    The switch enables the Bullpup controller and places the seeker in modified free gyro.

14. Bullpup controller — Use as required to refine seeker head aim to place target in gate

    NOTE

    If target is in gate when designate button is pressed, Bullpup controller corrections may not be required.

15. Target designate button — Release

    Lock-on signal is provided to enable target tracking by seeker head.

16. Verify missile is locked on target.

17. Armament release button — Press and hold (approximately 2 seconds) until missile leaves launcher

    The radar scope goes blank and, if in an operating mode, reverts to radar display when armament release button is released.

    CAUTION

    Failure to hold armament release button for approximately 2 seconds may result in activation of missile battery without rocket motor activation (no launch). TGM damage may also result since video could be turned off while the TGM remains in the tracking mode.

    (TGM) The armament release button or air ignite button must be actuated prior to pulling off the target during simulated missile attack. If the air ignite button is actuated, the station should be deselected momentarily. This will make the sun shutter active to protect the vidicon, and momentary deselection will remove video and reduce the time the missile is operating at full power.

After missile launch:

1. MASTER ARM switch — OFF, MASTER ARM armament monitor light goes off

2. ARMT station select switches — OFF

3. Standby reticle — As desired

4. Radar — Desired mode

GBU-8 Series Guided Bomb.

Airborne Alignment.

1. ARMT station select switch — RDY, GUIDED WEAPON, and MECH FUZE advisory lights on

   Following a 5-minute delay after selection, selected bomb is ready for alignment.

CAUTION

The air ignite button must not be actuated to uncage the bomb seeker head prior to completion of the 5-minute bomb warmup time. The gyros must be allowed to turn up for this period to reach full speed before mechanical uncage or damage to bomb seeker head may occur.

2. Radar power switch — STBY or POWER

   Following a 3-minute delay after turn-on, radar set and display are ready for complete operation.

NOTE

If an operating mode is selected and interference is encountered on the TV display, the radar can be placed in STBY to eliminate the interference.

3. Radar NORM-OVERRIDE switch — NORM

4. QUANTITY switch — 01

5. SINGLE/PAIRS/SIMULT switch — SINGLE

6. Air ignite button — Momentarily depress

   TV display from selected bomb appears on radar scope.

7. TV display — Adjusted

   The quality of the TV display directly effects the pilot's ability to successfully detect targets and employ the bomb. Display brightness and contrast should be adjusted for an optimum display. Optimum adjustment is normally near maximum contrast with brightness adjusted as necessary.

8. VISUAL ATTACK master function switch — Depress

   Aiming symbol appears on HUD at zero sight line or slaved to position for which station has been previously boresighted.

9. TV display — Presented with crosshairs

   Fly the aircraft so as to place the alignment target within the TV display crosshairs.

10. Bullpup controller — Use as required to place HUD aiming symbol over alignment target

11. Check that target within TV crosshairs is same target under aiming symbol

12. Target designate button — Press and release

    Aiming symbol offset is recorded into computer and seeker head caging power is removed, allowing seeker to track target.

13. Target designate button — Press and release

    Seeker head is returned to caged position.

14. Check that aiming symbol overlays target within TV crosshairs.

15. ARMT station select switch — Deselect. GUIDED WEAPON and MECH FUZE advisory lights go off. Radar returns to operating mode selected.

16. Repeat applicable steps 1 through 15 for each guided bomb.

17. VISUAL ATTACK master function switch — Deselect

    En route symbology appears on HUD.

Bomb Delivery.

Prior to target area entry:

1. ARMT station select switches — RDY, GUIDED WEAPON, and MECH FUZE advisory lights come on

Following a 5-minute delay after selection, selected bombs are ready for further control operation.

CAUTION

The air ignite button must not be actuated to uncage the bomb seeker head prior to completion of the 5-minute bomb warmup time. The gyros must be allowed to turn up for this period to reach full speed before mechanical uncage or damage to bomb seeker head may occur.

2. Radar power switch — STBY or POWER

   Following a 3-minute delay after turnon, radar set and display are ready for complete operation.

   NOTE

   If an operating mode is selected and interference is encountered on the TV display, the radar can be placed in STBY to eliminate the interference.

3. Radar NORM-OVERRIDE switch — NORM
4. QUANTITY switch — 01
5. SINGLE/PAIRS/SIMULT switch — SINGLE
6. FUZE switch — NOSE, TAIL or NOSE/TAIL. MECH FUZE light goes off and yellow station selected lights come on. Appropriate NOSE/TAIL fuze armament monitor lights illuminate.
7. MASTER ARM switch — ARM, yellow station selected lights go off. MASTER ARM armament monitor light illuminates.
8. ARMT station select switches — Deselect higher priority stations
9. Air ignite button — Momentarily depress. TV display from selected bomb appears on radar scope.
10. Radar range switch — Press and release. Green station ready light comes on within 5 seconds.
11. Radar range switch — Press and release. Green station ready light goes off.
12. ARMT station select switch — RDY for next highest priority station

    Following a 2-minute delay, bomb is ready for further control operations.

13. Repeat steps 9 through 12 for each bomb to be delivered.
14. MASTER ARM switch — OFF. Yellow station selected lights come on. MASTER ARM armament monitor light goes off.
15. NORM-OVERRIDE switch (if desired) — OVERRIDE

    Radar operating mode is displayed.

After target area entry:

16. NORM-OVERRIDE switch — NORM. Video display from priority selected bomb appears on radar scope.
17. VISUAL ATTACK master function switch — Depress

    Aiming symbol appears on HUD boresighted to bomb seeker head on priority selected station.

18. MASTER ARM switch — ARM. Station selected lights go off. MASTER ARM armament monitor light illuminates.
19. Radar range switch — Press and release. Green station ready lights come on.

During attack run:

20. Fly aircraft to overlay target with HUD aiming symbol.
21. Make final aiming adjustments to place target within center of TV crosshairs.
22. Target designate button — Press and release

    Caging power is removed from bomb seeker head, allowing seeker to track target within crosshairs.

23. Verify seeker head tracking target.
24. Armament release button — Press and release

TV display goes blank upon bomb separation, then reverts to video display from next bomb in priority or radar operating mode selected. Station ready light goes off when button is released. GUIDED WEAPON light goes off when button is released unless another guided bomb station is selected. HUD symbology changes to air-to-ground gunnery unless another guided bomb station is selected, in which case the previously released station must be deselected to cause the aiming symbol to move to seeker head boresight position of next bomb.

25. Repeat steps 19 through 24 to release succeeding bombs.

If release is aborted:

26. MASTER ARM switch — OFF, station ready advisory light goes off, and station selected light comes on. MASTER ARM armament monitor light goes off.

    Returns bomb to aircraft power for conservation of bomb battery. Maximum accumulated time for operation on aircraft power after battery activation is 1 hour after which weapon must be considered inoperative.

CAUTION

If PCO was accomplished and the weapon was not released, aircraft power must be maintained on the weapon to prevent vidicon damage until the weapon battery is removed or the weapon is returned to internal power for a subsequent release within the 1-hour time limit. Do not deselect the station with the unreleased weapon except when necessary to move the aiming symbol to seeker boresight position for release of bombs on lower priority stations. Total cumulative time of station deselection should not exceed 5 minutes.

After bomb release:

27. MASTER ARM switch — OFF, MASTER ARM armament monitor light goes off
28. ARMT station select switches — OFF
29. FUZE switch — SAFE, appropriate NOSE/TAIL fuze armament monitor lights go off
30. VISUAL ATTACK master function switch — Deselect
31. Radar — Desired operating mode

MANUAL BOMB.

NOTE

Manual bomb mode is initiated by nonselection or deselection of any computed mode.

The following procedures apply to delivery of all bomb type munitions, dispenser type CBU munitions, practice bombs in SUU-20 dispensers or loaded on MER's/TER's, and flares/markers in SUU-25 or SUU-42 dispensers.

NOTE

CBU-30/A, CBU-38/A, CBU-38A/A, and CBU-38B/A dispensers have an internal intervalometer which is set on the ground. The interval set on this intervalometer is obtainable by holding the armament release button depressed until the dispenser is empty. This will provide a train release of these munitions, although it may not be the most desirable under the prevalent target area conditions.

Ballistic equations for ASCU codes CP (CBU-38) and CQ (CBU-30) are included in the NAV WD Computer program. With green ready lights on CBU-30/38 stations, the NAV WD Computer will issue a continuous solid fire pulse, starting when the armament release button is depressed in Manual Ripple bombing mode. The solid fire pulse will continue until the armament release button is released. Because of the solid fire pulse, the FPM will not flash and the release freeze data will not be calculated.

Use of the standby reticle is not applicable when delivering flares/markers from SUU-25 or SUU-42 dispensers.

2. Reticle depression — As desired

Determine setting by algebraically summing the zero sight line angle of attack (figure 6-4) to depression angle from flightpath for the given weapon and delivery as presented in T.O. 1A-7K-34-1-2.

3. ARMAMENT RELEASE panel — Set

a. QUANTITY thumbwheel — As desired

NOTE

A selection of 01 permits a single fire pulse. The 00 setting is a safe position and does not permit a fire pulse.

b. SINGLE/PAIRS/SIMULT switch — SINGLE, PAIRS, or SIMULT

NOTE

SIMULT position of SINGLE/PAIRS/SIMULT switch can be used only with the CBU-30/A or CBU-38 series vertical dispensers.

c. INTERVAL-FT thumbwheel — As desired

4. ARMT station select switches — RDY, armament advisory lights checked

With flare station(s) selected, FLARE advisory light illuminates and goes off only when station(s) is deselected. Station selected advisory lights illuminate.

With CBU-12/30/38/46 dispensers selected, DISPENSER advisory light illuminates. Station selected advisory lights illuminate.

With fixed high-drag bombs, RETARDED advisory light illuminates.

With GBU-10C/B and -12B/B LGB, GUIDED WEAPON and MECH FUZE advisory lights illuminate.

With fire bombs, the NAPALM and MECH FUZE advisory lights illuminate.

With other bomb type munitions, the BOMB SINGLE or BOMB MULTIPLE and MECH FUZE advisory lights illuminate.

With SUU-20 practice bombs, the BOMB MULTIPLE advisory light illuminates. If Mk 106 practice bombs are loaded, the RETARDED advisory light illuminates. Station selected advisory lights illuminate.

NOTE

If ROCKETS advisory light illuminates when SUU-20 station is selected, cycle applicable station select switch(es) to OFF then RDY.

With bomb type munitions or fire bombs, the BOMB SINGLE or BOMB MULTIPLE and MECH FUZE advisory lights illuminate.

5. FUZE switch — Set as applicable

MECH FUZE advisory light does off and station selected advisory lights and appropriate NOSE/TAIL fuze armament monitor lights illuminate.

a. Mk 82, Mk 83, Mk 84, M117 GP, MC-1 GB — NOSE, TAIL, or NOSE/TAIL

b. BLU-1C/B, BLU-27 series fire bombs — NOSE/TAIL

c. Bomb type (SUU-30 dispenser) CBU munitions — NOSE/TAIL

d. Mk 20 cluster bomb — NOSE or NOSE/TAIL

For Mk 20 Mod 2, place FUZE switch in NOSE.

For Mk 20 Mods 3 and 4, if selected primary fuze functioning time is desired, place FUZE switch in NOSE.

For Mk 20 Mods 3 and 4, if selected option fuze functioning time is desired, place FUZE switch in NOSE/TAIL.

e. Mk 82 Snakeye pilot option — NOSE or TAIL

WARNING

The Mk 82 Snakeye I pilot option bomb is rigged so that when the high-drag option (tail fuzing) is selected, the bomb fuzes will not arm unless the MK 15 fin opens. Selection of NOSE/TAIL position on the FUZE switch will bypass this safety feature.

f. Mk 82 Snakeye fixed high-drag — NOSE/TAIL

g. Mk 82 Snakeye fixed low-drag — NOSE/TAIL

h. Mk 36 Destructor fixed high-drag — TAIL

i. Mk 36 Destructor fixed low-drag — NOSE/TAIL

j. GBU-10 and GBU-12 laser guided bombs — NOSE/TAIL

k. BDU-33 on MER's/TER's — NOSE, TAIL, or NOSE/TAIL

l. BL-755 bomb cluster — NOSE/TAIL

6. NAV WD Computer — Operating (a requirement in manual ripple mode only)

If quantity of one is selected, a single fire pulse is transmitted immediately upon depression of the armament release button, independent of the status of the NAV WD Computer. To make a manual ripple delivery, the computer must be operational and a quantity of two or more weapons selected. The interval between bombs will be equal to the selected interval divided by the groundspeed. In a dive, the interval between bombs will be smaller than that selected on the ARMAMENT RELEASE panel. As dive angle increases, interval decreases. Interval will be increased in positive g forces are introduced. Interval between bombs will increase as g forces increase.

7. MASTER ARM switch — ARM, STA RDY lights checked

a. Station selected lights go off.

b. MASTER ARM armament monitor light illuminates.

8. Fly aircraft to overlay target (aimpoint) with standby reticle.

9. Armament release button — Press and hold

For manual ripple release, weapon release begins immediately on depression of the armament release button, which must be held depressed until selected quantity of weapons are released.

For manual single release, weapon release is initiated by depression of armament release button. The button must be depressed once for each weapon or pair of weapons to be released.

For SUU-42 dispensers set on RIPPLE, depression and holding of the armament release button causes the dispensers to eject flares at the rate set on the dispenser intervalometer. Station transfer is obtained by deselecting SUU-42 station(s).

For SUU-7 dispensers (CBU-12 series and CBU-46/A), weapon release begins immediately on depression of the armament release button. Button must be held depressed until selected quantity of fire pulses have been delivered. Manual selector switch setting permits two, four, six or all (salvo) tubes to be released with each fire pulse received by the dispenser. If dispensers are loaded on a TER, STA RDY lights do not go off. If dispensers are loaded on the MAU-12, STA RDY lights go off when the dispensers are empty.

For SUU-13 dispensers (CBU-30/A and CBU-38 series), weapon release begins immediately on depression of the armament release button. Button must be held depressed for a time duration determined by the dispenser pulse rate setting. Available pulse rates are determined by the model of SUU-13 dispenser used. Pulse rate setting must be multiplied by 39 to determine time to hold armament release button depressed.

For bomb type munitions, as the last weapon is released from each selected station, the STA RDY light for that station goes off. If all selected stations are emptied, all armament advisory lights go off.

If reattack is desired:

10. MASTER ARM switch — OFF, any remaining STA RDY lights go off

    Station selected lights for remaining selected stations illuminate. MASTER ARM armament monitor light goes off.

11. ARMT panel — Checked, switches set

    Select any additional stations required and deselect all empty stations. Check mechanical fuzing requirements for weapons selected.

12. ARMAMENT RELEASE panel — Checked, switches set

    Check QUANTITY, INTERVAL-FT, and SINGLE/PAIRS/SIMULT switches for desired reattack release parameters.

13. MASTER ARM switch — ARM, STA RDY lights checked

    a. Station selected lights go off.

    b. MASTER ARM armament monitor light illuminates.

14. Fly aircraft to overlay target (aimpoint) with standby reticle.

15. Armament release button — Press and hold

If no reattack desired:

16. MASTER ARM switch — OFF, MASTER ARM armament monitor light goes off

17. FUZE switch — SAFE, appropriate NOSE/TAIL fuze armament monitor lights go off

18. ARMT station select switches — OFF

19. Armament advisory lights — Off

COMPUTED ROCKETS ATTACK.

The following procedures apply to computed delivery of 2.75-inch rockets from rocket launchers or SUU-20 dispensers.

NOTE

Rocket ballistics included in the current OFP are based on the Mk 1 warhead/Mk 4 motor combination. Rocket firing using other warhead/motor combinations must be made in the manual mode.

1. Attack mode master function switches — VISUAL ATTACK, CCIP, or BOC

2. Radar set — Operating mode selected

   The Forward-Looking Radar radiates in the AGR mode upon selection of a computed rockets attack mode.

3. ARMAMENT RELEASE panel — Set

   a. QUANTITY thumbwheel — 01

   NOTE

   A single fire pulse is produced each time the armament release button is actuated with the QUANTITY switch set in any position other than 00.

   b. SINGLE/PAIRS/SIMULT switch — As desired

   INTERVAL-FT thumbwheel has no application in rocket delivery.

4. ARMT station select switches — RDY, ROCKETS advisory light illuminates

   Station selected advisory lights illuminate.

   For SUU-20 rockets, if the BOMB MULTIPLE advisory light illuminates, cycle applicable station select switch(es) to OFF then RDY.

5. MASTER ARM switch — ARM, STA RDY lights checked

   a. Station selected advisory lights go off.

   b. MASTER ARM armament monitor light illuminates.

6. Aiming symbol — Fly aircraft to overlay aiming symbol on target

The aiming symbol indicates the computed impact point and is compensated for rocket jump in addition to wind and gravity. The in-range cue is displayed when slant range to computed impact point is less than 14,366 feet.

NOTE

Slewing commands and target designation are not applicable in computed rockets attack mode.

7. Armament release button — Press and release once for each fire pulse to be delivered

   With SINGLE/PAIRS/SIMULT switch in SINGLE or PAIRS, when all rocket launchers on a selected station have received one fire pulse, the STA RDY light for that station goes off. If all rocket launchers on all selected stations receive one fire pulse, all armament advisory lights go off. With SINGLE/PAIRS/SIMULT switch in SIMULT, armament advisory lights go off only when stations are deselected.

   For SUU-20 rockets, STA RDY and ROCKETS advisory lights go off only when station is deselected.

8. Execute pullup when desired.

If reattack is desired:

9. MASTER ARM switch — OFF, any remaining STA RDY light go off

   a. Station selected lights for remaining selected stations illuminate.

   b. MASTER ARM armament monitor light goes off.

10. ARMT panel — Checked, switches set

    Select any additional stations required and deselect all empty (fired) stations.

11. ARMAMENT RELEASE panel — Checked, switches set

    Check SINGLE/PAIRS/SIMULT and QUANTITY switches for desired reattack release parameters.

12. MASTER ARM switch — ARM, STA RDY lights checked

    a. Station selected lights go off.

    b. MASTER ARM armament monitor light illuminates.

13. Aiming symbol — Fly aircraft to overlay symbol on target

14. Armament release button — Press and release once for each fire pulse to be delivered

15. Execute pullup when desired.

If no reattack desired:

16. MASTER ARM switch — OFF, MASTER ARM armament monitor light goes off

17. ARMT station select switches — OFF

18. Armament advisory lights — Off

MANUAL ROCKET ATTACK.

The following procedures apply to manual delivery of 2.75-inch rockets from rocket launchers or SUU-20 dispensers.

1. STBY RETICLE — On, set intensity as desired

2. MILS DEPR knob — As desired

3. ARMAMENT RELEASE panel — Checked, switches set

   a. QUANTITY switch — 01

   b. SINGLE/PAIRS/SIMULT switch — As desired

4. ARMT station select switches — RDY, ROCKETS advisory light illuminates

   Station selected advisory lights illuminate.

   For SUU-20 rockets, if BOMB MULTIPLE advisory light illuminates, cycle applicable station select switch(es) to OFF then RDY.

5. MASTER ARM switch — ARM, STA RDY lights checked

   a. Station selected advisory lights go off.

   b. MASTER ARM armament monitor light illuminates.

6. Fly aircraft to overlay target (aimpoint) with standby reticle.

7. Armament release button — Press and release once for each fire pulse to be delivered

   With SINGLE/PAIRS/SIMULT switch in SINGLE or PAIRS, when all rocket launchers on a selected station have received one fire pulse, the STA RDY light for that station goes off. If all rocket launchers on all selected stations receive one fire pulse, all armament advisory lights go off. With SINGLE/PAIRS/SIMULT switch in SIMULT, armament advisory lights go off only when stations are deselected.

   For SUU-20 rockets, STA RDY and ROCKETS advisory lights go off only when applicable station is deselected.

8. Execute pullup when desired.

If reattack is desired:

9. MASTER ARM switch — OFF, any remaining STA RDY lights go off

   a. Station selected lights for remaining selected stations illuminate.

   b. MASTER ARM armament monitor light goes off.

10. ARMT panel — Checked, switches set

    Select any additional stations required and deselect all empty (fired) stations.

11. ARMAMENT RELEASE panel — Checked, switches set

    Check QUANTITY and SINGLE/PAIRS/SIMULT switches for desired reattack release parameters.

12. MASTER ARM switch — ARM, STA RDY lights checked

    a. Station selected advisory lights go off.

    b. MASTER ARM armament monitor light illuminates.

13. Fly aircraft to overlay target (aimpoint) with standby reticle.

14. Armament release button — Press and release once for each fire pulse to be delivered

15. Execute pullup when desired.

If no reattack desired:

16. MASTER ARM switch — OFF, MASTER ARM armament monitor light goes off

17. ARMT station select switches — OFF

18. Armament advisory lights — Off

19. STBY RETICLE — OFF

COMPUTED AIR-TO-AIR GUNNERY.

1. All master function switches — Deselected

   In computed air-to-air gunnery mode, the Forward-Looking Radar does not radiate.

2. STBY RETICLE — On, set intensity as desired

   The standby reticle may be used to approximate the range to the target.

3. MILS DEPR knob — Set as desired

If internal gun is desired:

4. GUN switch — HIGH or LOW, appropriate gun armament monitor light illuminates

If SUU-23/A gun pods are desired:

5. ARMT station select switches — RDY

   Station selected advisory lights illuminate.

GUN/GUN POD advisory light illuminates when either GUN switch is placed in HIGH or LOW or station(s) loaded with SUU-23/A gun pod is selected.

If autoclearing cutout is desired, place FUZE switch in NOSE or NOSE/TAIL.

6. MASTER ARM switch — ARM

   MASTER ARM armament monitor light illuminates

   With gun pod stations selected, STA RDY lights illuminate. Station selected advisory lights go off.

   GUN/GUN POD advisory light goes off and GUN RDY advisory light illuminates.

7. Fly aircraft to achieve desired sight picture to accomplish desired results.

   The aiming symbol must be positioned as discussed in Section I.

8. Trigger switch — Press to second detent (at precomputed open fire range)

After firing:

9. MASTER ARM switch — OFF, MASTER ARM armament monitor light off

If internal gun is selected:

10. GUN switch — SAFE, appropriate gun armament monitor light goes off

If SUU-23/A loaded stations are selected:

11. ARMT station select switches — OFF

12. Armament advisory lights — Off

13. FUZE switch (if applicable) — SAFE

MANUAL AIR-TO-AIR GUNNERY.

1. STBY RETICLE — On, set intensity as desired

2. MILS DEPR knob — Set as desired

If internal gun is desired:

3. GUN switch — HIGH or LOW, appropriate gun armament monitor light illuminates

If SUU-23/A gun pods are desired:

4. ARMT station select switches — RDY

   Station selected advisory lights illuminate.

   GUN/GUN POD advisory light illuminates when either GUN switch is placed in HIGH or LOW or station(s) loaded with SUU-23/A gun pod is selected.

   If autoclearing cutout is desired, place FUZE switch in NOSE or NOSE/TAIL.

5. MASTER ARM switch — ARM

   MASTER ARM armament monitor light illuminates.

   With gun pod stations selected, STA RDY lights illuminate. Station selected advisory lights go off.

   GUN/GUN POD advisory light goes off and GUN RDY advisory light illuminates.

6. Fly aircraft to achieve desired sight picture.

7. Trigger switch — Press to second detent

After firing:

8. MASTER ARM switch — OFF, MASTER ARM armament monitor light goes off

If internal gun is selected:

9. GUN switch — SAFE, appropriate gun armament monitor light goes off

If SUU-23/A loaded stations are selected:

10. ARMT station select switches — OFF

11. Armament advisory lights — OFF

12. FUZE switch (if applicable) — SAFE

COMPUTED AIR-TO-GROUND GUNNERY.

1. ARMT station select switches — Deselect stations carrying computed weapons

   In order to obtain HUD air-to-ground gunnery display, the highest priority station selected must be loaded with a SUU-23/A gun pod, another noncomputed store or be empty.

2. Attack mode master function switch — VISUAL ATTACK, BOC, or CCIP

3. Radar set — Operating mode selected

   The Forward-Looking Radar radiates in the AGR mode and is slaved to the aiming symbol with gun pods selected or GUN switch in HIGH or LOW and a computed attack mode selected.

If internal gun is desired:

4. GUN switch — HIGH or LOW, appropriate gun armament monitor light illuminates

If SUU-23/A gun pods are desired:

5. ARMT station select switches — RDY

   Station selected advisory lights illuminate.

   GUN/GUN POD advisory light illuminates when either GUN switch is placed in HIGH or LOW or station(s) loaded with SUU-23/A gun pod is selected.

   If autoclearing cutout is desired, place FUZE switch in NOSE OR NOSE/TAIL.

6. MASTER ARM switch — ARM

   MASTER ARM armament monitor light illuminates.

   With gun pod station(s) selected, STA RDY lights illuminate. Station selected advisory lights go off.

   GUN/GUN POD advisory light goes off and GUN RDY light illuminates.

NOTE

An in-range cue is displayed atop the aiming symbol when slant range to the computed impact point is less than 8,192 feet.

7. Aiming symbol — Fly aircraft to overlay symbol on target

8. Trigger switch — Press to second detent

After firing:

9. MASTER ARM switch — OFF, MASTER ARM armament monitor light goes off

If internal gun is selected:

10. GUN switch — SAFE, appropriate gun armament monitor light goes off

If SUU-23/A loaded stations are selected:

11. ARMT station select switches — OFF

12. Armament advisory lights — Off

13. FUZE switch (if applicable) — SAFE

MANUAL AIR-TO-GROUND GUNNERY.

1. STBY RETICLE — On, set intensity as desired

2. MILS DEPR knob — Set as desired

If internal gun is desired:

3. GUN switch — HIGH or LOW, appropriate gun armament monitor light illuminates

If SUU-23/A gun pods are desired:

4. ARMT station select switches — RDY

   Station selected advisory lights illuminate.

   GUN/GUN POD advisory light illuminates when either GUN switch is placed in HIGH or LOW or station(s) loaded with SUU-23/A gun pod is selected.

If autoclearing cutout is desired, place FUZE switch in NOSE or NOSE/TAIL.

5. MASTER ARM switch — ARM, MASTER ARM armament advisory light illuminates

   With gun pod station(s) selected, STA RDY lights illuminate. Station selected advisory lights go off.

   GUN/GUN POD advisory light goes off and GUN RDY advisory light illuminates.

6. Fly aircraft to overlay target (aimpoint) with standby reticle.

7. Trigger switch — Press to second detent

After firing:

8. MASTER ARM switch — OFF, MASTER ARM armament monitor light goes off

If internal gun is selected:

9. GUN switch — SAFE, appropriate gun armament monitor light goes off

If SUU-23/A loaded stations are selected:

10. ARMT station select switches — OFF

11. Armament advisory lights — Off

12. FUZE switch (if applicable) — SAFE

AIM-9 MISSILE ATTACK.

Before Missile Launch:

1. STBY RETICLE — On, set intensity as desired

2. MILS DEPR knob — Zero depression

3. ARMT station select switch — L or R/L

   SIDEWINDER advisory light illuminates.

   If the ARMT station select switch for stations 4 and 5 is placed in L, only the missile on station 4 will fire. If the switch is placed in R/L, the missile on station 5 fires when the armament release button is pressed and priority transfers to station 4 when the switch is released.

   Station selected advisory light(s) illuminates.

WARNING

If ROCKETS advisory light illuminates when an AIM-9 loaded station is selected, the missile cannot be launched.

NOTE

Air-to-air gunnery symbology will appear on the HUD if a computed attack mode is selected and either a gun pod station or the internal gun is selected when the fuselage station(s) is selected. This symbology will remain on the HUD until the attack mode is deselected, the gun/gun pod is deselected, or the fuselage station(s) is deselected.

4. Missile tone — Check

   If time and circumstances permit, boresight each missile and check that the tone intensity and volume vary properly with changes in infrared radiation in seeker gyro's cone of view.

5. Target designate button (if applicable) — Press and release

   The target designate button will uncage the seeker head of AIM-9E or AIM-9J missile. A second depression of the target designate button will recage the missile seeker.

Missile Launch:

1. MASTER ARM switch — ARM, armament advisory lights checked

   MASTER ARM armament monitor light illuminates.

STA RDY advisory light(s) illuminates.

Station selected lights go off.

2. Armament release button — Press and hold until missile leaves rail

With R/L selected on station select switch, station transfer occurs when the armament release button is released.

As each missile is launched, the STA RDY light for that station goes off. If all selected missile stations are fired, SIDEWINDER and STA RDY lights go off.

After Missile Attack:

1. MASTER ARM switch — OFF, MASTER ARM armament monitor light goes off

2. ARMT station select switches — OFF

3. Armament advisory lights — Off

TDU-11/B TARGET ROCKET LAUNCHING.

1. ARMT station select switch — L or R/L

SIDEWINDER advisory light illuminates.

Station selected light illuminates.

NOTE

If ROCKETS advisory light illuminates when a TDU-11/B loaded station is selected, the rocket cannot be launched.

2. MASTER ARM switch — ARM, armament advisory lights checked

MASTER ARM armament monitor light illuminates

STA RDY advisory light illuminates.

Station selected light goes off.

3. Armament release button — Press and hold until rocket leaves rail.

Automatic transfer from station 5 to station 4 will occur upon release of armament release button.

After rocket launch:

4. MASTER ARM switch — OFF, MASTER ARM armament monitor light goes off

5. ARMT station select switch — OFF

6. Armament advisory lights — Off

DEARMING AREA CHECKS.

GENERAL.

1. Armament switches — OFF, SAFE

2. Pilot — Hands in view

The following procedures will be performed by the dearming area ground crew.

PYLON AREA (GENERAL).

1. MAU-12 ground safety pins — Installed

2. MER/TER electrical and mechanical safety pins — Installed

DISPENSER TYPE MUNITIONS.

SUU-25 Series Flare Dispenser.

1. Dispenser shorting pin — Installed

2. Ground safety pins — Installed (if applicable)

SUU-42 Series Flare Dispenser.

1. Dispenser safety pin — Installed

SUU-20 Series Bomb and Rocket Dispenser.

1. Circuit disconnect safety spring — Installed

2. Intervalometers — SAFE

3. Ejector gun safety pins — Installed

CBU-30/A and CBU-38 Series Dispensers.

1. Intervalometer safety pin — Installed
2. Safety pallet — Installed (if applicable)

CBU-12 Series and CBU-46/A Dispensers.

1. Safety pin (except CBU-12/A) — Installed

BOMB TYPE MUNITIONS.

Mk 82, Mk 83, Mk 84, M117, MC-1 Gas Bomb, Mk 82 Snakeye, GBU-10 LGB, and GBU-12 LGB.

1. Arming wires and retaining clips (M-series fuzes/TDD) — Installed
2. Arming lanyard (FMU-series fuzes) — Not pulled

Mk 36 Destructor.

1. Arming wire — Installed in arming device
2. Firing mechanism arming wire — Installed through popout pin

GBU-8/B.

CAUTION

If PCO was accomplished and the weapon was not released, to prevent damage to vidicon, do not deselect station (removing aircraft power from weapon) until the weapon battery is removed.

1. Arming wires and retaining clips (M905) — Installed
2. Arming lanyards (FMU-26B/B) — Installed
3. Control section safety pin — Installed
4. If PCO accomplished, weapon battery — Removed
5. Protective dome cover — Installed

Mk 20 Cluster Bomb.

1. Fuze — Safe
2. Arming wire — Installed

Bomb Type (SUU-30 Dispenser) CBU Munitions.

1. Arming wire and retaining clip (M907) — Installed
2. Arming lanyard (FMU fuzes) — Not pulled
3. Armed indicators (FMU-110) — Not extended
4. Safing pins (FMU-56/110) — Installed
5. Pitot tubes (FMU-56) — Not extended

BLU-1C/B, BLU-27 Series Fire Bombs.

1. Bomb initiators — Not actuated
2. Initiator shear/safety wire — Installed
3. Initiator arming lanyard (FMU-7/B) — Taped
4. Arming wire (repaired BLU-27) — Cut, lanyard pushed inside end cap

BLU-52 Series Chemical Bombs.

1. Bombs — Not leaking

BL-755 Bomb Cluster.

1. Fuze arming vane safety pin — Installed

AGM-65 MAVERICK MISSILE AND TGM.

WARNING

In the event that the missile thermal battery has been activated without rocket motor activation (no launch), high temperatures, toxic gases, and presence of cadmium dust may result within the missile. Ground personnel shall be alerted to potential hazards. The pilot should egress on the side of the aircraft opposite the missile with the activated battery.

1. Missile igniter cables (except TGM) — Disconnected, coiled and taped/clipped. Igniter cable shorting devices are in shorting position.

LAU-3 SERIES AND LAU-68 SERIES ROCKET LAUNCHERS.

1. Launcher shorting pin — Installed

SUU-23/A GUN POD.

1. Starter motor lead — Disconnected
2. Gun fire lead — Disconnected
3. Pod side cowling — Installed

AIM-9 GUIDED MISSILE.

1. AERO 3B safety pin — Installed in top of launcher
2. Missile nose and influence fuze covers — Installed

TDU-11/B TARGET ROCKET.

1. AERO 3B safety pin — Installed in top of launcher

M61A1 GUN.

1. LOX compartment electrical harness — Disconnected from gun control unit and connected to stowage plug

SECTION III

EMERGENCY AIRCREW PROCEDURES

TABLE OF CONTENTS.

INTRODUCTION.

Emergency procedures contained in this section apply to all nonnuclear munitions covered in this manual. Basic aircraft emergency procedures and jettisoning restrictions are covered in T.O. 1A-7K-1.

EMERGENCY RELEASE.

NOTE

Emergency release using the SALVO JETT button may be accomplished from either the forward or aft cockpit.

1. SALVO JETT button — Press

Momentary actuation of the SALVO JETT button is the fastest way to clean munitions from aircraft stations 1, 2, 3, 6, 7, and 8. All stores and supplementary racks (MER's or TER's) are released from the MAU-12 ejector rack in all wing pylons. The MASTER ARM switch does not have to be in the ARM position to effect jettison. Munitions are jettisoned in a safe condition. External munitions can be jettisoned from the aircraft with weight on gear. With weight on gear or weight off the gear, gear not up and locked, stations 1, 2, 7, and 8 can be jettisoned. Munitions on all (wing) stations can be jettisoned with gear up and locked.

SELECTIVE JETTISON.

1. Station(s) to be jettisoned — Select RDY

2. SEL JETT button — SEL JETT for 2 seconds minimum

SEL JETT has the same functions as SALVO JETT except that a specific wing station or stations (1 through 8) must be selected on the armament select panel. When a station is selected, the corresponding yellow armament advisory light comes on to identify the type of munition on the selected station. The light remains on until the munition is jettisoned or the station deselected. To release selected munitions at the MAU-12, press the SEL JETT button. If munitions are attached to MER's or TER's, the MER or TER also jettisons. Actuation of the SEL JETT button disables mechanical and electrical fuzes and all selected munitions are jettisoned in a safe condition. The MASTER ARM switch does not have to be in the ARM POSITION. With weight off the gear, gear not up and locked, stations 1, 2, 7, and 8 can be jettisoned, and munitions on all (wing) stations can be jettisoned with the gear up and locked. On all aircraft after the completion of T.O. 11L1-3-15-510 on AERO 3B missile launchers, the select jettison circuit for fuselage stations 4 and 5 is deactivated and missiles cannot be jettisoned.

CAUTION

Do not jettison external loads to the extent that the asymmetrical load limit is exceeded. Refer to Section V of T.O. 1A-7K-1 for instruction on determining asymmetrical store moment and limitations.

AUXILIARY JETTISON.

1. FUZE switch — as desired

   If a live fuzing position is selected, a live weapon release is effected. Inert jettisoning is obtained in the FUZE SAFE position.

2. Station(s) select — RDY

3. SINGLE/PAIRS/SIMULT switch — As desired

4. MASTER ARM switch — ARM

5. AUX JETT switch — AUX JETT (actuate once for each munition or symmetrical pair of stations selected)

   Actuation of the AUX JETT switch ignites the rocket motor of the selected Maverick missile on the priority station without activating the other components of the missile. The missile is launched unarmed and unguided. If symmetrically paired stations are selected, station transfer to the paired station will occur and the priority missile on that station will be jettisoned with the next actuation of the AUX JETT switch. If asymmetrical stations are selected, the highest priority station must be emptied or deselected to obtain station transfer.

   Auxiliary jettison releases munitions from MER's and TER's, retaining the MER and TER. The AUX JETT switch must be actuated once for each munition to be jettisoned. When a station is selected, the corresponding yellow armament advisory light comes on to identify the type of munition on the selected station. STA RDY (green) light comes on if making a live auxiliary jettison release. The light remains on until the munition is jettisoned or the station is deselected. The MASTER ARM switch must be in ARM position to enable the auxiliary jettison circuit. To disable mechanical fuzing for unarmed release, the FUZE switch must be in the SAFE position. Munitions are released in SINGLE or PAIRS, as selected, and are jettisoned according to priority. Rocket launchers and vertical dispensers on the TER of the highest priority selected station will be jettisoned in SINGLE sequence if SIMULT sequence is selected. No other store types will be jettisoned if the SINGLE/PAIRS/SIMULT switch is in the SIMULT position. If a store is hung on the highest priority selected station, transfer will not occur until the station is deselected. Single mounted munitions on MAU-12 cannot be auxiliary jettisoned.

WARNING

Do not AUX JETT from the inboard shoulder positions of MER/TER on stations 2 and 7 with the landing gear down. Separating stores may strike the landing gear causing premature detonation of armed munitions or damage to the landing gear.

NOTE

Alternating release from paired stations is not performed when auxiliary jettisoning stores with the sequence switch in SINGLE. Only stores on the highest priority station will be released. When that station is empty, station transfer to the paired station on the opposite wing will occur. This could produce an undesirable asymmetrical load. When auxiliary jettisoning from paired stations, the sequence switch should be in PAIRS.

The auxiliary jettison system is powered by the secondary dc bus; therefore, auxiliary jettison is not possible following loss of secondary dc bus or when electrical power is being supplied by the RAT.

HUNG ORDNANCE.

Hung ordnance is the term applied to munitions that have failed to release or jettison.

If hung ordnance occurs:

1. All armament switches — Recheck and recycle

2. Station select switches — Cycle

   The appropriate station select switches must be cycled to reinitiate the ASCU release.

NOTE

Advisory lights are off with hung ordnance. These lights can be regained by cycling the STATION SELECT switches.

3. Attempt to release ordnance on target.

If ordnance does not release:

4. (MER/TER) Attempt to auxiliary jettison the munition(s) with live or safe fuzing position selected, as appropriate.

Still no release:

5. Attempt to jettison munitions over a safe area using select or salvo jettisoning procedures.

WARNING

Following an attempted release or jettison, any nonnuclear munition that does not separate from the aircraft should be considered armed and susceptible to inadvertent release during landing.

FIREFIGHTING AND EVACUATION CRITERIA.

These emergency procedures consist of actions to take if munitions are involved in a fire. The pilot should be thoroughly familiar with these instructions.

Aircraft fires involving conventional munitions cannot be definitized to any one set of circumstances and environmental conditions. This precludes development of reliable standardized test criteria and reliable specific item firefighting and withdrawal times. The conclusion to be reached from available data is that a munitions reaction to fire is a function of case thickness and type of explosive filler which can be varied by environmental conditions. Since the circumstances of a fire cannot be predicted, specific item by item firefighting and withdrawal times cannot be determined with any degree of reliability.

Normally, aircraft fire involving munitions occurs under a set of circumstances wherein it is impossible to know immediately the specific missile, bomb, or CBU model number. Such information is absolutely essential for specific firefighting and withdrawal times. Therefore, these times are presented for family groups only; i.e., bombs, CBU's, missile, etc.

Bombs: Bombs normally react in a deflagration to explosion between 2 and 4 minutes. Fuzes and boosters may be ejected and function as separate explosions. There is a major hazard to environmental and firefighting capability after 2 minutes. When withdrawal is accomplished take whatever cover is available.

CBU's: CBU's normally react in a deflagration to explosion between 2 and 5 minutes with the exception of the Rockeye and BL-755 which can be expected to detonate within 1 minute. Some munitions (bomblets) will be expelled by the force of the explosion to 1,000+ feet. These bomblets can detonate upon impact. There is a major hazard to environment and firefighting capability after 2 minutes in all cases and less with the Rockeye and BL-755. When withdrawal is accomplished, reenter after EOD approval only.

Missiles: Missiles normally react in propulsion, detonation, or both between +45 seconds and 2 minutes. A propulsion hazard (missile flight) exists within 45 seconds and a major hazard to environment and firefighting capability exists after 1 minute. Approach the fire, if necessary, from the side of the aircraft.

Rockets: Rockets and missiles are identical in reaction. Difference in designation is attributable to missile having guidance and control systems; rockets do not.

The firefighting guidance provided in AFR 127-100 will be utilized in all instances. There is no specific withdrawal time assigned to items which do not align into one of the four family groups.

SECTION IV
SUPPLEMENTARY DATA

TABLE OF CONTENTS.

INTRODUCTION.

The purpose of this section is to provide the pilot with data to use in determining the effects of errors in manual delivery of munitions. Using these data, the pilot can determine what must be done to compensate for and cancel the effects induced by deviations from the preplanned manual delivery envelope. The Error Analysis paragraphs provide equations for determining the exact effect of deviations from any of the parameters of manual dive bombing, low level bombing, and 2.75-inch FFAR rocket launching missions. The 20mm Ballistic Tables provide ballistic data for 20mm ammunition for mission planning purposes. The Bombing Errors During Manual Deliveries paragraph describes and illustrates the effects of deviations from the parameters of a preplanned manual delivery mission.

ERROR ANALYSIS — MANUAL DIVE BOMBING.

In the dive delivery, the bomb is released from a fixed dive angle approach to the target. Release is accomplished manually at a preplanned airspeed and altitude. The aircraft flightpath is projected beyond the target by means of a depressed sight line (standby reticle) to compensate for the curvature of the bomb trajectory (figure 4-1).

Figure 4-1 is drawn to scale for an M117 GP bomb with a MER release, 45° dive angle, 480 KTAS, and 4,000 feet AGL release altitude. The bomb range for this release condition (obtained from bombing table) is 3,370 feet. Therefore, for this release condition, the bomb must be released at a horizontal distance of 3,370 feet from the target at the planned 4,000 feet AGL and 45° dive angle. If the 45° dive flightpath is projected from the release point into the ground, it can be seen that sight depression, sufficient to project the flightpath approximately 550 feet beyond the target, is required to compensate for the trajectory curvature. Sections V and VI provide additional information on sight depression. The formula used to compute depression setting is as follows:

$$\phi = 17.45 \left[\tan^{-1} \frac{Y_p}{R_p \pm W_R t} - |\theta| \right] + \alpha - \beta$$

where

ϕ = sight depression in mils

Y_p = Y_R − (X parallax factor) sin $|\theta|$ + (Y parallax factor) cos $|\theta|$

R_p = R − (X parallax factor) cos $|\theta|$ − (Y parallax factor) sin $|\theta|$ + R

Y_R = release altitude (AGL) in feet

R = bomb range in feet under no-wind condition

X parallax factor = horizontal distance from the standby reticle back to the munitions

Y parallax factor = vertical distance from the standby reticle to the munitions

X parallax factor = 15.4 feet

Y parallax factor = 2.5 feet

R_C = range correction factor (positive R_C indicates a 6 o'clock correction)

ERROR ANALYSIS – DIVE BOMBING

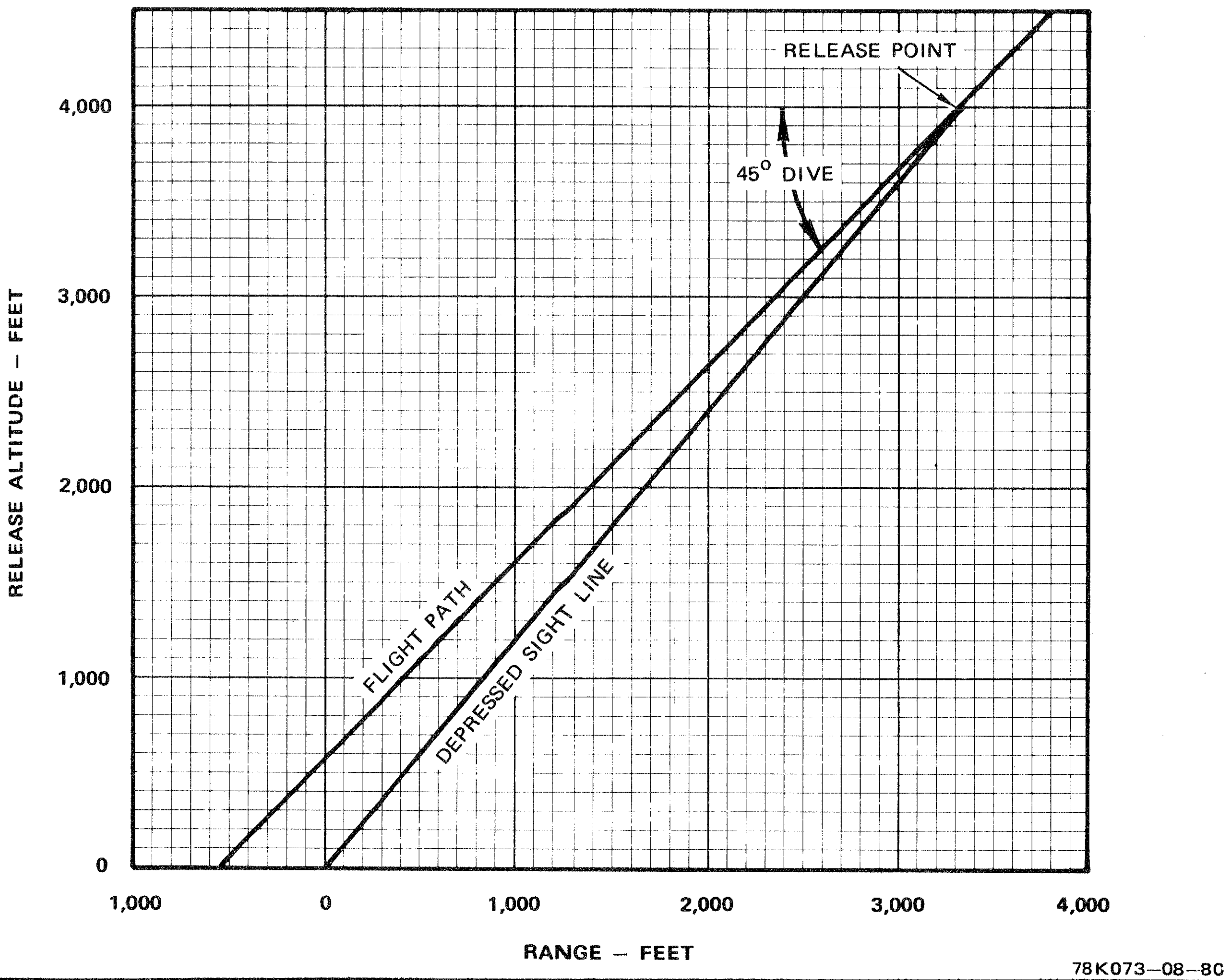


Figure 4-1

W_R = release rangewind component in feet per second. Headwind is minus; tailwind is plus.

t = bomb time of flight in seconds

θ = release angle in degrees. This is the angle between the horizontal and the aircraft flightpath.

α = angle of attack at release in mils

β = zero sight line orientation with respect to the aircraft fuselage reference line in mils

The quantity

$$17.45 \left[\tan^{-1} \frac{Y_p}{R_p \pm W_R t} - |\theta| \right]$$

in the sight depression angle formula represents the depression angle from flightpath which is listed in the bombing tables. It is a function of release altitude, bomb range, and dive angle. Bomb range, in turn, is a function of release altitude, dive angle, true airspeed, ejection velocity, and effective drag. Since many variables are involved and the depression setting is based on preplanned conditions, any deviation from preplanned conditions is bound to result in impact range error. The following paragraphs indicate the amount of impact error to be expected for certain deviations from planned release TAS, altitude, or dive angle. The following standard or planned conditions are assumed:

Release IAS	470 knots
Release TAS	480 knots
Release altitude	4,000 feet AGL
Target altitude	Sea level
Release temperature	−18°C
Release angle	−45°
Aircraft gross weight	31,000 pounds
Wind	Calm
Munition	M117 MER release

For these conditions, the sight depression from flightpath is 86 mils and the aircraft angle of attack at release is 2.9 mils. For simplicity, it will be assumed that the zero sight line (ZSL) coincides with the aircraft FRL. This is valid because actual depression angle from flightpath is all that matters. Using this assumption, the release depression setting would be 88.9 mils (sum of depression from flightpath and angle of attack). With a fixed depression setting assumed, the following equation determines an offset aimpoint required for a hit if the actual release condition is different from the planned release conditions.

$$A = R_p - Y_p \cot \left[\theta + \frac{\phi - \alpha_A + \alpha_p}{17.45} \right]$$

where

A = offset aimpoint in feet

Y_p = Y_R − (X parallax factor) sin $\emptyset$ + (Y parallax factor) cos $\emptyset$

R_p = R − (X parallax factor) cos $\emptyset$ − (Y parallax factor) sin $\emptyset$ + R_C

θ = release angle in degrees

$\emptyset$ = planned depression angle from flightpath in mils

α_A = actual angle of attack in mils

α_p = planned angle of attack in mils

Y_R = release altitude (AGL) in feet

R = bomb range in feet

X parallax factor = 15.4 feet

y parallax factor = 2.5 feet

A is an aimpoint offset. If the bomb is released with the depressed sight on the target, the A equation can be used to represent impact error. The Y_p cot [ ] part of the formula provides the horizontal distance from release to target for the actual release condition. A negative A (offset) indicates a negative (short) error, and a positive A (offset) indicates a positive (long) error. The offset is zero if all conditions are met.

EFFECT OF RELEASE TAS ERROR.

TAS = 460 knots (20 knots slower than planned), 45° dive, 4,000 feet AGL, α_A = 4.5 mils, and R = 3,331 feet

$$A = 3318 - 3991 \cot \left[45^\circ + \frac{86 - 4.5 + 2.9}{17.45} \right]$$

A = −50 feet (short error)

TAS = 500 knots (20 knots faster than planned), 45° dive, 4,000 feet AGL, α_A = 1.2 mils, and R = 3,405 feet

$$A = 3392 - 3991 \cot \left[45^\circ + \frac{86 - 1.2 + 2.9}{17.45} \right]$$

A = 47 feet (long error)

EFFECT OF RELEASE ALTITUDE ERROR.

Altitude = 3,800 feet (200 feet lower than planned), 45° dive, 480 KTAS, α_A = 2.9 mils, and R = 3,220 feet

$$A = 3207 - 3791 \cot \left[45^\circ + \frac{86 - 2.9 + 2.9}{17.45} \right]$$

A = 18 feet (long error)

Altitude = 4,200 feet (200 feet higher than planned), 45° dive, 480 KTAS, α_A = 2.9 mils, and R = 3,514 feet

$$A = 3501 - 4191 \cot \left[45^\circ + \frac{86 - 2.9 + 2.9}{17.45} \right]$$

A = –24 feet (short error)

EFFECT OF DIVE ANGLE ERROR.

Dive angle = 40° (5° less than planned), 480 KTAS, 4,000 feet AGL, α_A = 3.9 mils, and R = 3,913 feet

$$A = 3900 - 3992 \cot \left[40^\circ + \frac{86 - 3.9 + 2.9}{17.45} \right]$$

A = –110 feet (short error)

Dive angle = 50° (5° steeper than planned), 480 KTAS, 4,000 feet AGL, α_A = 1.0 mils, and R = 2,881 feet

$$A = 2869 - 3990 \cot \left[50^\circ + \frac{86 - 1.0 + 2.9}{17.45} \right]$$

A = 79 feet (long error)

ERROR ANALYSIS — MANUAL LOW LEVEL BOMBING.

In this mode, the bomb is released from a low altitude level approach at planned airspeed and altitude above ground. If the depressed sight line is used for estimating the release point, the procedure used for the dive bombing error analysis may be used to estimate low level bomb errors resulting from deviation from planned conditions. The following standard or planned conditions are assumed:

Release IAS	475 knots
Release TAS	480 knots
Release altitude above target	50 feet
Target altitude above MSL	450 feet
Release angle	0°
Aircraft gross weight	32,000 pounds
Temperature at release altitude	10°C
Wind	Calm
Munition	Unfinned BLU-27/B fire bomb MER release condition

For these conditions, the sight depression angle from flightpath is 44 mils, and the angle of attack is 10.0 mils.

EFFECT OF RELEASE TAS ERROR.

TAS = 460 knots (20 knots slower than planned), 0° release angle, 50 feet AGL, α_A = 12.1 mils, and R = 1,164 feet

$$A = 1149 - 52.5 \cot \left[0^\circ + \frac{44 - 12.1 + 10.0}{17.45} \right]$$

A = –104 feet (short error)

TAS = 500 knots (20 knots faster than planned), 0° release angle, 50 feet AGL, α_A = 8.0 mils, and R = 1,259 feet

$$A = 1244 - 52.5 \cot \left[0° + \frac{44 - 8.0 + 10.0}{17.45}\right]$$

A = 105 feet (long error)

EFFECT OF RELEASE ALTITUDE ERROR.

Release altitude = 40 feet (10 feet lower than planned), 0° release angle, 480 KTAS, α_A = 10.0 mils, and R = 1,079 feet

$$A = 1064 - 42.5 \cot \left[0° + \frac{44 - 10.0 + 10.0}{17.45}\right]$$

A = 98 feet (long error)

Release altitude = 60 feet (10 feet higher than planned), 0° release angle, 480 KTAS, α_A = 10.0 mils, and R = 1,331 feet

$$A = 1316 - 62.5 \cot \left[0° + \frac{44 - 10.0 + 10.0}{17.45}\right]$$

A = −104 feet (short error)

EFFECT OF RELEASE ANGLE ERROR.

Release angle = −1° instead of planned 0°, 50 feet AGL, 480 KTAS, α_A = 10.0 mils, and R = 974 feet

$$A = 959 - 52.8 \cot \left[1° + \frac{44 - 10.0 + 10.0}{17.45}\right]$$

A = 106 feet (long error)

Release angle = +1° instead of planned 0°, 50 feet AGL, 480 KTAS, α_A = 10.0 mils, and R = 1,502 feet

$$A = 1487 - 52.2 \cot \left[-1° + \frac{44 - 10.0 + 10.0}{17.45}\right]$$

A = −480 feet (short error)

ERROR ANALYSIS — NONCOMPUTED ROCKET LAUNCHING 2.75-INCH FFAR.

As in dive bombing, the depressed pipper is used to compensate for the curvature of the rocket trajectory from the launch point to impact. Under most circumstances, these projectiles can be delivered more accurately than a bomb because the high velocity attained after launch provides a flatter trajectory with less time of flight. Since the angle of attack is compensated for in the depressed sight settings, the following equation is used to compute the impact error for gun or rocket firing if the actual firing condition is different from the planned conditions:

$$A = R_p - Y_p \cot \left[\theta + \frac{\phi - \alpha_A}{17.45}\right]$$

where

A = impact error in feet

R_p = R − (X parallax factor) cos θ − (Y parallax factor) sin θ

R = horizontal range for actual firing conditions in feet

Y_p = Y − (X parallax factor) sin θ + (Y parallax factor) cos θ

Y = altitude (AGL) in feet at firing

X parallax factor = 15.4 feet

Y parallax factor = 2.5 feet

θ = dive angle in degrees at firing

$\emptyset$ = planned sight setting in mils

α_A = actual zero sight line angle of attack in mils

A negative A (offset) indicates a negative (short) error, and a positive A (offset) indicates a positive (long) error. The offset is zero if all conditions are met.

The following paragraphs indicate the amount of impact error to be expected for certain deviations from planned firing TAS, altitude, or dive angle. The following standard or planned conditions are assumed for launching a 2.75-inch FFAR with M-151 warhead:

Release IAS .... 510 knots

Release TAS .... 520 knots

Release altitude .... 3,000 feet AGL

Release angle .... $-30°$

Aircraft gross weight .... 27,000 pounds

Temperature at release altitude .... $-15°C$

Target altitude above MSL .... 500 feet

Wind .... Calm

For these conditions the sight depression from the zero sight line (Ø) is 23.0 mils, and the aircraft angle of attack at release (α_P) is 0.5 mils.

EFFECT OF TAS ERROR.

TAS = 500 knots (20 knots slower than planned), 30° dive, 3,000 feet AGL, α_A = 1.5 mils, and R = 4,926 feet

$$A = 4911 - 2994 \cot \left[30^\circ + \frac{23.0 - 1.5}{17.45}\right]$$

A = −27 feet (short error)

TAS = 540 knots (20 knots faster than planned), 30° dive, 3,000 feet AGL, α_A = −1.0 mils, and R = 4,937 feet

$$A = 4922 - 2994 \cot \left[30^\circ + \frac{23.0 + 1.0}{17.45}\right]$$

A = 11 feet (long error)

EFFECT OF ALTITUDE ERROR.

Altitude = 2,800 feet (200 feet lower than planned), 30° dive, 520 KTAS, α_A = 0.5 mils, and R = 4,622 feet

$$A = 4607 - 2794 \cot \left[30^\circ + \frac{23.0 - 0.5}{17.45}\right]$$

A = 10 feet (long error)

Altitude = 3,200 feet (200 feet higher than planned), 30° dive, 520 KTAS, α_A = 0.5 mils, and R = 5,259 feet

$$A = 5244 - 3194 \cot \left[30^\circ + \frac{23.0 - 0.5}{17.45}\right]$$

A = −11 feet (short error)

EFFECT OF DIVE ANGLE ERROR.

Dive angle = 25° (5° less than planned), 520 KTAS, 3,000 feet AGL, α_A = 1.0 mils, and R = 6,029 feet

$$A = 6014 - 2996 \cot \left[25^\circ + \frac{23.0 - 1.0}{17.45}\right]$$

A = −59 feet (short error)

Dive angle = 35° (5° more than planned), 520 KTAS, 3,000 feet AGL, α_A = −0.5 mils, and R = 4,106 feet

$$A = 4092 - 2993 \cot \left[35^\circ + \frac{23.0 + 0.5}{17.45}\right]$$

A = 25 feet (long error)

BALLISTIC TABLES — 20MM HEI.

Ballistic data in tabular form for 20MM HEI are provided in figure 4-2 for various altitudes, ranges, and velocities. These tables provide the projectile time of flight in seconds and drop in feet. These tables are used to determine the gravity drop for air-to-air gunnery missions. In addition, a correction of 6.0 feet should be used to correct for parallax error since the sight is located 6.0 feet above the mean gun line.

BOMBING ERRORS DURING MANUAL DELIVERIES.

Unlike a rocket or projectile, a freefall munition has no self-generated velocity and is entirely dependent on the velocity imparted to it by the launching aircraft and by gravity. In bombing there is no trajectory shift, but gravity drop is comparable to lead; therefore, a freefall munition will have the velocity and flightpath of the aircraft at the instant of release. From that point, the munition will be accelerated toward the earth by the force of gravity. A munition released from an aircraft in a wings-level attitude will impact along or very near the aircraft's ground track. When a freefall munition is to be released manually, the standby reticle in the aircraft must be depressed to a calculated sight angle in order to predict the impact point. The magnitude of sight angle, or sight depression, depends upon dive angle, airspeed, g-loading, and altitude or slant range.

Since the primary factors affecting freefall munition trajectory are the direction and speed of the aircraft at the moment of release and the effect of gravity, many errors may be induced in bombing that are of considerably more importance than in gun or rocket fire.

As an example, figure 4-3 provides the miss distances in bomb range due to variations in the release conditions for the BDU-33 practice bomb released from the SUU-20 series dispenser. Planned, or standard, conditions for each example are given in the first column. Each variation is considered independently of the others. The miss distance for each variation is shown in the adjacent column. Positive numbers indicate long errors.

EFFECT OF RELEASE ALTITUDE ERROR.

Munitions released at a higher altitude than planned, resulting in a greater slant range from the target, results in the munition impacting short of the target. Consequently, munitions released at a lower altitude, resulting in a shorter slant range from the target, will overshoot the target. The fallacy of pressing into the target becomes immediately apparent as the released munitions will overshoot the target while further exposing the aircraft to the blast and fragmentation envelope. Figure 4-4 depicts the results of higher, lower and planned release altitudes for dive and level deliveries.

EFFECT OF DIVE ANGLE.

Releasing munitions at a steeper than optimum dive angle results in the munitions overshooting the target due to the lesser sight depression requirement as the release dive angle increases. A reduced dive angle from optimum results in the munitions impacting short due to the requirement for a greater sight depression angle at shallower dive angles. When using the altimeter to determine correct release altitude commensurate with the optimum release slant range, variations in dive angle induces a double error in the munitions impact point. Releasing on a given altimeter indication when the dive angle is steeper than optimum also reduces the release slant range. Either condition requires less sight depression and munitions overshoot the target. Consequently, releasing on a given altimeter indication in a shallower dive angle than optimum creates a requirement for greater sight depression than selected to compensate for the decreased dive angle and increased range and the munitions will impact short of the intended target. When computing indicated altimeter indications to determine release, it is important to have the altimeter set to the target altimeter setting. Figure 4-5 depicts the results of too steep, too shallow, and planned release dive angles for constant and varying altitudes.

BALLISTIC TABLES – 20MM HEI

ALTITUDE FT	PRESENT RANGE FT	TRUE AIRSPEED – KNOTS									
		200		300		400		500		600	
		TF SEC	DROP FT	TF SEC	DROP FT	TF SEC	DROP FT	TF SEC	DROP FT	TF SEC	DROP FT
0	200	0.06	0.1	0.05	0.0	0.05	0.0	0.05	0.0	0.05	0.0
	400	0.11	0.2	0.11	0.2	0.10	0.2	0.10	0.2	0.10	0.2
	600	0.18	0.5	0.17	0.4	0.16	0.4	0.15	0.3	0.15	0.3
	800	0.24	0.9	0.23	0.8	0.22	0.7	0.21	0.7	0.20	0.6
	1,000	0.31	1.4	0.29	1.3	0.28	1.2	0.27	1.1	0.26	1.0
	1,200	0.38	2.1	0.36	1.9	0.34	1.7	0.33	1.6	0.31	1.4
	1,400	0.45	2.9	0.43	2.7	0.41	2.5	0.39	2.2	0.37	2.0
	1,600	0.53	4.0	0.50	3.6	0.48	3.3	0.46	3.1	0.44	2.8
	1,800	0.61	5.2	0.58	4.8	0.55	4.3	0.52	3.9	0.50	3.6
	2,000	0.69	6.6	0.66	6.1	0.63	5.5	0.60	5.0	0.57	4.6
	2,200	0.78	8.3	0.74	7.5	0.71	6.9	0.67	6.2	0.64	5.7
	2,400	0.88	10.4	0.83	9.3	0.79	8.5	0.75	7.7	0.72	7.1
	2,600	0.97	12.4	0.92	11.3	0.88	10.3	0.84	9.5	0.80	8.6
	2,800	1.08	15.2	1.02	13.6	0.97	12.4	0.92	11.2	0.88	10.3
	3,000	1.19	18.1	1.13	16.4	1.07	14.8	1.02	13.5	0.97	12.3
	3,200	1.31	21.5	1.24	19.4	1.17	17.4	1.11	15.8	1.06	14.4
	3,400	1.44	25.5	1.36	22.9	1.28	20.5	1.22	18.7	1.16	17.0
	3,600	1.57	29.8	1.48	26.7	1.40	24.1	1.33	21.9	1.26	19.8
	3,800	1.72	35.1	1.62	31.4	1.53	28.2	1.44	25.2	1.37	23.0
	4,000	1.87	40.8	1.76	36.4	1.66	32.7	1.57	29.4	1.49	26.7
5,000	200	0.06	0.1	0.05	0.0	0.05	0.0	0.05	0.0	0.05	0.0
	400	0.11	0.2	0.11	0.2	0.10	0.2	0.10	0.2	0.10	0.2
	600	0.17	0.5	0.16	0.4	0.16	0.4	0.15	0.4	0.15	0.4
	800	0.23	0.8	0.22	0.7	0.21	0.7	0.20	0.6	0.20	0.6
	1,000	0.30	1.4	0.28	1.2	0.27	1.1	0.26	1.0	0.25	1.0
	1,200	0.36	2.0	0.34	1.8	0.33	1.7	0.32	1.6	0.30	1.4
	1,400	0.43	2.8	0.41	2.5	0.39	2.3	0.37	2.1	0.36	2.0
	1,600	0.50	3.7	0.47	3.3	0.45	3.0	0.43	2.8	0.42	2.6
	1,800	0.57	4.8	0.54	4.3	0.52	4.0	0.50	3.7	0.48	3.4
	2,000	0.64	6.0	0.61	5.4	0.59	5.1	0.56	4.6	0.54	4.3
	2,200	0.72	7.5	0.68	6.7	0.65	6.1	0.63	5.7	0.60	5.2
	2,400	0.80	9.1	0.76	8.3	0.73	7.6	0.69	6.8	0.67	6.4
	2,600	0.88	11.0	0.84	10.0	0.80	9.1	0.76	8.2	0.73	7.6
	2,800	0.96	12.9	0.91	11.6	0.87	10.6	0.84	9.9	0.80	9.0
	3,000	1.04	15.0	1.00	13.9	0.95	12.6	0.91	11.5	0.87	10.6
	3,200	1.13	17.6	1.08	16.1	1.03	14.6	0.99	13.5	0.95	12.5
	3,400	1.22	20.3	1.17	18.7	1.12	17.1	1.07	15.6	1.02	14.2
	3,600	1.32	23.5	1.26	21.4	1.20	19.5	1.15	17.9	1.10	16.4
	3,800	1.41	26.6	1.35	24.4	1.29	22.3	1.23	20.3	1.18	18.7
	4,000	1.51	30.3	1.44	27.5	1.38	25.3	1.32	23.2	1.27	21.5

NOTE

TF equals time of flight.

78K200(1)–08–80

Figure 4-2 (Sheet 1)

BALLISTIC TABLES – 20MM HEI

ALTITUDE FT	PRESENT RANGE FT	TRUE AIRSPEED – KNOTS									
		200		300		400		500		600	
		TF SEC	DROP FT	TF SEC	DROP FT	TF SEC	DROP FT	TF SEC	DROP FT	TF SEC	DROP FT
10,000	200	0.06	0.1	0.05	0.0	0.05	0.0	0.05	0.0	0.05	0.0
	400	0.11	0.2	0.11	0.2	0.10	0.2	0.10	0.2	0.09	0.1
	600	0.17	0.5	0.16	0.4	0.16	0.4	0.15	0.4	0.14	0.3
	800	0.23	0.8	0.22	0.8	0.21	0.7	0.20	0.6	0.19	0.6
	1,000	0.29	1.3	0.28	1.2	0.26	1.1	0.25	1.0	0.24	0.9
	1,200	0.35	1.9	0.34	1.8	0.32	1.6	0.31	1.5	0.30	1.4
	1,400	0.41	2.6	0.39	2.3	0.38	2.2	0.36	2.0	0.35	1.9
	1,600	0.48	3.5	0.45	3.1	0.44	3.0	0.42	2.7	0.40	2.4
	1,800	0.54	4.4	0.52	4.1	0.50	3.8	0.48	3.5	0.46	3.2
	2,000	0.61	5.6	0.58	5.1	0.56	4.7	0.53	4.2	0.51	3.9
	2,200	0.67	6.8	0.64	6.2	0.62	5.8	0.59	5.2	0.57	4.9
	2,400	0.74	8.2	0.71	7.5	0.68	6.9	0.65	6.3	0.63	5.9
	2,600	0.81	9.8	0.78	9.0	0.74	8.1	0.71	7.5	0.69	7.0
	2,800	0.88	11.5	0.84	10.4	0.81	9.7	0.70	9.0	0.75	8.3
	3,000	0.95	13.3	0.91	12.2	0.88	11.3	0.84	10.3	0.81	9.6
	3,200	1.03	15.5	0.98	14.0	0.94	12.9	0.91	12.1	0.87	11.0
	3,400	1.10	17.6	1.05	16.0	1.01	14.8	0.97	13.6	0.94	12.8
	3,600	1.18	20.2	1.13	18.4	1.08	16.8	1.04	15.6	1.00	14.4
	3,800	1.25	22.5	1.20	20.7	1.15	19.0	1.11	17.6	1.07	16.4
	4,000	1.33	25.4	1.28	23.4	1.23	21.6	1.18	19.8	1.14	18.5
20,000	200	0.06	0.1	0.05	0.0	0.05	0.0	0.05	0.0	0.05	0.0
	400	0.11	0.2	0.11	0.2	0.10	0.2	0.10	0.2	0.09	0.1
	600	0.17	0.5	0.16	0.4	0.15	0.4	0.15	0.4	0.14	0.3
	800	0.22	0.8	0.21	0.7	0.20	0.6	0.20	0.6	0.19	0.6
	1,000	0.28	1.3	0.27	1.2	0.25	1.0	0.24	0.9	0.24	0.9
	1,200	0.33	1.7	0.32	1.6	0.31	1.5	0.29	1.3	0.28	1.2
	1,400	0.39	2.4	0.37	2.2	0.36	2.1	0.34	1.8	0.33	1.7
	1,600	0.45	3.2	0.43	2.9	0.41	2.7	0.40	2.5	0.38	2.3
	1,800	0.50	4.0	0.48	3.7	0.46	3.4	0.45	3.2	0.43	2.9
	2,000	0.56	5.0	0.54	4.6	0.52	4.3	0.50	3.9	0.48	3.6
	2,200	0.62	6.1	0.59	5.5	0.57	5.1	0.55	4.8	0.53	4.4
	2,400	0.67	7.1	0.65	6.7	0.62	6.1	0.60	5.7	0.58	5.3
	2,600	0.73	8.5	0.70	7.8	0.68	7.3	0.65	6.6	0.63	6.2
	2,800	0.79	9.9	0.76	9.1	0.73	8.4	0.70	7.7	0.68	7.2
	3,000	0.84	11.2	0.81	10.4	0.78	9.6	0.76	9.0	0.73	8.3
	3,200	0.90	12.8	0.87	11.9	0.84	11.1	0.81	10.3	0.78	9.5
	3,400	0.96	14.6	0.92	13.3	0.89	12.4	0.86	11.5	0.83	10.7
	3,600	1.02	16.5	0.98	15.1	0.95	14.1	0.91	12.9	0.88	12.0
	3,800	1.07	18.1	1.04	17.0	1.00	15.6	0.97	14.7	0.94	13.7
	4,000	1.13	20.2	1.09	18.7	1.06	17.6	1.02	16.2	0.99	15.2

NOTE

TF equals time of flight.

78K200(2)–08–80

Figure 4-2 (Sheet 2)

BALLISTIC TABLES – 20MM HEI

ALTITUDE FT	PRESENT RANGE FT	TRUE AIRSPEED – KNOTS 200 TF SEC	200 DROP FT	300 TF SEC	300 DROP FT	400 TF SEC	400 DROP FT	500 TF SEC	500 DROP FT	600 TF SEC	600 DROP FT
30,000	200	0.05	0.0	0.05	0.0	0.05	0.0	0.05	0.0	0.05	0.0
	400	0.11	0.2	0.10	0.2	0.10	0.2	0.10	0.2	0.09	0.1
	600	0.16	0.4	0.16	0.4	0.15	0.4	0.14	0.3	0.14	0.3
	800	0.22	0.8	0.21	0.7	0.20	0.6	0.19	0.6	0.18	0.5
	1,000	0.27	1.2	0.26	1.1	0.25	1.0	0.24	0.9	0.23	0.9
	1,200	0.32	1.7	0.31	1.6	0.30	1.5	0.29	1.4	0.28	1.3
	1,400	0.37	2.2	0.36	2.1	0.35	2.0	0.33	1.8	0.32	1.7
	1,600	0.43	3.0	0.41	2.7	0.40	2.6	0.38	2.3	0.37	2.2
	1,800	0.48	3.8	0.46	3.5	0.44	3.2	0.43	3.0	0.41	2.7
	2,000	0.53	4.6	0.51	4.3	0.49	3.9	0.47	3.6	0.46	3.4
	2,200	0.58	5.6	0.56	5.1	0.54	4.8	0.52	4.4	0.50	4.1
	2,400	0.63	6.6	0.61	6.1	0.59	5.7	0.57	5.3	0.55	4.9
	2,600	0.68	7.7	0.66	7.2	0.64	6.7	0.61	6.1	0.59	5.6
	2,800	0.73	8.8	0.71	8.3	0.68	7.6	0.66	7.1	0.64	6.6
	3,000	0.78	10.1	0.76	9.5	0.73	8.7	0.71	8.2	0.69	7.7
	3,200	0.83	11.5	0.80	10.6	0.78	10.0	0.75	9.2	0.73	8.7
	3,400	0.88	12.9	0.85	12.0	0.82	11.1	0.80	10.5	0.78	9.9
	3,600	0.93	14.4	0.90	13.4	0.87	12.5	0.85	11.8	0.82	10.9
	3,800	0.98	16.1	0.95	15.0	0.92	13.9	0.89	13.0	0.87	12.3
	4,000	1.00	17.8	1.00	16.6	0.97	15.5	0.94	14.5	0.91	13.5
40,000	200	0.05	0.0	0.05	0.0	0.05	0.0	0.05	0.0	0.05	0.0
	400	0.11	0.2	0.10	0.2	0.10	0.2	0.10	0.2	0.09	0.1
	600	0.16	0.4	0.15	0.4	0.15	0.4	0.14	0.3	0.14	0.3
	800	0.21	0.7	0.20	0.7	0.20	0.7	0.19	0.6	0.18	0.5
	1,000	0.26	1.1	0.25	1.0	0.24	0.9	0.24	0.9	0.23	0.9
	1,200	0.31	1.6	0.30	1.5	0.29	1.4	0.28	1.3	0.27	1.2
	1,400	0.36	2.2	0.35	2.0	0.34	1.9	0.33	1.8	0.31	1.6
	1,600	0.41	2.8	0.40	2.7	0.38	2.4	0.37	2.3	0.36	2.1
	1,800	0.46	3.6	0.45	3.4	0.43	3.1	0.42	2.9	0.40	2.6
	2,000	0.51	4.4	0.49	4.0	0.48	3.8	0.46	3.5	0.44	3.2
	2,200	0.56	5.3	0.54	4.9	0.52	4.5	0.50	4.2	0.49	4.0
	2,400	0.61	6.3	0.58	5.7	0.57	5.4	0.55	5.0	0.53	4.7
	2,600	0.65	7.2	0.63	6.7	0.61	6.3	0.59	5.8	0.57	5.4
	2,800	0.70	8.4	0.68	7.8	0.65	7.1	0.63	6.7	0.61	6.2
	3,000	0.74	9.4	0.72	8.8	0.69	8.0	0.68	7.8	0.65	7.1
	3,200	0.79	10.7	0.76	9.8	0.74	9.3	0.72	8.7	0.70	8.2
	3,400	0.84	12.2	0.81	11.2	0.78	10.3	0.76	9.7	0.74	9.2
	3,600	0.88	13.4	0.85	12.4	0.83	11.7	0.80	10.8	0.78	10.2
	3,800	0.92	14.7	0.90	13.9	0.87	12.9	0.84	12.0	0.82	11.3
	4,000	0.97	16.4	0.94	15.2	0.91	14.2	0.88	13.1	0.86	12.5

NOTE

TF equals time of flight.

78K200(3)-08-80

Figure 4-2 (Sheet 3)

ERROR ANALYSIS EXAMPLE

BDU-33 PRACTICE BOMB WITH SUU-20 DISPENSER

STANDARD CONDITIONS		VARIATIONS IN RELEASE VEL (KTS)	RANGE ERROR (FT)	VARIATIONS IN DIVE ANGLE (DEG)		RANGE ERROR (FT)	VARIATIONS IN RELEASE ALT (FT)	RANGE ERROR (FT)
Release Velocity:	410 KTAS			Degrees Shallow	5	–194		
	400 KIAS	20	55		4	–137	400	–245
Dive Angle:	15°	15	41		3	–92	300	–175
Release Altitude:	800 FT	10	27		2	–56	200	–111
Temp at Release:	+15°C	5	11		1	–26	100	–53
Weight:	30,000 LBS							
		–5	–19	Degrees Steep	1	14	–100	38
		–10	–35		2	29	–200	71
		–15	–51		3	41	–300	92
		–20	–69		4	50		
					5	58		
Release Velocity:	420 KTAS			Degrees Shallow	5	–361	500	–335
	400 KIAS	20	104		4	–260	400	–262
Dive Angle:	15°	15	78		3	–177	300	–191
Release Altitude:	1500 FT	10	51		2	–108	200	–124
Temp at Release:	+20°C	5	24		1	–51	100	–62
Weight:	30,000 LBS							
		–5	–32	Degrees Steep	1	35	–100	50
		–10	–61		2	68	–200	98
		–15	–91		3	94	–300	141
		–20	–121		4	117	–400	179
					5	134	–500	211
Release Velocity:	480 KTAS			Degrees Shallow	5	–189	500	–132
	450 KIAS	20	66		4	–142	400	–104
Dive Angle:	30°	15	49		3	–101	300	–78
Release Altitude:	3000 FT	10	31		2	–65	200	–52
Temp at Release:	+15°C	5	14		1	–34	100	–27
Weight:	30,000 LBS							
		–5	–24	Degrees Steep	1	21	–100	18
		–10	–42		2	43	–200	38
		–15	–61		3	64	–300	58
		–20	–82		4	82	–400	77
					5	98	–500	94

NOTE

Positive numbers indicate long errors.

78K026(1)–08–80

Figure 4-3 (Sheet 1)

ERROR ANALYSIS EXAMPLE

BDU-33 PRACTICE BOMB WITH SUU-20 DISPENSER

STANDARD CONDITIONS		VARIATIONS IN RELEASE VEL (KTS)	RANGE ERROR (FT)	VARIATIONS IN DIVE ANGLE (DEG)		RANGE ERROR (FT)	VARIATIONS IN RELEASE ALT (FT)	RANGE ERROR (FT)
Release Velocity:	480 KTAS			Degrees	5	−133	500	−65
	450 KIAS	20	57	Shallow	4	−102	400	−51
Dive Angle:	45°	15	43		3	−74	300	−38
Release Altitude:	4500 FT	10	29		2	−48	200	−25
Temp at Release:	0°C	5	15		1	−22	100	−12
Weight:	30,000 LBS							
		−5	−15	Degrees	1	22	−100	12
		−10	−30	Steep	2	41	−200	23
		−15	−45		3	60	−300	34
		−20	−61		4	77	−400	44
					5	94	−500	54
Release Velocity:	500 KTAS			Degrees	5	−256	500	−84
	450 KIAS	20	86	Shallow	4	−132	400	−67
Dive Angle:	45°	15	63		3	−145	300	−51
Release Altitude:	7000 FT	10	40		2	−96	200	−36
Temp at Release:	0°C	5	18		1	−49	100	−21
Weight:	30,000 LBS							
		−5	−30	Degrees	1	35	−100	8
		−10	−55	Steep	2	74	−200	23
		−15	−80		3	109	−300	36
		−20	−105		4	144	−400	50
					5	175	−500	64

NOTE

Positive numbers indicate long errors.

78K026(2)—08—80

Figure 4-3 (Sheet 2)

ALTITUDE ERROR EFFECT

CONSTANT AIRSPEED AND DIVE ANGLE

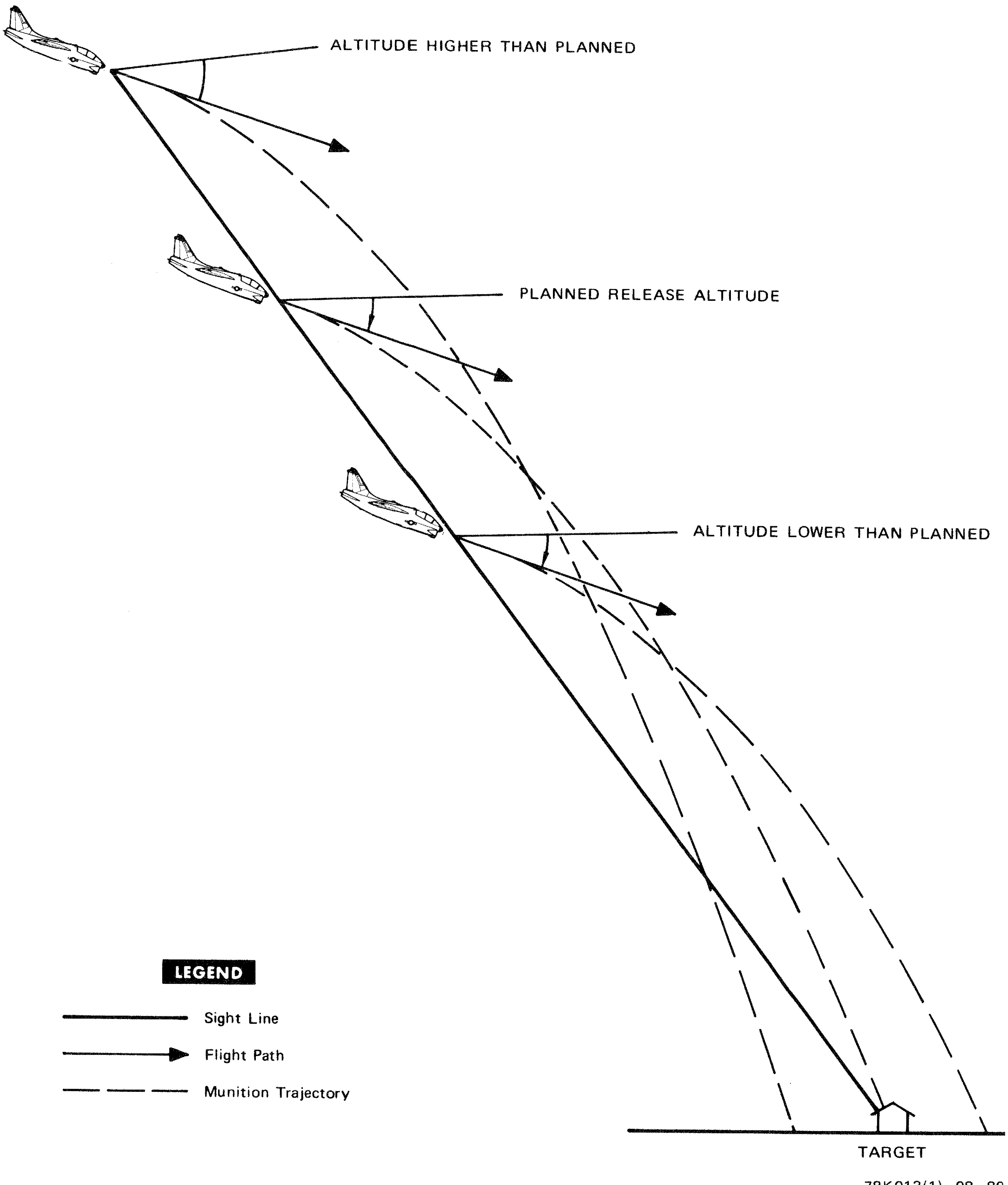


Figure 4-4 (Sheet 1)

ALTITUDE ERROR EFFECT

CONSTANT AIRSPEED

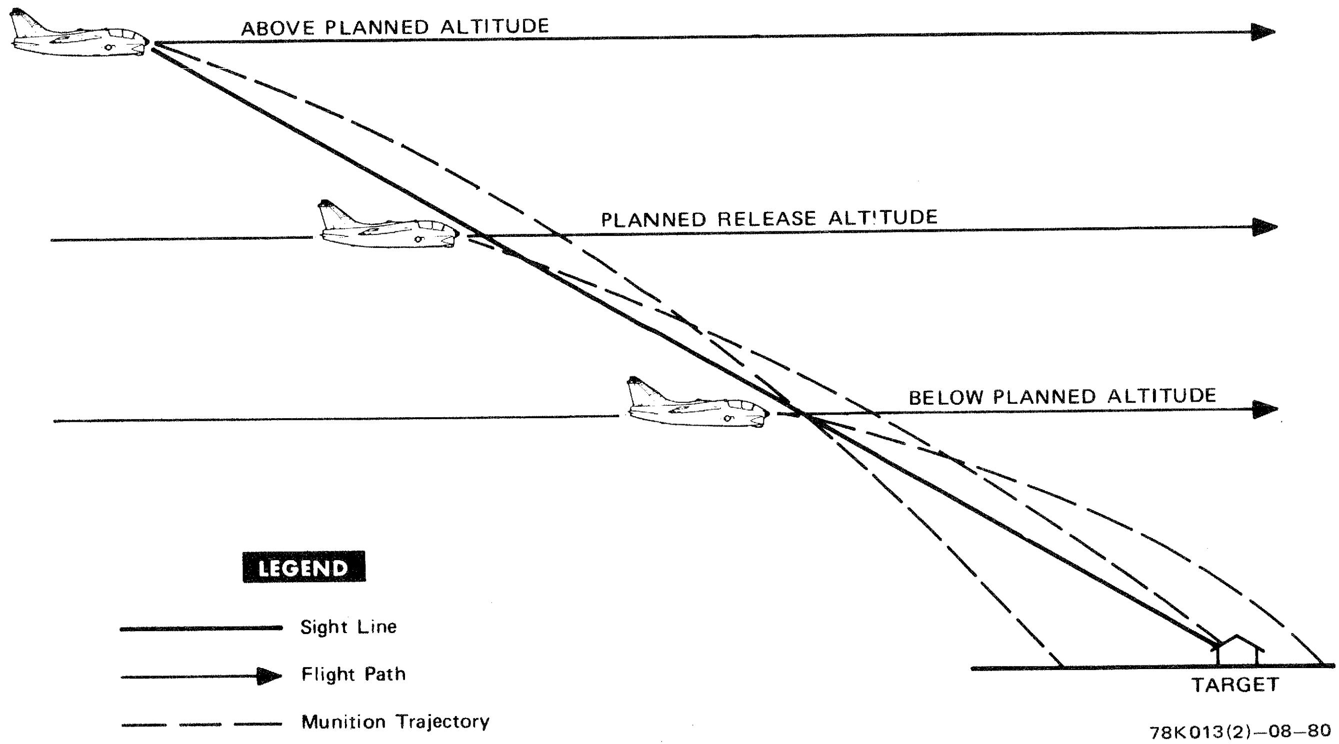


Figure 4-4 (Sheet 2)

FFFECT OF AIRSPEED.

The only velocity imparted to a freefall munition released from an aircraft is the velocity imparted by the speed of the aircraft at the time of release. Munitions released at a lower airspeed than required by the computed sight setting results in the munitions impacting short of the target and consequently munitions released at a higher than computed airspeed will overshoot the target. Changes in aircraft airspeed changes the angle of attack of the aircraft and will alter the sight depression relative to the flightpath of the aircraft. The changed angle of attack will in turn induce an overshoot or undershoot error in impact of the munitions. This same change in angle of attack of the aircraft will alter the angle of attack of the rocket launcher and the gun relative to the flightpath of the aircraft. This in turn alters the amount of trajectory shift of the rocket and gun while at the same time imparting a different aircraft release velocity to the projectiles. Rockets are greatly effected by changes in release airspeed from optimum and the gun to a lesser degree. An increase in airspeed from the optimum selected for a given release condition and precomputed sight setting will cause an overshoot for rocket and gun projectives. An undershoot will occur when the airspeed is less than optimum. Figure 4-6 depicts the effect of deviating from planned airspeed on munition impact point.

DIVE ANGLE ERROR EFFECT

CONSTANT AIRSPEED AND SLANT RANGE –
VARYING ALTITUDE

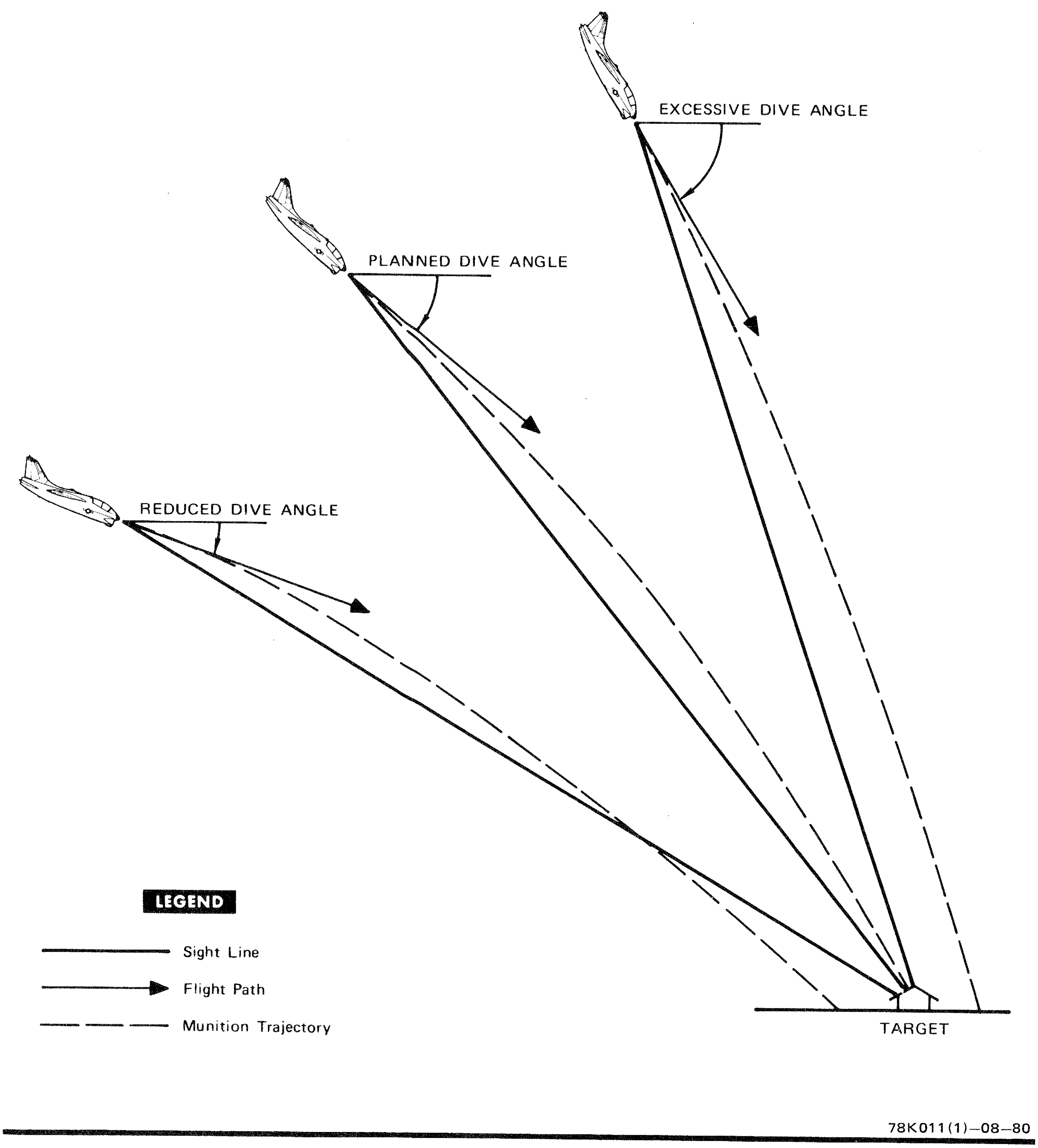


Figure 4-5 (Sheet 1)

DIVE ANGLE ERROR EFFECT

CONSTANT AIRSPEED AND ALTITUDE—
VARYING SLANT RANGE

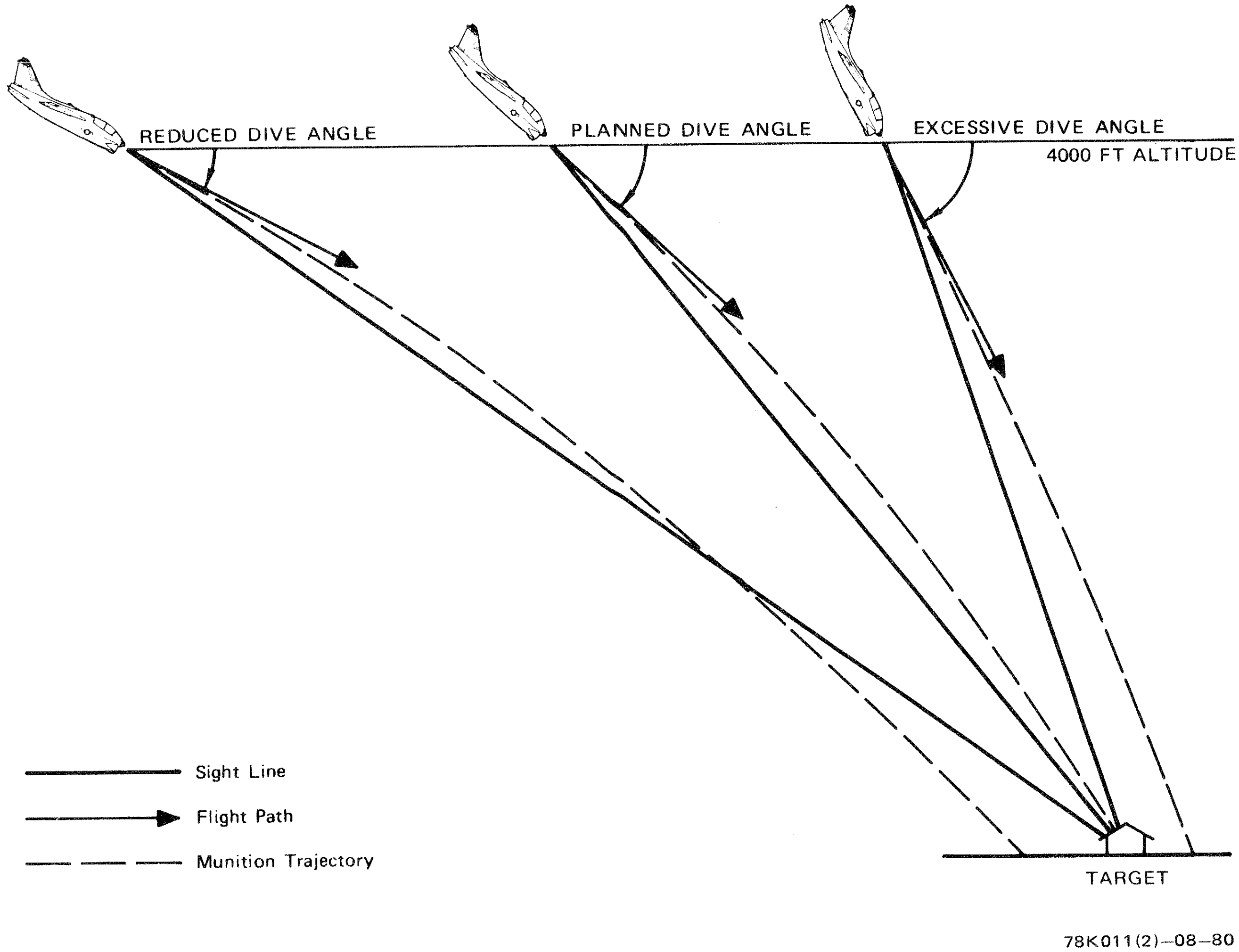


Figure 4-5 (Sheet 2)

AIRSPEED ERROR EFFECT

CONSTANT ALTITUDE AND DIVE ANGLE

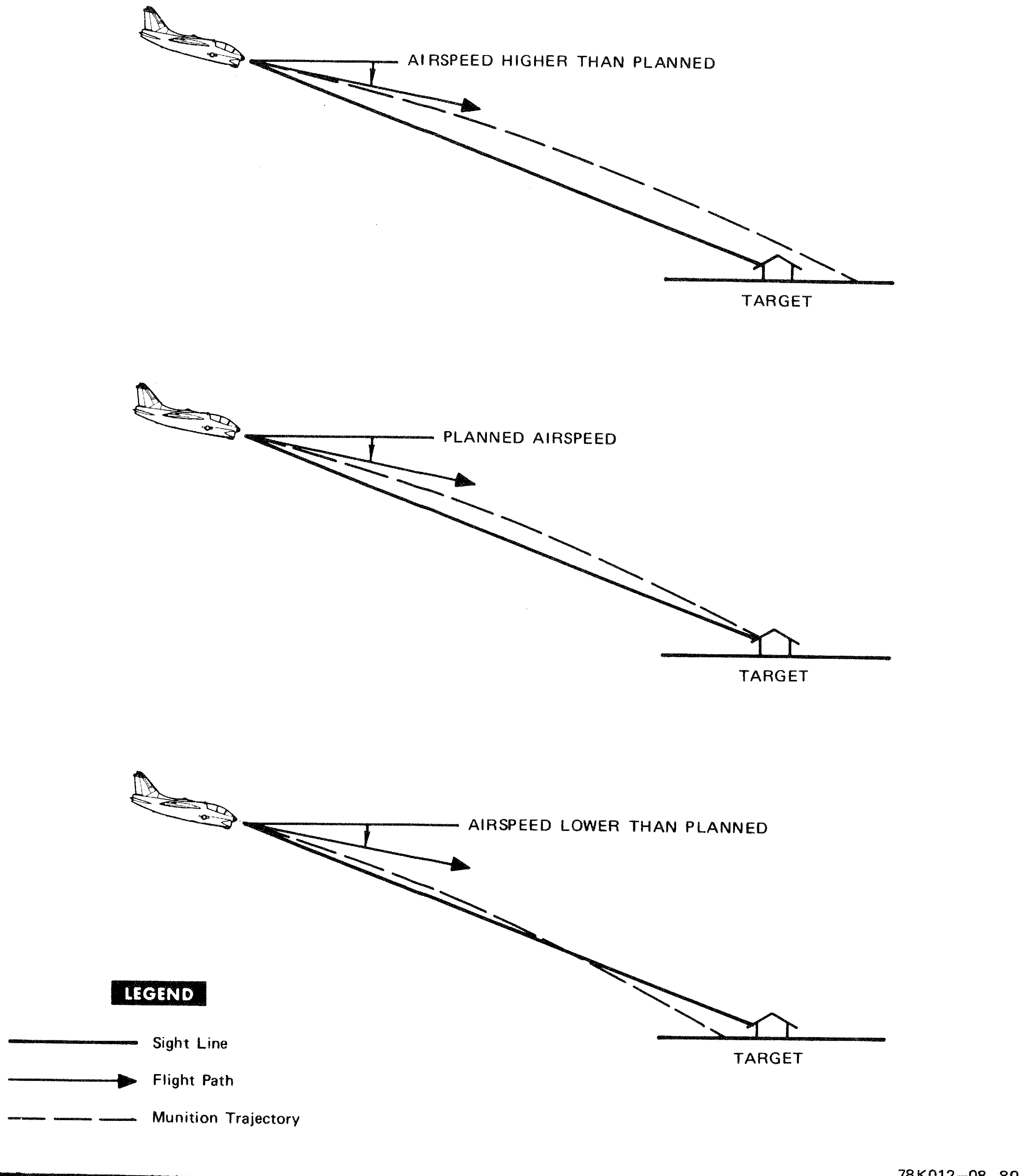


Figure 4-6

EFFECT OF SKID.

Munitions released while the aircraft is flying in a skid causes the impact to occur right or left of the target as a result of the cross vector forces acting on the munitions at the time of release. Right rudder application in an attempt to hold the sight picture in the target, will cause the munitions to impact left of the target and conversely left rudder application will cause the munitions to impact to the right. Bombs are the most effected by skid as bombs will follow the flight of the aircraft and the total error increases in proportion to the release slant range. Rockets and guns have their own velocity at release and the resultant forces cause less drift error. The bullet path is the result of the aircraft velocity and muzzle velocity. As the latter is so high when compared with aircraft speed the bullet veers very little from the sight line. The rocket velocity being less falls between the bomb and bullet projectile. Figure 4-7 depicts the effect of skid on munition impact point.

EFFECT OF G-LOADING.

Dive bombing ballistic tables are based on a release g-force equal to the cosine of the dive angle (0.866g at 30°, for example). Munitions released when the aircraft deviates from the planned g condition will result in an impact error. Figure 4-8 depicts the results of deviation from planned g-loading. An increase in g-loading on an aircraft results in an increase in angle of attack which, in effect decreases sight depression relative to the flightpath. The result will be an undershoot. Conversely, a negative g-loading will decrease the aircraft angle of attack, thus producing an overshoot. Gun and rocket accuracy is further aggravated by the different than computed trajectory shift caused by the change in the muzzle and launcher angle of attack.

EFFECT OF BANK ON SIGHT LINE AND MUNITIONS IMPACT.

Acquiring and tracking the target with the pipper (standby reticle) while the aircraft is in a bank produces two effects which can result in the munitions missing the target. Munitions released from the aircraft are immediately effected by gravity and, depending on the type of munitions released and the sight depression selected, the munitions will impact right or left of the target if released while the aircraft is in a bank. In addition to the azimuth error induced while in a bank, the apparent foreshortening of the sight lines makes the target look closer than it actually is, adding range error to the munition impact point. Thus, munitions released while the aircraft is in a bank will impact short of and to the side of the target in the direction of the bank. The Banked Flight portion of figure 4-9 depicts the effect of bank on munition impact and the sight picture visible to the pilot. Bank error effect is greatest when releasing bombs, as bombs have the least amount of forward velocity to counteract the force of gravity and require a greater amount of sight depression which will in turn place the aircraft further right or left of the target at release. Guns are least affected by firing while in a bank. Rocket projectiles have a velocity of their own and are less affected than bombs but more so than guns. Recognizing the effects of bank angle on sight line and bringing the aircraft to wings level flight brings the pendulum effect into play. The pendulum effect results in the sight picture swinging away from the target as the angle of bank is reduced. The Wings Level (Uncorrected) portion of figure 4-9 depicts the results of the pendulum effect. The pendulum effect becomes more pronounced as sight depression is increased. Counteracting the pendulum effect requires tracking the target with the nose of the aircraft, instead of the standby reticle, while bringing the aircraft to wings level flight, then transitioning to the standby reticle for completion of the weapon delivery. The Wings Level (Corrected) portion of figure 4-9 depicts the sight picture and munition trajectory when bank angle has been removed and the pendulum effect counteracted.

SKID EFFECT

CONSTANT ALTITUDE, AIRSPEED, AND DIVE ANGLE

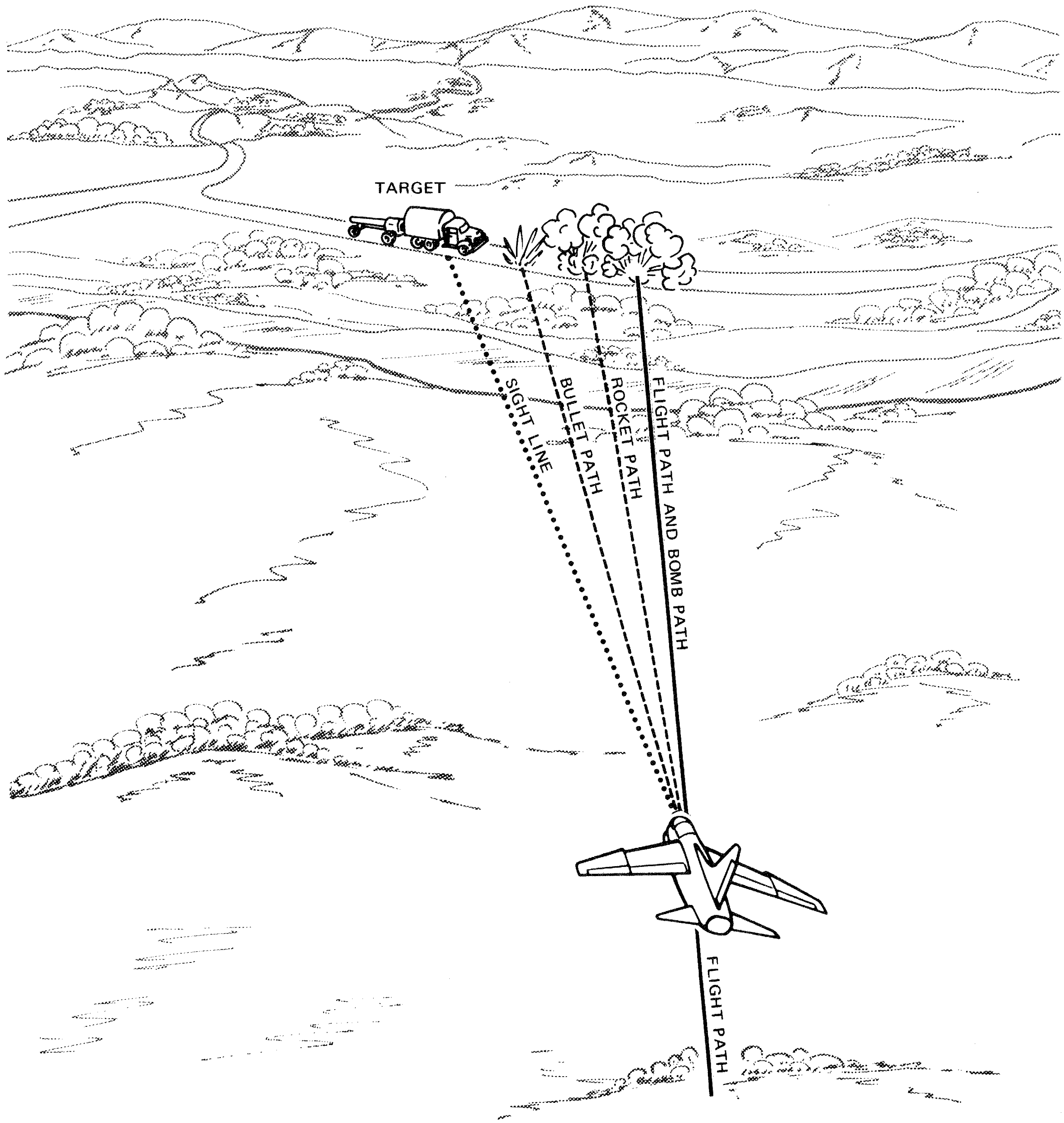


Figure 4-7

G-LOAD ERROR EFFECT

CONSTANT AIRSPEED AND ALTITUDE

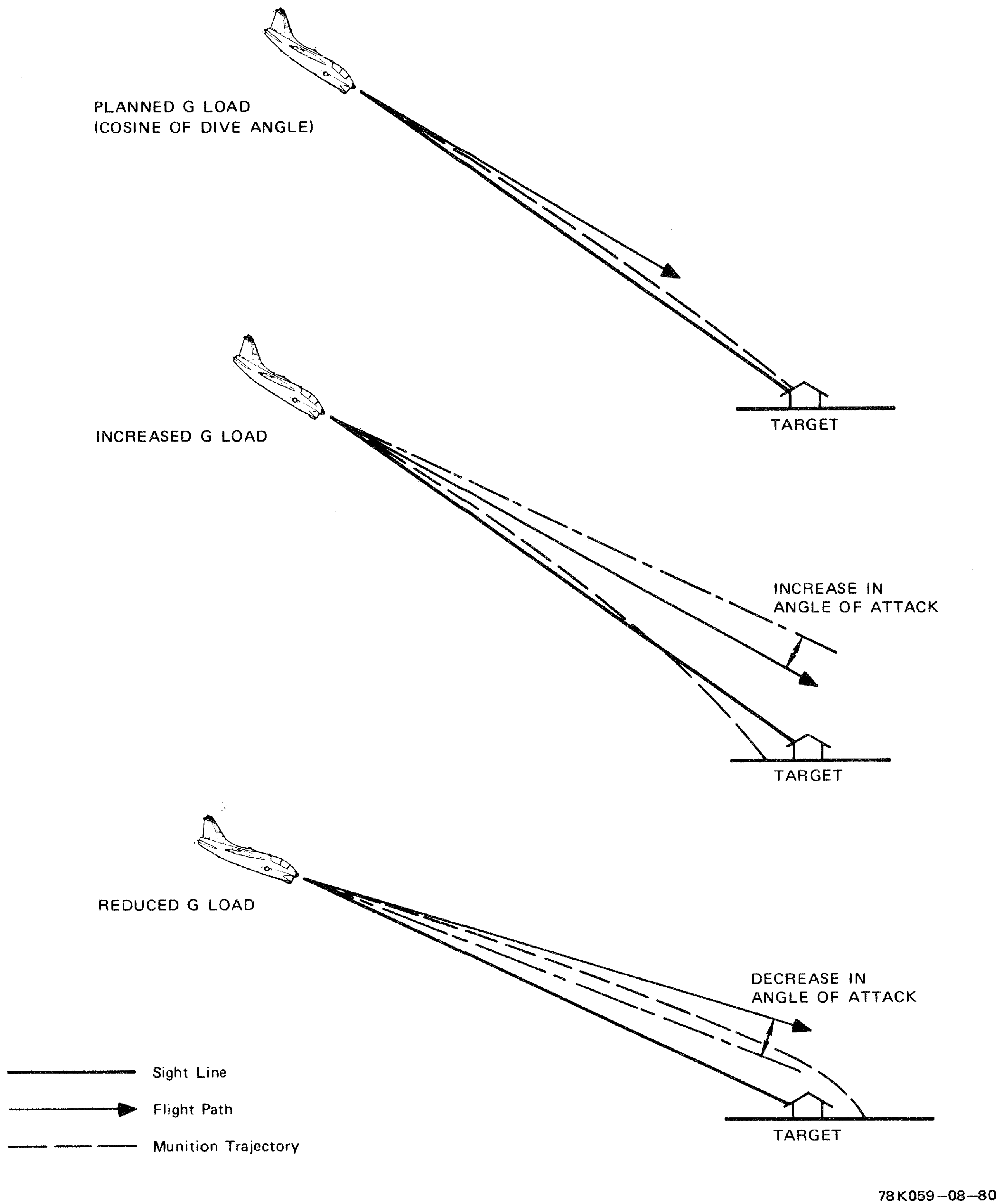


Figure 4-8

BANK ANGLE ERROR AND PENDULUM EFFECT

CONSTANT ALTITUDE, AIRSPEED, AND DIVE ANGLE

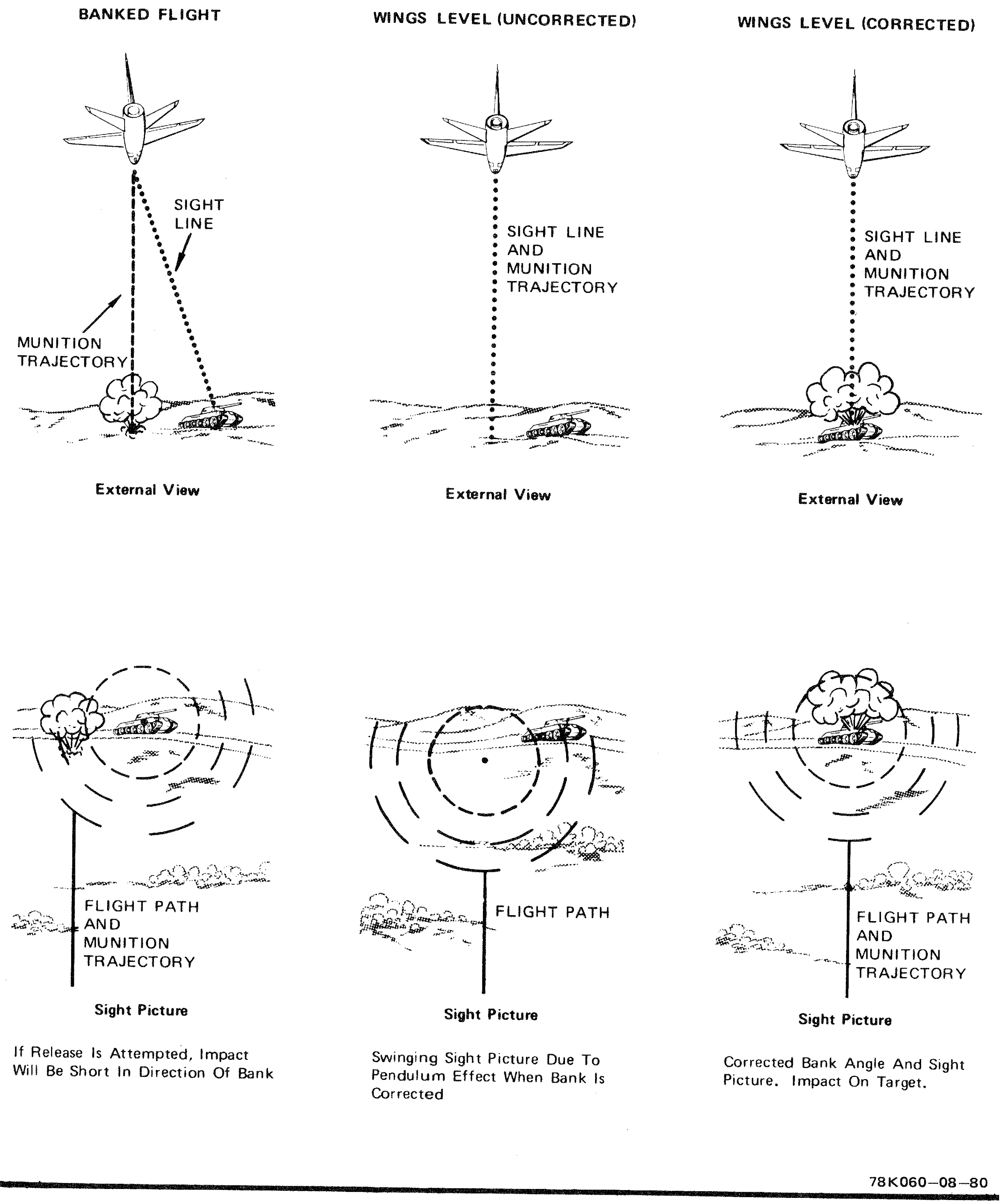


Figure 4-9

SECTION V

PLANNING PROCEDURES AND SAMPLE PROBLEMS

TABLE OF CONTENTS.

INTRODUCTION.

The purpose of this section is to provide the pilot with the steps required to plan a weapon delivery mission with conventional weapons or rockets and practice bombs used with the SUU-20 series bomb-rocket dispenser and to illustrate the planning procedure.

Ballistics tables, located in T.O. 1A-7K-34-1-2, are based on ICAO standard day conditions. Ambient pressure and temperature variations from the standard day are considered to have negligible effect on trajectory accuracy. This assumption is valid for most conventional weapon delivery conditions because the weapon time of flight is generally small.

REFERENCE LINES.

The various reference lines used in this manual are illustrated in figure 5-1. Other possible identifications of a particular reference line are also stated.

SIGHT SETTING COMPUTATION.

The rocket launch and 20mm ballistic tables provide the optical sight setting as a function of aircraft angle of attack from zero sight line.

The bombing tables provide the sight depression angle from flightpath. Use the angle-of-attack chart to find the aircraft angle of attack in mils. Angle of attack, plus sight depression angle from flightpath, equals the optical sight setting for zero wind.

Wind correction can be applied to the sight setting, or wind correction can be made by estimating an upwind aimpoint. The tables provide the data required for both methods of wind correction. The mil correction is added algebraically for head and tailwind corrections.

INTERPOLATION OF BALLISTIC TABLES.

When it is deemed necessary to interpolate the ballistic tables, the following review may be helpful. Assume that the sight depression is to be interpolated for 475 knots TAS.

460 knots = 123 mils

480 knots = 118 mils

5 mils

$$\frac{(480 \text{ knots}) - (475 \text{ knots})}{(480 \text{ knots}) - (460 \text{ knots})} \times 5.0 \text{ mils}$$

$$\frac{5}{20} \times 5.0 = 1.2 \text{ mils}$$

1.2 + 118 = 119.2 mils

475 knots = 119.2 mils

DESCRIPTION OF SECTION VI CHARTS AND TABLES.

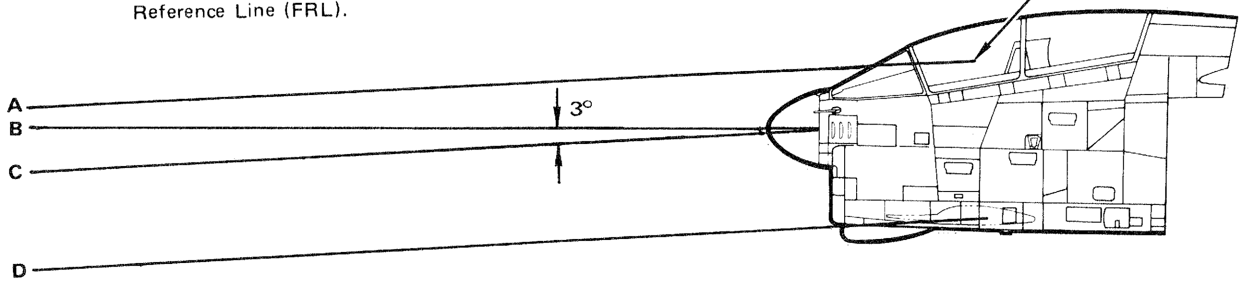
MISSION PLANNING FORM.

The mission planning form (figure 6-1) provides a sequence for planning a nonnuclear weapon delivery mission. The planning form is divided into six parts. The first three parts (Mission Conditions, Release Conditions, and Wind Values) are applicable to all delivery modes. The remaining three parts (Dive and Level Bombing Conditions, Rocket Launch and Strafing Conditions, and Ripple Release Conditions) are applicable only to the delivery mode implied.

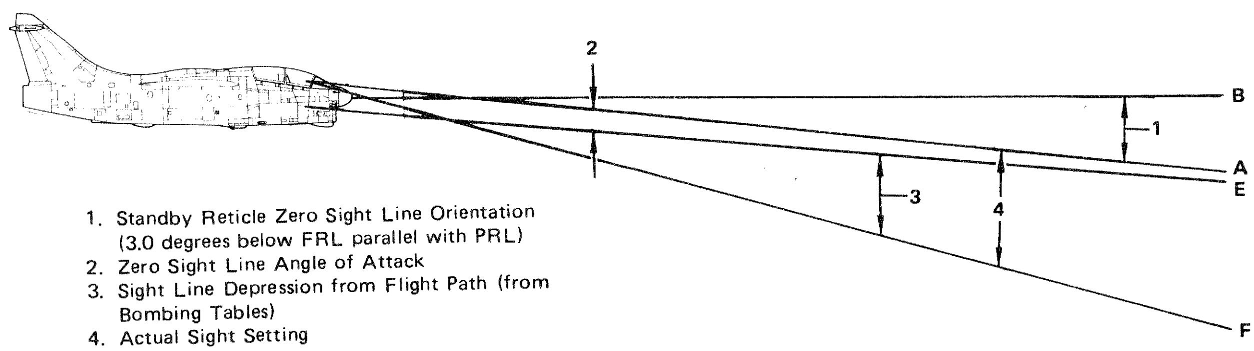
ARMAMENT REFERENCE LINES

NOTE

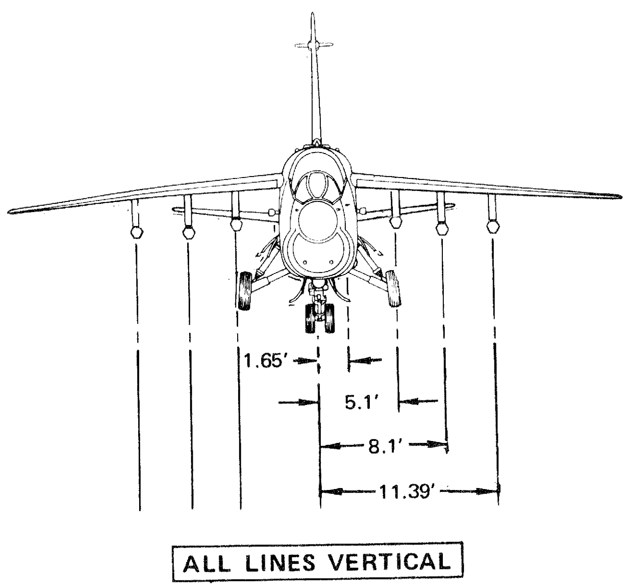
Wing and Fuselage Pylons, Standby Reticle ZSL, Radar, and Gun Bore Lines are all parallel to each other and are depressed 3° from the Fuselage Reference Line (FRL).



A. Standby Reticle Zero Sight Line (ZSL)
B. Fuselage Reference Line (FRL)
C. Fuselage and Wing Pylon Line, Radar Line
D. Gun Bore Line
E. Flight Path
F. Depressed Sight Line



1. Standby Reticle Zero Sight Line Orientation (3.0 degrees below FRL parallel with PRL)
2. Zero Sight Line Angle of Attack
3. Sight Line Depression from Flight Path (from Bombing Tables)
4. Actual Sight Setting



STATIONS	DISTANCE BELOW STANDBY RETICLE EYE*
1 and 8	33.0 Inches
2 and 7	34.6 Inches
3 and 6	27.9 Inches
4 and 5	26.9 Inches

*Distance is measured to the 30-inch hooks of the MAU-12.

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Figure 5-1

DIVE RECOVERY CHARTS.

The dive recovery charts (figure 6-2) are used to determine the altitude lost during pullout after bomb release. Charts are provided for the speed brake extended and for the speed brake retracted. Release altitudes must be greater than the sum of altitude lost during pullout and minimum recovery altitude above ground.

AIRSPEED CONVERSION CHART.

The airspeed conversion chart (figure 6-3) may be used to convert indicated airspeed (KIAS) to true Mach number to true airspeed (KTAS) and/or vice-versa. Release pressure altitude and free-air temperature (°C) are required for the use of this chart.

Enter the chart with release velocity IAS. Project up to release pressure altitude, across through Mach number to release temperature, and down to KTAS. Reverse this procedure for KTAS to KIAS conversion.

ZERO SIGHT LINE ANGLE-OF-ATTACK CHART.

The zero sight line angle-of-attack chart (figure 6-4) is used to determine the zero sight line angle of attack. The purpose of the chart is to aid in computing the optical sight depression angle in mils. The unit of measurement used to calibrate the mil scale is 1° = 17.45 mils. Enter the chart with release IAS. Project up to aircraft gross weight, across the dive angle, and down to obtain the zero sight line angle of attack.

SIGHT DEPRESSION CHART.

The sight depression charts (figure 6-5) provide the sight depression angle in mils for a given release altitude AGL and horizontal distance from release to impact. Thirteen charts are provided to accommodate dive angles from level flight through 60° dive in 5° increments. Enter the proper dive angle chart with desired distance from release to aimpoint (bomb range plus aiming allowance). Project up to release altitude and across to depression angle from flightpath. Parallax correction factors are included in these charts.

SINE AND COSINE TABLE.

The sine and cosine table (figure 6-6) may be used in computations required in manual attack.

ALTIMETER POSITION ERROR CORRECTION CHARTS.

The altimeter position error correction charts (figure 6-7) may be used to correct the altimeter reading for position or installation error. The error is a function of release pressure altitude and indicated airspeed. Charts are provided for both the STBY and RESET modes.

Enter the chart with release indicated airspeed (KIAS) and project up to release pressure altitude and across to the altitude error correction.

ALTIMETER LAG CHART.

No altimeter lag chart is provided. Until further notice, ignore references to the altimeter lag chart, both in the sample problems and in the mission planning forms. These areas will be amended at a later date to delete reference to altimeter lag.

ALTIMETER CORRECTIONS FOR HIGH G DIVE RECOVERIES.

Altimetry system position errors vary with aircraft airspeed and altitude and thus influence the accuracy of the AAU-19 altimeter during dive recovery procedures. Altimeter position error correction charts are presented in figure 6-7.

WARNING

The AAU-19 altimeter in RESET may read as much as 300 feet higher than actual aircraft altitude during a dive with a high rate of descent, throttle at MIL, and an indicated Mach number greater than 0.75. For the same conditions and throttle at IDLE, the indicated altitude may read as much as 500 feet lower than the actual aircraft altitude.

The corrections presented in these charts are only for stabilized level and/or diving flight. Position error corrections also vary with aircraft angle of attack. An indication of the magnitude of the additional altimeter error resulting from the large changes in aircraft angle of attack associated with high g dive recovery maneuvers is provided in the following table. This table provides estimated errors based on a 5.0g dive recovery.

Altimeter Corrections to be Added Due to Angle of Attack Change in 5.0g Dive Recovery

True Mach No.	Altitude ~ Feet	AAU-19 Correction To Be Added ~ Feet Standby Mode	Reset Mode
0.60	2,500	+112	+10
0.70	2,500	+43	−47
0.80	2,500	−322	−313

WARNING

AAU-19 altimeter indications in the STBY mode are not sufficiently accurate during high g maneuvers and must not be used during dive recoveries to determine terrain clearance.

HUD POSITION ERROR CORRECTION CHARTS.

These charts (figure 6-8) present the corrections that must be added to HUD indicated airspeed and altitude (cruise condition) to obtain calibrated airspeed and altitude. Aircraft velocity required in using these charts must correspond to that indicated on the HUD. Corrections presented are nominal and do not consider variations due to avionic tolerances or repeatability between aircraft.

RELEASE INDICATED ALTITUDE.

Release indicated altitude is the sum of the following items:

1. Target altitude above MSL.
2. Release altitude above target.
3. Altimeter position error correction.

RELATIVE WIND VECTOR CHART.

When forecast wind data is used for mission planning, the relative wind vector chart (figure 6-9) is used to obtain the rangewind and crosswind components. The wind velocity at release altitude should be used. The displacement of the bomb is a function of initial velocity and time of flight.

As the time becomes less, the magnitude of deflection is also less. Use the relative wind vector chart as follows:

Given:

Forecast wind.................................... 350° per 30 knots

Approach course to target.......................................040°

Find:

Relative wind direction...310°

Rangewind component.................... 20 knots headwind

Crosswind component.................................23 knots left

NOTE

If the aircraft course to target is greater than the wind direction, add 360° to the wind direction; then subtract aircraft course from the wind direction to obtain relative wind direction.

Relative wind direction must be determined before entering the relative wind vector chart. Obtain relative wind direction by subtracting approach course to target, 040°, from forecast wind direction over target.

350° − 040° = 310° relative wind direction

Enter the relative wind vector chart (figure 6-9) with 310°. Project to the 30-knot wind circle and over to the horizontal and the vertical axes. Read the rangewind and crosswind components respectively.

WIND CORRECTION.

Offset Aiming.

For level delivery of the high-drag bombs (Mk 82 Snakeye I, CBU's), crosswind correction is usually achieved by crabbing the aircraft into the wind and offsetting the ground track in the upwind direction parallel to the no-wind course. Rangewind correction is accomplished by correcting the sight setting or by releasing early or late (figure 5-2). The equation for rangewind is as follows:

(Rangewind in knots) (t_c) (1.69) = correction in feet

When the aircraft is crabbed to maintain a ground track during the approach and release, the need for crosswind correction is reduced, as illustrated by the following equation which is valid for both high-drag and low-drag bombs.

(Crosswind in knots) $[(t_c)\ (1.69) - (R_c/V_A)]$ = correction in feet

When the aircraft is drifting (not crabbed), the rangewind and crosswind correction factors are the same:

(Wind in knots) (t_c) (1.69) = correction in feet

where:

t_c = bomb time of fall in seconds

R_c = bomb range in feet

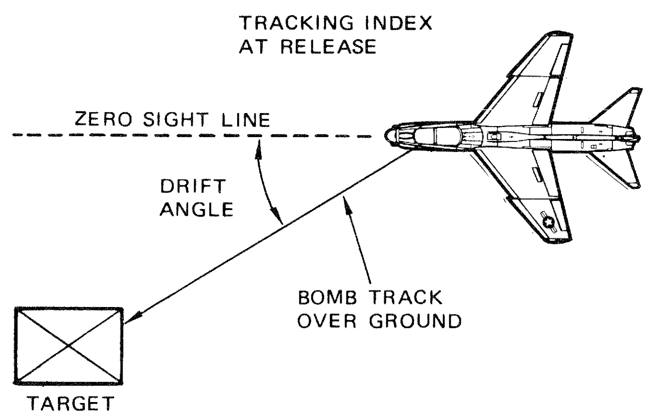
V_A = release velocity in knots TAS

1.69 = conversion factor to change knots to feet per second

For the low altitude level delivery of the low-drag bombs, crosswind correction is usually achieved by crabbing the aircraft into the wind so that the aircraft ground track passes through the target. The equation shows that an offset ground track is not required.

When the crabbing technique is used with a sight that is not drift stabilized, the pipper is not directly on the target when release occurs; because of the crab angle, there is an apparent increase in the sight angle. As the crab angle increases, the pipper describes an imaginary arc through the target radiating from the release point. Therefore, the bomb should be released when the pipper is on the arc which appears to be short of the target.

VISUAL OFFSET AIMPOINT



NOTE

Gunsight reticle is positioned the same at release regardless of the attack heading.

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Figure 5-2

Upwind Aiming.

The upwind aimpoint method of wind correction can be used for all delivery modes and all non-nuclear weapons. The total windspeed at release altitude is used to relocate the aimpoint upwind from the target by an amount equal to the product of the total windspeed times the weapon time of fall. The upwind aimpoint may be approached from any direction. The no-wind sight setting is used and the weapon is released at the planned release conditions. The aircraft is drifting, i.e., no attempt is made to correct the aircraft for drift by crabbing.

DIVE ANGLE VS DISTANCE CHART.

The dive angle vs distance chart (figure 6-10) provides a means to approximate the distance from target for a given dive angle and altitude. Trajectory drop can also be computed. To determine the trajectory drop, place a mark on the chart at the intersection of release altitude and dive angle; project down and find distance. Subtract the bomb range from the distance to obtain the trajectory drop. This chart is provided as supplementary data and is not used in the sample problem.

FUZE ARMING AND SAFE ESCAPE CHARTS.

WARNING

All fuzes have a manufacturing arming time tolerance. The negative tolerance of the fuze must be used when determining the minimum arming separation between weapon and aircraft. The positive tolerance must be used to determine the minimum release altitude to ensure arming before impact.

Fuze arming is the vertical distance below the release point where the fuze is unarmed. If bomb impact occurs within the fuze arming distance, a dud bomb is predicted.

WARNING

The lower release conditions provided in the ballistics tables should be checked with the fuze arming and safe escape tables to ensure safe delivery conditions:

Fuze Arming, figure 6-11

Required Fuze Safe Arming Time, figure 6-12

Fuze Arming and Safe Escape (retarded bombs), figure 6-13

NOTE

When using fuzes with selectable setting times, refer to figure 6-11, Fuze Arming.

Fuze Safe Arming Times.

The fuze arming times, which are required to assure safe escape from premature airbursts (or earlier than intended impact bursts), vary widely as a function of release conditions (level or dive, low altitude or high altitude) and release modes (singles, pairs, salvo, or timed ripple). The required safe arming times provided in figure 6-12 for M117, Mk 82, Mk 83, and Mk 84 GP bombs are listed as a function of release conditions and escape maneuvers. Charts are provided for 4.0g and 5.0g escape maneuvers attained in 2 seconds and for a 5.0g escape maneuver attained in 1.5 seconds. For clarity, an illustration of the delivery and escape maneuver profile for each type of release and escape maneuver is also presented.

Determination of Fuze Safe Arming Times.

VT Fuzed Munitions.

When using proximity fuzes with GP bombs, safety considerations require that the fuzes be kept unarmed until the releasing aircraft has attained an adequate distance from the munition to assure safe escape.

WARNING

Observance of this safety consideration is absolutely mandatory to assure that the delivery aircraft will not be hit by lethal fragments from its own munition in the event of a premature detonation at the expiration of the fuze arming time.

In the determination of the VT fuze safe arming time setting, the value selected should be equal to or greater than the required safe arming time value shown in the table for the desired release condition, release mode, and escape maneuver.

Impact Fuzed Munitions.

Ordinarily, premature airburst detonations of impact fuzed munitions are not anticipated. However, to protect the aircraft and pilot from any earlier than intended burst, fuze safe arming time settings, which will assure safe escape, should be employed with impact type fuzes (as well as VT fuzes) whenever operational considerations will permit this course of action. Use of this procedure would help protect the aircraft and pilot in the event of an inadvertent low altitude release as well as any premature airburst.

WARNING

If operational considerations and the range of available fuze arming time settings require the selection of settings which will not assure safe escape from an earlier than intended burst, the pilot should carefully observe the appropriate minimum release altitudes and recovery maneuvers required for safe escape.

As an additional safety precaution, whenever operational considerations require the use of fuze arming time settings which will not assure safe escape from a premature burst, the pilot should execute a 4g or 5g pullup or banked turn escape maneuver immediately after release.

For the M904 and M905 fuzes, only the 4- and 6-second arming delay settings are considered. Current tolerances listed for the arming delay times are ±20% (±10% for M904E2 and M904E3 fuzes) of the delay settings. The delay setting plus the positive tolerance was used in the determination of minimum release altitudes or vertical drop required for these fuzes to arm. For example, the 4-second arming delay setting (for an M904E1 fuze) will require a minimum bomb time fall of 4.8 seconds. The 6-second arming delay setting requires a minimum time fall of 7.2 seconds. Refer to figure 6-11 for a chart showing minimum release altitude for fuze arming for low-drag general purpose bombs.

Maximum Fragment Envelopes.

The maximum fragment envelope charts (figure 6-14), which show the fragment position relative to the weapon burst point as a function of time, are used in determining the safe release interval between aircraft during multiple aircraft attacks. The charts are based on the assumption that the most hazardous fragment (i.e., the heaviest fragment with the maximum velocity) can be projected from the burst point at any angle, regardless of weapon delivery conditions.

Minimum Release Altitudes for Safe Escape and Ground Clearance.

Minimum release altitudes for safe escape and ground clearance (figure 6-15) for level and dive release of GP bombs are provided for various airspeeds. A 4g or 5g power pullout is executed after release. For level release of GP bombs, both a 4g or 5g military power pullup and a straight and level constant speed recovery are included. Minimum launch altitudes for the 2.75-inch rocket with HE and M151 warhead are provided for various dive angles and airspeeds.

DETERMINATION OF MINIMUM ACCEPTABLE RELEASE ALTITUDE.

The vertical drop to fuze arming, bomb fragmentation envelope clearance, and minimum recovery altitude must all be considered in the determination of the minimum acceptable release conditions. The altitude or vertical drop required for each of these parameters should be determined from the data listed in the safe escape and fuze arming tables and charts. The greatest value is the minimum release altitudes for the fuzes, dive angles, and airspeed conditions being considered.

For example, assume that the M117 bomb with the M904 nose fuze is to be released from 480 knots TAS in a 45° dive. For this release condition, the M904 nose fuze with a 4-second setting requires a vertical drop of 3,120 feet for the fuze to arm. The minimum release altitude required for the fragment envelope clearance is 2,700 feet. In this case, the minimum release altitude is governed by fuze arming. The minimum acceptable release altitudes for the other compatible fuzes are determined in a similar manner.

WARNING

The pilot must determine the minimum ground clearance.

DIVE TOSS BALLISTIC DATA — GP BOMBS.

The dive toss ballistic data for the dive toss bombing mode 3-, 6-, 8-, and 12-bomb ripple release for GP bombs are presented in figure 6-16. These data were computed assuming zero sight depression at pickle (point blank designate) and a release interval of 76 milliseconds. This is the minimum release interval programmed into the NAV WD Computer for multiple carriage pairs release of MRI Class 2 weapons. If a bomb spacing is selected which is less than the minimum obtainable, then a minimum release interval of 76 milliseconds would be used by the computer. Figure 6-16 would provide the resulting bomb spacing. Bomb spacing (BS) is obtained by dividing the stick length (S) by the number of bombs (N) minus one bomb (N-1):

$$BS = \frac{S}{N-1}$$

The NAV WD Computer will provide the selected bomb spacing, when the selected bomb spacing is greater than minimum.

The dive toss ballistic data are presented as a function of the following parameters:

Pullout acceleration: 2.0g, 3.0g, and 4.0g obtained 1.5 seconds after pickle

NOTE

The ballistic data are based on the assumption that the pullup maneuver is initiated immediately after pickle and that the pullup g is attained 1.5 seconds after pickle.

Release interval: 0.076 second

True airspeed at time of pickle: 440, 500 knots

Dive angle at time of pickle: 15°, 30°, and 45°

Altitude above target at time of pickle: 1,000 through 6,500 feet varying with dive angle

The following data are obtained from the tables:

Slant range at the time of pickle as a function of the dive angle and altitude above target

The pattern length of 3-, 6-, 8- and 12-bomb ripple release. To approximate the pattern length for any other number of bombs, divide the eight-bomb stick length (S) by seven (S/7), and then multiply by the number of bombs, minus one bomb, to be released (N-1).

NOTE

The following data are presented for the middle bomb in ripple release.

The time from pickle to middle bomb release in seconds

The release altitude of the middle bomb in feet

The release angle of the middle bomb in degrees, measured from horizontal (0°) where negative is below the horizontal

The time of fall from release to impact of the middle bomb

DIVE-TOSS BALLISTIC DATA — ROCKEYE II, CBU-24B/B, AND CBU-49B/B.

The selection of initial conditions and pullout g for delivery of bomb type cluster munitions must provide ample time for the munition to open at a sufficient altitude above ground to ensure that the submunition fuzes will have adequate time to arm. Conversely, to enhance munition delivery accuracy, the function altitude should not be extremely high. If the function altitude is unnecessarily high, the submunition time of flight will be so great that unknown wind effects could significantly degrade impact accuracy. Figures 6-17 and 6-18 provide sample dive-toss delivery patterns for the Rockeye II (figure 6-17), CBU-24B/B, and CBU-49B/B (figure 6-18). These tables depict the release solution which will be provided by the NAV WD Computer for a single munition or a pair of munitions. The tables are not applicable to computed, manual ripple, or manual single delivery.

The Rockeye dive-toss ballistic data are based on a 4.0-second fuze setting and the CBU-24B/B and CBU-49B/B data are based on a 5.0-second fuze setting. Both sets of data were computed for pullup accelerations of 2.0, 3.0, and 4.0g and assume a zero sight depression at pickle (point blank designate). This listing of data provides information concerning the expected cluster function altitude for each pickle and pullout g condition. The total time of flight from release to impact is also listed. These data may be used to select pickle and pullout conditions which will provide adequate time for the submunition fuzes to arm and to optimize the function height to preclude unnecessarily long submunition time of flight from cluster opening to impact.

NOTE

When selecting pickle and pullout conditions for the Rockeye II with the 4.0-second fuze setting, the total time of flight to prevent submunition duds should be at least 1.2 seconds greater than the fuze setting plus its tolerance. Conversely, if higher function heights and longer submunition times of flight must be employed, every possible effort should be exerted to keep the function height lower than 2,000 feet AGL to minimize the effort of wind on the submunition trajectory from function to impact.

Use of figures 6-17 and 6-18 requires that the fuze function time (4.0 and 5.0 seconds) be entered under Data Address 28 and the fuze function altitude (obtained from the tables) be entered under Data Address 29. Since the fuze function time of figure 6-18 is 5.0 seconds, this table is intended for use with FMU-26 series or M907 time fuzes. The Data 28 entry for the FMU-56/110 series fuze is zero which causes the computer to calculate ballistics based on the selected fuze functioning altitude entered under Data Address 29 and provides a nominal 4.0-second arming time to ensure the dispenser is armed prior to reaching functioning altitude. Use of the table in figure 6-18 with the FMU-56/110 fuze would cause delivery inaccuracies, particulary since the function altitudes listed there are seldom selectable as HOBs on the FMU-56/110 fuze.

RIPPLE RELEASES OF CBU-52B/B AND CBU-58/71 SERIES MUNITIONS USING THE FMU-56D/B FUZE.

For proper operation of the FMU-56D/B fuze in ripple releases of up to six CBU-52B/B or CBU-58/71 series munitions, the munitions must have achieved a spatial separation of 20 feet within the height of burst (HOB) range for HOB of 2,200 feet and below, 24 feet spatial for a HOB of 2,500 feet, and 38 feet spatial separation for a HOB of 3,000 feet. The following information may be used to determine the minimum release intervals that may be used with the various release maneuvers to assure adequate munition spatial separation.

Dive-Toss Release.

For a 3g (or higher) pull-out acceleration, the use of a 0.14-second release interval and a 3.0-second safe arm time setting will provide adequate separation distance for proper fuze function.

Level or Dive Releases.

The information in the release envelopes tables for the FMU-56D/B fuze (figure 6-19) may be used to determine the minimum release altitude and minimum release interval setting that will provide adequate separation distance for a range of level and dive conditions. The tables also provide the minimum altitudes that may be used for single releases and the maximum release altitude that may be used for either single or ripple releases.

NOTE

Pairs or simultaneous releases are not recommended because the munitions may not achieve sufficient spatial separation to permit proper fuze functioning.

Data listed in figure 6-19 for the CBU-58/B is also applicable for the CBU-58A/B, CBU-71/B, and CBU-71A/B.

Ripple releases up to 12 FMU-56D/B fuzed munitions may be accomplished. However, if more than six munitions are ripple released on one pass, an increased dud rate must be expected. Also, for dive releases, the minimum release altitude must be increased to compensate for the additional aircraft loss in altitude during the longer ripple release time cycle. While the fuze dud rate will increase for ripples greater than six, munition effectiveness will increase due to the greater number of munitions functioning in close proximity to the target.

RIPPLE RELEASES OF THE CBU-52B/B AND CBU-58/71 SERIES MUNITIONS USING THE FMU-110/B FUZE.

For proper operation of the FMU-110/B fuzes in ripple releases of up to 12 CBU munitions, the munitions must obtain a spatial separation of 20 feet within the HOB range for HOB of 2,200 feet and below. The following information may be used to determine the minimum release intervals that may be used with the various release maneuvers to assure adequate munition spatial separation.

Dive-Toss Release.

For a 3g (or higher) pullout acceleration, the use of a 0.14-second or greater release interval and a 3.0-second safe separation time setting will provide adequate separation distance for proper fuze function.

Loft Release.

For loft releases, a 4g pullup acceleration and a release interval setting of 0.60-second or greater will provide adequate munition separation for release angles of 30° and greater. With this type of release, the greatest practical safe separation time setting should be used.

Level or Dive Releases.

Release envelopes to determine minimum release altitudes and minimum release interval settings which will provide adequate munition separation distance for ripple releases are provided in Section VI (figure 6-20). The envelopes also provide the minimum altitudes that may be used for single releases and the maximum release altitude that may be used for either single or ripple release.

NOTE

Data listed in figure 6-20 for CBU-52B/B and CBU-58/B is applicable for CBU-52B/B and CBU-58/71 series of munitions.

Spatial separation is the distance between the CBU proximity fuzes during a ripple release. The required spatial separation must be obtained before the lowest FMU-110/B fuze and CBU is at the HOB. The spatial separation achieved varies with release altitude, airspeed, and interval. As release altitude or airspeed becomes lower, the minimum release interval required to achieve spatial separation becomes greater.

The ripple release envelope was derived for a ripple of six munitions. To determine the minimum dive release altitude for a ripple other than six, add the drop from the following equation to the minimum release altitude in the appropriate table.

$$\text{Drop} = (N\text{-}6)\ (IS)\ (\sin A)\ (VT)$$

where

Drop = aircraft travel during ripple (ft)

N = number of munitions in ripple

IS = intervalometer setting (release interval) (sec)

A = release angle (deg)

VT = release velocity (ft/sec)

The FMU-110/B arming and functioning criteria used to define the release envelope are as follows:

1. The proximity data processing begins 3.0 seconds after release, regardless of fuze arming time setting.
2. The fuze must be armed before height of burst.
3. The fuze must sense 100 feet per second downward vertical velocity (minimum) after 3.0 seconds and as it passes through the height of burst.
4. No spatial separation is required for single or pair releases.
5. When 3 to 12 fuzes are ripple released, a spatial separation of 20 feet is required for all heights of burst up to 2,200 feet.

MINIMUM SAFE RELEASE CONDITIONS FOR CBU-52 AND CBU-58/71 SERIES BOMB TYPE CLUSTER MUNITIONS.

The information in the minimum safe release conditions tables for the CBU-52 and CBU-58/71 series bomb type cluster munitions (figures 6-21 and 6-22) may be used to determine the minimum release altitude required to provide safe release of a single munition under a variety of level flight and dive delivery conditions.

BOMB SPACING FOR MANUAL RIPPLE BOMBING CHARTS (LDGP BOMBS, HIGH-DRAG RETARDED BOMBS — STRAIGHT PATH DELIVERY).

The bomb spacing for manual ripple bombing charts (figures 6-23 and 6-24) are used in mission planning when using the manual ripple mode. For the low-drag GP bombs, charts are provided for dive angles of 5°, 10°, 15°, 30°, 45°, and 60°. For the high-drag retarded bombs, charts are provided for dive angles of 5°, 10°, 15°, and 30°. When using the manual ripple mode in a level release, the desired impact spacing inserted on the ARMAMENT RELEASE panel with the INTERVAL-FT thumbwheel is the bomb spacing obtained on the ground. However, when using the manual ripple mode in a dive release, the desired impact spacing inserted on the ARMAMENT RELEASE panel with the INTERVAL-FT thumbwheel is not the bomb spacing obtained on the ground. To determine bomb spacing on the ground in a dive release, first select the chart for the dive angle desired. Then enter the chart with release velocity, project up to INTERVAL-FT SELECTOR setting, across to release altitude, and down to bomb impact spacing. Pattern length (PL) is obtained by multiplying the bomb spacing (BS) times the number of bombs (N) minus one bomb (N-1): PL = BS(N-1).

These charts assume that a straight path delivery is maintained until all bombs in the ripple are released. The minimum release interval programmed into the NAV WD Computer varies with munition, carriage method, and release mode. Therefore, the minimum release interval should be checked prior to using these charts. The LDGP bomb charts are applicable for all low-drag general purpose bombs and finned fire bombs. The high-drag retarded bomb charts are applicable for all high-drag retarded bombs and unfinned fire bombs.

ALTITUDE LOSS DURING RIPPLE RELEASE CHART (STRAIGHT PATH DELIVERY).

The altitude loss during ripple release chart (figure 6-25) is used in mission planning when using the manual ripple mode. This chart assumes that a straight path delivery is maintained until all bombs in the ripple are released. To determine altitude loss during a ripple release, first enter the chart with release interval, then project up to release dive angle, across to the number of bombs in the ripple, and down to altitude loss during ripple release. The release altitude of the last bomb is the release altitude of the first bomb minus altitude loss during the ripple release.

NOTE

The release altitude of the last bomb must be sufficiently high to provide adequate time for fuze arming, ground clearance during recovery, and fragment envelope clearance.

For conditions not contained in the chart, the release altitude of the last bomb in the ripple can be computed by using the following equation:

$$A_L = A_F - [I_R\,(1.69)\,V_R \sin\theta\,(N\text{-}1)]$$

where

A_L = release altitude of last bomb in feet.

A_F = release altitude of first bomb in feet.

I_R = release interval in seconds.

V_R = release true airspeed in knots.

θ = dive angle in degrees.

N = number of bombs in ripple release.

MINIMUM BOMB SPACING FOR COMPUTED RIPPLE MODE (STRAIGHT PATH DELIVERY).

The minimum release intervals table (figure 6-26) can be used in conjunction with the bomb spacing for manual ripple bombing charts (figures 6-23 and 6-24) to compute the minimum bomb spacing for computed ripple mode in a straight path delivery. The minimum release intervals table provides the minimum release interval programmed into the NAV WD Computer as a function of weapon, carriage method, and release mode. To determine minimum bomb spacing enter the appropriate bomb spacing for manual ripple bombing chart with the minimum release intervals table and project across to release altitude and down to read bomb impact spacing. If the selected bomb spacing is less than the minimum obtainable, the NAV WD Computer will provide bomb spacing as just computed. If the selected bomb spacing is greater than the minimum obtainable, the NAV WD Computer will provide the selected bomb spacing.

IMPACT LATERAL DISPLACEMENT CHARTS.

When munitions are carried on the shoulder positions of either MER's or TER's, the munition impact pattern will be displayed laterally in the direction of the side ejection. The magnitude of this lateral displacement in feet is induced by an effective lateral munition ejection velocity component. The lateral displacement distances listed in figure 6-27 are measured from the point of ejection and include the release conditions provided in the bombing tables in T.O. 1A-7K-34-1-2. To obtain the total lateral displacement, the distance of the wing stations from the centerline of the fuselage must be considered. These distances can be obtained from figure 5-1.

Two impact lateral displacement charts are provided. One chart is for low-drag general purpose (LDGP) bombs and finned fire bombs. The other chart is for unfinned fire bombs and retarded munitions (Mk 82 SE, Mk 36D).

2.75-INCH FFAR WITH WDU-4A/A AND WDU-13/A FLECHETTE WARHEAD.

Planning Procedures And Sample Problem.

Refer to Section I, Parts 6 and 7 for a description of the flechette warheads and the fuzes. The following will explain the use of the charts to determine the optimum launch conditions and outline some of the launch requirements for effective employment of the flechette warhead. The rocket launch tables for the flechette warheads are contained in T.O. 1A-7K-34-1-2.

NOTE

> Figures 6-28 and 6-29 are for the twenty-grain WDU-4A/A warhead. Data on the sixty-grain WDU-13/A warhead will be provided when available.

Effective employment of the flechette warhead requires the slant range between the launch aircraft and target to be within certain limits. The slant range (stated as a specific launch altitude for a given dive angle) must be sufficient to allow ample time for the flechette fuze to function and eject its payload. The fuze will function when the rocket decelerates to approximately 11.0g's. The launch altitude must be low enough to ensure that the flechettes are still traveling at a lethal velocity upon impact. Therefore, the mission should be preplanned and accomplished accordingly. The effect of deviation from the preplanned conditions on the fuze functioning altitude, impact pattern size, and impact velocity can be found in figures 6-28 and 6-29. The boundaries of a workable slant range envelope can be developed by using the rocket launch tables and the flechette charts.

Flechette Impact Pattern Chart.

The flechette impact pattern chart (figure 6-28) is used to obtain the following data for various dive angles and launch true airspeeds:

1. Warhead function altitude.
2. The major axis of the impact pattern produced by one 2.75-inch FFAR flechette warhead. (The major axis will be along the aircraft flightpath.)
3. The minor axis of the impact pattern.
4. The area in square feet of the impact pattern associated with the size of the ellipse.
5. The number of flechettes impacting within each square foot of the area above. This value gives flechette density for one, two, or three rocket launchers.

Flechette Impact Velocity Chart.

The flechette impact velocity charts (figure 6-29) can be used to establish the dive angles, launch speeds, and launch altitudes that will produce the desired impact velocity. The charts can also be used to determine the impact velocity for a given launch true airspeed, launch altitude, and dive angle.

Flechette Warhead Rocket Launch Tables.

The rocket launch tables presented in T.O. 1A-7K-34-1-2 provide data which consider both rocket and flechette.

Sample Problem.

Given:

1. A-7K aircraft gross weight is 34,000 lb.
2. Temperature at launch is 0°C.
3. Target altitude above MSL is 1,600 ft.
4. Altitude at launch AGL is 2,400 ft.
5. Indicated airspeed at launch is 455 knots.
6. True airspeed at launch is 480 knots.
7. Wind velocity is 10 knots at 90°.
8. Dive angle is 30°.
9. Zero sight line (ZSL) angle of attack is 10 mils.

From Rocket Launch Tables:

1. Time of flight is 3.62 seconds.
2. A-7K sight setting is 38 mils.
3. Slant range is 4,584 ft.
4. Horizontal range is 3,903 ft.
5. Upwind aimpoint is 61 at 90°.

From Flechette Impact Pattern Chart:

1. Warhead function altitude is 920 ft.
2. Major axis per rocket is 196 ft.
3. Minor axis per rocket is 110 ft.
4. Impact area is 17,000 ft^2.
5. Flechettes per ft^2 is 1.25 ft^2.

From Flechette Impact Velocity Chart, flechette velocity at impact is 620 ft per second.

AIM OFF DISTANCE CHARTS.

Initial pipper placement and flightpath aim off distance are critical to accurate manual weapons delivery. The Aim Off Distance Charts (figure 6-30) can be used to determine initial pipper placement (in mils) short of the target, and FPM aim off placement (in feet) long of the target. By using the calculations in the following sample problem, the actual pipper placement can be determined for any altitude/airspeed combination from roll-out until release. Figure 5-3 illustrates the various parameters and terms used in computing aim off distances.

For this sample problem, the following conditions were assumed:

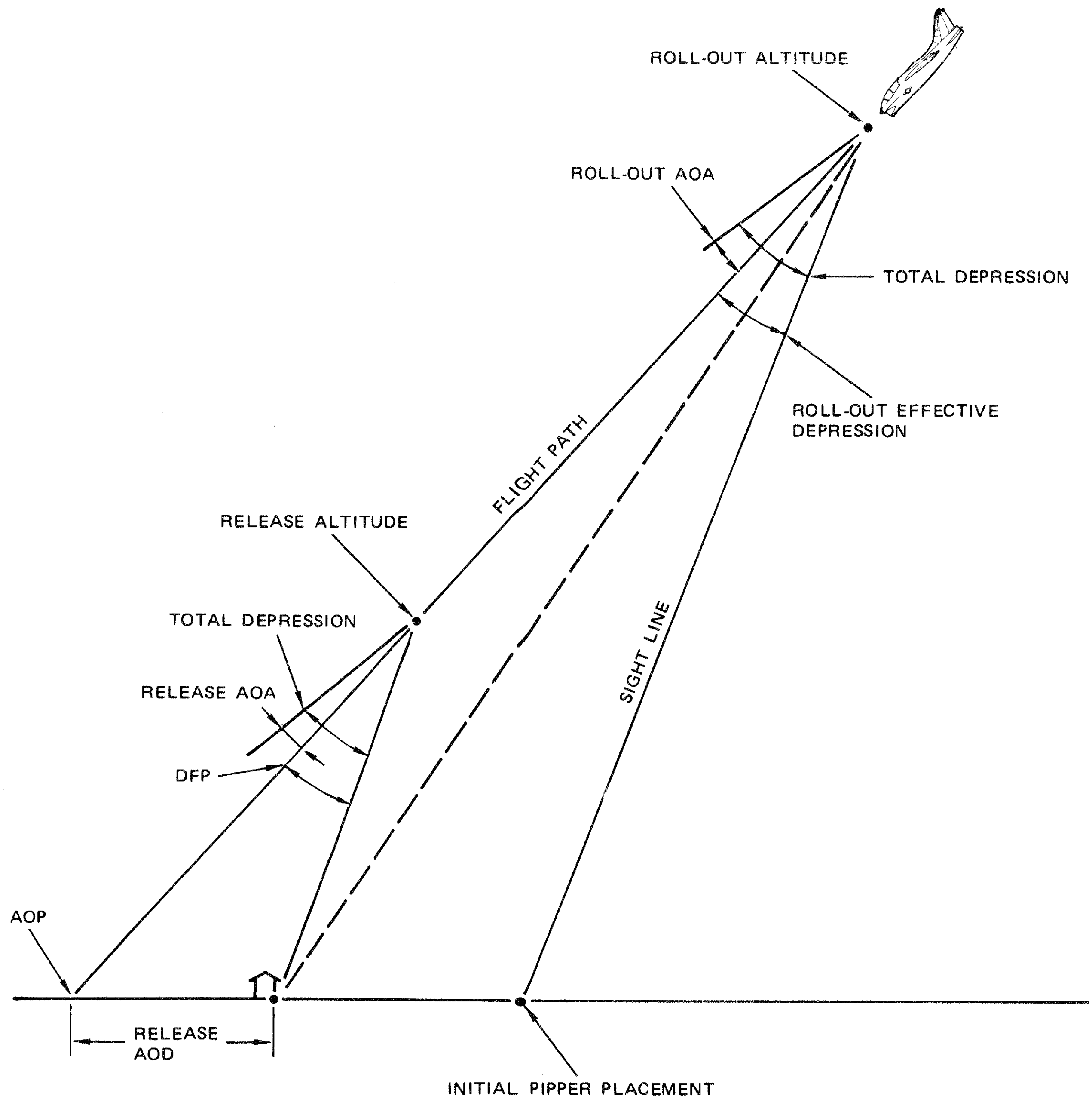
Dive Angle	30°
Release Altitude (AGL)	3,000 ft
Release Airspeed (KIAS/KTAS)	400/440
Planned Roll-Out Altitude (AGL)	7,000 ft
Planned Roll-Out Airspeed (KIAS)	300
Gross Weight (Pounds)	28,000
Bomb	BDU-33 (MER RELEASE)

Use the bombing tables in T.O. 1A-7K-34-1-2 to obtain the sight depression from flightpath, 121 mils. Use the zero sight line angle-of-attack chart in Section VI to obtain the angle of attack at release of 13 mils, and the angle of attack at roll-out of 35 mils. The total depressed sight setting is 134 mils (121 + 13).

Use the aim off distance charts in Section VI for the remaining computations.

1. To compute aim off distance at release:
   a. Enter the 30° aim off distance chart with sight depression from flightpath of 121 mils.
   b. Then, project up to the release altitude (AGL) of 3,000 ft.

DIVE DELIVERY USING AIM OFF TECHNIQUE



AOP – AIM OFF POINT
AOA – ANGLE OF ATTACK
AOD – AIM OFF DISTANCE
DFP – DEPRESSION FROM FLIGHT PATH

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Figure 5-3

c. Then, project across to the left to aim off distance of 1,180 ft. This is the distance the flight path marker will be at 12 o'clock to the target.

2. To compute initial pipper placement at the preplanned roll-out:

   a. Repeat step 1, substeps a and b.

   b. Then, project across to preplanned roll-out altitude (7,000 ft AGL).

   c. Then, project down to depression from flightpath, 46 mils. (This is the number of mils that subtend the aim off distance of 1,180 ft.)

   d. Determine effective depression at roll-out by subtracting roll-out angle of attack (35 mils) from the total sight setting (134 mils), 99 mils.

   e. Then, subtract depression from flightpath (c above) from effective depression at roll-out (d above), 99-46=53 mils. This is the distance at 6 o'clock from the target the pipper should be at roll-out, provided roll-out conditions are met.

USE OF BALLISTIC TABLES IN T.O. 1A-7K-34-1-2.

LEVEL AND DIVE BOMBING TABLES.

The release conditions contained in the dive bombing tables provide at least at 100-foot ground clearance. The ground clearance computations are based on a 4g pullout acceleration obtained in 2 seconds after release. Refer to figure 6-5 if other initial bomb impact conditions are desired.

The following data are obtained from the bombing tables:

Release altitude above target, in feet

Bomb horizontal range from release to impact, in feet

Bomb time of flight, in seconds

Slant range from release to impact, in feet

Bomb impact angle, in degrees

Sight depression from flightpath, in mils (zero sight line angle of attack, figure 6-4, must be added to obtain the optical sight depression.)

Wind correction factors: headwind and tailwind in mils per knot of wind; and crosswind for drifting aircraft and/or for a crabbing aircraft (level release) in feet per knot of wind. Refer to Wind Correction for a description of wind factor application.

Bombing data for MER release also apply to TER release.

Practice bomb data for SUU-20/A dispenser also apply to all SUU-20 series dispensers.

Bombing data for BLU-27/B fire bomb also applies for BLU-27B/B and BLU-27C/B fire bombs.

Bombing data for CBU-24B/B and CBU-49B/B applies for MAU-12 release and for MER/TER release.

FLARE WIND CORRECTION CHART.

The wind correction chart (figure 5-4) is used to determine wind corrections based on total time of fall. For the LUU-1/B and the LUU-5/B the total time of fall is the sum of the ejection fuze setting plus the ignition fuze setting plus the time of fall after flare ignition based on a rate of descent of 15 feet per second. For the Mk 24 Mod 4 the time of fall from release to flare ignition is the sum of the ejection fuze setting plus the ignition fuze setting. After flare ignition use a correction factor of 350 feet per knot for the Mk 24. For the LUU-2 series, the level release tables provide wind correction factors to be used from release to flare ignition. After flare ignition, use a correction factor of 450 feet per knot for the LUU-2 series.

WIND CORRECTION CHART

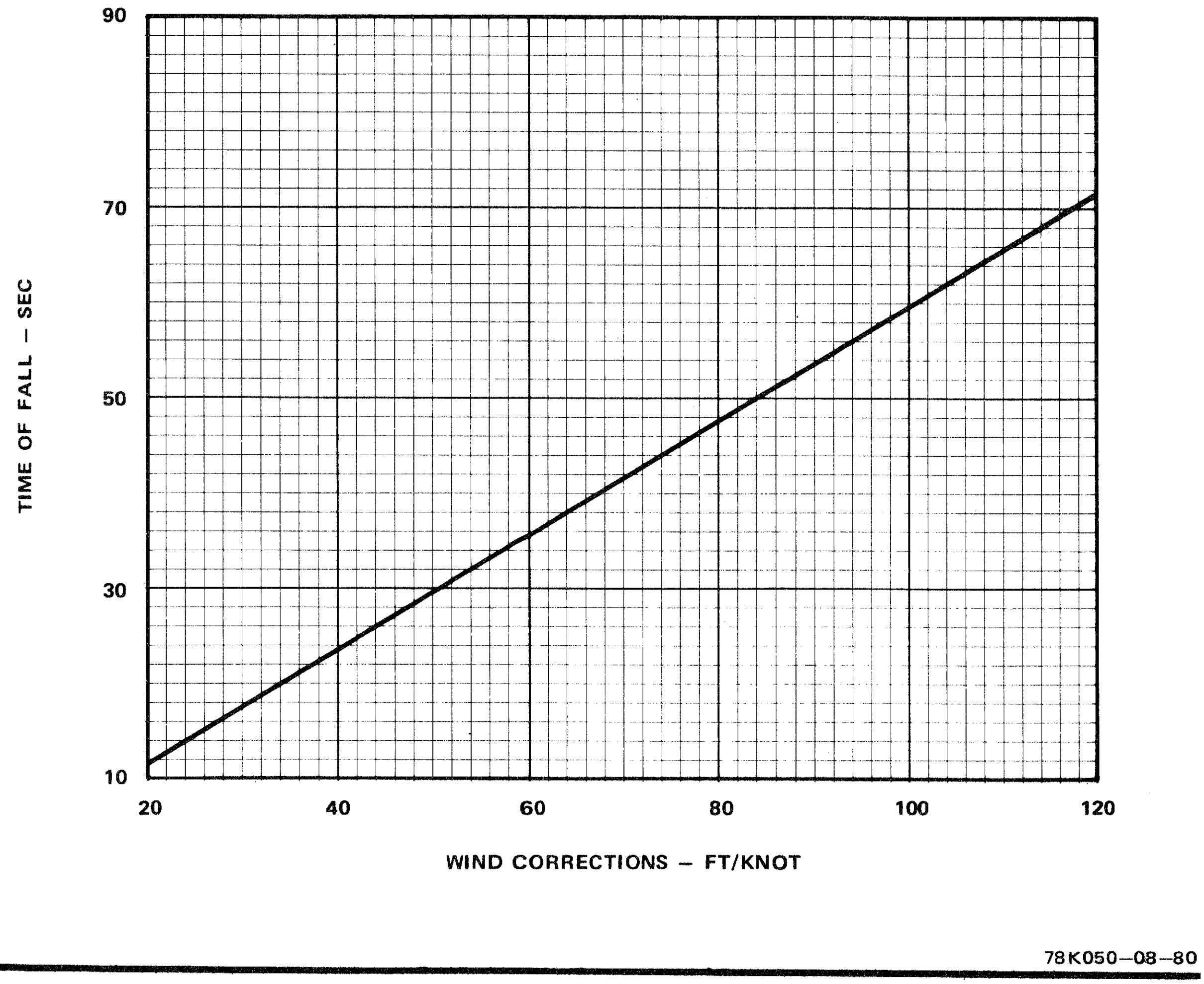

Figure 5-4

FLARE DELIVERY TABLES.

Mk 24 Mod 4 Flare.

The Mk 24 Mod 4 flare delivery tables in T.O. 1A-7K-34-1-2 provide the minimum release altitude AGL that will ensure flare burnout before impact. The desired burnout altitude AGL must be added to the minimum release altitude AGL to determine the actual release altitude AGL. It is recommended that release altitude be planned to provide burnout of the flare from 300 to 1,000 feet above the ground. The flare delivery tables also provide the horizontal distance traveled and vertical drop of the flare prior to ignition. The flare ejection fuze delay time and the flare ignition fuze delay time are set according to the mission requirements and the data on the flare delivery table. To properly position the flare at ignition, rangewind effect and crosswind offset (feet) may be determined by multiplying the rangewind or crosswind component (knots) times 1.7 times the sum of the ejection and ignition fuze delay settings. The wind correction chart (figure 5-4) can be used for determining these wind corrections. During the burning time (approximately 210 seconds), the Mk 24 Mod 4 will drift 350 feet per knot of effective wind. Both of these corrections should be used. For example, for the Mk 24 Mod 4 flare assume a desired release altitude of 4,000 feet and desired burnout altitude of approximately 500 feet. Assume a release velocity of 400 KTAS. From the Mk 24 table, the timer settings, vertical drop, and horizontal range can be determined. For a release altitude of 4,000 feet and a burnout altitude of 500 feet, a vertical fall of 3,500 feet is required. From the table it can be determined that an ignition fuze setting of 10 seconds and an ejection fuze setting of 15 seconds is required. For a 15-second ejection fuze setting and 400 KTAS, the horizontal range is 2,380 feet. For these timer settings the vertical drop to flare ignition of 2,050 feet can be determined. Therefore, the flare will ignite at approximately 2,000 feet. For this example use the winds at 4,000 feet to correct for drift from release to flare ignition and use winds at 2,000 feet to correct for drift from flare ignition to burnout. Assume a 12-knot tailwind, and an 8-knot crosswind at release altitude. At flare ignition (2,000 feet) assume a 10-knot tailwind and a 5-knot crosswind. To correct for wind from release to flare ignition, add the ignition fuze setting (10 seconds) and the ejection fuze setting (15 seconds) to obtain a total time of 25 seconds. Enter the wind correction chart (figure 5-4) with 25 seconds to obtain a wind correction factor of 42 feet/knot. Since the Mk 24 Mod 4 will drift 350 feet per knot of wind, for a 10-knot tailwind and a 5-knot crosswind the flare will drift 3,500 feet downrange and 1,750 feet to the side of the target area. Therefore, it is desirable to ignite the flare 1,750 feet uprange (one half the distance the flare will drift while burning) and 875 feet to the side of the target area. Before ignition the flare will drift 504 feet downrange and 336 feet across. Therefore, to place the flare at ignition 1,750 feet uprange and 875 feet to the side, the flare must be released 4,974 feet uprange (2,720 + 1,750 + 504) and 1,211 feet (875 + 336) to the side of the target area.

LUU-1/B and LUU-5/B Target Marker Flare.

The level release tables for the LUU-1/B and LUU-5/B target marker flares in T.O. 1A-7K-34-1-2 provide horizontal travel and vertical drop prior to flare ignition for the available range of ejection and ignition fuze settings. During mission planning, a release altitude, an ejection fuze setting, and an ignition fuze setting must be selected that will assure flare ignition prior to ground impact. After flare ignition the flare has a rate of descent of approximately 15 feet per second. The total time of fall is the sum of the ejection fuze setting plus the ignition fuze setting plus the time of fall after ignition based on a rate of descent of 15 feet/second. The wind correction chart (figure 5-4) can be used for determining wind corrections.

LUU-2 Series Flare.

The level release tables for the LUU-2/B and LUU-2A/B flares in T.O. 1A-7K-34-1-2 provide horizontal travel prior to flare ignition for the available range of feet of fall fuze settings. The tables also provide wind correction factors from release to flare ignition. After flare ignition use a wind correction factor of 450 feet per knot for the LUU-2 series flare.

CBU-12/A BALLISTIC TABLES.

The sight depression angle values listed in the CBU-12/A bombing tables were computed to provide initial BLU-17/B impacts commencing 750 feet short of the aimpoint. The CBU-12/A tables also apply to the CBU-12A/A.

CBU-46/A BALLISTIC TABLES.

The sight depression angle values listed in the CBU-46/A bombing tables in T.O. 1A-7K-34-1-2 were computed to provide initial BLU-66/B impacts commencing 750 feet short of the aimpoint. A deflection error chart (figure 6-31) is used to determine the deflection error induced by the spin motion of the bomb after release. This deflection error is always to the left.

BLU-66/B (CBU-46/A) DEFLECTION CHART.

The characteristics of the BLU-66/B bomb causes the trajectory to shift to the left at an approximate 6:1 ratio. See figure 6-31.

CBU-30/A BALLISTIC TABLES.

With a munition of this type, the impact patterns for a single package are variable. For planning purposes, the size of the impact pattern for a single package is approximately 225 feet in range and 200 feet in deflection. The CBU-30/A ripple release tables in T.O. 1A-7K-34-1-2 list the total impact pattern length for 40-package (bombs per release) release at the various available SUU-13/A intervalometer settings. This impact pattern length is based on the distance between the mean point of impact for the first and last cluster release. The tabulated sight depression from flightpath values assume that the center of the pattern is to be aimed at the target.

NOTE

Since the bomblet will start to dispense smoke 5 to 6 seconds after release, release conditions which provide a time of flight of less than 6 seconds should be selected.

CBU-38A/A BALLISTIC TABLES.

The CBU-38A/A bombing tables are also applicable for the CBU-38/A, CBU-38B/A, and CBU-38C/A. However, when releasing the CBU-38/A, release conditions must be selected which will provide a time of flight greater than 6.5 seconds. For the dive release conditions, the time of fall of the last bomb must be checked. These values are contained in the bombing tables.

The CBU-38 bombing tables provide data for full dispenser ripple releases at release intervals of 0.05, 0.10 and 0.20 second. The bomb range listed in the tables represents the horizontal range from initial release to the center of the impact pattern. The impact pattern length listed in the ripple release tables for a 40-bay release represents the distance between the impact points of the first and last bombs released. A fixed dive angle aircraft flightpath, throughout the entire ripple release time cycle, was assumed in this computation.

ROCKET LAUNCH AND GUN FIRING TABLES.

Rocket launch tables are provided for the 2.75-inch folding fin aircraft rocket (FFAR) launched from any rocket launchers loaded on the aircraft, including the SUU-20 bomb and rocket dispenser. For the 2.75-inch rockets, tables are provided for the Mk 1, M151, WDU-4A/A, and WDU-13/A warheads. The gun firing tables are applicable for the 20mm nose gun.

The rocket launch and gun firing tables provide the time of flight, optical sight setting, slant range, horizontal range, and wind correction factors as a function of the following parameters:

Target density altitude.

Aircraft gross weight.

Launch or firing altitude above target.

Launch or firing indicated airspeed.

Dive angle.

For aircraft gross weights not included in the tables, a linear interpolation can be used to obtain optical sight setting, slant range, and horizontal range values. The optical sight setting values provided in these tables are the actual sight settings for zero wind and include the angle-of-attack correction.

The wind correction factors provide wind effect in feet per knot, which can be used to establish an upwind aimpoint, and in mils per knot, which can be used to correct the sight setting for rangewind (add the mil correction for headwind and subtract the mil correction for tailwind). When the wind effect in feet is used to correct for rangewind, subtract the wind effect distance from the horizontal range for headwind or offset the aimpoint beyond the target. Reverse the process for tailwind. For crosswind, the aircraft flightpath should be offset in the upwind direction to a distance equal to the wind effect distance.

When fuel tanks are carried on stations 3 and 6, the sight settings in the 20mm gun tables should be increased by 2 mils. When fuel tanks are carried on stations 3 and 6, the sight settings in the 2.75-inch FFAR tables should be increased by 8 mils.

RIPPLE RELEASE TABLES.

Ripple release tables are provided for the CBU-24B/B, CBU-49B/B, CBU-52B/B, CBU-58 series or CBU-71 series, and MK 20 Rockeye II.

The following data can be obtained from the ripple release tables for a specific release true airspeed, dive angle, first bomb release altitude above target, release interval, and number of bombs released:

Slant range from first bomb released to the center of the impact pattern in feet.

Horizontal range from the first bomb released to the center of the impact pattern in feet.

Time of fall of the first and last bombs in seconds.

Release altitude of the first and last bombs in feet.

Pattern length in feet. This value is the distance from the center of the pattern of the first cluster munition to the center of the pattern of the last cluster munition. Therefore, to obtain total pattern length, add the pattern length of a single release (obtained from the single release tables) to the pattern length in the ripple release tables.

Sight depression from flightpath measured from the release altitude of the first bomb to the center of the impact pattern in mils.

Wind correction factors: headwind and tailwind in mils per knot of wind, and crosswind in feet per knot of wind.

The patterns of the CBU-24/49/52/58/71 munitions have a doughnut shape. The bomblets form an outer ring with a void in the center. This ring is approximately 175 feet wide. Therefore, the diameter of the void in the pattern would be the pattern diameter of a single munition minus 350 feet.

SAMPLE PROBLEMS.

DIVE BOMBING SAMPLE PROBLEM.

Mission Condition.

The sample problem in figure 5-5 uses 45° dive release conditions for the M117 GP bomb using the M904 series nose fuze and follows the order outlined in the mission planning form (figure 6-1). A release indicated airspeed of 475 knots, a release altitude of 4,000 feet AGL, and a target height of 1,000 feet MSL are assumed. Item 4d of the mission planning form is the total weight of the external stores carried. Compute the fuel remaining over the target (item 6). Add this value to the sum of aircraft operating weight (item 5) and external weight (item 4d) to obtain gross weight over the target (item 7). The aircraft operating weight (item 5) includes the weight of the pylons and internal gun ammunition.

Obtain the following data from the weather forecaster:

Altimeter setting at target (item 9) .... 29.92 inches mercury

Release pressure altitude (item 14) ....5,000 feet

Release altitude temperature (item 15) .... −20°C

Wind velocity (item 22) .... 350° true 30 knots

Release Conditions.

The following charts are used to determine items 16, 17, 18, 20, and 21 and to verify that the planned release altitude of 4,000 feet AGL is sufficiently high to provide adequate time for fuze arming, ground clearance during recovery, and fragment envelope clearance.

Dive Recovery Chart, figure 6-2

Zero Sight Line Angle-of-Attack Chart, figure 6-4

Airspeed Conversion Chart, figure 6-3

Altimeter Position Error Correction Chart, figure 6-7

Required Fuze Safe Arming Time, figure 6-12

MISSION PLANNING FORM

sample

MISSION CONDITIONS

1. Delivery Mode .... *Dive Bombing*
2. Munitions and Unit Weight:
   a. Outboard Pylon .... — , — pounds
   b. Centerline Pylon .... *M-117* , *823* pounds
   c. Inboard Pylon .... — , — pounds
3. Type of Fuzing (Impact) (Delay) (VT)

	Nose	Tail
a. Type	*M-904*	*None*
b. Action	*Impact*	—
c. Functioning Delay	*0.10 Sec. Delay*	—
d. Arming Delay	*4 Sec.*	—

4. External Weight

	No	Items	Total Weight	
a. Outboard Pylon	—	—	—	pounds
b. Centerline Pylon	*8*	*823*	*6584*	pounds
c. Inboard Pylon	—	—	—	pounds
d. Totals	*8*		*6584*	pounds

5. Aircraft Operating Weight .... *20101* pounds
6. Fuel Remaining Over Target .... *5315* pounds
7. Aircraft Gross Weight Over Target .... *32000* pounds
   (add items 4d, 5 and 6)
8. Target Altitude Above MSL .... *1000* feet
9. Altimeter Setting at Target .... *29.92* in Hg
10. Approach Course to Target .... *040* ° True

RELEASE CONDITIONS

11. Release Indicated Airspeed .... *475* knots
12. Release Dive Angle .... *45* degrees
13. Release Altitude Above Target (AGL) .... *4000* feet
    NOTE: Must be sufficiently high to provide adequate time for fuze arming, ground clearance during recovery, and fragment envelope clearance.
14. Release Pressure Altitude .... *5000* feet
15. Release Altitude Temperature .... *-20* ° C
16. Release True Airspeed .... *480* knots
    (from KIAS – KTAS Chart)
17. Altitude Lost During Pullout .... *2700* feet
    (from Dive Recovery Chart)
18. Altimeter correction .... *+320* feet
    (from Altimeter Correction Chart)
19. Altimeter Lag .... *35* feet
    (from Altimeter Lag Chart)
20. Release Indicated Altitude .... *4715* feet
    (add items 8, 13, and 19 and subtract algebraically item 18)
21. Angle of Attack (Zero Sight Line Angle of Attack) .... *3* mils

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Figure 5-5 (Sheet 1)

MISSION PLANNING FORM

sample

WIND VALUES

22.	Forecast Wind	350 ° True	30	knots
23.	Relative Wind	310 ° True	30	knots
24.	Rangewind Component (head) ~~(tail)~~		19	knots
25.	Crosswind Component (left) ~~(right)~~		23	knots

DIVE AND LEVEL BOMBING CONDITIONS

26.	Bomb Time of Flight	6.05	seconds
27.	Bomb Range (Horizontal Range)	3370	feet
28.	Range Correction for Initial Impact(s) (Predetermined distance short of target for CBU or single fire bomb releases)	—	feet
29.	Range from Release to Target (items 27 and 28)	3370	feet
30.	Sight Depression from Flight Path (from tables or charts)	86	mils
31.	Headwind Correction Factor	1.51	mils/knot
32.	Tailwind Correction Factor	-1.48	mils/knot
33.	Crosswind Correction Factor	10.2	feet/knot
34.	Rangewind Correction to Sight Depression Angle (item 31 or 32 times item 24)	29	mils
35.	Crosswind Correction (item 33 times item 25)	235	feet
36.	Depressed Sight Setting (item 30 plus item 34 plus item 21)	118	mils
37.	Offset Aimpoint (left) (right) (item 35)	235	feet

ROCKET LAUNCH OR STRAFING CONDITIONS

38.	Time of Flight		seconds
39.	Release Slant Range		feet
40.	Release Horizontal Range		feet
41.	Sight Depression (No Wind)		mils
42.	Rangewind Correction Factor		mils/knot
43.	Crosswind Correction Factor		feet/knot
44.	Rangewind Correction to Sight Depression Angle (+ head) (– tail) (item 42 times item 24)		mils
45.	Depressed Sight Setting (item 41 plus item 44)		mils
46.	Crosswind Correction (item 43 times item 25)		feet

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Figure 5-5 (Sheet 2)

The release KIAS (item 11, 475 knots), dive angle (item 12, 45°), release altitude above ground (item 13, 4,000 feet), release pressure altitude (item 14, 5,000 feet), and release altitude temperature (item 15, −20°C) are recorded in the planning form. Use the airspeed conversion chart (figure 6-3) to determine release KTAS (item 16, 480 knots). Use the dive recovery chart (figure 6-2) to determine the altitude lost during pullout (item 17, 2,700 feet). Use the altimeter position error correction chart (figure 6-7) to determine altimeter correction (item 18, 320 feet).

NOTE

Since pressure (calibrated) altitude is equal to the sum of indicated altitude and the position error correction, a positive correction factor must be subtracted (and a negative correction factor added) to release pressure altitude to determine release indicated altitude.

Release indicated altitude (item 20) is the sum of the following items minus the positive position error:

Item 8, target altitude above MSL	1,000 feet
Item 13, release altitude above ground	4,000 feet
	5,000
Item 18, altimeter correction	− 320 feet
Release indicated altitude	4,680 feet

Use the zero sight line angle-of-attack chart (figure 6-4) to find the zero sight line angle of attack (item 21, 3 mils) and the relative wind vector chart (figure 6-9) to determine the release altitude rangewind and crosswind components.

Dive and Level Bombing Conditions.

Select the proper bombing table (table 1-4, sheet 9 of T.O. 1A-7K-34-1-2) for the planned 45° dive, 4,000 feet AGL, and 480 KTAS release condition; record bomb time of fall, bomb range, sight depression angle from flightpath, and wind correction factors in the planning form.

Item 26, bomb time of flight .... 6.05 seconds

Item 27, bomb range .... 3,370 feet

Item 30, sight depression from flightpath .... 86 mils

Item 31, headwind correction factor .... 1.52 mils per knot

Item 32, tailwind correction factor .... −1.48 mils per knot

Item 33, crosswind correction factor .... 10.2 feet per knot

Rangewind Correction.

Multiply the headwind/tailwind correction factor (item 31/32) by the rangewind component (item 24) 19 knots headwind to obtain the rangewind correction to sight depression angle (item 34).

$$1.52 \times 19 = 29 \text{ mils}$$

Sight Setting.

Add sight depression angle from flightpath (item 30), rangewind correction factor (item 34), and zero sight line angle of attack (item 21).

$$86 + 29 + (3) = 118 \text{ mils}$$

Offset Aimpoint.

Multiply the crosswind correction factor (item 33) by the release crosswind component (item 25) to obtain the crosswind correction (item 35).

$$10.2 \times 23 = 235 \text{ feet}$$

NOTE

For level releases, two columns of crosswind correction factors are listed. If the aircraft is assumed to be drifting with the wind, use the crosswind correction factor listed under drift. If a crab angle is used to maintain a ground track through the target, use the crosswind correction factor listed under crab. For low-drag items released at low altitudes, use of a crab angle to maintain a ground track through the target eliminates the need for the offset aimpoint.

To compute the single offset aimpoint for dive bombing, accomplish the following steps:

1. Obtain the winds at the desired levels and compute an average wind.

2. Determine the total wind correction by multiplying the wind velocity times the crosswind (feet per knot) factor obtained from the appropriate ballistics tables (item 33).

3. Offset directly into the wind from the target.

4. Release the ordnance with the tracking index on the computed aimpoint from any direction of attack (figure 5-2).

RIPPLE RELEASE BOMBING SAMPLE PROBLEM.

There are two modes of ripple release, computed ripple release and manual ripple release. Both modes require some mission planning; however, a sample problem for only the manual ripple is presented (see figure 5-6). When planning a computed ripple release, a desired bomb spacing which is not less than the minimum obtainable spacing should be selected. For the dive toss maneuver, the Dive Toss Ballistic Data tables (figures 6-18, 6-19, and 6-20) can be used to determine the minimum obtainable bomb spacing. For the constant dive release maneuver, the Minimum Release Intervals table (figure 6-24) and the Bomb Spacing for Manual Ripple Bombing charts (figures 6-21 and 6-22) can be used to determine the minimum spacing.

Manual Ripple Mode.

The manual ripple release sample problem will follow the order outlined in the mission planning form, figure 5-6. The procedures for computing items 1 through 25 for this sample problem are the same as the procedures in the dive bombing sample problem. Therefore, for items 1 through 25 only the mission planning form will be completed. Items 26 through 46 do not pertain to ripple release and will be left blank. For this sample problem, a four-bomb stick (item 47) will be assumed and an INTERVAL-FT selector setting of 180 feet (item 48) will be used. Use the Bomb Spacing for Manual Ripple Bombing Chart to obtain a release interval (item 49) of 257 milliseconds and a bomb impact spacing (item 50) of 78 feet. Compute the impact pattern length (item 51) by multiplying the bomb spacing (item 50) times the number of bombs minus one (N-1). For this problem pattern length (item 51) is 234 feet. Use the Altitude Loss During Ripple Release Chart to obtain the value of item 50, 325 feet. Use the bombing tables to obtain the values of items 54 through 57. The sight depression angle from flightpath (item 59) 142 mils, is determined from the appropriate sight depression chart. Enter the chart with release range to target center (item 58, 6,357 feet) (obtained by adding the horizontal range of the first bomb and one-half the pattern length) and project up to the release altitude of the first bomb (item 13, 5,000 feet) and across to sight depression angle from flightpath (142 mils). Total sight setting for no-wind is then obtained by adding the sight depression angle from flightpath and the zero sight line angle of attack. Rangewind corrections can then be made by adjusting the no-wind sight setting or by estimating an aimpoint based on the rangewind effect.

ROCKET FIRING SAMPLE PROBLEM.

Computational procedures for rocket firing are very similar to the procedures used in the planning of a bombing mission. Due to the similarity of bombing and rocket computational procedures, a completed mission planning form (figure 5-7) for FFAR mission is provided to illustrate the rocket planning procedures.

MISSION PLANNING FORM

sample

MISSION CONDITIONS

1. Delivery Mode . . . . *Ripple Release*
2. Munitions and Unit Weight:
   a. Outboard Pylon . . . . *—* , *—* pounds
   b. Centerline Pylon . . . . *GP M-117* , *823* pounds
   c. Inboard Pylon . . . . ____ , ____ pounds
3. Type of Fuzing (Impact) (Delay) (VT)

	Nose	Tail
a. Type	*M904*	*None*
b. Action	*Impact*	*—*
c. Functioning Delay	*0.10 Sec Delay*	*—*
d. Arming Delay	*4.0 Sec*	*—*

4. External Weight

	No	Items	Total Weight	
a. Outboard Pylon	*—*	*—*	*—*	pounds
b. Centerline Pylon	*4*	*823*	*3292*	pounds
c. Inboard Pylon	*—*	*—*	*—*	pounds
d. Totals	*4*		*3292*	pounds

5. Aircraft Operating Weight . . . . *20101* pounds
6. Fuel Remaining Over Target . . . . *8607* pounds
7. Aircraft Gross Weight Over Target . . . . *32000* pounds
   (add items 4d, 5 and 6)
8. Target Altitude Above MSL . . . . *1000* feet
9. Altimeter Setting at Target . . . . *29.92* in Hg
10. Approach Course to Target . . . . *040* ° True

RELEASE CONDITIONS

11. Release Indicated Airspeed . . . . *450* knots
12. Release Dive Angle . . . . *30* degrees
13. Release Altitude Above Target (AGL) . . . . *5000* feet
    NOTE: Must be sufficiently high to provide adequate time for fuze arming, ground clearance during recovery, and fragment envelope clearance.
14. Release Pressure Altitude . . . . *6000* feet
15. Release Altitude Temperature . . . . *-12* ° C
16. Release True Airspeed . . . . *480* knots
    (from KIAS – KTAS Chart)
17. Altitude Lost During Pullout . . . . *1325* feet
    (from Dive Recovery Chart)
18. Altimeter correction . . . . *+300* feet
    (from Altimeter Correction Chart)
19. Altimeter Lag . . . . *25* feet
    (from Altimeter Lag Chart)
20. Release Indicated Altitude . . . . *5725* feet
    (add items 8, 13, and 19 and subtract algebraically item 18)
21. Angle of Attack (Zero Sight Line Angle of Attack) . . . . *9* mils

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Figure 5-6 (Sheet 1)

MISSION PLANNING FORM

sample

WIND VALUES

22. Forecast Wind . . . . 350 ° True 30 knots
23. Relative Wind . . . . 310 ° True 30 knots
24. Rangewind Component (head) ~~(tail)~~ . . . . 19 knots
25. Crosswind Component (left) ~~(right)~~ . . . . 23 knots

DIVE AND LEVEL BOMBING CONDITIONS

26. Bomb Time of Flight . . . . ______ seconds
27. Bomb Range (Horizontal Range) . . . . ______ feet
28. Range Correction for Initial Impact(s) . . . . ______ feet
    (Predetermined distance short of target for CBU or single fire bomb releases)
29. Range from Release to Target . . . . ______ feet
    (items 27 and 28)
30. Sight Depression from Flight Path . . . . ______ mils
    (from tables or charts)
31. Headwind Correction Factor . . . . ______ mils/knot
32. Tailwind Correction Factor . . . . ______ mils/knot
33. Crosswind Correction Factor . . . . ______ feet/knot
34. Rangewind Correction to Sight Depression Angle . . . . ______ mils
    (item 31 or 32 times item 24)
35. Crosswind Correction . . . . ______ feet
    (item 33 times item 25)
36. Depressed Sight Setting . . . . ______ mils
    (item 30 plus item 34 plus item 21)
37. Offset Aimpoint (left) (right). . . . . ______ feet
    (item 35)

ROCKET LAUNCH OR STRAFING CONDITIONS

38. Time of Flight . . . . ______ seconds
39. Release Slant Range . . . . ______ feet
40. Release Horizontal Range . . . . ______ feet
41. Sight Depression (No Wind). . . . . ______ mils
42. Rangewind Correction Factor . . . . ______ mils/knot
43. Crosswind Correction Factor . . . . ______ feet/knot
44. Rangewind Correction to Sight Depression Angle (+ head) (− tail) . . . ______ mils
    (item 42 times item 24)
45. Depressed Sight Setting . . . . ______ mils
    (item 41 plus item 44)
46. Crosswind Correction . . . . ______ feet
    (item 43 times item 25)

78K071(2)–08–80

Figure 5-6 (Sheet 2)

MISSION PLANNING FORM

sample

RIPPLE RELEASE BOMBING CONDITIONS

47. Number of Bombs to be Released 4
48. INTERVAL-FT Selector Setting . . . . 180 feet
49. Release Interval . . . . 257 milliseconds
    (from Bomb Spacing for Manual Ripple Bombing Chart)
50. Bomb Impact Spacing . . . . 78 feet
    (from Bomb Spacing for Manual Ripple Bombing Chart)
51. Impact Pattern Length . . . . 234 feet
    PL = BS (N−1)
52. Altitude Loss During Ripple Release . . . . 325 feet
    (from Altitude Loss During Ripple Release Chart)
53. Altitude of Last Bomb Released (A_L) . . . . 4675 feet
    (item 13 minus item 52)
    NOTE: Must be sufficiently high to provide adequate time for fuze arming, ground clearance during recovery, and fragment envelope clearance.
54. Range of First Bomb Impact . . . . 6240 feet
    (from tables)
55. Headwind Correction Factor . . . . 1.24 mils/knot
    (from first bomb released)
56. Tailwind Correction Factor . . . . -1.20 mils/knot
    (from first bomb released)
57. Crosswind Correction Factor . . . . 15.5 feet/knot
    (from first bomb released)
58. Range from Release to Target . . . . 6357 feet
    (item 54 plus one-half item 51)
59. Sight Depression from Flight Path . . . . 142 mils
    (from charts)
60. Rangewind Correction to Sight Depression Angle . . . . 23.6 mils
    (item 55 or 56 times item 24)
61. Crosswind Correction . . . . 357 feet
    (item 57 times item 25)
62. Depressed Sight Setting . . . . 175 mils
    (item 59 plus item 21 plus item 60)
63. Offset Aimpoint (left) (right) . . . . 357 feet
    (item 61)

78K071(3)–08–80

Figure 5-6 (Sheet 3)

MISSION PLANNING FORM

sample

MISSION CONDITIONS

1. Delivery Mode . . . . Rocket Firing
2. Munitions and Unit Weight:
   a. Outboard Pylon . . . . LAU-3/A, 427 pounds
   b. Centerline Pylon . . . . LAU-3/A, 427 pounds
   c. Inboard Pylon . . . . —, — pounds
3. Type of Fuzing (Impact) (Delay) (VT) — Nose / Tail
   a. Type . . . . MK 176, None
   b. Action . . . . Impact, —
   c. Functioning Delay . . . . Integral, —
   d. Arming Delay . . . . Integral, —
4. External Weight — No / Items / Total Weight
   a. Outboard Pylon . . . . 2, 427, 854 pounds
   b. Centerline Pylon . . . . 2, 427, 854 pounds
   c. Inboard Pylon . . . . —, —, ____ pounds
   d. Totals . . . . 4, 1708 pounds
5. Aircraft Operating Weight . . . . 20101 pounds
6. Fuel Remaining Over Target . . . . 6191 pounds
7. Aircraft Gross Weight Over Target . . . . 28000 pounds
   (add items 4d, 5 and 6)
8. Target Altitude Above MSL . . . . 1000 feet
9. Altimeter Setting at Target . . . . 29.92 in Hg
10. Approach Course to Target . . . . 040 ° True

RELEASE CONDITIONS

11. Release Indicated Airspeed . . . . 440 knots
12. Release Dive Angle . . . . 45 degrees
13. Release Altitude Above Target (AGL) . . . . 3000 feet
    NOTE: Must be sufficiently high to provide adequate time for fuze arming, ground clearance during recovery, and fragment envelope clearance.
14. Release Pressure Altitude . . . . 4000 feet
15. Release Altitude Temperature . . . . 30 ° C
16. Release True Airspeed . . . . 480 knots
    (from KIAS – KTAS Chart)
17. Altitude Lost During Pullout . . . . 2700 feet
    (from Dive Recovery Chart)
18. Altimeter correction . . . . +280 feet
    (from Altimeter Correction Chart)
19. Altimeter Lag . . . . 35 feet
    (from Altimeter Lag Chart)
20. Release Indicated Altitude . . . . 3755 feet
    (add items 8, 13, and 19 and subtract algebraically item 18)
21. Angle of Attack (Zero Sight Line Angle of Attack) . . . . ____ mils

78K070(1)–08–80

Figure 5-7 (Sheet 1)

MISSION PLANNING FORM

sample

WIND VALUES

22.	Forecast Wind	350	° True	30	knots
23.	Relative Wind	310	° True	30	knots
24.	Rangewind Component (head) ~~(tail)~~			19	knots
25.	Crosswind Component (left) ~~(right)~~			23	knots

DIVE AND LEVEL BOMBING CONDITIONS

26.	Bomb Time of Flight	______	seconds
27.	Bomb Range (Horizontal Range)	______	feet
28.	Range Correction for Initial Impact(s) (Predetermined distance short of target for CBU or single fire bomb releases)	______	feet
29.	Range from Release to Target (items 27 and 28)	______	feet
30.	Sight Depression from Flight Path (from tables or charts)	______	mils
31.	Headwind Correction Factor	______	mils/knot
32.	Tailwind Correction Factor	______	mils/knot
33.	Crosswind Correction Factor	______	feet/knot
34.	Rangewind Correction to Sight Depression Angle (item 31 or 32 times item 24)	______	mils
35.	Crosswind Correction (item 33 times item 25)	______	feet
36.	Depressed Sight Setting (item 30 plus item 34 plus item 21)	______	mils
37.	Offset Aimpoint (left) (right) (item 35)	______	feet

ROCKET LAUNCH OR STRAFING CONDITIONS

38.	Time of Flight	1.97	seconds
39.	Release Slant Range	4184	feet
40.	Release Horizontal Range	2916	feet
41.	Sight Depression (No Wind)	20	mils
42.	Rangewind Correction Factor	0.6	mils/knot
43.	Crosswind Correction Factor	3	feet/knot
44.	Rangewind Correction to Sight Depression Angle (+ head) (– tail) (item 42 times item 24)	11	mils
45.	Depressed Sight Setting (item 41 plus item 44)	31	mils
46.	Crosswind Correction (item 43 times item 25)	69	feet

78K070(2)–08–80

Figure 5-7 (Sheet 2)

SECTION VI
PLANNING CHARTS

TABLE OF CONTENTS.

MISSION PLANNING FORM

MISSION CONDITIONS

1. Delivery Mode . . . . ____________
2. Munitions and Unit Weight:
   a. Outboard Pylon . . . . ____________ , ____________ pounds
   b. Centerline Pylon . . . . ____________ , ____________ pounds
   c. Inboard Pylon . . . . ____________ , ____________ pounds
3. Type of Fuzing (Impact) (Delay) (VT) — Nose, Tail
   a. Type . . . . ____________ , ____________
   b. Action . . . . ____________ , ____________
   c. Functioning Delay . . . . ____________ , ____________
   d. Arming Delay . . . . ____________ , ____________
4. External Weight — No, Items, Total Weight
   a. Outboard Pylon . . . . ____________ , ____________ , ____________ pounds
   b. Centerline Pylon . . . . ____________ , ____________ , ____________ pounds
   c. Inboard Pylon . . . . ____________ , ____________ , ____________ pounds
   d. Totals . . . . ____________ ____________ pounds
5. Aircraft Operating Weight . . . . ____________ pounds
6. Fuel Remaining Over Target . . . . ____________ pounds
7. Aircraft Gross Weight Over Target . . . . ____________ pounds
   (add items 4d, 5 and 6)
8. Target Altitude Above MSL . . . . ____________ feet
9. Altimeter Setting at Target . . . . ____________ in Hg
10. Approach Course to Target . . . . ° True

RELEASE CONDITIONS

11. Release Indicated Airspeed . . . . ____________ knots
12. Release Dive Angle . . . . ____________ degrees
13. Release Altitude Above Target (AGL) . . . . ____________ feet
    NOTE: Must be sufficiently high to provide adequate time for fuze arming, ground clearance during recovery, and fragment envelope clearance.
14. Release Pressure Altitude . . . . ____________ feet
15. Release Altitude Temperature . . . . ____________ ° C
16. Release True Airspeed . . . . ____________ knots
    (from KIAS – KTAS Chart)
17. Altitude Lost During Pullout . . . . ____________ feet
    (from Dive Recovery Chart)
18. Altimeter correction . . . . ____________ feet
    (from Altimeter Correction Chart)
19. Altimeter Lag . . . . ____________ feet
    (from Altimeter Lag Chart)
20. Release Indicated Altitude . . . . ____________ feet
    (add items 8, 13, and 19 and subtract algebraically item 18)
21. Angle of Attack (Zero Sight Line Angle of Attack) . . . . ____________ mils

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Figure 6-1 (Sheet 1)

MISSION PLANNING FORM

WIND VALUES

22. Forecast Wind . . . . ________ ° True ________ knots
23. Relative Wind . . . . ________ ° True ________ knots
24. Rangewind Component (head) (tail) . . . . ________ knots
25. Crosswind Component (left) (right) . . . . ________ knots

DIVE AND LEVEL BOMBING CONDITIONS

26. Bomb Time of Flight . . . . ________ seconds
27. Bomb Range (Horizontal Range) . . . . ________ feet
28. Range Correction for Initial Impact(s) . . . . ________ feet
    (Predetermined distance short of target for CBU or single fire bomb releases)
29. Range from Release to Target . . . . ________ feet
    (items 27 and 28)
30. Sight Depression from Flight Path . . . . ________ mils
    (from tables or charts)
31. Headwind Correction Factor . . . . ________ mils/knot
32. Tailwind Correction Factor . . . . ________ mils/knot
33. Crosswind Correction Factor . . . . ________ feet/knot
34. Rangewind Correction to Sight Depression Angle . . . . ________ mils
    (item 31 or 32 times item 24)
35. Crosswind Correction . . . . ________ feet
    (item 33 times item 25)
36. Depressed Sight Setting . . . . ________ mils
    (item 30 plus item 34 plus item 21)
37. Offset Aimpoint (left) (right). . . . . ________ feet
    (item 35)

ROCKET LAUNCH OR STRAFING CONDITIONS

38. Time of Flight . . . . ________ seconds
39. Release Slant Range . . . . ________ feet
40. Release Horizontal Range . . . . ________ feet
41. Sight Depression (No Wind). . . . . ________ mils
42. Rangewind Correction Factor . . . . ________ mils/knot
43. Crosswind Correction Factor . . . . ________ feet/knot
44. Rangewind Correction to Sight Depression Angle (+ head) (— tail) . . . . ________ mils
    (item 42 times item 24)
45. Depressed Sight Setting . . . . ________ mils
    (item 41 plus item 44)
46. Crosswind Correction . . . . ________ feet

78K051(2)—08—80

Figure 6-1 (Sheet 2)

MISSION PLANNING FORM

RIPPLE RELEASE BOMBING CONDITIONS

47. Number of Bombs to be Released. . . . . ______________
48. INTERVAL-FT Selector Setting. . . . . ______________ feet
49. Release Interval . . . . ______________ milliseconds
    (from Bomb Spacing for Manual Ripple Bombing Chart)
50. Bomb Impact Spacing . . . . ______________ feet
    (from Bomb Spacing for Manual Ripple Bombing Chart)
51. Impact Pattern Length . . . . ______________ feet
    PL = BS (N–1)
52. Altitude Loss During Ripple Release. . . . . ______________ feet
    (from Altitude Loss During Ripple Release Chart)
53. Altitude of Last Bomb Released (A_L). . . . . ______________ feet
    (item 13 minus item 52)

    NOTE: Must be sufficiently high to provide adequate time for fuze arming, ground clearance during recovery, and fragment envelope clearance.
54. Range of First Bomb Impact . . . . ______________ feet
    (from tables)
55. Headwind Correction Factor . . . . ______________ mils/knot
    (from first bomb released)
56. Tailwind Correction Factor . . . . ______________ mils/knot
    (from first bomb released)
57. Crosswind Correction Factor . . . . ______________ feet/knot
    (from first bomb released)
58. Range from Release to Target . . . . ______________ feet
    (item 54 plus one-half item 51)
59. Sight Depression from Flight Path . . . . ______________ mils
    (from charts)
60. Rangewind Correction to Sight Depression Angle . . . . ______________ mils
    (item 55 or 56 times item 24)
61. Crosswind Correction . . . . ______________ feet
    (item 57 times item 25)
62. Depressed Sight Setting . . . . ______________ mils
    (item 59 plus item 21 plus item 60)
63. Offset Aimpoint (left) (right) . . . . ______________ feet
    (item 61)

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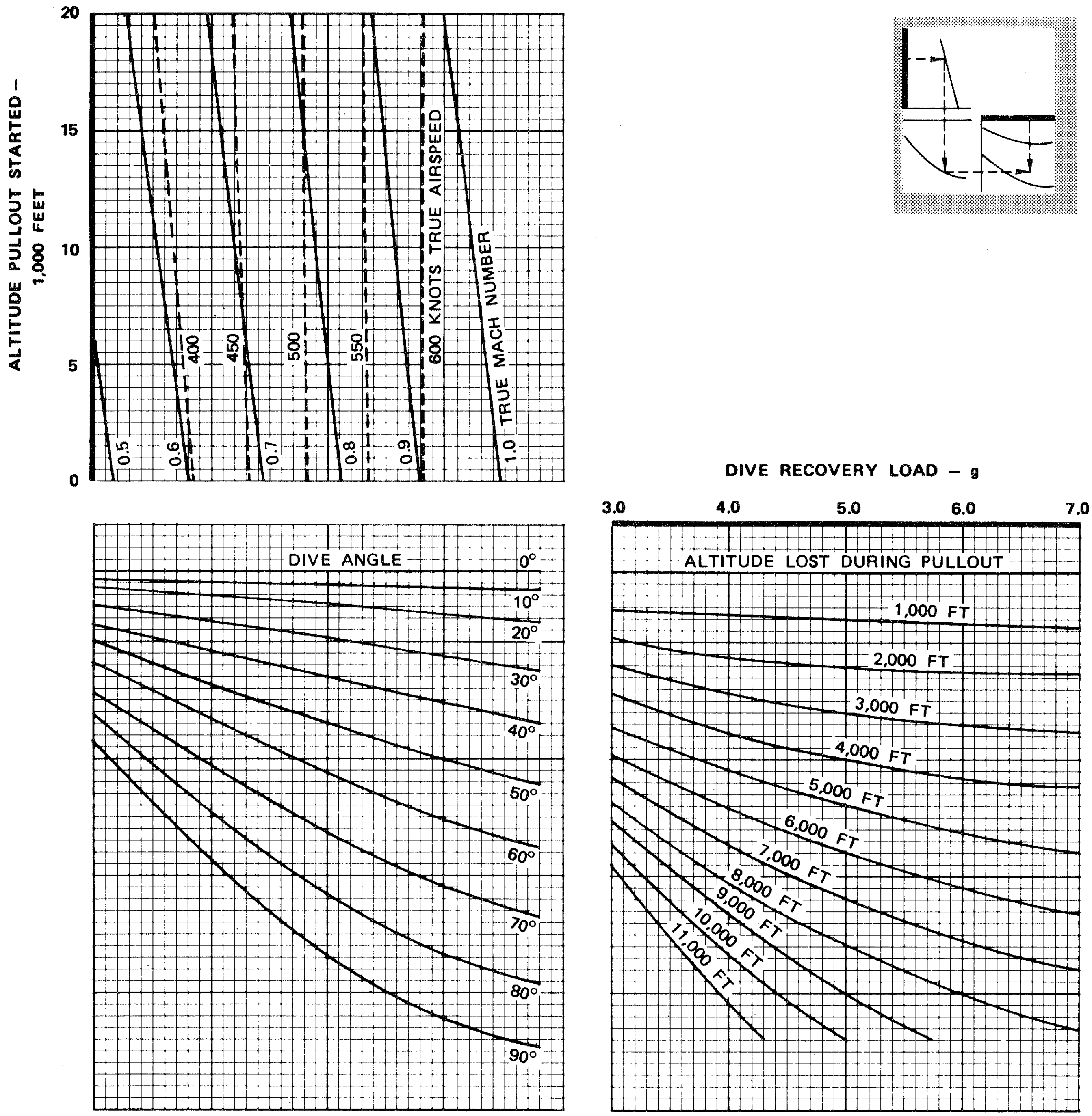
Figure 6-1 (Sheet 3)

DIVE RECOVERY CHART

SPEED BRAKE CLOSED

GROSS WEIGHT 29,570
TF41-A-1 ENGINE
DRAG COUNT 109
MILITARY RATED THRUST
STANDARD DAY



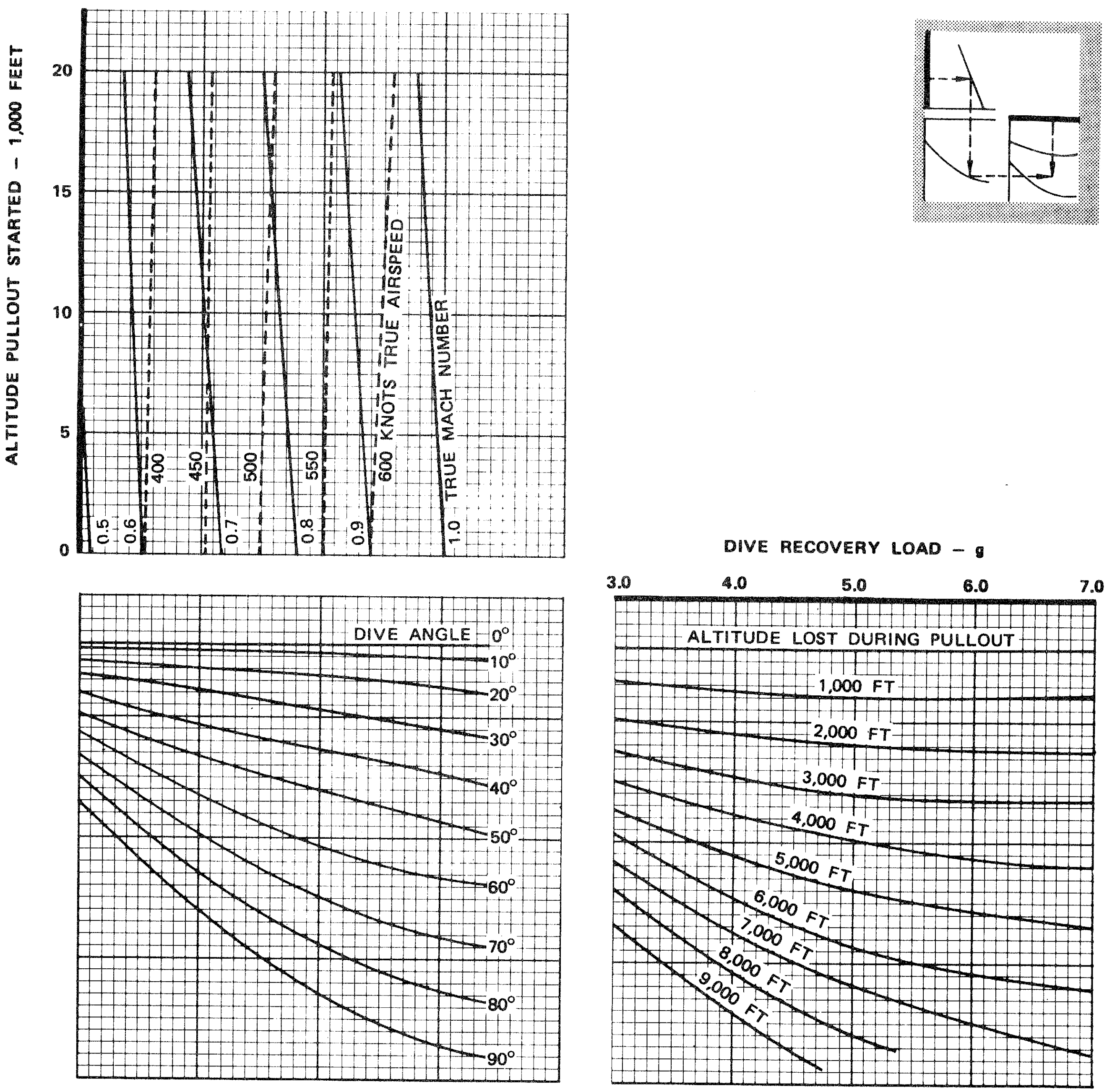
78K052(1)–08–80

Figure 6-2 (Sheet 1)

DIVE RECOVERY CHART

SPEED BRAKE EXTENDED 60°

GROSS WEIGHT 29,570
TF41-A-1 ENGINE
DRAG COUNT 109
MILITARY RATED THRUST
STANDARD DAY



78K052(2)–08–80

Figure 6-2 (Sheet 2)

AIRSPEED CONVERSION CHART

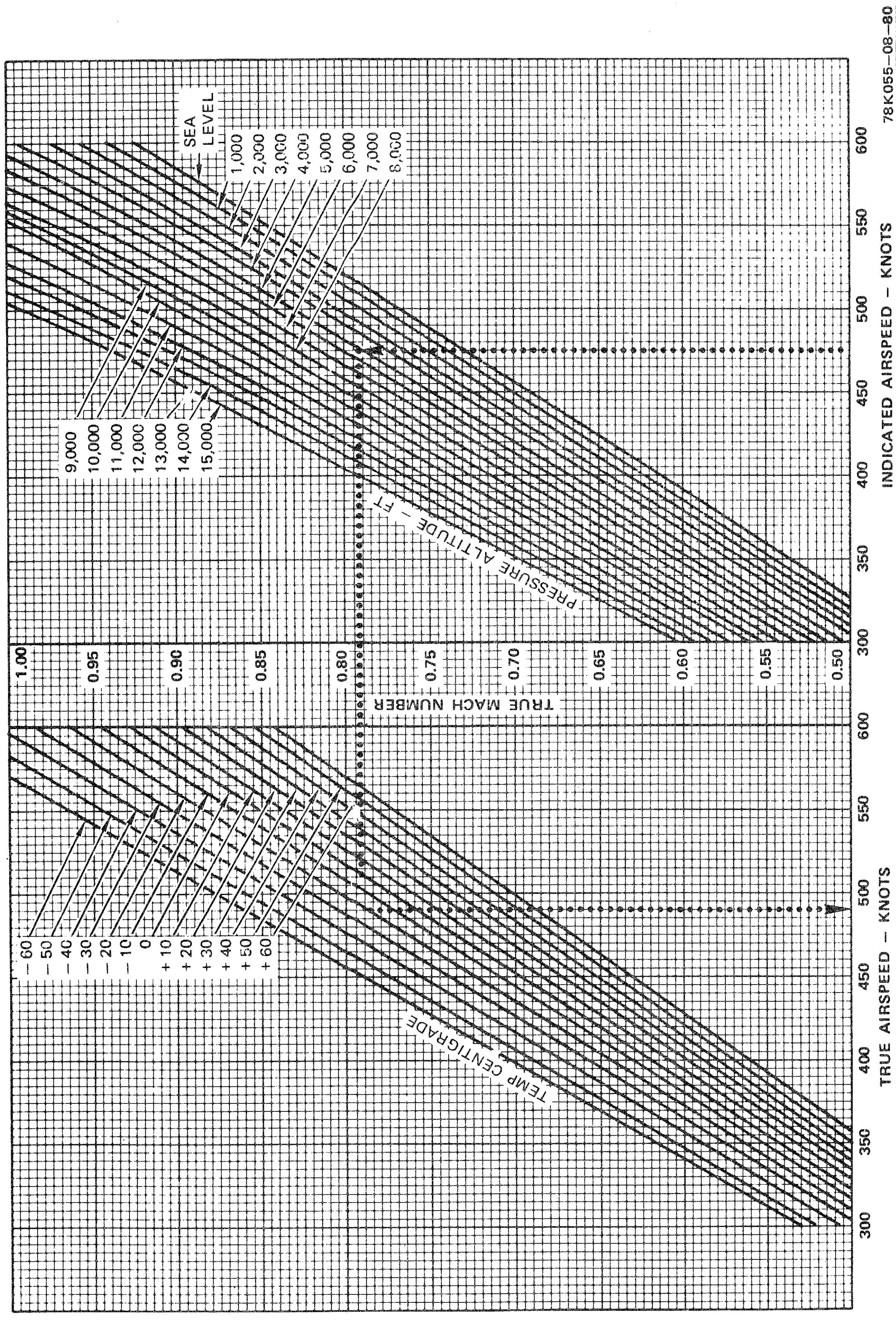


Figure 6-3

ZERO SIGHT LINE ANGLE OF ATTACK CHART

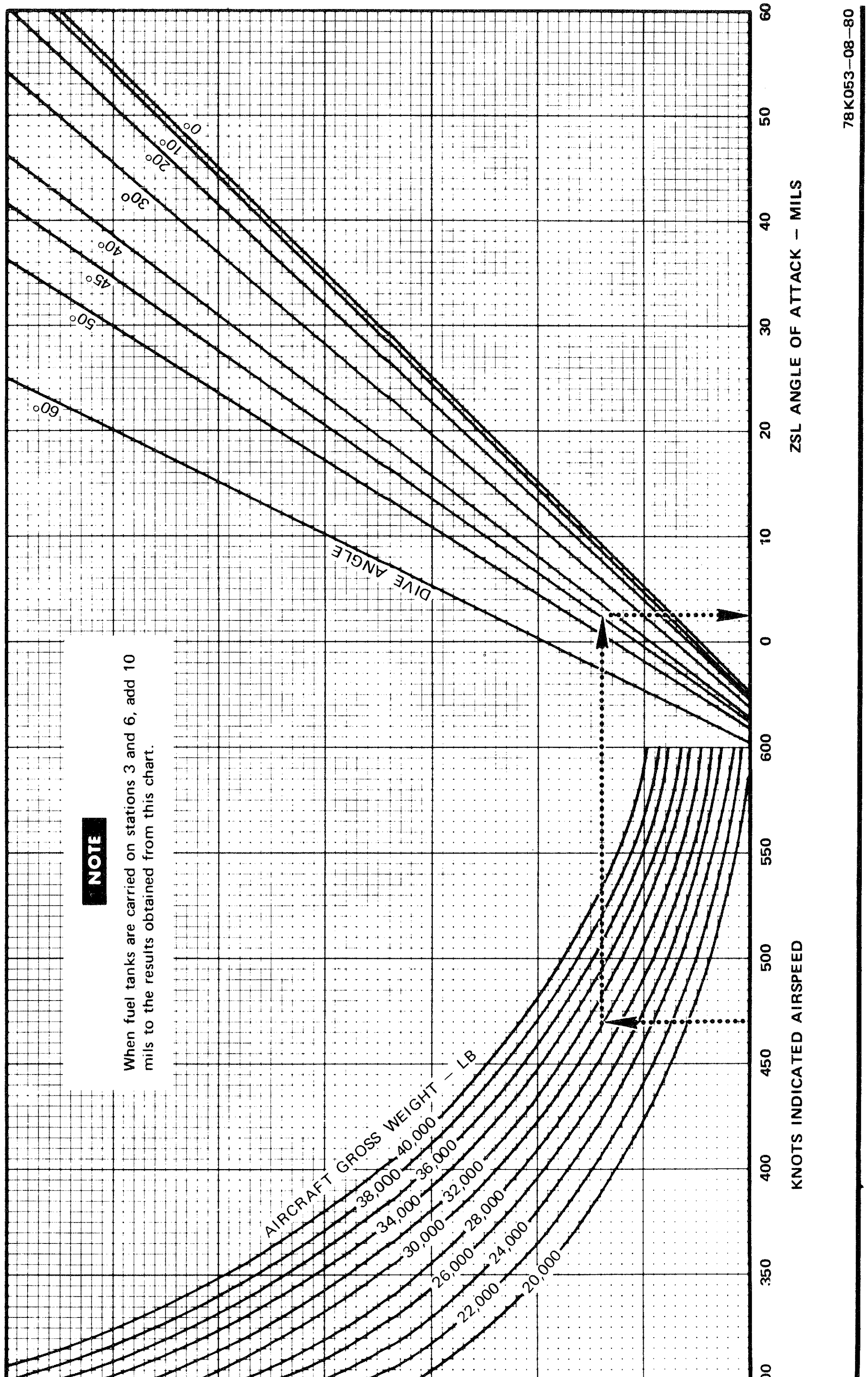


Figure 6-4

SIGHT DEPRESSION CHART

LEVEL RELEASE

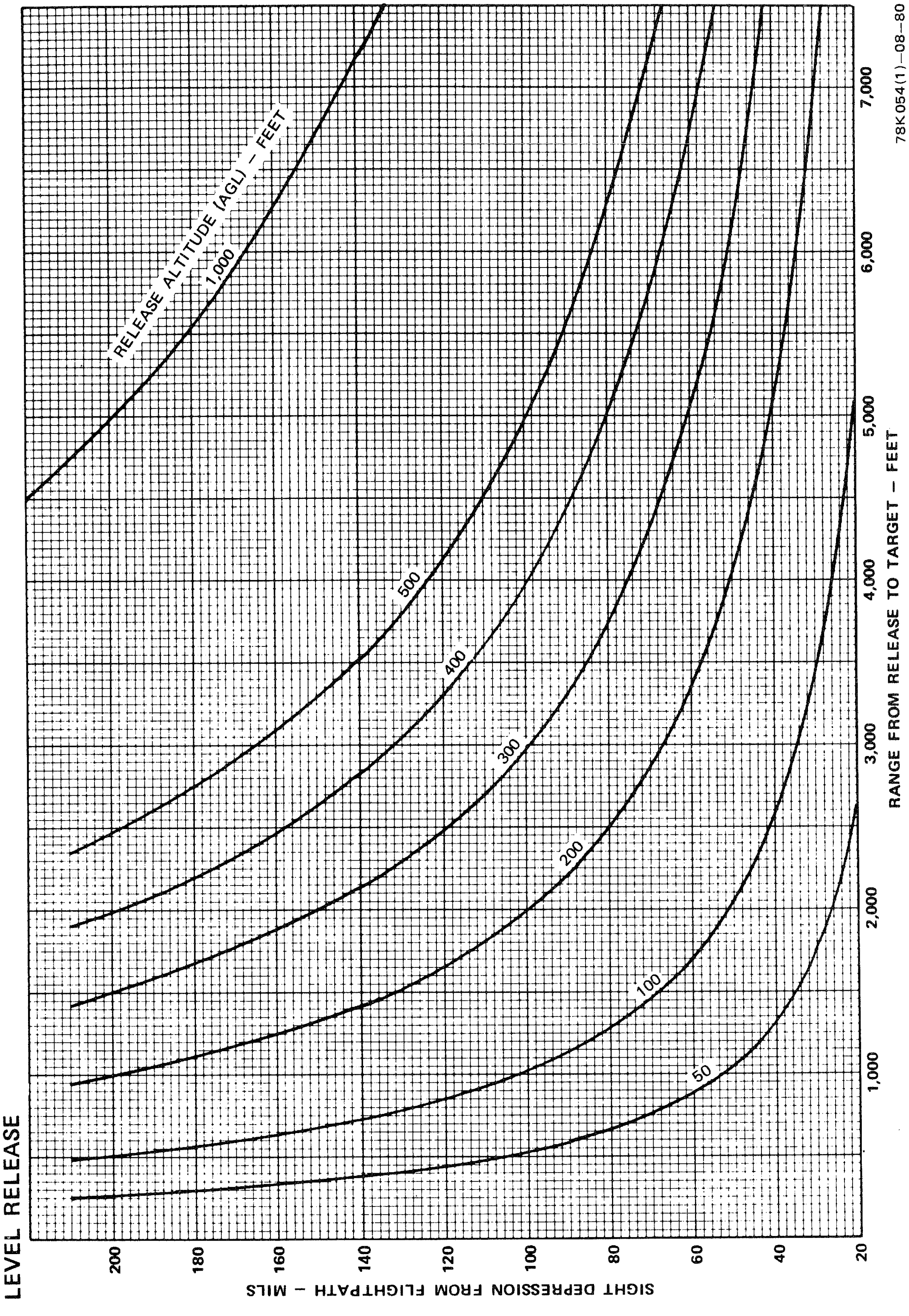


Figure 6-5 (Sheet 1)

SIGHT DEPRESSION CHART

5° DIVE RELEASE CONDITION

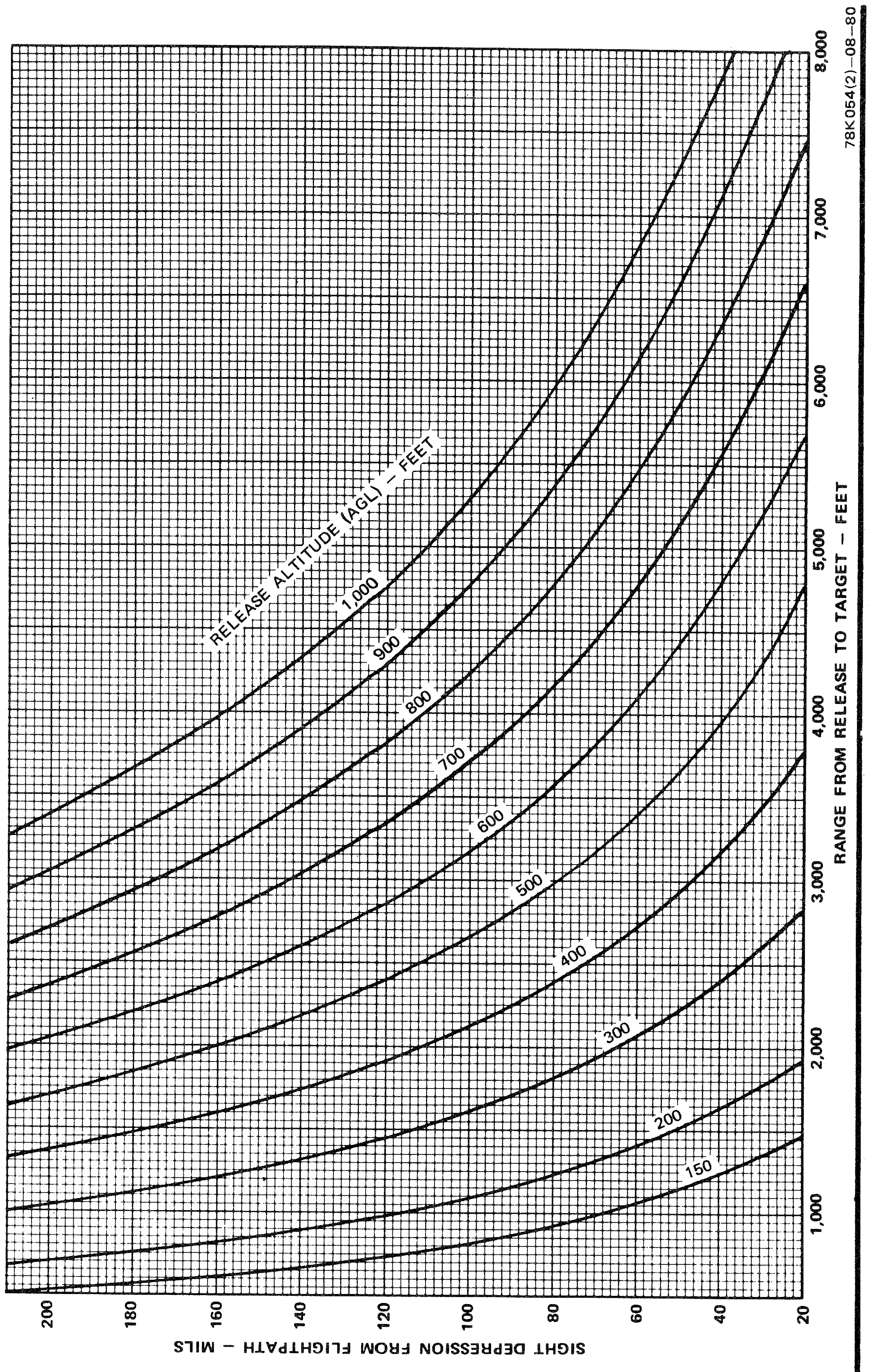


Figure 6-5 (Sheet 2)

SIGHT DEPRESSION CHART

10° DIVE RELEASE CONDITION

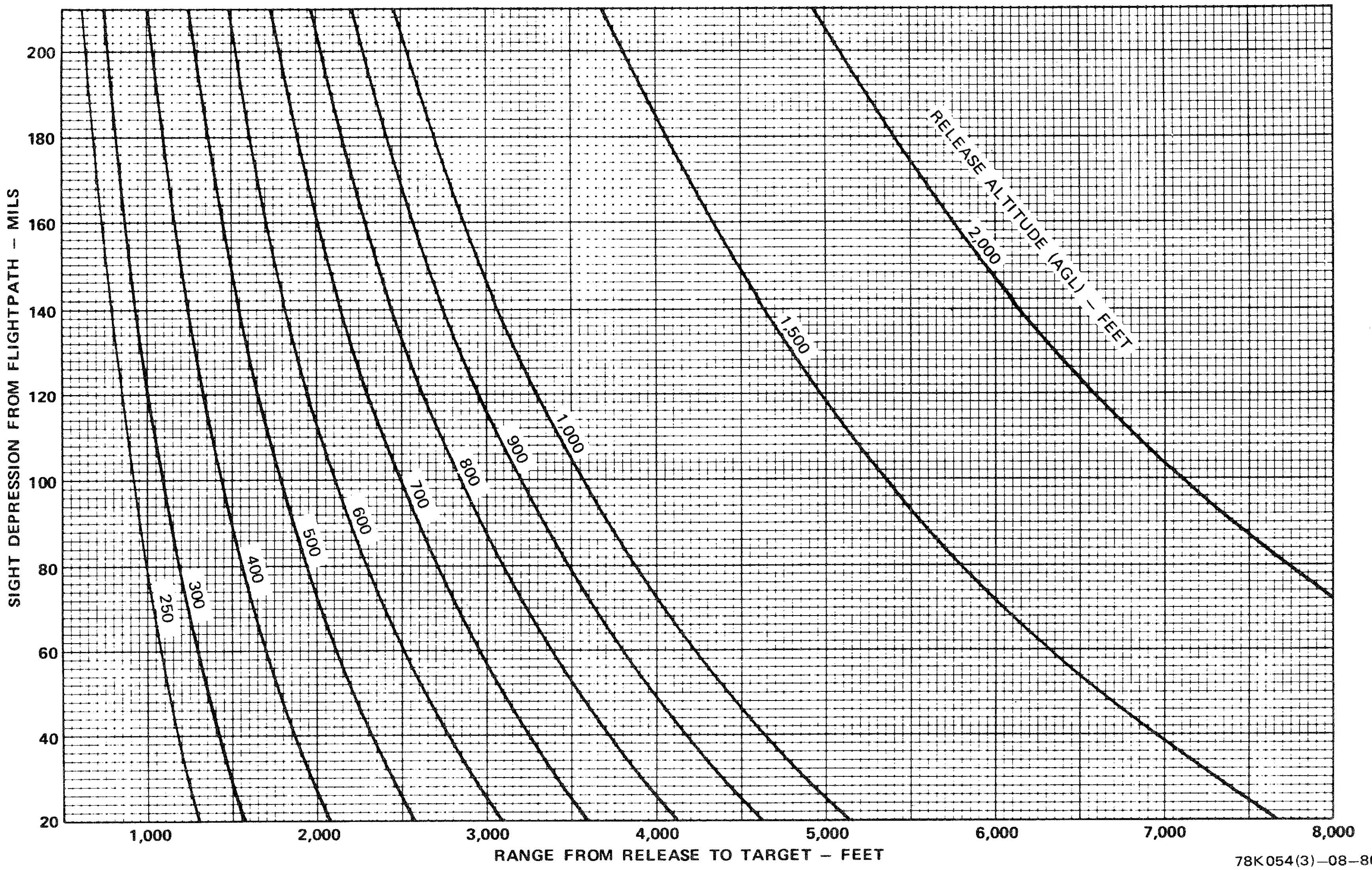


Figure 6-5 (Sheet 3)

15° DIVE RELEASE CONDITION

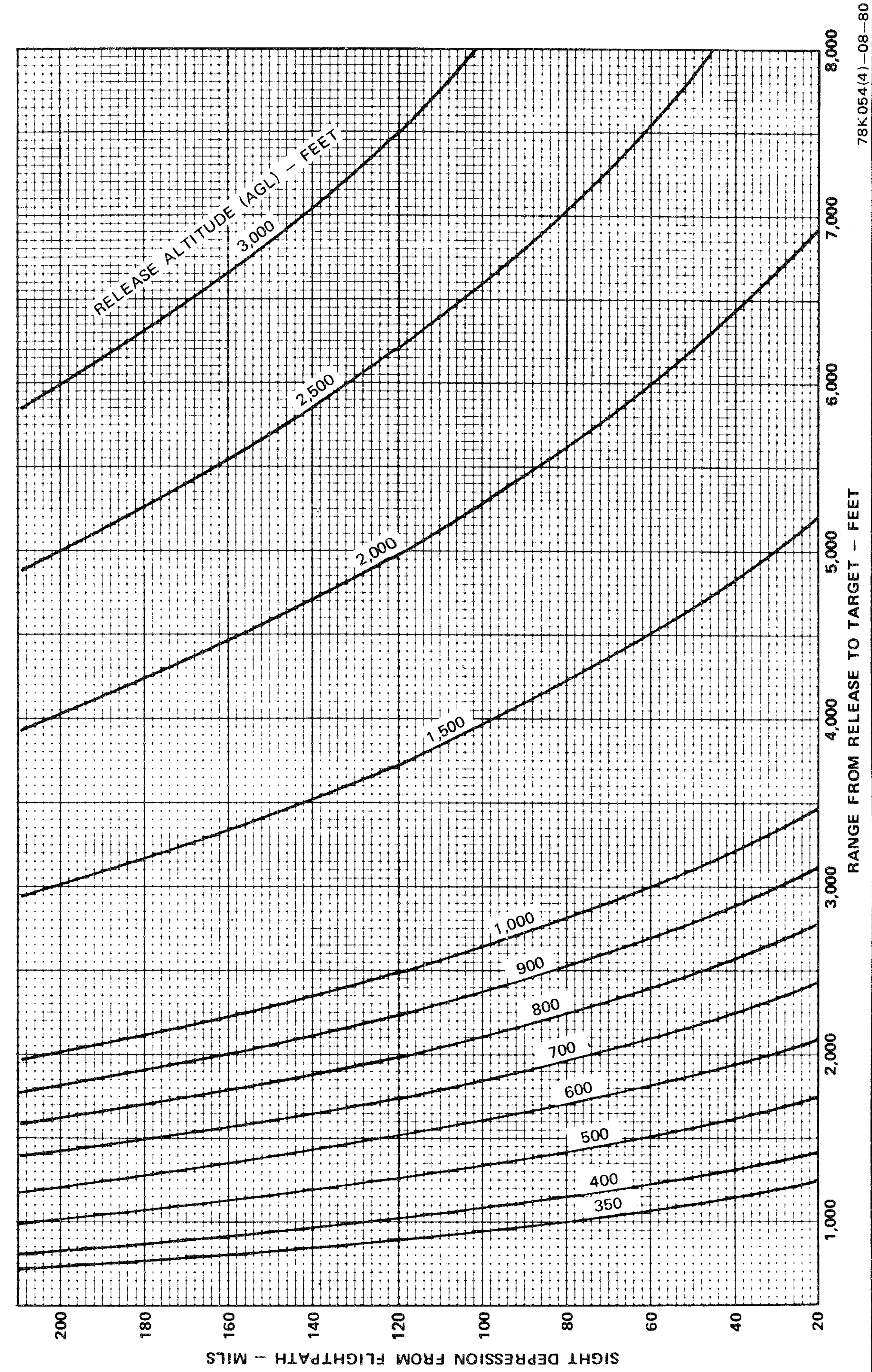


Figure 6-5 (Sheet 4)

SIGHT DEPRESSION CHART

20° DIVE RELEASE CONDITION

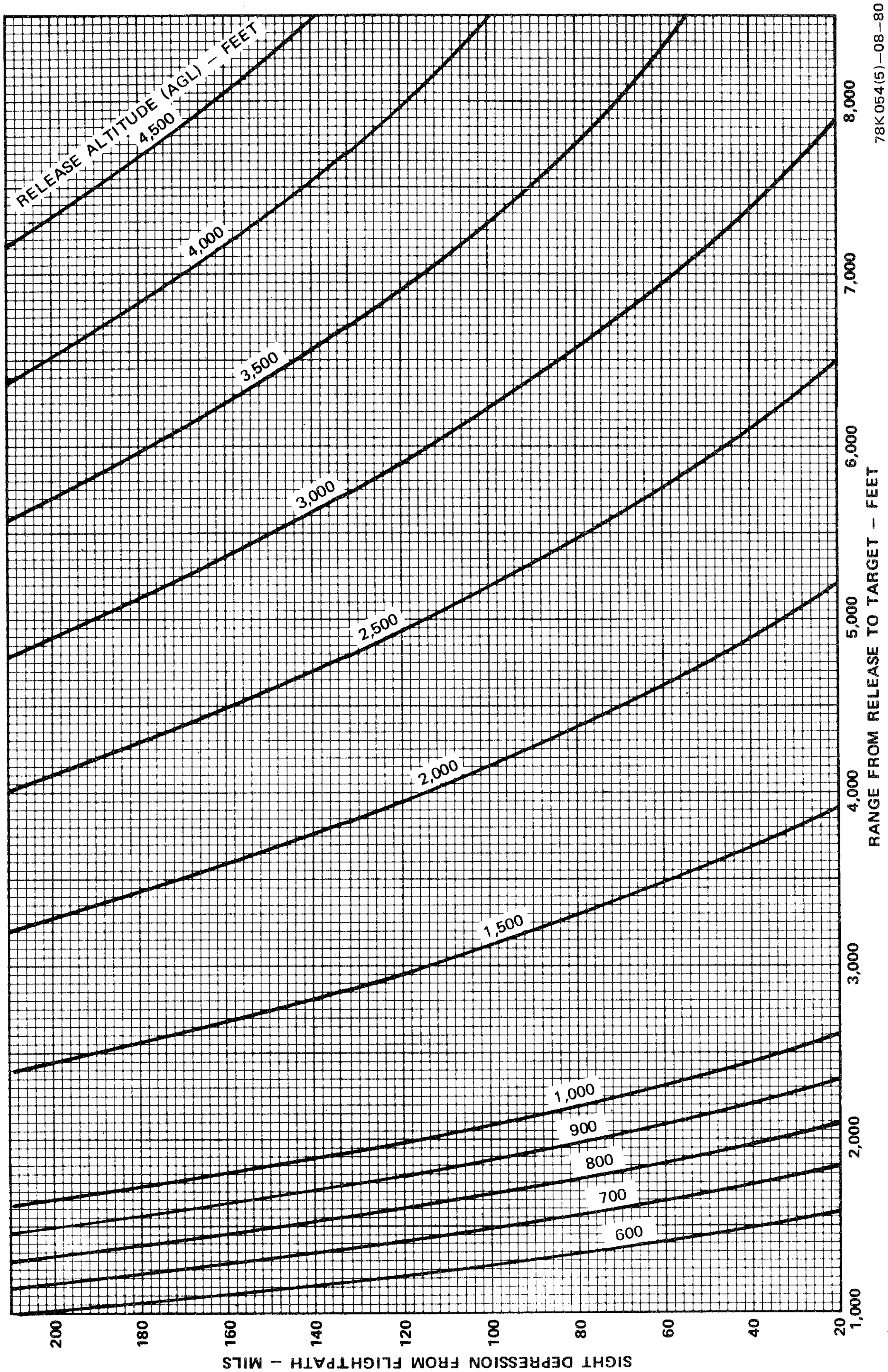


Figure 6-5 (Sheet 5)

SIGHT DEPRESSION CHART

25° DIVE RELEASE CONDITION

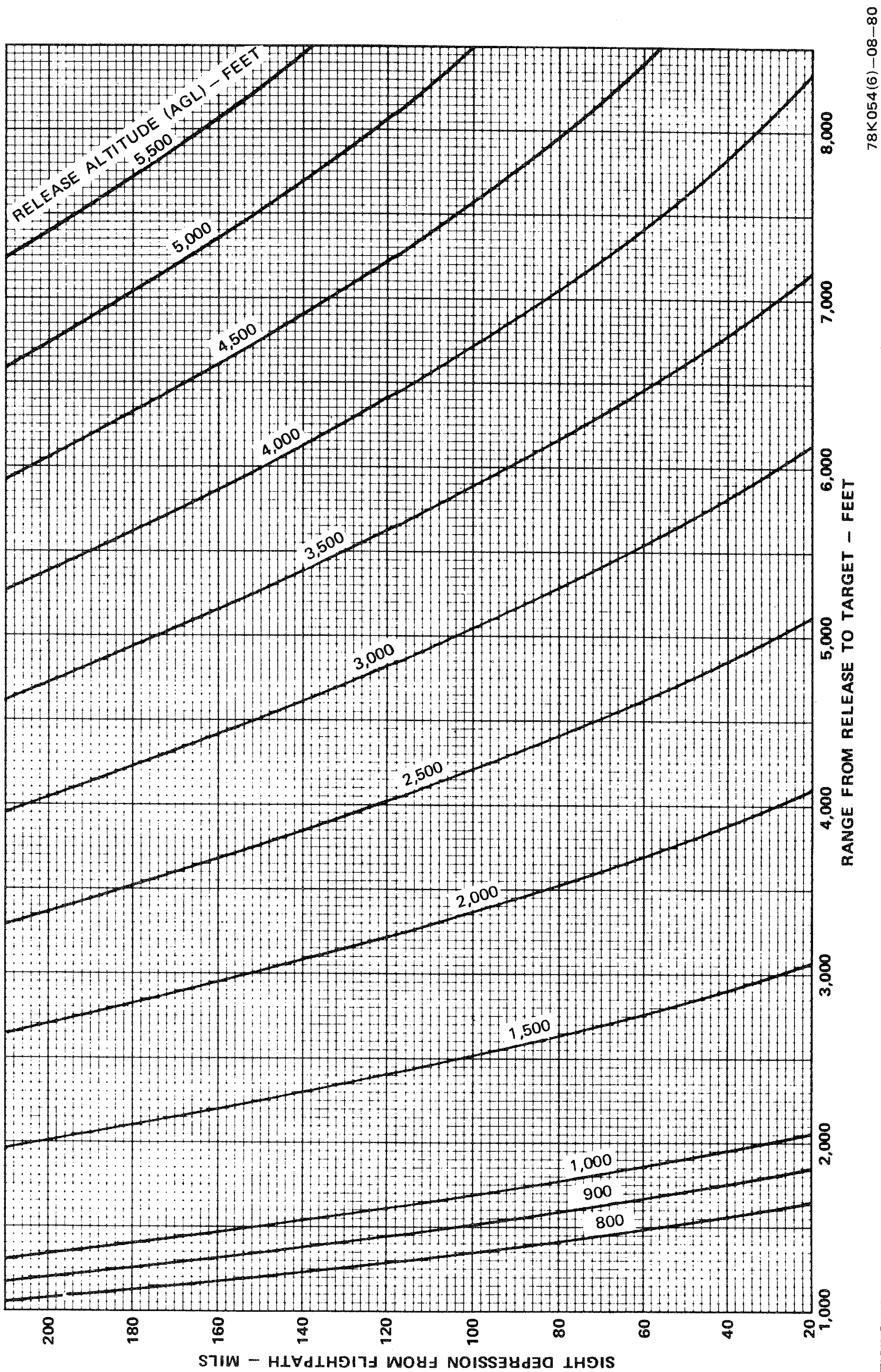


Figure 6-5 (Sheet 6)

SIGHT DEPRESSION CHART

30° DIVE RELEASE CONDITION

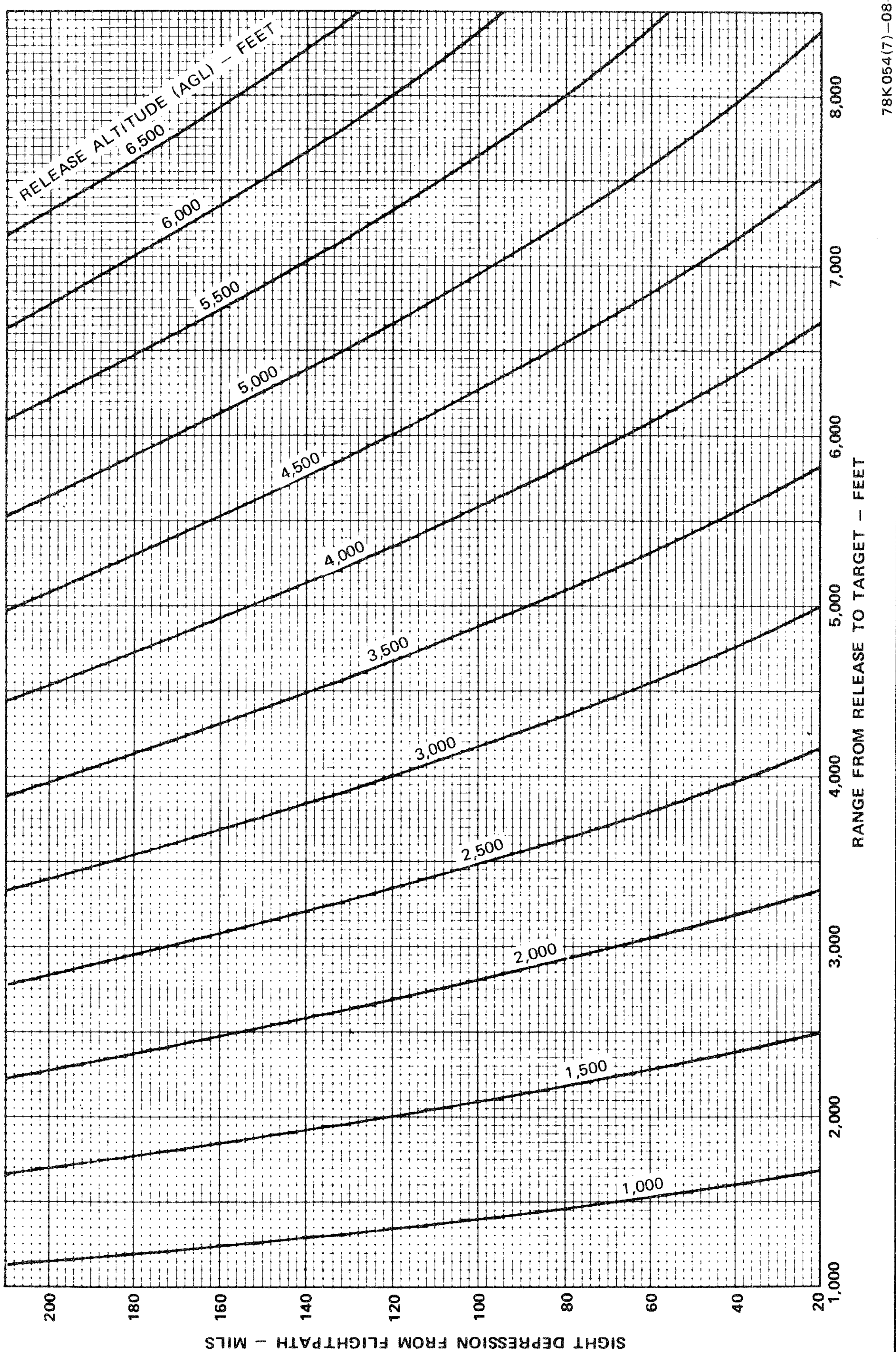


Figure 6-5 (Sheet 7)

SIGHT DEPRESSION CHART

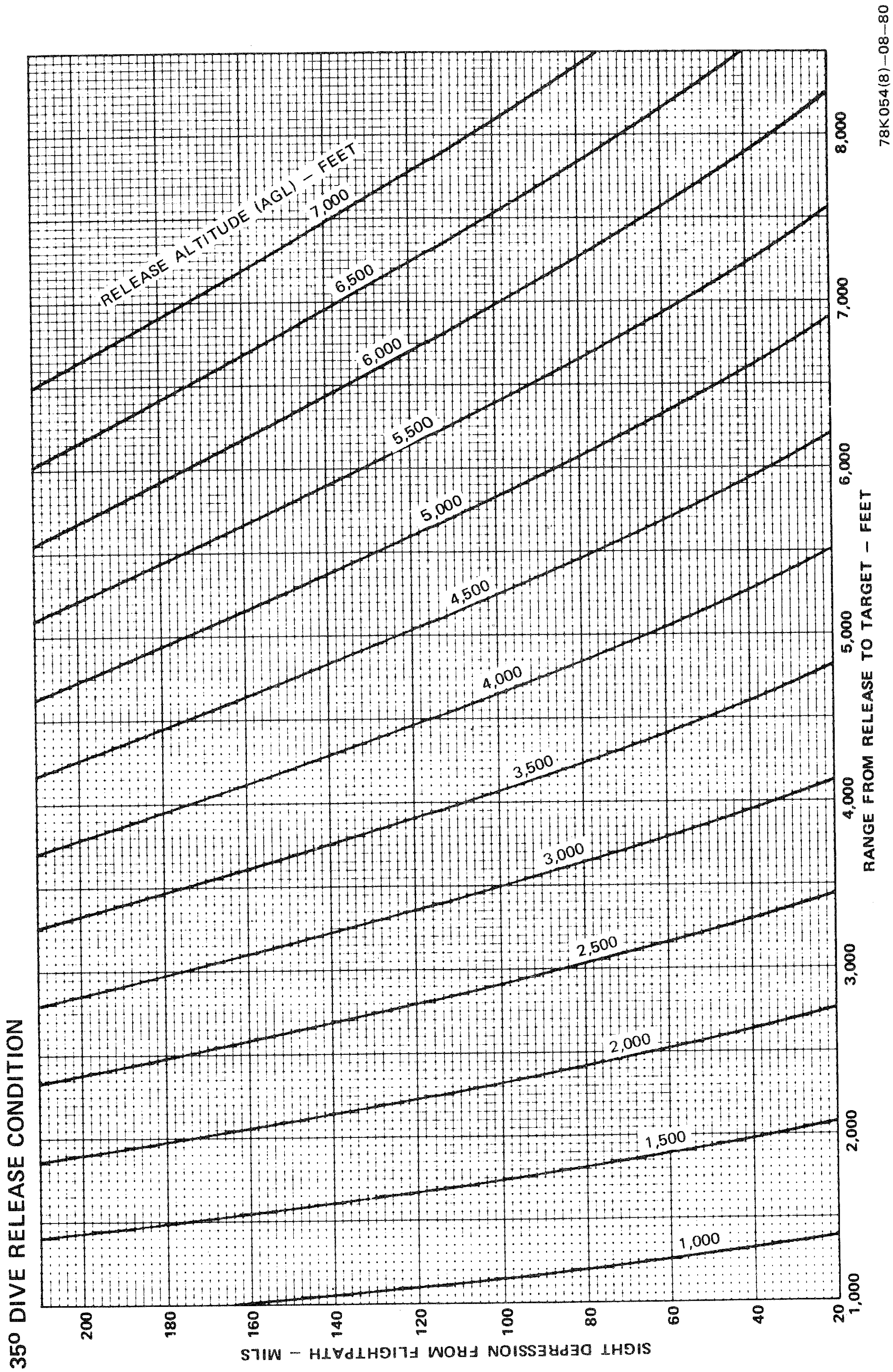


Figure 6-5 (Sheet 8)

SIGHT DEPRESSION CHART

40° DIVE RELEASE CONDITION

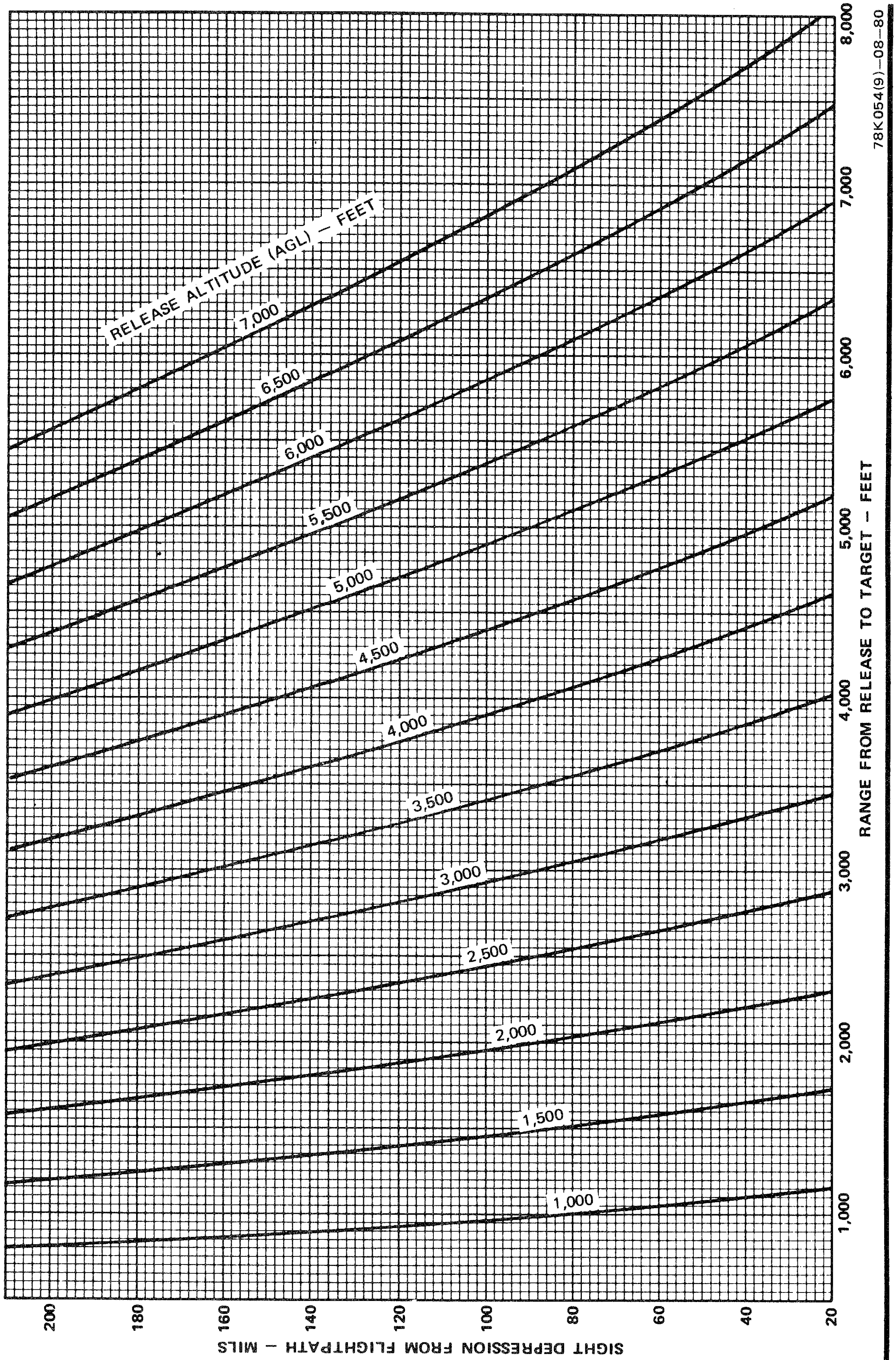


Figure 6-5 (Sheet 9)

SIGHT DEPRESSION CHART

45° DIVE RELEASE CONDITION

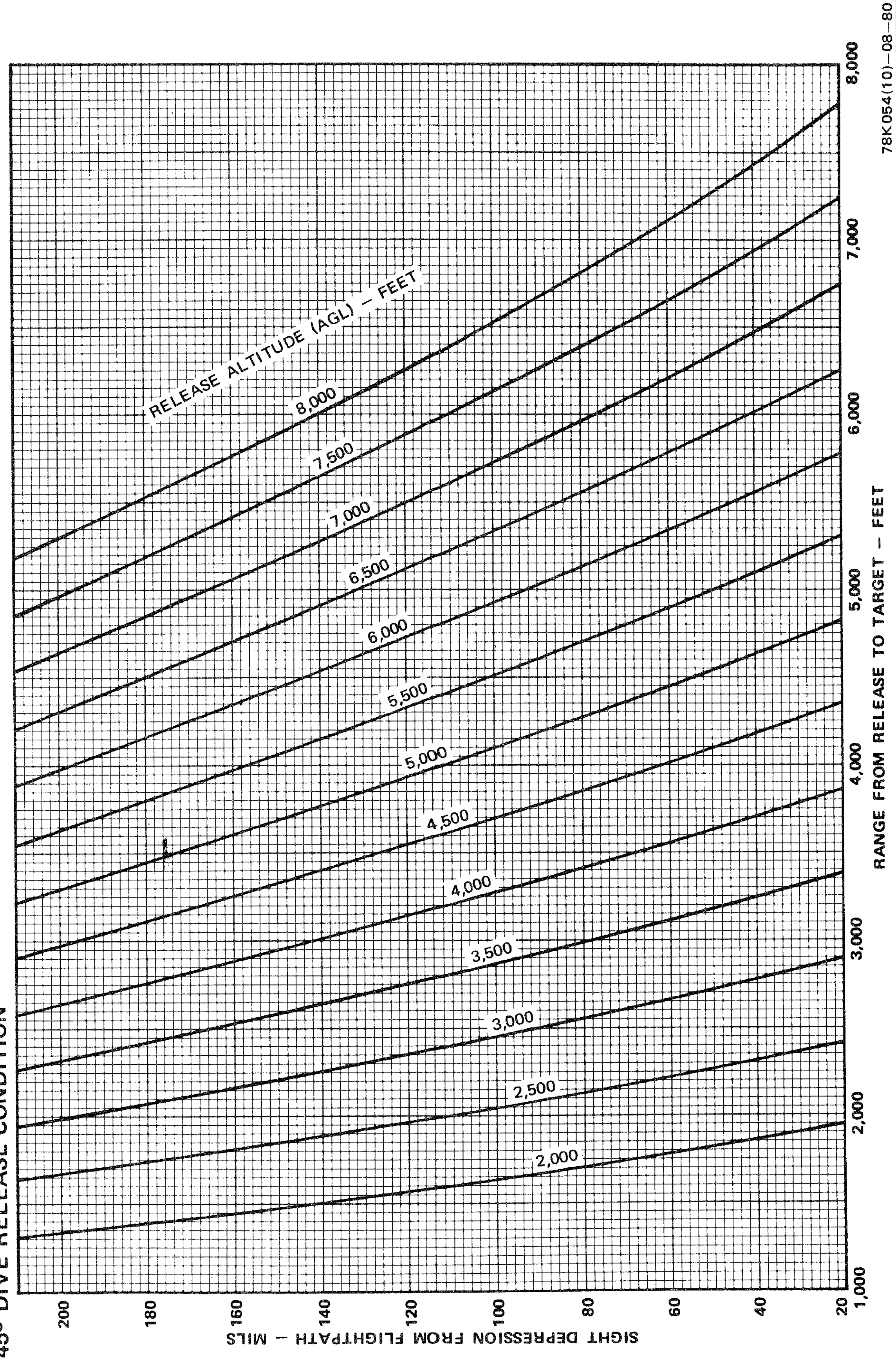


Figure 6-5 (Sheet 10)

SIGHT DEPRESSION CHART

50° DIVE RELEASE CONDITION

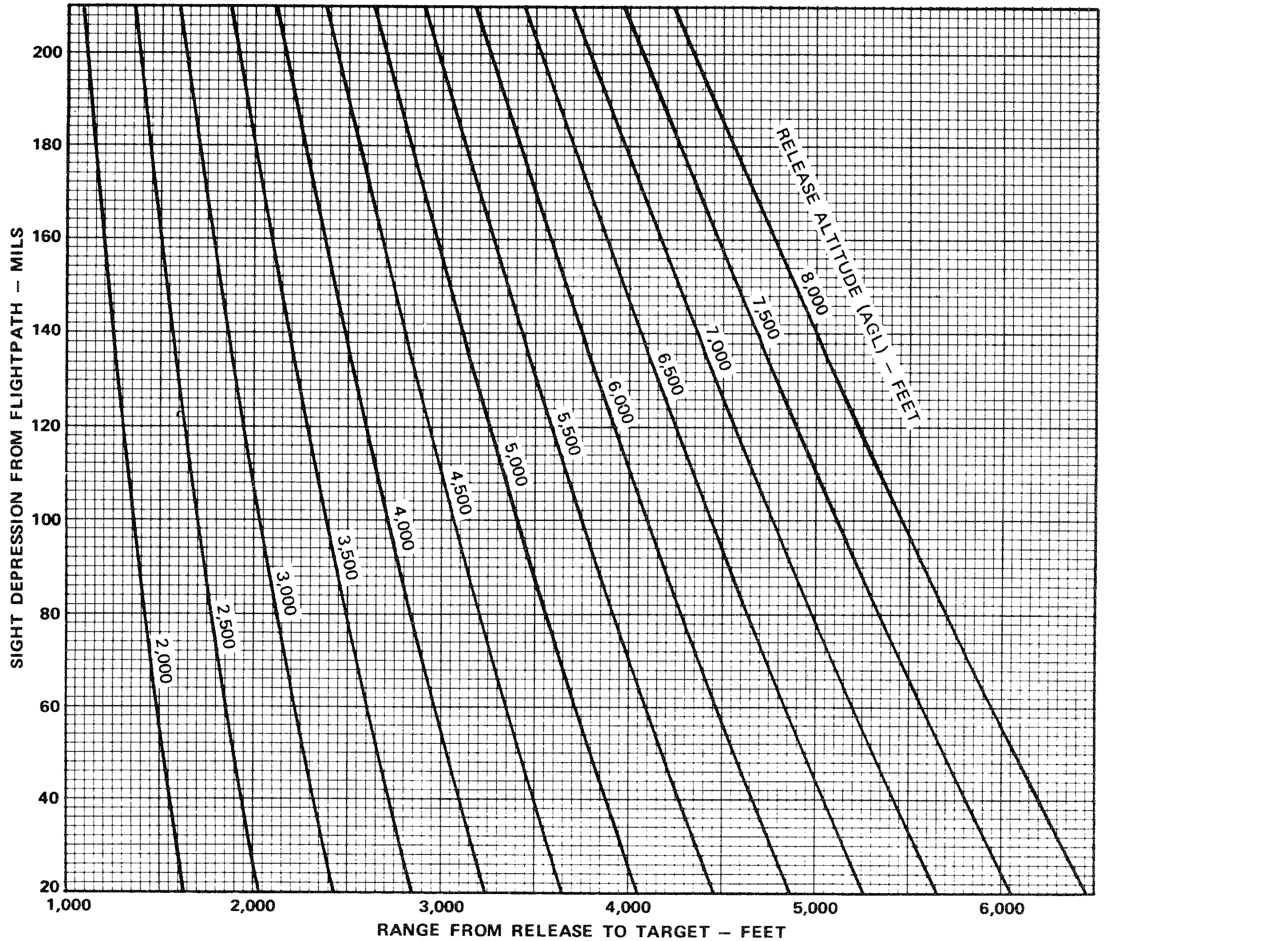
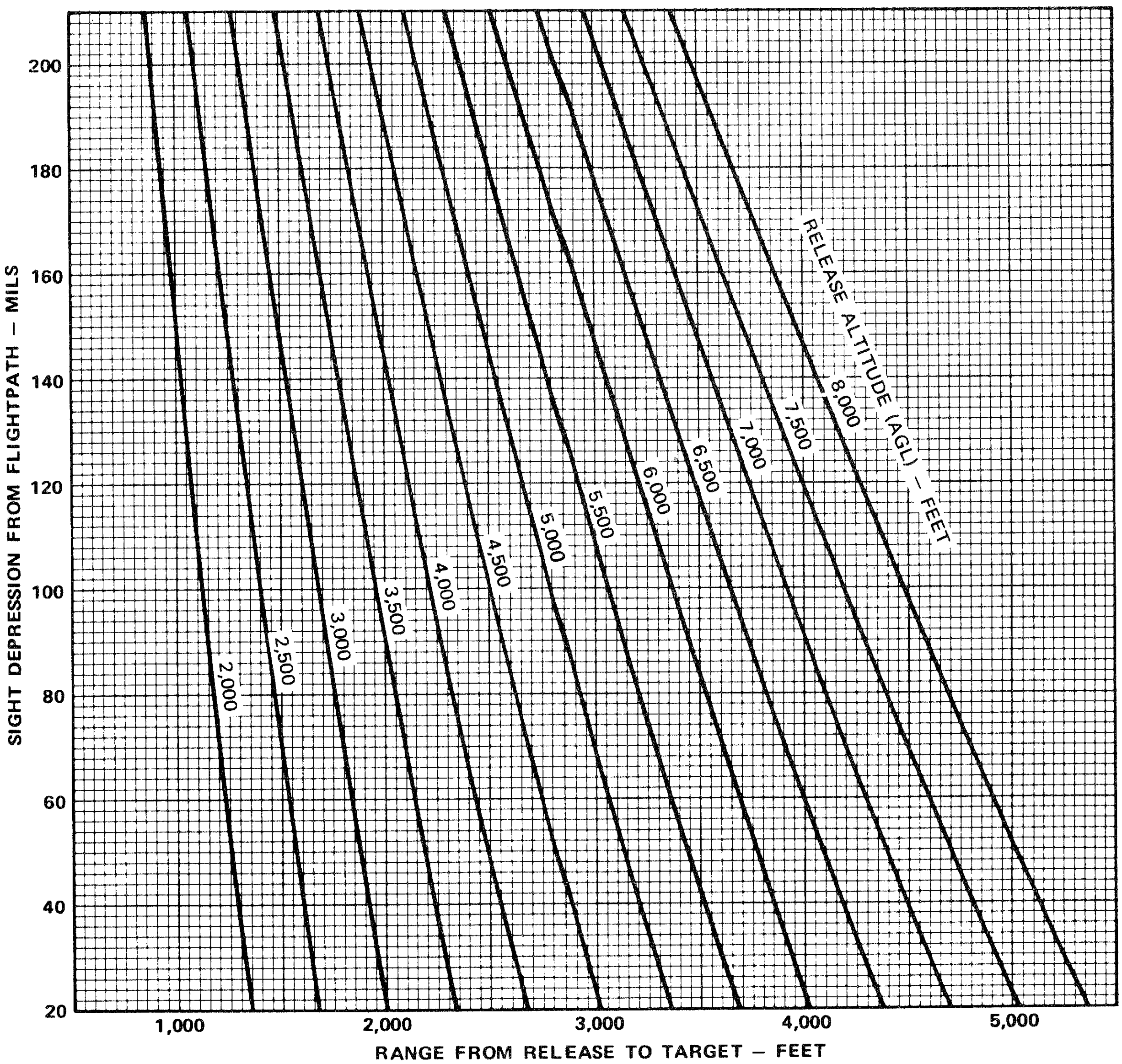


Figure 6-5 (Sheet 11)

SIGHT DEPRESSION CHART

55° DIVE RELEASE CONDITION

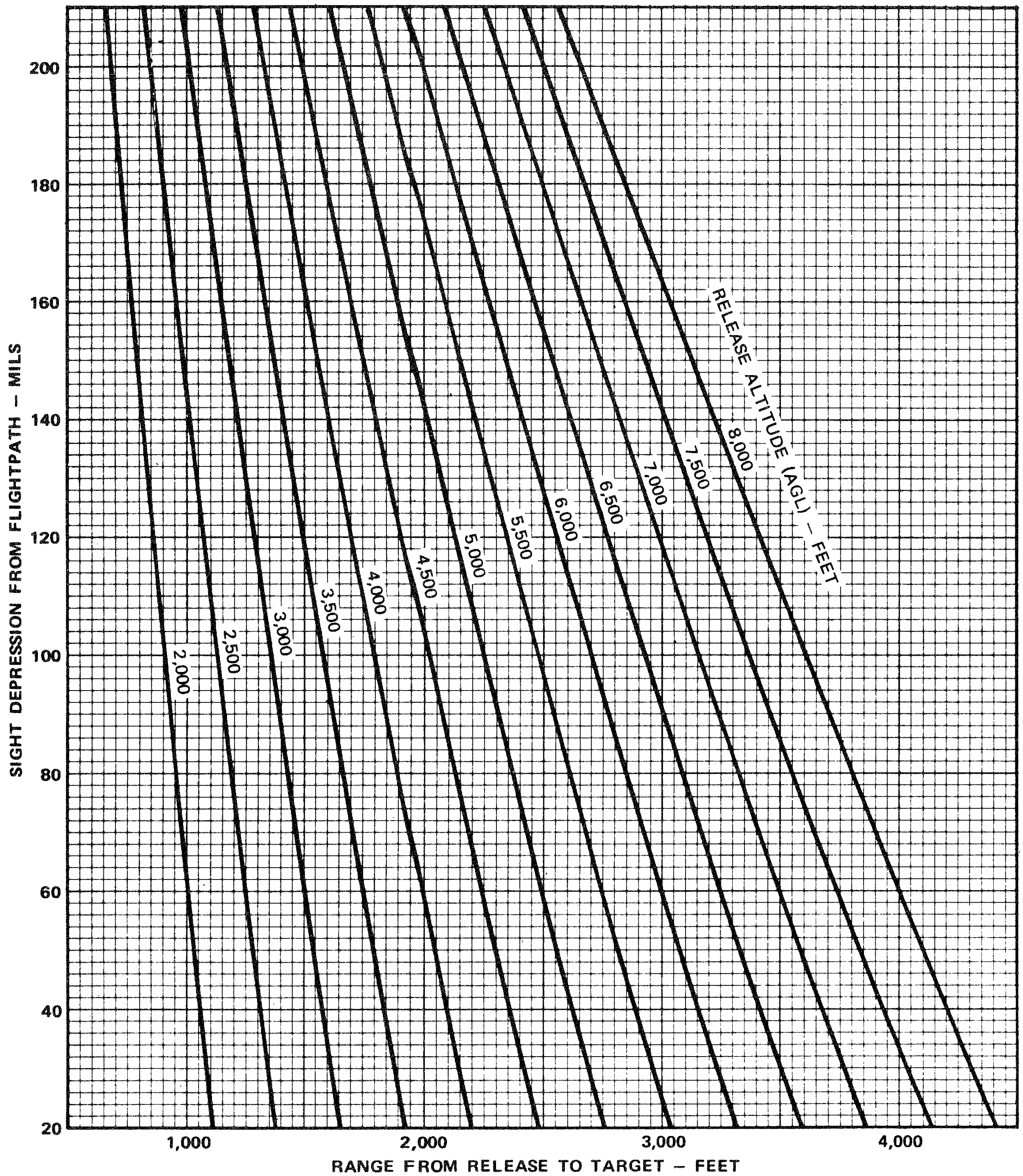


78K054(12)–08–80

Figure 6-5 (Sheet 12)

SIGHT DEPRESSION CHART

60° DIVE RELEASE CONDITION



78K054(13)–08–80

Figure 6-5 (Sheet 13)

SINE AND COSINE TABLE

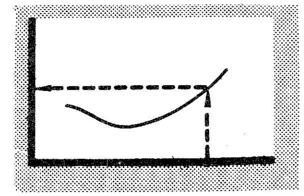
DIVE ANGLE	SINE	COSINE	DIVE ANGLE		SINE	COSINE	DIVE ANGLE		SINE	COSINE
0	.00000	1.00000	16		.27564	.96126	32	58	.52992	.84805
1	.01745	.99985	17		.29237	.95630	33	57	.54464	.83867
2	.03490	.99939	18		.30902	.95106	34	56	.55919	.82904
3	.05234	.99863	19		.32557	.94552	35	55	.57358	.81915
4	.06976	.99756	20		.34202	.93969	36	54	.58779	.80902
5	.08716	.99619	21		.35837	.93358	37	53	.60182	.79864
6	.10453	.99452	22		.37461	.92718	38	52	.61566	.78801
7	.12187	.99255	23		.39073	.92050	39	51	.62932	.77715
8	.13917	.99027	24		.40674	.91355	40	50	.64279	.76604
9	.15643	.98769	25		.42262	.90631	41	49	.65606	.75471
10	.17365	.98481	26		.43837	.89879	42	48	.66913	.74314
11	.19081	.98163	27		.45399	.89101	43	47	.68200	.73135
12	.20791	.97815	28		.46947	.88295	44	46	.69466	.71934
13	.22495	.97437	29		.48481	.87462	45	45	.70711	.70711
14	.24192	.97030	30	60	.50000	.86603				
15	.25882	.96593	31	59	.51504	.85717				
					COSINE	SINE			COSINE	SINE

78K124-08-80

Figure 6-6

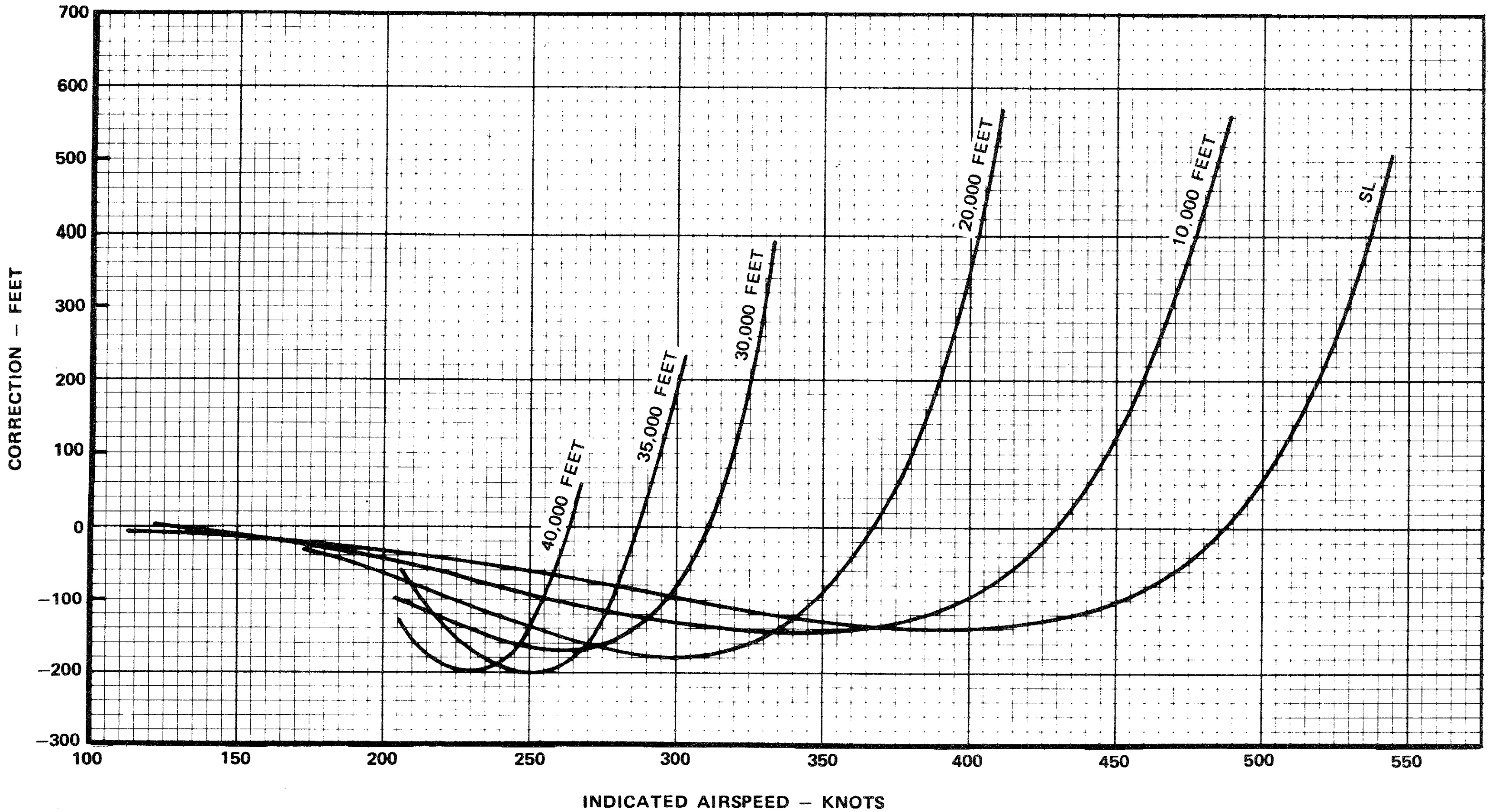
ALTIMETER POSITION ERROR CORRECTION CHART

ALTITUDE CORRECTION, ALL CONDITIONS, AAU-19/A PNEUMATIC (STBY) MODE



MODEL: A-7D
DATE: MAY 1973
DATA BASIS: AIR FORCE FLIGHT TEST*

PRESSURE ALTITUDE (CALIBRATED ALTITUDE) =
INDICATED ALTITUDE + CORRECTION



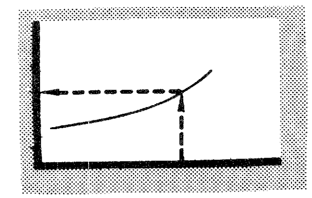
*FTC–TR–73–18

78K179(1)–08–80

Figure 6-7 (Sheet 1)

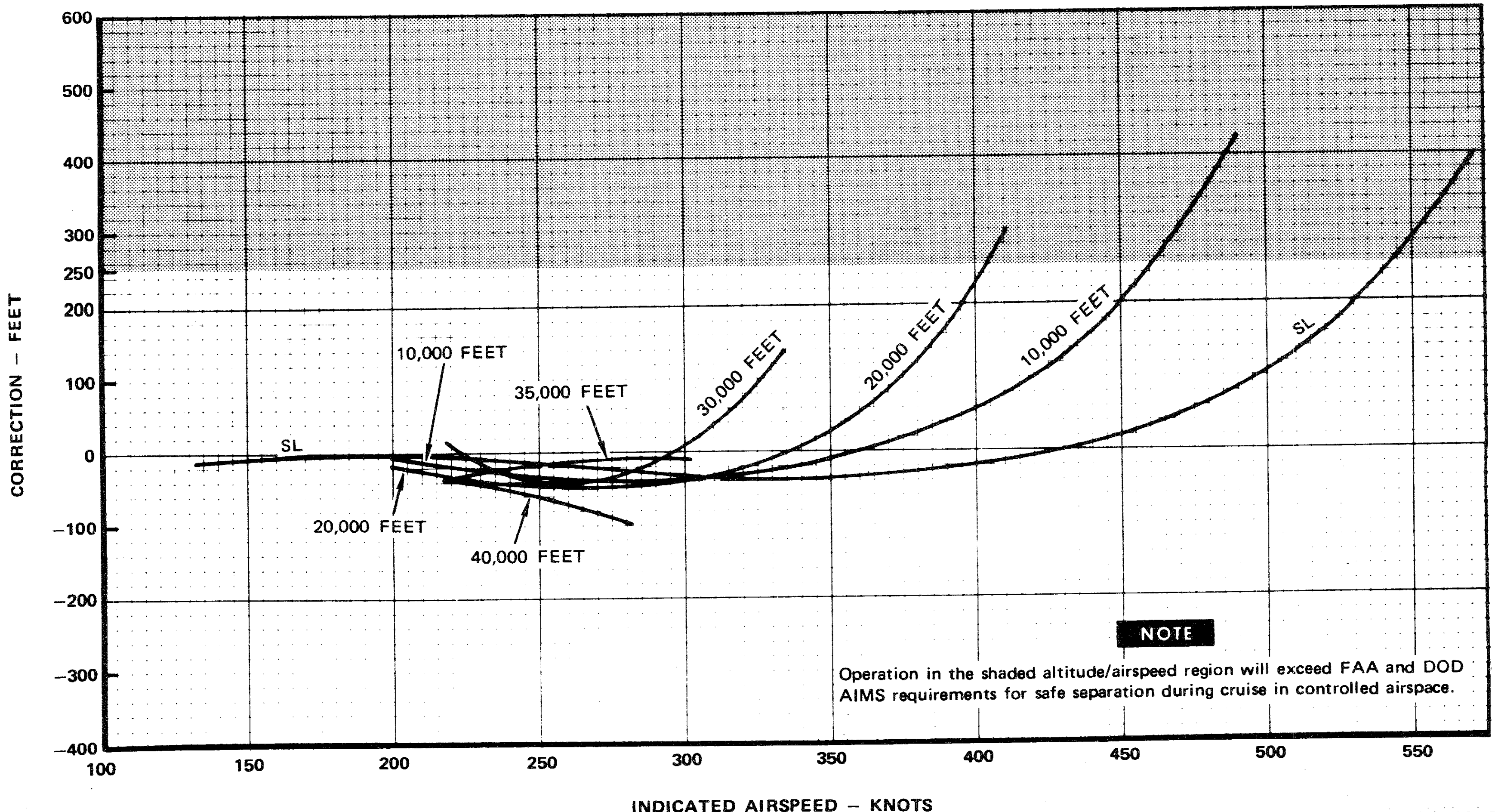
ALTIMETER POSITION ERROR CORRECTION CHART

ALTITUDE CORRECTION, CRUISE CONDITION, AAU-19/A SERVO (RESET) MODE



MODEL: A-7D
DATE: MAY 1973
DATA BASIS: AIR FORCE FLIGHT TEST*

PRESSURE ALTITUDE (CALIBRATED ALTITUDE) =
INDICATED ALTITUDE + CORRECTION



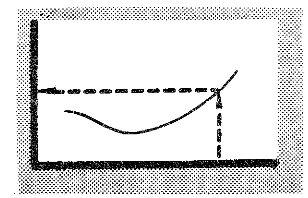
*FTC–TR–73–18

78K179(2)–08–80

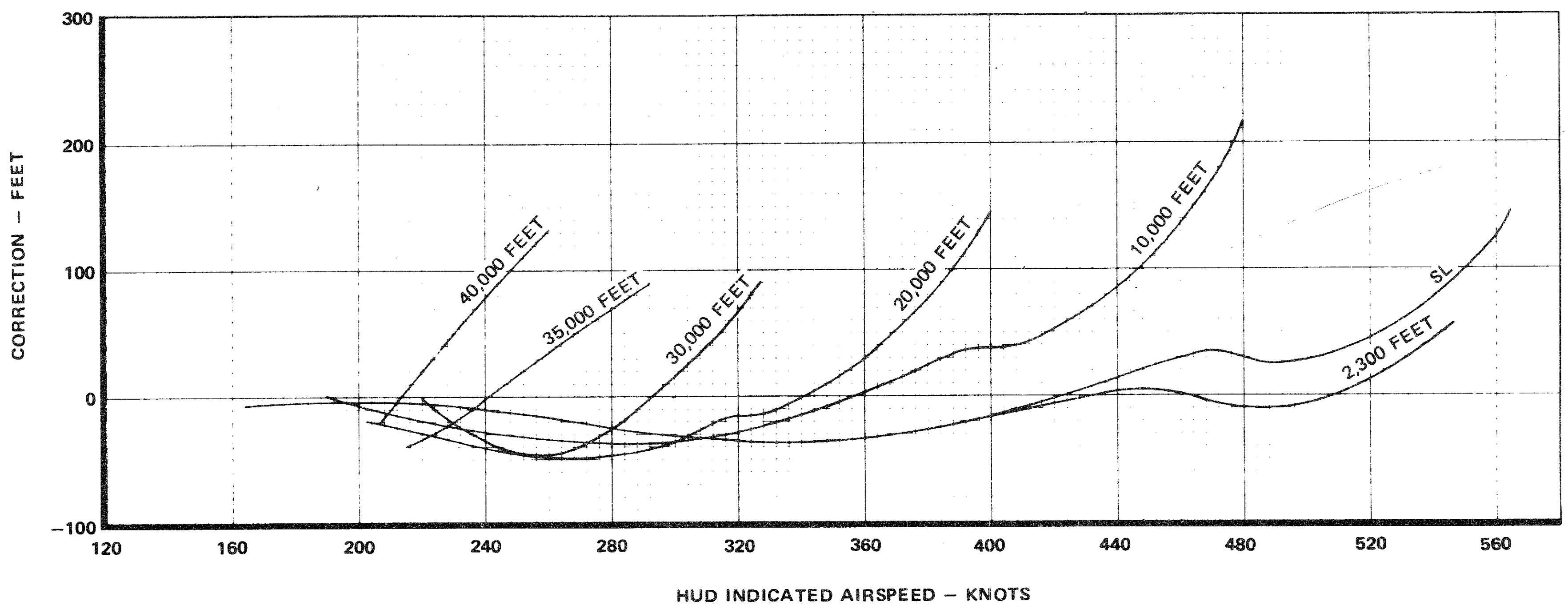
Figure 6-7 (Sheet 2)

HUD POSITION ERROR CORRECTION CHART

HUD ALTITUDE CORRECTION, CRUISE CONDITION



MODEL: A-7D
DATE: DECEMBER 1974
DATA BASIS: ESTIMATED*



NOTE

Position error in landing condition is negligible.

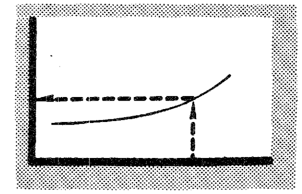
*Estimations based on data in FTC-TR-73-18.

78K202(1)–08–80

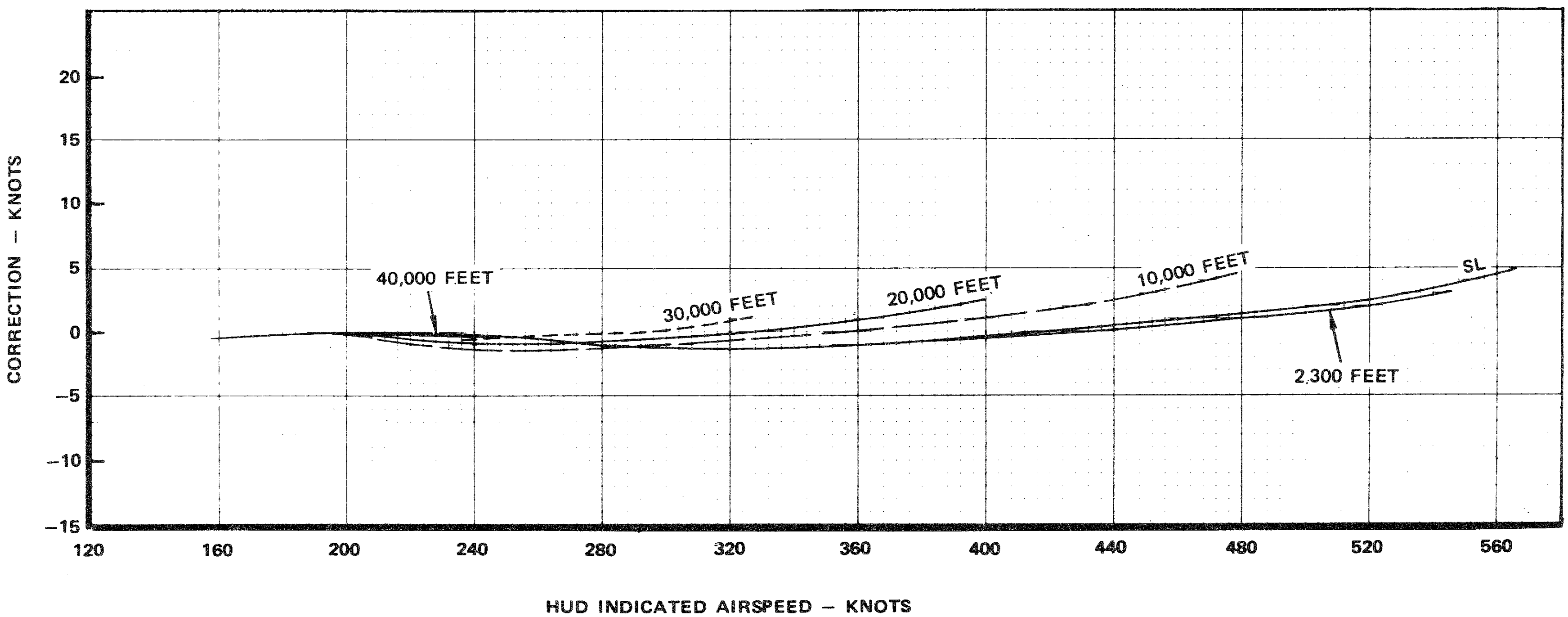
Figure 6-8 (Sheet 1)

HUD POSITION ERROR CORRECTION CHART

HUD AIRSPEED CORRECTION, CRUISE CONDITION



MODEL: A-7D
DATE: DECEMBER 1974
DATA BASIS: ESTIMATED*



NOTE

Position error in landing condition is negligible.

*Estimations based on data in FTC-TR-73-18.

78K202(2)–08–80

Figure 6-8 (Sheet 2)

RELATIVE WIND VECTOR CHART

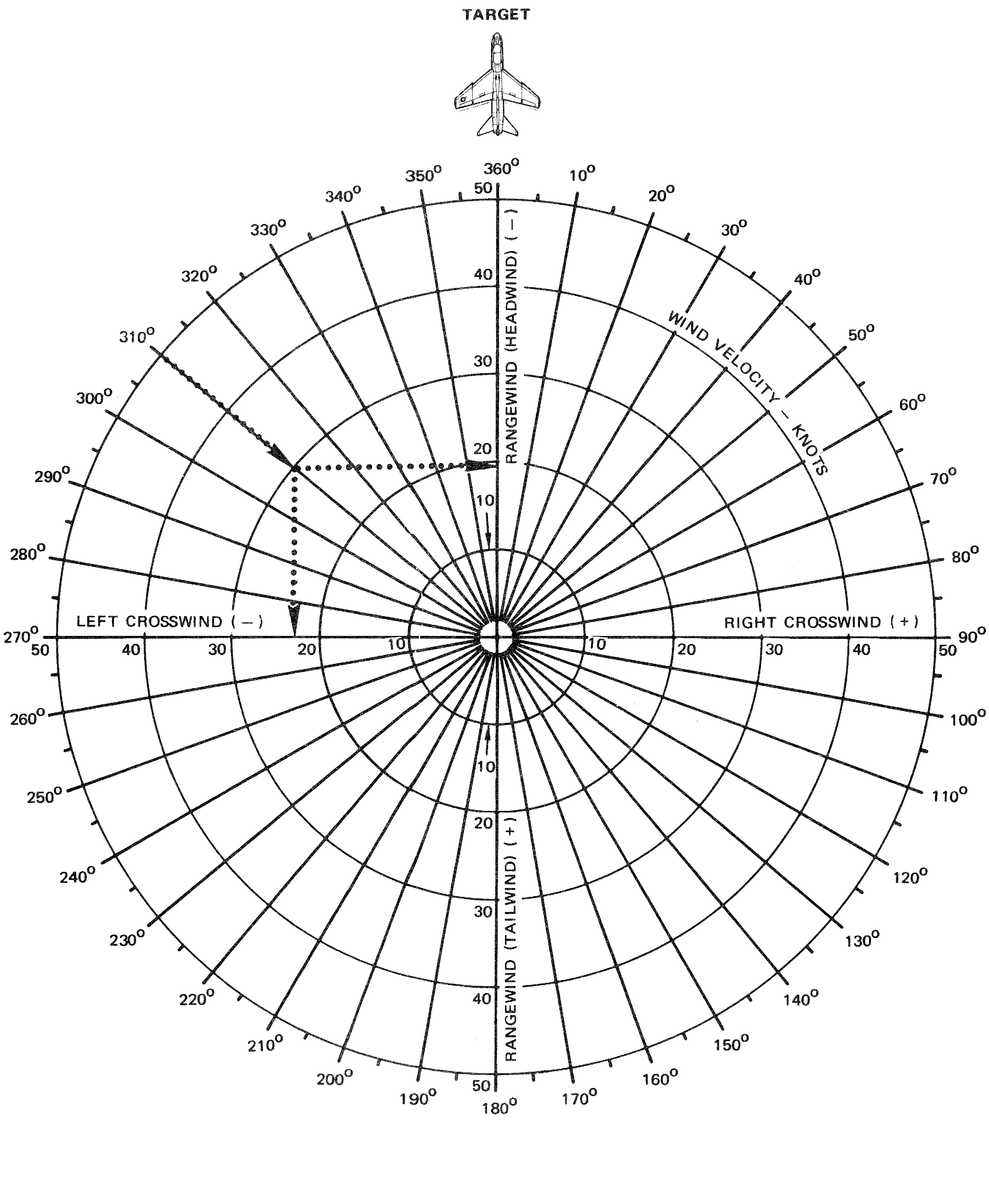


Figure 6-9

DIVE ANGLE VS DISTANCE CHART

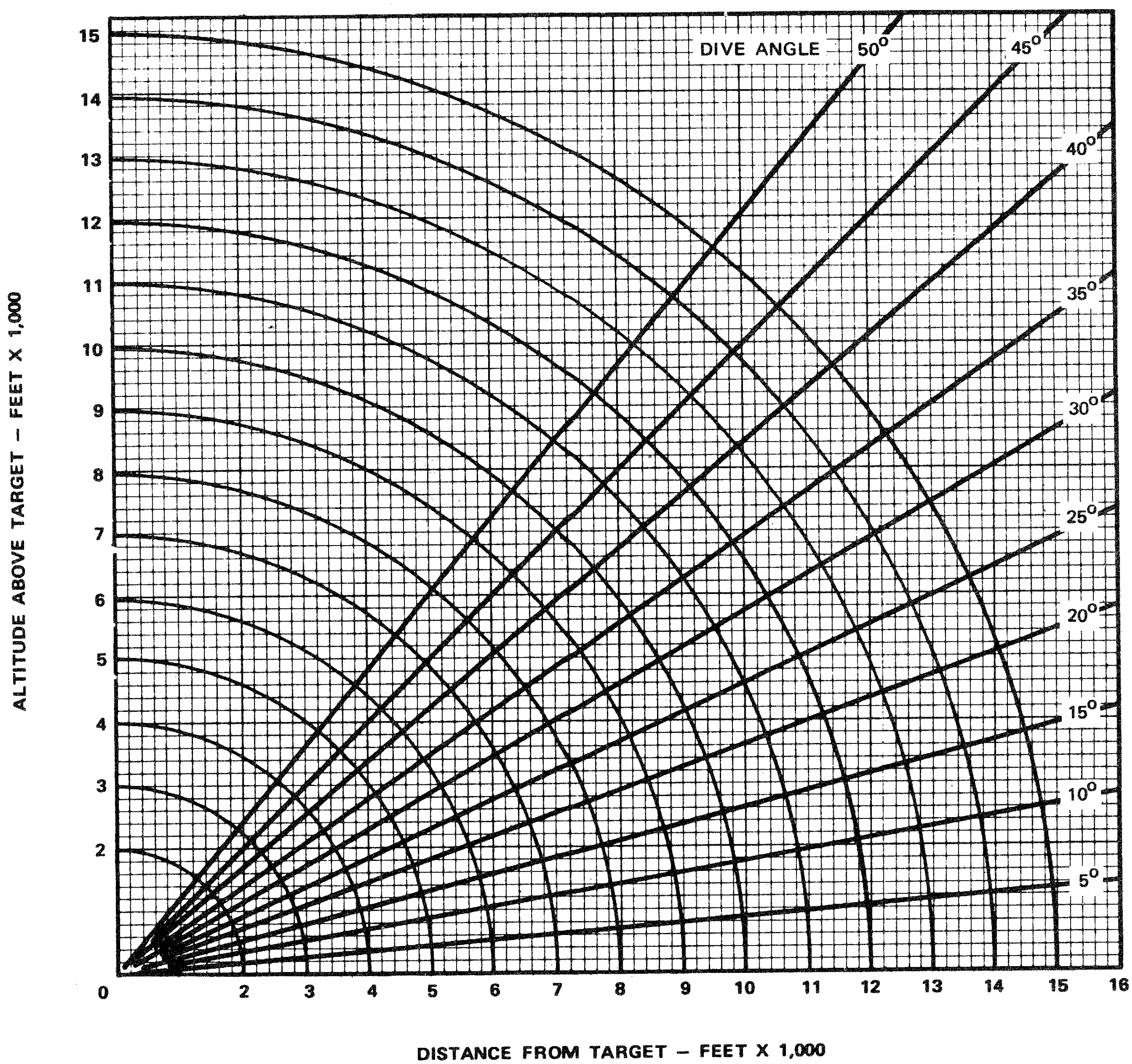


Figure 6-10

FUZE ARMING

MINIMUM RELEASE ALTITUDE OR VERTICAL DROP REQUIRED
FOR GENERAL PURPOSE, LOW DRAG, BOMB FUZE ARMING

RELEASE		M904E2/E3		M904E1 M905	M904E1 M905 FMU-72/B	FMU-26A/B OR FMU-26B/B NOSE OR TAIL FUZE ARMING DELAY SETTING	
TAS KTS	DIVE ANGLE DEG	4 SEC FT	6 SEC FT	4 SEC FT	6 SEC FT	4 SEC FT	6 SEC FT
400	0	360	770	430	910	290	630
400	15	1120	1900	1250	2140	1020	1700
400	20	1360	2260	1520	2540	1260	2050
400	30	1820	2950	2020	3280	1710	2700
400	45	2420	3840	2670	4260	2300	3560
400	60	2880	4520	3170	4990	2750	4220
440	0	360	770	430	910	290	620
440	15	1200	2010	1340	2260	1100	1810
440	20	1460	2410	1630	2700	1360	2180
440	30	1970	3160	2180	3520	1850	2900
440	45	2630	4150	2900	4590	2500	3850
440	60	3130	4890	3440	5400	2990	4570
480	0	360	770	430	910	290	620
480	15	1270	2120	1420	2380	1170	1910
480	20	1560	2560	1730	2860	1450	2320
480	30	2110	3380	2340	3750	1990	3110
480	45	2830	4450	3120	4910	2710	4130
480	60	3380	5260	3710	5800	3230	4920
520	0	360	770	430	910	290	620
520	15	1340	2230	1500	2500	1240	2010
520	20	1660	2700	1840	3010	1550	2460
520	30	2260	3590	2500	3980	2130	3310
520	45	3030	4750	3340	5230	2890	4420
520	60	3630	5620	3980	6180	3470	5260
560	0	360	770	430	910	290	620
560	15	1420	2340	1580	2610	1310	2110
560	20	1760	2840	1940	3160	1640	2590
560	30	2400	3790	2640	4190	2260	3500
560	45	3230	5020	3550	5520	3080	4680
560	60	3860	5950	4240	6530	3700	5580

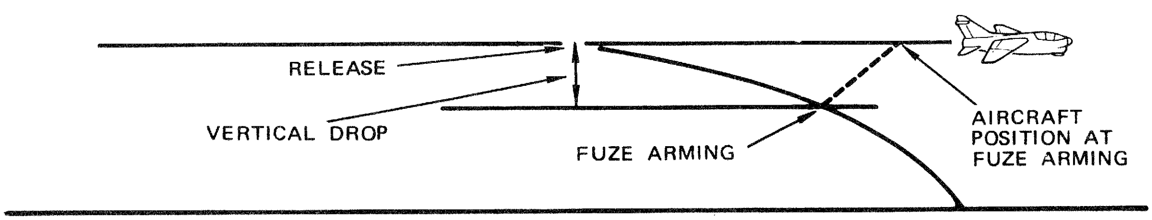
78K064—08—80

Figure 6-11

REQUIRED FUZE SAFE ARMING TIME

LOW ALTITUDE LEVEL RELEASE – LEVEL, CONSTANT SPEED ESCAPE MANEUVER

REL KTAS	SAFE ARMING TIME SEC	VERTICAL DROP TO FUZE ARMING FT	AIRCRAFT TO BOMB SLANT RANGE DISTANCE AT FUZE ARMING FT
M117, MK 82			
400	7.8	1,000	1,000
500	6.9	800	810
600	6.0	600	630
MK 83			
400	8.5	1,200	1,200
500	7.4	900	910
600	6.0	600	610
MK84			
400	9.6	1,600	1,600
500	8.9	1,400	1,410
600	8.3	1,200	1,210



NOTE

The values listed are applicable for use with single, pairs, or timed ripple releases. A straight and level, constant-speed, escape maneuver is assumed after release.

78K072(1)–08–80

Figure 6-12 (Sheet 1)

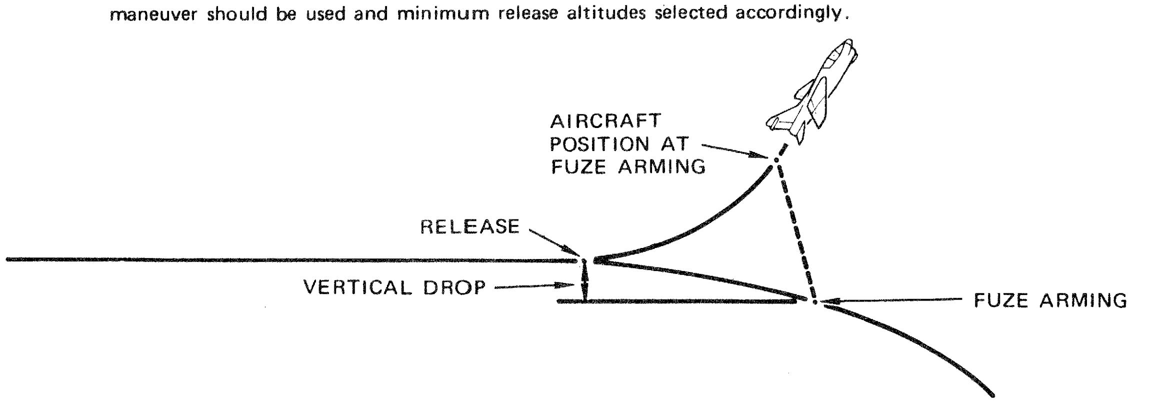
REQUIRED FUZE SAFE ARMING TIME

LOW ALTITUDE LEVEL RELEASE – 4.0G PULLUP OR 4.0G – 60° BANKED TURN ESCAPE MANEUVER

REL KTAS	SAFE ARMING TIME SEC	VERTICAL DROP TO FUZE ARMING FT	AIRCRAFT TO BOMB SLANT RANGE DISTANCE AT FUZE ARMING FT
M117, MK 82			
400	4.8	400	1,080
500	4.2	300	800
600	4.2	300	800
MK 83			
400	4.9	400	1,090
500	4.4	350	900
600	4.2	300	800
MK 84			
400	5.7	600	1,540
500	5.2	500	1,320
600	5.2	500	1,330

WARNING

The values listed are applicable for use with singles or pairs releases only and assume that the aircraft attains the 4.0g escape maneuver acceleration within two seconds after release. If a low altitude level ripple release is to be accomplished where the aircraft is held straight and level throughout the entire ripple release time cycle, the safe arming times listed for a level release – level constant speed escape maneuver should be used and minimum release altitudes selected accordingly.



78K072(2)–08–80

Figure 6-12 (Sheet 2)

REQUIRED FUZE SAFE ARMING TIME

LOW ALTITUDE LEVEL RELEASE – 5.0G PULLUP OR
5.0G – 60° BANKED TURN ESCAPE MANEUVER

REL KTAS	SAFE ARMING TIME SEC	VERTICAL DROP TO FUZE ARMING FT	AIRCRAFT TO BOMB SLANT RANGE DISTANCE AT FUZE ARMING FT
M117, MK 82			
400	4.5	400	1,340
500	4.2	300	890
600	3.9	300	800
MK 83			
400	4.6	400	1,380
500	4.3	350	930
600	3.9	300	800
MK 84			
400	5.5	550	1,820
500	5.2	500	1,330
600	5.2	500	1,390

WARNING

The values listed are applicable for use with singles or pairs releases only and assume that the aircraft attains the 5.0g escape maneuver acceleration within two seconds after release. If a low altitude level ripple release is to be accomplished where the aircraft is held straight and level throughout the entire ripple release time cycle, the safe arming times listed for a level release – level constant speed escape maneuver should be used and minimum release altitudes selected accordingly.

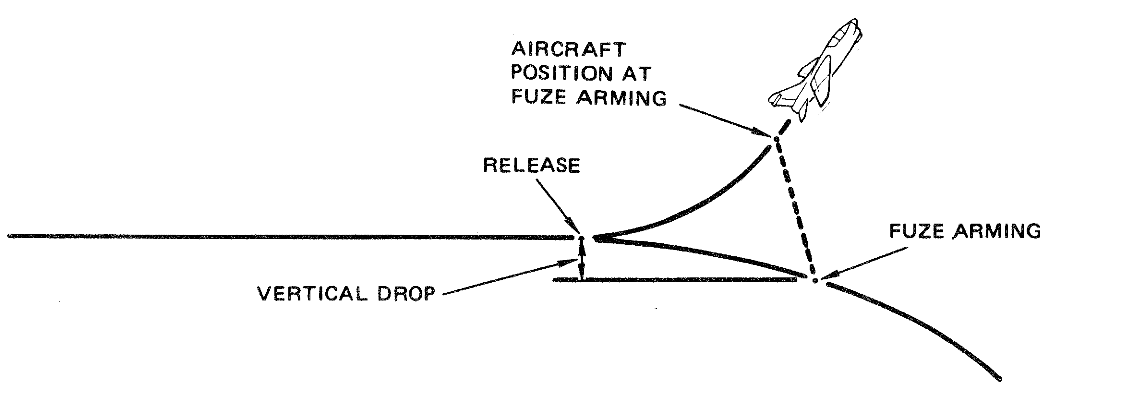


Figure 6-12 (Sheet 3)

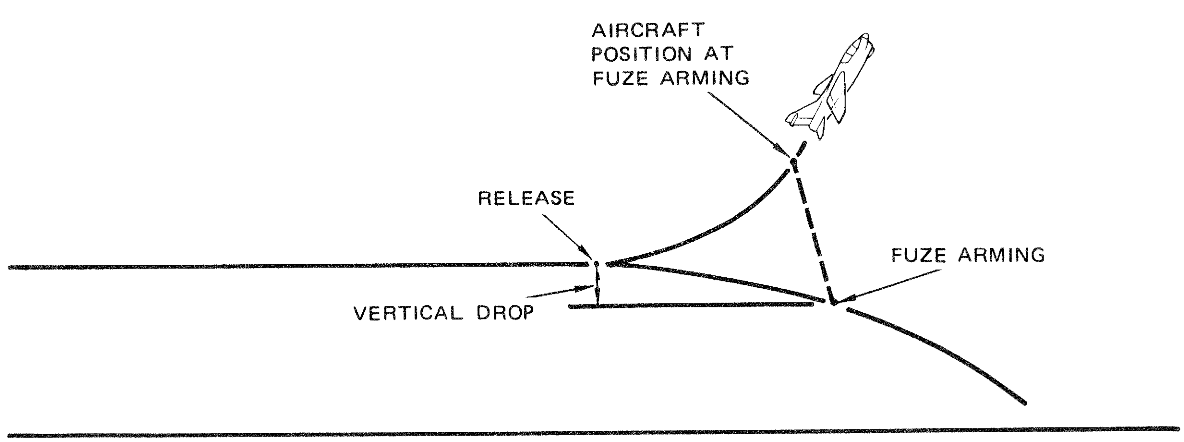
REQUIRED FUZE SAFE ARMING TIME

LOW ALTITUDE LEVEL RELEASE – 5.0G PULLUP OR
5.0G – 60° BANKED TURN ESCAPE MANEUVER

REL KTAS	SAFE ARMING TIME SEC	VERTICAL DROP TO FUZE ARMING FT	AIRCRAFT TO BOMB SLANT RANGE DISTANCE AT FUZE ARMING FT
M117, MK 82			
400	4.3	350	1,250
500	4.1	300	910
600	3.8	250	820
MK 83			
400	4.4	350	1,300
500	4.2	350	950
600	3.8	250	820
MK 84			
400	5.4	500	1,780
500	5.2	500	1,370
600	5.2	500	1,460

WARNING

The values listed are applicable for use with singles or pairs releases only and assume that the aircraft attains the 5.0g escape maneuver acceleration within 1.5 seconds after release. If a low altitude level ripple release is to be accomplished where the aircraft is held straight and level throughout the entire ripple release time cycle, the safe arming times listed for a level release – level constant speed escape maneuver should be used and minimum release altitudes selected accordingly.



78K072(4)–08–80

Figure 6-12 (Sheet 4)

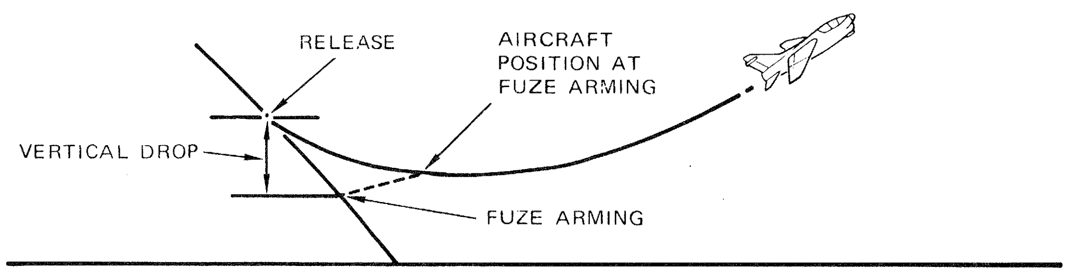
REQUIRED FUZE SAFE ARMING TIME

LOW TO MEDIUM ALTITUDE DIVE RELEASE – 4.0G
PULLUP TO 20° – 30° CLIMB ESCAPE MANEUVER

RELEASE		SAFE ARMING TIME SEC	VERTICAL DROP TO FUZE ARMING FT	AIRCRAFT TO BOMB SLANT RANGE DISTANCE AT FUZE ARMING FT
TAS KTS	DIVE ANGLE DEG			
		M117, MK 82		
400	15	4 7	1,200	1,050
	30	4.7	1,900	1,030
	45	4.7	2,600	990
500	15	4.2	1,200	790
	30	4.2	2,000	760
	45	4.2	2,800	740
600	15	3.8	1,200	620
	30	3.8	2,100	610
	45	3.8	2,950	630
		MK 83		
400	15	4.8	1,250	1,100
	30	4.8	2,000	1,080
	45	4.7	2,600	990
500	15	4.5	1,300	920
	30	4.5	2,200	910
	45	4.5	3,000	890
600	15	4.1	1,400	810
	30	4.1	2,300	730
	45	4.1	3,200	750
		MK 84		
400	15	5.2	1,400	1,340
	30	5.1	2,200	1,280
	45	5.1	2,900	1,260
500	15	4.9	1,500	1,170
	30	4.9	2,500	1,160
	45	4.7	3,200	1,060
600	15	4.6	1,600	1,030
	30	4.6	2,700	1,010
	45	4.6	3,700	1,040

WARNING

The values listed are applicable for use with singles or pairs releases only and assume that the aircraft attains the 4.0g escape maneuver acceleration within two seconds after release. For timed ripple releases, where the aircraft remains in a fixed dive angle flight condition until the last bomb is released, the safe arming time should be increased by an amount equal to the ripple release time cycle.



78K072(5)–08–80

Figure 6-12 (Sheet 5)

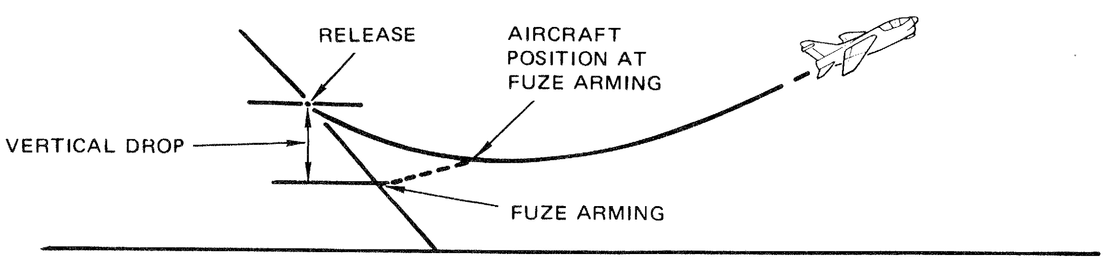
REQUIRED FUZE SAFE ARMING TIME

LOW TO MEDIUM ALTITUDE DIVE RELEASE – 5.0G
PULLUP TO 20° – 30° CLIMB ESCAPE MANEUVER

RELEASE TAS KTS	RELEASE DIVE ANGLE DEG	SAFE ARMING TIME SEC	VERTICAL DROP TO FUZE ARMING FT	AIRCRAFT TO BOMB SLANT RANGE DISTANCE AT FUZE ARMING FT
M117, MK 82				
400	15	4.0	1,000	1,180
	30	4.0	1,650	1,260
	45	3.9	2,100	930
500	15	3.8	1,100	790
	30	3.7	1,800	740
	45	3.7	2,450	720
600	15	3.6	1,200	700
	30	3.5	1,950	640
	45	3.5	2,700	630
MK 83				
400	15	4.1	1,050	1,240
	30	4.0	1,650	1,260
	45	4.0	2,200	980
500	15	3.9	1,150	840
	30	3.9	1,900	830
	45	3.8	2,500	770
600	15	3.7	1,200	740
	30	3.5	2,000	640
	45	3.5	2,700	630
MK 84				
400	15	4.8	1,250	1,600
	30	4.8	2,000	1,730
	45	4.8	2,650	1,420
500	15	4.8	1,450	1,340
	30	4.6	2,300	1,210
	45	4.6	3,100	1,190
600	15	4.6	1,600	1,220
	30	4.6	2,700	1,210
	45	4.6	3,700	1,190

WARNING

The values listed are applicable for use with singles or pairs releases only and assume that the aircraft attains the 5.0g escape maneuver acceleration within two seconds after release. For timed ripple releases, where the aircraft remains in a fixed dive angle flight condition until the last bomb is released, the safe arming time should be increased by an amount equal to the ripple release time cycle.



78K072(6)–08–80

Figure 6-12 (Sheet 6)

REQUIRED FUZE SAFE ARMING TIME

LOW TO MEDIUM ALTITUDE DIVE RELEASE – 5.0G
PULLUP TO 20° – 30° CLIMB ESCAPE MANEUVER

RELEASE TAS KTS	RELEASE DIVE ANGLE DEG	SAFE ARMING TIME SEC	VERTICAL DROP TO FUZE ARMING FT	AIRCRAFT TO BOMB SLANT RANGE DISTANCE AT FUZE ARMING FT
		M117, MK 82		
400	15	4.0	1,000	1,180
	30	3.8	1,550	1,150
	45	3.8	2,050	970
500	15	3.6	1,050	780
	30	3.5	1,700	720
	45	3.5	2,300	710
600	15	3.4	1,100	680
	30	3.4	1,900	670
	45	3.3	2,500	620
		MK 83		
400	15	4.1	1,050	1,240
	30	3.9	1,600	1,200
	45	3.9	2,150	1,020
500	15	3.8	1,100	880
	30	3.7	1,800	820
	45	3.6	2,400	760
600	15	3.4	1,100	680
	30	3.3	1,850	630
	45	3.3	2,550	620
		MK 84		
400	15	4.8	1,250	1,600
	30	4.4	1,850	1,510
	45	4.4	2,450	1,310
500	15	4.6	1,400	1,320
	30	4.4	2,200	1,200
	45	4.4	2,950	1,180
600	15	4.6	1,600	1,330
	30	4.5	2,600	1,260
	45	4.4	3,450	1,180

WARNING

The values listed are applicable for use with singles or pairs releases only and assume that the aircraft attains the 5.0g escape maneuver acceleration within 1.5 seconds after release. For timed ripple releases, where the aircraft remains in a fixed dive angle flight condition until the last bomb is released, the safe arming time should be increased by an amount equal to the ripple release time cycle.

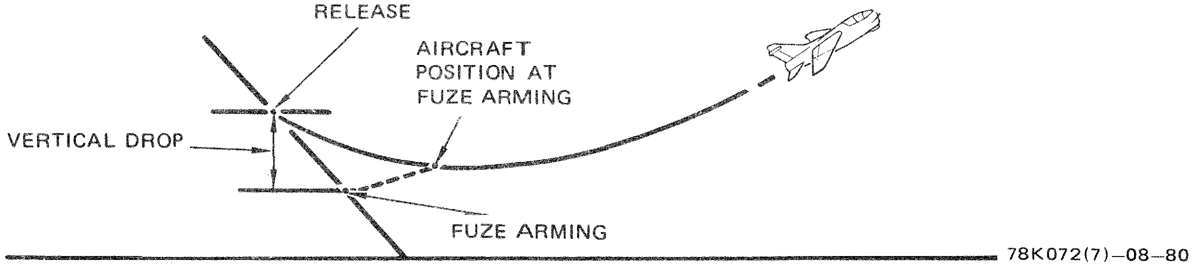


Figure 6-12 (Sheet 7)

REQUIRED FUZE SAFE ARMING TIME

HIGH ALTITUDE LEVEL RELEASE – LEVEL, CONSTANT SPEED ESCAPE MANEUVER

RELEASE ALTITUDE ABOVE TARGET FT	RELEASE TAS KTS	SAFE ARMING TIME SEC	VERTICAL DROP TO FUZE ARMING FT	AIRCRAFT TO BOMB SLANT RANGE DISTANCE AT FUZE ARMING FT
M117, MK 82				
10,000 or Lower	400	8	1,060	1,070
	500	7	820	830
	600	6	600	630
20,000	400	11	1,980	1,990
	500	9	1,340	1,350
	600	8	1,050	1,090
30,000	400	13	2,780	2,780
	500	11	1,980	1,990
	600	10	1,640	1,680
MK 83				
10,000 or Lower	400	9	1,340	1,340
	500	8	1,060	1,060
	600	7	830	850
20,000	400	12	2,360	2,360
	500	11	1,980	1,980
	600	10	1,630	1,650
30,000	400	14	3,190	3,190
	500	13	2,760	2,760
	600	12	2,330	2,350
MK 84				
10,000 or Lower	400	10	1,740	1,740
	500	9	1,430	1,430
	600	9	1,420	1,430
20,000	400	13	2,890	2,890
	500	12	2,470	2,470
	600	11	2,080	2,090
30,000	400	15	3,810	3,810
	500	14	3,330	3,330
	600	13	2,860	2,870

WARNING

The lower air density at high altitudes is responsible for the increase in required safe arming time for high altitude releases. A linear interpolation between the safe arming time values listed for 10,000, 20,000, and 30,000 feet may be accomplished to determine the required safe arming time value for intermediate altitudes.

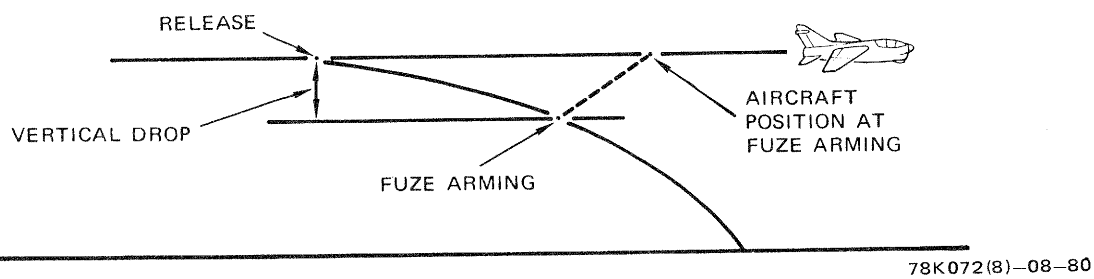


Figure 6-12 (Sheet 8)

FUZE ARMING AND SAFE ESCAPE

RELEASE		ALT LOST DURING PULL OUT FEET	SAFE ESCAPE*	FUSE ARMING†	FUSE ARMING†
TAS (KNOTS)	DIVE ANGLE (DEG)		MIN REL ALT FOR FRAG ENVELOPE CLEARANCE (FT)	MIN REL ALT FOR M904E2 FUZE WITH 2-SEC DELAY (FT)	MIN REL ALT FOR FMU-54/B WITH 2.5 SEC DELAY (FT)
			MK 82 (SNAKEYE 1) GP BOMB	MK 82 (SNAKEYE 1) GP BOMB	MK 82 (SNAKEYE 1) GP BOMB
400	0	– –	120	100	120
	10	174	400	330	365
	20	507	700	†	†
	30	978	1100	†	†
440	0	––	115	100	120
	10	201	400	345	385
	20	592	700	†	†
	30	1153	1300	†	†
480	0	––	100	95	115
	10	229	400	360	400
	20	682	800	†	†
	30	1339	1500	†	†
520	0	––	80	95	115
	10	259	400	375	415
	20	778	900	†	†
	30	1537	1700	†	†
560	0	––	55	95	115
	10	290	400	390	430
	20	879	1000	†	†
	30	1748	1900	†	†

*For the dive releases, the safe escape computations assume a 4.0g recovery.

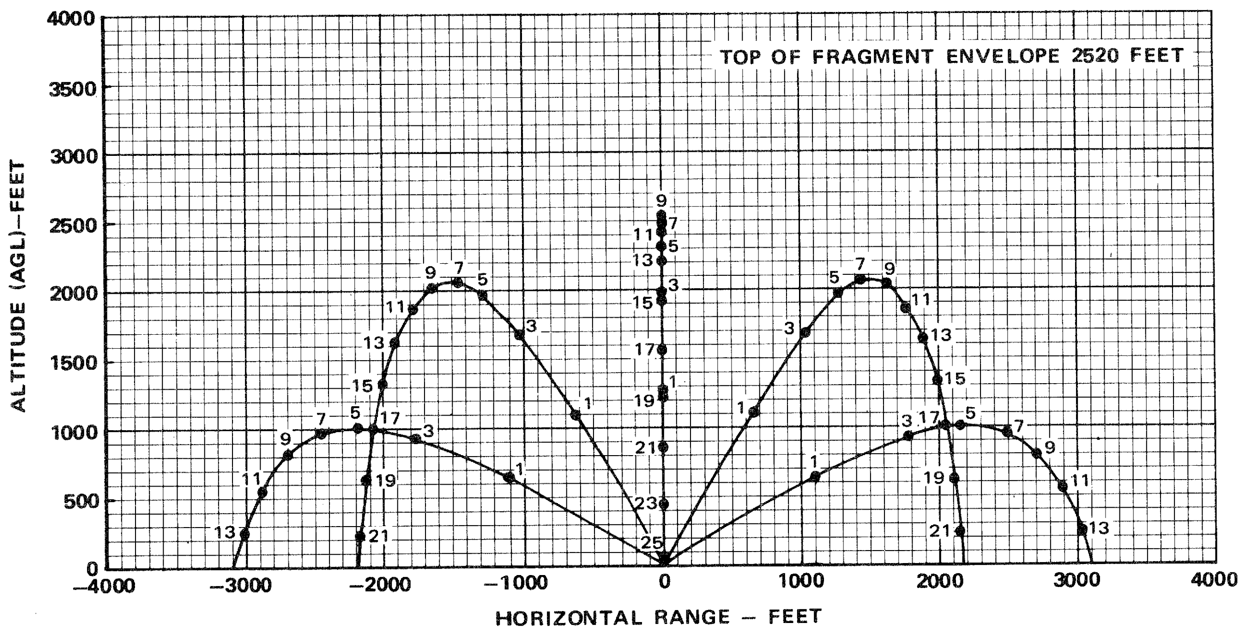
†For the 20° and 30° dive release conditions listed, the bomb time of flight is more than adequate to assure fuze arming for the M904 fuze with a 2.0-sec arming delay setting and the FMU-54/B fuze with a 2.5-sec arming delay setting.

78K066–08–80

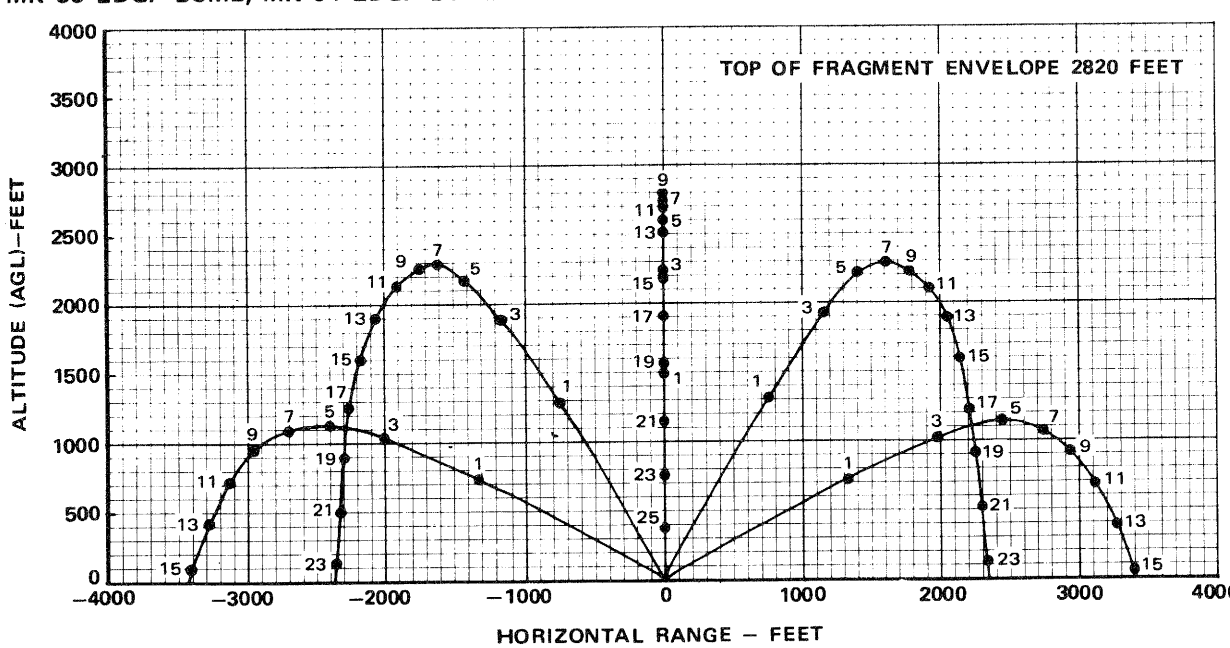
Figure 6-13

MAXIMUM FRAGMENT ENVELOPES

MK 82 LDGP BOMB, MK 82 (SNAKEYE 1) GP BOMB
MK 36 (DESTRUCTOR) HIGH DRAG BOMB



MK 83 LDGP BOMB, MK 84 LDGP BOMB



NOTE

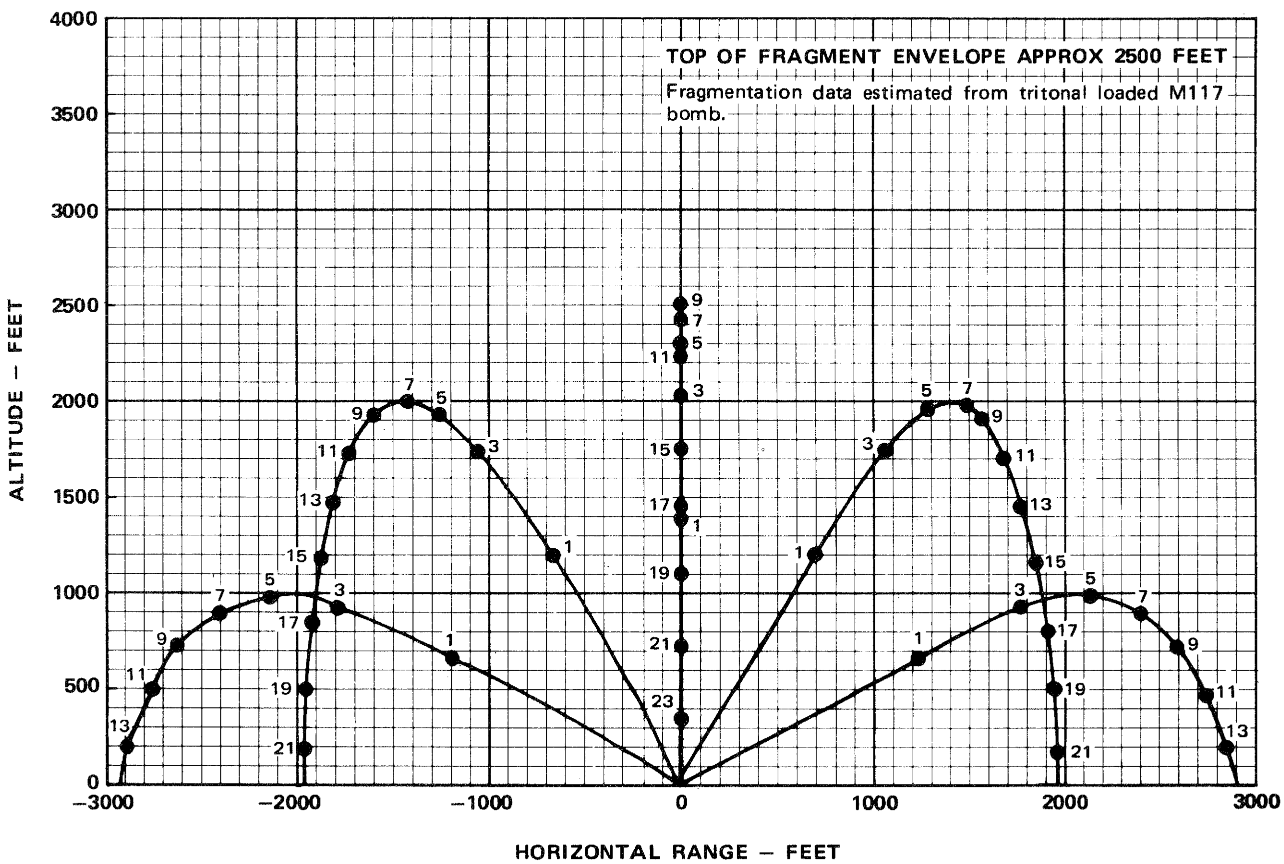
Time in seconds is given adjacent to each data point.

78K018(1)–08–80

Figure 6-14 (Sheet 1)

MAXIMUM FRAGMENT ENVELOPES

M117 GP BOMB



NOTE

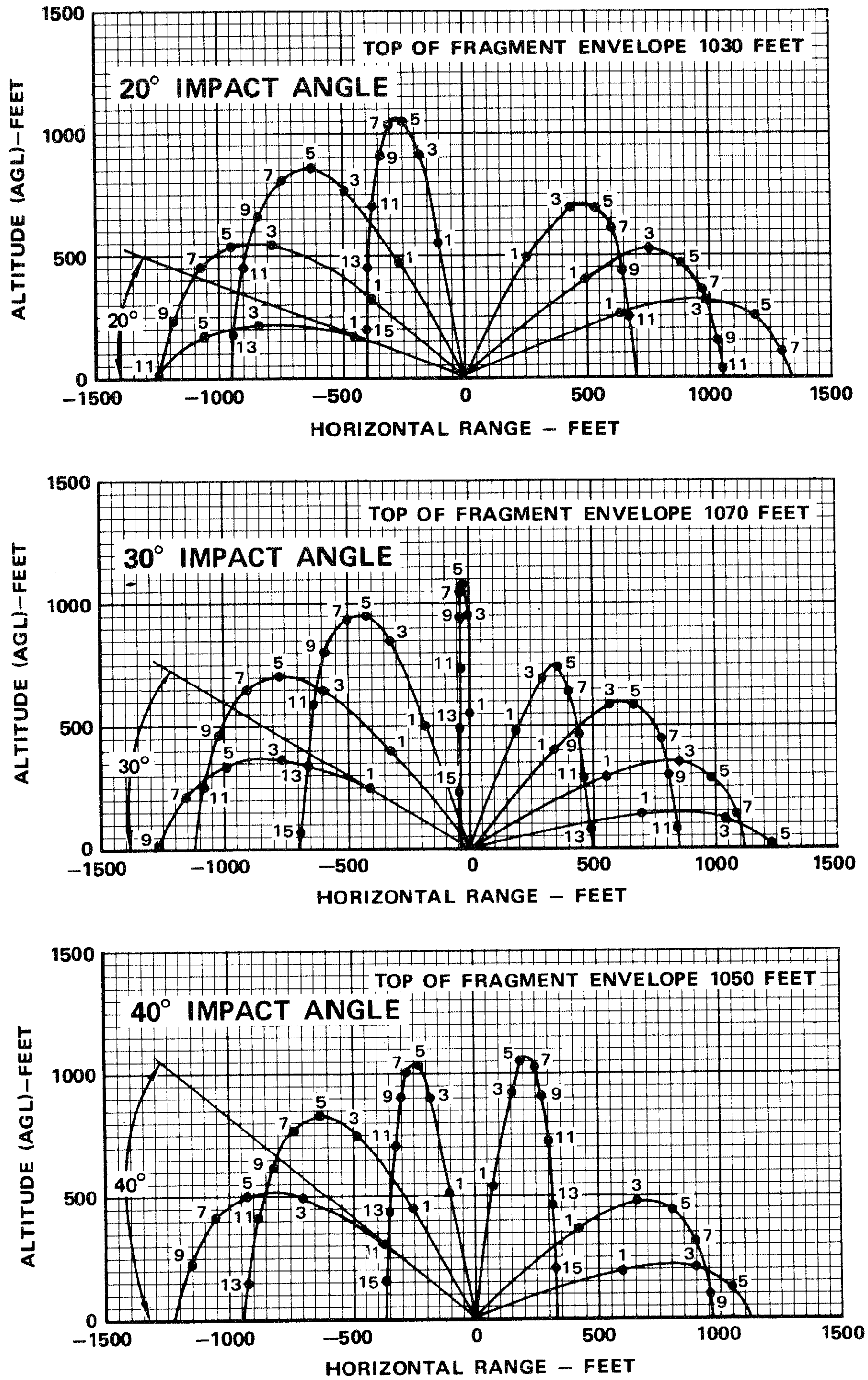
Time in seconds is given adjacent to each data point.

78K018(2)–08–80

Figure 6-14 (Sheet 2)

MAXIMUM FRAGMENT ENVELOPES

2.75–INCH FFAR WITH MK 1 MOD 1 WARHEAD



NOTE

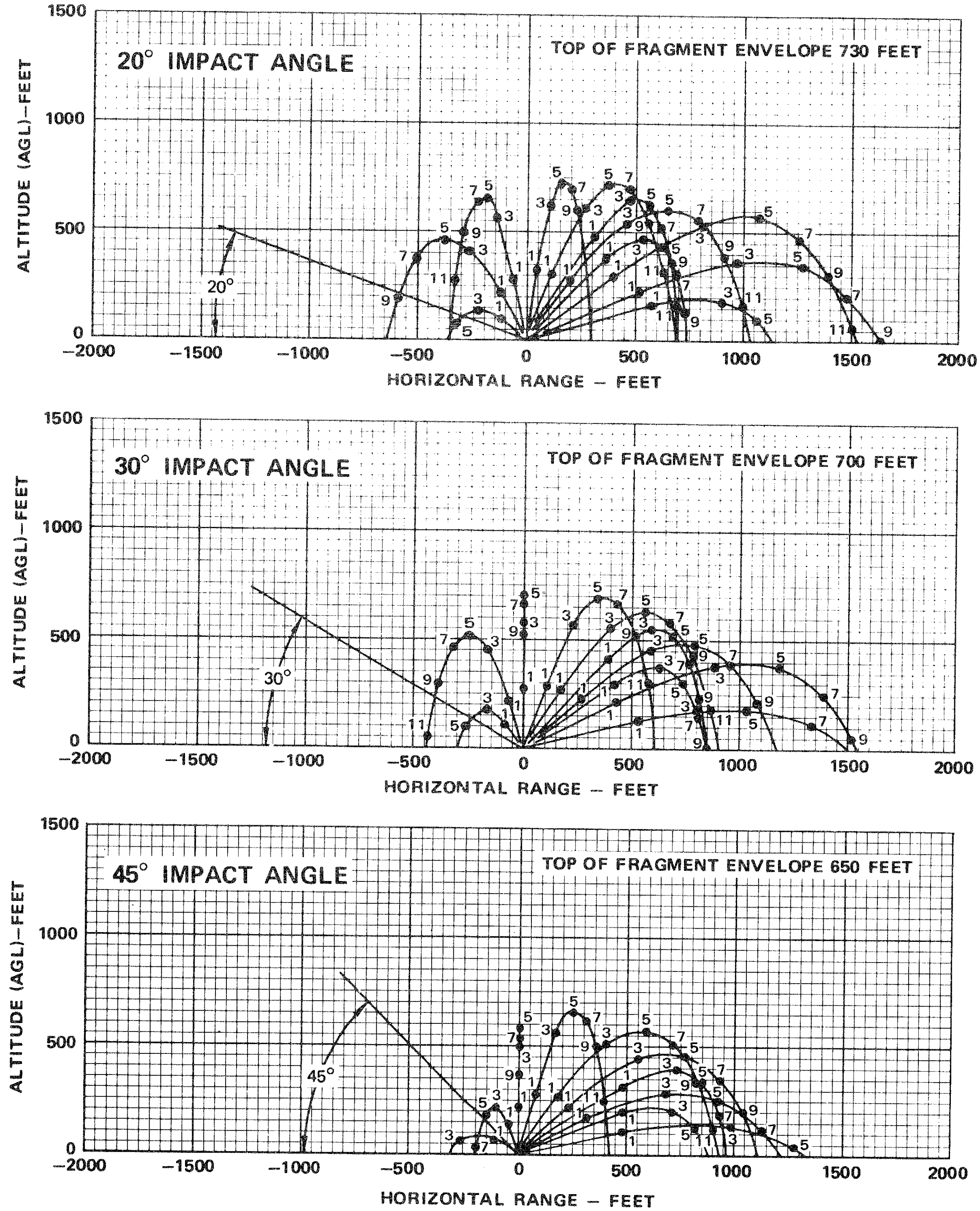
Time in seconds is given adjacent to each data point.

78K018(3)–08–80

Figure 6-14 (Sheet 3)

MAXIMUM FRAGMENT ENVELOPES

2.75–INCH FFAR WITH M151 WARHEAD



NOTE

Time in seconds is given adjacent to each data point.

78K018(4)–08–80

Figure 6-14 (Sheet 4)

MINIMUM RELEASE ALTITUDE

REQUIRED FOR SAFE ESCAPE AND GROUND CLEARANCE DURING RECOVERY*

RELEASE TAS KTS	RELEASE DIVE ANGLE DEG	ALTITUDE LOST DURING PULLOUT FT	M117 BOMB FT	MK 82 BOMB FT	MK 83 BOMB FT	MK 84 BOMB FT
			MINIMUM RELEASE ALTITUDE FOR FRAGMENTATION ENVELOPE CLEARANCE			
400	5	70	700	700	800	900
400	10	180	1000	900	1000	1200
400	15	330	1200	1100	1200	1400
400	20	510	1500	1200	1500	1700
400	25	730	1700	1500	1700	2000
400	30	890	1900	1700	1900	2200
400	35	1280	2100	1900	2200	2500
400	40	1610	2300	2100	2200	2700
400	45	1950	2500	2200	2600	2900
400	50	2350	2600	2400	2600	3100
400	55	2760	2800	2800	2900	3300
400	60	3210	3300	3300	3300	3400
420	5	70	700	600	700	900
420	10	190	1000	900	1000	1200
420	15	350	1200	1100	1300	1500
420	20	550	1500	1300	1500	1700
420	25	800	1700	1600	1800	2000
420	30	1080	1900	1700	2000	2300
420	35	1390	2200	2000	2200	2500
420	40	1750	2300	2200	2400	2800
420	45	2140	2500	2300	2600	3000
420	50	2560	2700	2600	2800	3100
420	55	3020	3100	3100	3100	3300
420	60	3500	3500	3500	3500	3500
440	5	80	700	600	700	900
440	10	210	1000	900	1000	1200
440	15	380	1200	1100	1300	1500
440	20	600	1500	1300	1500	1800
440	25	860	1700	1600	1800	2000
440	30	1160	2000	1800	2000	2300
440	35	1510	2200	2000	2300	2600
440	40	1890	2400	2200	2500	2800
440	45	2320	2600	2400	2600	3000
440	50	2780	2800	2800	2800	3200
440	55	3280	3300	3300	3300	3400
440	60	3810	3900	3900	3900	3900
460	5	80	700	600	700	900
460	10	220	1000	900	1000	1200
460	15	410	1200	1100	1300	1500
460	20	640	1500	1400	1600	1800
460	25	920	1700	1600	1800	2100
460	30	1250	2000	1800	2100	2400
460	35	1630	2200	2100	2300	2600
460	40	2050	2400	2300	2500	2800
460	45	2510	2600	2600	2800	3100
460	50	3010	3100	3100	3100	3300
460	55	3550	3600	3600	3600	3600
460	60	4120	4200	4200	4200	4200

*These minimum release altitudes are based on a 4.0 g recovery and assume that the 4.0 g is attained within 2.0 seconds after release.

78K131(1)–08–80

Figure 6-15 (Sheet 1)

MINIMUM RELEASE ALTITUDE

REQUIRED FOR SAFE ESCAPE AND GROUND CLEARANCE DURING RECOVERY*

RELEASE		ALTITUDE LOST DURING PULLOUT	MINIMUM RELEASE ALTITUDE FOR FRAGMENTATION ENVELOPE CLEARANCE			
TAS KTS	DIVE ANGLE DEG	FT	M117 BOMB FT	MK 82 BOMB FT	MK 83 BOMB FT	MK 84 BOMB FT
480	5	90	700	600	700	900
480	10	230	1000	900	1000	1200
480	15	430	1200	1100	1300	1500
480	20	690	1500	1400	1600	1800
480	25	990	1700	1700	1800	2100
480	30	1350	2000	1900	2100	2400
480	35	1750	2200	2200	2300	2700
480	40	2200	2400	2300	2600	2800
480	45	2700	2700	2700	2800	3200
480	50	3240	3300	3300	3300	3400
480	55	3820	3900	3900	3900	3900
480	60	4440	4500	4500	4500	4500
500	5	90	700	600	700	900
500	10	250	900	900	1000	1200
500	15	460	1200	1200	1300	1500
500	20	730	1500	1400	1600	1800
500	25	1160	1700	1700	1900	2200
500	30	1440	2000	1900	2200	2500
500	35	1880	2200	2200	2400	2800
500	40	2370	2400	2400	2600	3000
500	45	2900	2900	2900	2900	3300
500	50	3470	3500	3500	3500	3500
500	55	4080	4100	4100	4100	4100
500	60	4740	4800	4800	4800	4800
520	5	100	600	600	700	900
520	10	260	900	900	1000	1200
520	15	490	1200	1200	1300	1500
520	20	780	1500	1500	1600	1900
520	25	1130	1700	1700	1900	2200
520	30	1540	2000	2000	2200	2500
520	35	2000	2200	2200	2400	2800
520	40	2520	2600	2600	2700	3100
520	45	3090	3100	3100	3100	3400
520	50	3700	3700	3700	3700	3700
520	55	4350	4400	4400	4400	4400
520	60	5030	5100	5100	5100	5100
540	5	110	600	600	700	900
540	10	280	900	900	1000	1200
540	15	520	1200	1200	1300	1600
540	20	830	1500	1500	1600	1900
540	25	1200	1800	1800	1900	2300
540	30	1640	2000	2000	2200	2500
540	35	2130	2300	2300	2500	2900
540	40	2680	2700	2700	2700	3200
540	45	3280	3300	3300	3300	3400
540	50	3940	4000	4000	4000	4000
540	55	4640	4700	4700	4700	4700
540	60	5370	5400	5400	5400	5400

*These minimum release altitudes are based on a 4.0 g recovery and assume that the 4.0 g is attained within 2.0 seconds after release.

78K131(2)–08–80

Figure 6-15 (Sheet 2)

MINIMUM RELEASE ALTITUDE

REQUIRED FOR SAFE ESCAPE AND GROUND CLEARANCE DURING RECOVERY* (Continued)

RELEASE TAS KTS	RELEASE DIVE ANGLE DEG	ALTITUDE LOST DURING PULLOUT FT	MINIMUM RELEASE ALTITUDE FOR FRAGMENTATION ENVELOPE CLEARANCE: M117 BOMB FT	MK 82 BOMB FT	MK 83 BOMB FT	MK 84 BOMB FT
560	5	110	600	600	700	900
560	10	290	900	900	1000	1200
560	15	550	1200	1200	1300	1600
560	20	880	1500	1500	1700	1900
560	25	1280	1800	1800	1900	2300
560	30	1740	2000	2000	2200	2600
560	35	2270	2300	2300	2500	2900
560	40	2860	2900	2900	2900	3200
560	45	3500	3500	3500	3500	3500
560	50	4180	4200	4200	4200	4200
560	55	4920	5000	5000	5000	5000
560	60	5680	5700	5700	5700	5700

REQUIRED FOR SAFE ESCAPE (LEVEL RELEASE)

RELEASE TAS KTS	MINIMUM RELEASE ALTITUDE FOR FRAGMENTATION ENVELOPE CLEARANCE: M117 BOMB FT	MK 82 BOMB FT	MK 83 BOMB FT	MK 84 BOMB FT
	4.0 G MIL POWER PULLUP†			
400	500	400	500	700
420	500	400	500	600
440	500	400	500	600
460	400	400	400	600
480	400	400	400	600
500	400	400	400	600
520	300	400	400	500
540	300	400	400	500
560	300	400	400	500
	STRAIGHT AND LEVEL CONSTANT SPEED			
400	900	1000	1200	1600
420	900	1000	1100	1600
440	900	900	1100	1500
460	800	900	1000	1500
480	800	900	1000	1400
500	800	800	900	1400
520	800	800	900	1400
540	700	800	800	1300
560	700	700	800	1300

*These minimum release altitudes are based on a 4.0 g recovery and assume that the 4.0 g is attained within 2.0 sec after release.

†These minimum release altitudes assume that a 4.0 g mil power is attained 2.0 seconds after release. The g is maintained until a 20 deg–30 deg climb out angle is attained. An alternate maneuver may be accomplished by performing a 4.0 g banked turn using a 60° bank angle. This combination of g forces and bank angle will produce a climbing turn – not a level turn.

78K131(3)–08–80

Figure 6-15 (Sheet 3)

MINIMUM RELEASE ALTITUDE

REQUIRED FOR SAFE ESCAPE AND GROUND CLEARANCE DURING RECOVERY*

RELEASE		ALTITUDE LOST DURING PULLOUT	MINIMUM RELEASE ALTITUDE FOR FRAGMENTATION ENVELOPE CLEARANCE			
TAS KTS	DIVE ANGLE DEG	FT	M117 BOMB FT	MK 82 BOMB FT	MK 83 BOMB FT	MK 84 BOMB FT
400	10	150	900	800	900	1200
400	15	280	1200	1000	1100	1400
400	20	430	1400	1200	1300	1600
400	30	810	1800	1600	1800	2000
400	45	1560	2300	2100	2300	2700
400	60	2490	2700	2500	2800	3200
420	10	160	900	800	900	1200
420	15	300	1200	1000	1100	1400
420	20	460	1400	1200	1400	1600
420	30	880	1800	1600	1800	2100
420	45	1700	2400	2100	2400	2800
420	60	2720	2800	2800	2900	3300
440	10	170	900	800	900	1200
440	15	320	1200	1000	1200	1400
440	20	500	1400	1200	1400	1700
440	30	950	1800	1700	1900	2200
440	45	1840	2400	2200	2500	2900
440	60	2960	3000	3000	3000	3400
460	10	190	900	800	900	1200
460	15	340	1200	1000	1200	1400
460	20	540	1400	1300	1400	1700
460	30	1020	1800	1700	1900	2200
460	45	1990	2400	2300	2500	3000
460	60	3200	3300	3300	3300	3500

*These minimum release altitudes are based on a 5.0 g recovery and assume that the 5.0 g is attained within 2.0 seconds after release.

78K131(4)–08–80

Figure 6-15 (Sheet 4)

MINIMUM RELEASE ALTITUDE

REQUIRED FOR SAFE ESCAPE AND GROUND CLEARANCE DURING RECOVERY*

RELEASE TAS KTS	RELEASE DIVE ANGLE DEG	ALTITUDE LOST DURING PULLOUT FT	MINIMUM RELEASE ALTITUDE FOR FRAGMENTATION ENVELOPE CLEARANCE M117 BOMB FT	MK 82 BOMB FT	MK 83 BOMB FT	MK 84 BOMB FT
480	10	200	900	800	900	1200
480	15	370	1200	1100	1200	1500
480	20	570	1400	1300	1400	1700
480	30	1100	1900	1700	2000	2300
480	45	2140	2500	2300	2600	3000
480	60	3450	3500	3500	3500	3600
500	10	210	900	800	900	1200
500	15	390	1100	1100	1200	1500
500	20	610	1400	1300	1500	1800
500	30	1170	1900	1800	2000	2300
500	45	2300	2500	2400	2600	3100
500	60	3700	3800	3800	3800	3800
520	10	220	900	800	900	1200
520	15	410	1100	1100	1200	1500
520	20	650	1400	1300	1500	1800
520	30	1250	1900	1800	2000	2400
520	45	2450	2500	2500	2700	3200
520	60	3940	4000	4000	4000	4000
540	10	240	800	800	900	1200
540	15	440	1100	1100	1200	1500
540	20	690	1400	1400	1500	1800
540	30	1330	1900	1900	2000	2400
540	45	2610	2700	2700	2700	3300
540	60	4200	4200	4200	4200	4200
560	10	250	800	900	900	1200
560	15	460	1100	1100	1200	1500
560	20	730	1400	1400	1500	1900
560	30	1410	1900	1900	2100	2500
560	45	2780	2800	2800	2800	3400
560	60	4460	4500	4500	4500	4500

*These minimum release altitudes are based on a 5.0 g recovery and assume that the 5.0 g is attained within 2.0 seconds after release.

78K131(5)–08–80

Figure 6-15 (Sheet 5)

MINIMUM RELEASE ALTITUDE

REQUIRED FOR SAFE ESCAPE (LEVEL RELEASE)

RELEASE TAS KTS	MINIMUM RELEASE ALTITUDE FOR FRAGMENTATION ENVELOPE CLEARANCE			
	M117 BOMB FT	MK 82 BOMB FT	MK 83 BOMB FT	MK 84 BOMB FT
5.0 G MIL POWER PULLUP*				
400	400	400	400	600
500	300	300	400	500
600	300	300	300	500
STRAIGHT AND LEVEL CONSTANT SPEED				
400	900	1000	1200	1600
420	900	1000	1100	1600
440	900	900	1100	1500
460	800	900	1000	1500
480	800	900	1000	1400
500	800	800	900	1400
520	800	800	900	1400
540	700	800	800	1300
560	700	700	800	1300

REQUIRED FOR SAFE RECOVERY FROM FRAGMENTS

RELEASE KTAS	RELEASE DIVE ANGLE					
	10°	15°	20°	30°	45°	60°
2.75 FFAR W/MK 1 WARHEAD 4.0 G RECOVERY TO 10 DEG CLIMB						
400	700	900	1200	1600	2200	3300
440	700	1000	1200	1700	2400	3900
480	800	1100	1400	1800	2700	4500
520	800	1100	1500	2000	3100	5100
560	900	1200	1500	2000	3500	5700
2.75 FFAR W/M151 WARHEAD 4.0 G RECOVERY TO 10 DEG CLIMB						
400	600	800	1100	1500	2100	3300
440	700	900	1100	1600	2400	3900
480	700	1000	1200	1700	2700	4500
520	800	1000	1300	1900	3100	5100
560	800	1100	1400	2000	3500	5700

*These minimum release altitudes are based on a 5.0 g recovery and assume that the 5.0 g is attained within 2.0 sec after release.

78K131(6)–08–80

Figure 6-15 (Sheet 6)

DIVE TOSS BALLISTIC DATA — GP BOMBS

2.0G PULLOUT
0.076 SEC RELEASE INTERVAL*

PICKLE CONDITIONS				MIDDLE BOMB IN RIPPLE RELEASE							
KNOTS TAS	DIVE ANGLE DEG	ALT AGL FT	SLANT RANGE FT	PICKLE TO RELEASE TIME SEC	RELEASE ALT FT	RELEASE ANGLE DEG	TIME RELEASE TO IMPACT SEC	BOMB STICK LENGTH (FT) 3	6	8	12
440	−15	1,000	3,860	2.13	620	−12	3.0	90	230	320	500
		1,500	5,800	2.89	1,010	−10	4.8	130	320	450	700
		2,000	7,730	3.57	1,430	− 8	6.6	150	390	540	850
	−30	3,000	6,000	2.58	2,070	−25	5.0	80	210	290	460
		3,500	7,000	2.89	2,470	−25	5.9	100	240	340	530
		4,000	8,000	3.19	2,870	−24	6.8	110	270	380	590
		4,500	9,000	3.50	3,280	−23	7.7	120	290	410	640
		5,000	10,000	3.80	3,690	−22	8.6	130	320	440	700
	−45	6,500	9,190	2.96	4,950	−39	8.0	100	250	340	540
		7,000	9,900	3.12	5,380	−38	8.6	100	260	360	570
		7,500	10,610	3.27	5,800	−38	9.2	110	270	380	600
		8,000	11,310	3.42	6,230	−37	9.8	120	290	410	640
		8,500	12,020	3.57	6,650	−37	10.4	120	300	430	670
		9,000	12,730	3.72	7,080	−37	11.0	130	320	440	700
		9,500	13,440	3.80	7,540	−36	11.6	130	330	460	730
500	−15	1,500	5,800	2.58	990	−11	4.2	120	300	420	660
		2,000	7,730	3.19	1,400	−10	5.8	150	370	520	820
	−30	4,000	8,000	2.96	2,790	−25	6.0	100	250	350	550
		4,500	9,000	3.19	3,210	−24	6.8	110	280	380	600
		5,000	10,000	3.50	3,600	−24	7.6	120	300	420	660
		5,500	11,000	3.72	4,020	−23	8.4	130	320	450	710
		6,000	12,000	3.95	4,440	−23	9.2	140	340	480	750
	−45	8,000	11,310	3.12	6,150	−39	8.9	110	270	380	590
		8,500	12,020	3.27	6,570	−39	9.4	110	280	390	620
		9,000	12,730	3.42	6,980	−38	10.0	120	290	410	650
		9,500	13,440	3.57	7,400	−38	10.5	120	310	430	680
		10,000	14,140	3.72	7,810	−38	11.1	130	320	450	700
		10,500	14,850	3.80	8,270	−37	11.6	130	330	460	730
		11,000	15,560	3.95	8,690	−37	12.2	140	340	480	760

*Minimum release interval programmed into the NAV WD Computer for multiple carriage, pairs release, MRI Class 2 weapons.

78K201(1)−08−80

Figure 6-16 (Sheet 1)

DIVE TOSS BALLISTIC DATA – GP BOMBS

3.0G PULLOUT
0.076 SEC RELEASE INTERVAL*

PICKLE CONDITIONS				MIDDLE BOMB IN RIPPLE RELEASE							
KNOTS TAS	DIVE ANGLE DEG	ALT AGL FT	SLANT RANGE FT	PICKLE TO RELEASE TIME SEC	RELEASE ALT FT	RELEASE ANGLE DEG	TIME RELEASE TO IMPACT SEC	BOMB STICK LENGTH (FT) 3	6	8	12
440	–15	1,000	3,860	1.60	720	–11	3.5	150	390	540	840
		1,500	5,800	2.05	1,160	– 9	5.6	210	530	740	1,170
		2,000	7,730	2.51	1,610	– 7	7.6	250	640	890	1,400
	–30	2,000	4,000	1.52	1,450	–26	3.6	100	240	330	510
		2,500	5,000	1.75	1,870	–25	4.7	120	300	420	650
		3,000	6,000	1.90	2,320	–24	5.7	140	350	490	770
		3,500	7,000	2.13	2,750	–23	6.7	160	400	560	880
		4,000	8,000	2.36	3,190	–22	7.7	180	440	620	980
	–45	3,500	4,950	1.52	2,700	–41	4.7	90	220	310	480
		4,000	5,660	1.67	3,130	–40	5.4	100	260	360	560
		4,500	5,360	1.75	3,590	–40	6.1	120	290	400	630
		5,000	7,070	1.82	4,050	–39	6.8	130	320	440	690
		5,500	7,780	1.98	4,480	–39	7.5	140	340	480	760
		6,000	8,480	2.05	4,940	–38	8.2	150	370	520	810
		6,500	9,190	2.13	5,400	–38	8.8	160	390	550	870
500	–15	1,000	3,860	1.52	690	–12	3.0	140	350	490	760
		1,500	5,800	1.90	1,130	–10	4.9	200	500	710	1,110
		2,000	7,730	2.36	1,570	– 8	6.7	250	630	870	1,380
	–30	2,000	4,000	1.44	1,400	–27	3.2	80	210	290	440
		2,500	5,000	1.60	1,840	–26	4.1	110	270	370	580
		3,000	6,000	1.82	2,260	–25	5.0	130	320	450	700
		3,500	7,000	1.98	2,700	–25	5.9	150	370	510	810
		4,000	8,000	2.13	3,150	–24	6.8	160	410	580	900
	–45	4,500	6,360	1.67	3,510	–41	5.4	100	260	360	560
		5,000	7,070	1.75	3,960	–40	6.0	120	290	400	630
		5,500	7,780	1.82	4,420	–40	6.7	130	310	440	690
		6,000	8,480	1.90	4,880	–40	7.3	140	340	470	740
		6,500	9,190	1.98	5,340	–39	7.9	150	360	510	800
		7,000	9,900	2.13	5,750	–39	8.5	160	390	540	850
		7,500	10,610	2.20	6,210	–38	9.1	160	410	580	900

* Minimum release interval programmed into the NAV WD Computer for multiple carriage, pairs release, MRI Class 2 weapons.

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Figure 6-16 (Sheet 2)

DIVE TOSS BALLISTIC DATA – GP BOMBS

4.0G PULLOUT
0.076 SEC RELEASE INTERVAL*

PICKLE CONDITIONS				MIDDLE BOMB IN RIPPLE RELEASE							
KNOTS TAS	DIVE ANGLE DEG	ALT AGL FT	SLANT RANGE FT	PICKLE TO RELEASE TIME SEC	RELEASE ALT FT	RELEASE ANGLE DEG	TIME RELEASE TO IMPACT SEC	BOMB STICK LENGTH (FT) 3	6	8	12
440	−15	1,000	3,860	1.37	760	−11	3.7	200	510	710	1,110
		1,500	5,800	1.75	1,210	− 8	6.0	290	740	1,040	1,630
		2,000	7,730	2.05	1,690	− 6	8.1	350	870	1,220	1,920
	−30	2,000	4,000	1.37	1,510	−26	3.8	120	320	440	680
		2,500	5,000	1.52	1,960	−25	4.9	160	410	570	880
		3,000	6,000	1.60	2,440	−24	6.0	190	480	670	1,030
		3,500	7,000	1.75	2,890	−23	7.1	220	550	770	1,200
		4,000	8,000	1.90	3,350	−22	8.2	240	610	850	1,340
	−45	3,500	4,950	1.29	2,830	−41	4.9	110	280	390	610
		4,000	5,660	1.44	3,250	−40	5.6	140	340	470	730
		4,500	6,360	1.52	3,710	−39	6.3	160	390	540	830
		5,000	7,070	1.60	4,180	−39	7.1	170	430	600	930
		5,500	7,780	1.67	4,640	−38	7.8	190	470	660	1,020
		6,000	8,480	1.75	5,100	−38	8.5	200	510	710	1,110
		6,500	9,190	1.82	5,570	−37	9.2	220	540	760	1,190
500	−15	1,000	3,860	1.29	740	−12	3.2	170	450	640	1,000
		1,500	5,800	1.60	1,190	−10	5.2	280	700	970	1,520
		2,000	7,730	1.90	1,650	− 8	7.1	340	860	1,210	1,900
	−30	2,000	4,000	1.29	1,470	−27	3.3	110	270	380	590
		2,500	5,000	1.37	1,940	−26	4.3	140	350	490	760
		3,000	6,000	1.52	2,380	−25	5.3	180	440	610	940
		3,500	7,000	1.67	2,830	−24	6.3	200	510	710	1,110
		4,000	8,000	1.82	3,280	−23	7.2	230	580	810	1,270
	−45	3,500	4,950	1.29	2,730	−41	4.3	100	250	350	540
		4,000	5,660	1.37	3,190	−41	4.9	120	300	410	640
		4,500	6,360	1.44	3,650	−41	5.6	140	350	480	740
		5,000	7,070	1.52	4,100	−40	6.3	160	390	540	830
		5,500	7,780	1.60	4,560	−39	6.9	170	430	600	930
		6,000	8,480	1.60	5,060	−39	7.6	190	460	650	1,000
		6,500	9,190	1.67	5,520	−39	8.2	200	500	700	1,080

*Minimum release interval programmed into the NAV WD Computer for multiple carriage, pairs release, MRI Class 2 weapons.

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Figure 6-16 (Sheet 3)

DIVE TOSS BALLISTIC DATA – ROCKEYE II

DIVE TOSS BALLISTIC DATA – ROCKEYE II
4.0 SEC FUNCTION TIME

PICKLE CONDITIONS			SLANT RANGE	PICKLE TO RELEASE TIME	RELEASE ALTITUDE	RELEASE ANGLE	TIME REL TO IMPACT	CLUSTER FUNCTION ALTITUDE
KNOTS TAS	DIVE ANGLE DEG	ALTITUDE AGL FT	FT	SEC	FT	DEG	SEC	FT
2.0 G PULLOUT								
440	30	3500	7000	3.25	2340	-24	6.8	870
		4000	8000	3.75	2690	-23	8.5	1260
		4500	9000	4.30	3020	-21	10.3	1660
		5000	10000	4.90	3350	-20	12.2	2050
		5500	11000	5.60	3670	-18	14.1	2450
		6000	12000	6.30	4000	-17	16.1	2860
500	30	4000	8000	3.35	2640	-25	7.2	1000
		4500	9000	3.80	2980	-24	8.8	1390
		5000	10000	4.35	3290	-22	10.5	1750
		5500	11000	4.95	3590	-21	12.2	2120
		6000	12000	5.55	3900	-20	14.0	2500
		6500	13000	6.20	4210	-18	15.8	2880
440	45	7000	9900	4.10	4870	-36	12.8	2800
500	45	7500	10610	4.05	5120	-37	12.4	2780
3.0 G PULLOUT								
440	30	3500	7000	2.55	2610	-22	8.4	1240
		4000	8000	3.00	2990	-20	10.7	1710
		4500	9000	3.50	3360	-18	13.2	2200
		5000	10000	4.05	3750	-15	15.8	2710
500	30	3500	7000	2.35	2560	-24	7.1	960
		4000	8000	2.65	2950	-23	9.1	1420
		4500	9000	3.10	3310	-21	11.3	1870
		5000	10000	3.60	3660	-19	13.6	2340
		5500	11000	4.15	4010	-16	16.0	2820
440	45	5000	7070	2.25	3830	-38	8.7	1730
		5500	7780	2.50	4210	-37	10.3	2150
		6000	8480	2.75	4600	-36	12.0	2580
		6500	9190	3.05	4960	-34	13.8	3000
500	45	5000	7070	2.05	3780	-40	7.4	1400
		5500	7780	2.25	4170	-39	8.8	1820
		6000	8480	2.50	4530	-38	10.3	2220
		6500	9190	2.75	4900	-37	11.9	2630
4.0 G PULLOUT								
440	15	2000	7730	2.80	1630	- 2	12.0	1260
500	15	2000	7730	2.45	1580	- 6	9.8	990
440	30	3500	7000	2.20	2750	-21	9.4	1430
		4000	8000	2.60	3140	-18	12.1	1960
		4500	9000	3.05	3550	-15	15.0	2520
500	30	3500	7000	2.00	2700	-24	7.9	1150
		4000	8000	2.35	3090	-21	10.2	1640
		4500	9000	2.70	3480	-19	12.8	2160
		5000	10000	3.15	3870	-16	15.5	2700
440	45	5000	7070	2.00	3970	-37	9.5	1920
		5500	7780	2.20	4380	-36	11.4	2390
		6000	8480	2.40	4790	-34	13.3	2850
500	45	5000	7070	1.80	3940	-40	8.1	1590
		5500	7780	2.00	4330	-38	9.6	2030
		6000	8480	2.20	4720	-37	11.4	2480
		6500	9190	2.40	5120	-36	13.2	2930

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Figure 6-17

DIVE TOSS BALLISTIC DATA – CBU-24B/B AND CBU-49B/B

DIVE TOSS BALLISTIC DATA – CBU-24B/B AND CBU-49B/B
5.0 SEC FUNCTION TIME

PICKLE CONDITIONS			SLANT RANGE	PICKLE TO RELEASE TIME	RELEASE ALTITUDE	RELEASE ANGLE	TIME REL TO IMPACT	CLUSTER FUNCTION ALTITUDE	PATTERN DIAMETER
KNOTS TAS	DIVE ANGLE DEG	ALTITUDE AGL FT	FT	SEC	FT	DEG	SEC	FT	FT
				2.0 G PULLOUT					
440	15	2500	9660	4.95	1790	- 5	10.9	990	860
		3000	11590	6.55	2220	- 1	15.7	1670	1100
500	15	3000	11590	5.55	2110	- 5	12.8	1280	1000
		3500	13520	7.15	2530	- 2	17.3	1940	1230
440	30	5000	10000	4.50	3470	-21	11.7	1620	880
		5500	11000	5.20	3770	-19	14.0	2025	1100
		6000	12000	5.95	4080	-17	16.5	2450	1330
		6500	13000	6.75	4400	-16	19.0	2880	1560
500	30	5500	11000	4.55	3720	-22	11.7	1660	920
		6000	12000	5.15	4030	-21	13.9	2050	1120
		6500	13000	5.85	4310	-19	16.2	2440	1330
440	45	7000	9900	3.80	5030	-37	12.2	2190	970
		7500	10610	4.15	5360	-36	14.0	2560	1190
		8000	11310	4.60	5640	-35	15.8	2890	1400
500	45	8000	11310	4.10	5590	-37	13.5	2490	1160
		8500	12020	4.45	5900	-36	15.2	2840	1360
				3.0 G PULLOUT					
500	15	2500	9660	3.45	1940	- 4	12.3	1170	970
440	30	4500	9000	3.15	3450	-19	12.5	1730	960
		5000	10000	3.75	3810	-16	15.8	2270	1240
		5500	11000	4.45	4170	-13	19.3	2850	1560
500	30	4500	9000	2.80	3400	-22	10.1	1360	780
		5000	10000	3.25	3760	-20	12.9	1840	1030
		5500	11000	3.80	4100	-18	16.0	2350	1300
		6000	12000	4.45	4440	-15	19.2	2880	1590
440	45	6000	8480	2.40	4760	-38	11.1	1960	840
		6500	9190	2.80	5070	-36	13.2	2360	1080
		7000	9900	3.10	5440	-34	15.5	2800	1350
500	45	6500	9190	2.50	5030	-38	10.9	1950	840
		7000	9900	2.75	5400	-37	13.0	2370	1090
		7500	10610	3.10	5710	-35	15.0	2770	1330
				4.0 G PULLOUT					
440	15	2000	7730	2.55	1640	- 4	11.0	950	840
500	15	2500	9660	3.10	2590	- 1	14.9	1490	1090
440	30	4000	8000	2.35	3210	-20	11.0	1460	820
		4500	9000	2.80	3600	-17	14.7	2060	1130
		5000	10000	3.40	3980	-12	18.8	2720	1480
500	30	4500	9000	2.45	3560	-21	11.7	1620	920
		5000	10000	2.90	3930	-18	15.2	2200	1220
		5500	11000	3.45	4300	-14	19.0	2810	1560
440	45	5500	7780	2.00	4470	-37	10.1	1710	720
		6000	8480	2.20	4880	-36	12.4	2190	980
		6500	9190	2.45	5270	-34	14.9	2670	1280
500	45	6000	8480	2.00	4830	-38	10.1	1750	740
		6500	9190	2.20	5220	-37	12.3	2220	1000
		7000	9900	2.45	5590	-35	14.6	2680	1280

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Figure 6-18

RELEASE ENVELOPE FOR CBU-52B/B AND CBU-58/B WITH FMU-56D/B FUZE

SINGLE RELEASE

RELEASE ALTITUDE – FEET

REL ANG–DEG	0			-15			-30			-45		
REL VEL–KTAS	400	500	600	400	500	600	400	500	600	400	500	600
	HEIGHT OF BURST = 1100 FT											
MIN ALT	–	2500	2500	–	–	3000	–	–	–	–	–	–
MAX ALT	–	2500	3500	–	–	3500	–	–	–	–	–	–
	HEIGHT OF BURST = 1500 FT											
MIN ALT	3000	3000	3000	3000	3500	3500	–	4000	4000	–	–	–
MAX ALT	4000	6000	7500	4000	6500	9000	–	5000	7500	–	–	–
	HEIGHT OF BURST = 1800 FT											
MIN ALT	3500	3500	3500	3500	3500	3500	4000	4500	4500	–	5000	5000
MAX ALT	10500	20000	20000	12000	20000	20000	9000	19000	20000	–	13000	19000
	HEIGHT OF BURST = 2000 FT											
MIN ALT	3500	3500	3500	3500	4000	4000	4000	4500	4500	4500	5000	5500
MAX ALT	45000	45000	45000	20000	20000	20000	20000	20000	20000	20000	20000	20000
	HEIGHT OF BURST = 2200 FT											
MIN ALT	3500	3500	4000	4000	4000	4000	4500	4500	5000	5000	5500	5500
MAX ALT	45000	45000	45000	20000	20000	20000	20000	20000	20000	20000	20000	20000
	HEIGHT OF BURST = 2500 FT											
MIN ALT	4000	4000	4000	4000	4500	4500	4500	5000	5000	5000	5500	6000
MAX ALT	45000	45000	45000	20000	20000	20000	20000	20000	20000	20000	20000	20000
	HEIGHT OF BURST = 3000 FT											
MIN ALT	4500	4500	4500	4500	5000	5000	5000	5500	5500	5500	6000	6500
MAX ALT	45000	45000	45000	20000	20000	20000	20000	20000	20000	20000	20000	20000

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Figure 6-19 (Sheet 1)

RELEASE ENVELOPE FOR CBU-52B/B AND CBU-58/B WITH FMU-56D/B FUZE

RIPPLE (UP TO SIX) RELEASES (SEE NOTE)
RELEASE INTERVAL = 50 MILLISECONDS

RELEASE ALTITUDE – FEET

REL ANG–DEG	0			–15			–30			–45		
REL VEL–KTAS	400	500	600	400	500	600	400	500	600	400	500	600
(20 FT SPACIAL SEPARATION AT OUTER RANGE GATE)												
HEIGHT OF BURST = 1100 FT												
MIN ALT	–	–	3500	–	–	–	–	–	–	–	–	–
MAX ALT	–	–	3500	–	–	–	–	–	–	–	–	–
HEIGHT OF BURST = 1500 FT												
MIN ALT	–	4700	3900	–	–	7500	–	–	–	–	–	–
MAX ALT	–	6000	7500	–	–	9000	–	–	–	–	–	–
HEIGHT OF BURST = 1800 FT												
MIN ALT	5400	5000	4200	8200	8700	7800	–	13500	13300	–	–	–
MAX ALT	10500	20000	20000	12000	20000	20000	–	19000	20000	–	–	–
HEIGHT OF BURST = 2000 FT												
MIN ALT	5600	5200	4400	8400	8900	8000	12800	13700	13500	19200	–	–
MAX ALT	45000	45000	45000	20000	20000	20000	20000	20000	20000	20000	–	–
HEIGHT OF BURST = 2200 FT												
MIN ALT	5800	5400	4600	8600	9100	8200	13000	13900	13700	19400	–	–
MAX ALT	45000	45000	45000	20000	20000	20000	20000	20000	20000	20000	–	–
(24 FT SPACIAL SEPARATION AT OUTER RANGE GATE)												
HEIGHT OF BURST = 2500 FT												
MIN ALT	7500	7000	6000	11500	11700	10900	17300	19000	17900	–	–	–
MAX ALT	45000	45000	45000	20000	20000	20000	20000	20000	20000	–	–	–
(38 FT SPACIAL SEPARATION AT OUTER RANGE GATE)												
HEIGHT OF BURST = 3000 FT												
MIN ALT	16400	15000	12900	–	–	–	–	–	–	–	–	–
MAX ALT	45000	45000	45000	–	–	–	–	–	–	–	–	–

NOTE

For ripples of greater than six but not more than 12, the minimum release altitudes should be increased to compensate for the additional aircraft loss in altitude during the larger ripple release. For a release interval of 50 milliseconds increase the minimum release altitude 75 feet for a 15° dive, 125 feet for a 30° dive, and 150 feet for a 45° dive.

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Figure 6-19 (Sheet 2)

RELEASE ENVELOPE FOR CBU-52B/B AND CBU-58/B WITH FMU-56D/B FUZE

RIPPLE (UP TO SIX) RELEASES (SEE NOTE)
RELEASE INTERVAL = 100 MILLISECONDS

RELEASE ALTITUDE – FEET

REL ANG–DEG	0			–15			–30			–45		
REL VEL–KTAS	400	500	600	400	500	600	400	500	600	400	500	600
(20 FT SPACIAL SEPARATION AT OUTER RANGE GATE)												
HEIGHT OF BURST = 1100 FT												
MIN ALT	–	2500	2500	–	–	–	–	–	–	–	–	–
MAX ALT	–	2500	3500	–	–	–	–	–	–	–	–	–
HEIGHT OF BURST = 1500 FT												
MIN ALT	3000	3000	3000	4000	4200	4400	–	–	6500	–	–	–
MAX ALT	4000	6000	7500	4000	6500	9000	–	–	7500	–	–	–
HEIGHT OF BURST = 1800 FT												
MIN ALT	3500	3500	3500	4300	4500	4700	5600	6500	6800	–	8700	10000
MAX ALT	10500	20000	20000	12000	20000	20000	9000	19000	20000	–	13000	19000
HEIGHT OF BURST = 2000 FT												
MIN ALT	3500	3500	3500	4500	4700	4900	5800	6700	7000	7000	8900	10200
MAX ALT	45000	45000	45000	20000	20000	20000	20000	20000	20000	20000	20000	20000
HEIGHT OF BURST = 2200 FT												
MIN ALT	3500	3500	4000	4700	4900	5100	6000	6900	7200	7200	9100	10400
MAX ALT	45000	45000	45000	20000	20000	20000	20000	20000	20000	20000	20000	20000
(24 FT SPACIAL SEPARATION AT OUTER RANGE GATE)												
HEIGHT OF BURST = 2500 FT												
MIN ALT	4100	4000	4000	5500	5800	5900	7000	8100	8700	8800	11300	12800
MAX ALT	45000	45000	45000	20000	20000	20000	20000	20000	20000	20000	20000	20000
(38 FT SPACIAL SEPARATION AT OUTER RANGE GATE)												
HEIGHT OF BURST = 3000 FT												
MIN ALT	6100	5900	5600	8500	9100	9100	11300	13200	13800	15100	20000	–
MAX ALT	45000	45000	45000	20000	20000	20000	20000	20000	20000	20000	20000	–

NOTE

For ripples of greater than six but not more than 12, the minimum release altitudes should be increased to compensate for the additional aircraft loss in altitude during the larger ripple release. For a release interval of 100 milliseconds increase the minimum release altitude 150 feet for a 15° dive, 300 feet for a 30° dive, and 400 feet for a 45° dive.

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Figure 6-19 (Sheet 3)

RELEASE ENVELOPE FOR CBU-52B/B AND CBU-58/B WITH FMU-56D/B FUZE

RIPPLE (UP TO SIX) RELEASES (SEE NOTE)
RELEASE INTERVAL = 150 MILLISECONDS

RELEASE ALTITUDE – FEET

REL ANG–DEG	0			–15			–30			–45		
REL VEL–KTAS	400	500	600	400	500	600	400	500	600	400	500	600
(20 FT SPACIAL SEPARATION AT OUTER RANGE GATE)												
HEIGHT OF BURST = 1100 FT												
MIN ALT	–	2500	2500	–	–	3000	–	–	–	–	–	–
MAX ALT	–	2500	3500	–	–	3500	–	–	–	–	–	–
HEIGHT OF BURST = 1500 FT												
MIN ALT	3000	3000	3000	3300	3500	3500	–	4800	4800	–	–	–
MAX ALT	4000	6000	7500	4000	6500	9000	–	5000	7500	–	–	–
HEIGHT OF BURST = 1800 FT												
MIN ALT	3500	3500	3500	3600	3800	3700	4500	5100	5100	–	6700	7400
MAX ALT	10500	20000	20000	12000	20000	20000	9000	19000	20000	–	13000	19000
HEIGHT OF BURST = 2000 FT												
MIN ALT	3500	3500	3500	3800	4000	4000	4700	5300	5300	5800	6900	7600
MAX ALT	45000	45000	45000	20000	20000	20000	20000	20000	20000	20000	20000	20000
HEIGHT OF BURST = 2200 FT												
MIN ALT	3500	3500	4000	4000	4200	4100	4900	5500	5500	6000	7100	7800
MAX ALT	45000	45000	45000	20000	20000	20000	20000	20000	20000	20000	20000	20000
(24 FT SPACIAL SEPARATION AT OUTER RANGE GATE)												
HEIGHT OF BURST = 2500 FT												
MIN ALT	4000	4000	4000	4700	4800	4800	5700	6400	6600	7100	8400	9100
MAX ALT	45000	45000	45000	20000	20000	20000	20000	20000	20000	20000	20000	20000
(38 FT SPACIAL SEPARATION AT OUTER RANGE GATE)												
HEIGHT OF BURST = 3000 FT												
MIN ALT	4800	4700	4500	6500	6800	6700	8300	9400	9500	10300	13000	14100
MAX ALT	45000	45000	45000	20000	20000	20000	20000	20000	20000	20000	20000	20000

NOTE

For ripples of greater than six but not more than 12, the minimum release altitudes should be increased to compensate for the additional aircraft loss in altitude during the larger ripple release. For a release interval of 150 milliseconds increase the minimum release altitude 200 feet for a 15° dive, 450 feet for a 30° dive, and 600 feet for a 45° dive.

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Figure 6-19 (Sheet 4)

RELEASE ENVELOPE FOR CBU-52B/B AND CBU-58/B WITH FMU-56D/B FUZE

RIPPLE (UP TO SIX) RELEASES (SEE NOTE)
RELEASE INTERVAL = 200 MILLISECONDS

RELEASE ALTITUDE – FEET

REL ANG–DEG	0			–15			–30			–45		
REL VEL–KTAS	400	500	600	400	500	600	400	500	600	400	500	600
(20 FT SPACIAL SEPARATION AT OUTER RANGE GATE)												
HEIGHT OF BURST = 1100 FT												
MIN ALT	–	2500	2500	–	–	3000	–	–	–	–	–	–
MAX ALT	–	2500	3500	–	–	3500	–	–	–	–	–	–
HEIGHT OF BURST = 1500 FT												
MIN ALT	3000	3000	3000	3000	3500	3500	–	4200	4400	–	–	–
MAX ALT	4000	6000	7500	4000	6500	9000	–	5000	7500	–	–	–
HEIGHT OF BURST = 1800 FT												
MIN ALT	3500	3500	3500	3500	3500	3600	4000	4500	4700	–	5500	6300
MAX ALT	10500	20000	20000	12000	20000	20000	9000	19000	20000	–	13000	19000
HEIGHT OF BURST = 2000 FT												
MIN ALT	3500	3500	3500	3500	4000	4000	4100	4700	4900	4800	5700	6500
MAX ALT	45000	45000	45000	20000	20000	20000	20000	20000	20000	20000	20000	20000
HEIGHT OF BURST = 2200 FT												
MIN ALT	3500	3500	4000	4000	4000	4000	4500	4900	5100	5000	5900	6700
MAX ALT	45000	45000	45000	20000	20000	20000	20000	20000	20000	20000	20000	20000
(24 FT SPACIAL SEPARATION AT OUTER RANGE GATE)												
HEIGHT OF BURST = 2500 FT												
MIN ALT	4000	4000	4000	4300	4500	4500	5000	5600	5800	5800	6800	7700
MAX ALT	45000	45000	45000	20000	20000	20000	20000	20000	20000	20000	20000	20000
(38 FT SPACIAL SEPARATION AT OUTER RANGE GATE)												
HEIGHT OF BURST = 3000 FT												
MIN ALT	4500	4500	4500	5500	5800	5800	6800	7700	8000	8100	9800	11200
MAX ALT	45000	45000	45000	20000	20000	20000	20000	20000	20000	20000	20000	20000

NOTE

For ripples of greater than six but not more than 12, the minimum release altitudes should be increased to compensate for the additional aircraft loss in altitude during the larger ripple release. For a release interval of 200 milliseconds increase the minimum release altitude 300 feet for a 15° dive, 550 feet for a 30° dive, and 800 feet for a 45° dive.

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Figure 6-19 (Sheet 5)

RELEASE ENVELOPE FOR CBU-52B/B AND CBU-58/B WITH FMU-56D/B FUZE

RIPPLE (UP TO SIX) RELEASES (SEE NOTE)
RELEASE INTERVAL = 250 MILLISECONDS

RELEASE ALTITUDE – FEET

REL ANG–DEG	0			–15			–30			–45		
REL VEL–KTAS	400	500	600	400	500	600	400	500	600	400	500	600
(20 FT SPACIAL SEPARATION AT OUTER RANGE GATE)												
HEIGHT OF BURST = 1100 FT												
MIN ALT	–	2500	2500	–	–	3000	–	–	–	–	–	–
MAX ALT	–	2500	3500	–	–	3500	–	–	–	–	–	–
HEIGHT OF BURST = 1500 FT												
MIN ALT	3000	3000	3000	3000	3500	3500	–	4000	4100	–	–	–
MAX ALT	4000	6000	7500	4000	6500	9000	–	5000	7500	–	–	–
HEIGHT OF BURST = 1800 FT												
MIN ALT	3500	3500	3500	3500	3500	3500	4000	4500	4500	–	5200	5700
MAX ALT	10500	20000	20000	12000	20000	20000	9000	19000	20000	–	13000	19000
HEIGHT OF BURST = 2000 FT												
MIN ALT	3500	3500	3500	3500	4000	4000	4000	4500	4600	4700	5400	5900
MAX ALT	45000	45000	45000	20000	20000	20000	20000	20000	20000	20000	20000	20000
HEIGHT OF BURST = 2200 FT												
MIN ALT	3500	3500	4000	4000	4000	4000	4500	4600	5000	5000	5600	6100
MAX ALT	45000	45000	45000	20000	20000	20000	20000	20000	20000	20000	20000	20000
(24 FT SPACIAL SEPARATION AT OUTER RANGE GATE)												
HEIGHT OF BURST = 2500 FT												
MIN ALT	4000	4000	4000	4200	4500	4500	4700	5200	5500	5500	6400	6900
MAX ALT	45000	45000	45000	20000	20000	20000	20000	20000	20000	20000	20000	20000
(38 FT SPACIAL SEPARATION AT OUTER RANGE GATE)												
HEIGHT OF BURST = 3000 FT												
MIN ALT	4500	4500	4500	5200	5500	5500	6300	6900	7200	7500	8800	9600
MAX ALT	45000	45000	45000	20000	20000	20000	20000	20000	20000	20000	20000	20000

NOTE

For ripples of greater than six but not more than 12, the minimum release altitudes should be increased to compensate for the additional aircraft loss in altitude during the larger ripple release. For a release interval of 250 milliseconds increase the minimum release altitude 350 feet for a 15° dive, 700 feet for a 30° dive, and 1,000 feet for a 45° dive.

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Figure 6-19 (Sheet 6)

RELEASE ENVELOPE FOR CBU-52B/B AND CBU-58/B WITH FMU-110/B FUZE

SINGLE, PAIR AND RIPPLE RELEASES

RELEASE ALTITUDE – FEET

REL ANG –DEG	+60				+45				+30				+15			
REL VEL –KTAS	300	400	500	600	300	400	500	600	300	400	500	600	300	400	500	600
	HEIGHT OF BURST = 700 FT															
MIN ALT	–	–	–	–	–	–	–	–	–	–	–	–	–	–	200	100
MAX ALT	–	–	–	–	–	–	–	–	–	–	–	–	–	–	200	100
	HEIGHT OF BURST = 900 FT															
MIN ALT	–	–	–	–	–	–	–	–	–	–	–	–	–	–	400	200
MAX ALT	–	–	–	–	–	–	–	–	–	–	–	–	–	–	600	700
	HEIGHT OF BURST = 1200 FT															
MIN ALT	–	–	–	–	–	–	–	–	–	–	–	–	–	1200	700	500
MAX ALT	–	–	–	–	–	–	–	–	–	–	–	–	–	1400	1500	2000
	HEIGHT OF BURST = 1500 FT															
MIN ALT	–	–	–	–	–	–	–	–	–	100	100	100	1500	1300	1000	800
MAX ALT	–	–	–	–	–	–	–	–	–	500	600	600	1500	3000	3500	4500
	HEIGHT OF BURST = 1800 FT															
MIN ALT	–	–	–	–	–	–	–	–	1100	400	100	100	1800	1600	1300	1100
MAX ALT	–	–	–	–	–	–	–	–	1300	2000	4500	7500	2500	6500	10000	10000
	HEIGHT OF BURST = 2200 FT															
MIN ALT	8000	4500	600	100	5500	100	100	100	1500	800	100	100	2200	2000	1700	1500
MAX ALT	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000
	HEIGHT OF BURST = 2600 FT															
MIN ALT	1600	100	100	100	1000	100	100	100	1900	1200	500	100	3000	2400	2100	1900
MAX ALT	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000
	HEIGHT OF BURST = 3000 FT															
MIN ALT	1000	100	100	100	1400	100	100	100	2300	1600	900	100	3000	2800	2500	2300
MAX ALT	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000

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Figure 6-20 (Sheet 1)

RELEASE ENVELOPE FOR CBU-52B/B AND CBU-58/B WITH FMU-110/B FUZE

SINGLE AND PAIR RELEASES

RELEASE ALTITUDE – FEET

REL ANG–DEG	0				-15				-30			
REL VEL–KTAS	300	400	500	600	300	400	500	600	300	400	500	600
HEIGHT OF BURST = 500 FT												
MIN ALT	–	–	–	700	–	–	–	–	–	–	–	–
MAX ALT	–	–	–	800	–	–	–	–	–	–	–	–
HEIGHT OF BURST = 700 FT												
MIN ALT	–	–	900	900	–	–	–	–	–	–	–	–
MAX ALT	–	–	1100	1400	–	–	–	–	–	–	–	–
HEIGHT OF BURST = 900 FT												
MIN ALT	–	1100	1100	1100	–	–	–	1800	–	–	–	–
MAX ALT	–	1200	1800	2300	–	–	–	2200	–	–	–	–
HEIGHT OF BURST = 1200 FT												
MIN ALT	–	1400	1400	1400	–	1900	2000	2500	–	–	–	–
MAX ALT	–	2000	3000	4000	–	2000	3000	4500	–	–	–	–
HEIGHT OF BURST = 1500 FT												
MIN ALT	1700	1700	1700	1700	–	2500	2500	2500	–	–	3000	3500
MAX ALT	2100	4000	6000	7500	–	4000	6500	8000	–	–	5000	7500
HEIGHT OF BURST = 1800 FT												
MIN ALT	2000	2000	2000	2000	2400	2500	3000	3000	–	3000	3500	3500
MAX ALT	3500	10500	20000	20000	3500	12000	20000	20000	–	9000	19000	20000
HEIGHT OF BURST = 2200 FT												
MIN ALT	2400	2400	2400	2400	2800	2900	3000	3500	3500	3500	4000	4000
MAX ALT	45000	45000	45000	45000	20000	20000	20000	20000	20000	20000	20000	20000
HEIGHT OF BURST = 2600 FT												
MIN ALT	2800	2800	2800	2800	3200	3500	3500	3500	3500	4000	4000	4500
MAX ALT	45000	45000	45000	45000	20000	20000	20000	20000	20000	20000	20000	20000
HEIGHT OF BURST = 3000 FT												
MIN ALT	3200	3200	3200	3200	3600	4000	4000	4000	3900	4500	4500	5000
MAX ALT	45000	45000	45000	45000	20000	20000	20000	20000	20000	20000	20000	20000

RELEASE ALTITUDE – FEET

REL ANG–DEG	-45				-60			
REL VEL–KTAS	300	400	500	600	300	400	500	600
HEIGHT OF BURST = 1500 FT								
MIN ALT	–	–	–	4000	–	–	–	–
MAX ALT	–	–	–	4000	–	–	–	–
HEIGHT OF BURST = 1800 FT								
MIN ALT	–	–	4000	4000	–	–	–	4500
MAX ALT	–	–	13000	19000	–	–	–	10000
HEIGHT OF BURST = 2200 FT								
MIN ALT	3500	4000	4500	4500	6000	4500	4500	5000
MAX ALT	20000	20000	20000	20000	20000	20000	20000	20000
HEIGHT OF BURST = 2600 FT								
MIN ALT	4000	4500	4500	5000	4500	4500	5000	5500
MAX ALT	20000	20000	20000	20000	20000	20000	20000	20000
HEIGHT OF BURST = 3000 FT								
MIN ALT	4500	5000	5000	5500	4500	5000	5500	6000
MAX ALT	20000	20000	20000	20000	20000	20000	20000	20000

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Figure 6-20 (Sheet 2)

RELEASE ENVELOPE FOR CBU-52B/B AND CBU-58/B WITH FMU-110/B FUZE

RIPPLE OF SIX
RELEASE INTERVAL = 60 MILLISECONDS

RELEASE ALTITUDE – FEET

REL ANG–DEG	0				-15				-30			
REL VEL–KTAS	300	400	500	600	300	400	500	600	300	400	500	600
	HEIGHT OF BURST = 900 FT											
MIN ALT	—	—	—	2100	—	—	—	—	—	—	—	—
MAX ALT	—	—	—	2300	—	—	—	—	—	—	—	—
	HEIGHT OF BURST = 1200 FT											
MIN ALT	—	—	3000	2400	—	—	—	—	—	—	—	—
MAX ALT	—	—	3000	4000	—	—	—	—	—	—	—	—
	HEIGHT OF BURST = 1500 FT											
MIN ALT	—	3400	3300	2700	—	—	6300	5400	—	—	—	—
MAX ALT	—	4000	6000	7500	—	—	6500	8000	—	—	—	—
	HEIGHT OF BURST = 1800 FT											
MIN ALT	—	3700	3600	3000	—	6600	6600	5700	—	—	10800	9900
MAX ALT	—	10500	20000	20000	—	12000	20000	20000	—	—	19000	20000
	HEIGHT OF BURST = 2200 FT											
MIN ALT	4500	4100	4000	3400	6300	7000	7000	6100	8600	10300	11200	10300
MAX ALT	45000	45000	45000	45000	20000	20000	20000	20000	20000	20000	20000	20000

RELEASE ALTITUDE – FEET

REL ANG–DEG	-45				-60			
REL VEL–KTAS	300	400	500	600	300	400	500	600
	HEIGHT OF BURST = 900 FT							
MIN ALT	—	—	—	—	—	—	—	—
MAX ALT	—	—	—	—	—	—	—	—
	HEIGHT OF BURST = 1200 FT							
MIN ALT	—	—	—	—	—	—	—	—
MAX ALT	—	—	—	—	—	—	—	—
	HEIGHT OF BURST = 1500 FT							
MIN ALT	—	—	—	—	—	—	—	—
MAX ALT	—	—	—	—	—	—	—	—
	HEIGHT OF BURST = 1800 FT							
MIN ALT	—	—	—	16300	—	—	—	—
MAX ALT	—	—	—	19000	—	—	—	—
	HEIGHT OF BURST = 2200 FT							
MIN ALT	10700	14600	18400	16700	13400	—	—	—
MAX ALT	20000	20000	20000	20000	20000	—	—	—

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Figure 6-20 (Sheet 3)

RELEASE ENVELOPE FOR CBU-52B/B AND CBU-58/B WITH FMU-110/B FUZE

RIPPLE OF SIX
RELEASE INTERVAL = 100 MILLISECONDS

RELEASE ALTITUDE – FEET

REL ANG–DEG	0				-15				-30			
REL VEL–KTAS	300	400	500	600	300	400	500	600	300	400	500	600
	HEIGHT OF BURST = 700 FT											
MIN ALT	–	–	–	1300	–	–	–	–	–	–	–	–
MAX ALT	–	–	–	1400	–	–	–	–	–	–	–	–
	HEIGHT OF BURST = 900 FT											
MIN ALT	–	–	1600	1500	–	–	–	–	–	–	–	–
MAX ALT	–	–	1800	2300	–	–	–	–	–	–	–	–
	HEIGHT OF BURST = 1200 FT											
MIN ALT	–	2000	1900	1800	–	–	–	3600	–	–	–	–
MAX ALT	–	2000	3000	4000	–	–	–	4500	–	–	–	–
	HEIGHT OF BURST = 1500 FT											
MIN ALT	–	2300	2200	2100	–	3500	3700	3900	–	–	–	6000
MAX ALT	–	4000	6000	7500	–	4000	6500	8000	–	–	–	7500
	HEIGHT OF BURST = 1800 FT											
MIN ALT	2600	2600	2500	2400	3400	3800	4000	4200	–	5100	6000	6300
MAX ALT	3500	10500	20000	20000	3500	12000	20000	20000	–	9000	19000	20000
	HEIGHT OF BURST = 2200 FT											
MIN ALT	3000	3000	2900	2800	3800	4200	4400	4600	4800	5500	6400	6700
MAX ALT	45000	45000	45000	45000	20000	20000	20000	20000	20000	20000	20000	20000

RELEASE ALTITUDE – FEET

REL ANG–DEG	-45				-60			
REL VEL–KTAS	300	400	500	600	300	400	500	600
	HEIGHT OF BURST = 700 FT							
MIN ALT	–	–	–	–	–	–	–	–
MAX ALT	–	–	–	–	–	–	–	–
	HEIGHT OF BURST = 900 FT							
MIN ALT	–	–	–	–	–	–	–	–
MAX ALT	–	–	–	–	–	–	–	–
	HEIGHT OF BURST = 1200 FT							
MIN ALT	–	–	–	–	–	–	–	–
MAX ALT	–	–	–	–	–	–	–	–
	HEIGHT OF BURST = 1500 FT							
MIN ALT	–	–	–	–	–	–	–	–
MAX ALT	–	–	–	–	–	–	–	–
	HEIGHT OF BURST = 1800 FT							
MIN ALT	–	–	8200	9500	–	–	–	–
MAX ALT	–	–	13000	19000	–	–	–	–
	HEIGHT OF BURST = 2200 FT							
MIN ALT	5500	6700	8600	9900	6300	8000	12200	16800
MAX ALT	20000	20000	20000	20000	20000	20000	20000	20000

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Figure 6-20 (Sheet 4)

RELEASE ENVELOPE FOR CBU-52B/B AND CBU-58/B WITH FMU-110/B FUZE

RIPPLE OF SIX
RELEASE INTERVAL = 140 MILLISECONDS

RELEASE ALTITUDE – FEET

REL ANG–DEG	0				-15				-30			
REL VEL–KTAS	300	400	500	600	300	400	500	600	300	400	500	600
	HEIGHT OF BURST = 700 FT											
MIN ALT	–	–	1100	1100	–	–	–	–	–	–	–	–
MAX ALT	–	–	1100	1400	–	–	–	–	–	–	–	–
	HEIGHT OF BURST = 900 FT											
MIN ALT	–	–	1300	1300	–	–	–	–	–	–	–	–
MAX ALT	–	–	1800	2300	–	–	–	–	–	–	–	–
	HEIGHT OF BURST = 1200 FT											
MIN ALT	–	1700	1600	1600	–	–	2800	2800	–	–	–	–
MAX ALT	–	2000	3000	4000	–	–	3000	4500	–	–	–	–
	HEIGHT OF BURST = 1500 FT											
MIN ALT	2000	2000	1900	1900	–	3000	3100	3100	–	–	4400	4700
MAX ALT	2100	4000	6000	7500	–	4000	6500	8000	–	–	5000	7500
	HEIGHT OF BURST = 1800 FT											
MIN ALT	2300	2300	2200	2200	2900	3300	3400	3400	–	4100	4700	5000
MAX ALT	3500	10500	20000	20000	3500	12000	20000	20000	–	9000	19000	20000
	HEIGHT OF BURST = 2200 FT											
MIN ALT	2700	2700	2600	2600	3300	3700	3800	3800	4000	4500	5100	5400
MAX ALT	45000	45000	45000	45000	20000	20000	20000	20000	20000	20000	20000	20000

RELEASE ALTITUDE – FEET

REL ANG–DEG	-45				-60			
REL VEL–KTAS	300	400	500	600	300	400	500	600
	HEIGHT OF BURST = 700 FT							
MIN ALT	–	–	–	–	–	–	–	–
MAX ALT	–	–	–	–	–	–	–	–
	HEIGHT OF BURST = 900 FT							
MIN ALT	–	–	–	–	–	–	–	–
MAX ALT	–	–	–	–	–	–	–	–
	HEIGHT OF BURST = 1200 FT							
MIN ALT	–	–	–	–	–	–	–	–
MAX ALT	–	–	–	–	–	–	–	–
	HEIGHT OF BURST = 1500 FT							
MIN ALT	–	–	–	–	–	–	–	–
MAX ALT	–	–	–	–	–	–	–	–
	HEIGHT OF BURST = 1800 FT							
MIN ALT	–	–	6300	7100	–	–	–	–
MAX ALT	–	–	13000	19000	–	–	–	–
	HEIGHT OF BURST = 2200 FT							
MIN ALT	4700	5400	6700	7500	6300	6400	8700	11700
MAX ALT	20000	20000	20000	20000	20000	20000	20000	20000

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Figure 6-20 (Sheet 5)

RELEASE ENVELOPE FOR CBU-52B/B AND CBU-58/B WITH FMU-110/B FUZE

RIPPLE OF SIX
RELEASE INTERVAL = 200 MILLISECONDS

RELEASE ALTITUDE – FEET

REL ANG–DEG	0				–15				–30			
REL VEL–KTAS	300	400	500	600	300	400	500	600	300	400	500	600
HEIGHT OF BURST = 500 FT												
MIN ALT	–	–	–	800	–	–	–	–	–	–	–	–
MAX ALT	–	–	–	800	–	–	–	–	–	–	–	–
HEIGHT OF BURST = 700 FT												
MIN ALT	–	–	1000	1000	–	–	–	–	–	–	–	–
MAX ALT	–	–	1100	1400	–	–	–	–	–	–	–	–
HEIGHT OF BURST = 900 FT												
MIN ALT	–	1200	1200	1200	–	–	–	2200	–	–	–	–
MAX ALT	–	1200	1800	2300	–	–	–	2200	–	–	–	–
HEIGHT OF BURST = 1200 FT												
MIN ALT	–	1500	1500	1500	–	–	2400	2800	–	–	–	–
MAX ALT	–	2000	3000	4000	–	–	3000	4500	–	–	–	–
HEIGHT OF BURST = 1500 FT												
MIN ALT	1800	1800	1800	1800	–	2700	2700	2800	–	–	3700	4000
MAX ALT	2100	4000	6000	7500	–	4000	6500	8000	–	–	5000	7500
HEIGHT OF BURST = 1800 FT												
MIN ALT	2100	2100	2100	2100	2600	2800	3200	3300	–	3400	4000	4200
MAX ALT	3500	10500	20000	20000	3500	12000	20000	20000	–	9000	19000	20000
HEIGHT OF BURST = 2200 FT												
MIN ALT	2500	2500	2500	2500	3000	3200	3400	3800	3800	3900	4400	4600
MAX ALT	45000	45000	45000	45000	20000	20000	20000	20000	20000	20000	20000	20000

RELEASE ALTITUDE – FEET

REL ANG–DEG	–45				–60			
REL VEL–KTAS	300	400	500	600	300	400	500	600
HEIGHT OF BURST = 500 FT								
MIN ALT	–	–	–	–	–	–	–	–
MAX ALT	–	–	–	–	–	–	–	–
HEIGHT OF BURST = 700 FT								
MIN ALT	–	–	–	–	–	–	–	–
MAX ALT	–	–	–	–	–	–	–	–
HEIGHT OF BURST = 900 FT								
MIN ALT	–	–	–	–	–	–	–	–
MAX ALT	–	–	–	–	–	–	–	–
HEIGHT OF BURST = 1200 FT								
MIN ALT	–	–	–	–	–	–	–	–
MAX ALT	–	–	–	–	–	–	–	–
HEIGHT OF BURST = 1500 FT								
MIN ALT	–	–	–	–	–	–	–	–
MAX ALT	–	–	–	–	–	–	–	–
HEIGHT OF BURST = 1800 FT								
MIN ALT	–	–	5000	5800	–	–	–	8400
MAX ALT	–	–	13000	19000	–	–	–	10000
HEIGHT OF BURST = 2200 FT								
MIN ALT	3900	4500	5400	6200	6500	5100	6400	8800
MAX ALT	20000	20000	20000	20000	20000	20000	20000	20000

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Figure 6-20 (Sheet 6)

RELEASE ENVELOPE FOR CBU-52B/B AND CBU-58/B WITH FMU-110/B FUZE

RIPPLE OF SIX
RELEASE INTERVAL = 250 MILLISECONDS

RELEASE ALTITUDE – FEET

REL ANG–DEG	0				-15				-30			
REL VEL–KTAS	**300**	**400**	**500**	**600**	**300**	**400**	**500**	**600**	**300**	**400**	**500**	**600**
	HEIGHT OF BURST = 500 FT											
MIN ALT	–	–	–	800	–	–	–	–	–	–	–	–
MAX ALT	–	–	–	800	–	–	–	–	–	–	–	–
	HEIGHT OF BURST = 700 FT											
MIN ALT	–	–	1000	1000	–	–	–	–	–	–	–	–
MAX ALT	–	–	1100	1400	–	–	–	–	–	–	–	–
	HEIGHT OF BURST = 900 FT											
MIN ALT	–	1200	1200	1200	–	–	–	2100	–	–	–	–
MAX ALT	–	1200	1800	2300	–	–	–	2200	–	–	–	–
	HEIGHT OF BURST = 1200 FT											
MIN ALT	–	1500	1500	1500	–	–	2300	2800	–	–	–	–
MAX ALT	–	2000	3000	4000	–	–	3000	4500	–	–	–	–
	HEIGHT OF BURST = 1500 FT											
MIN ALT	1800	1800	1800	1800	–	2700	2800	2800	–	–	3500	4100
MAX ALT	2100	4000	6000	7500	–	4000	6500	8000	–	–	5000	7500
	HEIGHT OF BURST = 1800 FT											
MIN ALT	2100	2100	2100	2100	2600	2700	3300	3300	–	3400	4000	4100
MAX ALT	3500	10500	20000	20000	3500	12000	20000	20000	–	9000	19000	20000
	HEIGHT OF BURST = 2200 FT											
MIN ALT	2500	2500	2500	2500	3000	3100	3300	3800	3800	3900	4500	4600
MAX ALT	45000	45000	45000	45000	20000	20000	20000	20000	20000	20000	20000	20000

RELEASE ALTITUDE – FEET

REL ANG–DEG	-45				-60			
REL VEL–KTAS	**300**	**400**	**500**	**600**	**300**	**400**	**500**	**600**
	HEIGHT OF BURST = 500 FT							
MIN ALT	–	–	–	–	–	–	–	–
MAX ALT	–	–	–	–	–	–	–	–
	HEIGHT OF BURST = 700 FT							
MIN ALT	–	–	–	–	–	–	–	–
MAX ALT	–	–	–	–	–	–	–	–
	HEIGHT OF BURST = 900 FT							
MIN ALT	–	–	–	–	–	–	–	–
MAX ALT	–	–	–	–	–	–	–	–
	HEIGHT OF BURST = 1200 FT							
MIN ALT	–	–	–	–	–	–	–	–
MAX ALT	–	–	–	–	–	–	–	–
	HEIGHT OF BURST = 1500 FT							
MIN ALT	–	–	–	–	–	–	–	–
MAX ALT	–	–	–	–	–	–	–	–
	HEIGHT OF BURST = 1800 FT							
MIN ALT	–	–	4800	5200	–	–	–	7500
MAX ALT	–	–	13000	19000	–	–	–	10000
	HEIGHT OF BURST = 2200 FT							
MIN ALT	4000	4600	5300	5600	6600	5300	6100	7900
MAX ALT	20000	20000	20000	20000	20000	20000	20000	20000

78K074(7)–08–80

Figure 6-20 (Sheet 7)

MINIMUM SAFE RELEASE CONDITIONS – CBU-52

DIVE ANGLE (DEGREES)	PULL UP (GEES)	RELEASE VELOCITY (KTAS)	ALTITUDE LOSS DURING RECOVERY (FEET)	TIME OF FALL (SECONDS)	MINIMUM ALTITUDE (FEET)
0	1.0	400	0	3.39	200
0	1.0	420	0	3.39	200
0	1.0	440	0	3.20	180
0	1.0	460	0	3.01	160
0	1.0	480	0	2.91	150
0	1.0	500	0	2.81	140
0	1.0	520	0	2.70	130
0	1.0	540	0	2.59	120
0	1.0	560	0	2.47	110
5	4.0	400	67	2.52	260
5	4.0	420	71	2.47	260
5	4.0	440	77	2.42	260
5	4.0	460	82	2.38	260
5	4.0	480	87	2.34	260
5	4.0	500	93	2.29	260
5	4.0	520	98	2.25	260
5	4.0	540	104	2.21	260
5	4.0	560	109	2.04	240
10	4.0	400	184	2.50	400
10	4.0	420	198	2.43	400
10	4.0	440	213	2.37	410
10	4.0	460	227	2.31	410
10	4.0	480	242	2.25	410
10	4.0	500	258	2.19	410
10	4.0	520	274	2.14	410
10	4.0	540	290	2.10	410
10	4.0	560	306	2.04	410
15	4.0	400	339	2.62	570
15	4.0	420	365	2.54	570
15	4.0	440	392	2.46	570
15	4.0	460	421	2.39	570
15	4.0	480	449	2.32	570
15	4.0	500	480	2.25	570
15	4.0	520	510	2.22	580
15	4.0	540	542	2.17	580
15	4.0	560	576	2.11	580

78K215–08–80

Figure 6-21

MINIMUM SAFE RELEASE CONDITIONS – CBU-58/71

DIVE ANGLE (DEGREES)	PULL UP (GEES)	RELEASE VELOCITY (KTAS)	ALTITUDE LOSS DURING RECOVERY (FEET)	TIME OF FALL (SECONDS)	MINIMUM ALTITUDE (FEET)
0	1.0	400	0	2.58	120
0	1.0	420	0	2.58	120
0	1.0	440	0	2.34	100
0	1.0	460	0	2.34	100
0	1.0	480	0	2.21	90
0	1.0	500	0	2.07	80
0	1.0	520	0	2.07	80
0	1.0	540	0	2.08	80
0	1.0	560	0	1.93	70
5	4.0	400	67	2.07	200
5	4.0	420	71	2.03	200
5	4.0	440	77	1.98	200
5	4.0	460	82	1.94	200
5	4.0	480	87	1.90	200
5	4.0	500	92	1.87	200
5	4.0	520	98	1.83	200
5	4.0	540	104	1.79	200
5	4.0	560	109	1.61	180
10	4.0	400	184	2.08	320
10	4.0	420	198	2.02	320
10	4.0	440	212	1.96	320
10	4.0	460	227	2.01	340
10	4.0	480	242	1.95	340
10	4.0	500	258	1.80	320
10	4.0	520	273	1.75	320
10	4.0	540	290	1.71	320
10	4.0	560	306	1.67	320
15	4.0	400	339	2.22	470
15	4.0	420	365	2.14	470
15	4.0	440	392	2.07	470
15	4.0	460	420	2.01	470
15	4.0	480	449	1.95	470
15	4.0	500	479	1.93	480
15	4.0	520	510	2.01	520
15	4.0	540	543	2.10	560
15	4.0	560	576	2.15	580

78K216–08–80

Figure 6-22

BOMB SPACING FOR MANUAL RIPPLE BOMBING CHART (LDGP BOMBS AND FINNED FIRE BOMBS – STRAIGHT PATH DELIVERY)

5° DIVE RELEASE CONDITION

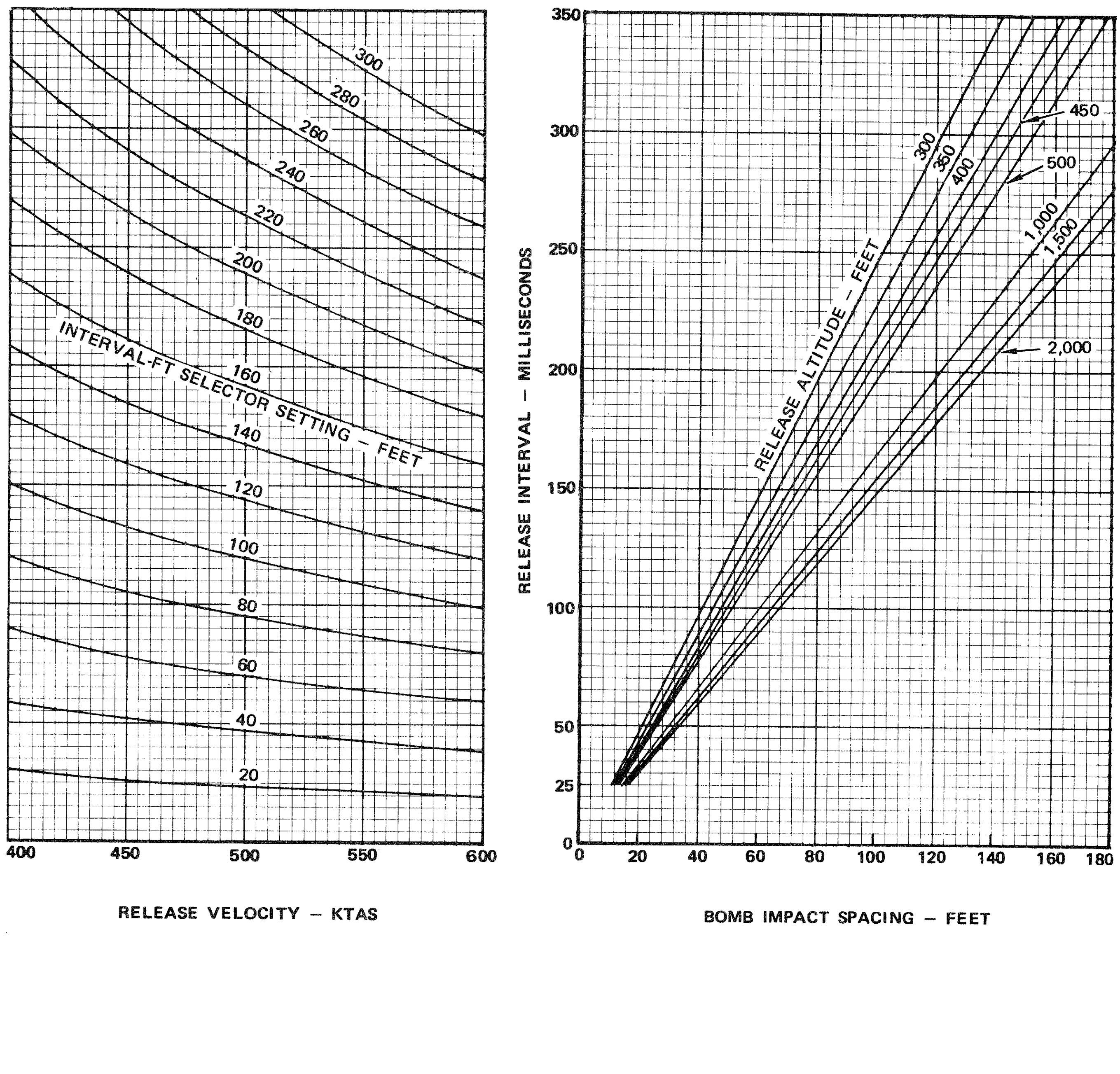


Figure 6-23 (Sheet 1)

BOMB SPACING FOR MANUAL RIPPLE BOMBING CHART (LDGP BOMBS AND FINNED FIRE BOMBS – STRAIGHT PATH DELIVERY)

10° DIVE RELEASE CONDITION

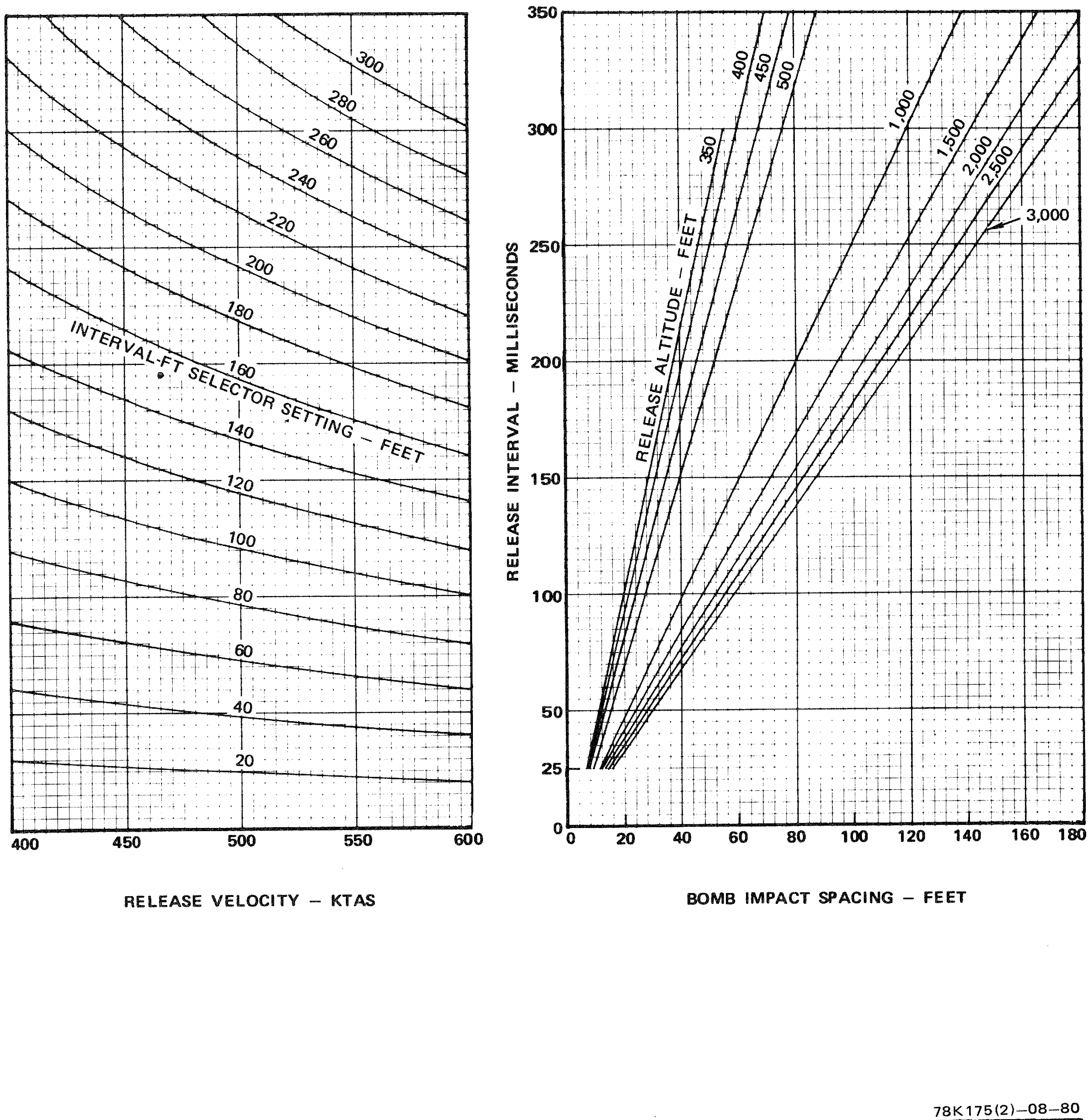
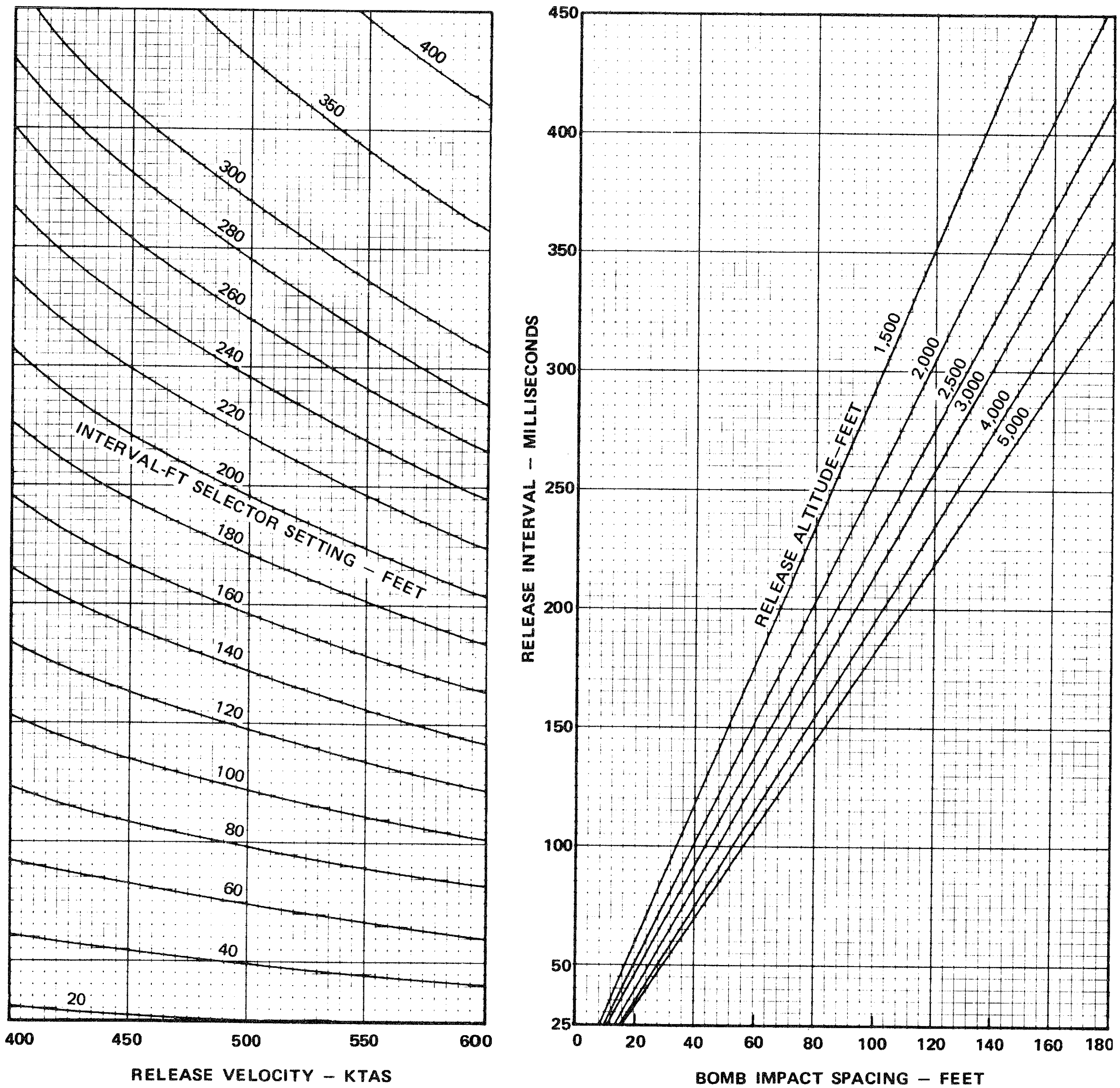


Figure 6-23 (Sheet 2)

BOMB SPACING FOR MANUAL RIPPLE BOMBING CHART (LDGP BOMBS AND FINNED FIRE BOMBS – STRAIGHT PATH DELIVERY)

15° DIVE RELEASE CONDITION



78K175(3)–08–80

Figure 6-23 (Sheet 3)

BOMB SPACING FOR MANUAL RIPPLE BOMBING CHART (LDGP BOMBS AND FINNED FIRE BOMBS – STRAIGHT PATH DELIVERY)

30° DIVE RELEASE CONDITION

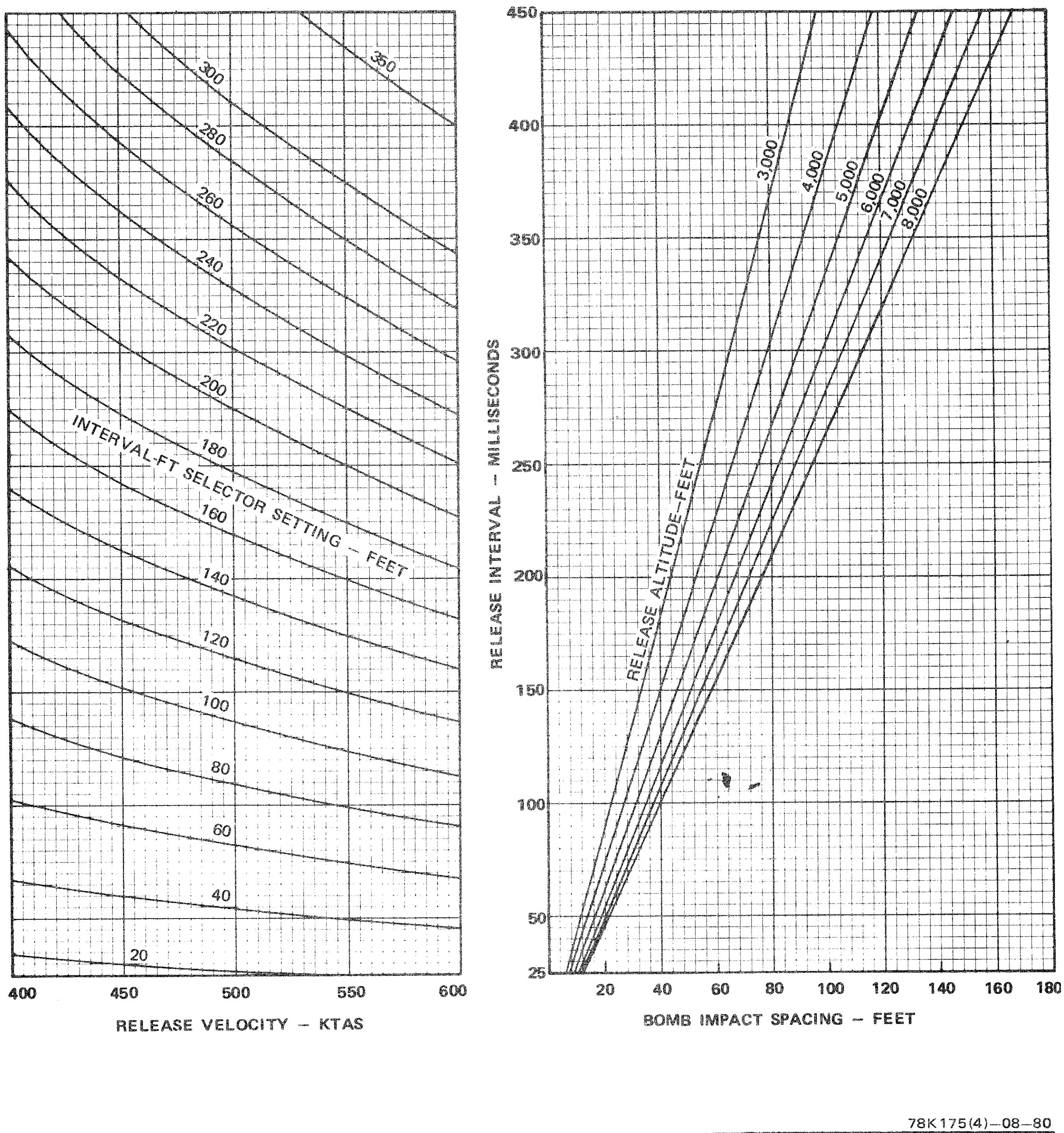
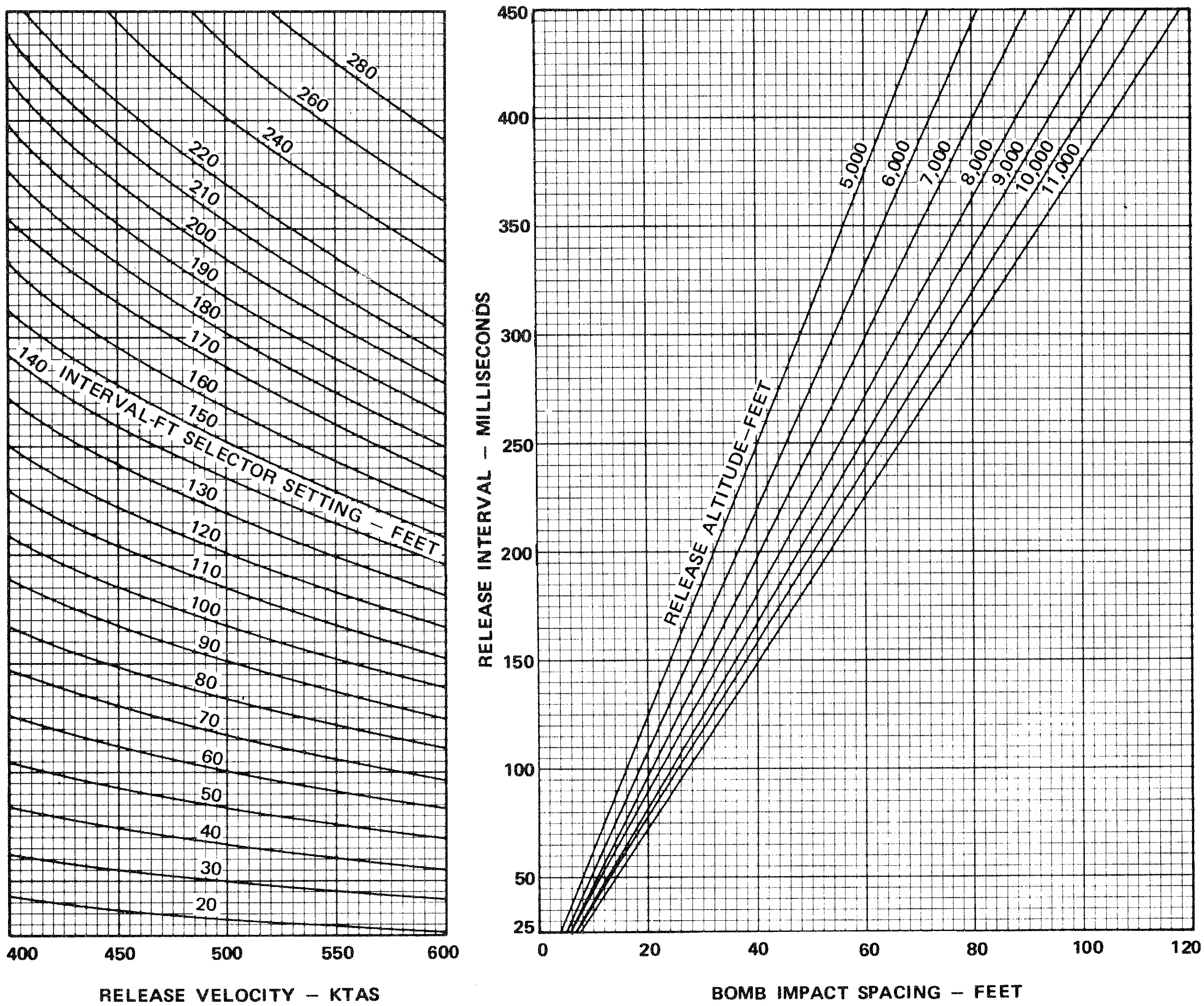


Figure 6-23 (Sheet 4)

BOMB SPACING FOR MANUAL RIPPLE BOMBING CHART (LDGP BOMBS AND FINNED FIRE BOMBS – STRAIGHT PATH DELIVERY)

45° DIVE RELEASE CONDITION



78K175(5)–08–80

Figure 6-23 (Sheet 5)

BOMB SPACING FOR MANUAL RIPPLE BOMBING CHART (LDGP BOMBS AND FINNED FIRE BOMBS – STRAIGHT PATH DELIVERY)

60° DIVE RELEASE CONDITION

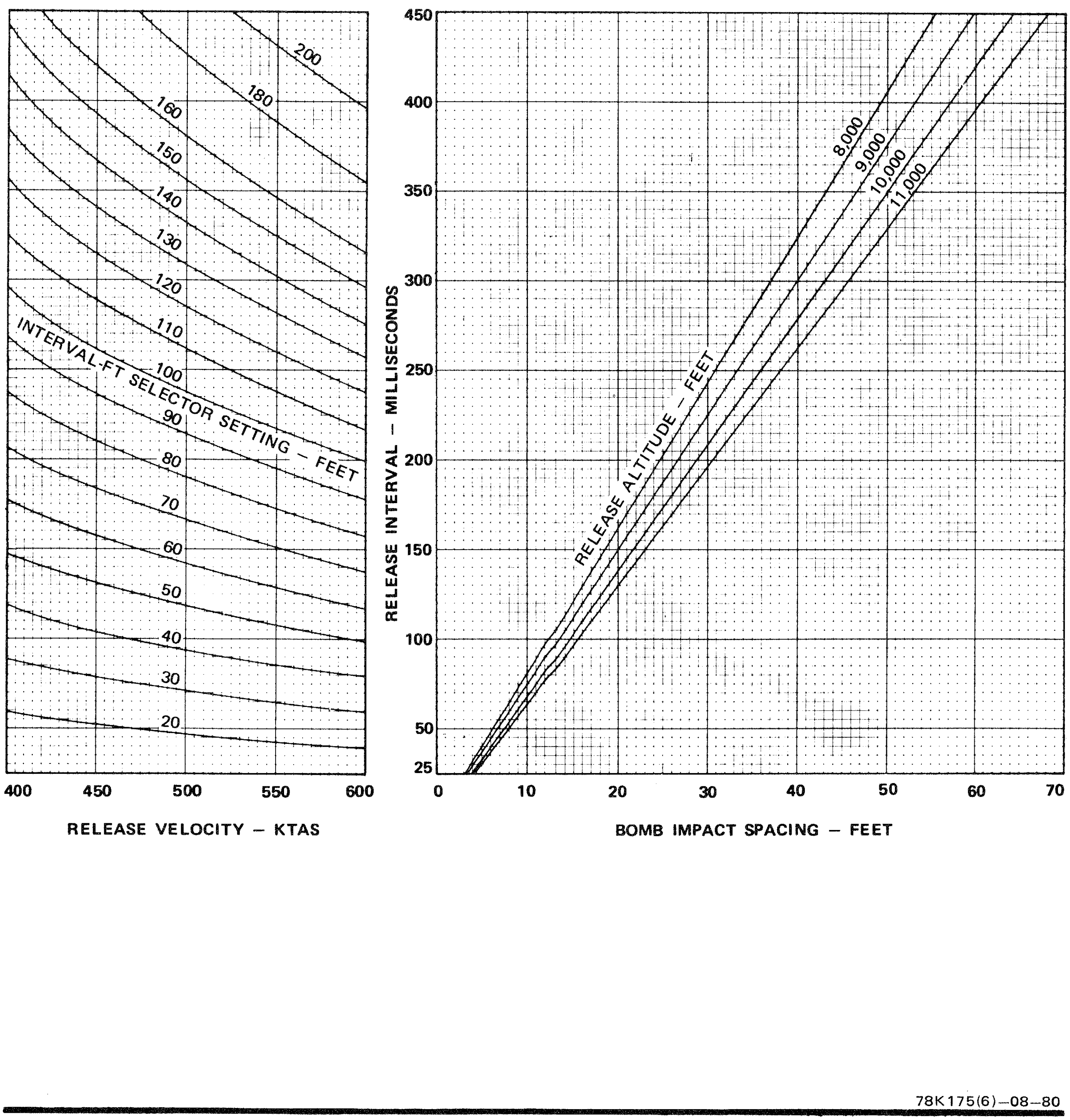


Figure 6-23 (Sheet 6)

BOMB SPACING FOR MANUAL RIPPLE BOMBING CHART (HIGH-DRAG RETARDED BOMBS AND UNFINNED FIRE BOMBS — STRAIGHT PATH DELIVERY)

5° DIVE RELEASE CONDITION

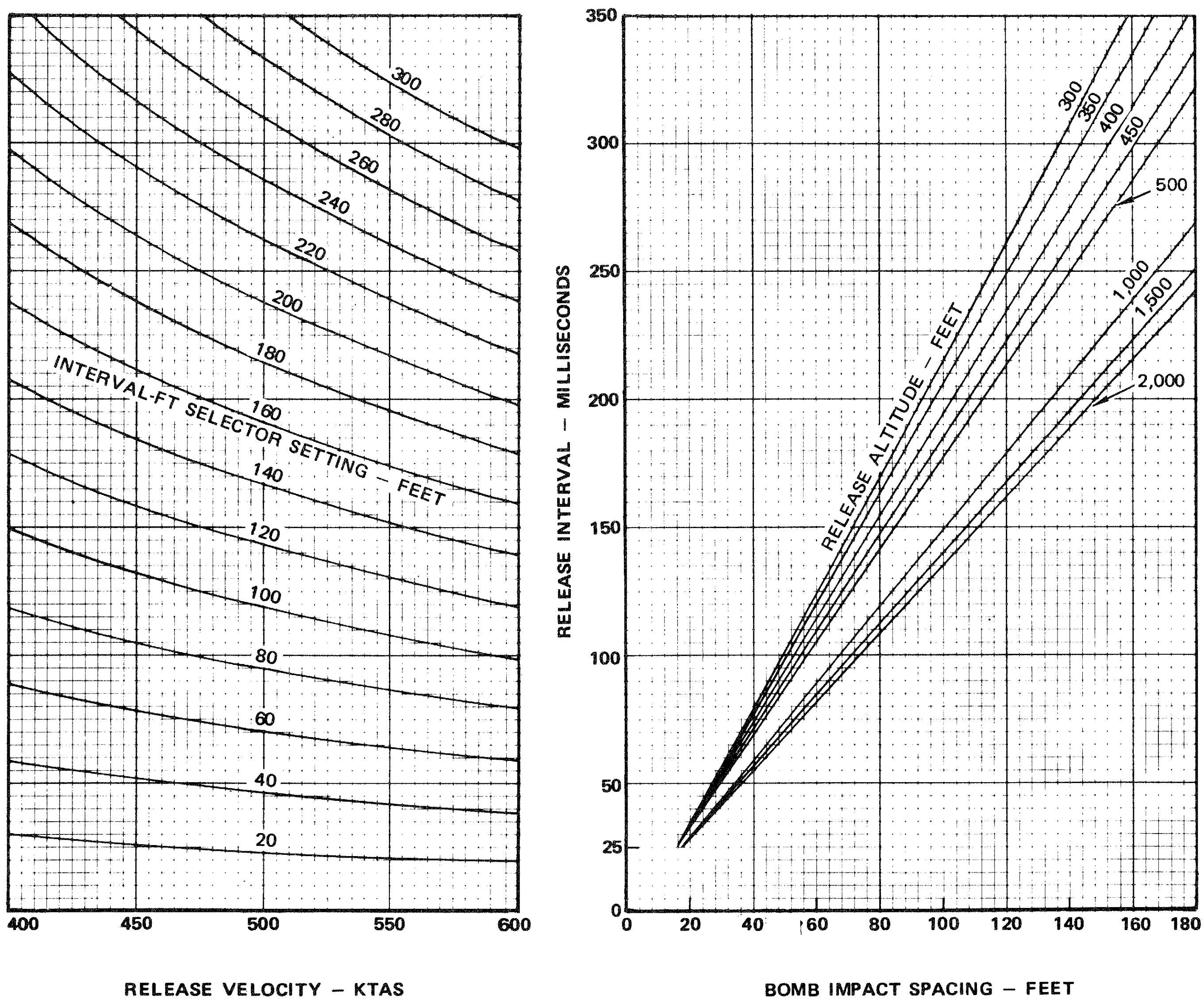
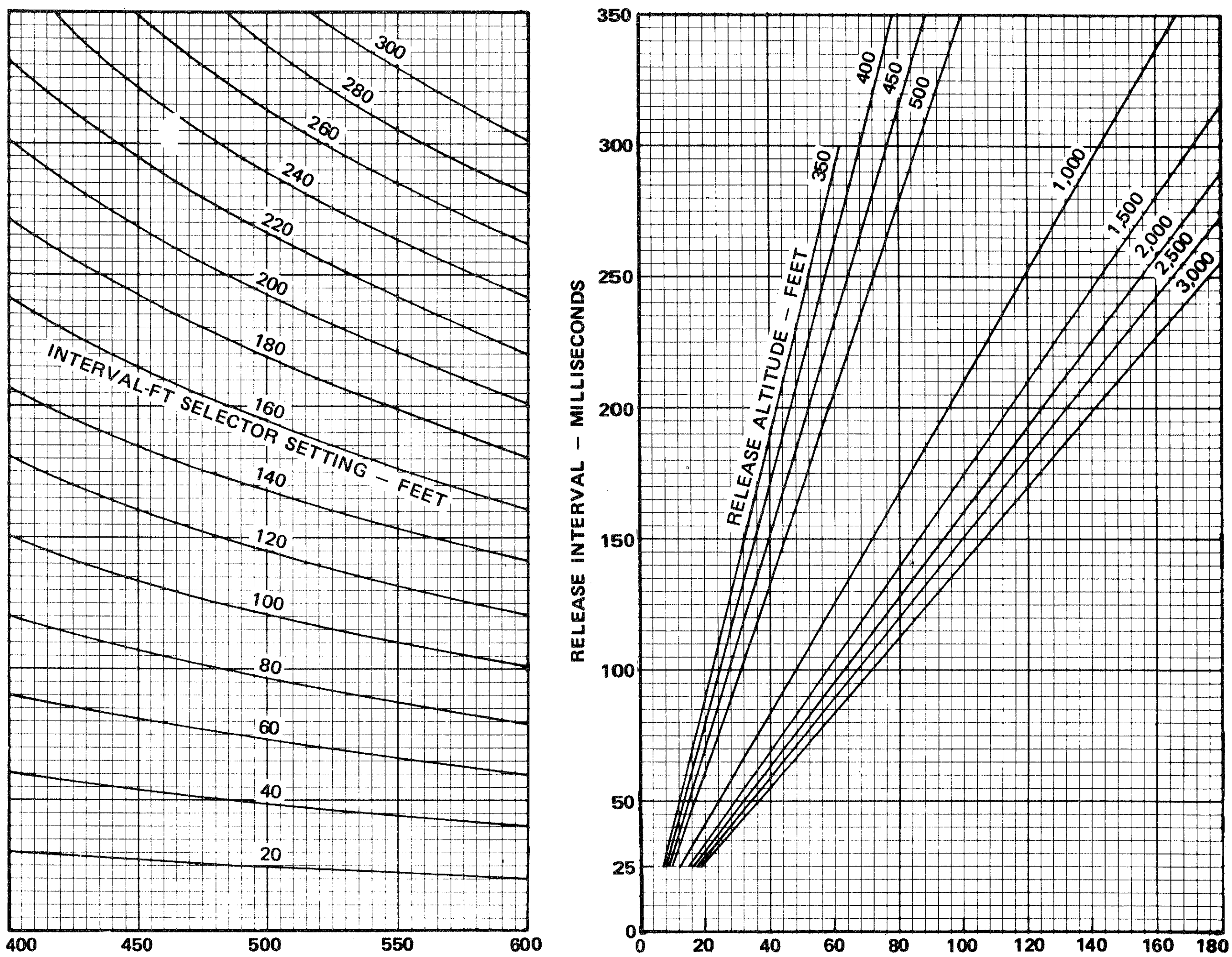


Figure 6-24 (Sheet 1)

BOMB SPACING FOR MANUAL RIPPLE BOMBING CHART (HIGH-DRAG RETARDED BOMBS AND UNFINNED FIRE BOMBS – STRAIGHT PATH DELIVERY)

10° DIVE RELEASE CONDITION

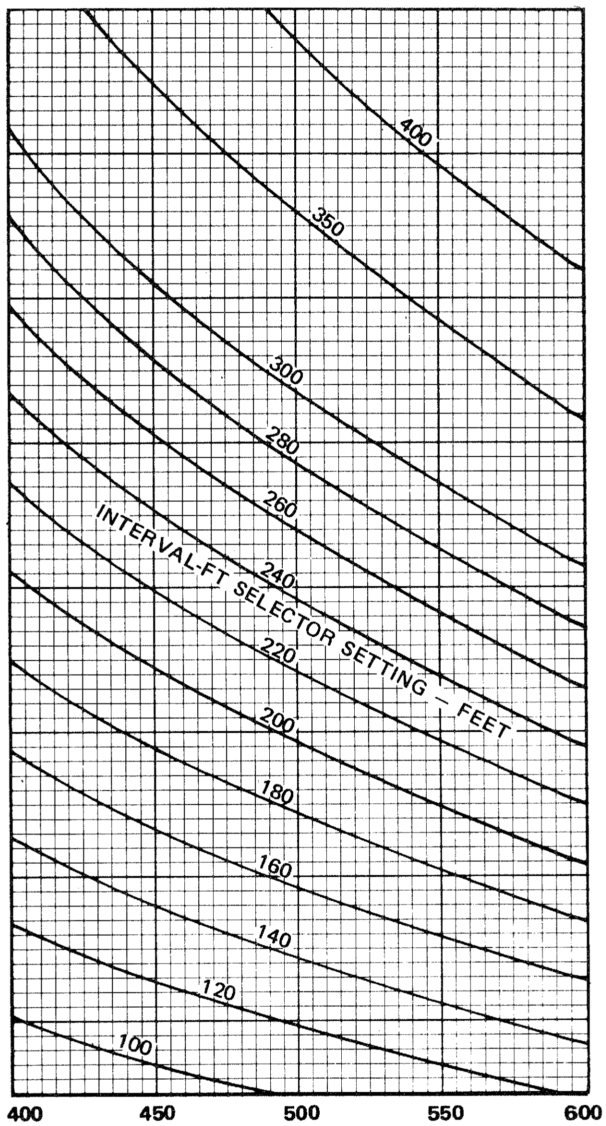


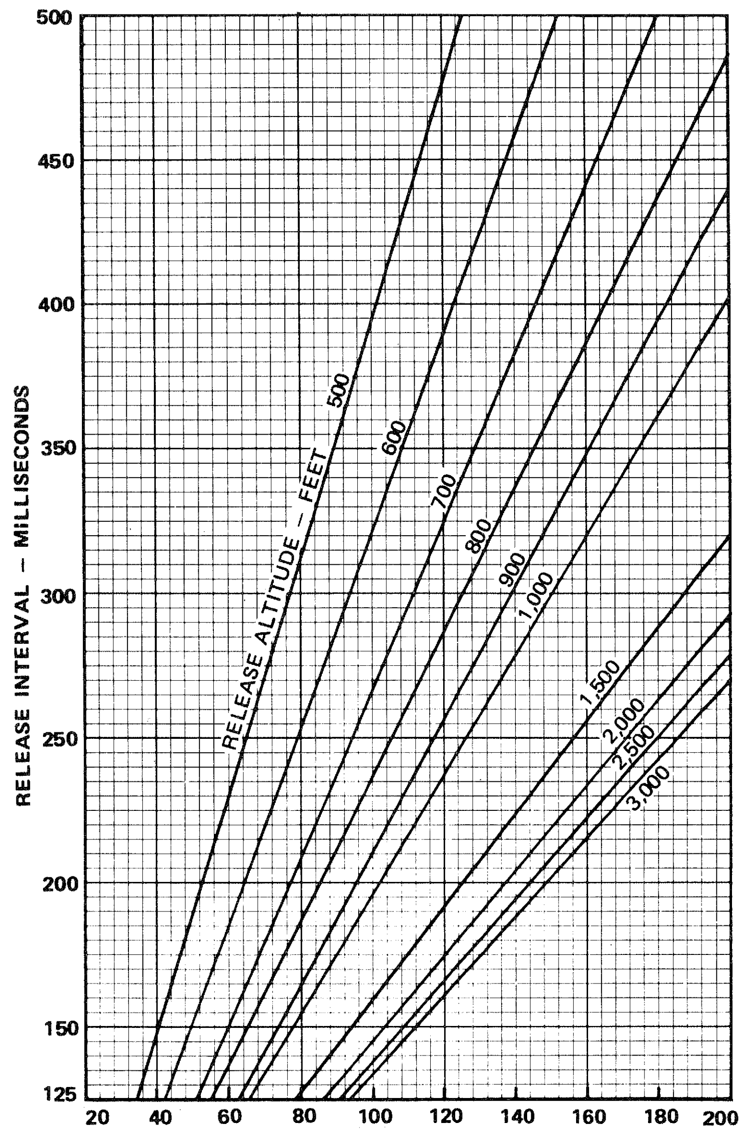
78K177(2)–08–80

Figure 6-24 (Sheet 2)

BOMB SPACING FOR MANUAL RIPPLE BOMBING CHART (HIGH-DRAG RETARDED BOMBS AND UNFINNED FIRE BOMBS — STRAIGHT PATH DELIVERY)

15° DIVE RELEASE CONDITION



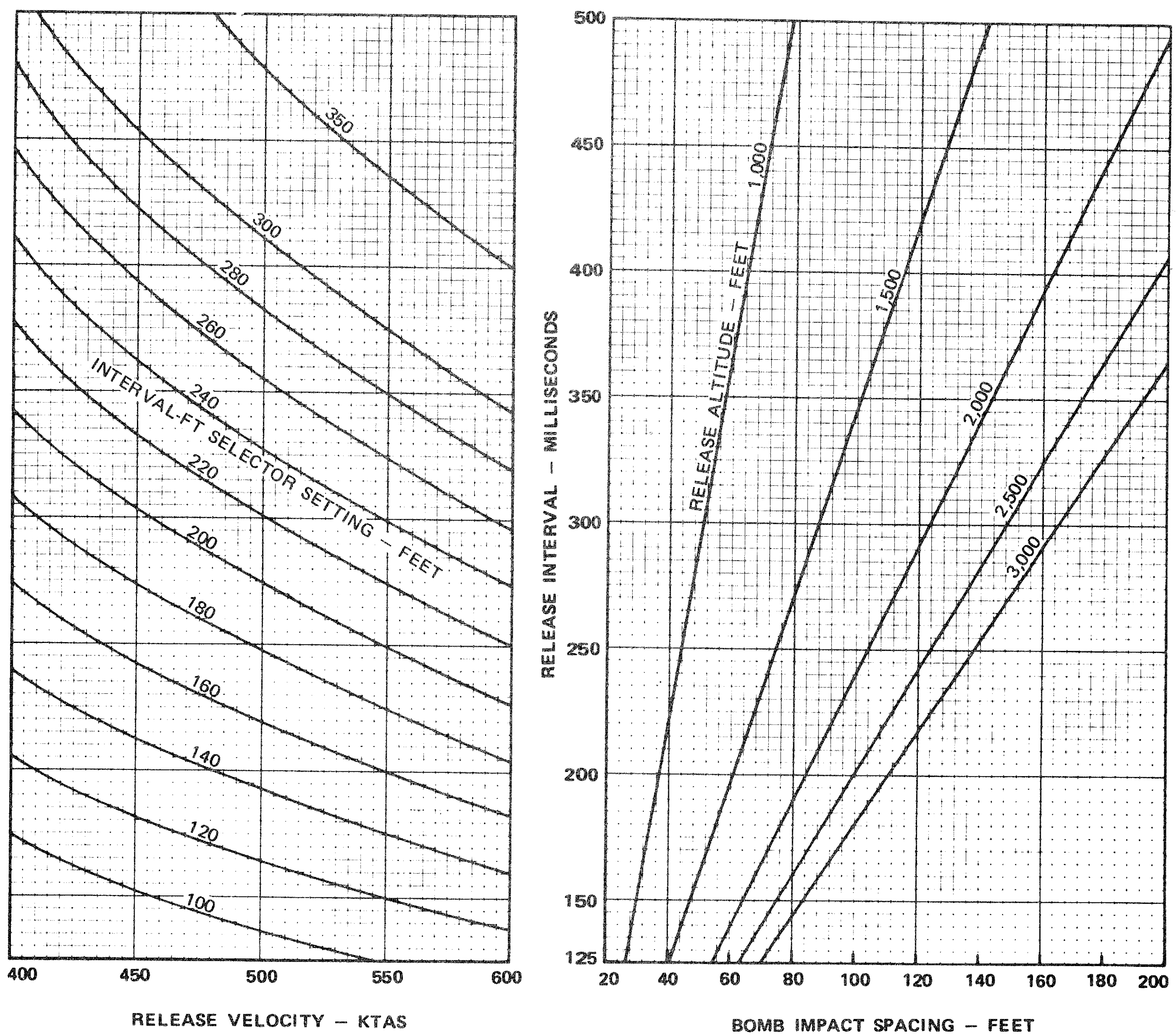


78K177(3)–08–80

Figure 6-24 (Sheet 3)

BOMB SPACING FOR MANUAL RIPPLE BOMBING CHART (HIGH-DRAG RETARDED BOMBS AND UNFINNED FIRE BOMBS — STRAIGHT PATH DELIVERY)

30° DIVE RELEASE CONDITION



78K177(4)–08–80

Figure 6-24 (Sheet 4)

ALTITUDE LOSS DURING RIPPLE RELASE CHART (STRAIGHT PATH DELIVERY)

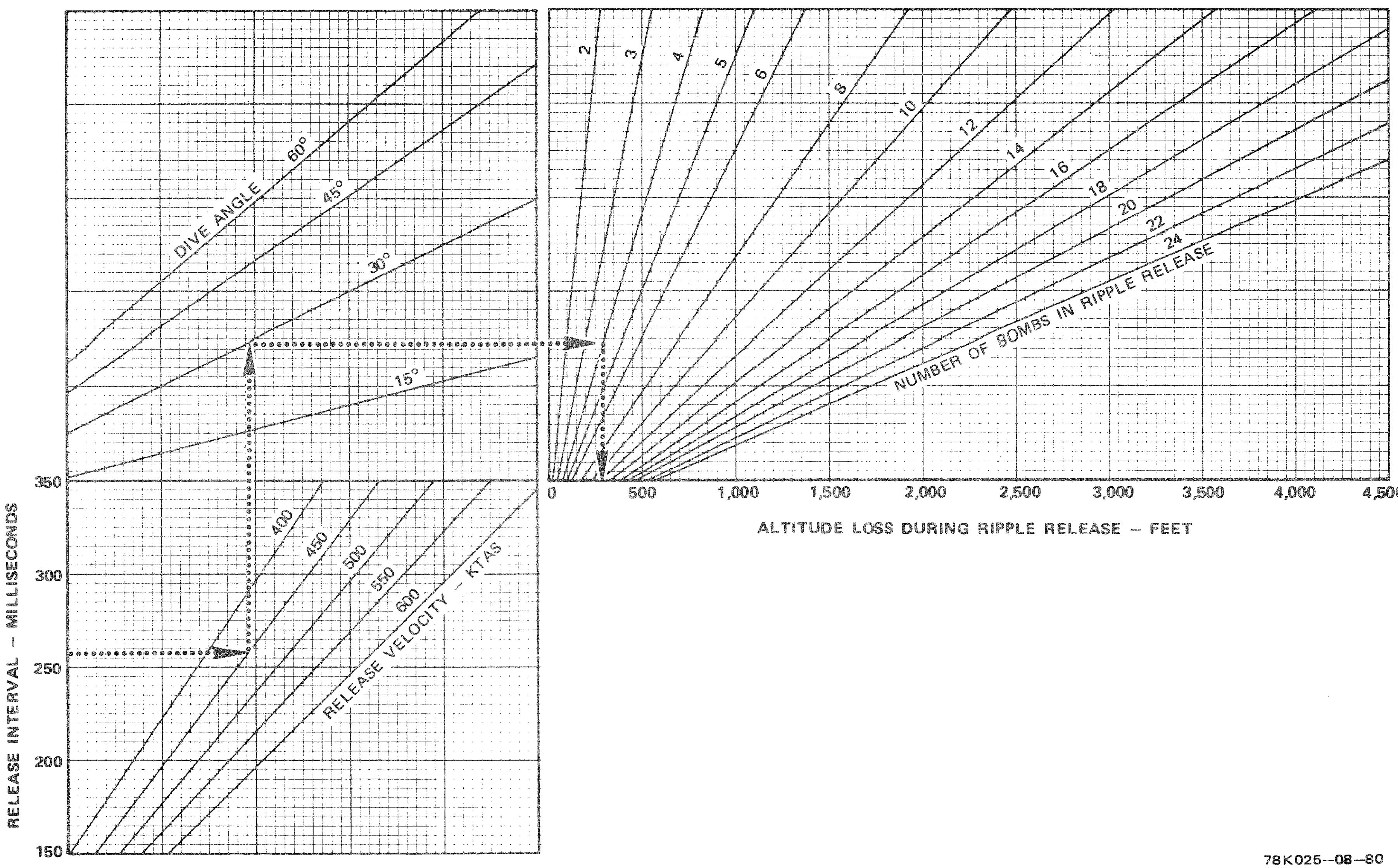


Figure 6-25

MINIMUM RELEASE INTERVALS TABLE

WEAPON	ASCU CODE	CARRIAGE METHOD	RELEASE MODE	MIN INTERVAL (MILLISECONDS)	MRI CLASS
MK 82 SE HD MK 36 HD BLU-1C/B BLU-27 SERIES	GQ, GR (HD OPT) GQ IL (UNFINNED) IN (UNFINNED)	MAU-12 OR MER/TER	PAIR	250	1
			SINGLE	125	
M117, MC-1 MK 82 GP MK 83 GP MK 82 SE LD MK 36 LD CBU-24/49 CBU-52B/B CBU-58 SERIES CBU-71 SERIES BDU-33 CBU-12 CBU-46 BLU-52	FK, FL GO, JQ GS, HN GP, GR (LD OPT) GO JK JL JM JM HR CL CM IQ	MER/TER	PAIR	76	2
			SINGLE	41	
M117, MC-1 MK 82 GP MK 83 GP MK 84 GP MK 82 SE LD MK 36 LD CBU-24/49 CBU-52B/B CBU-58 SERIES CBU-71 SERIES GBU-12 SERIES GBU-10 SERIES CBU-12 CBU-46 BLU-52	FK, FL GO, JQ GS, HN GT GP, GR (LD OPT) GO JK JL JM JM DL, GK DK, FT CL (Note 4 applies) CM (Note 4 applies) IQ	MAU-12	PAIR OR SINGLE	25	3
MK 20 ROCKEYE BLU-1C/B BLU-27 SERIES	JN IK (FINNED) IM (FINNED)	MER/TER	PAIR	150	
		MAU-12	PAIR		
		MAU-12 OR MER/TER	SINGLE	76	4

NOTE

1. Weapons not listed in MRI classes 1-4 are limited to manual delivery mode only. Computed functions in the VISUAL (NORM) ATTACK mode only have been added for the AGM-65/A missile (ASCU code BT) and the GBU-8 (Mk 84 EO, ASCU code BK) but do not include ballistics or an MRI class.

2. Computer has capability for delivery of BDU-33 and Mk 106 practice bombs from SUU-20 dispenser. No MRI class is applicable due to fire pulse duration required by SUU-20 which is incorporated in the computer enabling only one release signal per solution.

3. When only one station or unsymmetrical stations are selected along with "single" release mode, the computer will automatically revert to the higher (pair) interval of each MRI class.

4. When the priority selected station is loaded with a parent rack weapon and the combination of quantity and release mode used will account for the release of a number of weapons greater than the number of stations selected, the computer will automatically revert to the multiple carriage release interval. When a MER/TER station is selected the computer will automatically revert to the MER/TER MRI even though the station may not be in priority.

78K205—08—80

Figure 6-26

IMPACT LATERAL DISPLACEMENT CHART – MER/TER SHOULDER POSITION CARRIAGE

LOW DRAG GP BOMBS AND FINNED FIRE BOMBS

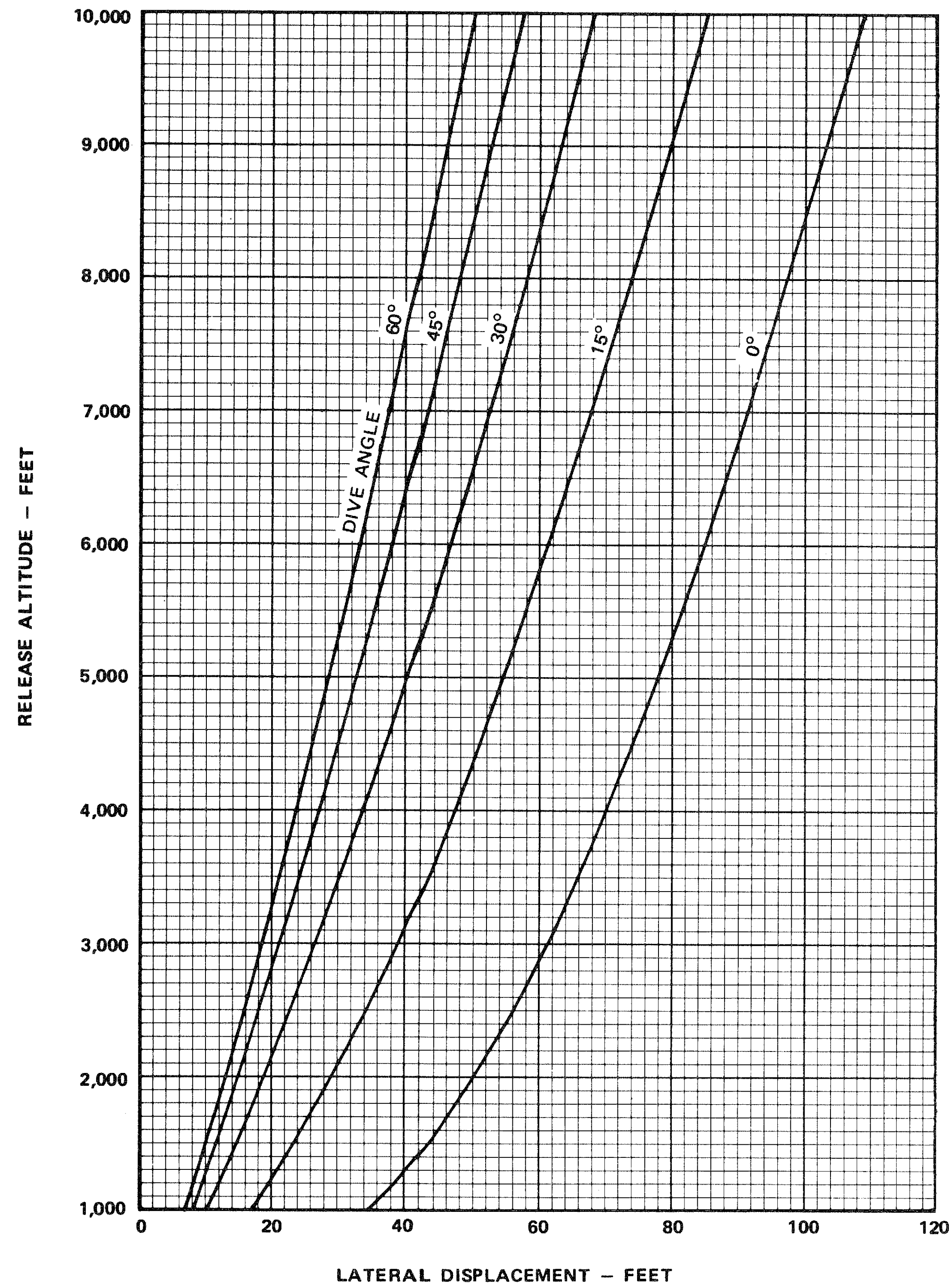


Figure 6-27 (Sheet 1)

IMPACT LATERAL DISPLACEMENT CHART — MER/TER SHOULDER POSITION CARRIAGE

HIGH DRAG RETARDED BOMBS AND UNFINNED FIRE BOMBS

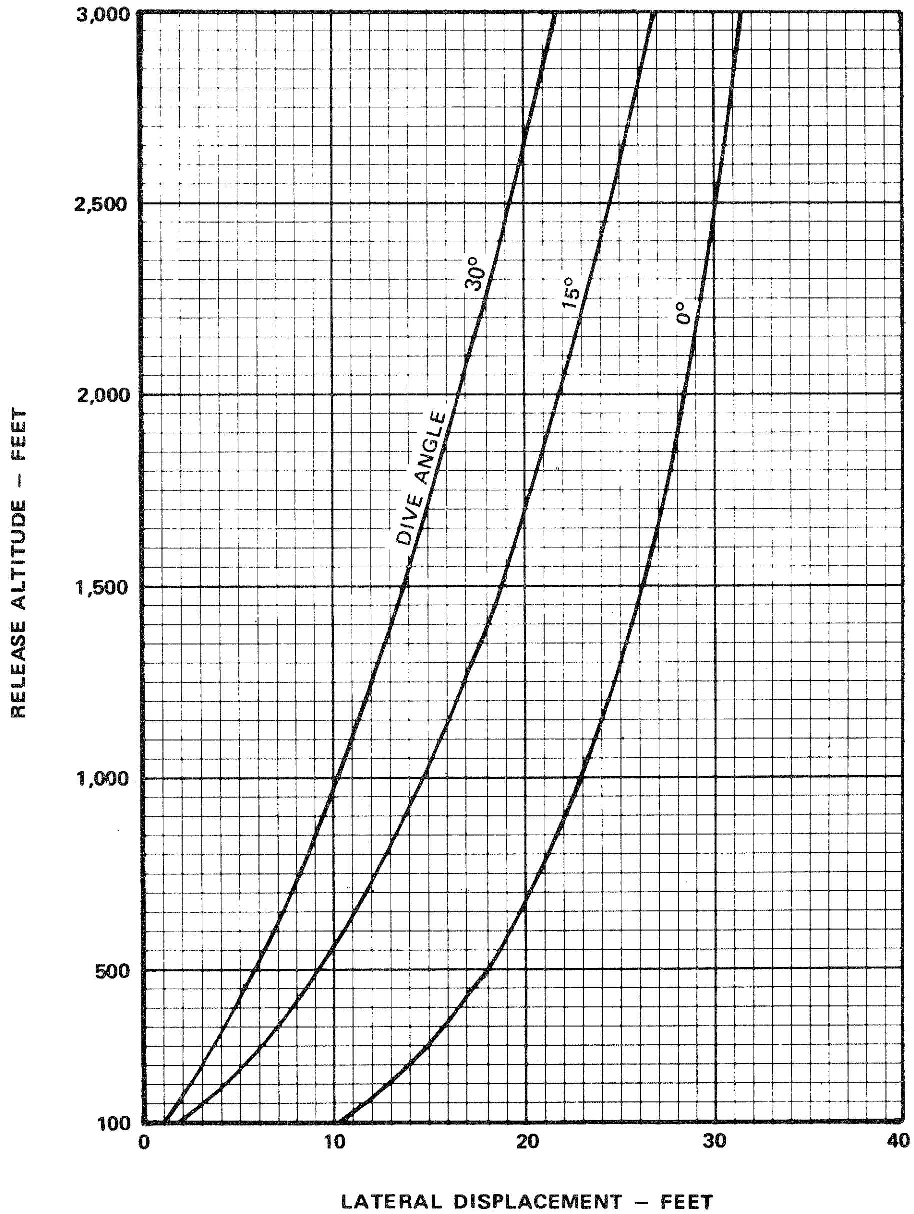


Figure 6-27 (Sheet 2)

FLECHETTE IMPACT PATTERN CHART

ONE SIGMA (68.26%) DISPERSION IMPACT AREA – 2.75-INCH FFAR WDU-4A/A

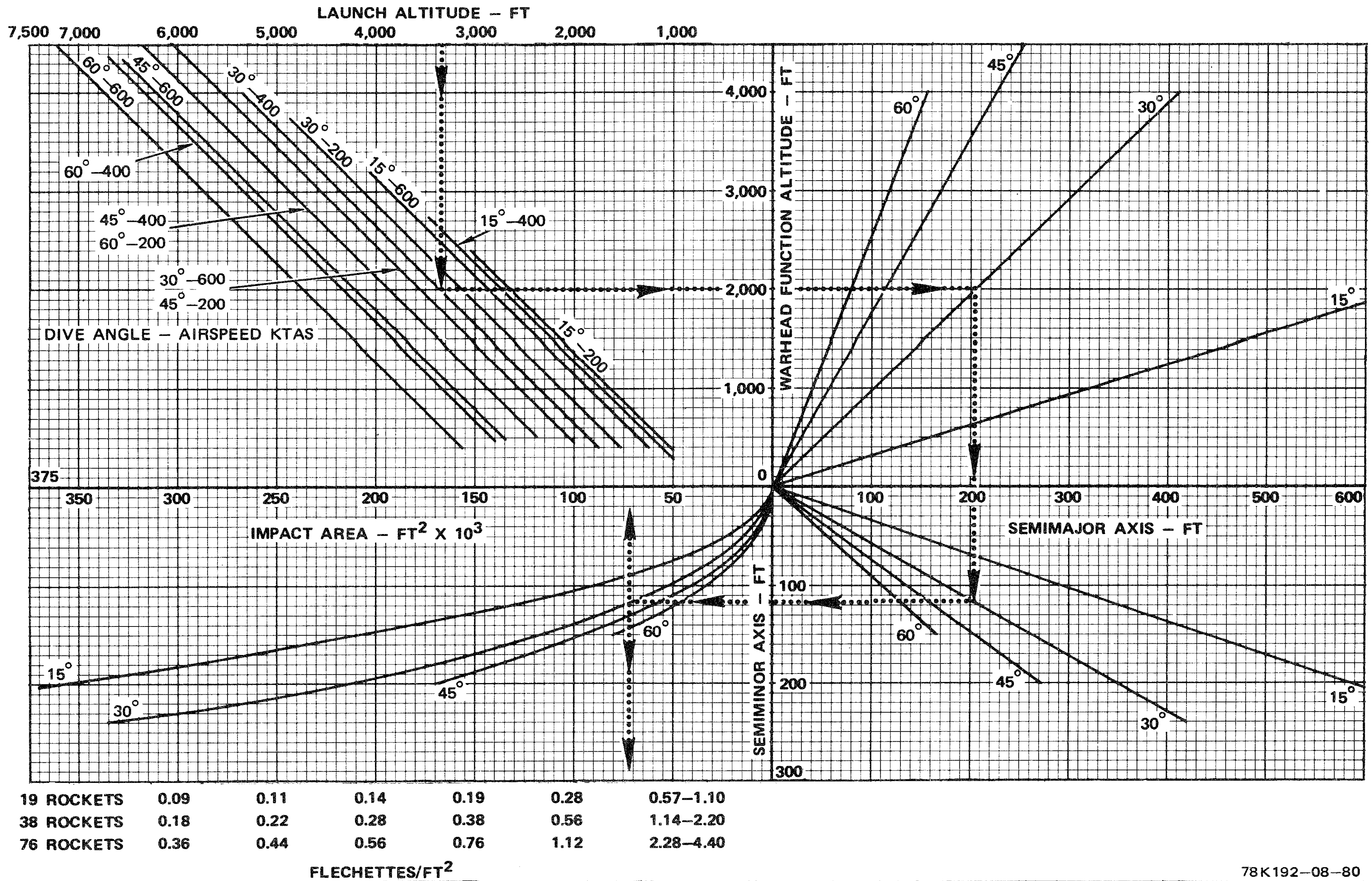
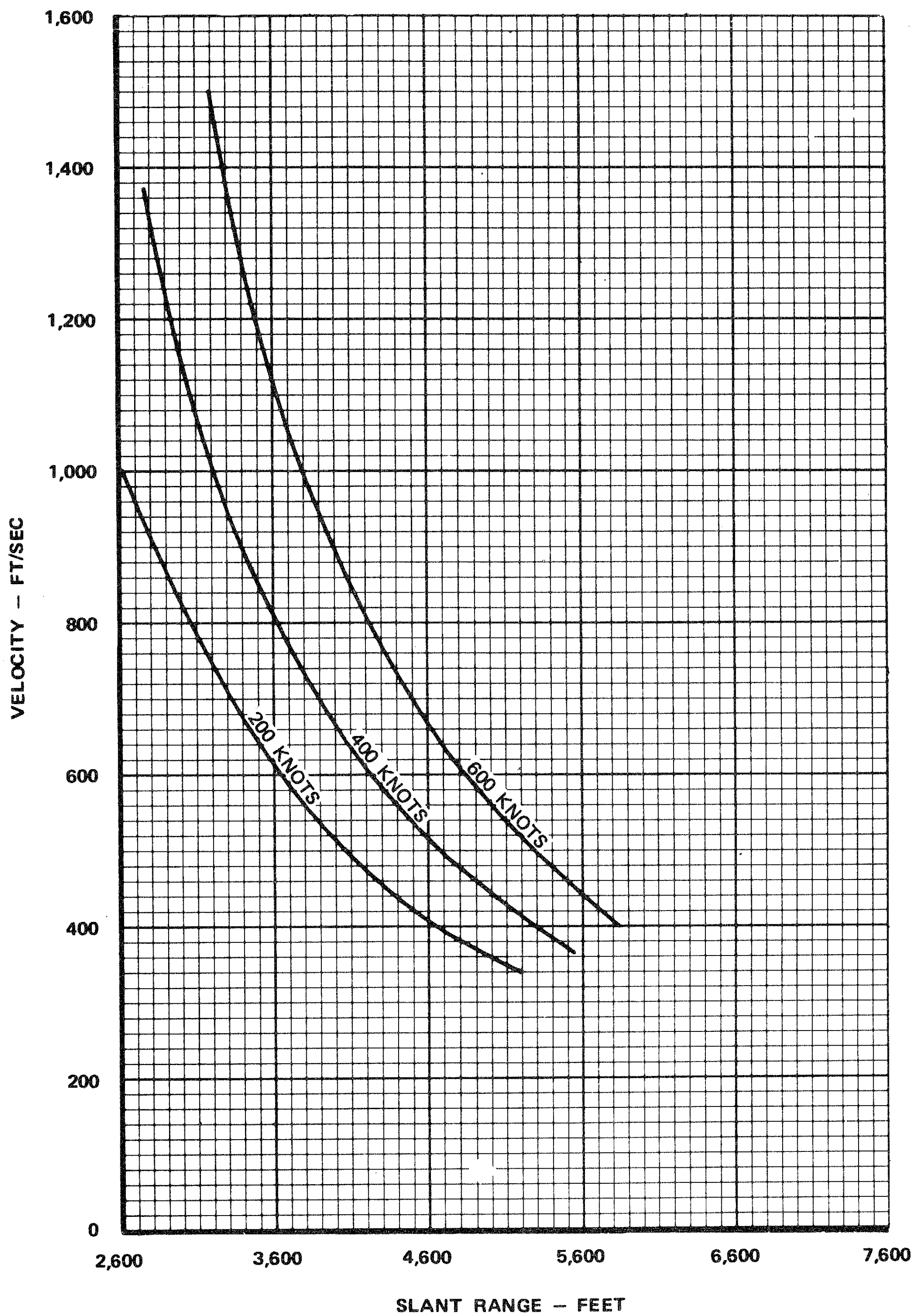


Figure 6-28

FLECHETTE IMPACT VELOCITY CHART

15° DIVE ANGLE

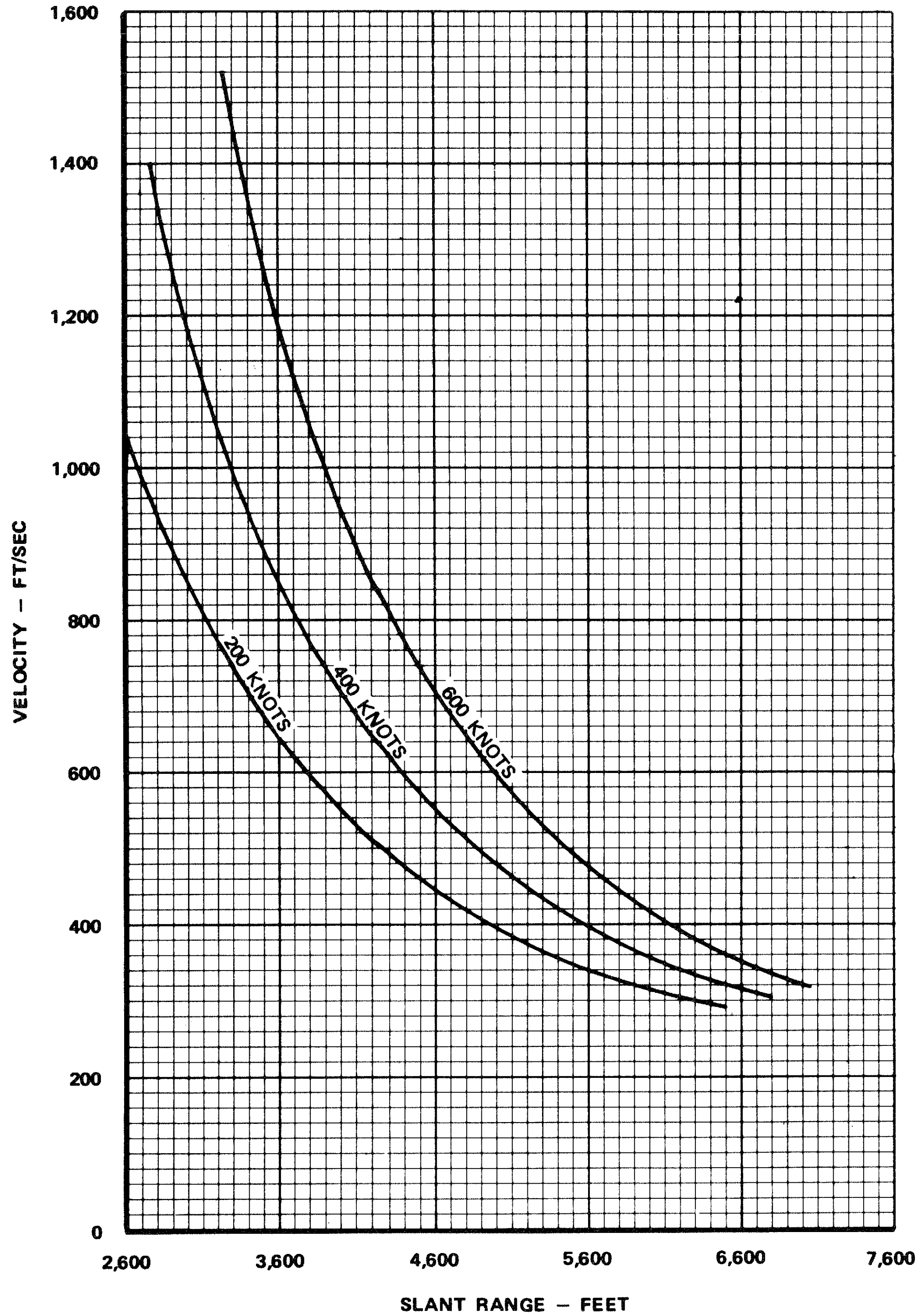


78K193(1)—08—80

Figure 6-29 (Sheet 1)

FLECHETTE IMPACT VELOCITY CHART

30° DIVE ANGLE



78K193(2)–08–80

Figure 6-29 (Sheet 2)

FLECHETTE IMPACT VELOCITY CHART

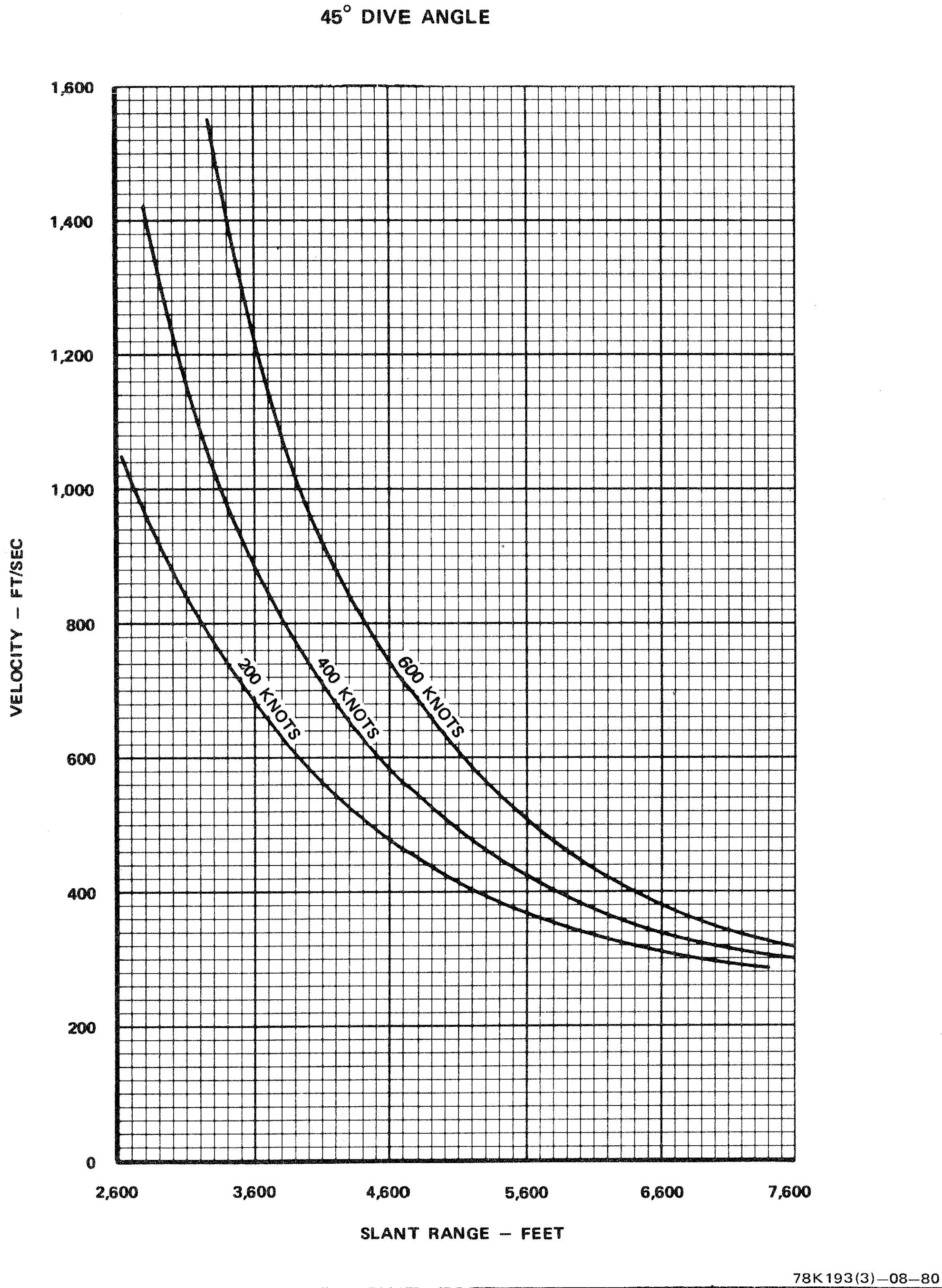


Figure 6-29 (Sheet 3)

FLECHETTE IMPACT VELOCITY CHART

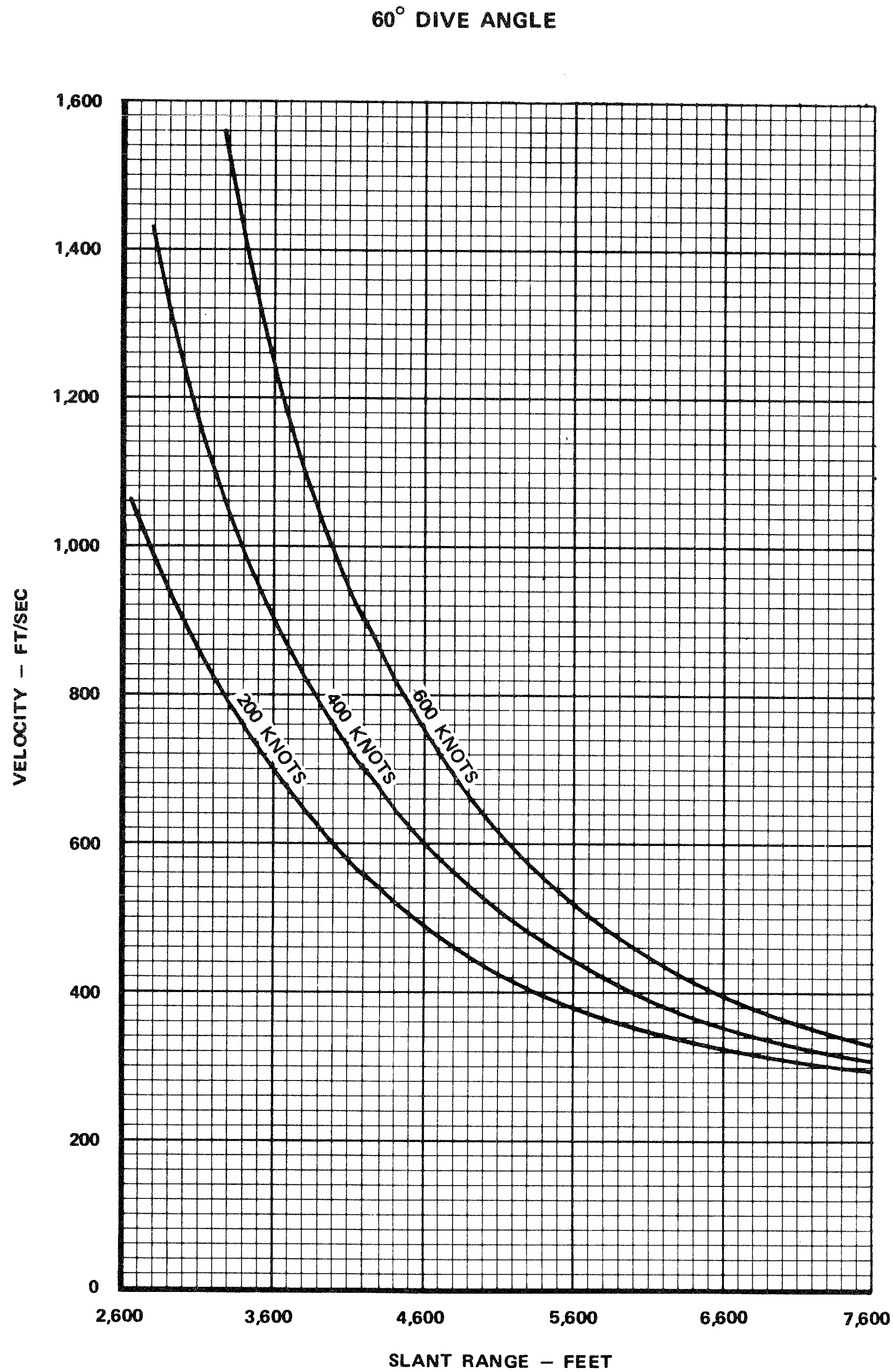


Figure 6-29 (Sheet 4)

AIM OFF DISTANCE CHART

10° DIVE ANGLE

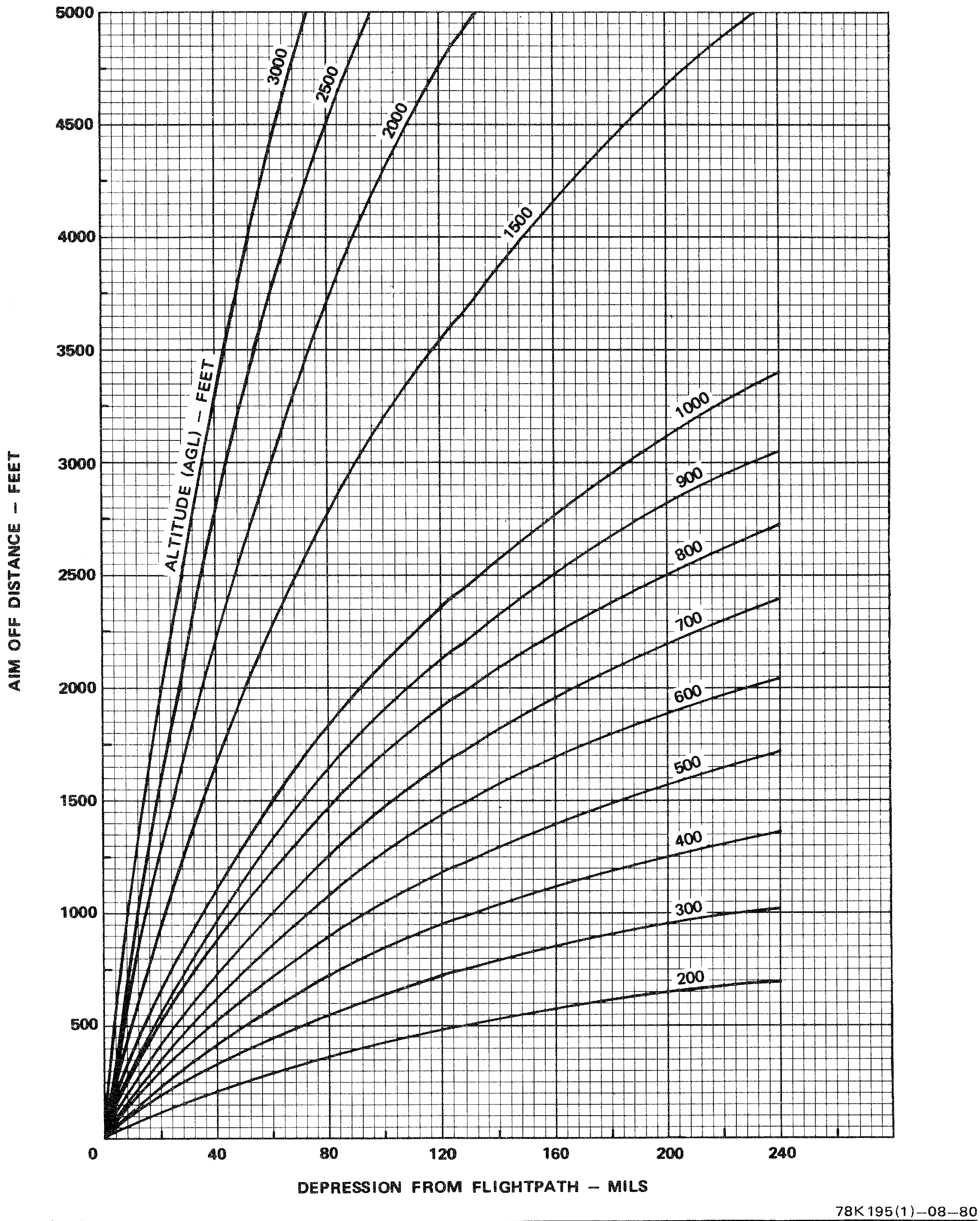
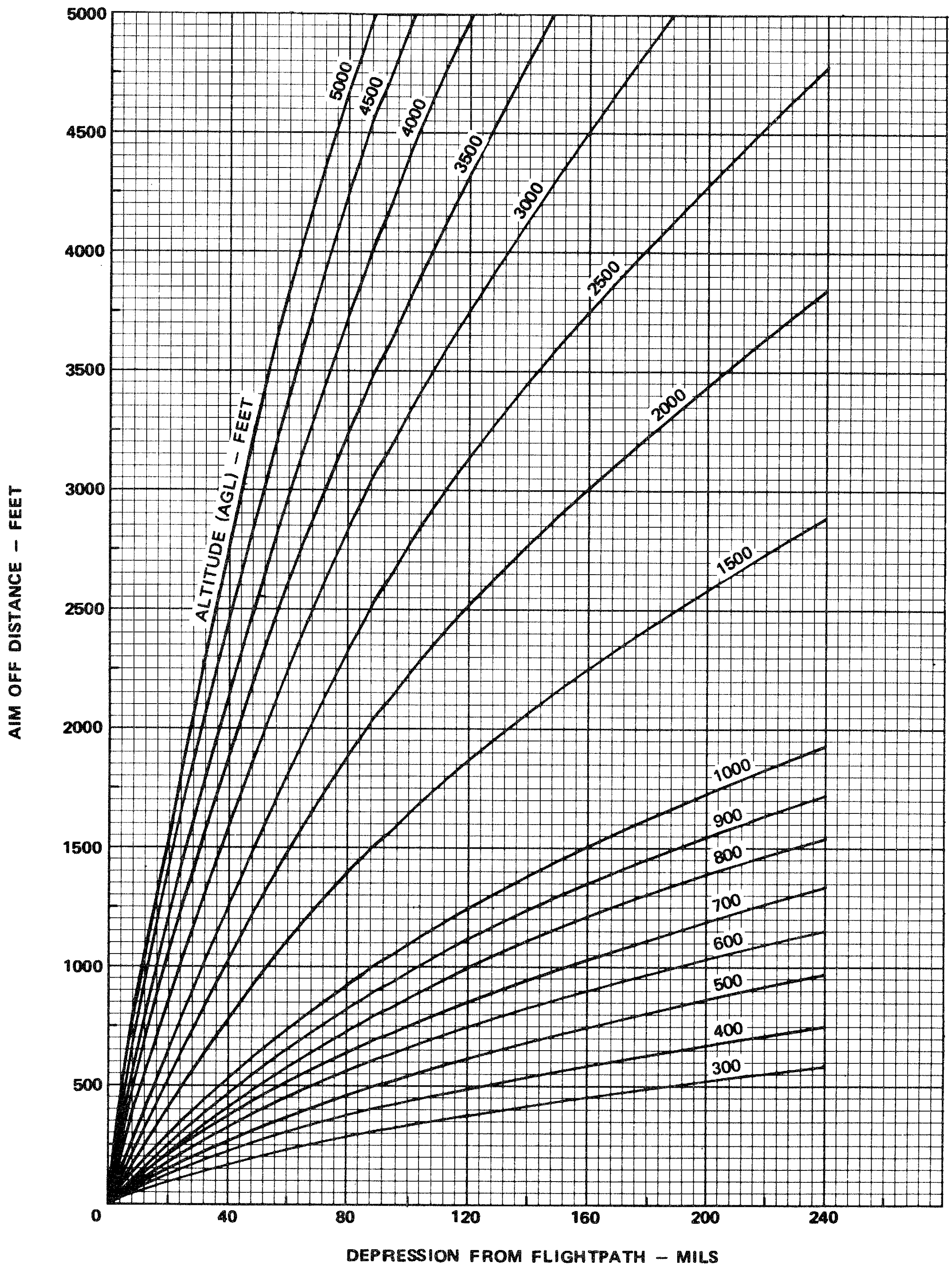


Figure 6-30 (Sheet 1)

AIM OFF DISTANCE CHART

15° DIVE ANGLE



78K195(2)–08–80

Figure 6-30 (Sheet 2)

AIM OFF DISTANCE CHART

20° DIVE ANGLE

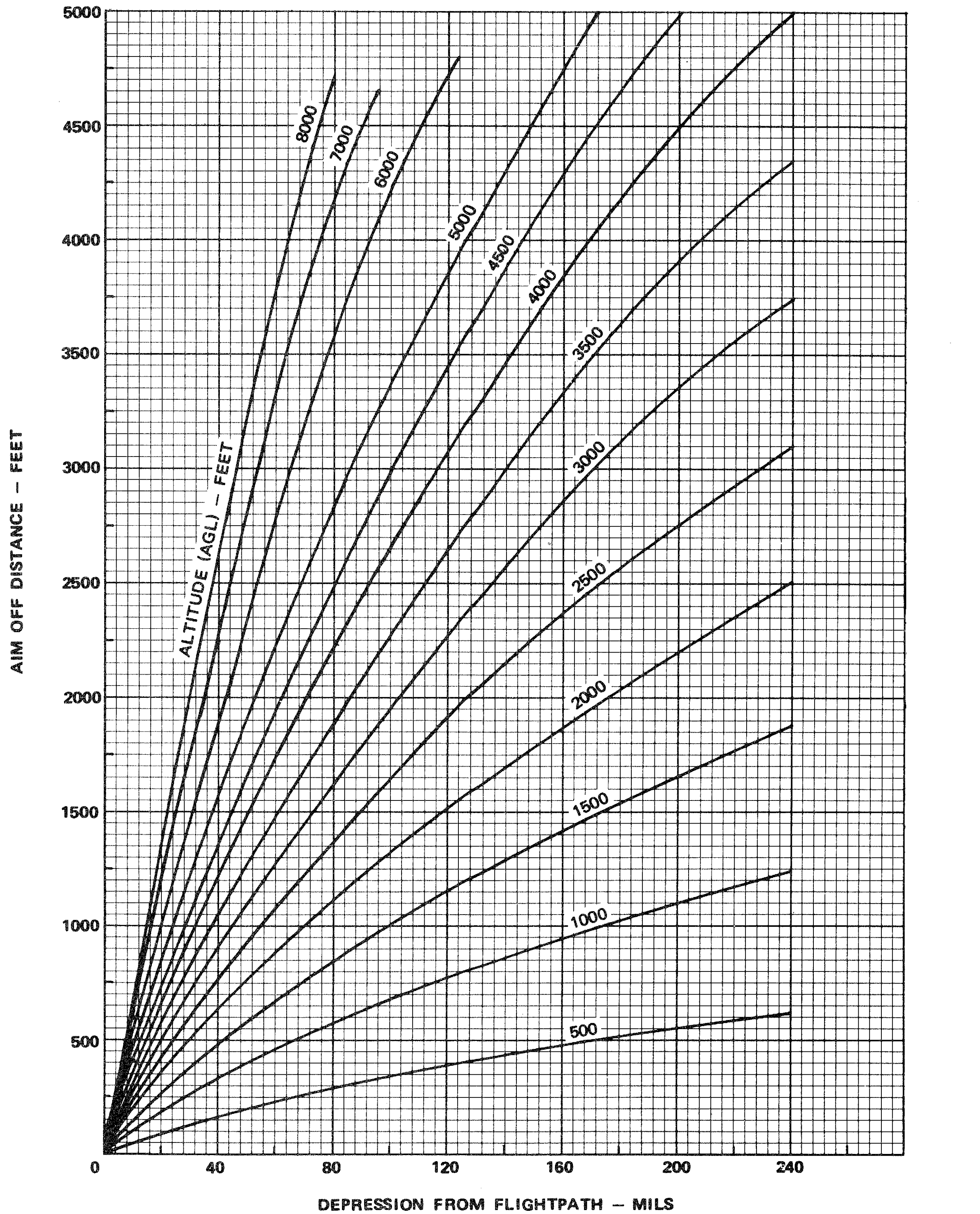


Figure 6-30 (Sheet 3)

AIM OFF DISTANCE CHART

30° DIVE ANGLE

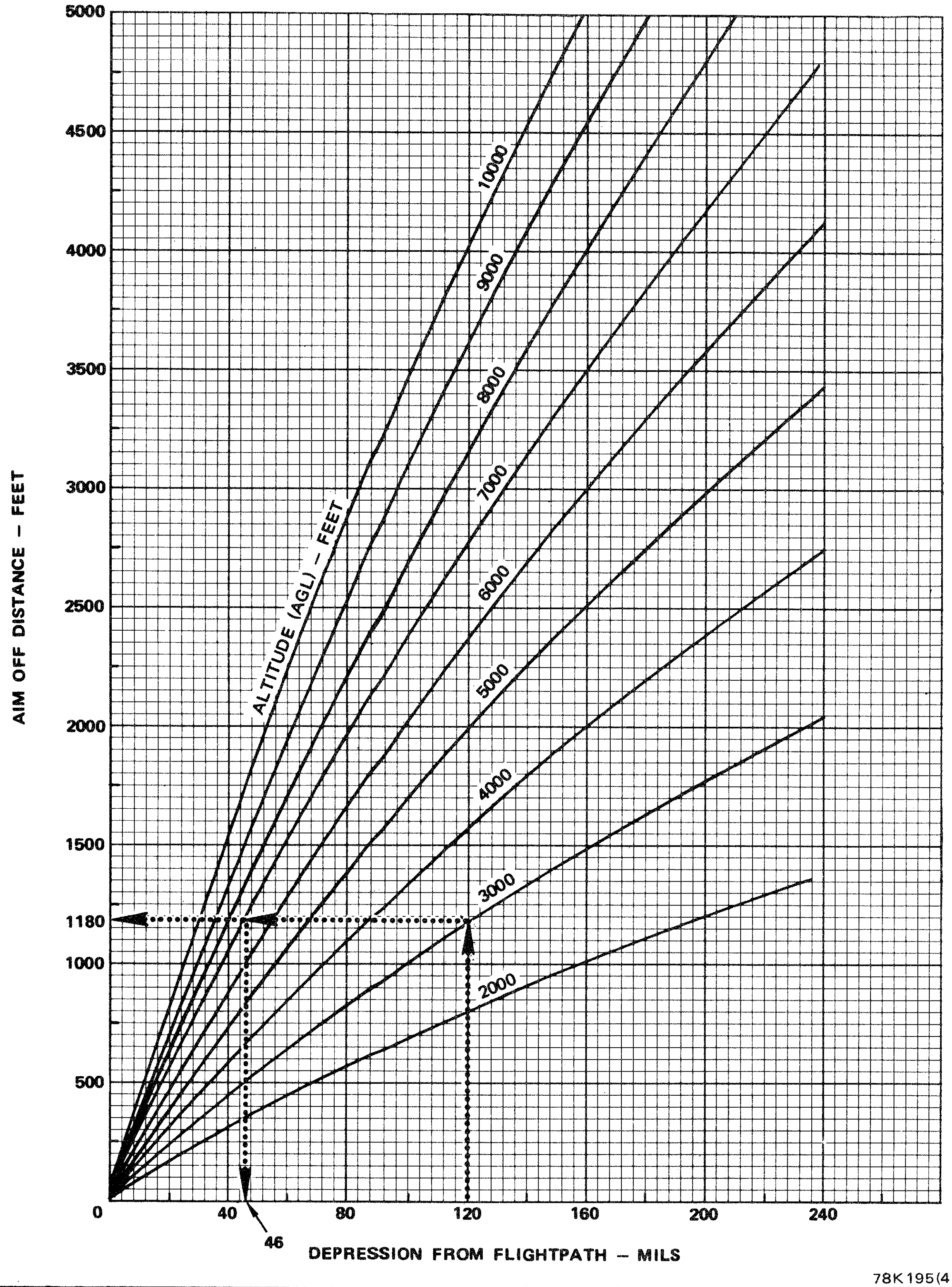


Figure 6-30 (Sheet 4)

AIM OFF DISTANCE CHART

45° DIVE ANGLE

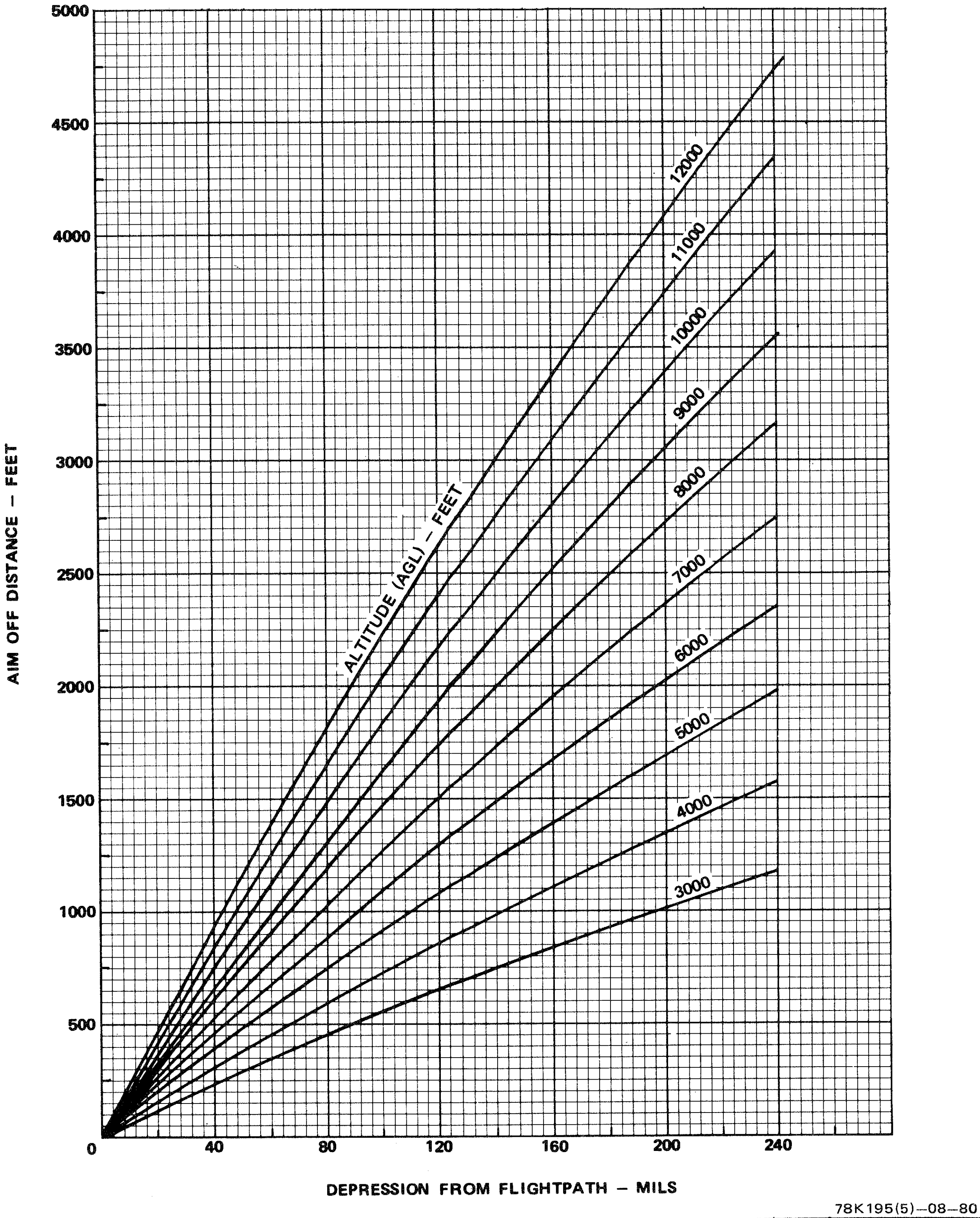


Figure 6-30 (Sheet 5)

BLU-66/B (CBU-46/A) DEFLECTION CHART

OFFSET AIMPOINT COMPUTATION: THE EFFECT OF CROSSWIND AND BY THE SPIN MOTION OF THE BLU-66/B BOMB AFTER RELEASE MUST BE COMBINED TO OBTAIN THE CORRECT OFFSET AIMPOINT.

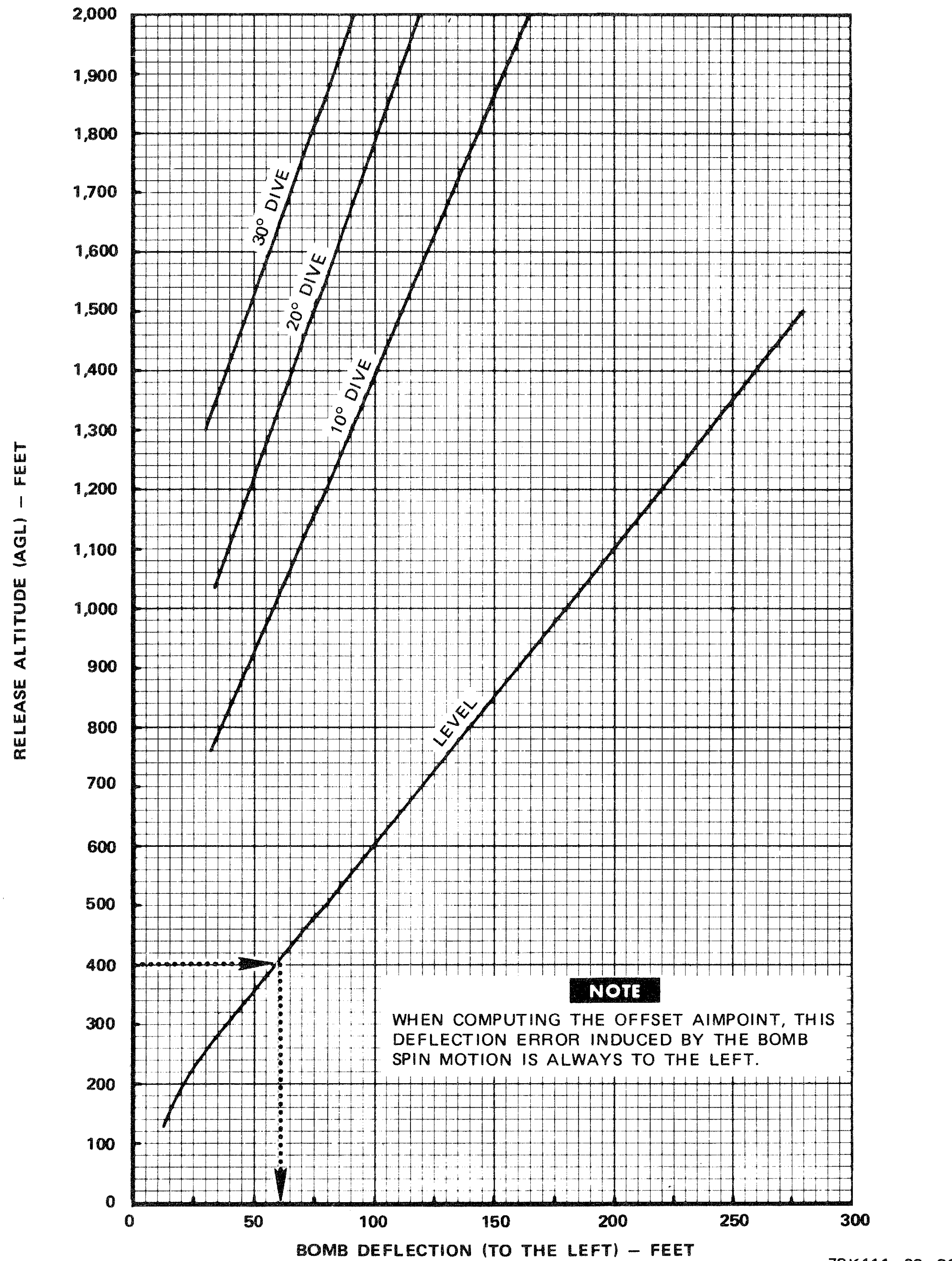


Figure 6-31

IMPACT DATA TABLE

MK 82 (SNAKEYE) LOW DRAG
MK 36 DESTRUCTOR MOD 2 OR 3 FUZING

DIVE ANGLE (DEG)	RELEASE ALTITUDE (FT)	MAXIMUM RELEASE TAS FOR 900 FPS IMPACT VELOCITY	IMPACT ANGLE (DEG)
0	4,000	580	31
	5,000	565	35
	6,000	545	39
	7,000	520	43
	8,000	495	46
	9,000	465	49
	10,000	430	53
15	4,000	525	35
	5,000	515	38
	6,000	500	42
	7,000	480	45
	8,000	460	48
	9,000	430	52
	10,000	405	55
30	4,000	500	43
	5,000	485	46
	6,000	470	49
	7,000	455	51
	8,000	430	54
	9,000	410	57
	10,000	380	60
45	4,000	485	54
	5,000	470	56
	6,000	455	58
	7,000	435	60
	8,000	415	62
	9,000	390	64
	10,000	365	66

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Figure 6-32 (Sheet 1)

IMPACT DATA TABLE

MK 82 LOW DRAG GP
MK 75 MOD 2 OR 3 FUZING

DIVE ANGLE (DEG)	RELEASE ALTITUDE (FT)	MAXIMUM RELEASE TAS FOR 900 FPS IMPACT VELOCITY	IMPACT ANGLE (DEG)
0	1,000	540	16
	2,000	530	13
	3,000	515	28
	4,000	495	33
	5,000	470	37
	6,000	445	41
	7,000	420	45
	8,000	390	49
	9,000	355	54
	10,000	315	58
15	1,000	525	22
	2,000	510	27
	3,000	495	32
	4,000	475	36
	5,000	455	39
	6,000	435	44
	7,000	405	48
	8,000	380	51
	9,000	350	55
	10,000	310	60
30	3,000	490	41
	4,000	470	44
	5,000	445	47
	6,000	425	50
	7,000	400	53
	8,000	370	56
	9,000	340	60
	10,000	300	64
45	4,000	460	54
	5,000	440	56
	6,000	415	59
	7,000	390	61
	8,000	360	64
	9,000	335	66
	10,000	300	69

78K226(2)–08–80

Figure 6-32 (Sheet 2)

ALPHABETICAL INDEX

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