

**NON-NUCLEAR WEAPONS
DELIVERY MANUAL**

**USAF SERIES
A-10/OA-10A AIRCRAFT
SERNO 78-0582 AND SUBSEQUENT**



1A-10A-34-1-1S-8-53

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FOREWORD

PURPOSE AND SCOPE

This Aircrew Weapons Delivery Manual provides tactical pilots with the information required to perform all types of missions employing nonnuclear weapons. Weapon delivery techniques or tactics are not included, except in a general vein, to describe a particular delivery maneuver or to support certain ballistic data. Refer to USAF Weapons School texts and ACC/PACAF/USAFE/AAC AFTTP 3-1 (Secret NofoRN) for detailed mission tactics and techniques. When a conflict exists between T.O. 1A-10A-1 Flight Manual and this technical manual, the flight manual will take precedence. This manual and T.O. 1-1M-34 contains the data required to plan a combat attack or a practice mission using the A-10A aircraft.

SECTION I, DESCRIPTION

Section I contains a description of nonnuclear munition delivery profiles, aircraft munition systems and controls. Nonnuclear combat munitions and fuzes, and nonnuclear training munitions and equipment are incorporated in T.O. 1-1M-34.

SECTION II, NORMAL AIRCREW PROCEDURES

Section II contains the amplified instructions for the performance of nonnuclear combat or training missions, including procedures necessary to ensure correct loading and configuration of all munitions, in-flight delivery procedures, and after landing procedures.

SECTION III, EMERGENCY AIRCREW PROCEDURES

Section III contains amplified procedures for emergency: release, malfunction procedures, and fire fighting and evacuation criteria.

SECTION IV, SUPPLEMENTARY DATA

Contains the armament reference lines specific to the A-10/OA-10 aircraft.

SECTION V, PLANNING PROCEDURES AND SAMPLE PROBLEMS

Contains information on minimum release altitude determination, chart usage, and weapons delivery calculation format.

SECTION VI, PLANNING CHARTS AND TABLES

Section VI contains the safe escape charts and conversion tables applicable to the A-10A aircraft only. The other data applicable to all aircraft is incorporated in T.O. 1-1M-34.

SECTION VII, NON-NUCLEAR WEAPONS DELIVERY INFORMATION

Contains non-nuclear weapons delivery information on GBU-10 and GBU-12 series general purpose guided laser bombs.

CHECKLISTS

The Weapons Delivery Manual contains the expanded Aircrew Checklist procedures. A checklist has been issued as a separate technical order. Refer to the A page for T.O. number and date of latest checklist. Line items in the Weapons Delivery Manual and checklist are identical with respect to arrangement and item number.

REFERENCES

AFM 50-3	Fighter Weapons (Training)
AFM 127-100	Explosive Safety Manual (Ground Safety)
T.O. 1-1M-34	Aircrew Weapons Delivery Manual (Nonnuclear) Standard Volume
T.O. 1-1M-34-2FD	Combat Weapon Delivery Software
T.O. 11A-1-1	Ammunition - Restricted or Suspended
T.O. 11A-1-33	Handling and Maintenance of Explosive Loaded Aircraft
T.O. 11A-1-55	Technical Manual-Fire Fighting and Withdrawal Time, Distance, and Related Criteria for Explosives (Except Nuclear Weapons)
T.O. 11A-1-58	General Instructions - Demolitions
T.O. 1A-10A-1	Flight Manual
T.O. 1A-10A-1-2	(EGI)
T.O. 1A-10A-2-1-1	General Vehicle Description
T.O. 1A-10A-2-1-1	Navigation System
T.O. 1A-10A-2-1-1	Weapons System
T.O. 1A-10A-33-1-1	Nonnuclear Munitions Basic Information
T.O. 1A-10A-33-1-2	Nonnuclear Munition Loading Procedures
T.O. 1A-10A-34-1-1	Nonnuclear Weapons Delivery
T.O. 1A-10A-34-1-2	Weapons Delivery Manual (Non-Nuclear Ballistic Tables) (Not maintained)

T.O. 1A-10A-34-1-1

EXTERNAL STORES LIMITATIONS

The Flight Manual T.O. 1A-10A-1 or 1A-10A-1-2, provides limitations for carriage release and jettison of certified stores. Only the stores listed in the Flight Manual are authorized, unless interim flight clearance is received from SM-ALC/LAFE.

STORE CERTIFICATION

New nonnuclear munitions and external stores certification will be implemented as established by HQ USAF PMD (Seek Eagle Program). Operating commands will generate these requirements by Statement of Operational Need (SON) LAW AFR 57-1.

FLIGHT CLEARANCE

Authorization for flight clearance after any necessary testing and appropriate analysis has been made that an aircraft/store combination would not cause an unacceptable risk for a specific limited purpose such as DT&E, JOT&E or FOT&E, will be requested through SM-ALC/LAFE.

DEFINITION WORDS "SHALL", "WILL", "SHOULD", AND "MAY"

The words "shall", and "will" indicate a mandatory requirement. The word "should" indicates a nonmandatory desire or preferred method of accomplishment. The word "may" indicates an acceptable or suggested means of accomplishment.

WARNINGS, CAUTIONS, AND NOTES

The following definitions apply to Warnings, Cautions, and Notes found throughout the manual.

WARNING

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

CAUTION

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

NOTE

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

YOUR RESPONSIBILITY - TO LET US KNOW

Every effort is made to keep the weapons delivery manual current. Review conferences with operating personnel and a constant review of accident and flight test reports assure inclusion of the latest data in the manual. We cannot correct an error unless we know of its existence. In this regard, it is essential that you do your part. Comments, corrections, and questions regarding this manual or any phase of the flight manual program are welcomed. These should be forwarded through your command channels on AF Form 847 to: SM-ALC/LAFF, 5020 Dudley Blvd., McClellan AFB, California 95652-1391.

TCTO IDENTIFICATION

The following TCTO's affecting A-10 aircraft are covered in this manual. This is not a complete listing, and only includes TCTO's listed by number directly affecting this manual. Refer to the Numerical Index and Requirement Table (T.O. 0-1-1-5) for complete listing of TCTO's for these aircraft.

T.O. NUMBER	DISPOSITION SECTION	SUBJECT
1A-10-1321	II	Installation of Bracket for Aircrew Eye/Respiratory Protection (AERP) Blower
1A-10-1366	I	Installation of Right Hand Map Light
1A-10-1369	III	Installation of Night Vision Imaging System (NVIS)
1A-10-1378	I	Replacement Installation of AN/ALR-69(V) Receiver Controller and Signal Processor for R&M Block Cycle Update
1A-10-1389	I, II	Installation of CCTVS/CAVTR System
1A-10-1399	I, II	Installation of Counter Measures Set (CMS)
1A-10-1414	I,II	BCC-01, (LASTE V6.0 OFP) for GPS and Non-GPS Modified A/OA-10A Aircraft

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| <div>68</div> | Aircraft prior to serno 80-0180. |
| <div>69</div> | Aircraft serno 80-0180 and subsequent. |
| <div>75</div> | Aircraft serno 79-0173 and subsequent. |
| <div>83</div> | Aircraft serno 82-0646 and subsequent. |
| <div>131</div> | Aircraft modification by T.O. 1A-10-1327 (LARS). |
| <div>132</div> | Aircraft modification by T.O. 1A-10-1366. |
| <div>136</div> | Aircraft modification by T.O. 1A-10-1414 , Block Cycle Change -01, (LASTE V6.0 OFF) for EGI and Non-EGI Modified A/OA-10A Aircraft |
| <div>137</div> | Aircraft not modified by T.O. 1A-10A-1399 (CMS) |
| <div>138</div> | Aircraft modified by T.O. 1A-10A-1399 (CMS) |
| <div>139</div> | Aircraft not modified by T.O. 1A-10A-1389 (CCTVS/CAVTR) |
| <div>140</div> | Aircraft modified by 1A-10A-1389 (CCTVS/CAVTR) |

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PART I

MISSION DESCRIPTION

LASTE VERSIONS 4.0 AND 6.0

GENERAL

The A-10A is a dual-engine single-seat aircraft specifically designed and optimized for ground attack. The A-10A can deliver a wide variety of guided and unguided weapons. Weapon carriage capabilities and release sequences are contained in T.O. 1A-10A-1 Section V. The A-10A armament control and release systems are manual only, but are optimized for one-man operation. Major weapons release controls and switches are located on the stick and throttles for fingertip control of weapons-related equipment. Additional mission related capabilities of the A-10A aircraft include threat warning, chaff/flare dispensing, and Electronic Countermeasure (ECM) systems.

NAVIGATION AND ATTITUDE REFERENCE SYSTEMS (LASTE V4.0 AND V6.0 136 NON-GPS)

The Heading Attitude Reference System (HARS) and/or Inertial Navigation System (INS) are the primary attitude and navigation systems used in the A-10A for weapons delivery. LASTE processes HUD attitude information from either the INS or HARS, as determined by the Nav Mode Select Panel and the attitude fault flag generated based on information from the INU. Attitude information from the INS is used when NAV CRS is selected and the INU indicates that the attitude information is valid. HARS data is used whenever HARS is selected on the Nav Mode Select Panel or the attitude fault flag state is TRUE. Attitude references provided by HARS are corrected by the filtered, measured Angle of Attack (AOA), but the references are limited in accuracy by the vane sensor. The INS attitude reference provides true flight path data compensating for ZSL AOA, thus aiding in more accurate weapons delivery. Time to go, distance to go, and offset point computations can help the pilot determine impact points, offset points, and pull up points. Individual techniques may vary. For further information on the HARS and INS systems, refer to T.O. 1A-10A-1.

NAVIGATION AND ATTITUDE REFERENCE SYSTEMS (LASTE V6.0 136 GPS)

The Heading Attitude Reference System (HARS) and/or Embedded Global Positioning System/Inertial Navigation System (EGI) are the primary attitude and navigation systems used in the A-10A for weapons delivery. LASTE processes HUD attitude information from either the EGI or HARS, as determined by the Nav Mode Select Panel and the attitude fault flag generated based on information from the EGI. Attitude information from the EGI is used when EGI is selected and indicates that the attitude data is valid. HARS data is used whenever HARS is selected on the Nav Mode Select Panel or the attitude fault flag state is TRUE. Attitude references provided by HARS are corrected by the filtered, measured Angle of Attack (AOA), but the references are limited in accuracy by the vane sensor. The EGI attitude reference provides true flight path data compensating for ZSL AOA, thus aiding in more accurate weapons delivery. The STR INFO and POS INFO page functions of the CDU can assist the pilot in vertical and lateral loft deliveries, as well as forward firing ordnance deliveries. For example, time to go, distance to go, and offset point computations can help the pilot determine impact points, offset points, and pull up points. Individual techniques may vary. For further information on the HARS and EGI systems, refer to T.O. 1A-10A-1.

BALLISTICS ADJUSTMENTS

For Head-Up Display (HUD) alignment, ± 15 mils maintenance boresight adjustments are provided to align all dynamic symbols on the HUD. Maintenance adjustments must be done on the ground. In addition, inflight adjustable gun and bomb boresights are provided to align applicable symbology. Settings for individual aircraft due to tail number unique characteristics are adjusted with the gun/bomb boresights. Offset adjustments of ± 15 mils for individual bombs are provided in the appropriate weapon submenu. Individual weapon adjustments should be set to fleet-wide standards as determined by operational testing of weapon delivery.

WARNING

Care must be taken when boresight adjustments are set. It is possible to adjust aircraft boresight to such an extent that use of aiming references may result in significant, and in some cases, dangerous errors during weapons employment.

TARGET ELEVATION

Target elevation provides information for Continuously Computed Impact Point (CCIP), Continuously Computed Release Point (LASTE V6.0 **136**) (CCRP), Maverick ranging, Target Designation Box, and Target Designation Cue (TDC). Target elevation is entered through the ELEV/TIME submenu (LASTE V4.0 and V6.0 **136** non-GPS) or through the Control Display Unit (CDU – LASTE V6.0 **136** GPS). A unique elevation can be assigned for each steerpoint. In addition, the target elevation can be displayed in meters or feet, selectable by the HUD Function Selector Switch.

Hot Elevation

Hot Elevation refers to the target elevation LASTE is currently using; the target elevation can be changed by either selecting a different steerpoint or by toggling the DATA switch on the Option Select Panel (OSP). If the DATA switch is used, the target elevation in the HUD will scroll up or down. The new target elevation will flash for ten seconds. Pressing the ENTR button on the OSP at this time will store the new target elevation in the currently selected steerpoint. Changing the steerpoint while the new target elevation is flashing will allow the new target elevation to be stored in another steerpoint. If ENTR is not depressed while the new target elevation is flashing, the selected steerpoint elevation in the ELEV/TIME submenu (LASTE V4.0 and V6.0 **136** non-GPS) or in the CDU (LASTE V6.0 **136** GPS) will not change, but the new value will be retained as the hot elevation. If a selected steerpoint has no target elevation entered (no entry) in BARO or DELTA modes, a CCIP INVALID or CCRP INVALID (LASTE V6.0 **136**) message is displayed on the HUD, the CCIP gunsight reverts to the fixed range gunsight, the bomb piper/rocket is deselected, and "XXXX" is displayed for the target elevation.

Overhead Markpoint

When an overhead markpoint is taken with the INS (LASTE V4.0) or with the EGI (LASTE V6.0 GPS **136**), LASTE simultaneously computes a ground eleva-

tion by subtracting radar altitude from the selected Baro or Delta altitude if less than 5000 ft AGL and Rad Alt is on. In LASTE V4.0, the mark is accomplished by flying over the desired ground reference and depressing the NWS switch for less than 1/2 second, if EAC is OFF, or by depressing the MARK button on the Control Display Unit (CDU) with the CDU selector knob not in update. In LASTE V6.0 GPS **136**, the mark is accomplished by depressing the MK button on the CDU when the CDU is not displaying the UPDT page. Once a markpoint elevation is acquired, it is automatically stored in markpoint (A-F) of the ELEV/TIME submenu (LASTE V4.0) or sent to the CDU (LASTE V6.0 GPS **136**). The new markpoint elevation will also be stored in the current steerpoint if the OSP ENTR button is pressed while the elevation is flashing. The elevation will flash in the center of the HUD for 10 seconds. The stored location of the most recent markpoint will be indicated by an "o" in the ELEV/TIME submenu (LASTE V4.0).

Offset Markpoint

For LASTE V6.0 GPS **136**, if the HCP option select Switch is in the MARK position, and the NWS button on the stick is depressed for less than 1/2 second, LASTE will retain the offset markpoint (or Designate if in CCRP mode) data and send it to the CDU. The current steerpoint in the CDU will not change unless the AAP switch is in the MARK position; otherwise, a new offset markpoint will be created.

NOTE

When an offset markpoint is to be performed, the elevation of the markpoint must be at least 1 foot below the LASTE system current elevation; the markpoint must be less than 14.8 NM (line of sight) from the aircraft, and the markpoint must be at least 5 miles below the horizon.

Once a mark point elevation is acquired, it is automatically stored in mark point (A-F) of the ELEV/TIME submenu (LASTE V4.0 and V6.0 **136** non-GPS) or sent to the CDU (LASTE V6.0 **136** GPS). The new mark point elevation will also be stored in the current steerpoint if the OSP ENTR button is pressed while the elevation is flashing. The elevation will flash in the center of the HUD for 10 seconds. The stored location of the most recent mark point will be indicated by an "o" in the ELEV/TIME submenu (LASTE V4.0 and V6.0 **136** non-GPS).

For LASTE V6.0 **136** GPS, if the HCP option select switch is in the MARK position and the NWS button on the stick is depressed for less than 1/2 second, LASTE will retain the Markpoint (or Designate if in CCRP mode) data

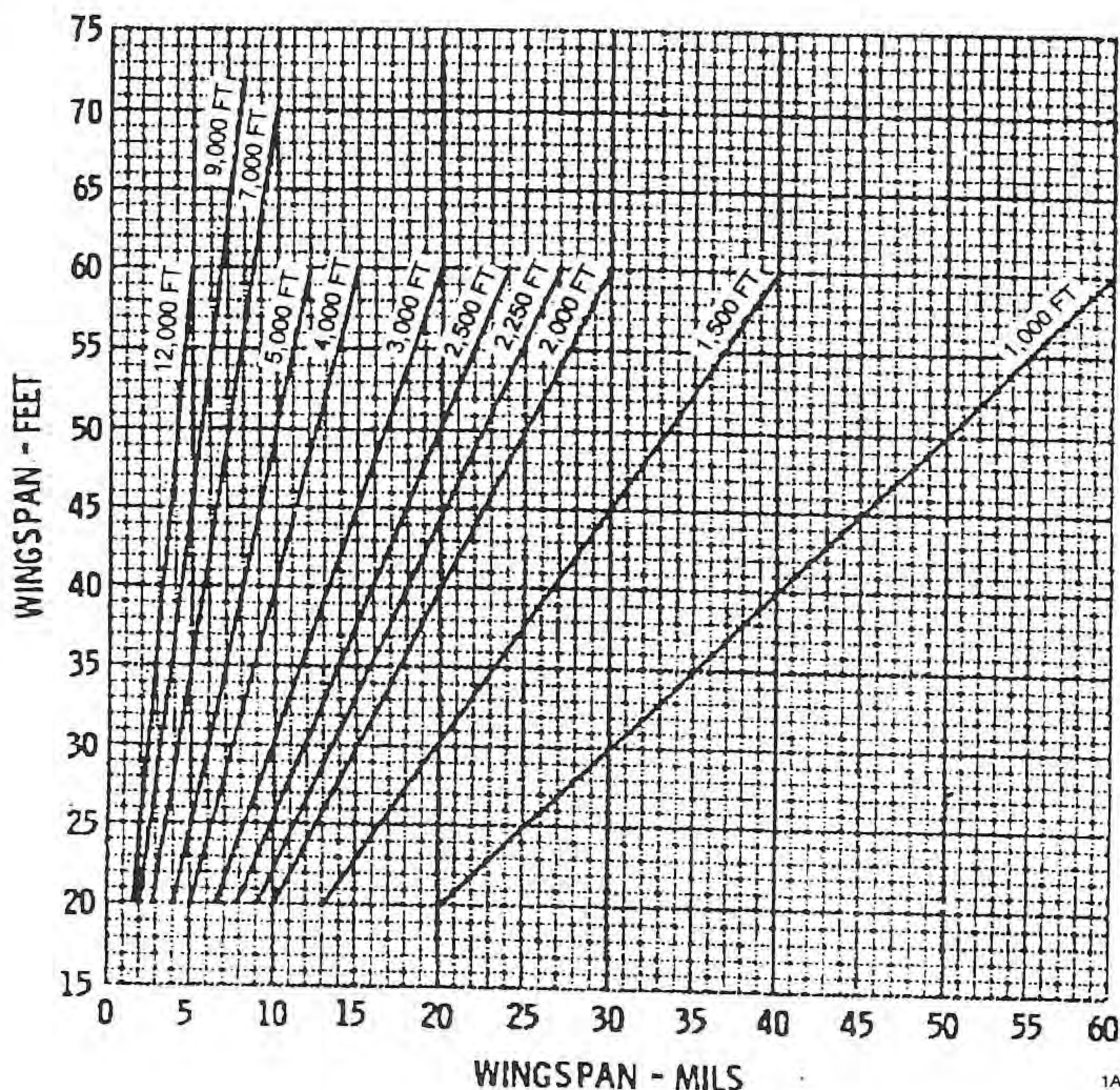
and send it to the CDU. The current steerpoint in the CDU will not change unless the AAP switch is in the MARK position; otherwise, a new markpoint will be created.

AIR-TO-AIR ATTACK

The AIM-9 Sidewinder air-to-air missile and the 30mm gun, described below, provide the A-10A with self-

defense capability during air-to-air attack. The air-to-air target range (Figure 1-1) can be estimated using the 15-mil diameter AIM-9 seeker, and the known wingspan or length of the target. For example, the F-15 at a range of 2,900 feet will just fill the circle with its 43-foot wingspan.

$(1,000)(43 \text{ feet WS}) \div (2,900 \text{ feet range}) = 15 \text{ mils diameter (approximately)}$.



1A-10A-34-1-1-1

Figure 1-1. Wingspan vs Range.

AIM-9 Sidewinder Missile

The AIM-9 select switch must be in SELECT to display A/A HUD symbology. The pilot must then fly the aircraft to place the target in the AIM-9 seeker head Field Of View (FOV) or slew the seeker head to the TGT.

The AIM-9 seeker head position is displayed as a 15 mil circle on the HUD. The AIM-9 Seeker FOV is aligned at 40 mils in the boresight position. When the seeker FOV is

aligned with and detects the target, the missile detection tone is presented in the pilot's headset. The detection tone is controlled by pulling up and adjusting the HF button on the intercom panel. To obtain a self-track, the pilot must push the missile reject/uncage switch forward (reject/uncage switch is time-shared with the AGM/TGM-65) or depress and release the missile slew button on the right throttle or the missile track button on the control stick. To obtain circular scan, the pilot must activate the missile

track button. This enables a 0.9° circular scan pattern of the missile seeker head and consents to self-track a target when the missile tone has achieved a self tracking level (signal to noise ratio). Lock-on and self track are indicated by a change in the detection tone. The pilot may then steer off boresight to maneuver into better launch parameters.

CAUTION

The pilot must be sure that the missile seeker is tracking a valid target and not a background IR clutter.

Once the missile is in the self-track mode, the pilot may launch the missile by pressing the weapons release button.

NOTE

The pilot must estimate the valid launch envelope, since there is no cockpit indication of target parameters. Detection tone quality and mil size relationship will provide the best estimates.

30MM Gun

LASTE provides several systems for using the 30MM gun in an air-to-air attack against maneuvering and non-maneuvering aerial targets.

LASTE System Gunsight Displays

When AIM-9 is selected on the Armament Control Panel (ACP), the LASTE system provides MRGS, funnel, AMIL, and FEDS gunsight displays on the HUD (Figure 1-2). Two separate HUD modes allow the pilot to select RTY (rotary wing) or FXD (fixed wing) sights on the HUD. FXD is the power-on default. The pilot can toggle between fixed and rotary sights by means of the SEL switch on the OSP. Target dimensions for rotary and fixed targets are entered separately into the computer through the AAS sub-menu. Hovering or low-speed helicopters can be treated as moving ground targets. The air-to-air mode, option C, provides the air-to-ground CCIP gun cross for these targets.

Multiple Reference Gunsight (MRGS)

The Multiple Reference Gunsight (MRGS) display is a stadiametric sight that is used on targets between 60° and 120° aspect angle. The sight uses input target length and target velocity to compute lead angle solutions. The display is composed of a series of lines spaced in an arc pointing at the Gun Bore Line (GBL). The lines are spaced at a mil distance from the GBL corresponding to 1/2 the input target velocity. The multiple displays represent the planes of motion of multiple targets for which the gun is properly aimed. The displays collapse laterally towards the shooter's plane of motion. The pilot uses MRGS when confronted

with a beam aspect target by placing the GBL in the target's plane of motion and pulling enough lead to track the target with a MRGS line. If the pilot has placed the GBL in the target's plane of motion, the MRGS will begin collapsing on the target. If the MRGS are moving across the target, the pilot is not in the target's plane of motion and must adjust his GBL position. In this type of attack, the target aircraft will generally generate a very high line of sight rate. A target for which the pilot is not pulling enough lead, or is out of range, will appear smaller than the reference lines. A target which is over led or is too close will appear larger than the reference lines. Again, to increase the probability of a hit, the pilot should take a raking shot by starting the target aircraft on the MRGS and allowing it to pass upward through the GBL or vice versa.

Funnel Display

The funnel display is used for front and rear quarter gun attacks, with aspect angles below approximately 60° and above 120°. The sight uses stadiametric ranging based on input target wingspan to compute lead angle solutions at various target ranges. The funnel is predictive in nature and does not always depict the shooter's actual plane of motion in maneuvering flight. Also, the calculations used in shaping the funnel will not be accurate in all situations. Therefore, the bullets of a tracking shot, with the aircraft wingspan equaling the width of the funnel may miss the target. To ensure a hit, the pilot must take a raking gunshot by either pulling excessive lead (funnel width smaller than target aircraft wingspan), opening fire early, then releasing backstick pressure until the funnel is larger than the target aircraft wingspan, or opening fire with not enough lead (funnel larger than target aircraft wingspan), then increase backstick pressure until the funnel is smaller than target aircraft wingspan.

Air Mass Impact Line (AMIL)

The AMIL is intended for use against targets directly head on or tail on. The AMIL is a line of approximately 10 mils which represents the lead angle due to trajectory shift and gravity drop of rounds fired from close range to 2 seconds bullet time of flight (approximately 6000 feet).

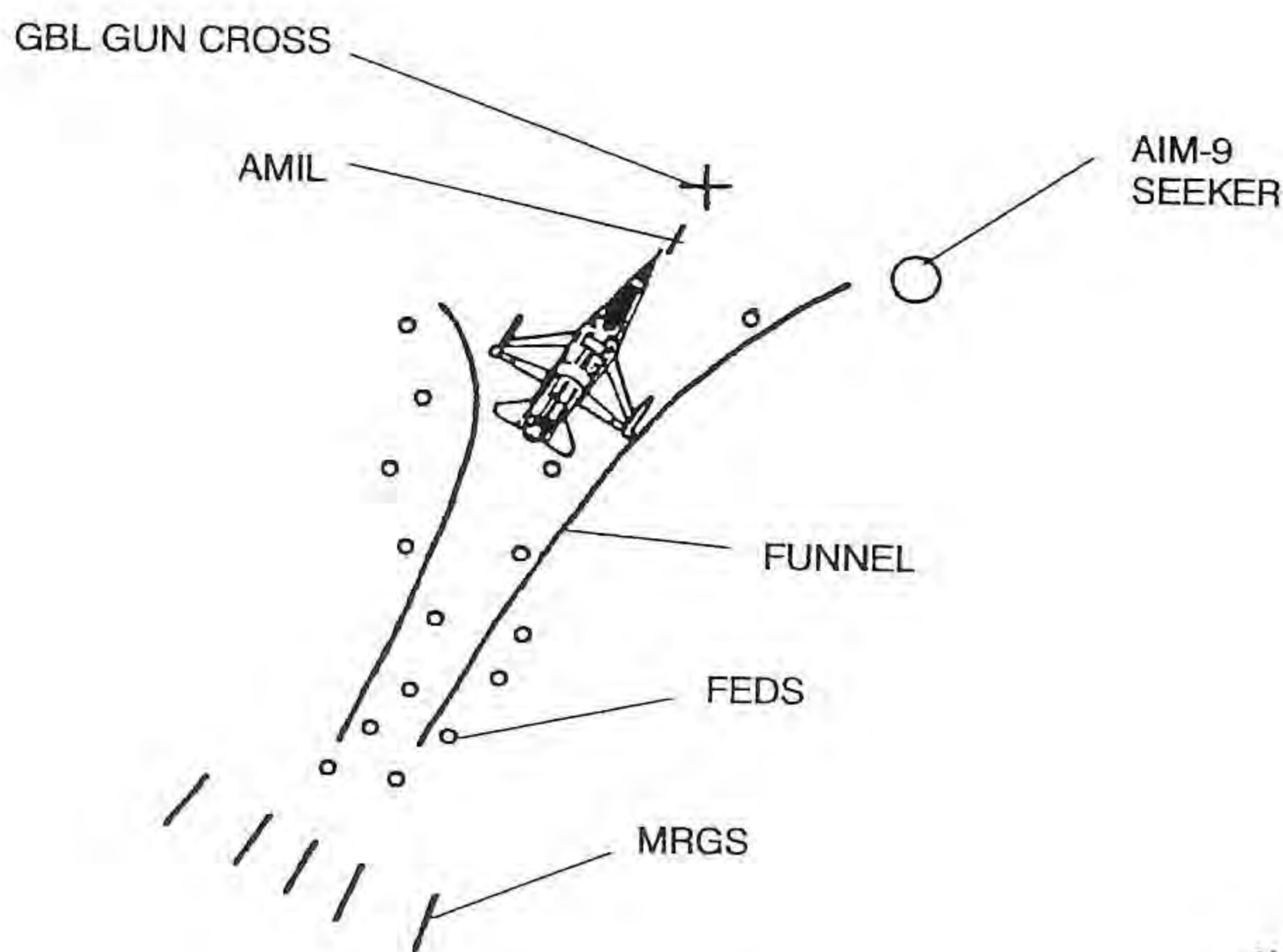
The aircraft is maneuvered to place the target exactly head or tail on, then placed on the top or bottom of the AMIL. A gunburst is then fired while moving the target from one end of the AMIL to the other. Head and tail on shots may be taken beyond 6000 feet due to high closing or opening velocities.

Firing Evaluation Display System (FEDS)

The FEDS is provided so training can be conducted against other aircraft. Two electronic tracer streams are displayed on the HUD separated by the input target wingspan. The

stream is displayed when the trigger is depressed to the second detent, with the MASTER ARM in ARM or CAMERA, and continues as long as the trigger is depressed. Evaluation is done postflight, using the gunsight video re-

corded by the Airborne Video Tape Recorder (AVTR). By comparing the known wingspan of the target aircraft to the width of the FEDS which bracket the target, a hit or miss assessment can be made.



1A-10A-34-1-1-2

Figure. 1-2 LASTE Gunsight Display.

AIR-TO-SURFACE ATTACK

The A-10A is designed and optimized for air-to-surface attack using the 30mm gun and various types of bombs and rockets.

Altitude Source (LASTE V4.0 and V6.0 136 Non-GPS)

In NAV mode and the Air-to-Air sight, LASTE repeats the altitude displayed on the cockpit altimeter within normal tolerances. The altitude can be adjusted along with the cockpit altimeter using the altimeter settings. In the weapons delivery modes, the LASTE system provides three other options of altitude source selection via the Option Select Panel (OSP) ALTITUDE switch. The selected altitude source is used in CCIP guns and bombs, CCRP (LASTE V6.0 136), Maverick, and the EXP Mode Target Designation Cue (TDC) ranging.

The first option is Baro Mode. When Baro Mode is selected, the system computes a true MSL altitude from the Central Air Data Computer (CADC) Barometric Reference altitude which is adjusted by the altimeter setting. The geometric altitude is corrected for static port installation errors, dynamic lag, and nonstandard air temperatures. The

system captures the field elevation on takeoff roll from the Baro Altimeter - not the steerpoint elevation, and uses this as the calibration point to formulate the corrections. This calibration point is stored in Non-Volatile Memory (NVM) such that in the event of an in-flight power interruption the calibration point will be recalled.

NOTE

- In BARO mode the calibration point is valid only for the altimeter setting and air mass which exists at takeoff. Changing the altimeter setting may cause bias errors in the geometric attitude as great as 250 feet to be displayed on the HUD.
- This note should not be confused with the Delta update generated on take off roll. This is a barometric calibration that applies to the BARO altitude source only.

The second option is the Delta Mode. When Delta Mode is selected, the system computes the true MSL altitude above mean sea level from the CADC Pressure Altitude which is not affected by the altimeter setting. The true MSL altitude in Delta Mode is also corrected for static port installation errors, dynamic lag, and nonstandard air temperatures. The

calibration reference point for Delta Mode is derived from two parameters: the Delta value (CADC pressure altitude minus the sum of radar plus target elevation) and true MSL altitude (radar plus target elevation). This calibration point is first automatically captured on takeoff roll using the barometric altitude. An in-flight Delta update is accomplished over a known ground reference by first depressing the ENTR button on the OSP with a valid radar altitude and target elevation displayed. After the ENTR is first depressed, the two calibration numbers are displayed in the center of the HUD. The delta value is suffixed with a "D" and the Radar computed MSL value with an "R". A second depression of the ENTR button within the next 10 seconds will accept the new calibration reference values and store them in the DELTA CAL submenu for verification and adjustment. These values can also be manually entered into the DELTA CAL submenu if obtained from other aircraft. The altitude corrections will then start from the new reference point when either a Delta update has been accepted or new data is entered in the DELTA CAL submenu and the menu is exited via the STORE option.

NOTE

- The Delta Calibration reference values will be reset to zero feet in the event of LASTE power interruption.
- Delta mode can be used prior to taking an airborne update because it performs an automatic DELTA update on takeoff.
- Delta altitudes are not affected by altimeter settings.
- LASTE will only use one Delta. If a Delta is accepted, all previous Delta values are lost.

For the most accurate calibration on takeoff, for either Baro or Delta altitude source, touchdown zone elevation for the departure runway should be read in the HUD as adjusted at the altimeter setting. Air traffic control altimeter should be reset after takeoff.

The third option is the Radar Mode. When Radar Mode is selected, the system uses the radar altimeter altitude. The radar altitude is valid up to approximately 5000 feet. Beyond 5000 feet, the system estimates Above Ground Level (AGL) altitude for a period of time after which the radar altitude is declared invalid. This is a GCAS function and should not be used for performing a Delta update. For LASTE V4.0, when radar altitude is invalid, the altitude source defaults to the BARO mode altitude. For LASTE V6.0, when the radar altitude is invalid, the altitude source defaults to Delta mode. An invalid radar altitude is displayed as XXXXR. The altitude source used for ranging is displayed on the HUD in the EAC Messages window.

Either BARO, RDR, DELT (DELR for LASTE V6.0 [136]), or XXXX is displayed provided the HUD Option Display or any EAC Message is not being displayed. For LASTE V4.0, BARO will be displayed if Radar Mode is

selected and radar altitude is invalid; for LASTE V6.0, DELR will be displayed. An XXXX is displayed if the altitude source is invalid.

NOTE

- The barometric altitude displayed on the HUD (tapes or numerics) is the true MSL altitude in WD-1, WD-2, and EXP modes(V4.0), [GUNS, CCIP and CCRP V6.0], and is the raw CADC barometric altitude in NAV mode, Air-to-Air mode, and whenever the aircraft is on the ground.
- The altitude displayed in GUNS, CCIP and CCRP modes is corrected for static port installation, dynamic lag, and non-standard air temperatures with BARO mode selected on the OSP ALT switch. True MSL altitude is referenced from field elevation on takeoff and computed from CADC barometric reference altitude, which is a function of the Kollsman altimeter setting. With Delta Mode selected, the true MSL altitude is referenced from a radar altitude update after the delta has been accepted (see ENTR function under Option Select Panel) and computed from CADC pressure altitude, which is independent of the Kollsman setting. The altitude displayed in the NAV and Air-to-Air modes is the uncorrected CADC barometric altitude.

Altitude Source (LASTE V6.0 [136] GPS)

In NAV mode and the Air-to-Air sight, LASTE repeats the altitude displayed on the cockpit altimeter within normal tolerances. The altitude can be adjusted along with the cockpit altimeter using the altimeter barometric pressure settings. In the weapons delivery modes the LASTE system provides three other options of altitude source selection via the OSP switch. The selected altitude source is used in CCIP/CCRP, Maverick, and Target Designation Cue (TDC) ranging.

The first option is Baro Mode. When Baro Mode is selected, the system computes a true MSL altitude from the CADC barometric reference altitude, which is adjusted by the altimeter barometric pressure setting. The geometric altitude is corrected for static port installation errors, dynamic lag, and nonstandard air temperatures. The geometric altitude also contains a bias correction based upon the GPS system altitude when the Estimated Vertical Error (EVE) is less than 50 ft. The system captures the field elevation on takeoff roll from the Baro Altimeter - not the steerpoint elevation, and uses this as the calibration point to formulate the corrections. This calibration point is stored in Non-Volatile Memory such that in the event of an in-flight power interruption the calibration point will be recalled. If the EVE is less than 50 ft. then the BARO alti-

tude source (which contains the GPS system altitude bias correction) is the most accurate altitude mode.

NOTE

- In BARO Mode the calibration point is valid only for the altimeter setting and air mass which exists at takeoff. Changing the altimeter barometric pressure setting may cause bias errors as great as 250 feet displayed on the HUD.
- This note should not be confused with the Delta update generated on take off roll. This is a barometric calibration that applies to the BARO altitude source only.

The second option is the Delta Mode. When Delta Mode is selected, the system computes the true MSL altitude from the CADC Pressure Altitude, which is not affected by the altimeter barometric pressure setting. The geometric MSL altitude in Delta Mode is also corrected for static port installation errors, dynamic lag, and nonstandard air temperatures. The calibration reference point for Delta Mode is derived from two parameters: the true MSL altitude and the delta value (CADC pressure altitude minus true MSL altitude). This calibration point is first automatically captured on takeoff roll using the displayed barometric altitude for true MSL altitude. An in-flight Delta update can be accomplished at any altitude by first depressing the ENTR button on the OSP. Both, radar and GPS based calibration references, are then computed. The LASTE computer will display the Delta GPS altitude value as a big size numeric symbol (suffixed by the letter "G" to identify Delta GPS Altitude). The radar based true MSL altitude is computed as the radar altitude plus target elevation (the Radar mode will be valid only if the AGL is less than 5,000 ft and RADALT is valid). The GPS based true MSL altitude is simply the raw GPS altitude (the GPS mode will be valid if the EVE is less than 50 ft.). Invalid modes will be displayed as "XXX"s. Once both calibration references are computed, one set of references will be displayed in the center of the HUD for 10 seconds. The GPS based calibration references are displayed first, and the OSP SEL switch can be used to alternate between radar and GPS based values. Pressing the OSP ENTR switch within 10 seconds causes whichever value is displayed to be accepted and stored in the DELTA CAL submenu. The Delta GPS altitude numeric will flash for an additional two seconds to acknowledge the acceptance. These values can also be manually entered into the DELTA CAL submenu if obtained from other aircraft. The altitude corrections will then start from the new reference point when either a Delta update has been accepted or new data is entered in the DELTA CAL submenu and the menu is exited via the STORE option.

NOTE

- The Delta Calibration reference values will be reset to zero feet in the event of LASTE power interruption.
- Delta mode can be used prior to taking an airborne update because it performs an automatic DELTA update on takeoff.
- Delta altitudes are not affected by the altimeter barometric pressure settings.

NOTE

A Delta Update can be taken at any altitude and over any terrain since the GPS will automatically update the altitude source. GPS Delta Updates may be passed to Non-GPS A/C for altitudes above 5000 ft AGL. Below 5000 ft AGL the best method is for each jet to accomplish its own Delta Update.

For the most accurate calibration on takeoff, for either Baro or Delta altitude source, touchdown zone elevation for the departure runway should be read in the HUD as adjusted at the altimeter barometric pressure setting. The air traffic control altimeter should be reset after takeoff.

The third option is the Radar Mode. When Radar Mode is selected, the system uses the radar altimeter altitude. The radar altitude is valid up to approximately 5000 feet. Beyond 5000 feet, the system estimates Above Ground Level (AGL) altitude for a period of time after which the radar altitude is declared invalid. This is a GCAS function and should not be used for performing a Delta update. When the radar altitude is invalid, the altitude source defaults to Delta mode. An invalid radar altitude is displayed as XXXXR. The altitude source used for ranging is displayed on the HUD in the EAC Messages window. Either BARO, RDR, DELR, DELG, or XXXX is displayed provided the HUD Option Display or any EAC Message is not being displayed. DELR will be displayed if a Radar Mode DELTA calibration is selected and radar altitude is invalid. DELG will be displayed if a GPS DELTA calibration is selected and Radar altitude is invalid.

NOTE

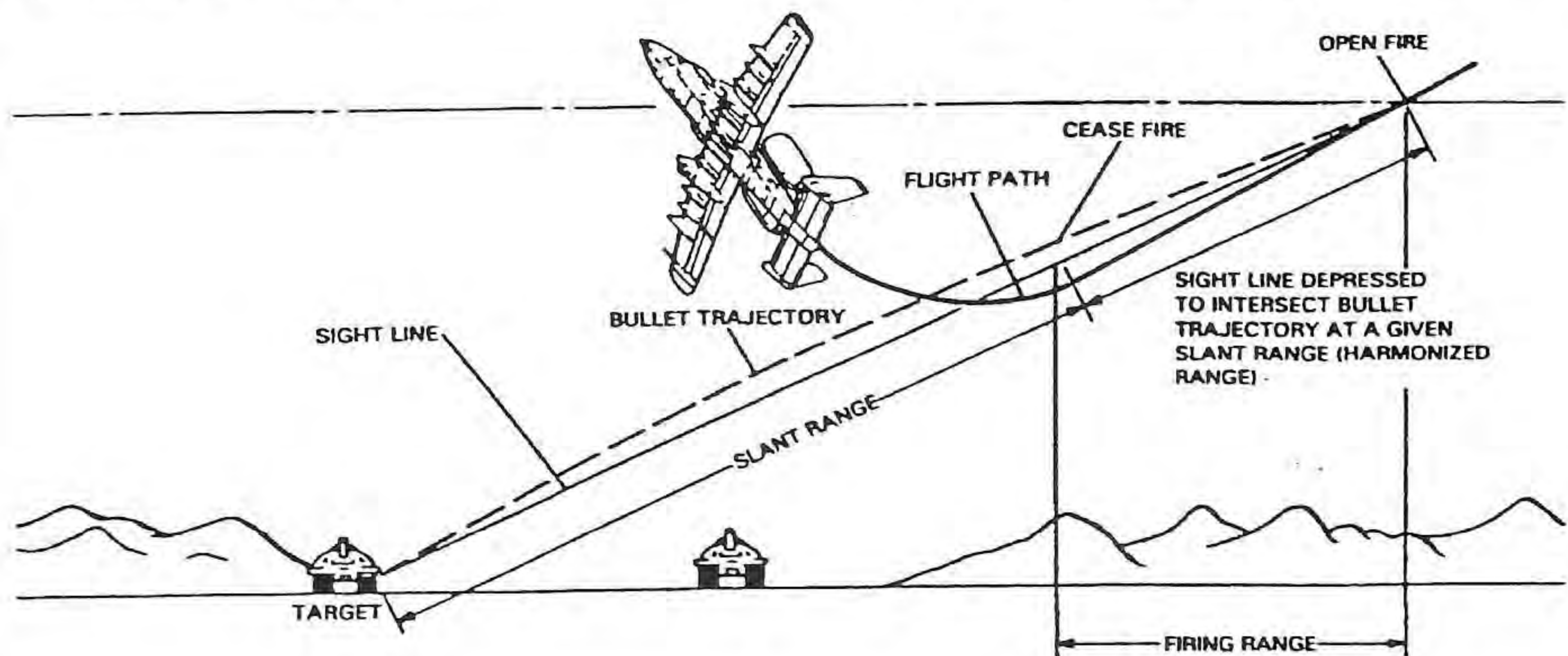
- The barometric altitude displayed on the HUD (tapes or numerics) is the true MSL altitude in WD-1, WD-2, and EXP modes (V4.0), [GUNS, CCIP and CCRP V6.0], and is the raw CADC barometric altitude in NAV mode, Air-to-Air mode, and whenever the aircraft is on the ground.
- The altitude displayed in WD-1, WD-2, and EXP modes (V4.0), [GUNS, CCIP and CCRP V6.0], is corrected for static port installation, dynamic lag, and nonstandard air temperatures with Baro mode selected on the OSP ALT switch. True MSL altitude is referenced from field elevation on takeoff and computed from CADC barometric reference altitude,

which is a function of the altimeter barometric pressure setting. With Delta Mode selected, the true MSL altitude is referenced from a radar altitude or GPS altitude update after the delta has been accepted (see ENTR function under option select panel) and computed from CADC pressure altitude, which is independent of the altimeter barometric pressure setting. The altitude displayed in the NAV and Air-to-Air mode is uncorrected CADC barometric altitude.

Gun Attack

The gun attack (Figure 1-3) is a versatile and accurate

method of attacking a surface target. The gun must be fired at the proper slant range for optimum bullet effectiveness. In a dive, area targets may be strafed by walking the projectiles along an impact corridor. Area targets can also be attacked at longer slant ranges and/or very low dive angles to take advantage of bullet dispersion patterns to cover the area. Hard targets must be tracked to increase bullet density and therefore the probability of kill of the target. Safe escape considerations when firing the gun must include terrain avoidance, ricochet, and target explosions. Adherence to minimum slant ranges followed by an escape maneuver are critical to avoid ricochets, especially at low strafing angles and or short ranges. Pilots must exercise caution and avoid target fixation during gun attacks.



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Figure 1-3. Air-to-Surface Attack.

NOTE

LAAP will disengage anytime the gun trigger is depressed to the second detent.

Gun Attack (LASTE V4.0)

Air-to-surface gun attacks can be accomplished in WD-1, WD-2 and EXP modes. The LASTE system uses INS, CADC, and AGL altitude data to provide CCIP solutions.

Computed sight solutions for the gun are available out to 15,000 feet slant range and are adjusted for wind, angle of attack, and sideslip. Accuracy is dependent on accurate target elevation information, and is degraded beyond 12,000 feet. If the aircraft is below the set target elevation, with BARO or DELTA selected, or a computed gun solution is not possible, the CCIP will revert to a 4,000 foot wind corrected gun cross or reticle. Figure 1-5 shows sight pictures for no solution, a valid solution (with an approximately 8,000 foot slant range), and an outside maximum range solution. A no solution condition is indicated by zero

range displayed on the reticle or by no top bar present on the guncross. A condition outside max range is indicated by 15,000 foot range displayed on the reticle or no top bar present on the gun cross. When strafing in the BARO or DELTA altitude source mode and there is no target elevation entered, or LASTE sensor information (CADC, INS, and SAS) is lost, the HUD will display a "CCIP INVALID" message.

If the ground is hilly or sloping, the LASTE system can accommodate variations in target elevation. Dual Pippers are displayed within the CCIP reticle when a VAR TGT ELEV is entered in the OSP WEAPONS sub-menu. The amount of separation between the pippers is determined from the Variable Target Elevation and elements of the CCIP solution. Aircraft Roll Attitude is used to stabilize the two pippers in a vertical plane. The OSP menu input represents one-half the total target altitude uncertainty, so that the lower pipper is a CCIP for the lowest expected target elevation, and the upper pipper is a CCIP for the

highest expected target elevation. The two pippers are used to judge the actual target elevation relative to the pre-set target elevation, or to bracket the target using the Variable Target Elevation as altitude uncertainty. The undisplayed mid-point between the two pippers is the nominal CCIP solution. Dual pippers will be displayed only with the CCIP Pipper/Reticle selected; the CCIP gun cross has only a single pipper. In the event that variable target elevation data results in a pipper deviation of more than 20 mils, i.e., low dive angle deliveries, the reticle will revert to a standard pipper and variable target elevation information will not be displayed.

The Moving Target Indices are two vertical bars that bracket the CCIP pipper (Figure 1-6). They provide lead for a moving target. Elements of the CCIP solution are used with an assumed constant target velocity (20 knots perpendicular to the current line of sight) to calculate the position of the moving target indices with respect to the nominal CCIP solution. Menu selection of a higher velocity bullet or decreasing slant range to target will result in the moving target indices being placed closer together as the target cannot move as far during a shorter time of flight. The indices are roll stabilized (i.e. a line drawn between centers would always be parallel to the horizon) by using roll attitude data.

A Bullets-at-Target-Altitude (BATA) symbol is displayed on the HUD indicating the impact point at the set target elevation for bullets fired one bullet time-of-flight ago. BATA is displayed on the HUD at the computed time of ground impact. This gives the pilot the ability to assess dry or actual strafe airborne or postflight.

Gun Attack (LASTE V6.0 136)

Air-to-surface gun attacks can be accomplished in GUNS, CCIP and CCRP modes. Max CCIP solution is within HUD FOV. The increased performance is due to the following: improved sensor input from EGI and Radar; PAC adjustment for spin-up effect; and compensation for temperature, round manufacturer and rate of fire (3900 rpm).

GUNS mode offers the following symbology selections: CCIP Reticle, CCIP Gun Cross, 4/8/12 Reticle, and 4000' Gun Cross (Figure 1-6 Sheet 1). Examples of the above symbologies under both normal and no solution conditions may be seen in Figure 1-6 Sheet 2. When strafing in the BARO or DELTA altitude source mode and there is no target elevation entered, or LASTE sensor information (CADC, INS [LASTE V6.0 136 non-GPS] EGI [LASTE V6.0 136 GPS] and SAS) is lost, the HUD will display a "CCIP INVALID" message. When the "CCIP INVALID" message occurs, symbology identical to a no solution condition is displayed, but the symbology will be fixed in elevation at 41 mils.

CCIP mode offers the following symbologies: CCIP Gun Reticle and 4000' Gun Cross. Symbology carry over when switching from GUNS to CCIP may be seen in Figure 1-6 Sheet 3.

NOTE

Slant range to CCIP is displayed directly below the gun cross. CCIP numeric is only displayed when the slant range is greater than 15,000ft. (2.5NM) and in CCIP Mode.

CCRP mode offers a 41 mil fixed (non wind corrected) gun cross. This sight is available with option C selected.

[LASTE V6.0 136 non-GPS] Targets may be designated in both GUNS and CCIP by using the depressible pipper or maverick symbol and depressing the NWS button for less than 0.5 seconds.

If the ground is hilly or sloping, the LASTE system can accommodate variations in target elevation. Dual Pippers are displayed within the CCIP reticle when a VAR TGT ELEV is entered in the OSP WEAPONS sub-menu. The amount of separation between the pippers is determined from the Variable Target Elevation and elements of the CCIP solution. Aircraft Roll Attitude is used to stabilize the two pippers in a vertical plane. The OSP menu input represents one-half the total target altitude uncertainty, so that the lower pipper is a CCIP for the lowest expected target elevation, and the upper pipper is a CCIP for the highest expected target elevation. The two pippers are used to judge the actual target elevation relative to the pre-set target elevation, or to bracket the target using the Variable Target Elevation as altitude uncertainty. The undisplayed mid-point between the two pippers is the nominal CCIP solution. Dual pippers will be displayed only with the CCIP Reticle selected; the CCIP gun cross has only a single pipper. In the event that variable target elevation data results in a pipper deviation of more than 20 mils, i.e., low dive angle deliveries, the reticle will revert to a standard pipper and variable target elevation information will not be displayed.

The Moving Target Indices are two vertical bars that bracket the CCIP pipper (Figure 1-6). They provide lead for a moving target. Elements of the CCIP solution are used with an assumed constant target velocity (20 knots perpendicular to the current line of sight) to calculate the position of the moving target indices with respect to the nominal CCIP solution. Menu selection of a higher velocity bullet or decreasing slant range to target will result in the moving target indices being placed closer together as the target cannot move as far during a shorter time of flight. The indices are roll stabilized (i.e. a line drawn

between centers would always be parallel to the horizon) by using roll attitude data.

LASTE provides a positive pitch gun solution (Figure 1-4) when the target is located at higher elevation than that of the aircraft, and BARO or DELTA is selected as the altitude source (RDR results in a fixed range gunsight). Target altitude may be set by OSP menu or Hot Target Elevation (OSP SEL switch). PAC and BATA are available throughout the positive pitch engagement.

A Bullets-at-Target-Altitude (BATA) symbol is displayed on the HUD indicating the impact point at the set target elevation for bullets fired one bullet time-of-flight ago. BATA is displayed on the HUD at the computed time of ground impact. This gives the pilot the ability to assess dry or actual strafe airborne or postflight.

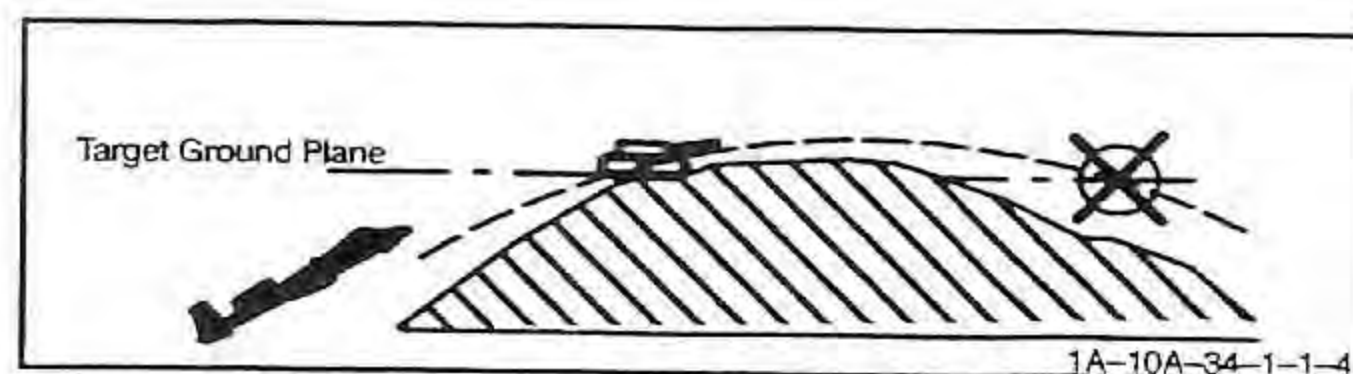
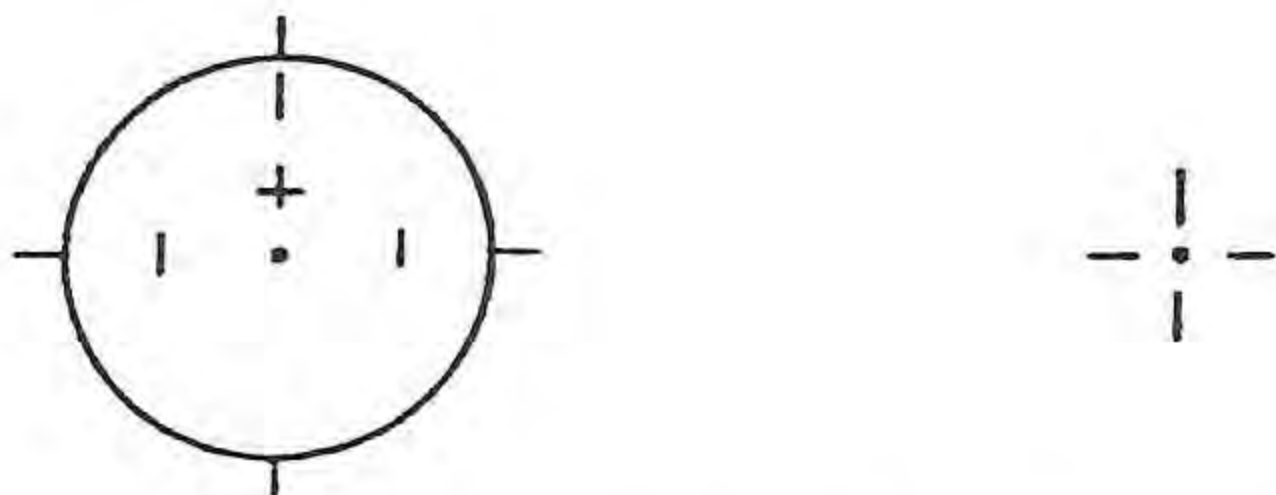


Figure 1-4. Positive Pitch Gun Solution.

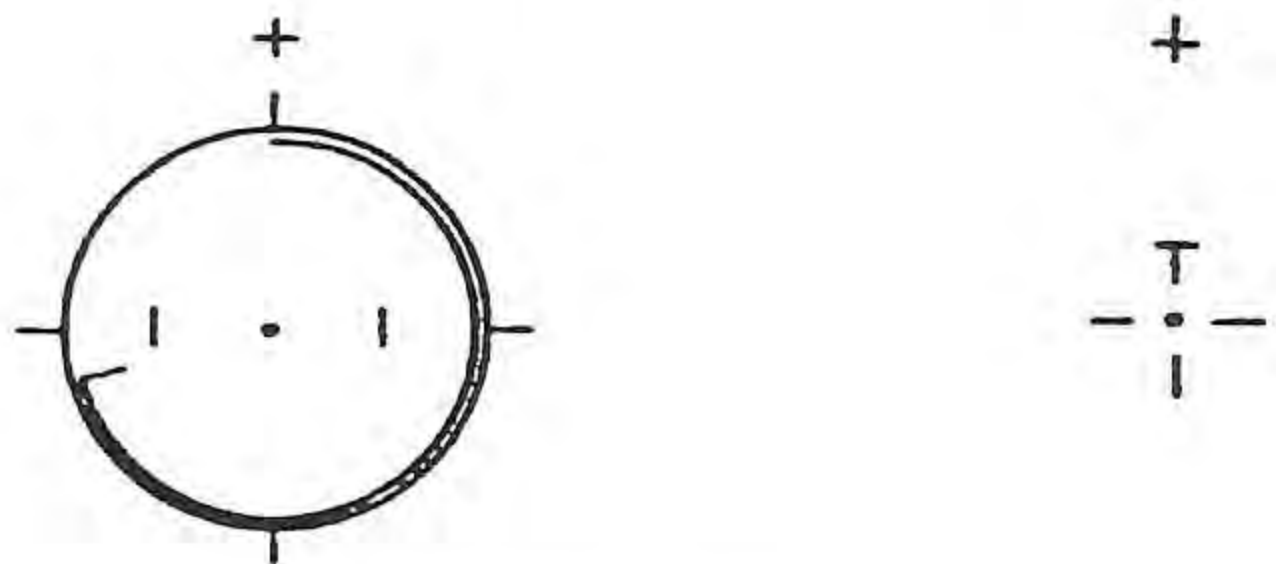
BATA is normally displayed when the computed bullet time of flight is less than or equal to the following values in different modes:

- HUD GUNS mode — 19 seconds
- HUD CCIP — 6 seconds
- Air-to-Air Gunsight mode (option C) — 1.8 seconds

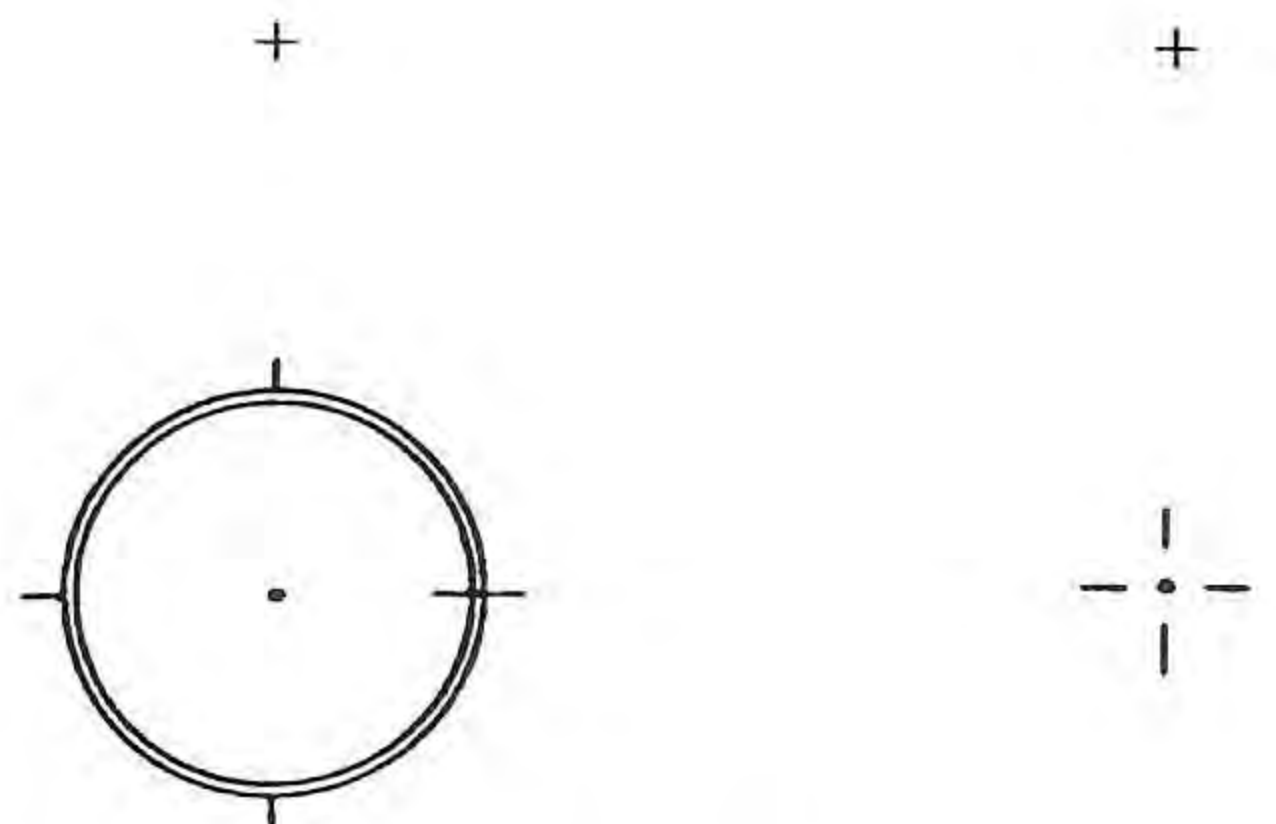
WD-1 HUD Symbology (LASTE V4.0)



NO SOLUTION – TARGET ELEVATION HIGHER THAN BAROMETRIC ALTITUDE
(CCIP FIXED AT 41 MILS)

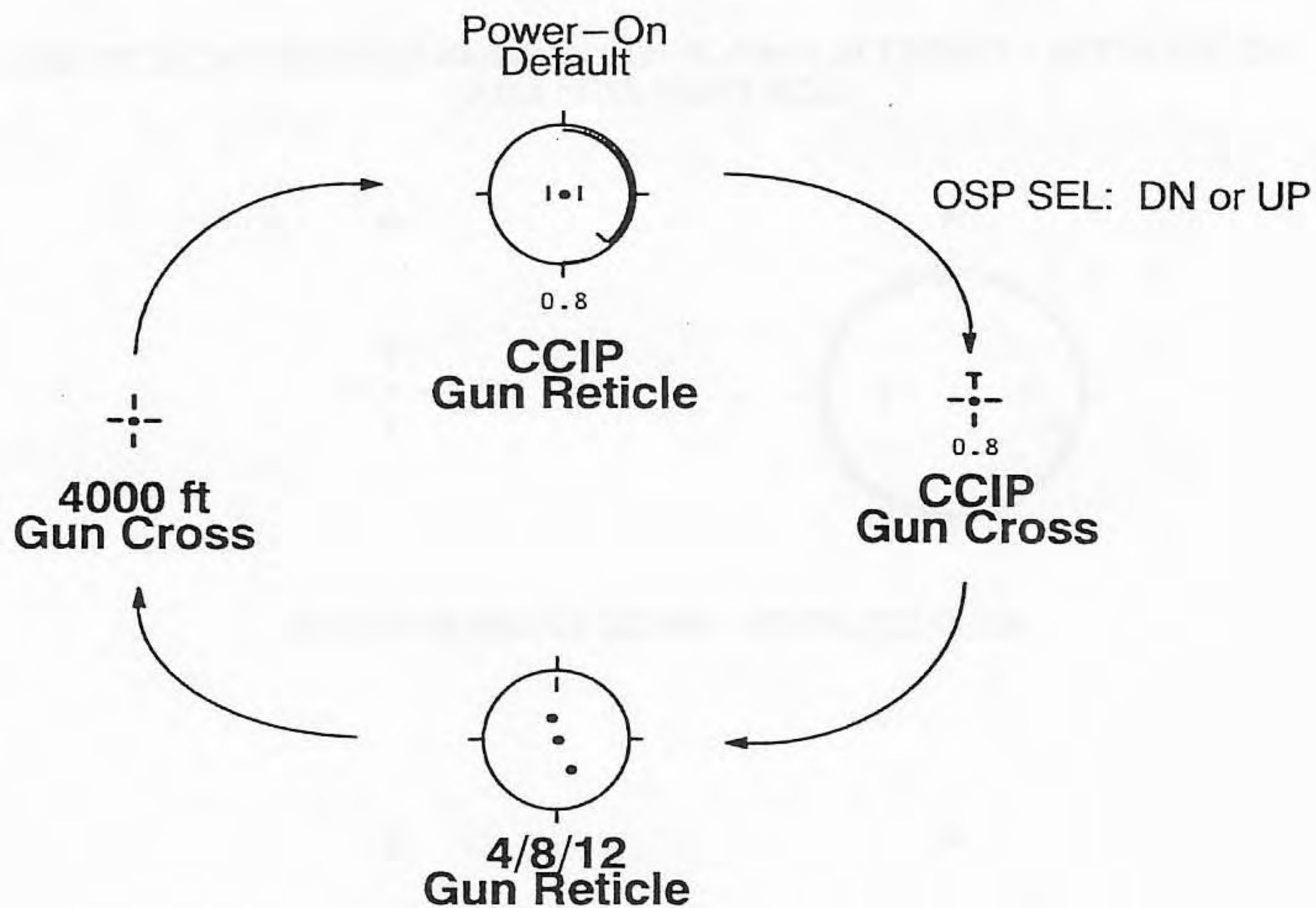


VALID SOLUTION – INSIDE MAXIMUM RANGE



SOLUTION AT/OUTSIDE MAXIMUM RANGE

Figure 1-5. CCIP Gun Solutions (LASTE V4.0).



1A-10A-34-1-1-6

Figure 1-6. CCIP Gun Solutions (LASTE V6.0 136) (Sheet 1 of 3).

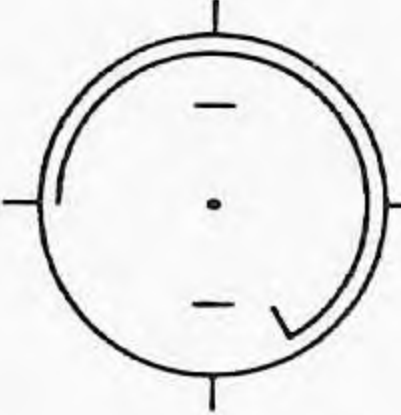
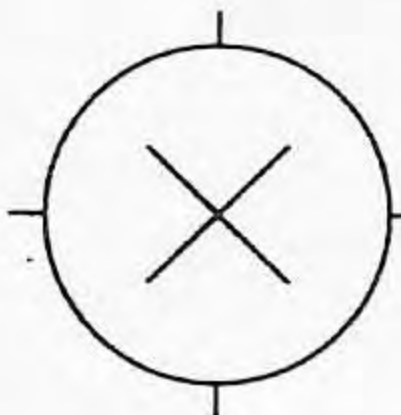
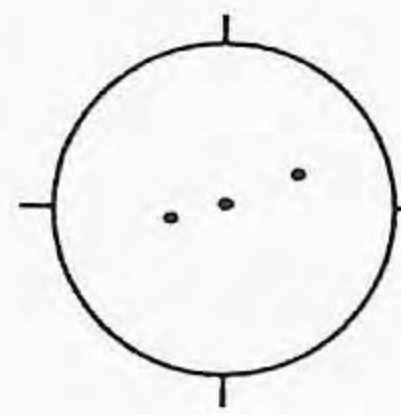
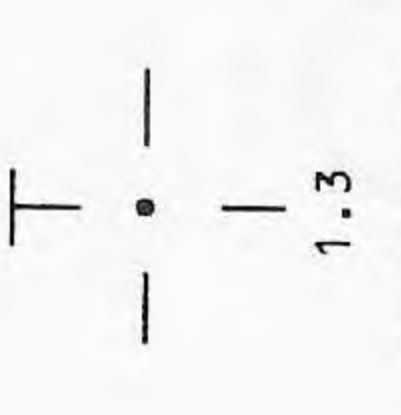
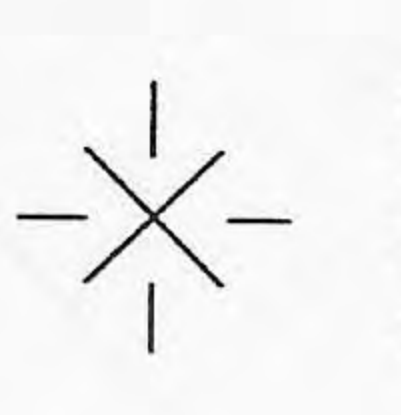
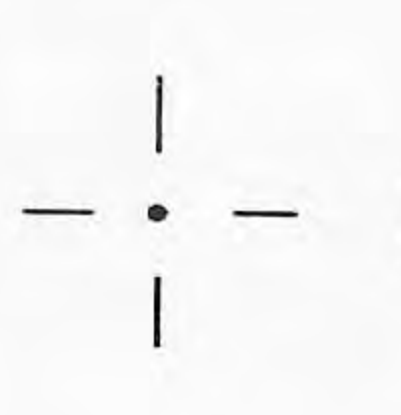
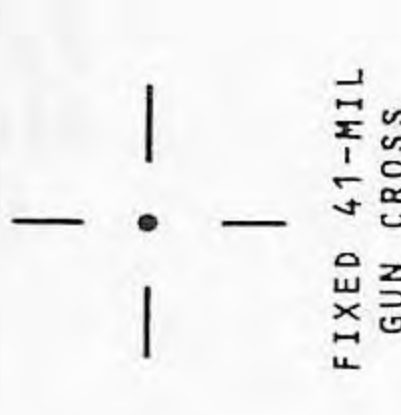
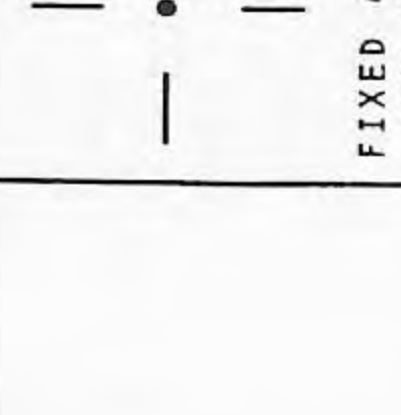
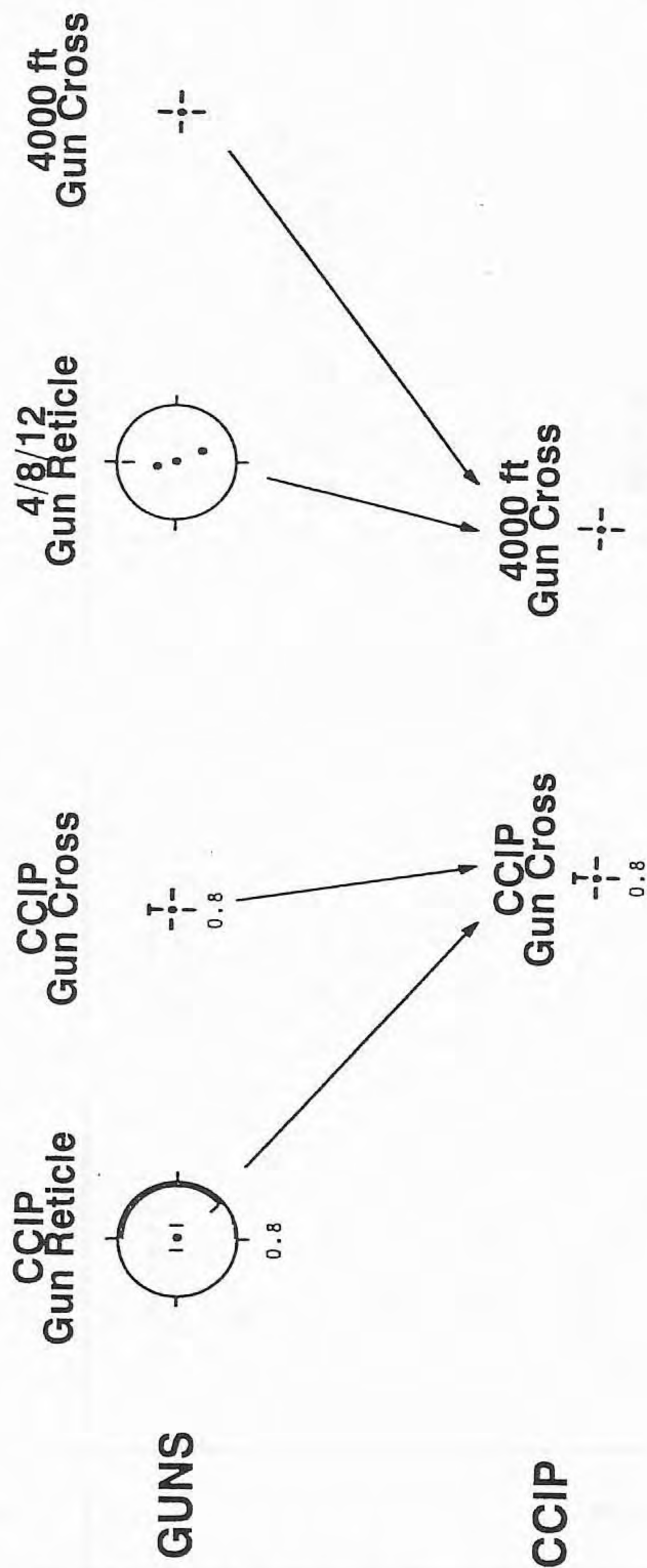
Option	Guns Mode	CCIP Mode	EXP Mode
NORM A B	 1.3 IN SOLUTION CCIP RETICLE	 NO SOLUTION CCIP RETICLE	 4/8/12 RETICLE
	 1.3 IN SOLUTION CCIP GUN CROSS	 NO SOLUTION CCIP GUN CROSS	 4000' GUN CROSS
C HARS	 FIXED 41-MIL GUN CROSS	 NO SOLUTION CCIP GUN CROSS CLAMPED AT 15,000'	 FIXED 41-MIL GUN CROSS

Figure 1-6 CCIP Gun Solutions (LASTE V6.0 136) (Sheet 2 of 3)



1A-10A-1-1-6-3

Figure 1-6 CCIP Gun Solutions (LASTE V6.0 136) (Sheet 3 of 3)

Precision Attitude Control (PAC)

PAC is only available when: EAC is armed, PAC switch is ON, master armament switch is set to CAMERA or ARM position, the air refueling door is closed, and HUD mode selector is in WD-1 or WD-2 (V4.0), GUNS or CCIP (V6.0).

Optimal PAC performance is achieved by ensuring that immediately prior to PAC's engagement the A/C meets the following condition for a minimum of 8 seconds: The pilot will maintain a bank angle less than ± 12.0 degrees while keeping the G force between $+0.8G$ and $+1.2G$. Time periods less than 8 seconds will result in a degraded PAC mode. Re-trimming the A/C results in PAC calculating a new stick position. Therefore PAC requires that the above condition is met again. Flight conditions are subject to many variables. Fuel consumption, 30mm round expenditure, and winds make it unreasonable to expect that a single PAC solution will perform accurately for multiple passes.

NOTE

PAC relies on 8 seconds of setting time. As the dive angle and airspeed acceleration increase, the time period between trimming the A/C and trigger pull become smaller. As this setting time decreases from 7.9 to 0.0 seconds, the pilot can expect an increasingly greater "PAC Jump". These jumps normally occur to the 12' o'clock position relative to the target with little if any lateral pipper movement.

PAC is divided into two modes: PAC-1 and PAC-2. PAC-1 is designed for target acquisition while PAC-2 is used for target engagement. Each mode is in turn divided into two submodes: PAC-1a, PAC-1b and PAC-2a, PAC-2b.

When PAC-1a is first engaged (first detent of trigger) with a bank angle greater than 10 degrees, PAC initially provides the bank stop and target hold function. PAC will filter out stick inputs up to a point. If PAC-1a is engaged at a wings level attitude then only the target hold function is enabled, and corrections can not be made until a calculated threshold (control stick deflection) between PAC and SAS is reached. During PAC-1a, the targeting line-of-sight reference input to PAC differs between computed (CCIP) and fixed (4/8/12) range gunsights, resulting in different operating characteristics. For computed gunsights, the line-of-sight reference is constantly updated to maintain the

ground aimpoint in effect when the trigger is depressed to the first detent. For fixed range gunsights, the line-of-sight reference is held constant at the value when the trigger is depressed to the first detent. With fixed range gunsights, the aircraft pitch attitude is maintained, not the ground aimpoint.

Transition from PAC-1a to PAC-1b occurs when the bank angle is less than 10 degrees and LASTE senses sufficient pilot stick or pedal inputs. (PAC-1b processing is identical for both computed and fixed range gunsights.) When pilot control input exceeds the limits of PAC the line of sight reference input is removed and the pilot is able to refine the aimpoint with stick and pedal inputs without interference from PAC. Stick and pedal inputs are attenuated to allow accurate refinement. With the line-of-sight reference removed neither the ground aimpoint nor the aircraft attitude is maintained by PAC. PAC-1b is not exited until PAC-2 is engaged or PAC is disengaged.

NOTE

A return to PAC-1a sub-mode cannot be made by reducing stick or pedal inputs below transition thresholds. The pilot must completely release the trigger and then depress the trigger to the first detent again.

Pressing the trigger to the second detent engages PAC-2. If the pilot selects WD-1/GUNS with a CCIP gun solution, PAC will compensate for gun spin up and bullet tangential throw for the first 0.55 seconds. Immediately thereafter PAC-2b is initiated. In this mode PAC-2b attempts to track the moving CCIP, and in turn keep rounds on target. Again, the pilot can only alter the flight path when the pilot initiated input surpasses the limits of PAC.

If the pilot did not select WD-1/GUNS with a CCIP solution, then gun spin up and bullet tangential throw are not compensated for. Resulting in a direct transition from PAC-1a or PAC-1b to PAC-2b (target hold mode). In this case, PAC-2b processing for CCIP and 4/8/12 range gunsights are identical to that found in PAC-1a processing. For computed gunsights, the ground aimpoint is maintained. For fixed range gunsights, the aircraft pitch attitude is maintained. Stick and pedal inputs are cancelled out in PAC-2 to the extent allowed by elevator and rudder authority. If the trigger is released to the first detent, PAC-1a mode re-engages. PAC disengages when the trigger is completely released.

CAUTION

When in the CCIP mode, engagement of PAC will inhibit minimum range and Realtime Safe Escape Cues.

Stick/pedal inputs greater than ± 0.5 inches from takeoff trim due to stick pressure or trim inputs may cause aircraft transients during PAC-1 or PAC-2 engagement. This 0.5 inch is approximately the amount of stick trim required to remove the 2 degree PAC bias. If the above thresholds are exceeded PAC will not hold the pipper on the target. Until the trigger is released the aircraft will behave as if the saturated SAS channel is disconnected. A disconnected SAS channel may result in an oscillatory aircraft response to pilot inputs.

CAUTION

Steep dives in combination with gun bursts greater than 2.5 seconds may cause PAC to exceed full SAS authority. As a result, SAS will have no damping authority, and pilot induced oscillations may occur.

NOTE

PAC will disengage when the gun solution transitions from a fixed range to a CCIP solution and vice versa.

If EAC disarms in this situation, a 2° nose up elevator trim change occurs. Rearming EAC in the same configuration causes a 2° nose down elevator trim change. EAC will disarm when invalid data is received from the LASTE sensors (EGI [LASTE V6.0 136] GPS] and SAS), or, when any of the SAS Engage switches on the SAS Control Panel are disengaged, or, when EGI (LASTE V6.0 136] GPS) is deselected either automatically by an EGI (LASTE V6.0 136] GPS) failure or manually via the switch on the NAV Mode Select Panel.

The initial recoil correction provides an automatic correction for initial gun recoil. The gun recoil is corrected continuously when the 30mm gun is fired. The recoil correction is measured on live bursts greater than 2 seconds and used to null recoil transients of subsequent passes. The last measured recoil correction is stored for use on the next flight. Aircraft configuration / weight changes which affect the center of gravity (cg), such as ammo load, fuel load, or external stores, will change the initial recoil transient. For significant cg changes, it is recommended to reset the recoil correction to its nominal value. The recoil correction may be reset to the nominal value at any time by selecting "Y" for recoil reset in the 30mm submenu.

WARNING

Failure to perform a recoil reset on significant cg changes may result in a pitch rate transient up to a maximum of 37 degrees/second on PAC-2 engagement.

BOMB ATTACK

The discussion does not consider specific munitions, but simply describes delivery maneuvers available to the A-10A aircraft. Several factors must be considered when determining release parameters for bombing:

1. Altitude loss during pull out
2. Minimum aircraft ground clearance
3. Fragment envelope clearance
4. Fuze arming time
5. Target elevation

The altitude displayed on the HUD is corrected for altimeter lag, installation error, and nonstandard air temperatures. Immediately following bomb release an escape maneuver is initiated.

The selected weapon is displayed in the lower left corner of the HUD, just above target elevation. The pilot can toggle between preselected weapons for a given mission. Weapons with CCIP available are as follows:

BDU-33B/B, D/B

MK-82 LDGP

MK-82 AIR (High and Low Drag)

MK-84 LDGP

CBU-87

CBU-89

CBU-97/B (LASTE V6.0 136 only)

BLU-52/B, A/B

M151/156 WTU-1B with MK 4/40 or MK 66 motor

MK1/5/61 with MK 4/40 or MK 66 motor

WDU-4A with MK 4/40 motor

LUU-1/-5/-6 (CCRP only) (LASTE V6.0 136 only)

LUU-2 (CCRP only) (LASTE V6.0 136 only)

The ballistic models for all the above weapons, except LUUs, have been validated against the Combat Weapon Delivery Software (CWDS). LUU flares are validated against T.O. 1A-10A-34-1-1 since CWDS does not support LUUs.

NOTE

The MK 66 motor/WDU-4A warhead combination is invalid because a ballistics model is not available from AFSEO and verification is not supported by CWDS.

For HUD alignment, ± 15 mil maintenance boresight adjustments are provided to align all dynamic symbols on the HUD. In addition, gun and bomb boresights are provided to align applicable symbology. The gun boresight aligns the A/G gunsight, the A/A gunsight, FEDS, and BATA. The bomb boresight aligns the bomb reticles, PBIL, MRC, DRC (and for LASTE V6.0 only: PBRL, Release Cue, ASL, and Relative Bearing Numeric). A ± 15 mil offset adjustment for specific bombs is also provided. These offsets, a RT offset adjust (horizontal offset) and an UP offset adjust (vertical offset), are used for vertical and horizontal offset adjustments. These offset adjustments are made in the appropriate submenu provided for each weapon. The OFFSET ADJ option in these menus must be set at Y in order to change the values. With the OFFSET ADJ option set on N, the offsets can not be changed. Figures 1-7 (LASTE V4.0) and 1-8 (LASTE V6.0 136) show which symbols are affected by the different boresight and offset adjustments.

Ejection velocity and rack delay adjustments are available for all free fall bombs in the appropriate weapon submenu. These adjustments are added to nominal values (Figure 1-9) used in the CCIP and CCRP (LASTE V6.0 136 only) computations. Individual weapon adjustments should be set to fleet-wide standards as determined by operational testing of weapon delivery.

WARNING

The boresight adjustments are capable of ± 15 mils (for a total of ± 45 mil). In EXPAND Mode (V4.0), (CCRP mode), the values of BOMB OFFSETS and SPECIFIC BOMB OFFSETS are compressed along with the other EXPAND Mode (V4.0), (CCRP mode), symbology, by the compression factor (1.0, 1.7, or 3.0). Care must be taken when making ballistics adjustments including offset, ejection velocity, and rack delay adjustments to ensure valid solution and safe escape cues.

BORESIGHTS/ OFFSETS	SYMBOLS AFFECTED
MAINTENANCE	TVV GBL CROSS DESTINATION INDEX TD BOX FLT PATH LADDER TWO-BAR FLT PATH LADDER ROLL BARS DEPRESSIBLE PIPPER/RETICLE RETICLE EYEBROWS TDC MAVERICK SYMBOL TISL DIAMOND
MAINTENANCE, GUN OFFSETS	CCIP GUN RETICLE CCIP GUN CROSS FIXED GUN CROSS FUNNEL AMIL MRGS FEDS BATA
MAINTENANCE, BOMB OFFSETS, SPECIFIC BOMB OFFSETS	CCIP BOMB RETICLE PBIL DESIRED RELEASE CUE MINIMUM RANGE STAPLE

1A-10A-34-1-1S-8-6

Figure I-7. Boresight to Symbol Relationship (LASTE V4.0)

WARNING

The boresight adjustments are capable of ± 15 mils (for a total of ± 45 mil). In WD-2, CCIP (V6.0), Mode (LASTE V6.0 136 non-GPS and EGI LASTE V6.0 136 GPS), the values of BOMB OFFSETS and SPECIFIC BOMB OFFSETS are compressed along with the other CCIP Mode symbology, by the compression factor (1.7, or 3.0). Care must be taken when making ballistics adjustments including offset, ejection velocity, and rack delay adjustments to ensure valid solution and safe escape cues.

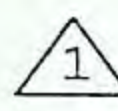
BORESIGHTS/ OFFSETS	SYMBOLS AFFECTED
MAINTENANCE	TVV GBL CROSS DESTINATION INDEX TD BOX FLT PATH LADDER TWO-BAR FLT PATH LADDER DEPRESSIBLE PIPPER/RETICLE RETICLE EYEBROWS TDC MAVERICK SYMBOL TISL SPIDER
MAINTENANCE, GUN OFFSETS	CCIP GUN RETICLE 4/8/12 GUN RETICLE CCIP GUN CROSS 4000 FT. GUN CROSS FIXED GUN CROSS FUNNEL AMIL MRGS FEDS BATA
MAINTENANCE, BOMB OFFSETS, SPECIFIC BOMB OFFSETS	CCIP BOMB RETICLE PBIL DESIRED RELEASE CUE MINIMUM RELEASE STAPLE CCRP BOMB RETICLE PBRL RELEASE CUE RELEASE ANGLE NUMERIC AZIMUTH STEERING LINE RELATIVE BEARING NUMERIC

1A-10A-34-1-1S-8-7

Figure 1-8. Boresight to Symbol Relationship (LASTE V6.0 136)

CAUTION

These values are already stored in memory. Values displayed in individual submenus simply add or subtract from these values. **Do not enter these values into the submenus.**

BOMB	MOUNT	EJECTION VEL (FT/SEC)	RACK DELAY (SEC)
BDU-33B/B	SUU-20	22.0	0.0
BDU-33B/B	TER	0.0	0.0
BDU-33D/B	SUU-20	22.0	0.0
BDU-33D/B	TER	0.0	0.0
MK 84 LDGP	PYLON	11.0	0.3492
MK 82 LDGP	PYLON	11.0	0.0
MK 82 LDGP	TER	4.73	0.0
MK 82 AIR	PYLON	11.0	0.0
MK 82 AIR	TER	7.0	0.0
BLU-52/B, A/B	N/A	30.0	0.0 
CBU-87	PYLON	13.0	0.0
CBU-87	TER	6.0	0.0
CBU-89	PYLON	13.0	0.0
CBU-89	TER	6.0	0.0
CBU-97	PYLON	13.0	0.0
CBU-97	TER	6.0	0.0

1A-10A-34-1-1S-8-8

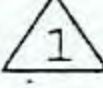
 NO ADJUSTMENTS ARE AVAILABLE FOR THIS WEAPON

Figure 1-9. Normal Ejection Velocity and Rack Delays.

The weapons and fuzing data to be used on the mission are entered into the LASTE Computer by the pilot. The master armament, mechanical fuzing, release mode, ripple quantity, and ripple interval selections are automatically transmitted from the ACP to the LASTE computer. It is essential that the weapon selected on the store loading display of the ACP for the selected station matches the store that is displayed on the HUD.

In WD-2 mode(V4.0), (CCIP mode V6.0), the pilot can select via the DISPLAY MODES submenu whether the WD-2(V4.0), (CCIP V6.0) gun cross will occult the TVV symbol or not. In LASTE V6.0 136 WD-1(V4.0), (GUNS V6.0) mode, the pilot can also select whether the CCIP reticle will occult the TD Box or not. The initial state for both options is no occultation.

NOTE

In WD-2 with WD-2 GUN occult set to yes, the WD-2 GUN cross will occult the TVV and TD Box until the CCIP bomb solution has a solid PBIL. At this time the WD-2 gun occults will no longer function.

The pilot can also select the type of bomb mount, which is TER or PYLON for most bombs. However, for BDU33, the pilot has the option of selecting TER or SUU-20 as the bomb mount configuration. For MK 82 Air bombs, the pilot can set the bomb mount configuration to fixed high drag (FIXDHI), fixed low drag (FIXDLO), or pilot option (PILOPT) in the MK 82 AIR individual weapon submenu. If PILOPT option is selected, then the bomb ballistics are determined by the mechanical fuzing switch.

CCIP Bomb Attack

CCIP for bombs is provided on the HUD in WD-2 and EXP modes(V4.0), (CCIP and CCRP modes V6.0), except in LASTE V6.0 136 CCRP mode Options B and C, when the appropriate weapon selection is made using the select switch on the OSP.

The CCIP bombs display is a 50 mil diameter reticle with a center pipper and an analog range bar as in CCIP gun reticle. In addition, a minimum range caret (MRC) is displayed just inside the analog range bar. The minimum range caret displays minimum range to the CCIP based on data entered in the weapons submenus and the position of the mechanical fuzing switch (refer to Weapon Data Entry). For training purposes, if the master armament switch is in SAFE or CAMERA, N/T fuzing is assumed, regardless of selected mechanical fuzing. CCIP bombing solutions can be used for all dive and level deliveries. If there is no CCIP solution available, the CCIP reticle and PBIL are not displayed. If a solution is available but not within the HUD field of view, the PBIL is displayed as a dashed line but the CCIP is not displayed. There may be situations when the CCIP is totally out of view of the HUD until the pilot approaches release parameters. This

situation normally occurs during deliveries with large sight depressions, such as with CBUs or high drag general purpose bombs.

When bombing in the BARO or DELTA mode and no target elevation is entered, or when LASTE sensor information is lost (from the CADC, INS, or SAS), the HUD will display a "CCIP INVALID" message. If LUUs are selected during a CCIP mode, the HUD will display a "USE CCRP" message (LASTE V6.0 136 only).

NOTE (LASTE V4.0)

In BARO or DELTA Mode, ranging for the bombing CCIP is based on a temperature corrected true MSL altitude. The temperature measurement from the CADC inherently has a jump in it that causes the CCIP to jitter, approximately 2-4 mils at about a once-per-second rate. The magnitude of jitter depends on the altitude change from the last calibration reference. For BARO Mode, this would be the Takeoff reference. For DELTA MODE, it would be either the automatic DELTA update on takeoff or the last accepted update. The greater the altitude change from the reference, the larger the jitter will be.

Projected Bomb Impact Line (PBIL)

The projected bomb impact line (PBIL) is displayed as a line directed outward from the center of the CCIP reticle. The PBIL is a linear prediction of where the CCIP will track across the ground. It is based upon the assumption that the aircraft will maintain present airspeed, G-load, and bank angle. If the aircraft is maneuvered to track the target down the PBIL, the pipper can be guided directly to the target even at high bank angles. If a ripple release is selected, the bomb stick will fall along the PBIL. The displayed CCIP solution is for the center of the bomb stick length. The PBIL is a dashed line if the CCIP bomb reticle is outside of the HUD FOV and changes to a solid line when the CCIP bomb reticle enters the HUD FOV.

NOTE (LASTE V6.0)

The PBIL may not track the MRS and DRC during banked maneuvers because it is a linear prediction of the Locus of Future Impact Points (LFIP), which is a curved path. The MRS and DRC are implemented as two points along the LFIP.

Minimum Range Staple (MRS)

LASTE uses the data from the weapons submenus, Air Force Seek Eagle Office (AFSEO) to provide safe escape tables (LASTE V6.0 only), and the current state of the aircraft to predict the minimum release slant range to the target.

The Minimum Range Staple (MRS) is displayed on the PBIL and provides a graphical representation of time-to-go to this minimum release slant range for fuzing consideration (LASTE V4.0) or the worst case minimum release

slant range between fuzing and safe escape considerations (LASTE V6.0 only).

For hard bombs, the MRC/MRS are based on a Time Of Fall (TOF) in the appropriate weapon submenu and are intended to be used for safe escape and fuzing (see weapons planning section). For CBU deliveries the MRC/MRS are designed to specifically ensure canister fuze function and submunition arming across all ranges of fuze and bomb combinations.

NOTE

Large deviations from planned release parameters may result in invalid MRC/MRS.

Real-Time Safe Escape Cue (RTSEC)

The RTSEC (LASTE V6.0) indicates the minimum range for safe escape and is calculated by A/C state, selected weapon, and planned escape maneuver.

If the flight parameters are within the boundaries of the table, the MRS will be steady. If any flight parameter exceeds these table boundaries, LASTE will extrapolate outside the table along a line slope connecting the last two data points. In this case, the MRS will flash at 4Hz. The MRC will flash in conjunction with the MRS and will be the Pilots only cue of this situation if the MRS is not in the HUD FOV.

The CCIP will be displayed when the MRS is below the piper or the analog range bar is below the MRC (Figure 1-12).

CAUTION

- When the MRS and MRC are flashing, they are being driven by the safe escape extrapolation or fuzing.
- The RTSEC shall be used as an indicator only and should not be used as a substitute for proper mission planning.
- RTSEC is inhibited when PAC or LAAP is engaged.
- The RTSE cue will display the AFSEO true MRA within $-5/+20\%$.
- If the delivery parameters vary greatly from the planned deliveries, the DRC may be above the MRS. Especially when the dive angle is much greater than planned.

NOTE

- For MK series free fall ordnance, if 0.0 is set as the MTOF, RTSE information will not be displayed.

The limitations of the RTSE are defined in Figure 1-10.

RTSEC makes use of Non-standard Atmosphere Adjustments (NSATMADJ) and applies this to the Target Density Altitude (TDA). The JSATMADJ is based on the air density at A/C altitude. Therefore, LASTE makes the assumption that the air density (DA) at the A/C altitude is similar to that of the target.

Desired Release Cue (DRC)

The Desired Release Cue (DRC) is used in the same manner as the MRS. The menu parameters for the DRC define a desired total time of fall to provide a cue for a release typically earlier than the MRS. This is to provide a margin of safety in advance of the minimum range solution, or to produce desired dispersion effects with a cluster weapon. The DRC serves as a guide in setting up proper aim off distance for the subsequent delivery. The pilot should maneuver the aircraft to place the DRC on or long of the target. If the DRC is on the target, and a constant bank angle and load factor are maintained, the DRC will move down the PBIL at the same rate as the actual target, and the CCIP will be coincident with the target just as the weapon time of fall matches the menu entry. This will give the DRC the ability to act as a continuously computed Initial Piper Placement (IPP).

An X will appear individually over the MRS or DRC to indicate a problem with the delivery parameters. Normally the X indicates that the affected range cue will depart the HUD FOV before the CCIP enters the FOV. This means that the aircraft will pass minimum range before reaching release parameters. For radar fuzed CBUs the X can also indicate that the CBU submunitions will not arm before impact.

For ripple deliveries, the DRC indicates the release point, so that the middle bomb of a stick falls at the point of desired impact. If an even number of bombs are selected the center bombs will bracket the target.

Invalid Fuzing

To prevent incorrect fuzing of bombs and rockets, the message "INVALID FUZING" appears in the HUD when an invalid fuze condition occurs (Figure 1-13). Invalid rocket warhead and motor combinations are prevented from selection in the submenu during entry. See Figure 1-13.

Safe Escape Table Bounds (LASTE V6.0 136)

Flight Path Angle

Maneuver / Weapon	Min (deg)	Max (deg)
CLM (GP Bombs)	-65	+2
CLM (CBUs)	-50	+2
TRN and TLT	-25	+2

Air Speed

Maneuver / Weapon	Min (KTAS)	Max (KTAS)
CLM	275	450
TRN and TLT	275	400

Target Density Altitude

Maneuver / Weapon	Min (ft)	Max (ft)
All	-5000	10,000

Number of Bombs/Pairs

Maneuver / Weapon	Max
MK-84 LDGP	4
Other	6

NOTE

LASTE will correct the perceived target elevation for target density altitude. The pilot must realize that the 'set' target elevation is not what is used by LASTE for TDA. LASTE adds what it perceives as the A/C density altitude to the target elevation to calculate TDA. LASTE assumes this A/C density altitude is the target density altitude.

Figure 1-10 (Sheet 1 of 2).

Ripple Interval Settings

Weapon Type	Lower (msec)	Upper (msec)
CBUs	100	300

Weapon Type	Dive Angle °	High Drag Lower (msec)	High Drag Upper (msec)	Low Drag Lower (msec)	Low Drag Upper (msec)
General Purpose Bombs	0	70	360	130	340
	5	70	410	130	400
	10	70	470	130	460
	15	70	530	130	520
	20	70	590	130	580
	25	70	650	130	640
	30	70	720		
	35	70	790		
	40	70	880		
	45	70	>990		
	50	70	>990		
	55	70	>990		
	60	70	>990		
	65	70	>990		

NOTE

This table represents the lower and upper interval limits. The minimum limits do not change. The maximum limits are based on the A/C position at the min release altitude. As the dive angle varies the pilot's HUD display may show out of range RTSE indication if the maximum intervalometer is set for a dive angle.

Figure 1-10 (Sheet 2 of 2)

Escape Maneuver Display (LASTE V6.0 136)

- Maneuver in-line with selected weapon
- “XXX” is displayed if NONE is selected.

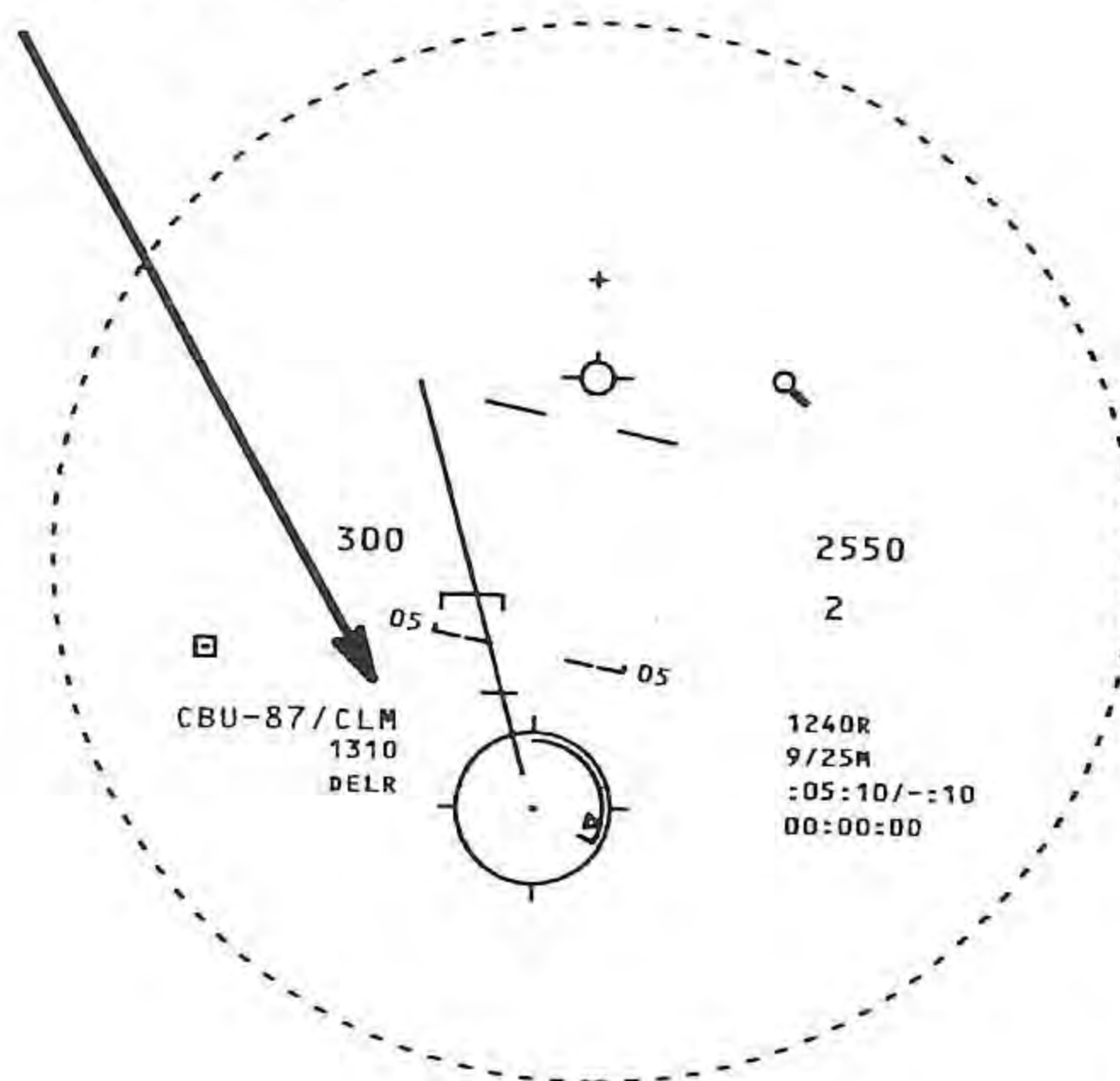
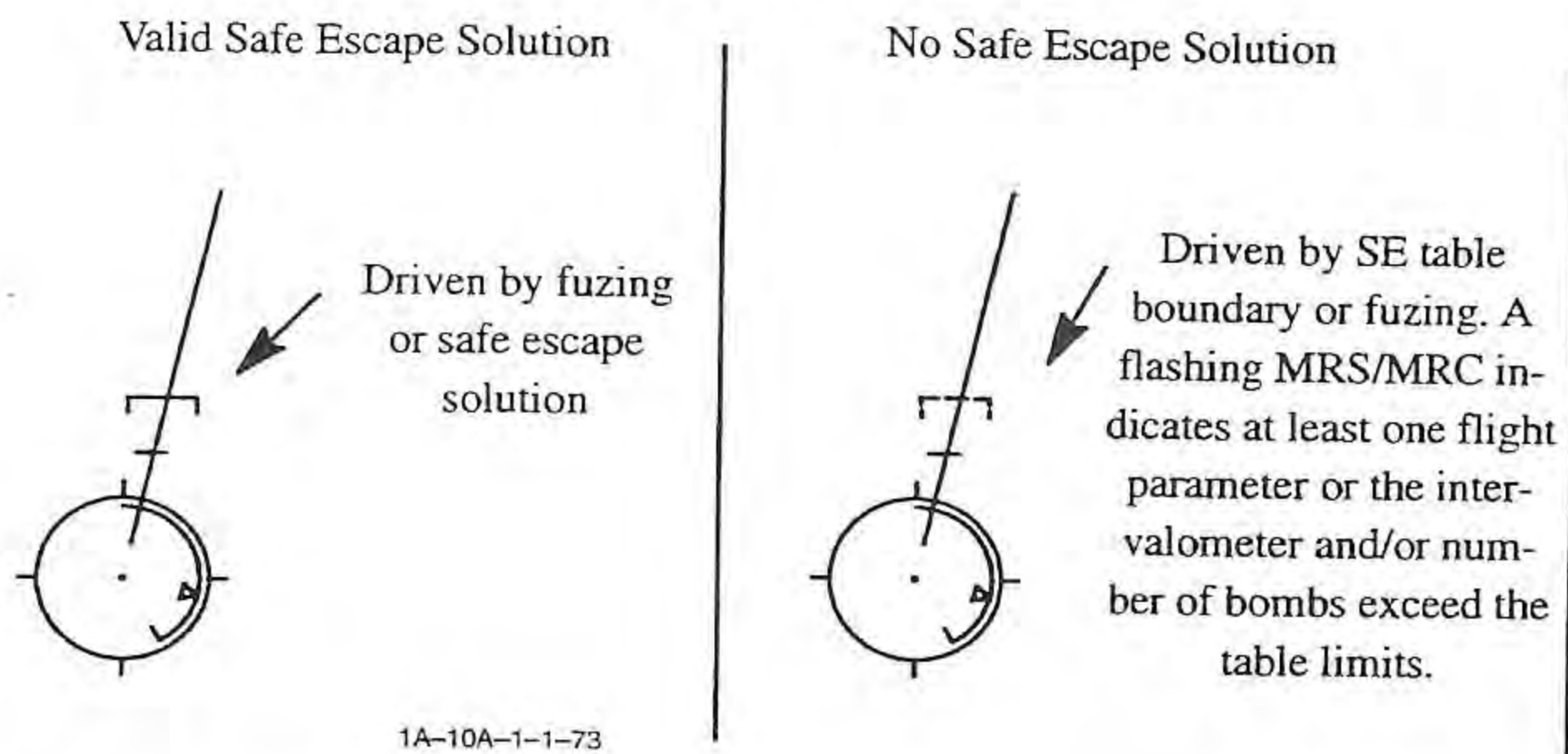


Figure 1-11.

Safe Escape Solutions (LASTE V6.0 136)

CLM, TRN or TLT selected



WARNING

Although there is an MRS with an "X" over the pipper, the MRS should not be considered an accurate indication of a true min release altitude

An "X" indicates AFSEO ballistic tables. The CCIP has passed the MRS and based on all the info LASTE has, it is unsafe to expend.

Figure 1-12.

Weapon	Invalid Fuze Conditions
BDU-33 B/B - D/B MK 82 LDGP BLU-52	Mechanical fuzing selector on the ACP set to SAFE.
MK 82 AIR HD MK-82 AIR LD	Mechanical fuzing selector on the ACP set to SAFE. Nose fuzing on a fixed high drag bomb. Tail FMU-139 fuzing on a bomb which is not fixed high drag.
CBU-87 CBU-89 CBU-97	Mechanical fuzing selector on the ACP set to SAFE. Tail fuzing.
LUU-1/-5/-6 LUU-2 M151 / M156 / WTU-1/B MK 1 / MK 5 / MK 61 WDU-4A/A	Mechanical fuzing selector on the ACP not set to SAFE.

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Figure 1-13. Invalid Fuze Conditions.

EXPAND Mode CCIP (LASTE V4.0)

EXPAND Mode CCIP is designed for delivering ordnance on targets outside the HUD field of view. For CCIP EXPAND Mode (options Normal, A and B), a target can be designated by the pilot with either the depressible pipper or the IR Maverick. This is accomplished by either manually flying the depressible pipper or slaving the IR Maverick seeker head to the desired target and depressing the Nose Wheel Steering (NWS) button (refer to the Nose Wheel Steering button interface section in Part 2 for button logic).

NOTE

- When using an accurate altitude source, the accuracy of the TDC will increase as dive angles increase and slant ranges decrease.
- TDC placement accuracy is maximized when target designations are accomplished in a non-maneuvering state with the target near the TVV. The Maverick is not required to be locked on the target, although a lock-on normally would provide a more accurate designation. As long as it is called up on the TVM, uncaged, and the symbol is displayed on the HUD, a target can be designated.

The depressible pipper will then be deselected and a LASTE designated target will be represented on the HUD as a target designation cue (TDC), which is a 5-mil box with a pipper in the center. The TDC ranging is based on the ALTITUDE source selected on the OSP and will track the point on the ground within the accuracy of the initial designation and INS drift and altitude source accuracy.

In the manual designation mode (with depressible pipper), the second depression of the NWS button compresses the HUD field of view, in both the vertical and horizontal axes

by a factor of 1.7, where the TISL diamond, TDC, CCIP, and PBIL including the MRS and DRC will be compressed. The third depression of the NWS button will compress the HUD field of view by a factor of 3.0. A fourth depression of the NWS button deselects the TDC, reselects the depressible pipper, and returns the compression factor to 1.0. The compression factor is displayed in the lower left corner of the HUD. The gun cross, TVV, depressible pipper, and pitch ladder will not be compressed or affected by the compression factor, except for Options C and HARS, where the depressible pipper will be compressed by a fixed factor of 3.0. The target designation box will not be displayed when a TDC has been selected. For steering to the selected steer point the tadpole is still available.

When using the Maverick, subsequent depressions of the NWS button will only release and redesignate the target. The compression factor is always 1.0 when the Maverick is called up. If the Maverick is deselected after designating, the TDC will be retained and the manual mode entered at 1.0 compression factor. When the Maverick is called up on the Television Monitor, the CCIP Bomb Reticule, PBIL, MRC/MRS, and DRC will not be displayed.

Flying the CCIP along the PBIL to the TDC will place the aircraft in the proper position to release the selected weapon. When compression factors greater than 1.0 are selected, the TDC, TISL Diamond, CCIP and PBIL, including the MRS and DRC, will function as in WD-2(V4.0), (CCIP V6.0) mode relative to each other but may not overlay their ground related positions when viewed through the HUD.

NOTE

All references in this technical order to "autopilot" refer to the same feature referred to as "Low Altitude Autopilot" or "LAAP" in previous manuals.

NOTE (LASTE V4.0)

- Autopilot can only be engaged/disengaged from the LASTE control panel while in the expanded mode. In expanded mode, the NWS button is used to designate a target.
- When using an accurate altitude source, the accuracy of the TDC will increase as dive angles increase and slant ranges decrease.

CCRP Mode (LASTE V6.0 [136])

CCRP mode is available only in Normal and Option A. Additionally, the current steerpoint is automatically converted to a TDC as in Expanded mode. The TDC ranging is based on the ALTITUDE source selected on the OSP and will track the point on the ground within the accuracy of the initial designation and EGI drift. Targets may be designated using the depressible pippier or Maverick.

NOTE

- TDC placement accuracy is maximized when target designations are accomplished in a non-maneuvering state with the target near the TVV. The Maverick is not required to be locked on the target, although a lock-on normally would provide a more accurate designation. As long as it is called up on the TVM, uncaged, and the symbol displayed on the HUD, a target can be designated.
- In V6.0 a TDC may be generated in GUNS, CCIP and CCRP and carried over to all modes (including NAV).

(LASTE V4.0) If a target has been designated, and Expanded mode is exited, HUD symbology regarding the designated target is removed and the current steerpoint reverts to a TD Box. Although no HUD symbology is displayed for the designated target, it is still tracked by LASTE. If Expanded mode is re-entered, the current steerpoint reverts to a tadpole and a TDC is again displayed for the designated target. The designated target can be undesignated outside Expanded mode if the nosewheel steering switch is depressed for less than 1/2 second.

NOTE

- While in the EXP mode, autopilot can only be engaged/disengaged from the LASTE control panel because the NWS button is used exclusively for TGT designation only.

- If CCRP mode is exited with Option B (CCRP) selected, no HUD symbology is displayed for the current steerpoint or designated target. Option B symbology does not include a TD Box or tadpole in any mode except Expanded. This applies to V6.0-136.
- The nosewheel steering button may be used as an alternative method to engage/disengage the autopilot. The nosewheel steering button must be depressed for more than 1/2 second in order to engage/disengage the autopilot. This applies to V6.0-136.

Range to TDC Numeric (LASTE V6.0 [136])

The Range to TDC Numeric is displayed immediately below the TVV in GUNS and CCIP HUD modes whenever a TDC is displayed. This two-digit numeric displays the range in nautical miles (beginning at 0.1 and increasing to 9.9, and then changing to an integer starting at 10 and increasing to 99). A pilot has the option to display the range numerics in kilometers, in which case the range numeric is followed by a "K." If the range numerics are displayed in kilometers, the maximum range displayed is 99K.

CCRP Bomb Attack (LASTE V6.0 [136])

A CCRP solution and symbology are provided in CCRP mode, Options Normal, A, B and C. The CCRP solution allows for weapon delivery over a larger envelope of release parameters than is possible with the CCIP solution, most notably that of a positive flight path angle (loft delivery). Selection of a particular set of bomb or rocket ballistics data is made using the OSP. The data is made available to the LASTE computer which determines the weapon release point. The CCRP solution is displayed on the HUD and includes symbology for CCRP Reticle, Release Cue, Release Angle Numeric, Predicted Bomb Release Line, Azimuth Steering Line and Relative Bearing Numeric.

The CCRP release cue is actually a point in space. As the A/C approaches this point the pilot must be aware of two related facts: 1. Increasingly smaller adjustments are needed, and 2. An uncorrected error in A/C position will multiply into a much larger error.

If a target is designated, the current steerpoint is converted to a designation index (tadpole). If a target has been designated, depressing the nosewheel steering button again for less than 1/2 second releases the target, and the current steerpoint reverts to a TDC. In the Normal, Option B and Option C modes, subsequent depressions of the NWS button toggle the designate/undesignate function.

CCRP Reticle (LASTE V6.0 136)

The CCRP reticle consists of a pipper centered in a 50 mil diameter circle, with 5-mil increment marks extending outward at the 3, 6, 9, and 12 o'clock positions. A triangular Minimum Range Caret (MRC) rotates around the inside of the circle and indicates the minimum safe escape range. An analog range bar extends around the inside of the reticle clockwise from the 12 o'clock position to a clock position that indicates target range (slant range) in thousands of feet (for example, 5 o'clock = 5,000 feet). A 5-mil tick marks the end of the analog range bar. Beyond the maximum computed range for a 30° (bombs) or a 45° (rockets) CCRP delivery, the analog range bar displays 0 feet to indicate that the maximum range has been exceeded. For ranges greater than 12,000 feet, the range bar is clamped at 12 o'clock position, and a two-digit range numeric is displayed below the reticle. This numeric displays the range in nautical miles (starting at 2.0, increasing to 9.9, and then changing to an integer starting at 10 and increasing to 99). When beyond the maximum computed range, the range numeric will continue to be updated. If the maximum range is less than 12,000 feet, the range numerics will be provided until an "in range" condition exists (as indicated by the analog range bar). A pilot can choose to display the range numerics in kilometers, in which case the range numeric is followed by a "K". If the range numerics are displayed in kilometers, the maximum range displayed is 99K. When the selected weapon is a rocket, the letters "RKT" are displayed below the letters. When LUU flares are selected, the range bar indicates current altitude above target, and the MRC represents the desired release altitude above target. A 36- by 36-mil occultation window is centered in the reticle and occults all lower priority symbols. The reticle is positioned 100 mils below the TVV and the CAP will move towards the pipper as the jet approaches the CCRP release point.

With LUU flares selected, the MRC is clamped at 12 o'clock if the desired release altitude above target is greater than 12,000 feet, and the analog range bar is clamped at 12 o'clock if the current altitude above target is greater than 12,000 feet.

- LUU-1/-5/-6 ballistic solution corresponds to the impact point of the flare.
- LUU-2 ballistic solution corresponds to the release point which places the flare over the

target when it is halfway through its burn time and ensures burnout above 500 ft.

If a CCRP NO SOLUTION condition occurs, or the Maverick symbol is displayed, the CCRP symbology is not displayed. When bombing in BARO or DELTA mode and no target elevation is entered, or CCRP input data is invalid, the HUD will display the "CCRP INVALID" message. If the pilot enters an invalid fuze setting for the selected weapon, the "INVALID FUZING" message will be displayed.

Release Cue (LASTE V6.0 136)

The release cue consists of a 7-mil circle around a pipper, called the CCRP Aim Point (CAP), with two horizontal lines extending outward from the CAP at the 3 and 9 o'clock positions. The total length of the Release Cue is 50 mils. The CAP represents the computed weapon release point. Weapon release should be initiated when the CAP overlays the CCRP reticle pipper.

Since the LUU flares are very wind sensitive it is difficult to place the CAP directly over the CCRP Reticle Pipper. In most cases, the CAP will deviate laterally to the edge of the HUD during the final stages of the delivery. The LUU flare should be released when the CAP is vertically even with the CCRP reticle pipper, as indicated by the Release Cue horizontal lines.

Release Angle Numeric (LASTE V6.0 136)

For bombs and rockets, the Release Angle Numeric appears to the right of the Release Cue when the aircraft is within range of the target for the weapon selected, but does not indicate the aircraft has reached the computed release point. The release angle numeric indicates that if the aircraft was instantaneously rotated to the proper ground track and specified flight path angle the weapon could be released and strike the target. The release angle numeric changes dynamically, getting smaller as the aircraft nears the target, increasing as the aircraft gets farther from the target. For LUU flares, the release angle numeric always reads 0 since flares are to be released during straight and level flight. The release angle numeric and flight path angle computations are limited for each weapon type (Figure 1-14). The release angle numeric is not displayed if the target is beyond range of the maximum flight path angle for bombs. With rockets selected, the "45" numeric is displayed approximately seven seconds prior to the target being in range.

Weapon Type	Maximum Flight Path Angle
Flares	0°
Rockets	+45°
Bombs	+30°

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Figure 1-14. Maximum CCRP Flight Path Angles (LASTE V6.0)

Relative Bearing Numeric (LASTE V6.0 136)

The Relative Bearing Numeric indicates the relative bearing between the CCRP pipper and the CAP when the TDC is outside the HUD field-of-view in azimuth. The RBN is rounded to the nearest 10 degrees. The RBN is displayed near the TVV in a way to indicate the shortest direction of turn to the target. If the shortest turn is to the left, the numeric is displayed slightly above and to the left of the TVV. If the shortest turn is to the right, the numeric is displayed slightly above and to the right of the TVV. When the RBN indicates "180", it is displayed directly above the TVV.

Steerpoint Database ID (LASTE V6.0 136 GPS)

The steerpoint database identifier is displayed (in 6 to 8 mil characters) at a fixed position on the lower right side of the HUD FOV, below the selected steerpoint identifier. The steerpoint database consists of up to six characters, as provided by the CDU, with trailing blanks suppressed.

Steerpoint ID (LASTE V6.0 136 GPS)

The selected steerpoint identifier is displayed (in 6 to 8 mil characters) at a fixed position on the lower right side of the HUD FOV below the radar altitude numeric. The steerpoint identifier consists of up to 12 alphanumeric characters.

Steerpoint ID (LASTE V6.0 136 Non-GPS)

The selected steerpoint identifier is displayed (in 6 to 8 mil characters) at a fixed position on the lower right side of the HUD FOV as a one character alphanumeric ranging from 0 to 9 or A to F.

After a successful MARK is accomplished, the selected steerpoint identifier and distance-to-go flashes as a string for approximately 4 seconds at approximately 4 Hz.

Predicted Bomb Release Line (PBRL) (LASTE V6.0 [136](#))

The PBRL is displayed as a line directed outward from the center of the CCRP reticle to the zero sight line. The PBRL is a prediction of the aircraft's flight path based upon the assumption the aircraft will maintain present air-speed, G-load, and bank angle. If the pilot maneuvers the aircraft such that the PBRL intersects the CCRP Aim Point (CAP), the pipper can be guided directly to the CAP even at high bank angles and positive flight path angles. The CAP does not move down the PBRL until the release point is within the HUD FOV. The PBRL is not displayed if the release point is greater than 60° off the center line of the aircraft.

NOTE

If LUU flares are selected and Autopilot is engaged, the CCRP solution has unpredictable behavior. This utilization of CCRP is NOT recommended.

Azimuth Steering Line (LASTE V6.0 [136](#))

The ASL is a roll stabilized line, with the CAP centered at its top, and extending even with the bottom of the CCRP reticle. The ASL indicates the flight path required for a wings level delivery. For a wings level delivery the pilot maneuvers the aircraft such that the PBRL is coincident with the ASL.

Delivery Modes

The following paragraphs describe delivery modes which include Single Release, Ripple Delivery, Cluster Delivery, and Laser Guided Bomb Delivery.

Single Release

To release a single weapon, the pilot selects SGL release mode on the Armament Control Panel and WD-2 or EXP mode(V4.0), (CCIP or CCRP modes V6.0), on the HUD Control Panel. The solutions are based on similar altitude

ranging techniques described in Gun Attack, CCIP Bomb Attack, and CCRP Bomb Attack (LASTE V6.0). The pilot uses the PBRL, MRS, DRC, (and for LASTE V6.0 [136](#) only: PBRL and CAP) to accurately hit the target. Refer to CCIP Bomb Attack and CCRP Bomb Attack (LASTE V6.0 [136](#)) for more information on HUD symbology used for single release.

Ripple Delivery

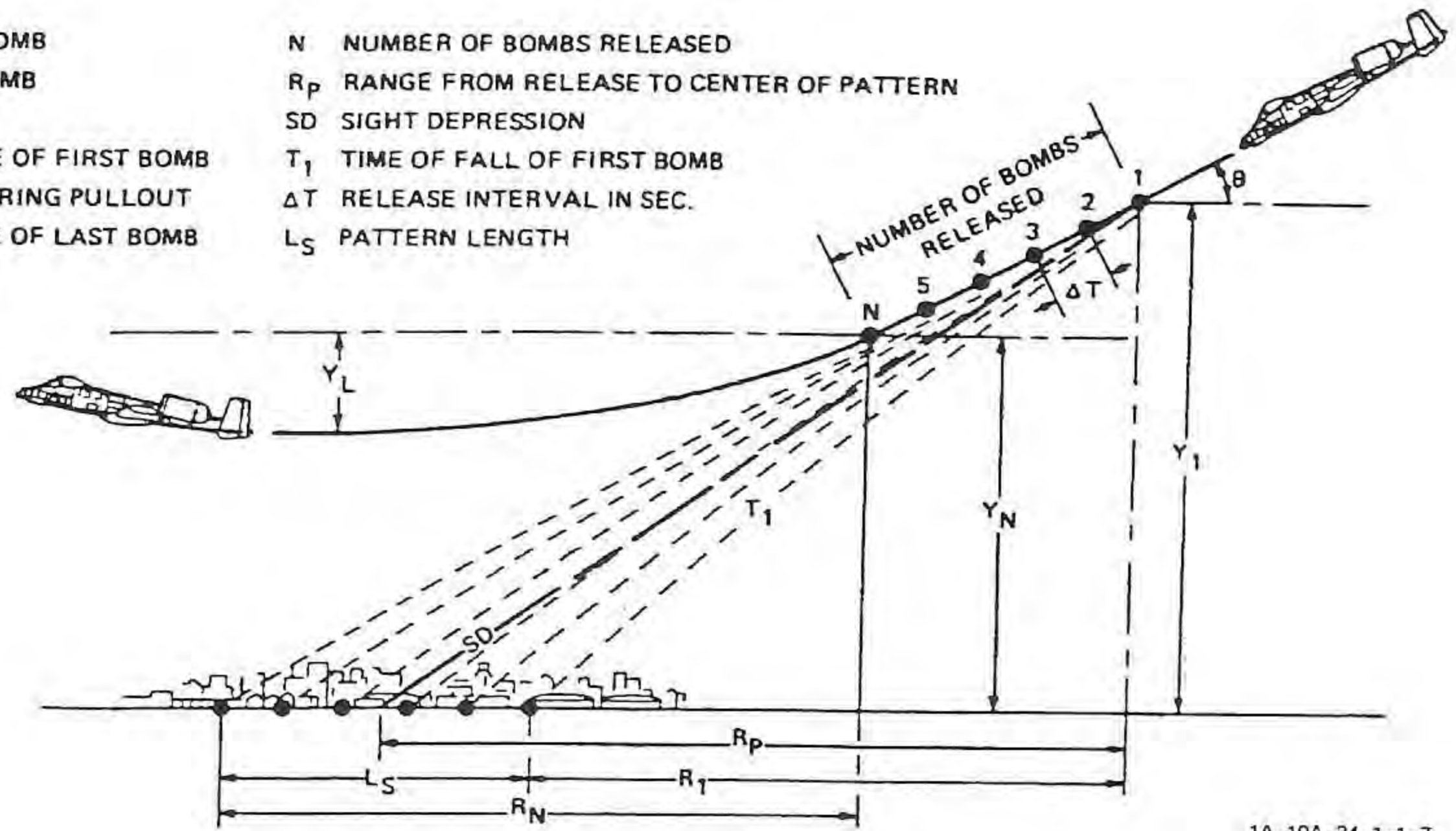
To release ripple bombs, the pilot selects RIP SGL or RIP PRS release mode, the ripple quantity, and the ripple interval on the Armament Control Panel. The standard bomb delivery factors also apply to ripple release modes. Weapons are released along a planned ground track to impact on a target of considerable area. The weapon spread for a given release interval setting is a function of release velocity, dive angle, and G-load (see Figures 1-15 and 1-16). Additional factors for safe escape, fuze arming, and dive recovery must be considered (see Section V and CWDS).

During the ripple release, the current pipper path should be maintained; the pipper will pass beyond the aim point during the ripple release. If the pipper is maintained on the aim point during the ripple release, the following adverse conditions may be expected.

1. Increased dive angle.
2. Increase altitude loss during recovery.
3. Erratic pattern length and spread.
4. Reduced g-loading.
5. Possible bomb-to-aircraft collision.

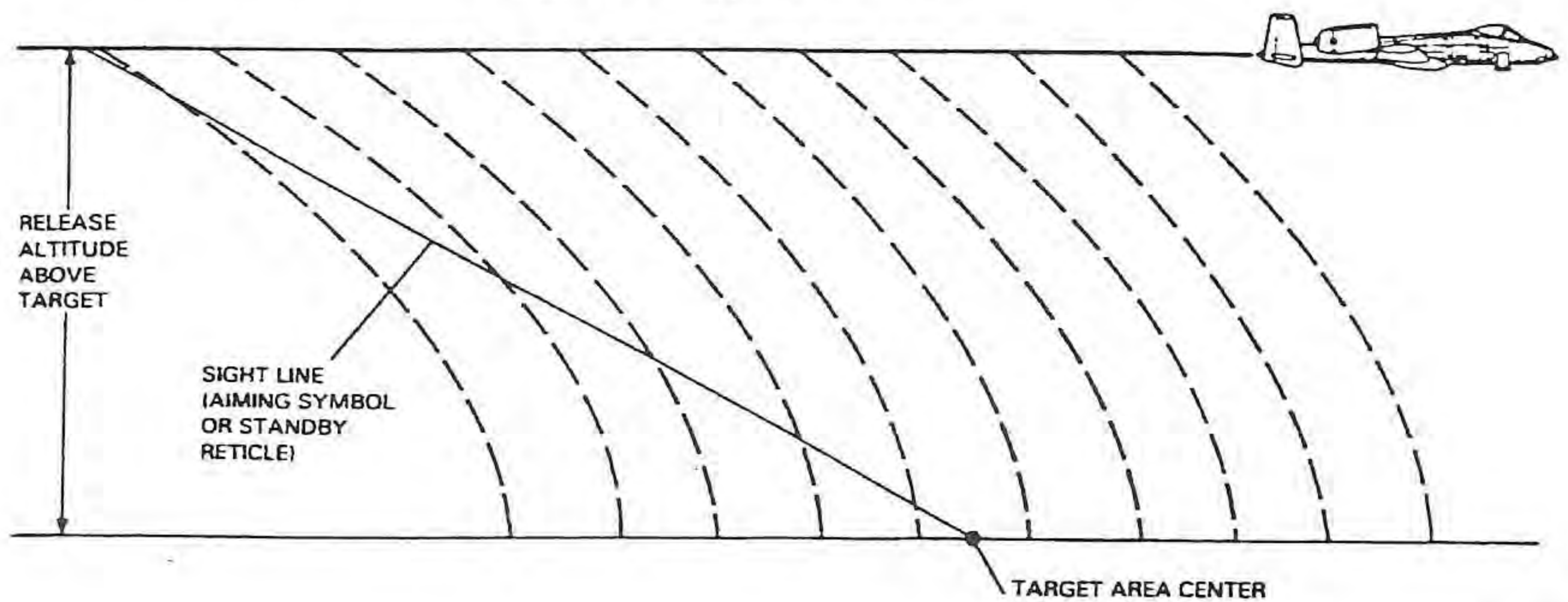
The pilot inputs minimum times of fall for single weapons, then the system computes adjustments to the MRC/MRS for ripple releases based on intervalometer and quantity selections. The pipper shows the middle of the stick, and the MRC indicates when the first bomb should be released such that the last bomb will meet the minimum range conditions.

- | | |
|--------------------------------------|---|
| R_1 RANGE OF FIRST BOMB | N NUMBER OF BOMBS RELEASED |
| R_N RANGE OF LAST BOMB | R_p RANGE FROM RELEASE TO CENTER OF PATTERN |
| θ DIVE ANGLE | SD SIGHT DEPRESSION |
| Y_1 RELEASE ALTITUDE OF FIRST BOMB | T_1 TIME OF FALL OF FIRST BOMB |
| Y_L ALTITUDE LOST DURING PULLOUT | ΔT RELEASE INTERVAL IN SEC. |
| Y_N RELEASE ALTITUDE OF LAST BOMB | L_S PATTERN LENGTH |



1A-10A-34-1-1-7

Figure 1-15. Ripple Release - Dive.



1A-10A-34-1-1-8

Figure 1-16. Ripple Release - Level.

Cluster Delivery

CBU weapons have varied payloads and dispenser designs that distribute their munitions over an area. Bomblet density in the target area can vary greatly, depending on delivery angles, release altitudes, and airspeeds.

CBU-87/-89/-97 series munitions are fuze-initiated clam-shell dispensers. Cluster bombs available are as follows:

CBU-87

CBU-89

CBU-97 (LASTE V6.0 136 only)

For the selected cluster weapon, the pilot enters the fuze type, the height of burst (HOB), and/or the height of function and the fuze time for each cluster bomb in the appropriate submenu.

NOTE

LASTE will accept HOBs that are not compatible with the fuze selected.

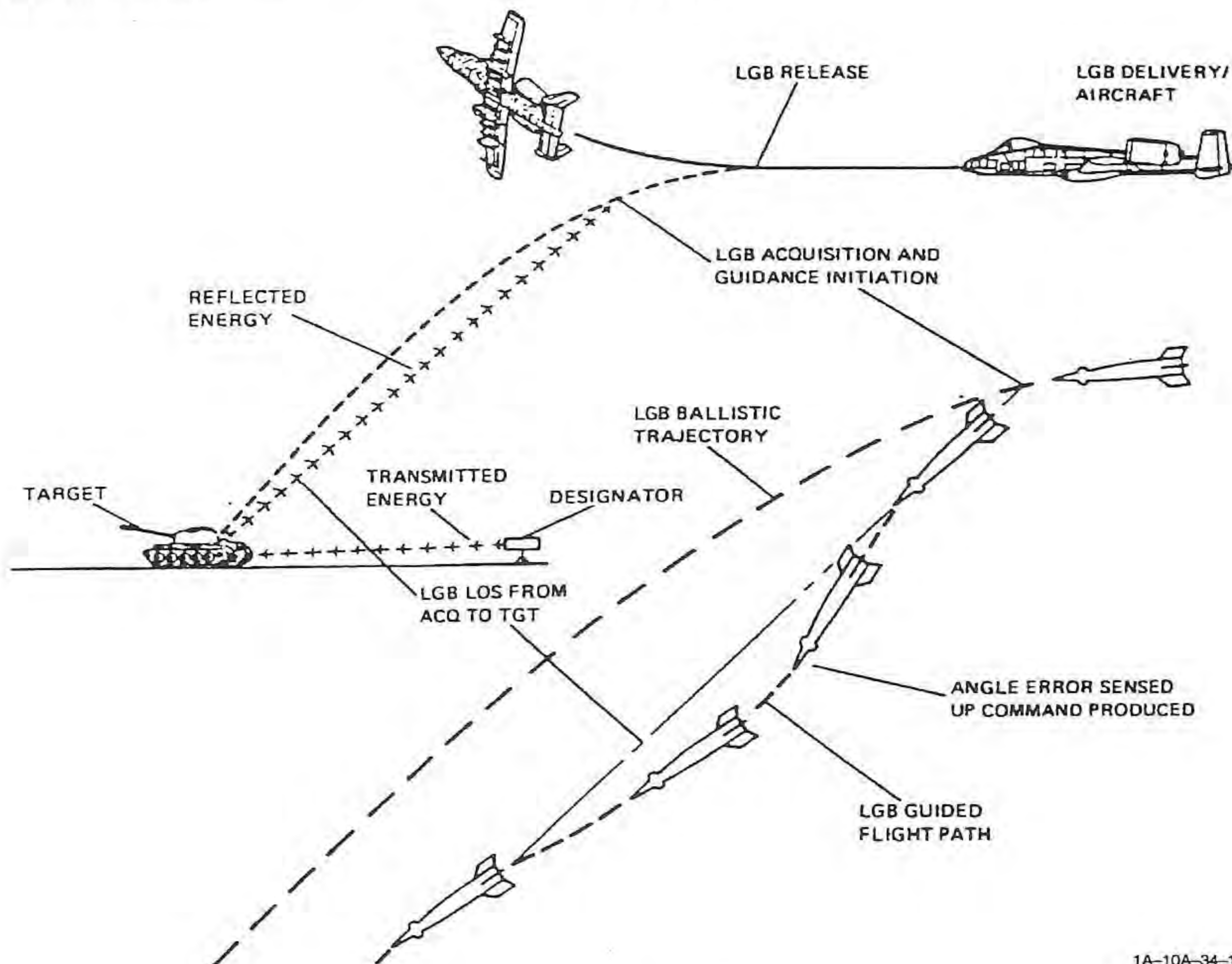
Laser Guided Bomb Delivery

Laser guided bombs (LGBs) (Figure 1-17) may be released from level or dive deliveries in much the same manner as conventional unguided bombs. The target must first be illuminated by a ground or airborne laser designator. The guidance system senses the reflected laser energy and provides terminal steering commands to the illuminated target.

NOTE

Guidance system acquisition of the illuminated target prior to release is not necessary.

The weapon flies ballistically until the illuminated target is within the detector field of view and the reflected laser energy is strong enough to activate the guidance system. Ballistics and weapons envelopes/profile data for laser guided weapons is available in Section II of this T.O. and CWDS.



1A-10A-34-1-1-9

Figure 1-17. Laser Guided Bomb Delivery.

EXPAND Mode (LASTE V4.0) and CCRP Mode (LASTE V6.0 [136]) Deliveries

EXPAND (LASTE V4.0) and CCRP modes (LASTE V6.0 [136]) are designed for delivering ordnance on targets outside the HUD field of view. In EXPAND (V4.0) or CCRP and CCIP Modes (V6.0), a target can be designated by the pilot with either the depressible pipper or the IR Maverick. This is accomplished by either manually flying the depressible pipper or slaving the IR Maverick seeker head to the desired target and depressing the Nose Wheel Steering (NWS) button (Refer to the Nose Wheel Steering button interface section for button logic).

NOTE

The Maverick is not required to be locked on the target. As long as it is called up on the TVM, uncaged, and the symbol displayed on the HUD, a target can be designated.

The depressible pipper will then be deselected and a LASTE designated target will be represented on the HUD as a target designation cue (TDC), which is a 5 mil box with a pipper in the center. The TDC ranging is based on the ALTITUDE source selected on the OSP and will track the point on the ground within the accuracy of the initial designation and INS drift and altitude source accuracy.

When using WD-2/CCIP modes the following applies: In the manual designation mode (with depressible pipper), the second depression of the NWS button compresses the HUD field of view, in both the vertical and horizontal axes by a factor of 1.7, where the TISL diamond (LASTE V4.0) or spider (LASTE V6.0 [136]), TDC, CCIP, and PBIL including the MRS and DRC will be compressed. The third depression of the NWS button will compress the HUD field of view by a factor of 3.0. A fourth depression of the NWS button deselects the TDC, reselects the depressible pipper, and returns the compression factor to 1.0. The compression factor is displayed in the lower left corner of the HUD. The gun cross, TVV, depressible pipper, and pitch ladder will not be compressed or affected by the compression factor, except for Options C and HARS, where the depressible pipper will be compressed by a fixed factor of 3.0. The target designation box will not be displayed when a TDC has been selected.

When using the Maverick, subsequent depressions of the NWS button will only release and redesignate the target. The compression factor is always 1.0 when the Maverick is called up. If the Maverick is deselected

after designating, the TDC will be retained and the manual mode entered at 1.0 compression factor. When the Maverick is called up on the Television Monitor, the CCIP Bomb Reticule, PBIL, MRC, MRS, and DRC will not be displayed.

Flying the CCIP along the PBIL to the TDC will place the aircraft in the proper position to release the selected weapon. When compression factors greater than 1.0 are selected, the TDC or TISL diamond (LASTE V4.0) or spider (LASTE V6.0 [136]), CCIP and PBIL, including the MRS and DRC, will function as in uncompressed WD-2 (V4.0), (CCIP V6.0) mode relative to each other but will not overlay their ground related positions when viewed through the HUD.

Attack Profiles

Diving, Level, Maneuvering, and Loft deliveries are the main attack profiles associated with bomb delivery, and are described below.

Diving Deliveries

Figure 1-18 shows a typical dive delivery for a single weapon release. The ballistic data (Combat Weapon Delivery System [CWDS]) provides sight depression values at given release parameters for specific munitions. Release parameters are established by reference to airspeed, altitude, and attitude. Charts and tables are provided in this manual to apply speed and altitude instrument error correction when performing HARS deliveries.

Establishing the proper entry parameters is the most important phase of a dive bomb pass. The desired dive angle can be achieved with reasonable accuracy by beginning the roll-in at the correct altitude and horizontal range from the target. This position can be estimated, using pilot experience, or computed, using the dive angle versus distance chart, the aim off distance charts, or simple trigonometric calculations. Aim off distance (AOD) is the horizontal distance between the target and the aim off point (AOP). The AOP is the flight path (aircraft velocity vector) projected to the ground. Therefore, the AOP remains stationary throughout the dive as the pipper appears to move up to the target during a straight line dive delivery.

The base horizontal distance from target (B) can be computed trigonometrically as follows:

$$B = \frac{\text{Base Altitude (AGL)}}{\text{Tangent of Dive Angle}} - \text{AOD}$$

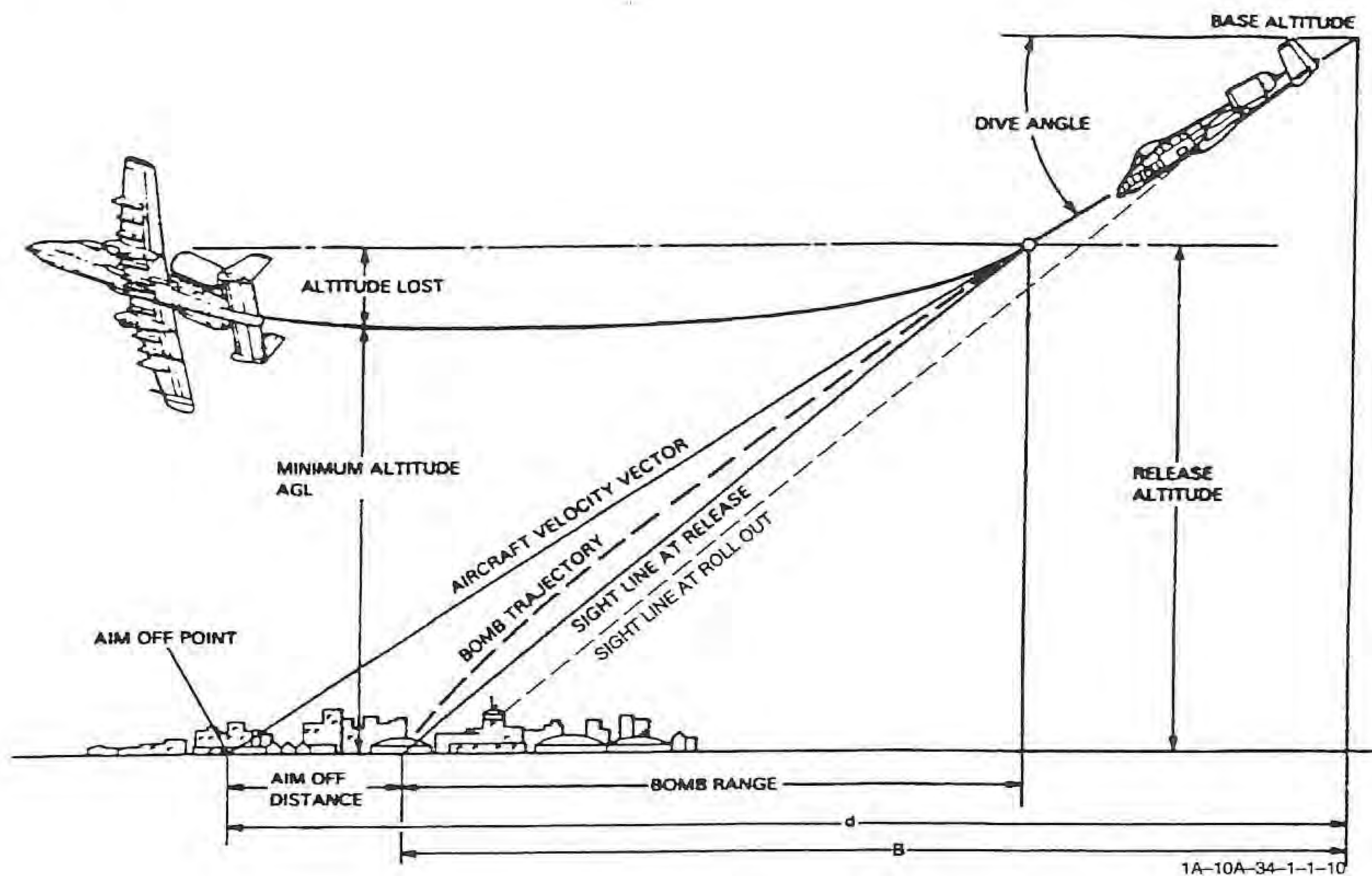


Figure 1-18. Diving Delivery.

At roll-out, the aircraft flight path should be established on the AOP beyond the target. Several methods exist to aid the pilot in setting his aim off distance. Initial Pipper Placement (IPP) references the target's position relative to a fixed depressible pipper at a particular altitude during the pass. This is a standard method for manual deliveries. Initial Target Placement (ITP) references the target position to the pitch ladders at a particular altitude and is suitable for manual and computed deliveries. For LASTE, ground stabilized minimum range staple and desired range cues are added. Set properly, these cues will act as a continuously computed IPP/ITP valid at any altitude in a delivery. The depressed sightline (pipper) at roll-out will be short of the release aim point and as the dive continues, the pipper will track toward the release aim point. Simultaneous achievement of release parameters should be met prior to depression of the weapons release button. The LASTE system compensates for wind and release altitude in computing CCIP. LASTE aircraft allow releases in banks or G-loaded conditions. Immediately following release, initiate appropriate safe escape maneuver.

LASTE computes the winds at release and uses the full wind component for CCIP corrections. LASTE does not incorporate a wind model in CCIP/CCRP solutions. For long slant range deliveries, the winds at release will most likely be stronger and/or from a different direction, than the winds throughout the majority of the TOF of the weapon. In this case most weapons will land upwind of the target. The upwind distance is a function of the wind disparity at release vs. the entire TOF of the weapon.

LASTE V6.0 CCRP expands the weapons delivery envelope to where the jet may release in or near jet stream winds. In this case weapons may impact well upwind of the target.

The stores may be released in the following manner: single, pairs, ripple single, or ripple pairs, as selected by the pilot. In dive delivery, dive recovery and safe escape must be based on the first bomb released.

Level Deliveries

Level bombing (Figure 1-19) is a release from level flight at a planned altitude. Prior to reaching the release point, the pilot should ensure that the aircraft is established at the preplanned release airspeed. The pilot may establish a crabbed approach to compensate for crosswind conditions. The LASTE system compensates for winds and parameter errors. It may be necessary to compensate for store loading on other than centerline stations.

Maneuvering Deliveries

LASTE allows accurate deliveries to be performed with bank or G-loading. Maneuvering deliveries are entered from preplanned dive, level, or climbing deliveries. Continuous curvilinear deliveries maintain a bank angle completely through release of the weapon. The PBIL, PBRL and minimum range cue are mechanized to compensate for banked deliveries. For G-loading deliveries, establish a dive angle with a valid CCIP solution and pull back smoothly on the stick to move the CCIP more quickly to the target. The amount of G that can be pulled is limited by the FOV of the HUD and can be increased by using the

expanded mode. Maneuvering deliveries are inherently less accurate than non-maneuvering deliveries and are usually performed with ripple releases. Maneuvering deliveries can significantly change the weapons effects because the intervalometer setting/impact spacing numbers are planned for certain G-loading conditions.

NOTE (V6.0 Only)

The PBIL may not track the MRS and DRC dur-

ing banked maneuvers because it is a linear prediction of the Locus of Future Impact Points (LFIP), which is a curved path. The MRS and DRC are implemented as two points along the LFIP.

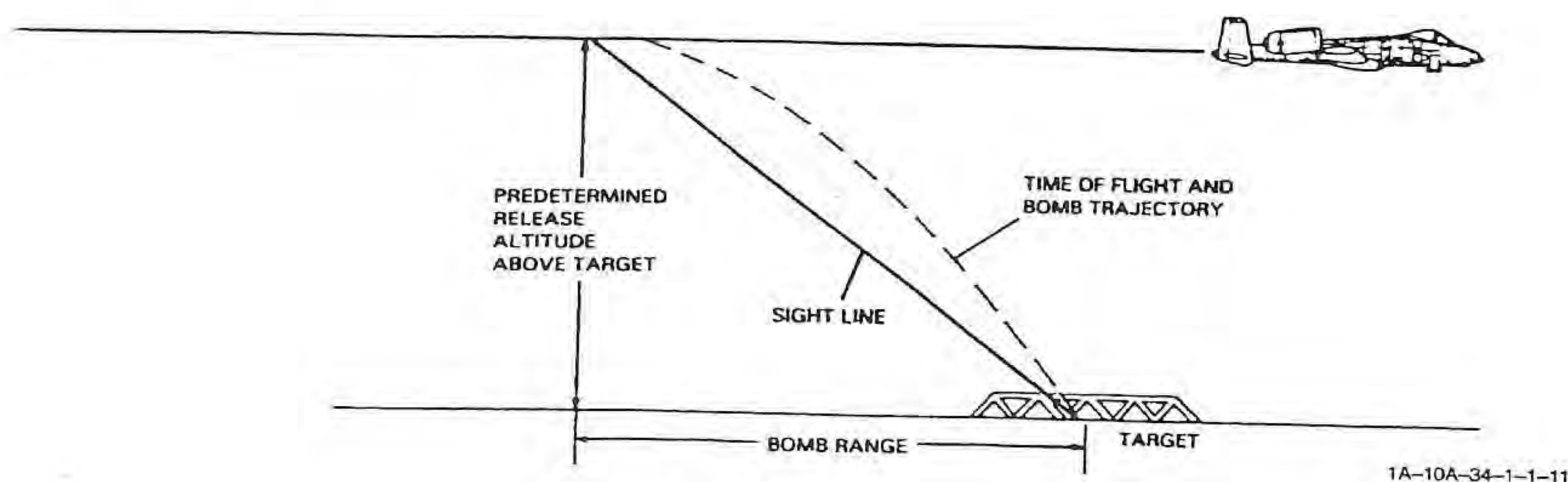


Figure 1-19. Level Delivery.

Loft Deliveries (CCRP) (LASTE V6.0 136)

Loft deliveries can be made using a CCRP solution. The deliveries may be from a banked or wings-level attitude. Placing the PBRL on the CAP and maintaining bank and G-load results in the CAP moving smoothly down the PBRL. Pulling back on the stick when the release angle numeric appears will move the CAP quickly down the PBRL to the pipper.

ROCKET ATTACKS

Three submenus are provided for rockets, RKT1, RKT2, and RKT3 are located in Weapon Submenu (V4.0) and RKT Submenu (V6.0). In these menus, the motor/warhead combination and the station number are entered for each rocket. Offset adjustments for each rocket can also be set in the rocket submenus. Only valid combinations of mo-

tors and warheads can be entered, invalid combinations will not be accepted by the rocket submenus.

NOTE

The MK 66 motor/WDU-4A/A warhead combination is invalid. A verified ballistics model for this combination is not available.

The following are the valid motor and warhead combinations accepted:

<u>MOTOR</u>	<u>WARHEADS</u>
MK 4/40	M151/156/WTU-1/B MK 1/5/61 WDU-4A/A
MK 66	M151/156/WTU-1/B MK 1/5/61

CCIP Rocket Attack (V6.0)

The symbology is the same as that for CCIP bomb except "RKT" appears at the bottom of the display, and there are no PBIL, DRC, MRS, MRC symbols. A lofted solution (Figure 1-20) for CCIP rockets is provided, similar to the gun positive pitch solution in WD-1 mode. It is mathematically possible for a rocket to cross the target altitude twice when lofted: once when the rocket is climbing, and again when it is descending. For CCIP rockets, LASTE solves for the second occurrence; when the rocket is descending. The CCIP is available for 2.75 inch rockets with MK-66 (WAFAR) and MK-40 (FFAR) motors and the following warheads:

MK-1	M156
MK-5	WDU-4A/A
MK-61	WDU-13/A
M151	WTU-1/B
M257	XM278
M274	

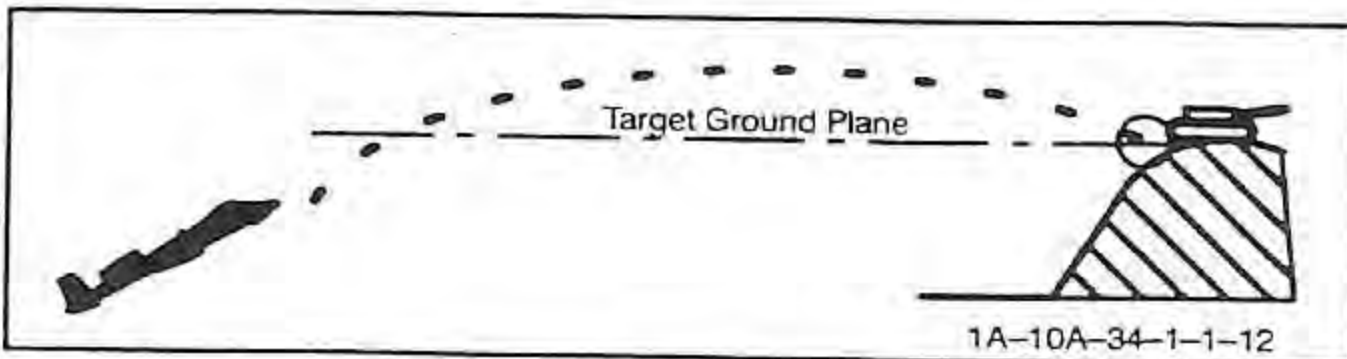


Figure 1-20. CCIP Lofted Rocket Solution.

NOTE

An MRC is displayed in the reticle for the WDU-4A/A warhead indicating desired release range. (LASTE V6.0 [136] only)

CCRP Rocket Attack (LASTE V6.0)

CCRP rocket symbology includes the CCRP reticle, Release Cue, Release Angle Numeric, ASL, and PBRL. Refer to CCRP Bomb Attack for a description of the Release Cue, Release Angle Numeric, PBRL and ASL.

CCRP Reticle (LASTE V6.0 [136])

The CCRP reticle used for rockets is similar to that described in CCRP Bomb Attack, except "RKT" is displayed below the reticle. Also, with slant range greater than 12,000 feet but less than the maximum range for the rocket, the range bar is clamped at 12 o'clock and a two-digit range numeric is displayed below the reticle. For a wings level delivery the PBRL, ASL, and CCRP reticle pipper must be coincident.

Attack Profiles

Rockets (Figure 1-21) may be delivered from a variety of dive/climb angles. Lofted deliveries for rockets are possible using a CCRP solution (LASTE V6.0) [136]. The most important delivery parameter for rockets is slant range to the target. The rocket CCIP display only gives range out to 12,000 feet slant range. However, the solution is valid out to 20,000 feet slant range and is valid any time the CCIP is present. It is also important that the aircraft be at the proper G for release.

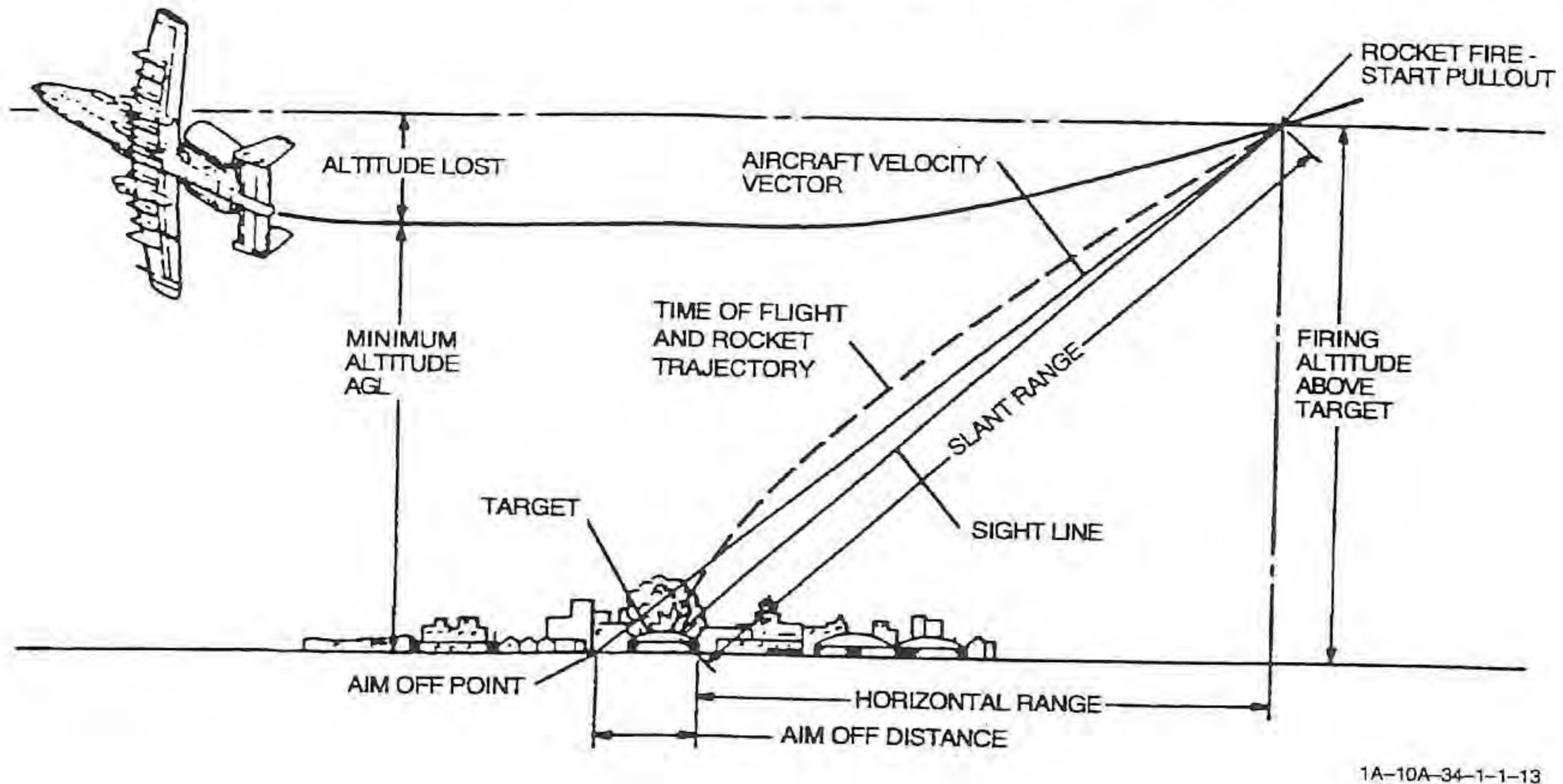


Figure 1-21. Surface Attack - Rockets.

ELECTRO-OPTICAL WEAPONS DELIVERY

Electro-optical weapons (Figure 1-22) may be released from dive or level deliveries. The scene viewed by the weapon's camera is presented to the pilot on the TV monitor, which provides the necessary video acquisition and identification capability.

Target acquisition with the AGM/TGM-65 is normally accomplished by correlating the missile boresight to a symbol on the HUD. The AGM/TGM-65A/B has fixed boresights, ranging from 70 mils to 87 mils depending on the individual aircraft and launch rail. The AGM/TGM-65D/G has an electronic boresight that can be aligned to a pilot selected line of sight. In non-EGI aircraft, the depressible pipper in WD-1 mode (V4.0), (GUNS mode V6.0), is commonly used to indicate the missile boresight angle in the HUD. For LASTE aircraft, there is a dedicated Maverick symbol to display the missile line of sight. This symbol appears whenever missile video is called up. With AGM/

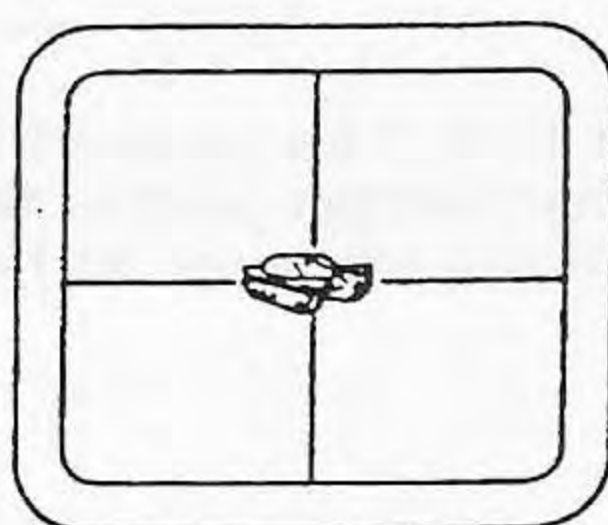
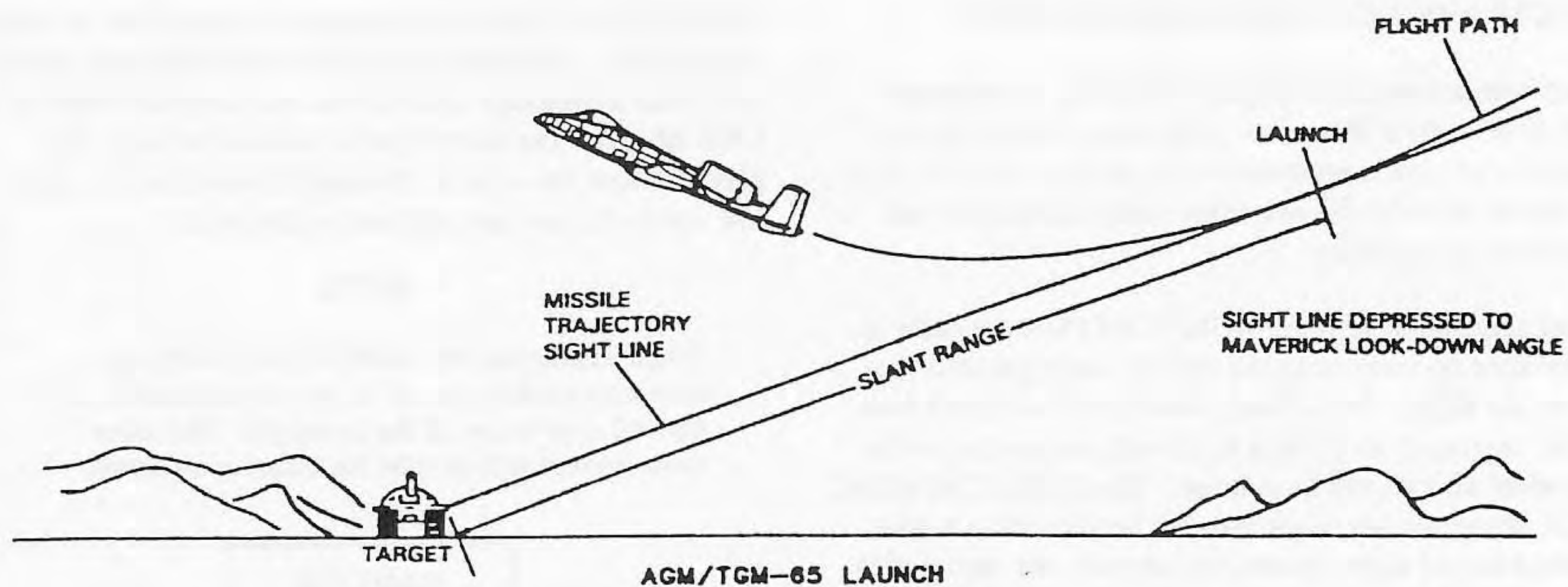
TGM-65D/G/K, the symbol tracks the seeker line of sight in the HUD. The Maverick symbol will track only when used with a modified LAU-117/A and modified cable or a LAU-88A/A. The slant range in nautical miles is displayed below the symbol. Boresight procedures for A/A and Air to Ground are outlined in Section II.

NOTE

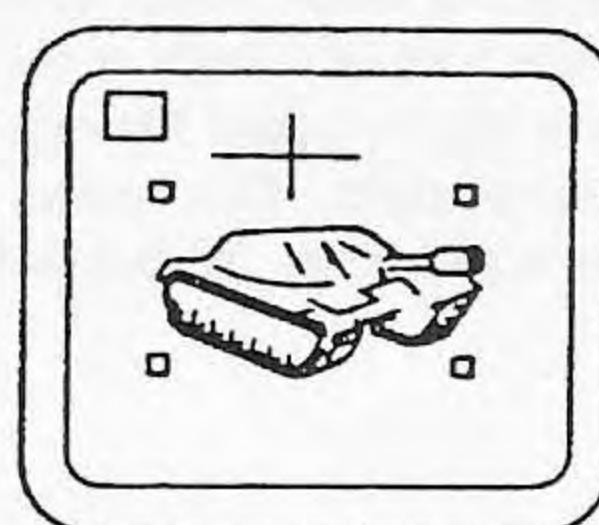
When employing the AGM/TGM-65A/B, the maverick seeker symbol is only an indication of the mil depression of the boresight. The pilot must correct left or right for target acquisition.

CAUTION

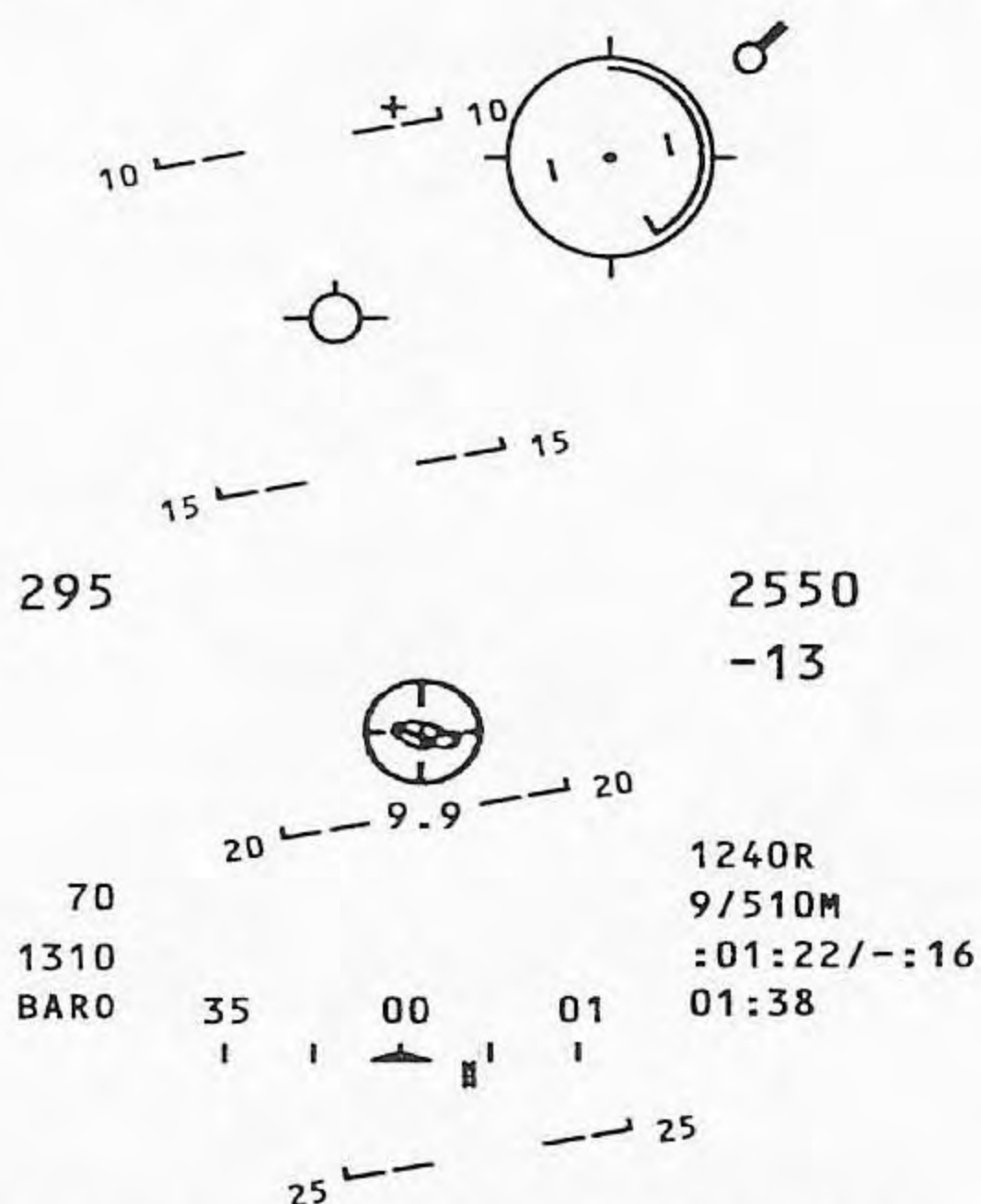
If the HCP function switch is depressed in the Day/Nite/Spare position ONLY the MAV Pipper Position will change, NOT the actual boresight.



TV MONITOR
AGM/TGM-65A VIEW



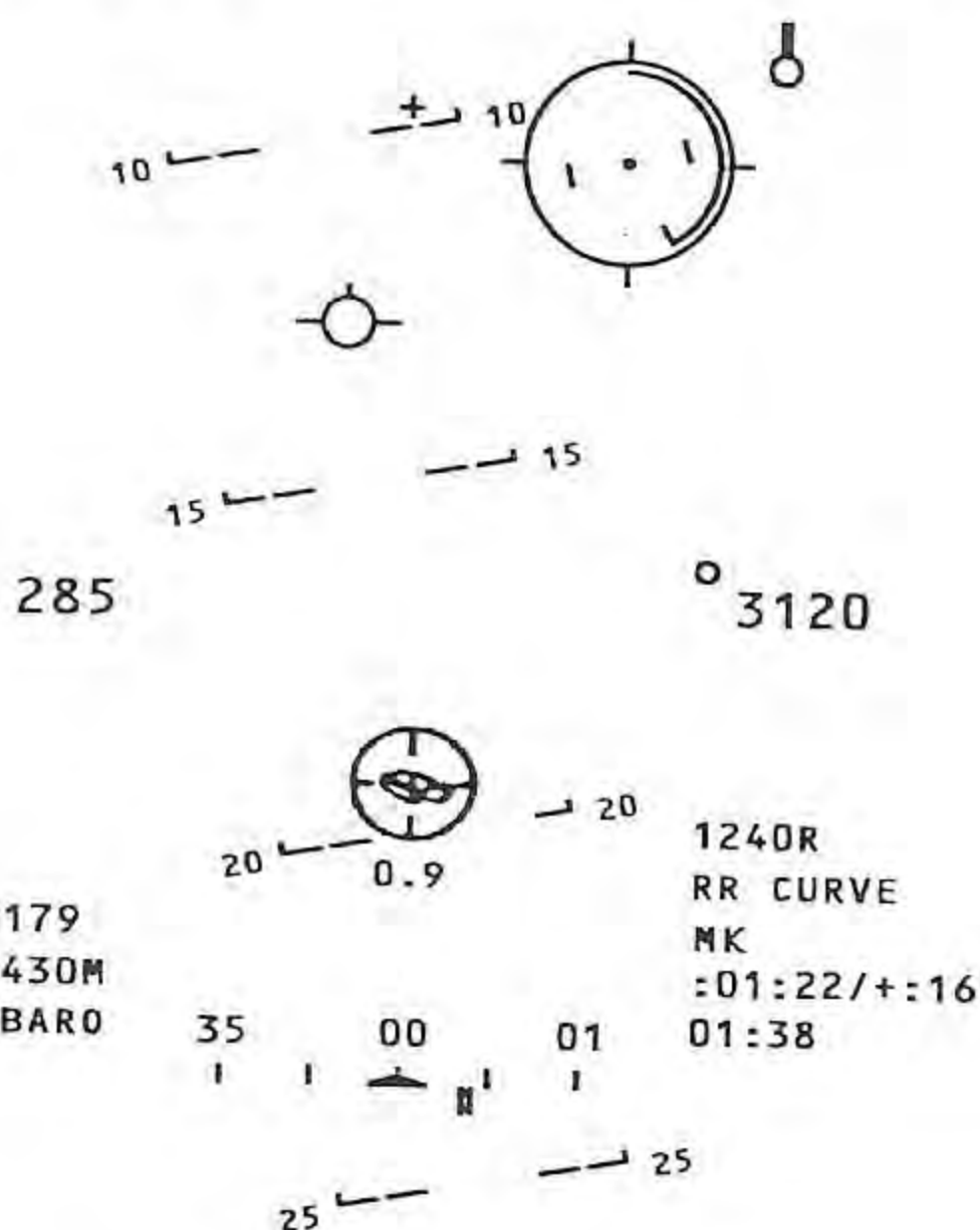
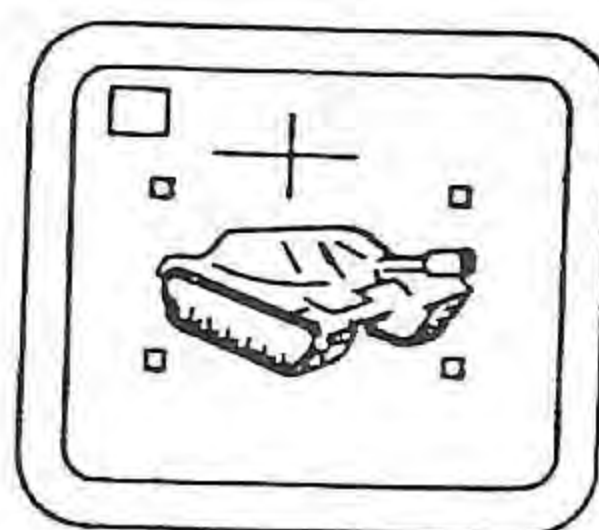
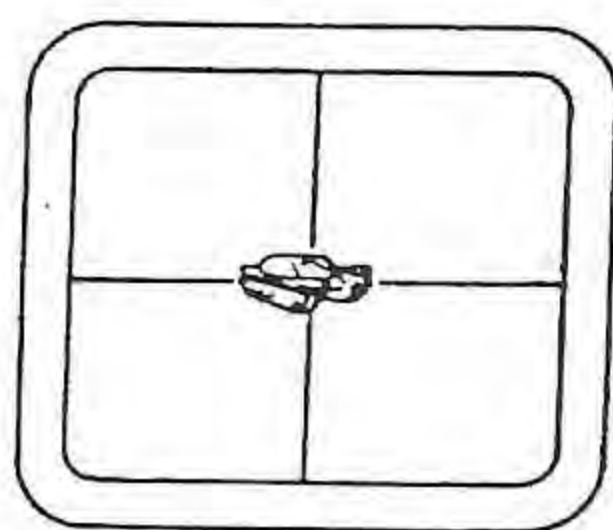
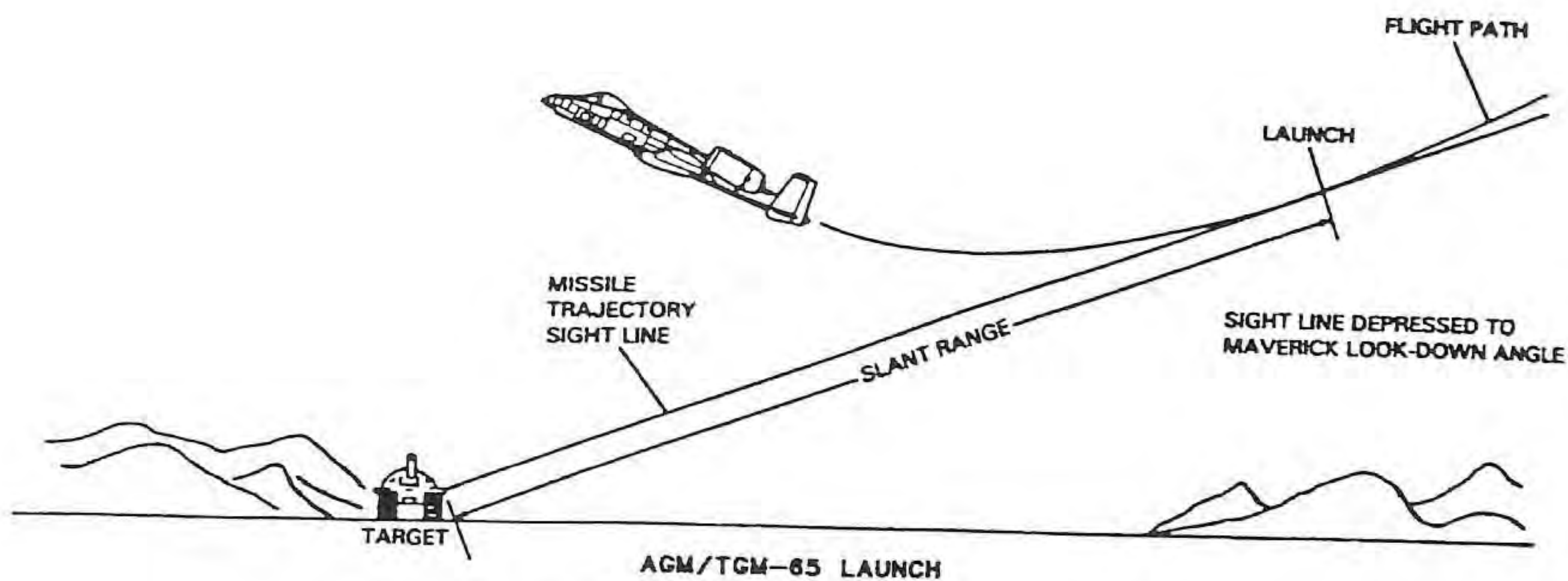
TV MONITOR
AGM/TGM-65B



WD-1 MODE (V4.0), OPTION NORMAL

1A-10A-34-1-1-14

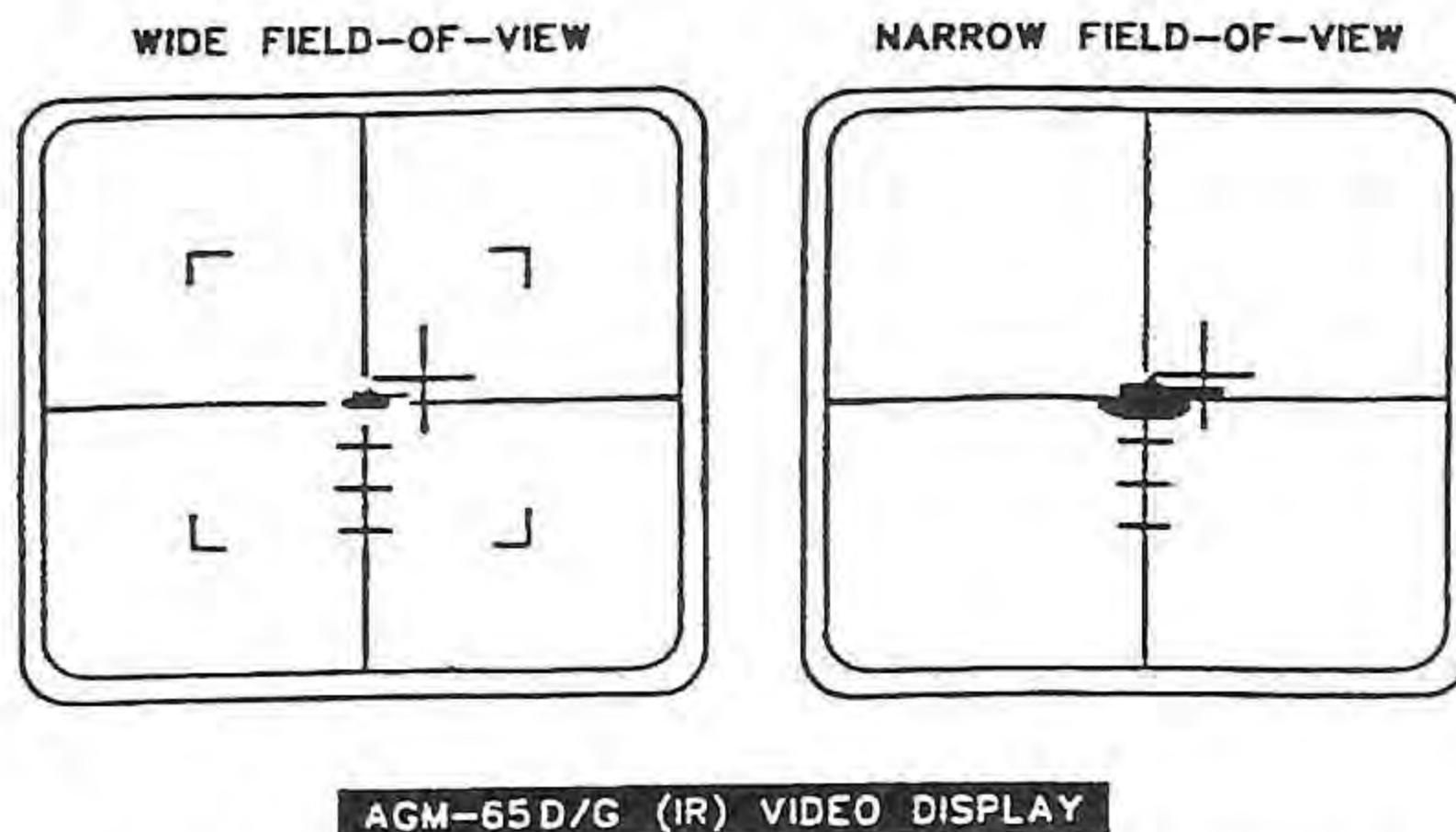
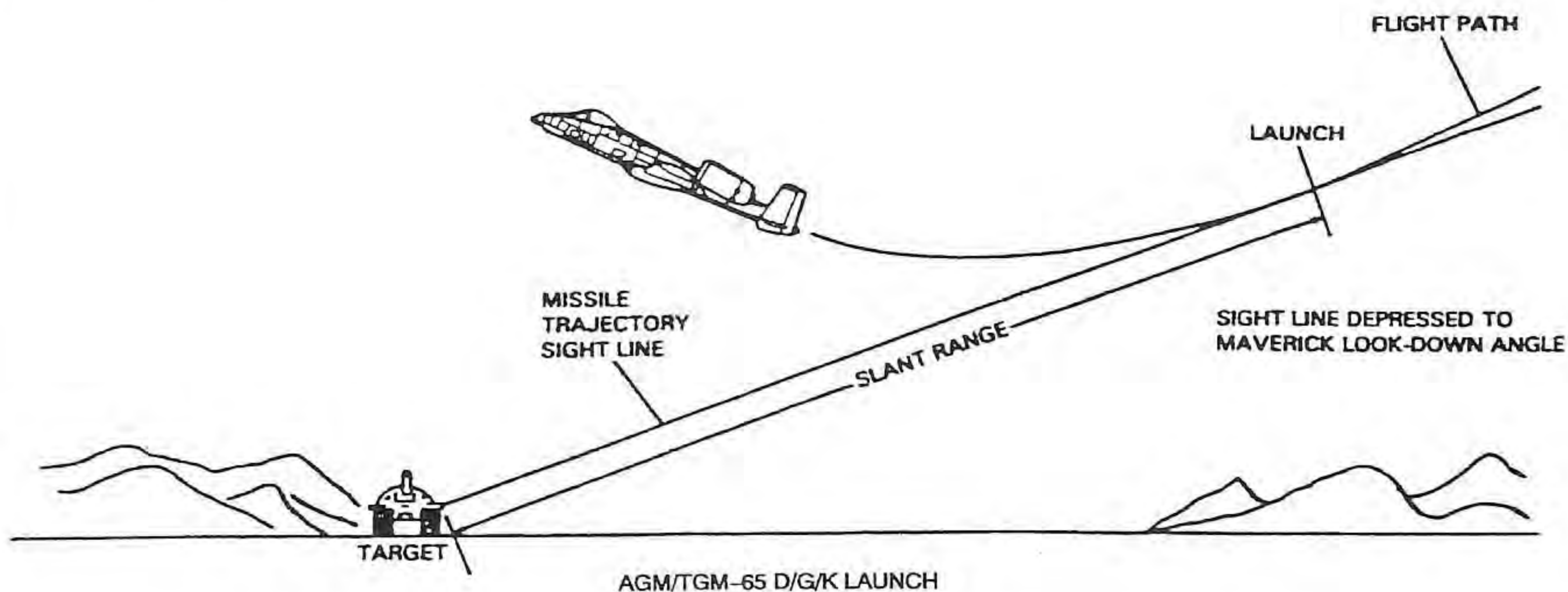
Figure 1-22. EO Maverick Weapons Delivery (Sheet 1 of 3).



GUNS MODE (V6.0) EGI OPTION NORMAL (Cont'd)

1A-10A-34-1-1-15

Figure 1-22. EO Maverick Weapons Delivery (LASTE V6.0 136) (Sheet 2 of 3).



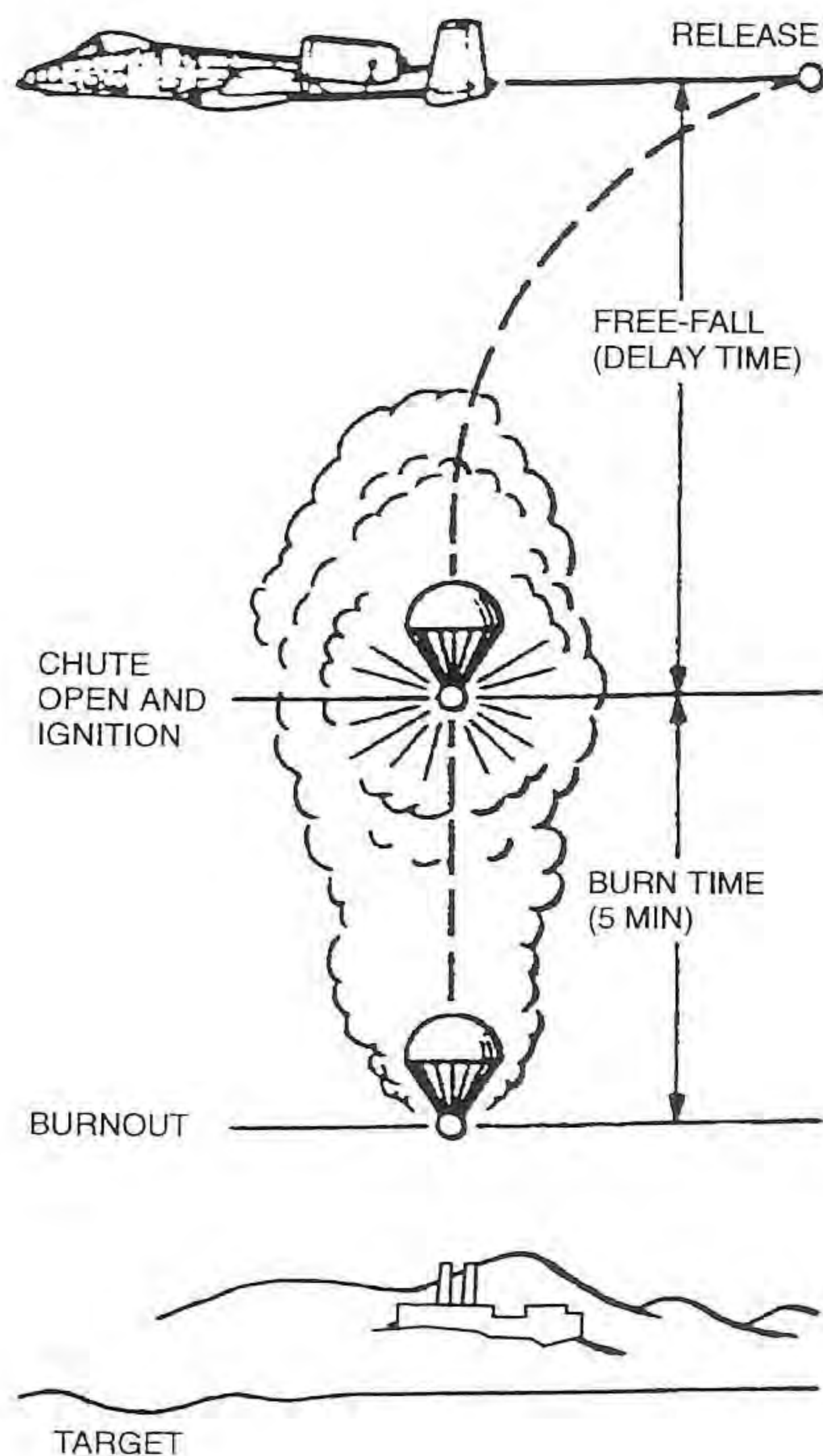
WD-1 MODE(V4.0), (GUNS MODE(V6.0)) OPTION NORMAL (cont'd)

1A-10A-34-1-1-16

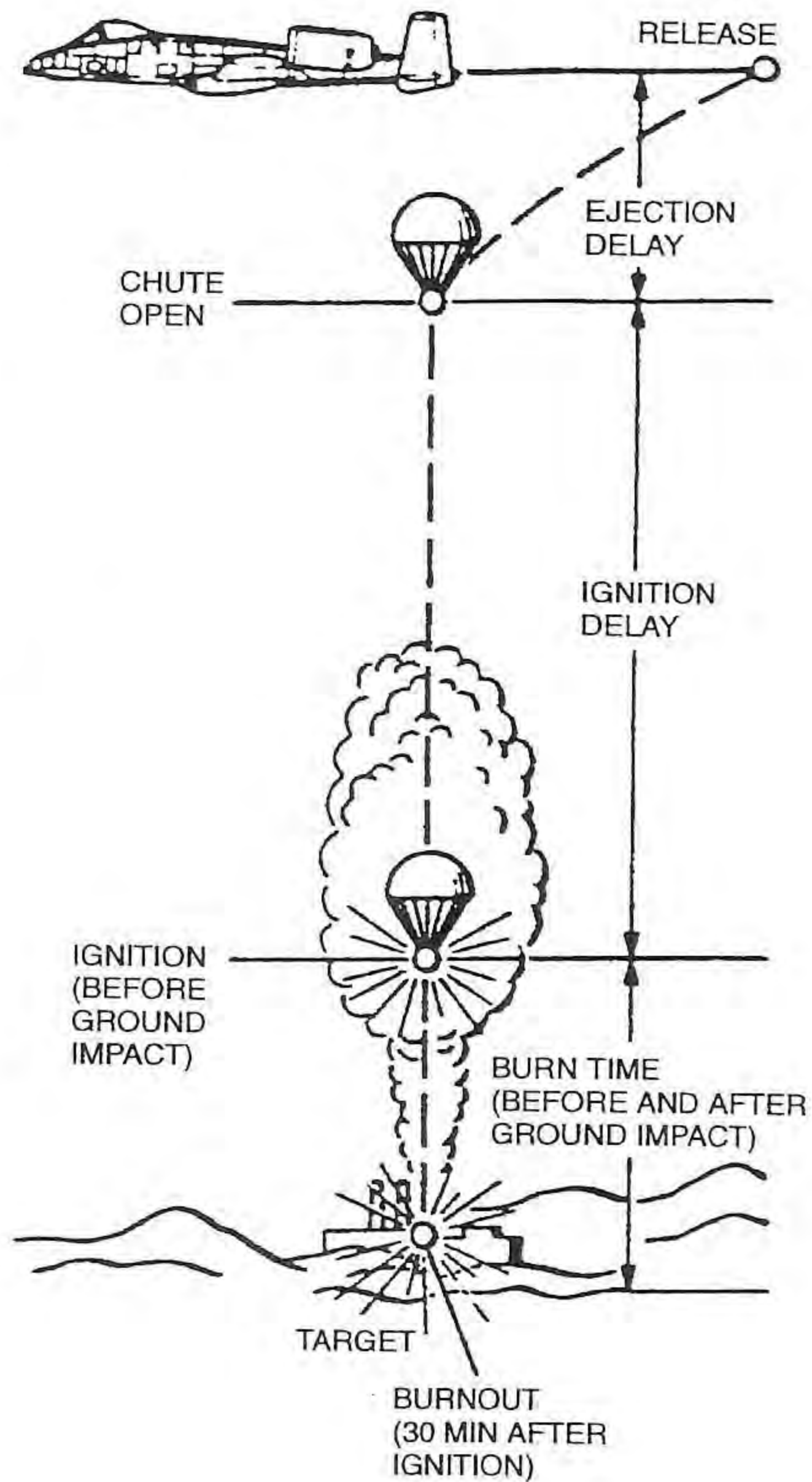
*Figure 1-22. IR & EO Maverick Weapons Delivery (Sheet 3 of 3).***FLARE DELIVERIES**

LASTE flare delivery (Figure 1-23) is only available using a CCRP solution, selecting LUUs during a CCIP mode causes the "USE CCRP" message to be displayed on the HUD (LASTE V6.0 [136](#)). For illuminating flares (LUU 2 series), release altitude is critical when it is desirable to

obtain flare burnout above the ground. Target marking flares (LUU-1/B, LUU-5/B, LUU-6/B) require release altitudes and fuze settings that will ensure flare ignition prior to ground impact. Wind correction is critical and must be considered for proper release point. See Section V for employment considerations.



LUU-2/B ILLUMINATING

LUU-2/B, LUU-5/B, LUU-6/B
TARGET MARKER

1A-10A-34-1-1-17

Figure 1-23. Flare Drop Profiles.

PART 2

WEAPON RELEASE SYSTEMS AND CONTROLS

LATEST VERSIONS 4.0 AND 6.0

PILOT CONTROL INTERFACES

General Controls And Indicators

The following paragraphs describe general pilot interfaces used for various modes of operation. The following controls (Figure 1-24) include the Ground Safety Circuit, Armament Ground Safety Override Switch, Emergency Jettison Button, Precision Attitude Control (PAC) Panel and Gun Ready Light.

Ground Safety Circuit

The Ground Safety Circuit, activated by the LDG GEAR DOWN position of the landing gear handle, prevents arming or normal release of the ordnance and gun firing circuits. Emergency jettison of external stores with the landing gear handle set to LDG GEAR DOWN can still be accomplished with the emergency jettison button.

Armament Ground Safety Override Switch

The Armament Ground Safety Override switch is a guarded two-position switch, located on the left console, placarded SAFE and O'RIDE. The O'RIDE position overrides the ground safety circuitry when required. During normal operations this switch should be in SAFE; however, during actual Integrated Combat Turns (ICTs), pilots may be required to go to override to assist weapons personnel in rehoming TERs.

Emergency Jettison Button

The Emergency Jettison button is used for emergency jettison of all ordnance on pylon stations no. 1 through 11, regardless of landing gear handle position. The emergency jettison button, placarded EXT STORES JETT, is located on the glare shield. It is dual-powered from the DC essential bus with automatic backup from the battery bus. When the emergency jettison button is momentarily depressed, external stores on pylon stations no. 1 through 11 are released in the following sequence:

NOTE

Stores must be canted for release to actually depart the jet.

- Simultaneous with switch actuation – stations 1, 2, 10, and 11
- 0.5 second after switch actuation – stations 3, 4, 8, and 9
- 1.0 seconds after switch actuation – stations 5, 6, and 7

WARNING

The Emergency Jettison button is for emergency use only. It results in the jettison of stores contrary to normal release logic, and at intervals that may be below the minimum release interval for that particular store. This may result in store-to-store collision. Use selective jettison if practical and always attempt to jettison above the maximum fragmentation clearance altitude when possible.

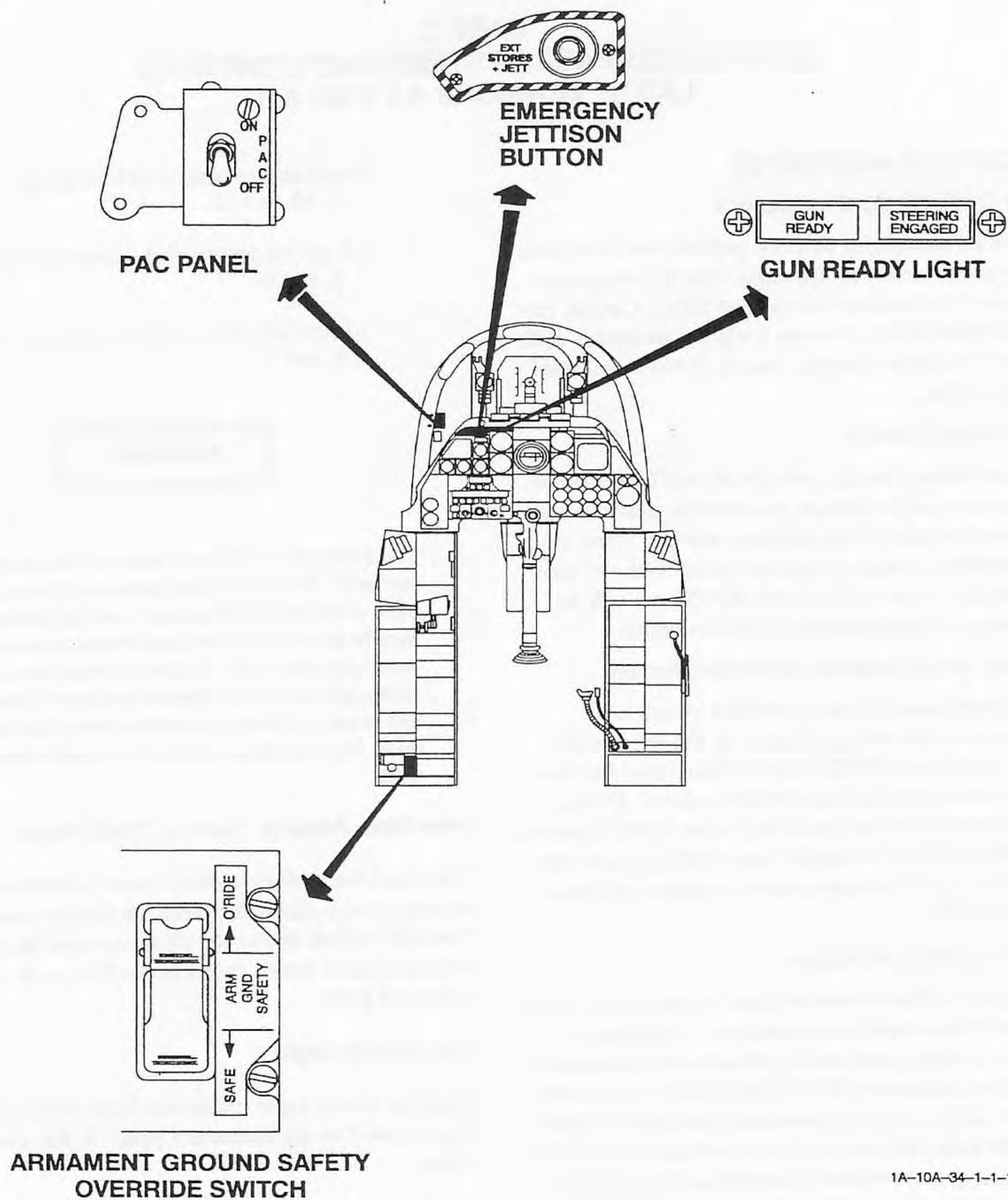
Precision Attitude Control (PAC) Panel

The Precision Attitude Control panel is located on the left canopy bow, contains the precision attitude control switch. The PAC switch allows the pilot to enable the precision attitude control which compensates for gunfire vibration and wind gusts.

Gun Ready Light

The Gun Ready Light, placarded GUN READY, is a green light located on the instrument panel. It will come on when:

- The MASTER armament switch is in ARM.
- Either the landing gear handle is up or the ARM GND SAFETY switch is set to O'RIDE.
- The gun rate switch is set to HI.



1A-10A-34-1-1-18

Figure 1-24. General Controls and Indicators.

CONTROL STICK CONTROLS

The following paragraphs describe the Control Stick Controls (Figure 1-25) which include the Weapons Release Button, Missile Track Button, Emergency Disconnect Lever, Nosewheel Steering (NWS) Button, and Gun Trigger.

Weapons Release Button

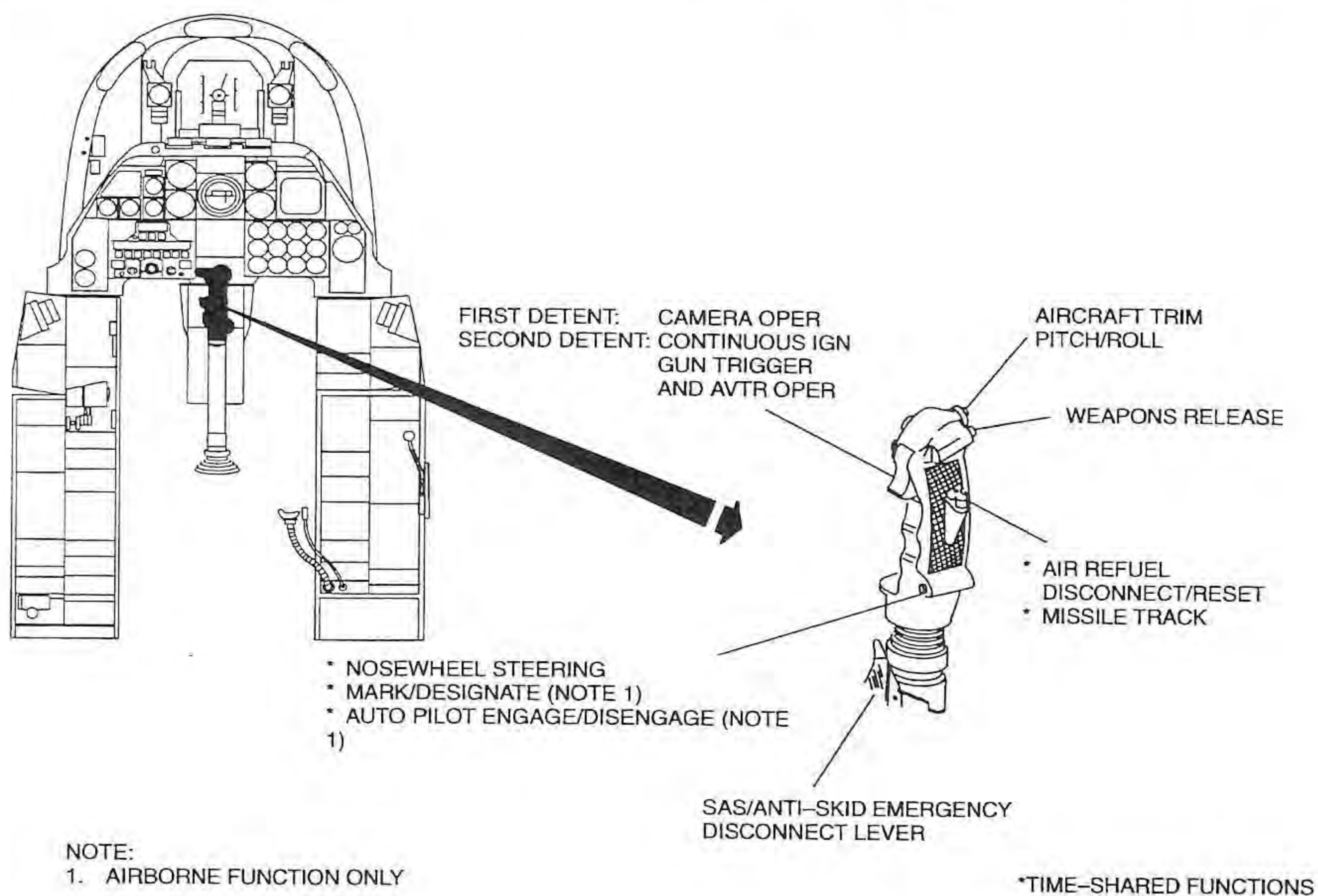
The Weapons Release button is located on the control stick grip. Depressing the button will release stores from selected stations showing a green ready light on the armament control panel. Depressing the weapon release button with master armament switch out of SAFE will display an event marker (letter W) on the HUD two Airborne Video Tape Recorders (AVTR) frames later.

Missile Track Button

The Missile Track Button is located on the control stick grip, and when depressed, provides an alternate capability for enabling the slew/track control circuit on the AGM/TGM-65 or circular scan for the AIM-9.

For AGM/TGM-65 employment, depressing the track button initially stabilizes the missile seeker in space. The seeker will no longer "move" with the aircraft.

For AIM-9 employment, depressing the track button provides a circular scan pattern of the missile seekerhead and consents to self track a target when the missile tone has achieved a self tracking level. A second depression of the track button will return the seekerhead to fixed missile boresight position. Subsequent depressions of the missile track button will toggle between the auto track capability and the missile boresight.



1A-10A-34-1-1-19

Figure 1-25. Control Stick Controls.

EAC/SAS/Anti-Skid Emergency Disconnect Lever

The EAC/SAS/Anti-Skid Emergency Disconnect Lever is located on the forward side of the control stick below the control grip. This yellow and black striped lever functions as an anti-skid and SAS disconnect lever. The anti-skid switch and all SAS switches will return to off when the lever is actuated. The EAC/SAS/Anti-Skid Emergency Disconnect Lever can also be used to disengage EAC. Immediately upon actuation of the EAC/SAS/Anti-Skid Emergency Disconnect Lever anti-skid, SAS and EAC are disengaged.

Nosewheel Steering (NWS) Button (LASTE V4.0)

The NWS button is located on the control stick. The NWS button can be used as an autopilot engage/disengage switch, or as a target designation button in EXPAND Mode. Whenever nosewheel steering is not available, and the EAC switch is set to ARM, the NWS button can act as a LAAP engage/disengage switch. In EXPAND mode, autopilot can only be engaged or disengaged from the LASTE control panel.

NOTE

While in the EXP mode, autopilot can only be engaged/disengaged from the LASTE control panel because the NWS button is used exclusively for TGT designation only.

Depressing the NWS button when the EAC switch is set to arm, allows the pilot to self designate targets in the EXP mode of the HUD using a depressible pipper or the IR Maverick. Refer to EXPAND Mode (LASTE V4.0) Delivery in Section I, Part 1 of this manual for more information on using the NWS button in Expanded Mode.

NOTE

TDC placement accuracy is maximized when target designations are accomplished in a nonmaneuvering state with the target or steerpoint near the TVV.

When EAC is disarmed (OFF), the NWS button can be used as an Mark/Designate button.

Nosewheel Steering (NWS) Button (LASTE V6.0 136)

The NWS button is located on the control stick. The NWS button can be used as an autopilot engage/disengage switch, as a target designation button or for an offset markpoint. Whenever nosewheel steering is not available, the NWS button can act as a LAAP engage/disengage switch. Autopilot can be engaged/disengaged in all modes by depressing the NWS for more than 1/2 second.

Depressing the NWS button for less than 1/2 second allows the pilot to self designate targets in the CCRP mode of the HUD using a depressible pipper or the IR Maverick. Refer to CCIP Mode (LASTE V6.0 136) Deliveries in Section I, Part 1 of this manual for more information on using the NWS button in CCIP Mode. Targets may be designated in the GUNS mode as well.

If a target designation is performed while the option selector switch on the HUD Control Panel is in the MARK position or if the switch is moved to the MARK position while a target is designated, an offset markpoint is performed using the designated target. This offset markpoint method is available in all modes (NAV, GUNS, CCIP, CCRP).

For Non EGI, V6.0 with the HCP set to MARK, a HUD update is performed by using the depressible pipper. LASTE will move the TD box according to the HUD Update. For EGI V6.0 with the HCP set to MARK and depressed, INS HUD UPDATE' is displayed in the HUD. Once the update is accomplished, EGI will update the INS which in turn will place the TD box over the point of interest.

NOTE

- TDC placement and HUD Update accuracy are maximized when target designations and HUD Update marks are accomplished in a nonmaneuvering state with the target or steerpoint near the TVV.
- HUD Updates should not be accomplished in Option B of NAV, GUNS, and CCIP modes since the TD Box is not displayed, and TD Box misalignment cannot be determined.
- When an INS HUD update or a markpoint is to be performed, the elevation of the update point or markpoint must be at least 1 foot below the LASTE system current elevation; the point must be less than 14.8 NM (line of sight) from the aircraft, and the point must be at least 5 miles below the horizon.

Gun Trigger

The gun trigger is mounted on the forward upper surface of the control stick grip in a position to be activated by the pilot's index finger. The trigger works in conjunction with the MASTER armament switch on the armament control panel. Neither the internal gun, nor externally mounted gun pods can be fired unless the MASTER armament switch is in ARM. Externally mounted gun pods will fire only upon gun trigger actuation to the second detent with the gun pod stations selected, and the landing gear handle up. Additionally, the release mode selector must not be in a jettison mode.

The internally mounted gun will fire only upon gun trigger actuation to the second detent, with the MASTER arma-

ment switch in ARM, the gun rate switch in HI and the landing gear handle up (or the ARM GND SAFETY in O'RIDE). Depressing the gun trigger to the second detent also initiates continuous engine ignition.

NOTE

Depressing gun trigger to the second detent will disengage all features of LAAP.

With PAC engaged depressing the trigger to the first detent activates PAC-1. Depressing the trigger to the second det-

ent activates PAC-2, displays an event marker (W) on the HUD (two AVTR frames later) and provides BATA. In air-to-air mode, depressing trigger to second detent displays an event marker (W) on the HUD (two AVTR frames later) and provides FEDS.

NOTE

If Auto Data Display is selected (via test menu) and the bullet TOF is greater than 2 seconds, BATA will not be displayed.

THROTTLE CONTROLS

The following paragraphs describe the Throttle Controls (Figure 1-26) which include the Missile Seeker, Chaff and Flare Dispensing Buttons, Missile Video Polarity Switch, and the Missile Reject/Uncage Switch.

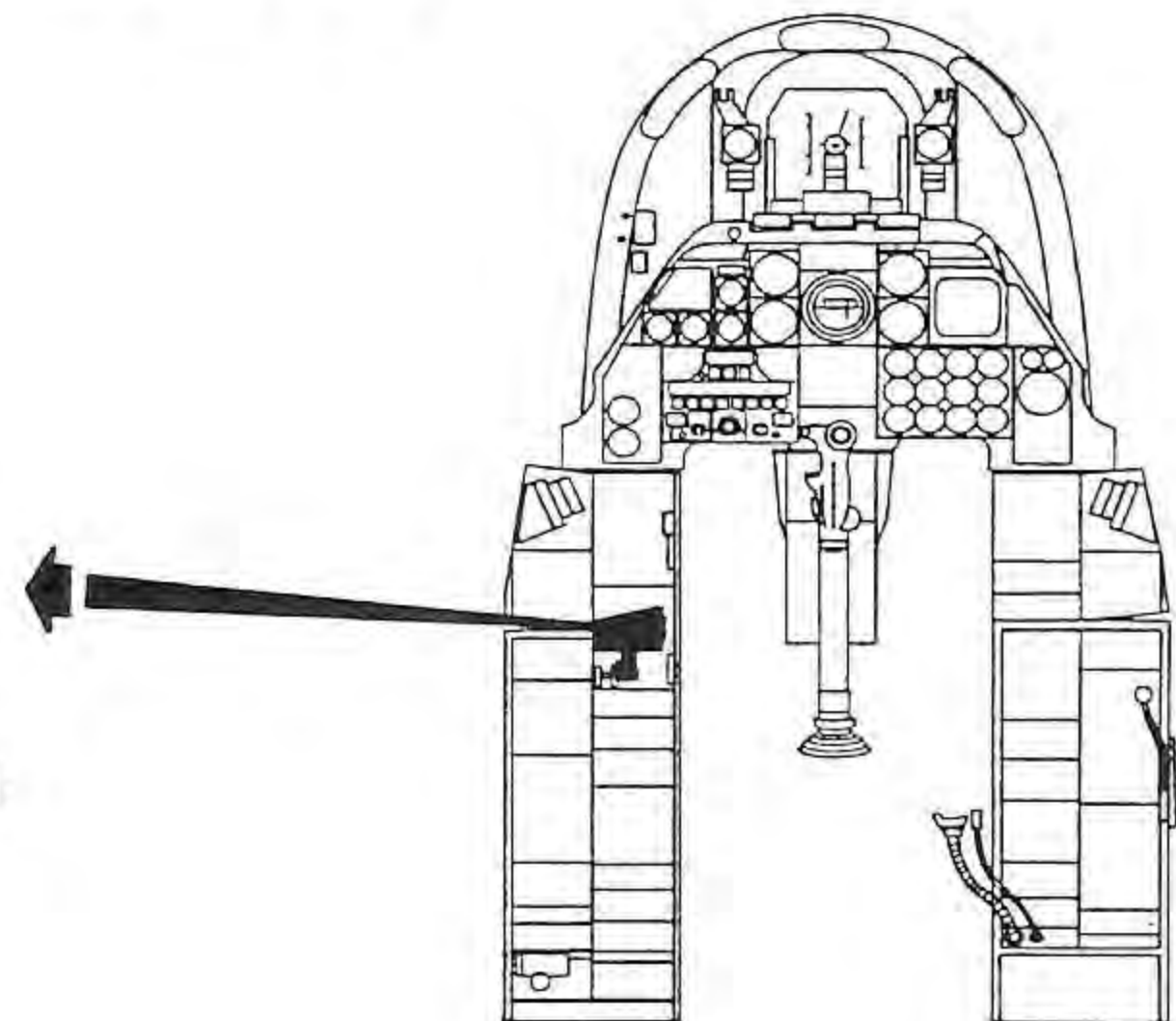
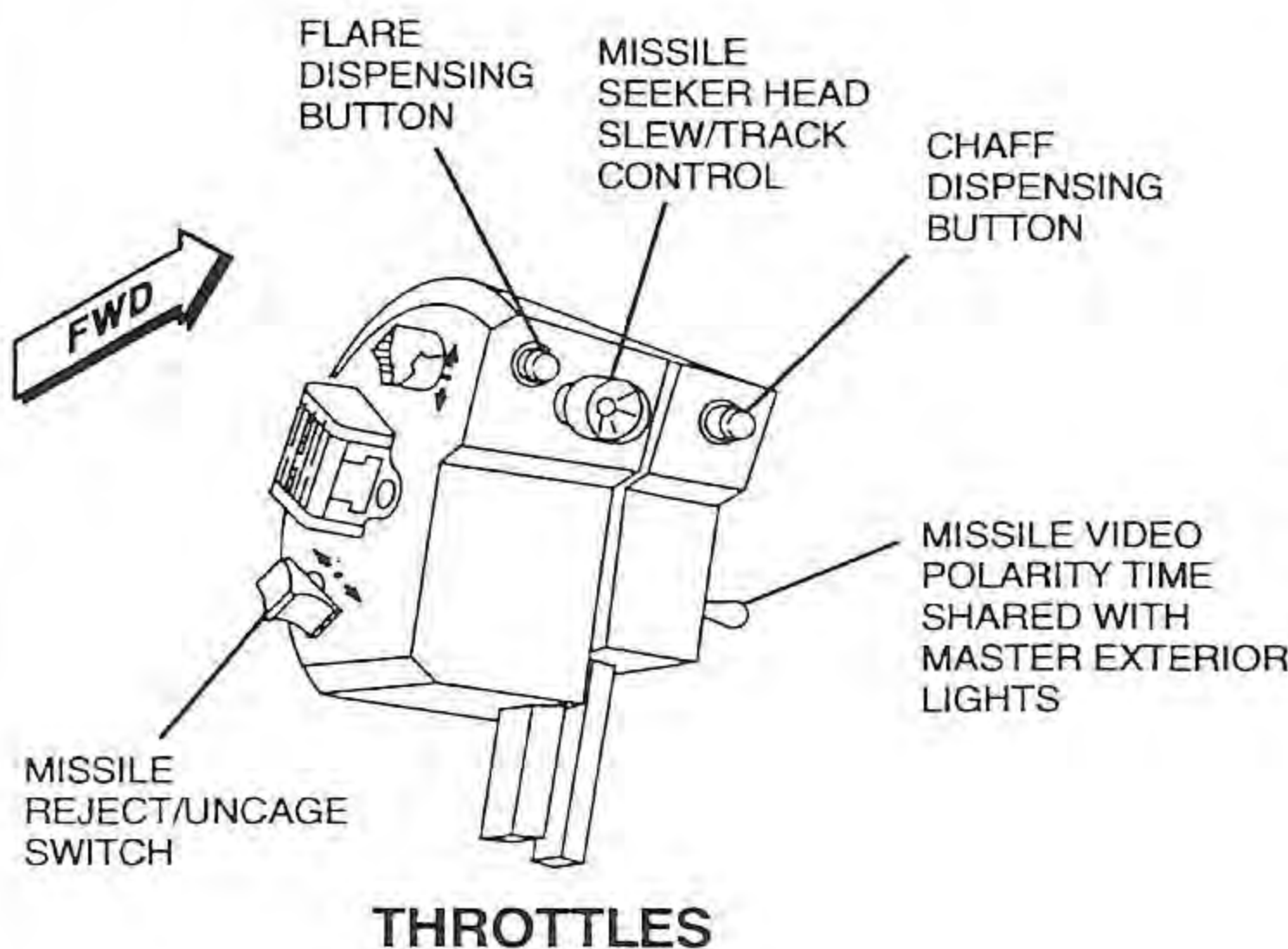
Missile Seeker Head Slew/Track Control

The Missile Slew/Track Control is located on the forward face of the right throttle. Depressing the control activates the AGM/TGM-65 or AIM-9 slew control. Exerting direc-

tional force on the control moves the AGM/TGM-65 or AIM-9 seeker head in azimuth and elevation, if either the missile track or the missile seeker head slew/track control has been depressed to enable the slew/track control feature. Release of either control will enable missile lock-on, providing the other control is not depressed.

Chaff and Flare Dispensing Buttons

For a complete description of the Chaff and Flare Dispensing Buttons refer to Part 4.



1A-10A-34-1-1-20

Figure 1-26. Throttle Controls.

Missile Reject/Uncage Switch

The Missile Reject/Uncage switch is located on the inboard side of the right throttle. The aft position rejects the selected AGM/TGM-65 missile or AIM-9 and the next missile in launch priority is selected.

If installed, initial actuation to the forward position jettisons the dome cover, and electrically unlocks the missile holdback pin on the LAU-117 launcher, providing the MASTER armament switch is in ARM and the gear up signal is present. In addition, it removes the mechanical brakes and electrically boresights the seeker head along the longitudinal axis of the missile. Initial boresight is approximately 70 mils. AGM/TGM-65D/G/K missiles can be boresighted ± 6 degrees of the longitudinal axis of the missile and this boresight can be used for the remainder of the mission. Boresight will remain valid for subsequent sorties until changed. Subsequent forward applications of the missile reject/uncage switch will cause the AGM/TGM-65D/G/K field of view to change (wide to narrow/ narrow to wide).

AIM-9 operations: Initial actuation to forward position uncages the missile seekerhead, providing the AIM-9 MODE switch is in SEL, and a gear up signal is present. The next forward actuation will cause the AIM-9 missile to break the lock-on and recage the seekerhead. The aft position rejects selected AIM-9 missile, selecting next missile in launch priority.

NOTE

With the AIM-9 MODE selector in SELECT, if the MASTER armament switch is set in the SAFE position and more than one AIM-9 missile is loaded, the cooling will be removed from the highest priority missile each time the REJECT switch is activated. Cooling may be regained on all rejected missiles by going to OFF and then back to COOL/SELECT, by recycling to COOL and then back to SELECT with the AIM-9 MODE selector, or by placing the MASTER armament switch to ARM.

Missile Video Polarity Switch

With the EO PWR switch set to ON and an EO station selected, the master exterior light switch functions as the Missile Video Polarity Switch. For aircraft lighting while in the EO mode, refer to T.O. 1A-10A-1.

The missile video polarity switch is a three-position toggle switch on the outboard face of the left throttle, which provides the tracking mode select command to the missile guidance unit. The switch affects the target tracking characteristics of the AGM/TGM-65 Maverick missiles. The aft position enables the AGM/TGM-65A/B/K missile to track a light target against a dark background. The forward position enables the AGM/TGM-65A/B/K missile to track a dark target against a light background. The center position of the switch selects an automatic tracking mode. With AGM/TGM-65D/G(IR) missiles, the aft position of the switch enables the missile to track a hot target against a cold background. The forward position enables the AGM/TGM-65D/G(IR) missiles to track a cold target against a warm background. The AGM/TGM-65D has no automatic tracking mode and the center

position of the missile video polarity switch performs an airborne alignment procedure (Section II). The AGM/TGM-65G uses the center position of the missile video polarity switch for both airborne alignment of the seeker and in commanding Force Correction mode of tracking (Section II).

NOTE

If the contrast switch is set incorrectly (opposite to the actual contrast conditions), the missile may lock-on to the wrong contrast area or may not lock-on at all.

When the missile selected is an AGM/TGM-65D/G, HUD is in WD-1, WD-2, or EXP(V4.0), [GUNS, CCIP or CCRP(V6.0)], (except option C) mode, and missile video is on, the missile seeker head position is displayed on the HUD. The AGM/TGM-65A/B boresight position is displayed as soon as station is selected but will not slew with seeker head.

ARMAMENT CONTROL PANEL

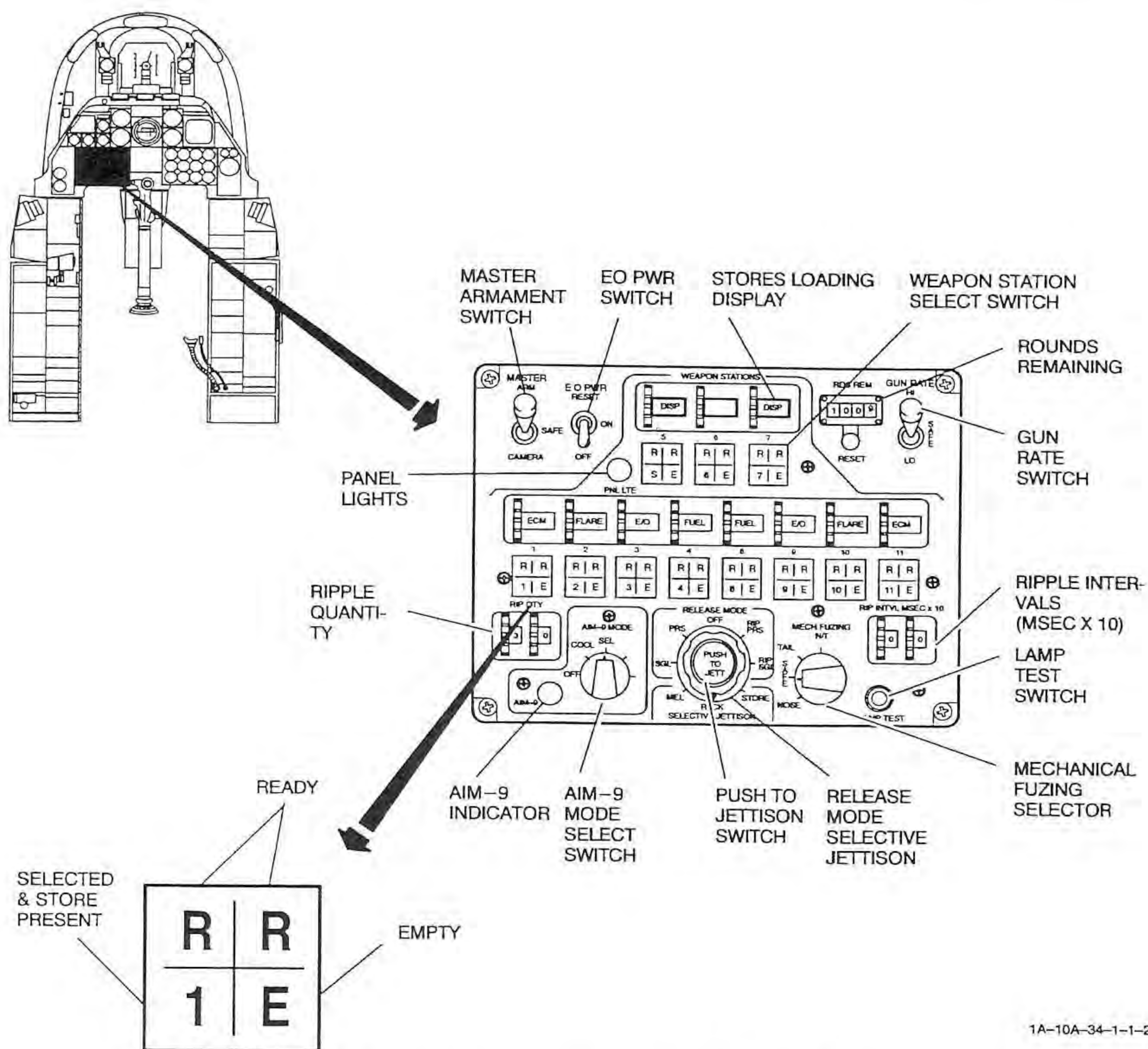
The armament control panel (Figure 1-28) is located on the instrument panel. The armament control panel provides switches for selection of weapons stations, control of gun firing, arming of selected weapon and gunsight camera circuits, mechanical bomb fuzeing, selective external jettison and release modes, ripple quantity and interval con-

trols. In addition, the armament control panel contains an ammunition rounds remaining digital display, an external stores loading display, and readiness indicators. The store loading display for each of the 11 pylon stations is a 16-position thumb wheel switch.

Each display and its associated store is listed as follows:

THUMB WHEEL DISPLAY	WEAPONS
LDGP	MK 82, MK 84, BDU-33, CTU-2/A, M117
CW	SUU--64/-65,BL-755
SMOKE	None
FIRE	Fire Bomb
SPL	BLU-52
DISP	AIM-9, EMPTY TER
ECM	AN/ALQ-131/-184
RKT	2.75 inch/LAU-68/LAU-131
FLARE	SUU-25
E/O	AGM/TGM-65
LASER	GBU
GUN	None
FUEL	External tanks
HDGP	MK 36, MK 82 AIR
(Blank)	None

Figure 1-27. Armament Control Panel Store Loading Display.



1A-10A-34-1-1-21

Figure 1-28. Armament Control Panel (Sheet 1 of 10).

CONTROL OR INDICATOR	POSITION OR DISPLAY	FUNCTION
Store loading display		Eleven thumbwheel-controlled displays indicate the type of load carried and control the armament release logic of the associated weapon station. The associated weapon station select switch is located directly below the store loading display. CAUTION Incorrect thumbwheel display can result in unintentional release of suspension equipment.
Weapon station select switches		Eleven weapon station select pushbutton switches allow pilot selection of a particular weapon station. Three different colored alphanumeric lights indicate the status of each weapon station. The selected station ready light(s) will show steady green for store jettison and normal release modes to indicate the MASTER armament switch is in ARM, station selected, and fuzing is selected. The selected station ready light(s) will flash in selective STORE jettison mode to indicate the MASTER arm switch is in ARM, station is selected, and store fuzing selector is in SAFE. Selected station ready light(s) will flash whenever the MASTER armament switch is set to ARM, station is selected, and the release mode is MSL or RACK jettison. The AIM-9 system uses the station select switch to indicate mode of operation. When the AIM-9 MODE switch is in SEL the station select pushbutton is not required. An available missile station is selected automatically.
	White lighted numeral 1, 2 etc. (selected)	Weapons station selected and store or suspension equipment present on pylon or rack.
	Green lighted letters RR (ready)	Same conditions as white light, plus the release mode, master arm and fuzing have been selected, for those stores requiring a fuzing option. Rockets, flares, and Maverick missiles (AGM or TGM) do not require a fuzing option to get ready indications. Store is ready for release. AIM-9 store is ready for release if AIM-9 mode switch is in SEL. AIM-9 system is disabled if AIM-9 switch is off.

Figure 1-28. Armament Control Panel (Sheet 2 of 10).

CONTROL OR INDICATOR	POSITION OR DISPLAY	FUNCTION
Weapon station select switches (Cont)	Amber lighted letter E (empty)	Weapon station selected and (a) TER or (b) LAU-88/LAU-117/LAU-105 launcher empty or (c) AIS POD loaded (steady). When AIM-9 and AIS pod loaded on same DRA (flashing). NOTE • Rockets and flares will not indicate amber E once gone. • A hung ordnance condition on a TER configured station will not prevent the EMPTY light from coming on. The TER will step by the hung ordnance and the EMPTY light will come on upon station transfer.
	No lighted status indication	Weapon station not selected or no store suspension equipment on pylon.
MASTER armament switch	ARM	Controls application of power from the DC armament bus for the following functions. Enables the mechanical fuzing, gun arm, and selective jettison controls (armament control panel), and the store release and trigger controls (control stick grip), provided the landing gear handle is up or ARM GND SAFETY switch is set to O'RIDE.
	CAMERA	Enables camera or AVTR operation using the gun trigger or weapons release switch.
	SAFE (locked level)	Disables all functions activated by either the ARM or CAMERA position. NOTE Selecting ARM or CAMERA on the master armament switch enables the PAC function of EAC providing all other PAC requirements are satisfied (refer to TO 1A-10A-1).
EO PWR switch		Controls the application of power from the DC armament bus for the following functions.
	ON	Applies three-phase aircraft power to all seeker gyros (AGM/TGM-65 missiles). Also enables the following controls/switches: a. Track b. Missile reject/uncage c. Missile video polarity (track mode)

Figure I-28. Armament Control Panel (Sheet 3 of 10).

CONTROL OR INDICATOR	POSITION OR DISPLAY	FUNCTION
EO PWR switch (Cont)	OFF	Removes electrical power from the AGM/TGM-65 missiles gyros.
	RESET	Not used.
PNL LTS		Controls the variable lighting (OFF control knob through MAX bright) of the armament control panel, HUD control panel, TISL control panel, and TV monitor control panel information placard.
RDS REM (ROUNDS REMAINING) digital display (GAU-8/A)		Manually set display corresponds with the number of rounds of ammunition loaded in the ammunition drum. Indicates depletion in 10-round decrements.
RESET control knob		Resets ammunition rounds remaining display.
GUN RATE switch (GAU-8/A)	HI	Selects gun firing rate of 3900 rounds per minute.
	SAFE	Disconnect trigger circuit from the gun system and safes the gun.
RELEASE MODE/ SELECTIVE JETTISON selector		The release mode/selective jettison selector is the outer dial that surrounds the PUSH TO JETT button. This selector is used to select normal release modes (SGL, PRS, RIP PRS, RIP SGL) where release is accomplished by depressing the weapons release button on the control stick grip, and selective jettison modes (MSL, RACK, STORE) where jettison is accomplished by depressing the PUSH TO JETT button.
	Release mode SGL	One release shall be initiated for each weapons release button depression. Station 8 shall have first release priority with decreasing priority to 4, 11, 1, 10, 2, 9, 3, 7, 6, and 5. When two stations of equal pair priority are selected (e.g., 8 and 4, 11 and 1, 10 and 2, 9 and 3) releases shall alternate between each station of the pair until both are empty or one or both are deselected. Subsequent release shall be from the next highest priority station or pair of stations selected. Station 7 and 5 do not have paired priority and release will be in descending order (e.g., station 7 and then station 5). Should two stations of unequal pair priority be selected (e.g., 8 and 3), releases shall be from the station with the higher pair priority until empty, then the lower pair priority station will release.

Figure I-28. Armament Control Panel (Sheet 4 of 10).

CONTROL OR INDICATOR	POSITION OR DISPLAY	FUNCTION
RELEASE MODE/ SELECTIVE JETTISON selector (Cont)		NOTE Anytime the MASTER ARM, RELEASE MODE, or any one of/both of the WEAPONS STATION select switches is/are SAFED/turned OFF or deselected and reselected, the priority will revert to the highest priority station.
	Release mode PRS	One release shall be initiated from each station of a selected priority pair for each weapons release button depression, following the same priority sequence as for the SGL mode. Should two stations be selected that are not of equal pair priority (e.g., 9 and 4), a single release shall occur from the station with the higher pair priority with each depression of the weapons release button. This logic will continue until the stations are empty or deselected.
	Release mode RIP SGL	Weapon release is similar to SGL mode, except that release pulses are provided by an intervalometer as long as the weapons release button is depressed and the ripple quantity selected has not been exceeded. When HDGP is in the store select display, RIP SGL is the same as for LDGP, except for two release inhibit circuits, which are activated when the mechanical fuzing selector is in the TAIL or N/T position. These inhibit circuits will terminate the release of subsequent stores, if the pilot attempts to release at less than 130 msec from paired stations that are ready, or at less than 250 msec from nonpaired stations. The system will not allow HDGP bombs to be released from the same station at less than 250 msec. Neither will the ACS allow sequencing at less than 250 msec to the next lower priority station, unless that station has a paired station and that paired station is also ready. Therefore, the ACS will not allow HDGP releases from or between station 7 and 5 at less than 250 msec. NOTE • RIP SGL release of rockets or flares with paired stations may result in hung munitions, as the ACS may not automatically sequence between pods or dispensers. • The interface of the RIP SGL mode and the LAU-68/-131 intervalometer causes system anomalies and may cause hung rockets.

Figure 1-28. Armament Control Panel (Sheet 5 of 10).

CONTROL OR INDICATOR	POSITION OR DISPLAY	FUNCTION
RELEASE MODE/ SELECTIVE JETTISON selector (Cont)		NOTE - Anytime the MASTER ARM, RELEASE MODE, or any or/both of the WEAPONS STATION select switches is/are SAFED/turned OFF or deselected and reselected, the priority will revert to the highest priority station. - If a pylon-mounted weapon hangs during ripple release, release is inhibited from all lower priority stations until that station is deselected. TER mounted weapons that hang will not inhibit subsequent releases.
	Release mode RIP PRS	Weapon release is similar to PRS mode except that release pulses are provided by an intervalometer as long as the weapons release button is depressed and the ripple quantity of stores selected has not been exceeded. If an odd number of stores has been selected, the system shall provide pulses to release the next higher even quantity of stores when the last two bombs are released from paired stations. If the last two stations with ordnance are nonpaired wing stations, or stations 5, 6, or 7, the actual number of bombs released will be the number in the RIP quantity selector. If an even quantity of stores is selected and stations 5 and 7 are selected along with paired stations, the system will drop available ripple pairs in normal sequence. If priority pairs are not available, the system logic will then release bombs from station 7 and then station 5, in ripple single mode. If RIP PRS is selected, with an even quantity, but a single bomb has been previously released from the highest priority station of the highest priority pair, the system logic will first release the remaining single bomb of the priority pair, then attempt to release the required even number of pairs. Therefore, it is possible to get one more bomb than the quantity selected. When HDGP is in the store select display, RIP PRS is the same as for LDGP except for a 250 msec inhibit circuit, which is activated when the mechanical fuze selector is in TAIL or N/T position. The release inhibit circuit will terminate the release of subsequent stores if the pilot attempts to release at less than 250 msec. NOTE The interface of the RIP SGL mode and the LAU-68/-131 intervalometer causes system anomalies. These anomalies may cause hung rockets.

Figure 1-28. Armament Control Panel (Sheet 6 of 10).

CONTROL OR INDICATOR	POSITION OR DISPLAY	FUNCTION
RELEASE MODE/ SELECTIVE JETTISON selector (Cont)	Selective Jettison MSL	When pushed in, the selective jettison MSL mode applies a release signal to the selected station to launch an AGM-65 missile in an unarmed, unguided mode with each depression of the button. In addition, the EO PWR switch must be set to ON and the station selected. The MASTER armament switch must be in ARM position and the landing gear handle and flap lever must be up. Should paired stations be selected, a simultaneous unarmed, unguided launch of one missile from the right and left stations shall take place. NOTE • AGM-65 missiles cannot be jettisoned from LAU-117 launchers. If jettison is necessary, the LAU-117 must be jettisoned using selective jettison RACK. • AIM-9 missiles cannot be missile jettisoned from the LAU-105 launcher. Only a complete missile station (DRA, launcher, and missiles present) can be jettisoned when the pylon is carted.
	Selective Jettison RACK	Permits jettison of multiple carriage racks from a selected single station or a priority pair of stations with each depression of the PUSH TO JETT button. Should all stations be selected, stations 8 and 4 shall have first release priority upon first actuation with decreasing priority to 11 and 1, 10 and 2, 9 and 3, 7 and 6, then 5 with repeated actuation. Since station 11, 1, 10, and 2 cannot accommodate multiple carriage racks, any store carried on these station will be released in priority sequence should these stations be selected.
	Selective Jettison STORE	Permits jettison of stores (either armed or unarmed) from selected stations in a ripple pairs mode with a single depression of the PUSH TO JETT button. Stores will be jettisoned armed if appropriate fuzing is selected. Station 8 and 4 shall have first release priority, with decreasing priority to 11 and 1, 10 and 2, 9 and 3, 7 and 6, then 5. The interval between pairs jettisoned shall be 250 msec as long as the PUSH TO JETT button is depressed. Selected stations of equal pair priority must be totally depleted of stores before jettison from lower priority stations is initiated. Multiple carriage racks are not jettisoned.

Figure 1-28. Armament Control Panel (Sheet 7 of 10).

CONTROL OR INDICATOR	POSITION OR DISPLAY	FUNCTION
RELEASE MODE/ SELECTIVE JETTISON selector (Cont)	Selective Jettison STORE (Cont)	When a TER, or SUU-20 is carried on the selected stations, depressing the PUSH TO JETT button applies release pulses to the TER or SUU-20 ejector or impulse cartridges. NOTE Jettison will occur in a ripple pairs mode for selected stations with a single depression of the PUSH TO JETT button as long as the button is held depressed. TER's or SUU-20's will be retained because the release pulse is applied to the TER or SUU-20 carts rather than the parent station carts. NOTE Rocket pods or dispensers should not be jettisoned unless the intent is to jettison all TER- mounted pods/dispensers on the selected stations(s). The PUSH TO JETT button should be held in for 2 seconds for each set of pods/dispensers being jettisoned from one TER or pair of TER's. If the RELEASE MODE/SELECTIVE JETTISON switch is set to RACK, STORE, or MSL, the MASTER armament switch is set to ARM, and the station with AIM-9(s) loaded is selected, cooling to that station is turned off. Upon returning to a normal release mode, cooling is reinitiated.
PUSH TO JETT button		RACK - When pushed in RACK jettison mode, a release signal is applied to detonate the pylon bomb rack ejector impulse cartridges of the selected station, or the highest priority pair when more than one station has been selected. STORE - When pushed in and held in STORE jettison mode, release pulses are applied at 250 msec intervals, in priority pair sequence as long as the button is depressed, to the pylon bomb rack ejector impulse cartridges of the selected station(s), except when a TER or SUU-20 is carried on the selected station. Then release pulses are applied to the TER or SUU-20 ejector or impulse cartridges. MSL - When pushed in MSL jettison mode, a release signal is applied to launch an AGM - 65 missile from the selected station in an unarmed, unguided

Figure 1-28. Armament Control Panel (Sheet 8 of 10).

CONTROL OR INDICATOR	POSITION OR DISPLAY	FUNCTION
PUSH TO JETT button (Cont)		mode with each depression of the button. Should paired stations be selected, a simultaneous unarmed, unguided launch of one missile from both right and left stations shall take place. NOTE Selective jettison of other racks, stores, or missiles, affects the AIM-9 system as follows: If the AIM-9 MODE selector is set to SELECT and the MASTER armament switch is set to ARM, and the RELEASE MODE/SELECTIVE JETTISON switch is set to RACK, STORE, or MSL, the SCS will inhibit AIM-9 launch, and ready lights will go out. Under these same conditions, if the weapon station select switch for the station loaded with AIM-9 missiles is depressed, cooling is removed from the missiles.
RIP INTVL-MSEC X 10 selector		Used during ripple release modes. The intervalometer selections are made by setting the two thumbwheel switches in 10 msec intervals within a range of 50 to 990 msec. Any selection of intervals less than 50 msec results in a 50 msec interval. Provides input to LASTE computer for calculation of CCIP/CCRP.
LAMP TEST button	Depressed	Simultaneously causes all armament control panel status displays to come on to check the lamps.
MECH FUZING	NOSE	Activates nose and center on MAU-40/A and MAU-50/A bomb racks. Activates nose solenoids on TER-9/A. The selector must be pulled and rotated to obtain NOSE position.
	TAIL	Activates tail bomb rack or TER arming solenoids.
	N/T	Activates nose, center, and tail bomb rack or nose and tail TER arming solenoids. NOTE Selecting NOSE, TAIL, or N/T determines the value used by the LASTE computer to display minimum range caret/ staple on the HUD with master armament switch in ARM. With master armament switch in SAFE or CAMERA, N/T fuzing is assumed by the LASTE computer regardless of the mechanical fuzing switch setting. The CCIP/CCRP is affected on some weapons, refer to weapons submenu data entry for effect on the CCIP/CCRP.

Figure 1-28. Armament Control Panel (Sheet 9 of 10).

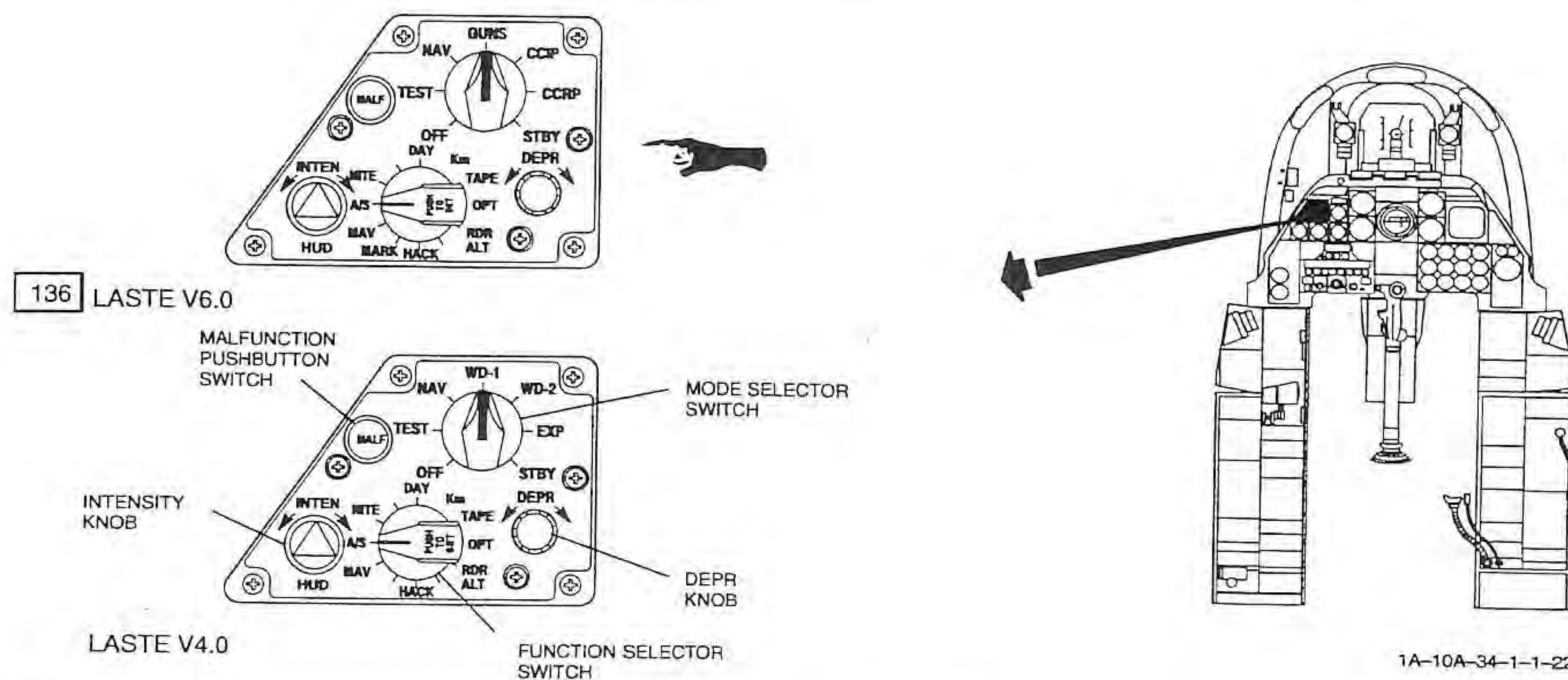
CONTROL OR INDICATOR	POSITION OR DISPLAY	FUNCTION
AIM-9 MODE selector	SEL	Enables AIM-9 seeker and permits arming. NOTE Selects air-to-air mode on HUD and overrides HUD mode selector switch setting. For air-to-air mode information refer to HUD Control Panel descriptions.
	COOL	Cools AIM-9 seeker head.
	OFF	Disable AIM-9 system.
AIM-9 light	ON	Indicates AIM-9 cooling has been initiated.
RIP QTY selector		Two thumbwheel-operated controls select the number of stores to be released in the ripple modes. Control shall be in 1-pulse increments with a range of 0 to 99. The ripple release of stores shall continue until the ripple quantity is reached, all selected stores are expended, or the weapons release button is released, whichever occurs first. The number of stores released shall always equal the number on the ripple quantity selector, except when zero is selected in either the ripple singles or ripple pairs mode, or an odd number is selected in the ripple pairs mode. When zero is selected, one store will be released in the ripple singles mode and two stores will be released in the ripple pairs mode. If an odd number is selected in the ripple pairs mode, the number of stores released shall be one more than the selected quantity provided the last two bombs released are from paired stations. In the event the last two stations with ordnance are non-paired wing station, or station 5, 6, or 7, the actual number of bombs released will be the number in the RIP quantity selector. NOTE Provides input to LASTE computer for calculation of CCIP/CCRP.

Figure 1-28. Armament Control Panel (Sheet 10 of 10).

HUD CONTROL PANEL

The HUD Control Panel (Figure 1-29) is located on the instrument panel above and to the left of the Armament

Control panel. The HUD Control Panel provides switches which include the mode select switch, option select switch, DEPR knob, INTEN knob, and MALF switch. A description of the HUD controls is given in Figure 1-29.



CONTROL OR INDICATOR	POSITION OR DISPLAY	FUNCTION
Mode selector	OFF	The HUD and LASTE system are completely de-energized.
	TEST	In conjunction with the OSP, displays LASTE system MAIN MENU and submenus, and provides for data entry into the LASTE computer (normal). Provides visual self test displays of HUD symbology (options A, B, and C.)
	NAV	Used during normal point-to-point flight. The flight path ladder rotates around the total velocity vector to display roll in all modes. There are five NAV mode displays, normal, option A, option B, option C, and HARS, which contain navigation information, but no weapon delivery symbology.
	WD-1 (V4.0) GUNS (V6.0)	In conjunction with the LASTE system, displays symbology for air-to-ground gun and Maverick delivery. There are five WD-1(V4.0), (GUNS V6.0), mode displays: normal, option A, option B, option C, and HARS.
	WD-2 (V4.0) CCIP (V6.0)	Primary mode for bomb and rocket delivery. There are five WD-2 (CCIP V6.0) mode displays: normal, option A, option B, option C, and HARS. The HARS mode provides the same symbology as WD-1 (GUNS V6.0), mode (HARS), and also provides reticle eyebrows. In LASTE V6.0, it has the ability to compress the weapon delivery symbology's position on the HUD by a factor of 1.7 or 3.0.

Figure 1-29. HUD Control Panel (Sheet 1 of 3).

CONTROL OR INDICATOR	POSITION OR DISPLAY	FUNCTION
Mode selector (Cont)	EXP (V4.0) CCRP (V6.0)	EXP (V4.0) is WD-2 with the capability to expand the HUD to 1.7/3.0 compression factors. Target designation capability is available with the depressible pipper or maverick symbol. CCRP (V6.0 display symbology has the same designation capability as EXP (V4.0).
Mode selector (Cont)	STBY	Used as a backup or emergency mode in the event of a cathode ray tube (CRT) or associated electronics malfunction. When STBY mode is selected, a separately generated, manually depressible reticle and mil depression readout are provided. This reticle is depressible over the same range as that available in primary weapon delivery mode. STBY mode receives power from the dc armament bus, and becomes active 6 seconds after selection.
AIM-9 switch (armament control panel)	NAV, WD-1, WD-2, or EXPAND(V4.0) NAV, GUNS, CCIP, or CCRP(V6.0)	NOTE Air-to-air mode selected by placing the AIM-9 switch on armament control panel to SEL. The air-to-air mode provides the same symbology as NAV mode with the addition of the Funnel, MRGS, AIM-9 Seeker, AMIL, and FEDS.
DEPR knob		Enable depressible pipper/reticle and standby aiming reticles to be manually depressed over a range of +10 to -300 mil referenced to the ZSL.
Option selector switch	NITE	Energizes a motor-driven roller mechanism which draws a red plastic film from across the lens of the projection unit, which serves as a filter during night operations.
	DAY	Energizes a motor-driven roller mechanism which withdraws the red plastic film across the lens of the projection unit for day operations.
	Km	Toggles the distance to go display between kilometers and nautical miles and target elevations between feet and meters (M).
	TAPE	Toggles the airspeed and altitude displays between tape and numerics.
	OPT	Provides three optional symbol display sets: A, B, C, which add or subtract symbols. Depressing the knob once selects option A, depressing twice selects option B, depressing three times selects option C, and depressing again, returns display to normal.
	RDR ALT	Toggles radar altitude scale on and off. Scale will be displayed when aircraft is below 1500 feet AGL ascending or below 1200 feet AGL descending if HUD altitude/airspeed tapes are not selected.

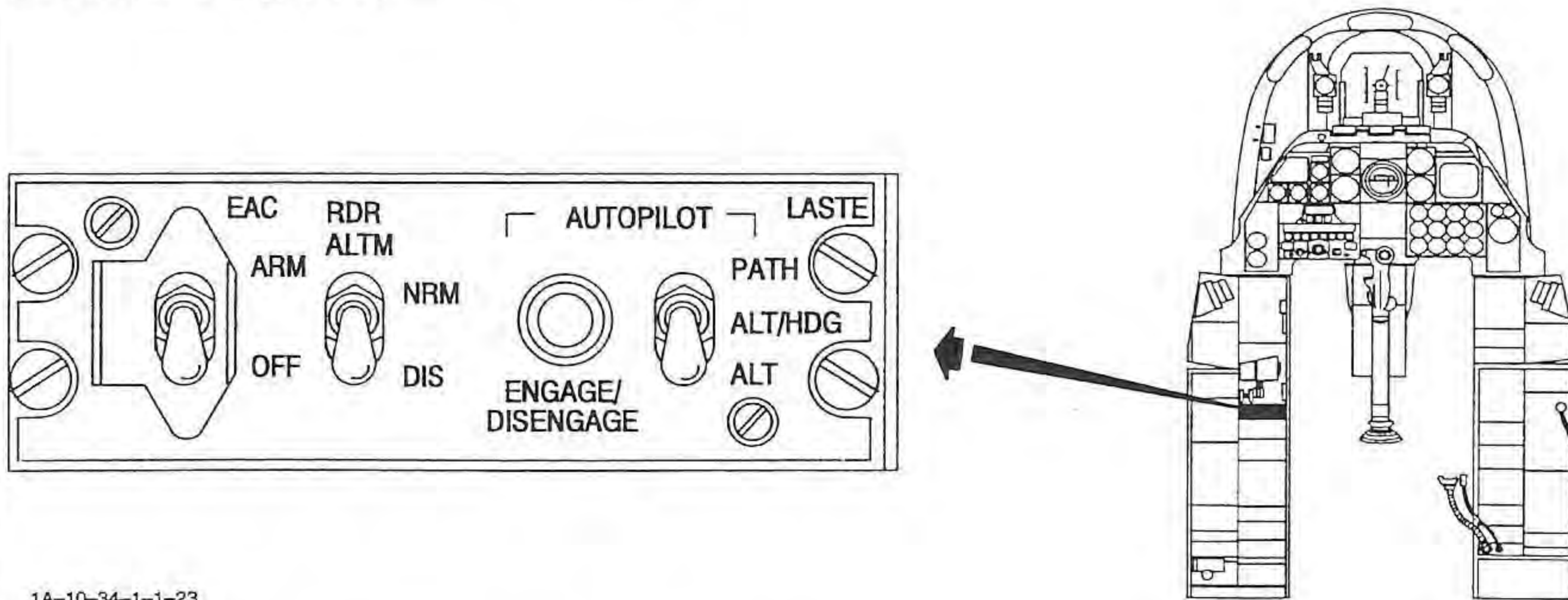
Figure 1-29. HUD Control Panel (Sheet 2 of 3).

CONTROL OR INDICATOR	POSITION OR DISPLAY	FUNCTION
Option selector switch (Cont)	HACK	Depressing the switch once enters HACK mode and displays previously entered HACK Time-on-target.
	MARK (LASTE V6.0)	For GPS and non-GPS aircraft, with the switch in this position, momentarily depressing the <u>switch</u> enters/exits the HUD UPDATE mode. When in the HUD UPDATE mode, depressing the <u>nosewheel steering button</u> for <u>less</u> than 1/2 second causes an INS HUD update to be performed. In a GPS aircraft, rotating the switch to this position (without depressing it) will allow the generation of an offset markpoint in the CDU. If the NWS button is depressed for less than 1/2 second (or the switch is moved to this position with a target already designated), the LASTE will send the target designation coordinates to the CDU for storage as a markpoint.
	A/S	Depressing the switch once will display the true airspeed with a 'T' to the right of the airspeed or tape pointer. Depressing the switch again will display ground speed with a 'G' to the right of the airspeed or tape pointer. Depressing the switch again will return the display to indicated airspeed.
	MAV	Used to boresight the Maverick symbol on the HUD. Depressing the switch with any maverick called up aligns the maverick symbol with the depressible pipper. CAUTION It is possible to perform an inadvertent Maverick boresight if the Maverick is called up and the option selector Switch is depressed in the DAY, NITE, or SPARE (5 o'clock) positions.
INTEN knob	Adjustable	Permits continuous control of brightness for both primary and standby symbology. Fully CW is maximum intensity, fully CCW extinguishes all symbology.
MALF warning light	ON	Indicates projection display unit malfunctions. When pressed, the light will go off and the LASTE system will perform an internal reset to clear any latched faults. The BIT fault codes will remain for post-flight evaluation. If the light remains off, the malfunction is resolved. If the failure persists, the light will come on again.
MALF warning pushbutton	Press	Independent of the warning light, pressing this button restores LASTE operations after intermittent faults are logged which affect a LASTE subsystem. If the fault reappears, the applicable subsystem will again be disabled.

Figure I-29. HUD Control Panel (Sheet 3 of 3).

LASTE CONTROL PANEL

The LASTE control panel is located on the left console. The controls and indicators on the LASTE control panel are described in Figure 1-30.



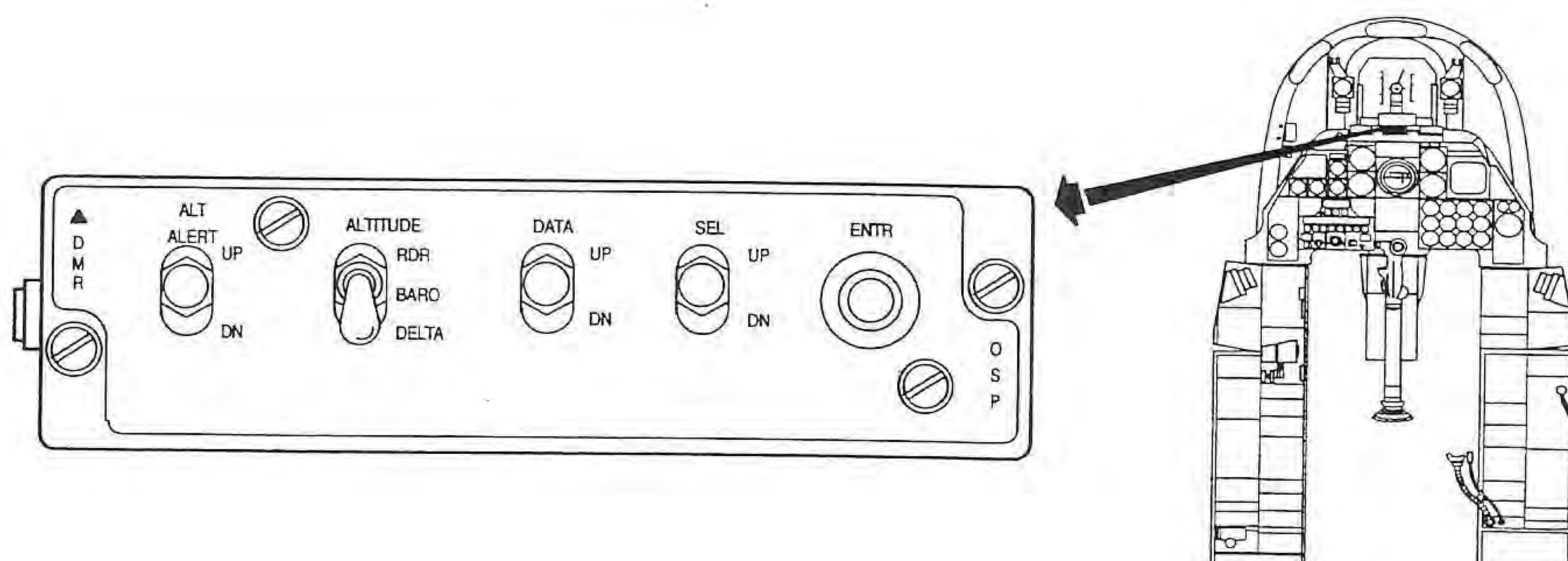
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CONTROL OR INDICATOR	POSITION OR DISPLAY	FUNCTION
EAC switch	OFF	Disables EAC function of LASTE system, and causes the EAC caution light on the caution light panel to be illuminated.
	ARM	Enables EAC function of LASTE system. INS or EGI (LASTE V6.0 136 GPS) needs to be in NAV, and NAV CRS, or EGI (LASTE V6.0 136 GPS) needs to be selected on the Navigation Mode select panel to allow arming. The switch is held in ARM position by a latching coil. The switch will reset to OFF for any of the following: - An invalid signal is received by the LASTE computer from the CADc, INS, EGI (LASTE V6.0 136 GPS) or SAS - Pitch and yaw SAS switches disengage - An internal LASTE BIT fails - If the Emergency Disconnect Lever is engaged.
RDR ALTM switch	DIS	Disables radar altimeter and GCAS.
	NRM	Enables radar altimeter to provide altitude signals to the LASTE computer.
AUTOPILOT (push-button) switch	ENGAGE/DISENGAGE	Turns on/off selected autopilot function in the LASTE computer.
AUTOPILOT (three-position) switch	PATH	Selects path hold mode to fly the aircraft along a straight path without pilot control inputs.
	ALT/HDG	Selects ALT/HDG hold mode to fly the aircraft at constant altitude and heading without pilot control inputs.
	ALT	Selects ALT/BANK hold mode to fly the aircraft at a constant altitude and bank angle. Lateral control stick inputs allow the pilot to change the bank angle

Figure 1-30 . LASTE Control Panel.

OPTION SELECT PANEL (OSP)

The OSP is located on the glareshield. The controls and indicators on the OSP are described in Figure 1-31.



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CONTROL OR INDICATOR	POSITION OR DISPLAY	FUNCTION
DMR control knob	Adjustable	Controls brightness of panel lights.
ALT ALERT switch	UP/DN	Adjusts altitude alert setting (audio warning). Altitude alert is displayed on the HUD when switch is activated, and displays for 4 seconds after switch is released. The altitude advances in 10 foot increments from zero to 500 feet, and 100 foot increments from 500 to maximum setting. For MSL the maximum setting is 45,000. For AGL the maximum setting is 5,000 feet.
ALTITUDE switch	RDR	Selects radar altimeter as altitude source for CCIP/CCRP, Maverick, and EXPAND(V4.0), (CCRP(V6.0)) Modes and TDC range computations. (See Altitude Source section in Section I, Part 1 of this T.O.).
	BARO	Selects barometric reference altitude as altitude source for CCIP/CCRP, Maverick, and EXPAND(V4.0), (CCRP(V6.0)), Modes, and TDC range computations. (See Altitude Source section in Section I, Part 1 of this T.O.).
	DELTA	Selects pressure altitude referenced from a radar or GPS (LASTE V6.0 [136] GPS) update as altitude source for CCIP/CCRP, Maverick, and EXP(V4.0), (CCRP(V6.0)) Mode TDC range computations. (See Altitude Source section in Section I, Part 1 of this T.O.).

Figure 1-31. Option Select Panel (Sheet 1 of 3).

CONTROL OR INDICATOR	POSITION OR DISPLAY	FUNCTION
DATA switch	UP/DN	Use in conjunction with the HUD control panel as follows: TEST mode - alters data to be subsequently entered from submenus and display on HUD. NAV, WD-1, WD-2, EXP(V4.0), (GUNS, CCIP and CCRP(V6.0)), and Air-to-Air modes - increments/decrements the target elevation displayed on HUD. HACK TIME mode - adjusts the displayed HACK time interval.
SEL switch	UP/DN	Use in conjunction with the HUD control panel as follows: TEST mode - scrolls the cursor up or down through the main menu and submenus. NAV mode - Not applicable. WD-1(V4.0), (GUNS(V6.0)) mode - Toggles the gunsight display. WD-2 and EXP(V4.0), (CCIP, CCRP(V6.0)) modes - Cycles through selected weapons and escape maneuver. Air-to-Air mode - Toggles between rotary wing (RTY) and fixed wing (FXD) displays. ALT Alert displayed - Toggles between AGL and MSL after ALT ALERT switch has been toggled. DELTA Altitude calibration displayed - toggles between GPS (LASTE V6.0 [136] GPS only) and radar based calibrations after ENTR button has been pressed
ENTR button		Use in conjunction with the HUD control panel as follows: NOTE Depressing ENTR button with the cursor at EXIT will cause a return to the next item in the MAIN MENU. TEST mode, option Normal - Used to bypass SAS check in preflight BIT, acknowledge faults or queries during BIT checks. TEST mode, option normal is also used in conjunction with the cursor in the MAIN MENU, to select MAIN MENU options. In the ELEV/TIME submenu - While setting a steerpoint elevation, depressing the ENTR button will select the next field to be changed. While setting CUR TIME, depressing the ENTR button will select the next field to be changed and start the clock. Depressing the ENTR button with the cursor at CLEAR will reset all steerpoint elevation, time, or both depending on the selection made with the DATA UP/DN switch.

Figure 1-31. Option Select Panel (Sheet 2 of 3).

CONTROL OR INDICATOR	POSITION OR DISPLAY	FUNCTION
ENTR button (Cont)		In WEAPONS submenu - Depressing the enter button with the cursor at WPN CLEAR will deselect all weapon types (except 30mm). Depress enter button at any of the individual weapon names will bring up that individual weapon submenu. Individual Weapon Submenus - Depressing enter button with the cursor at STORE will select that weapon in the weapon submenu and cause a return to the WEAPONS submenu. Depressing the ENTER button with the cursor at CANCEL will deselect the weapon in the WEAPONS submenu and cause a return to the WEAPONS submenus. NAV, (WD-1, WD-2(V4.0)), GUNS, CCIP(V6.0)), Air-to-Air modes - Used to store a local correction factor for barometric altitude in the LASTE computer for optional use during subsequent weapon deliveries in delta mode. Depressing the ENTR button displays delta value with a D appended on the end and the MSL radar altitude with an R appended on the end (LASTE V4.0) or the MSL GPS altitude with a G appended on the end (LASTE V6.0 136 GPS only) in the center of the HUD. The radar and delta values are displayed on the HUD for 10 seconds. In LASTE V6.0 136 GPS, the OSP SEL switch can be used to select the display of either the GPS MSL altitude and its delta value or the radar MSL altitude and its delta value. If ENTR is depressed again within 10 seconds, the values will flash for 2 seconds to acknowledge storage of the displayed values into the LASTE computer for delta altitude computations in DELTA mode, otherwise the data will not be stored and previous delta values will be used. Stores hot elevation in the current steerpoint elevation if pushed within 10 seconds after changing hot elevation with data switch or performing an overfly mark. WPN Rel Data submenu - Depressing enter changes the page being displayed or exits the submenu. HACK mode - Displays time remaining in the HACK.

Figure 1-31. Option Select Panel (Sheet 3 of 3)

LASTE MODES AND HUD DISPLAY SYMBOLOGY

The LASTE system provides HUD displays for four weapon delivery modes along with NAV, STBY, and TEST modes. The weapon delivery modes include (WD-1 WD-2, EXP(V4.0)), (GUNS, CCIP, CCRP(V6.0)), and Air-to-Air. The HUD provides a variety of symbols and alphanumerics in each of these modes for various uses. The HUD display symbology matrices (Figure 1-32 for LASTE V4.0; Figure 1-34 for LASTE V6.0 [136]) list the symbols that can be displayed in each mode for various display options selected including HARS. Also included is a list of notes that explain unique characteristics for certain symbols. Symbols with notes are identified by a number in parenthesis next to the symbol name.

A mode is selected by turning the mode select switch on the HUD Control Panel (HCP) to the appropriate mode location. The HUD options (normal, A, B, and C) are selected using the option selector switch also located on the HCP. For a detailed explanation of what each option does, refer to the HUD control panel description. The HARS option is selected by depressing the HARS switch indicator located on the navigation mode select panel. For further information on the HARS system refer to T.O. 1A-10A-1.

The following paragraphs provide a brief explanation of the modes. Typical displays (Figure 1-33 for LASTE V4.0; Figure 1-35 for LASTE V6.0 [136]) for NAV, TEST, STBY and the weapon delivery modes are shown for the various options (normal, A, B, C, and HARS). A complete description for all of the symbology displayed in the figures is contained in T.O. 1A-10A-1.

Navigation Mode

The navigation mode provides the pilot with data presented on the HUD pertaining to aircraft state, including airspeed, altitude, heading, and velocity vector information.

Specifically, the LASTE computer uses angular rate sensor data, removes sensor errors due to known lag characteristics in the INU or EGI (Figure 1-36 LASTE V6.0 [136] GPS only) data output, and variable drift rate bias in the sensors to estimate the aircraft state. The computer also provides an estimate of airspeed velocity vector using the angle of attack, angular rate, acceleration, and aerodynamic data. Local wind is determined by the computer as the difference between inertial and airspeed velocity. The enhanced attitude control system closes the loop between the aircraft sensors and the flight controls to provide altitude/bank, path, and altitude/heading hold functions.

WD-1 Mode(V4.0), GUNS Mode(V6.0)

WD-1 (GUNS(V6.0)) mode is primarily an air-to-ground gun mode that uses the INS, CADC, radar altimeter, SAS, and HUD systems to compute and display the appropriate CCIP gun solution. When the gun trigger is depressed to the second detent, the positions of the bullet impacts on the

ground [Bullets At Target Altitude (BATA)] are generated by the simulated bullet function, and are displayed at the computed time of ground impact on the HUD. The CCIP gun reticle and BATA symbology are displayed in addition to the navigation displays. WD-1 (GUNS(V6.0)) mode also contains a depressible pipper limited to the centerline of the HUD for use in boresighting AGM/TGM-65 missiles.

NOTE

If Auto Data display is selected (via test menu) and the bullet TOF is greater than 2 seconds BATA will not be displayed.

WD-2 Mode(V4.0), (CCIP Mode(V6.0))

WD-2 (CCIP(V6.0)) mode is primarily an air-to-ground bomb mode. A simultaneous air-to-ground gunnery solution with option for PAC is also provided. Selection of a particular set of bomb ballistics data is made using the Option Selection Panel (OSP) menu. The data is channeled to the ballistics algorithm, which determines the bomb impact point. The CCIP solution is displayed on the HUD.

EXPAND Mode(V4.0), (CCRP Mode(V6.0))

EXPAND (CCRP(V6.0)) mode adds the capability to perform blind deliveries with a CCIP solution by using target position data from the TISL, or a LASTE computed Target Designation Cue (TDC). In LASTE V6.0 [136] a CCRP capability has been added.

Air-to-Air Mode

In this mode low-aspect lead angles are defined by the Funnel, and beam-aspect lead angles are defined by the Multiple Reference Gun Sight (MRGS). Both gunsights utilize stadiametric ranging. The mode also incorporates FEDS for dry-fire training and post-flight evaluation of air-to-air gunnery performance.

Test Mode

The test mode is initiated when the pilot selects TEST on the HUD control panel. The test mode normal option displays the option select main menu, which allows the pilot to select submenus, enter data on the submenu using the OSP, or run initiated self-tests of the LASTE system and display the results on the HUD.

Standby Mode

The standby mode provides a standby reticle display on the HUD. The standby reticle is a manually depressed aiming reticle ring and pipper, generated independently of the LASTE computer in the HUD projection unit by means of a lamp and optics. The standby reticle is provided as a mechanical backup in the event of a computer failure. The standby mode will show a pipper depressed 14 to 20 mils greater than the setting selected using LASTE. If the failure does not cause an invalid GCAS solution, the GCAS remains operational in the standby mode. Autopilot function remains available in the standby mode.

HUD Display Symbology Matrix (LASTE V4.0)

SYMBOLS	SYMBOLGY SELECTION MATRIX																			
	NAV					WD-1					WD-2					EXPANDED				
	NORMAL	OPTION A	OPTION B	OPTION C	HARS	NORMAL	OPTION A	OPTION B	OPTION C	HARS	NORMAL	OPTION A	OPTION B	OPTION C	HARS	NORMAL	OPTION A	OPTION B	OPTION C	HARS
AIM-9 SEEKER																				
AIRSPED NUMERIC/TAPE	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
ALTITUDE ALERT	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
ALTITUDE DELTA	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
ALTITUDE NUMERIC/TAPE	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
ALTITUDE SOURCE (1)						X	X	X			X	X	X			X	X	X	X	X
AMIL																				
BATA (2)(3)						X	X	X		X	X	X		X	X	X		X		
CCIP BOMB RETICLE											X	X	X			X	X	X		
CCIP GUN CROSS (4)						X	X	X			X	X	X			X	X	X		
CCIP GUN RETICLE						X	X	X											X	
CCIP INVALID						X	X	X			X	X	X			X	X	X		
COMPRESSION FACTOR																X	X	X		
DEPRESSIBLE PIPPER/RETICLE (5)						X	X	X	X	X				X	X	X	X	X	X	X
DEPRESSION READOUT					X	X	X	X	X	X				X	X					
DESIRED RELEASE CUE (6)											X	X	X			X	X	X		
DESTINATION INDEX (7)	X	X		X		X	X		X		X	X		X		X	X		X	
DISTANCE TO GO, M/K	X	X		X		X	X		X		X	X		X		X	X		X	
EAC MESSAGES (8)	X	X	X	X		X	X	X	X		X	X	X	X		X	X	X	X	
EVENT MARKER						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
FEDS (3)																X	X	X	X	X
FIXED GUN CROSS (9)									X	X				X	X					
FLIGHT PATH ANGLE NUM (1)	X	X	X	X		X	X	X	X		X	X	X	X		X	X	X	X	
FLIGHT PATH LADDER (1)	X	X		X		X			X		X			X		X			X	
FUNNEL																				
GBL CROSS (10)						X	X	X			X	X	X			X	X	X	X	
GCAS BREAK-X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
HEADING TAPE (11)(1)	X	X		X		X			X		X			X		X			X	
HUD OPTION	X	X	X	X		X	X	X	X		X	X	X	X		X	X	X	X	
INVALID FUZING											X	X	X			X	X	X		
MARKPOINT ELEVATION	X	X	X	X		X	X	X	X		X	X	X	X		X	X	X	X	
MAVERICK SYMBOL (12)						X	X	X			X	X	X			X	X	X		
MIN RANGE CARET (6)											X	X	X			X	X	X		
MINIMUM RANGE STAPLE (6)											X	X	X			X	X	X		
MRGS																				
OPTION SELECT MENU																				
PBIL (6)											X	X	X			X	X	X		
PITCH NUMERIC					[X]					[X]					[X]					[X]
RADAR ALTITUDE NUMERIC	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
RADAR ALTITUDE SCALE (13)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
RETICLE EYEBROWS (14)																				
ROLL BARS (15)					X					X										
STEERPOINT	X	X		X		X	X		X		X	X		X		X	X		X	
TARGET ELEVATION	X	X	X	X		X	X	X	X		X	X	X	X		X	X	X	X	
TARGET DESIGNATION CUE																X	X	X		
TGT DES BOX (16)	X	X		X		X	X		X		X	X		X		X	X		X	
TIME ON TARGET	X	X		X		X	X		X		X	X		X		X	X		X	
TISL DIAMOND (17)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
TVV (7)	X	X	X	X		X	X	X	X		X	X	X	X		X	X	X	X	
TWO-BAR FLT PATH LAD						X	X				X	X				X	X			
VERT VELOCITY SCALE		X		X												X	X			
WEAPON SELECT (18)											X	X	X			[X]	[X]	[X]		[X]

[X] Indicates displayed data is boxed.

NOTE: In standby mode a depression readout and pipper are displayed on the HUD.

1A-10A-34-1-1-25

Figure 1-32. HUD Display Symbology Matrix (LASTE V4.0) (Sheet 1 of 4).

NOTES:

- (1) IF THE LASTE SYMBOL GENERATOR ENCOUNTERS A WORSE CASE DISPLAY FORMAT DURING NORMAL OPERATION (NO TRANSIENT SYMBOLOGY) AND IS UNABLE TO DRAW ALL OF THE SELECTED SYMBOLOGY IN THE CURRENT FRAME TIME, IT WILL AUTOMATICALLY DETECT THIS DRAWING OVERFLOW AND WILL BLANK THE UNFINISHED OR UNDRAWN SYMBOLS UNTIL CONDITIONS INDICATE THAT THOSE SYMBOLS CAN AGAIN BE DRAWN COMPLETELY. THE FOLLOWING LOW PRIORITY SYMBOLOGY WILL BE BLANKED DURING ANY DRAWING OVERFLOWS IN THE ORDER SHOWN BELOW: (NOTE: BLANKING OF THE SYMBOLOGIES MAY OCCUR IN PAIRS.)
- | | |
|----------------------------------|-----|
| HDG TAPE SCALE | 1ST |
| ALTITUDE SOURCE | 2ND |
| FLIGHT PATH ANGLE NUMERIC | 3RD |
| REPLACE FLIGHT PATH LADDER | 4TH |
| WITH TWO BAR FLIGHT PATH LADDER | |
- (2) DISPLAYED AFTER GUN TRIGGER IS PRESSED TO 2ND DETENT AS FUNCTION OF BATA ALGORITHM.
- (3) FOR THE MANUAL HARS OPTION (INU IS VALID) BATA, FEDS, AND PREDICTED GCAS WARNINGS (BOTH AURAL AND FLASHING BREAK-X) ARE PROVIDED. IN AUTOMATIC HARS (INU INVALID), IF THE RADAR ALTIMETER IS VALID, AN AURAL ALTITUDE ALERT WARNING IS STILL PROVIDED, BUT GCAS WARNING (BOTH AURAL AND FLASHING BREAK-X) ARE NOW ONLY PROVIDED FOR A HARD PENETRATION OF THE 90 FT GROUND PLANE.
- (4) OCCULTATION WINDOW AROUND CCIP GUN CROSS IS +/- 12 MILS IN AZIMUTH AND +15/-12 MILS IN ELEVATION.
- (5) A PIPPER IS DISPLAYED IN THE CENTER OF A 25 MIL DIAMETER DASHED CIRCLE.
- (6) DELETED WHEN RKTS ARE SELECTED.
- (7) WILL BE OCCULTED INSIDE 12 MILS OF CCIP GUN CROSS OR CCIP GUN RETICLE (INSIDE 10 MILS OF FIXED GUN CROSS OR 18 MILS OF CCIP BOMB PIPPER), OCCULTATION IS PILOT SELECTABLE IN WD-2 MODE.
- (8) DISPLAYS PATH HLD, ALT HLD, OR ALT/HDG, AS SELECTED FOR ALL MODES EXCEPT TEST. IN TEST MODE, ALT HLD IS DISPLAYED IN OPTION A.
- (9) ONLY APPEARS WHEN DEPRESSIBLE PIPPER IS 50 MILS OR GREATER, EXCEPT IN AIM-9/HARS (ALWAYS DISPLAYED IN AIM-9/HARS).
- (10) IN THE WD-1 MODE THE GBL CROSS IS OCCULTED BY THE CCIP GUN CROSS. THE GBL CROSS IS OCCULTED BY THE CCIP GUN CROSS AND THE CCIP BOMB RETICLE IN WD-2 AND EXP MODES.
- (11) WILL BE DELETED INSIDE 12 MILS OF DEPRESSIBLE PIPPER (OCCULTED INSIDE 18 MILS OF CCIP BOMB PIPPER).
- (12) DISPLAYED ONLY WHEN AGM-65/TGM-65 IS CALLED UP ON THE TV MONITOR. IN WD-2 AND EXP MODES, DELETE CCIP BOMB RETICLE, PBIL, MRS, AND DRC WHEN MAVERICK SYMBOL IS DISPLAYED.
- (13) ONLY DISPLAYED IF AIRSPEED/ALTITUDE TAPES ARE NOT SELECTED, BELOW 1500 FEET ASCENDING OR 1200 FEET AGL DESCENDING, AND RDR ALT SELECTED ON THE HCP.
- (14) ONLY APPEARS WHEN DEPRESSION IS 100 MILS OR GREATER.
- (15) FOR AIM-9/HARS MODE, THE ELEVATION POSITION OF THE ROLL BAR IS DETERMINED BY THE MANUAL DEPRESSED VALUE, EVEN THOUGH THE DEPRESSION READOUT AND DEPRESSIBLE PIPPER/RETICLE ARE NOT DISPLAYED.
- (16) TD BOX APPEARS ONLY WHEN DESTINATION INDEX IS IN FOV AND STEERPOINT ELEVATION HAS BEEN ENTERED. THE TD BOX IS NOT PRESENT IF TISL DIAMOND OR TDC IS DISPLAYED.
- (17) ONLY APPEARS WITH TISL LOCK-ON FOR MODES OTHER THAN TEST, AND NOT PRESENT WHEN AIM-9 IS SELECTED.
- (18) IN AIM-9 MODE, DISPLAYS FXD OR RTY FOR FIXED OR ROTARY WING. IN WD-2 AND EXP MODES, THE RKTS DISPLAY FORMAT IS "RKT1 S10", RIGHT JUSTIFIED.

Figure I-32. HUD Display Symbology Matrix (LASTE V4.0) (Sheet 2 of 4).

Symbol Names	LASTE Symbology Size (V4.0)		HUD Position (V4.0)	
	Azimuth [mils]	Elevation [mils]	Azimuth [mils]	Elevation [mils]
AIM-9 Seeker Circle	15	15	Dynamic	Dynamic
AMIL	N/A	10	Dynamic	Dynamic
Airspeed Numeric	6.5	7.9	-70	0
Airspeed Tape	35.6	89.5	-74.5	Centered
Altitude Alert	6.5	7.9	Centered	13
Altitude Delta Update	6.5	7.9	Centered	13
Altitude Numeric	6.5	7.9	76.5	0
Altitude Source	5.25	6.3	-70	-89
Altitude Tape	29	89.5	74.5	Centered
BATA	5	5	Dynamic	Dynamic
CCIP Bomb Reticle	50	50	Dynamic	Dynamic
CCIP Gun Cross	20	20	Dynamic	Dynamic
CCIP Gun Reticle	50	50	Dynamic	Dynamic
CCIP Invalid	6.5	7.9	Centered	13
Compression Factor	5.25	6.3	-70	-101.5
Depressible Pipper/Reticle	1 / 25	1 / 25	Centered	Dynamic
Depression Readout	5.25	6.3	-70	-64
Desired Release Cue	10	N/A	Dynamic	Dynamic
Destination Index	6	6	Dynamic	Dynamic
Distance To Go	5.25	6.3	70	-76.5
EAC Messages	5.25	6.3	-70	-89
Event Marker	5.25	6.3	80	102.5
FEDS	Variable	Variable	Dynamic	Dynamic
Fixed Gun Cross	20	20	0	89.6
Flight Path Angle Numeric	6.5	7.9	47 / 76.5	-16
Flight Path Ladder	70	2.5 (Tab)	Dynamic	Dynamic
Funnel	Variable	Variable	Dynamic	Dynamic
GBL Cross	5	5	0	99.2
GCAS Break X	100	100	Centered	Centered
HUD Option	5.25	6.3	-70	-89
Heading Tape	122	24.7	Centered	-112
Invalid Fuzing	6.5	7.9	Centered	13
MRGS	Variable	Variable	Dynamic	Dynamic
Markpoint Elevation	6.5	7.9	Centered	-13
Maverick Symbol	20	20	Dynamic	Dynamic
Min Range Caret	5 mils each side	5 mils each side	Dynamic	Dynamic
Min Range Staple	20	5 (Tab)	Dynamic	Dynamic
Moving Target Index	Variable	5	Dynamic	Dynamic
Option Select Menu	5.25	6.3	Variable	Variable
PBIL	N/A	Variable	Dynamic	Dynamic
Pitch Numeric	6.3	7.9	47 / 76.5	-16
RADAR Altitude Numeric	5.25	6.3	70	-64
RADAR Altitude Scale	N/A	100	50	Centered
Reticle Eyebrows	6	N/A	Dynamic	Dynamic
Roll Bars	70	2.5 (Tab)	Dynamic	Dynamic

1A-10A-34-1-1-26

Figure 1-32. HUD Display Symbology Matrix (LASTE V4.0) (Sheet 3 of 4).

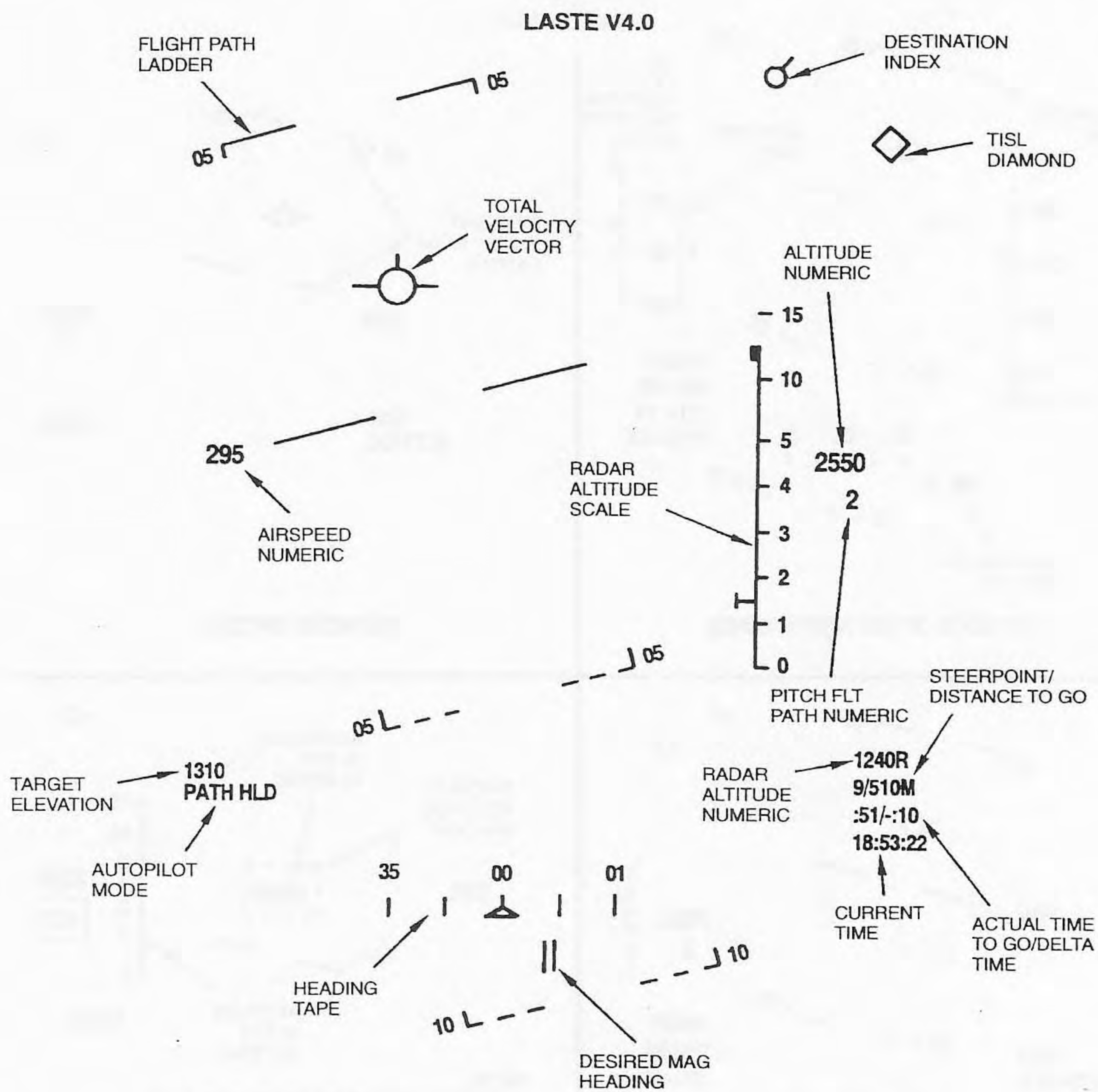
Symbol Names	LASTE Symbology Size (V4.0)		HUD Position (V4.0)	
	Azimuth [mils]	Elevation [mils]	Azimuth [mils]	Elevation [mils]
Steerpoint ID	5.25	6.3	70	-76.5
TD Box	7	7	Dynamic	Dynamic
TISL Diamond	7	7	Dynamic	Dynamic
TVV	10	10	Dynamic	Dynamic
Target Designation Cue	5	5	Dynamic	Dynamic
Target Elevation	5.25	6.3	-70	-76.5
Time On Target	5.25	6.3	70	-89
Two-Bar Flight Path Ladder	70	2.5 (Tab)	Dynamic	Dynamic
Vertical Velocity Scale	-	-	119.5	Centered
Weapon Select	5.25	6.3	-70	-64

Notes:

1. LASTE symbology size is not mode dependent.
2. The table contains symbol sizes; not occultation window sizes.
3. Symbol positions are measured in reference to HUD center.
4. Negative azimuth positions are measured from the y-axis to a point flush with right edge of symbol.
5. Positive azimuth positions are measured from the y-axis to a point flush with left edge of symbol.
6. Elevation positions are measured from the x-axis to a point flush with bottom edge of symbol.
7. Positions of crosses, tapes, and Break-X are measured from x- or y-axis to the centers of the respective symbols.

1A-10A-34-1-1-27

Figure 1-32. HUD Display Symbology Matrix (LASTE V4.0) (Sheet 4 of 4).

**NAV MODE, NORMAL**

1A-10A-34-1-28

Figure 1-33. HUD System Displays (LASTE V4.0) (Sheet 1 of 11).

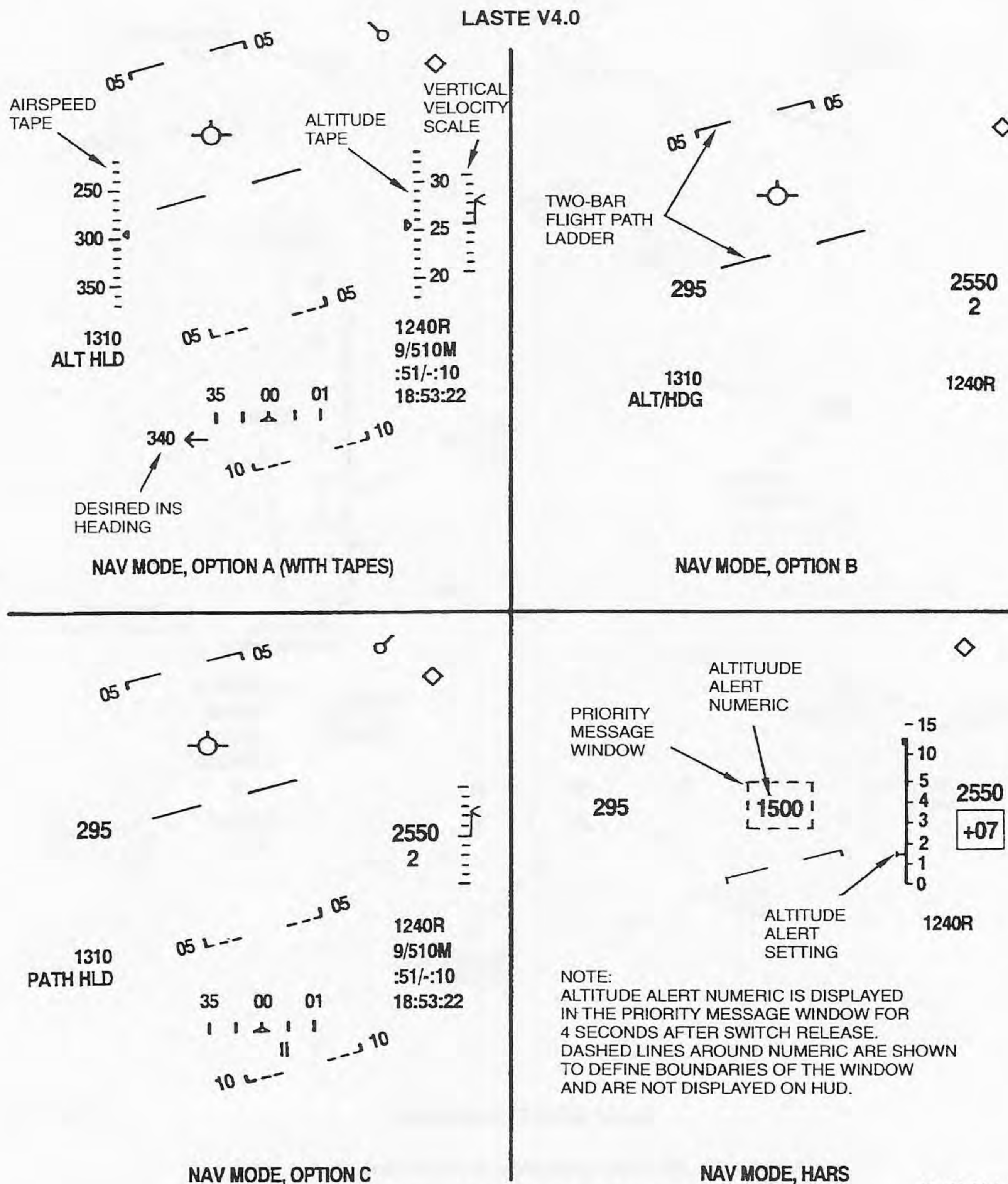
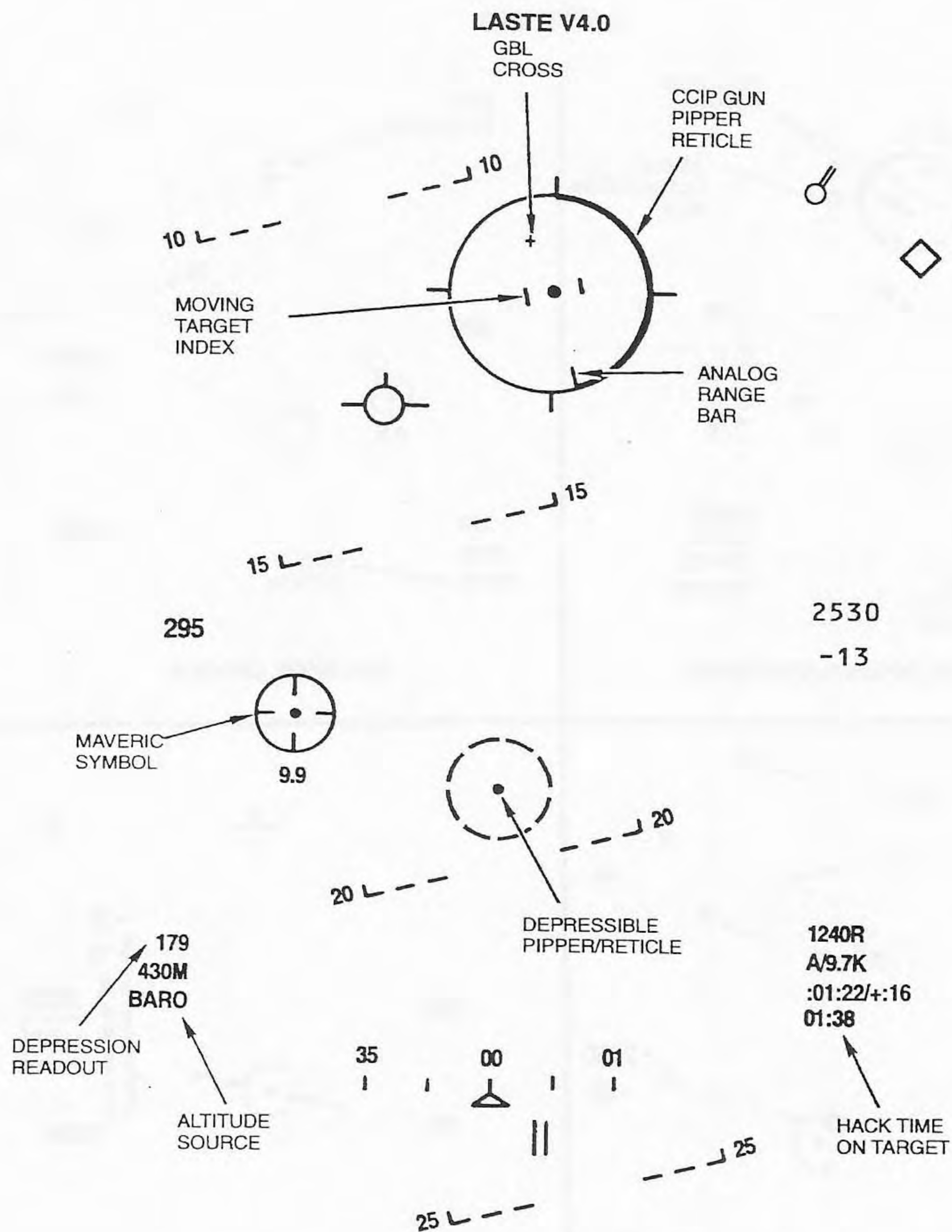


Figure 1-33. HUD System Displays (LASTE V4.0) (Sheet 2 of 11).

1A-10A-34-1-1-29

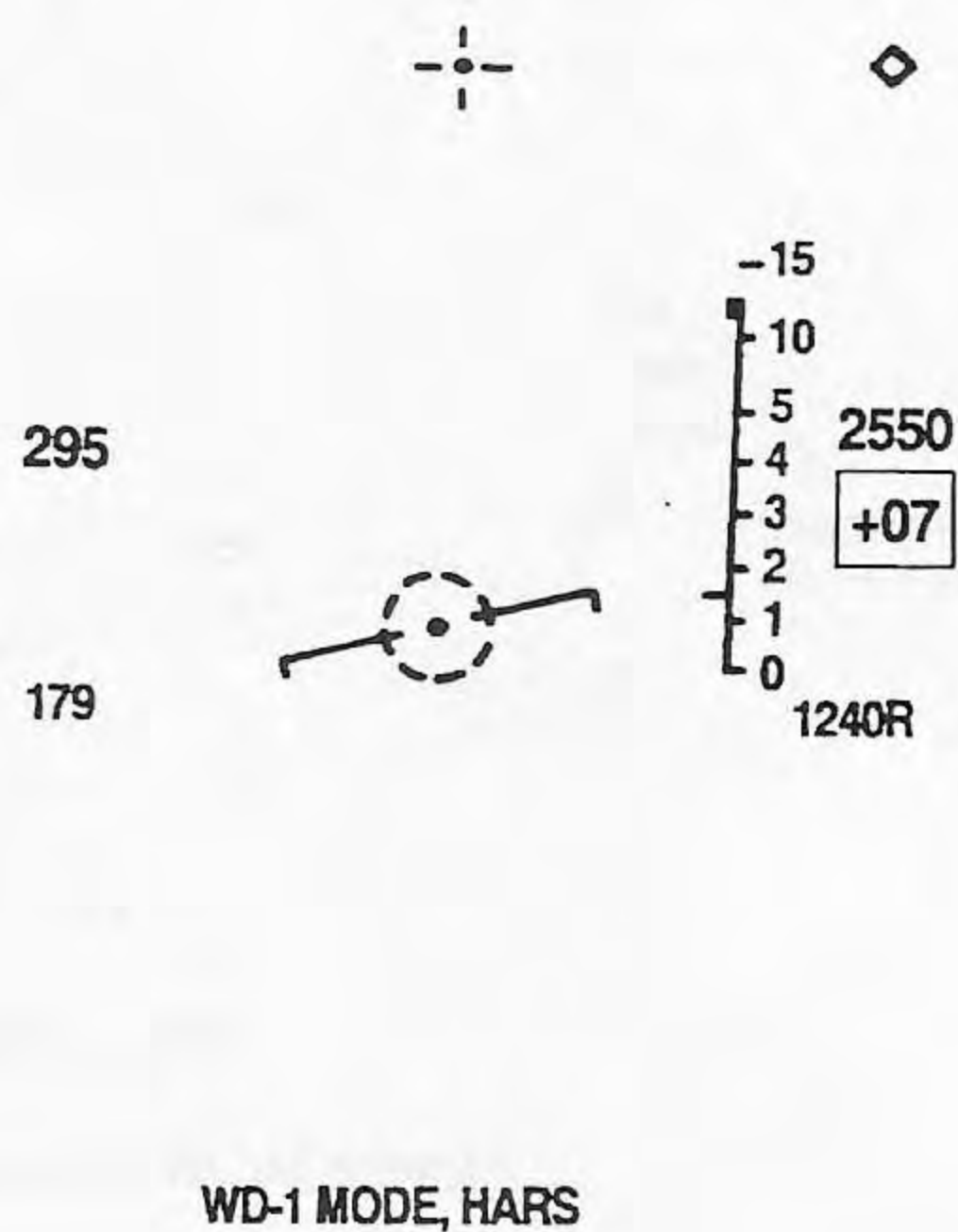
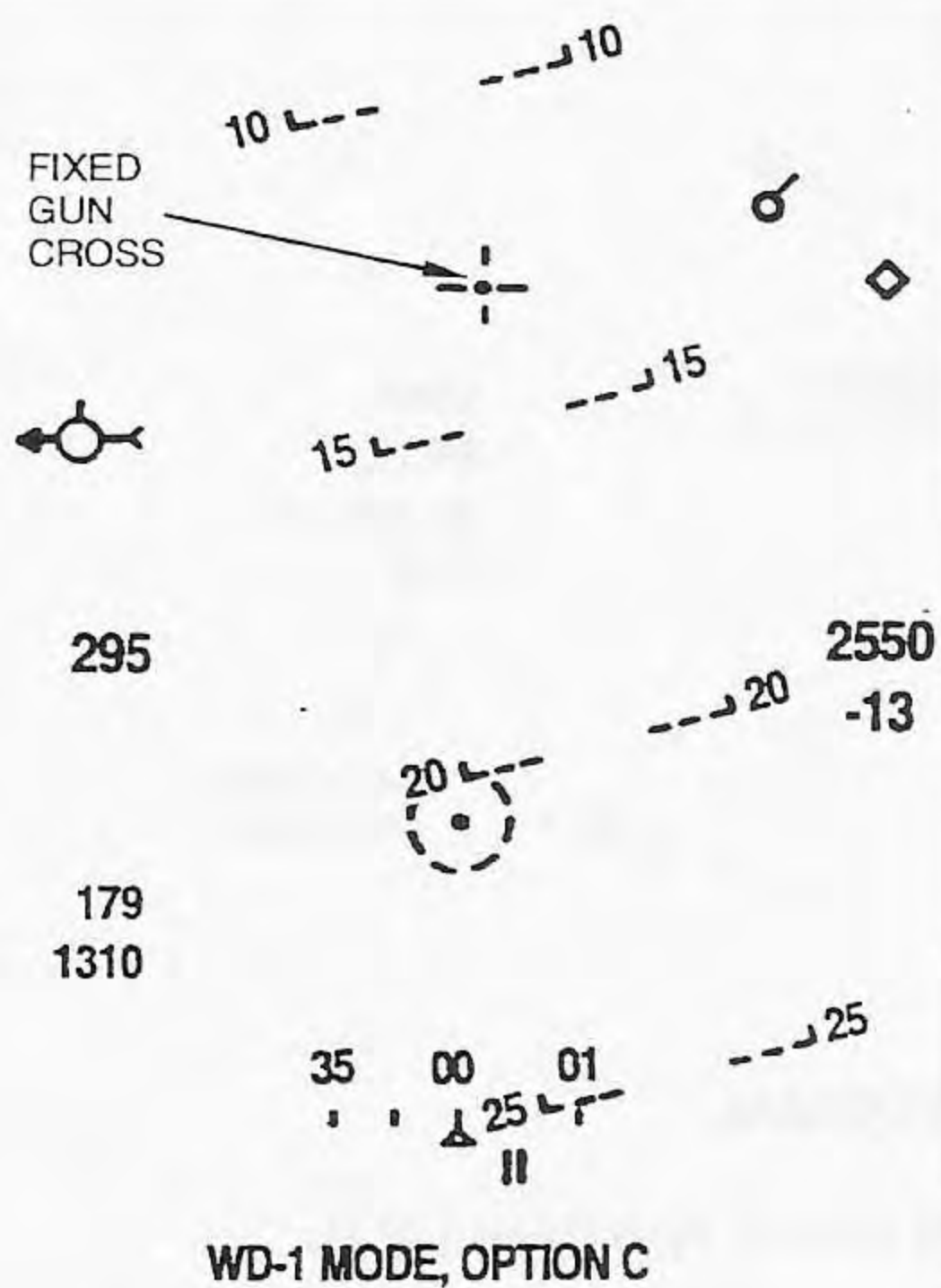
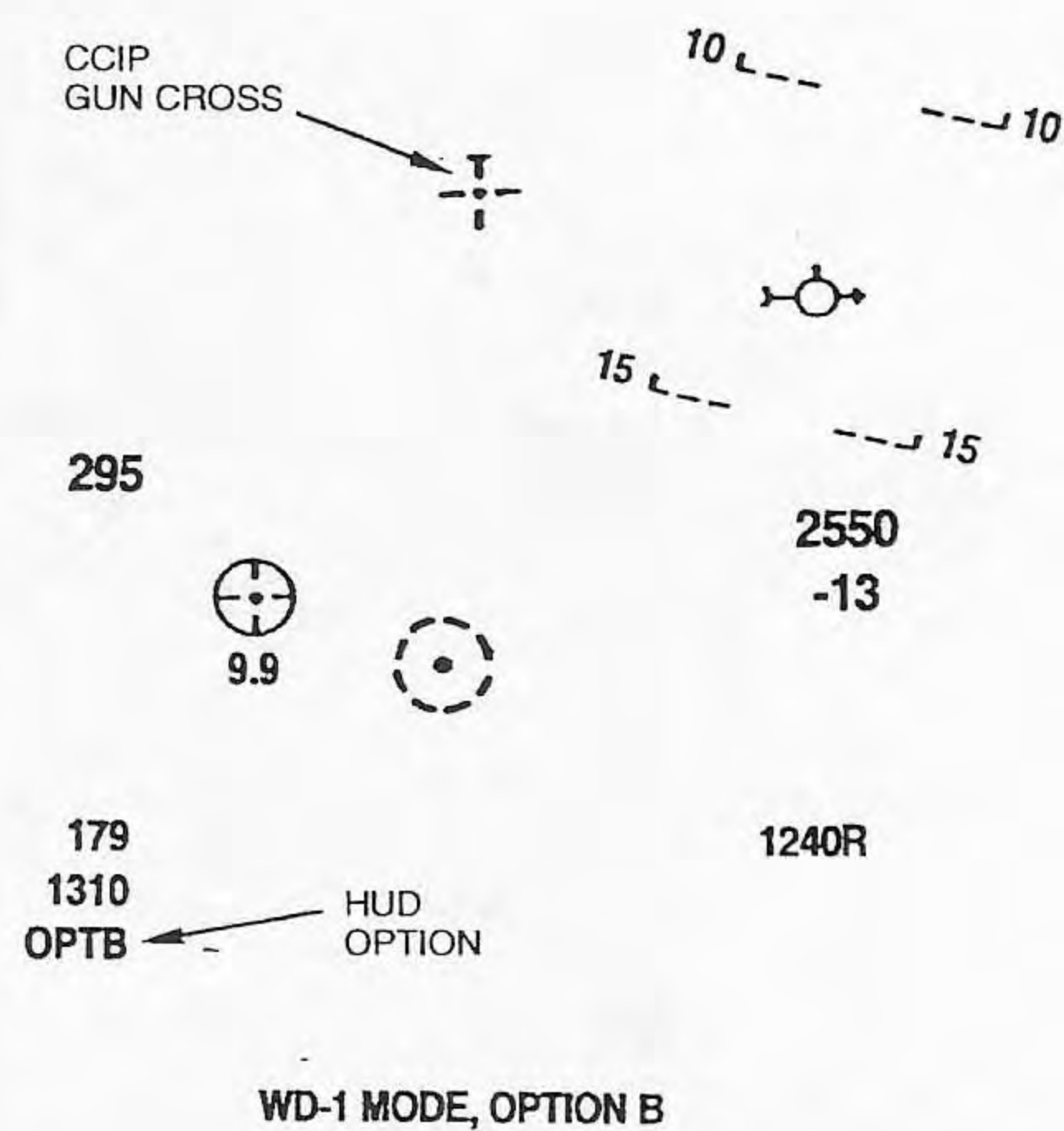
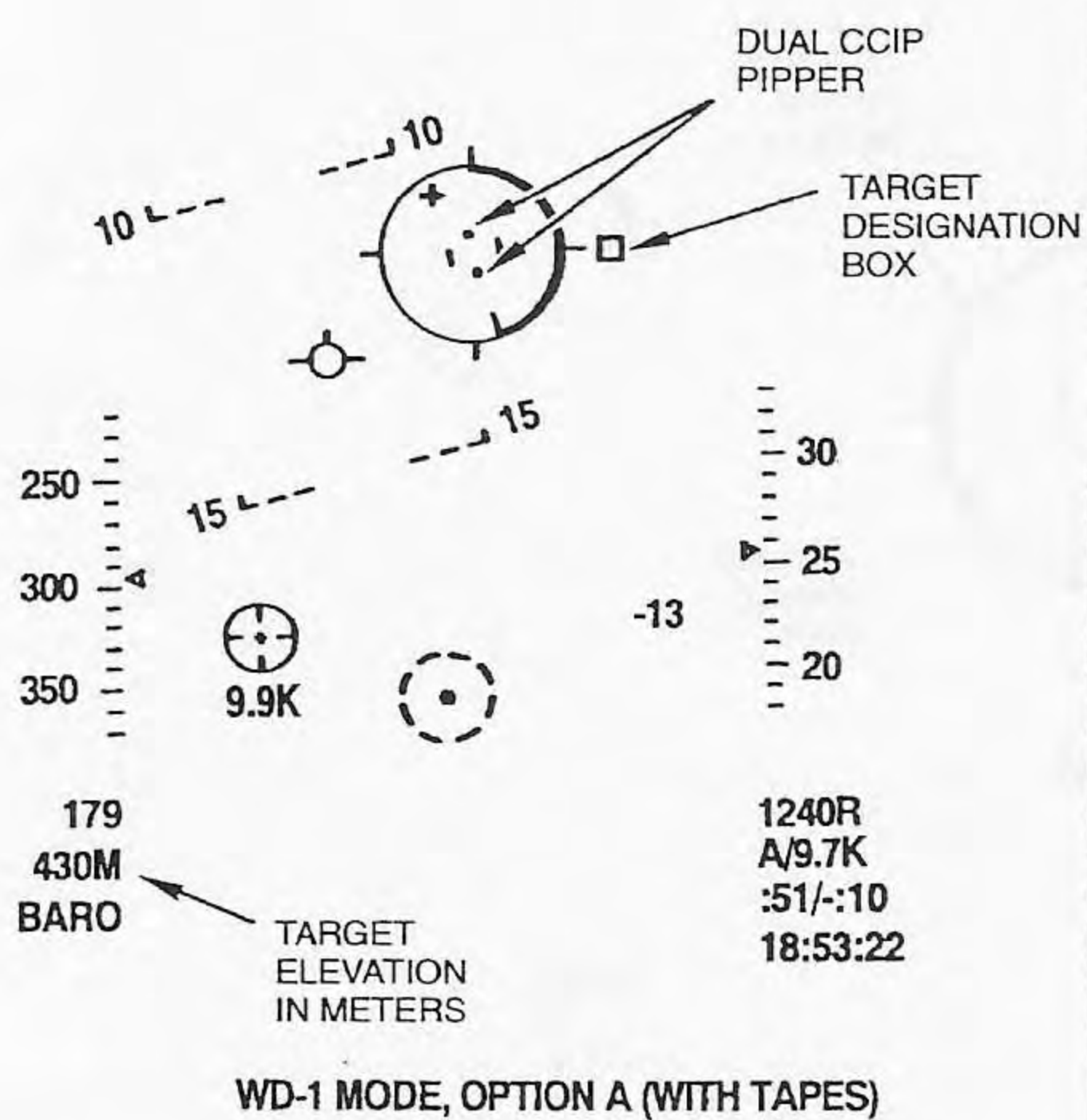


WD-1 MODE, NORMAL

1A-10A-34-1-1-30

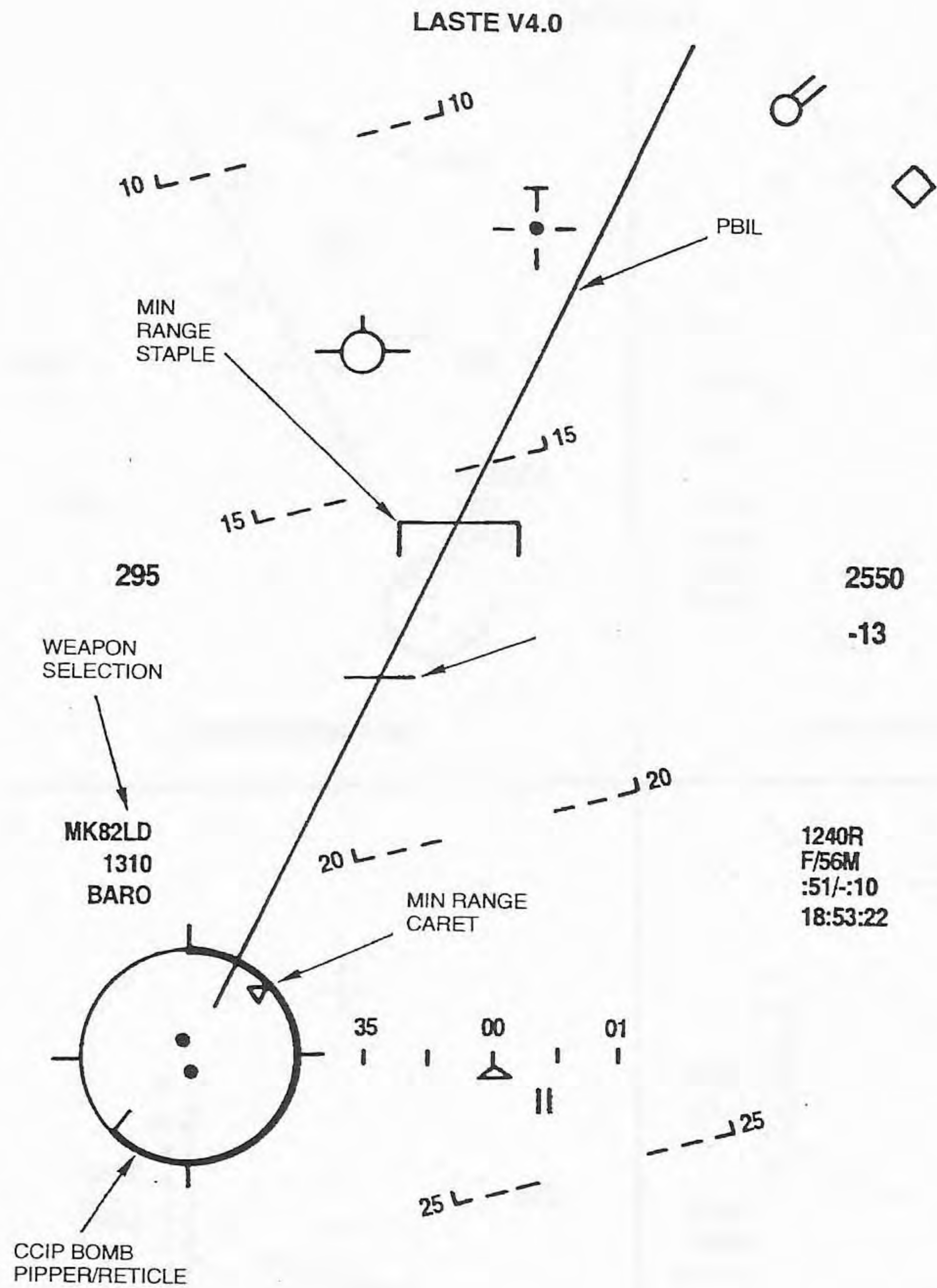
Figure 1-33. HUD System Displays (LASTE V4.0) (Sheet 3 of 11).

LASTE V4.0



1A-10A-34-1-1-31

Figure 1-33. HUD System Displays (LASTE V4.0) (Sheet 4 of 11).

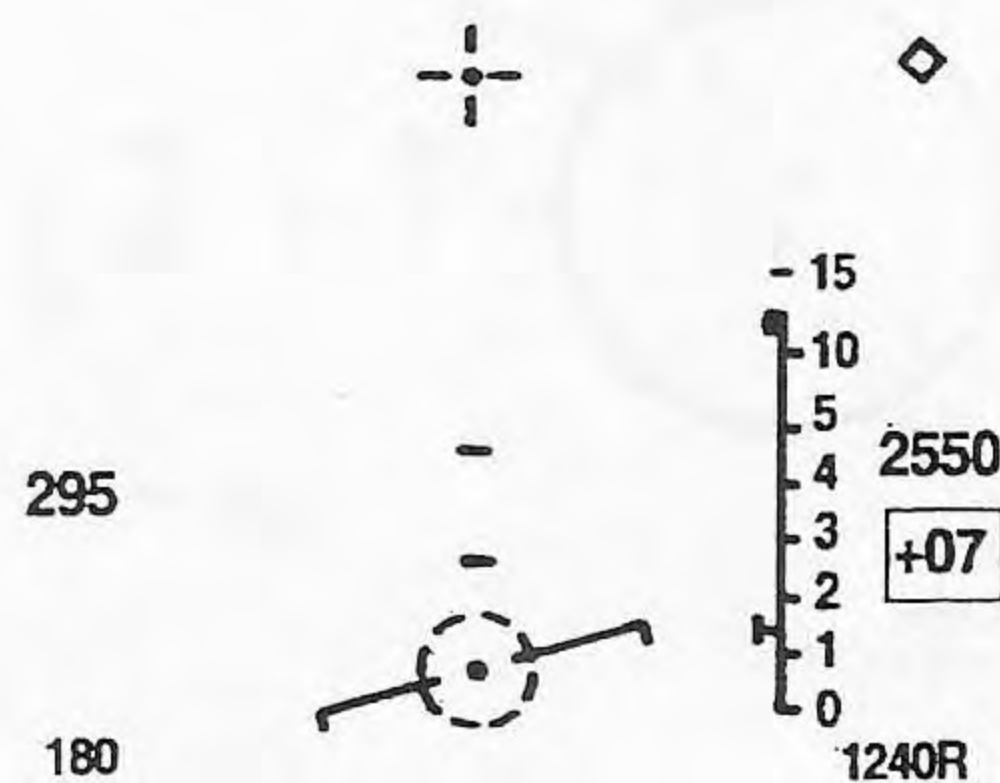
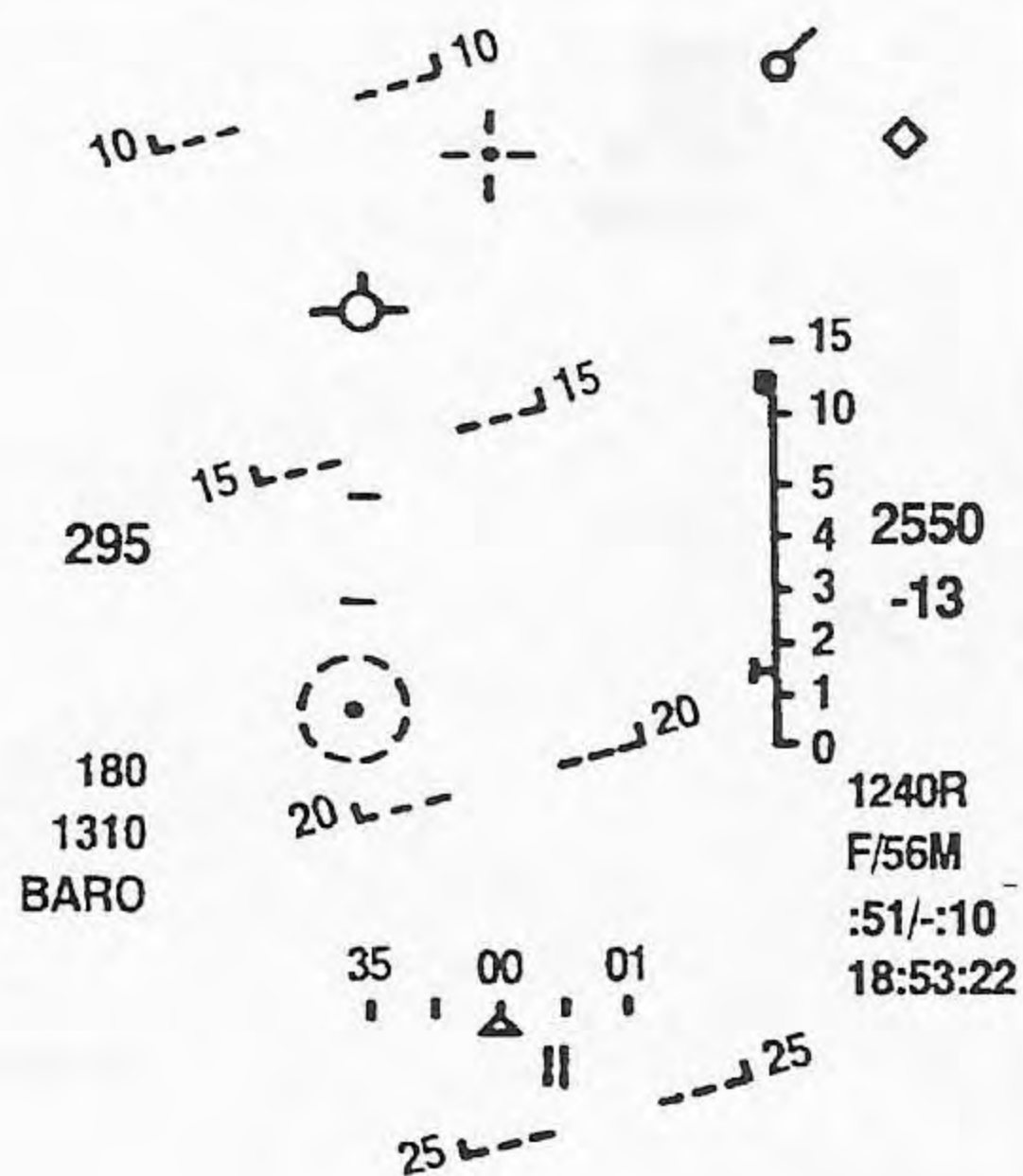
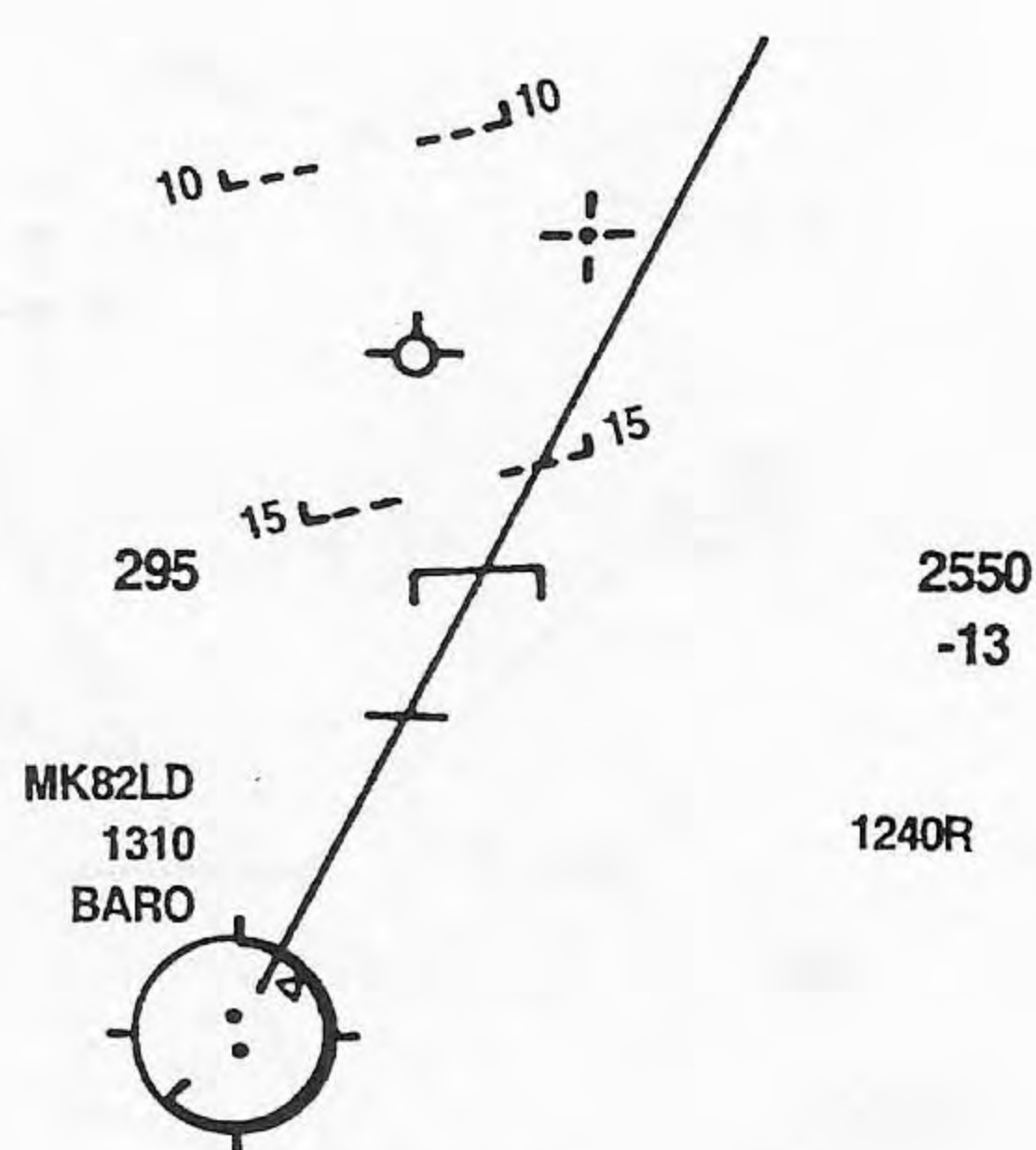
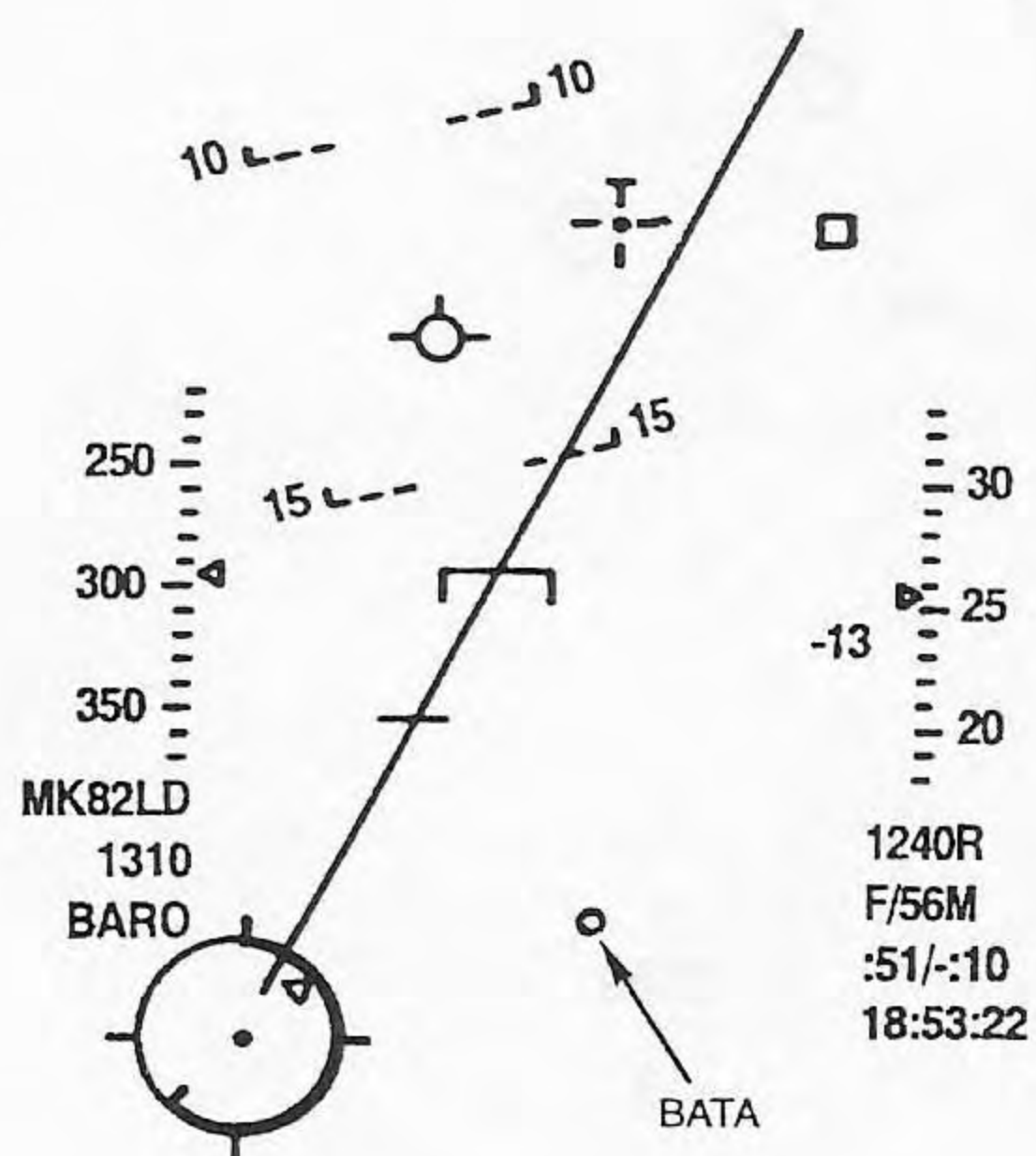


WD-2 MODE, NORMAL

1A-10A-34-1-1-32

Figure 1-33. HUD System Displays (LASTE V4.0) (Sheet 5 of 11).

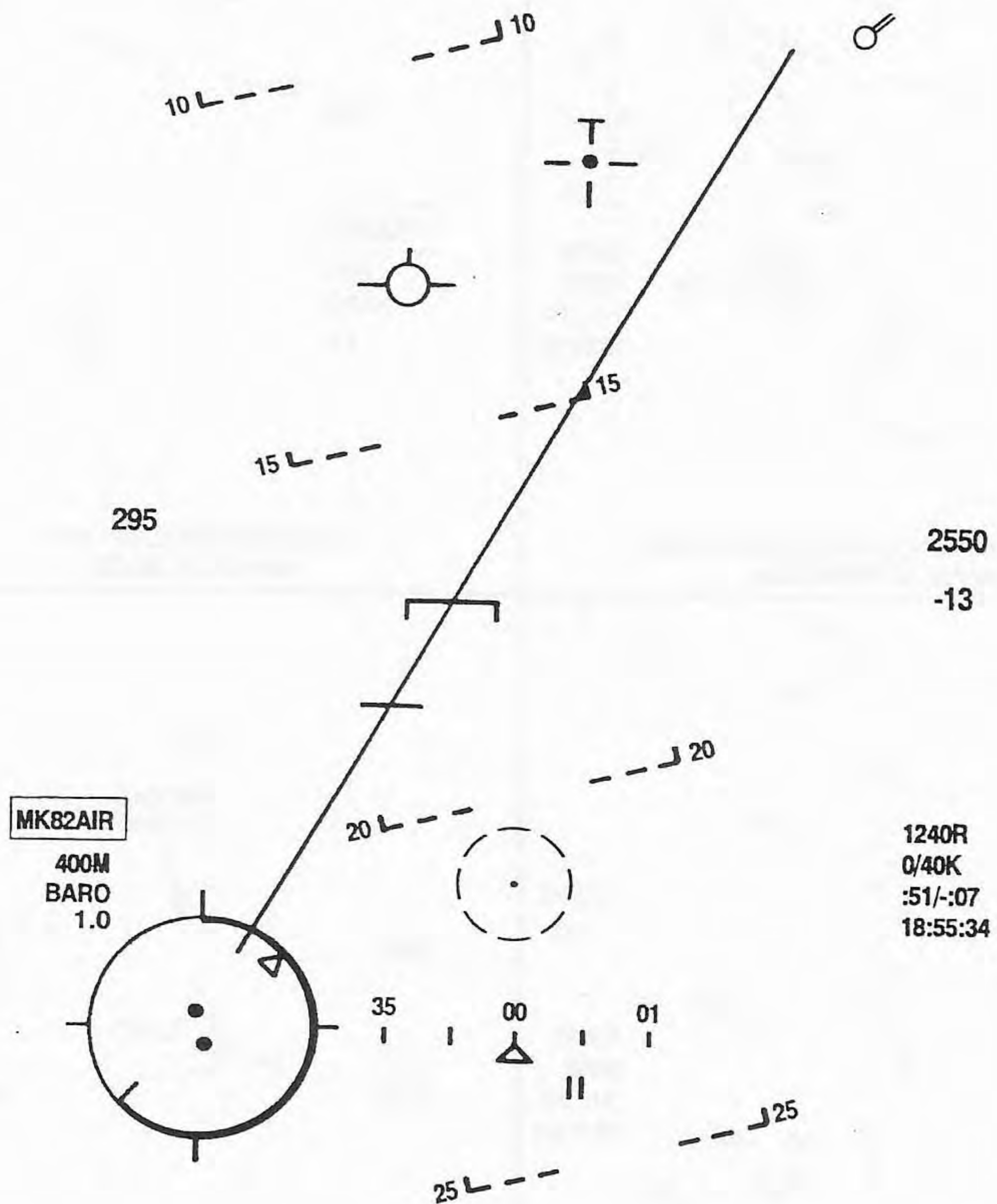
LASTE V4.0



1A-10A-34-1-1-33

Figure 1-33. HUD System Displays (LASTE V4.0) (Sheet 6 of 11).

LASTE V4.0



**EXPANDED MODE, NORMAL
(MANUAL MODE, NO TARGET DESIGNATED)**

1A-10A-34-1-1-34

Figure 1-33. HUD System Displays (LASTE V4.0) (Sheet 7 of 11).

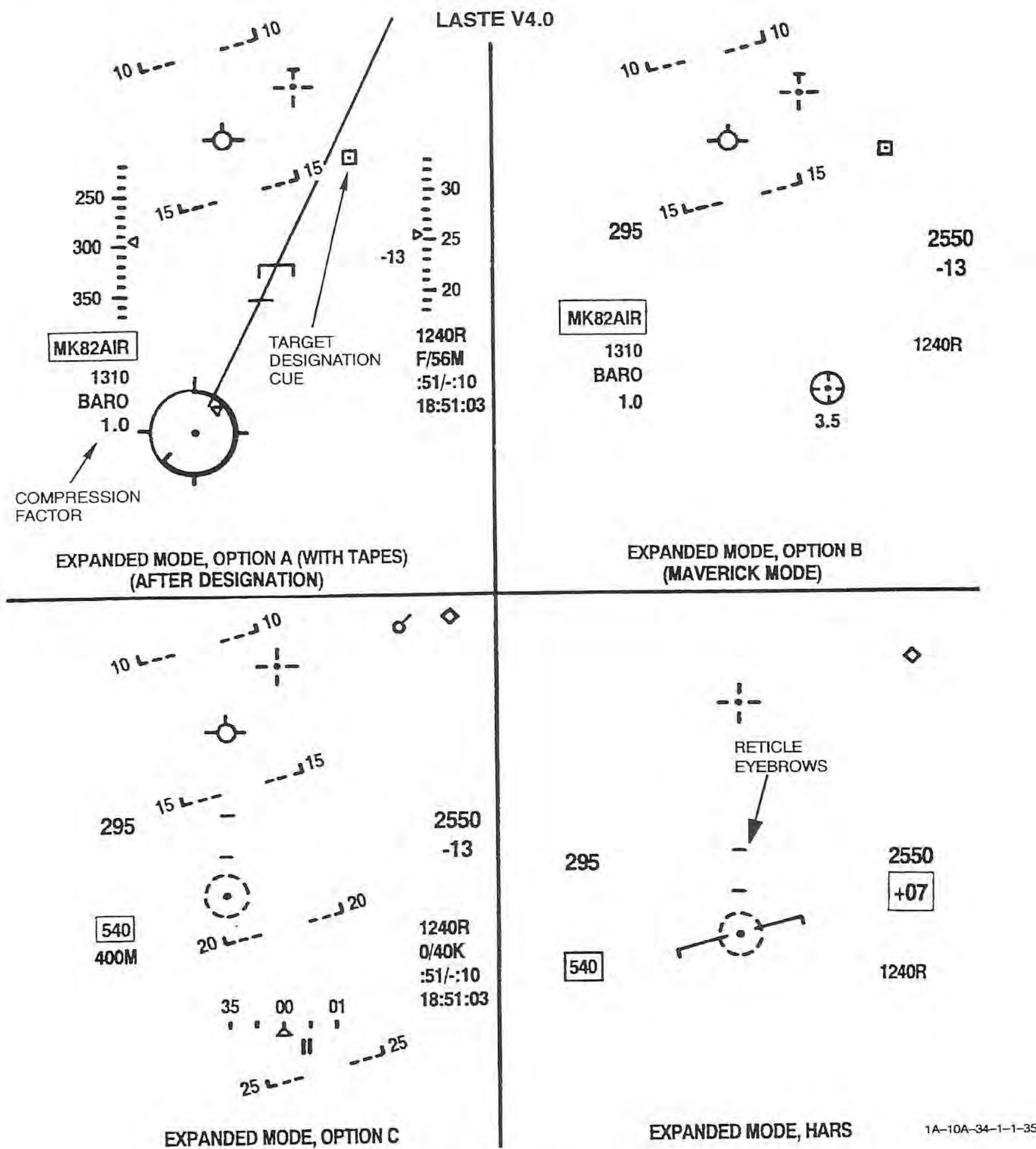
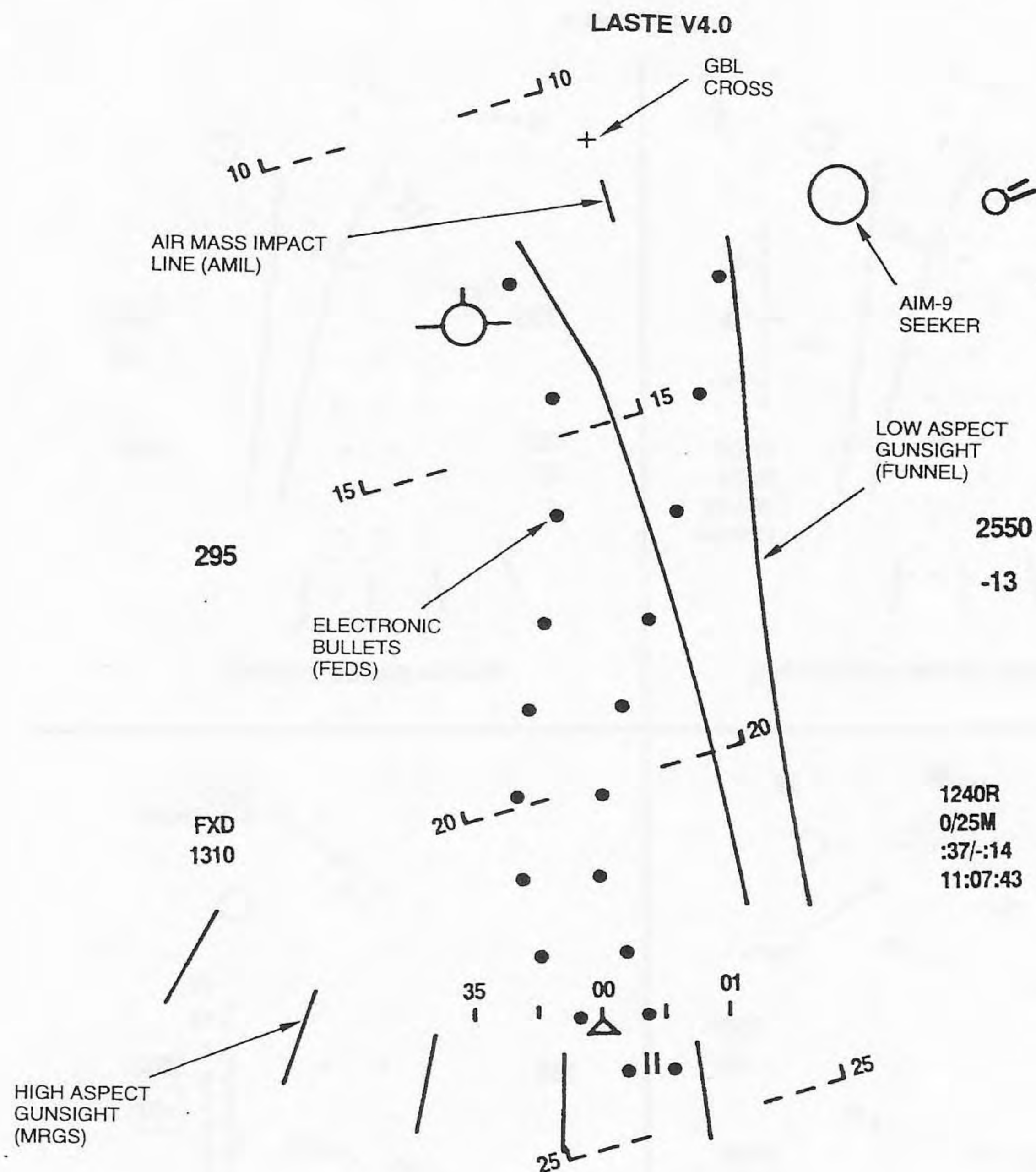


Figure I-33. HUD System Displays (LASTE V4.0) (Sheet 8 of 11).

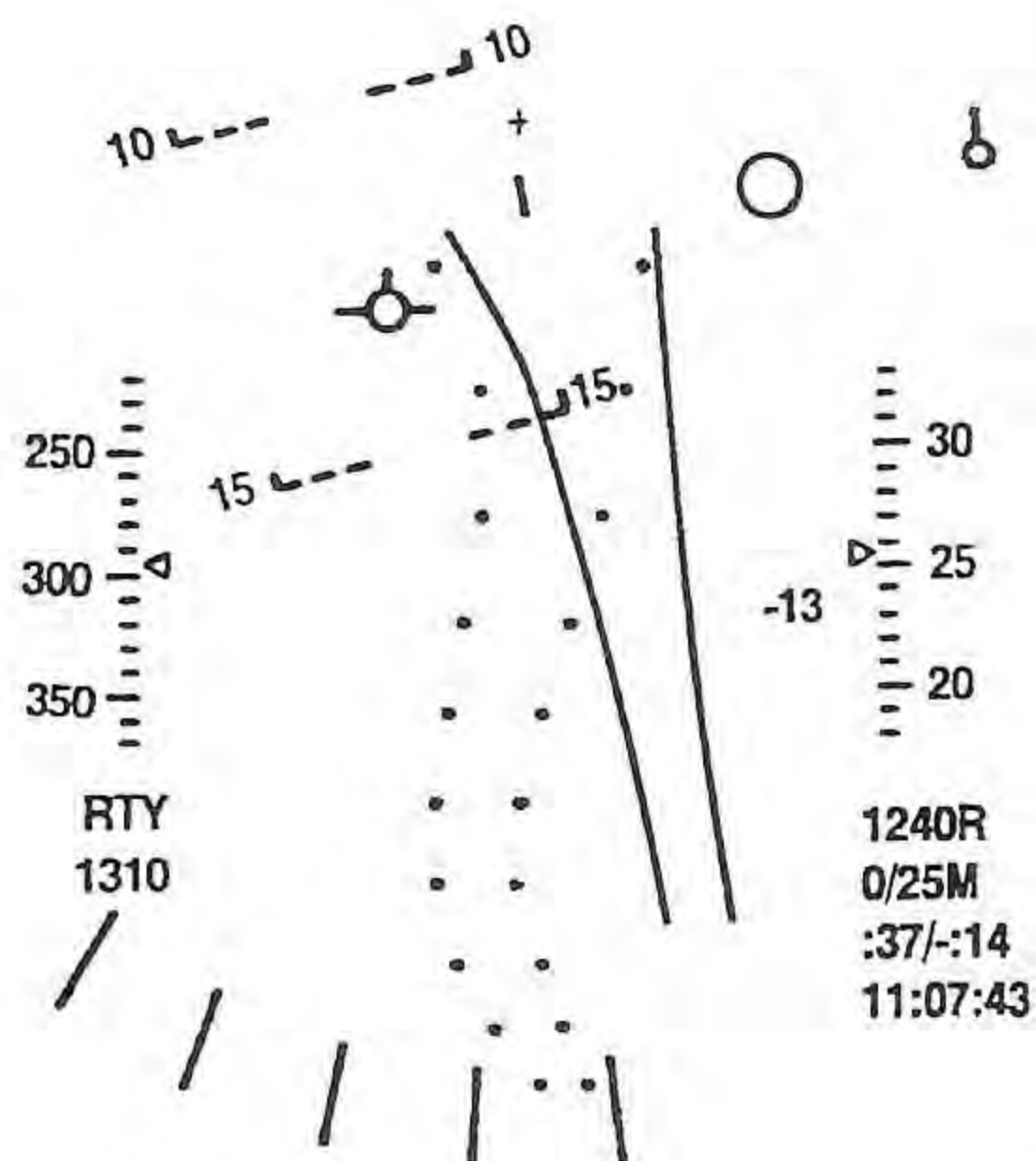


AIR-TO-AIR MODE, NORMAL

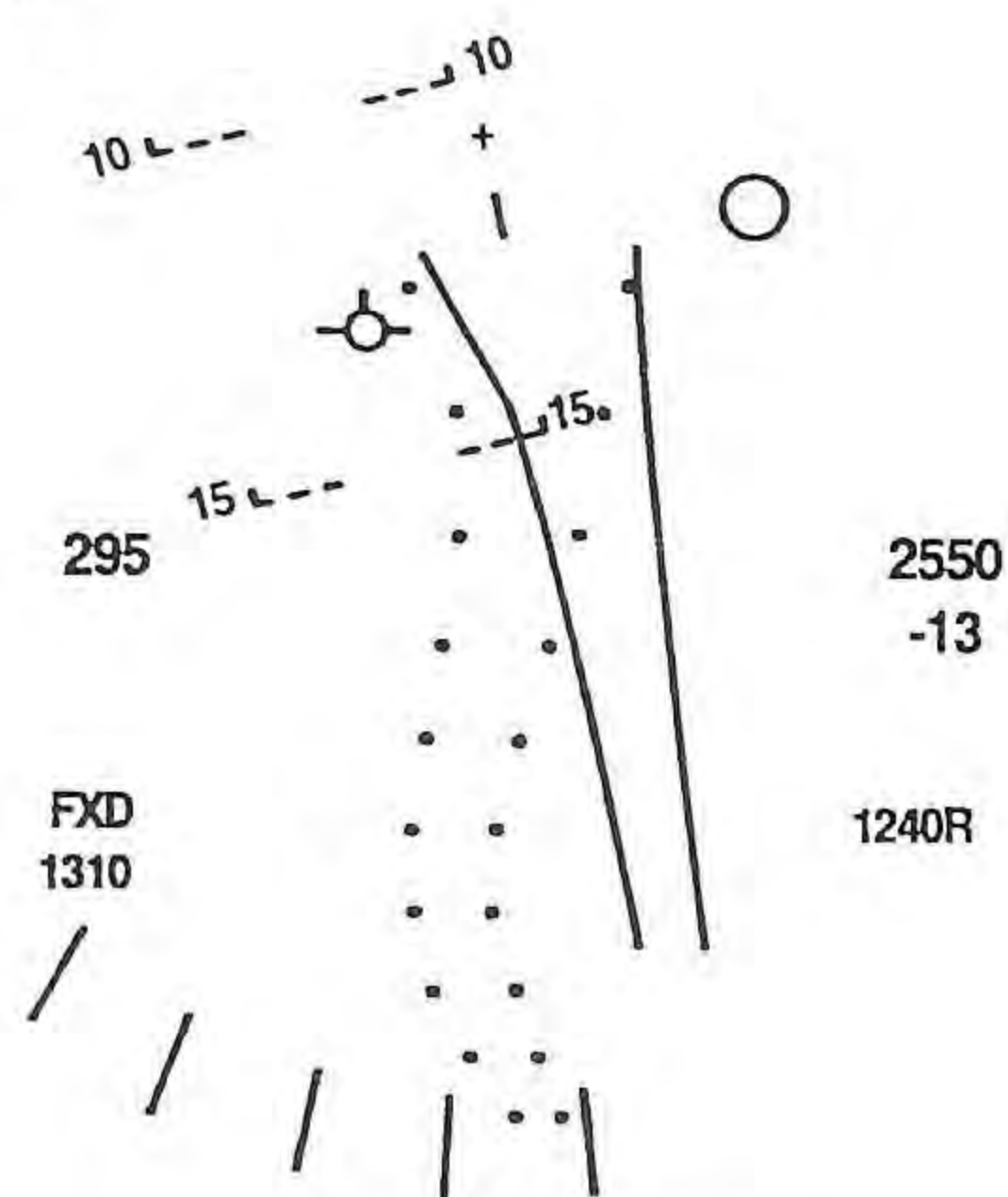
1A-10A-34-1-1-36

Figure 1-33. HUD System Displays (LASTE V4.0) (Sheet 9 of 11).

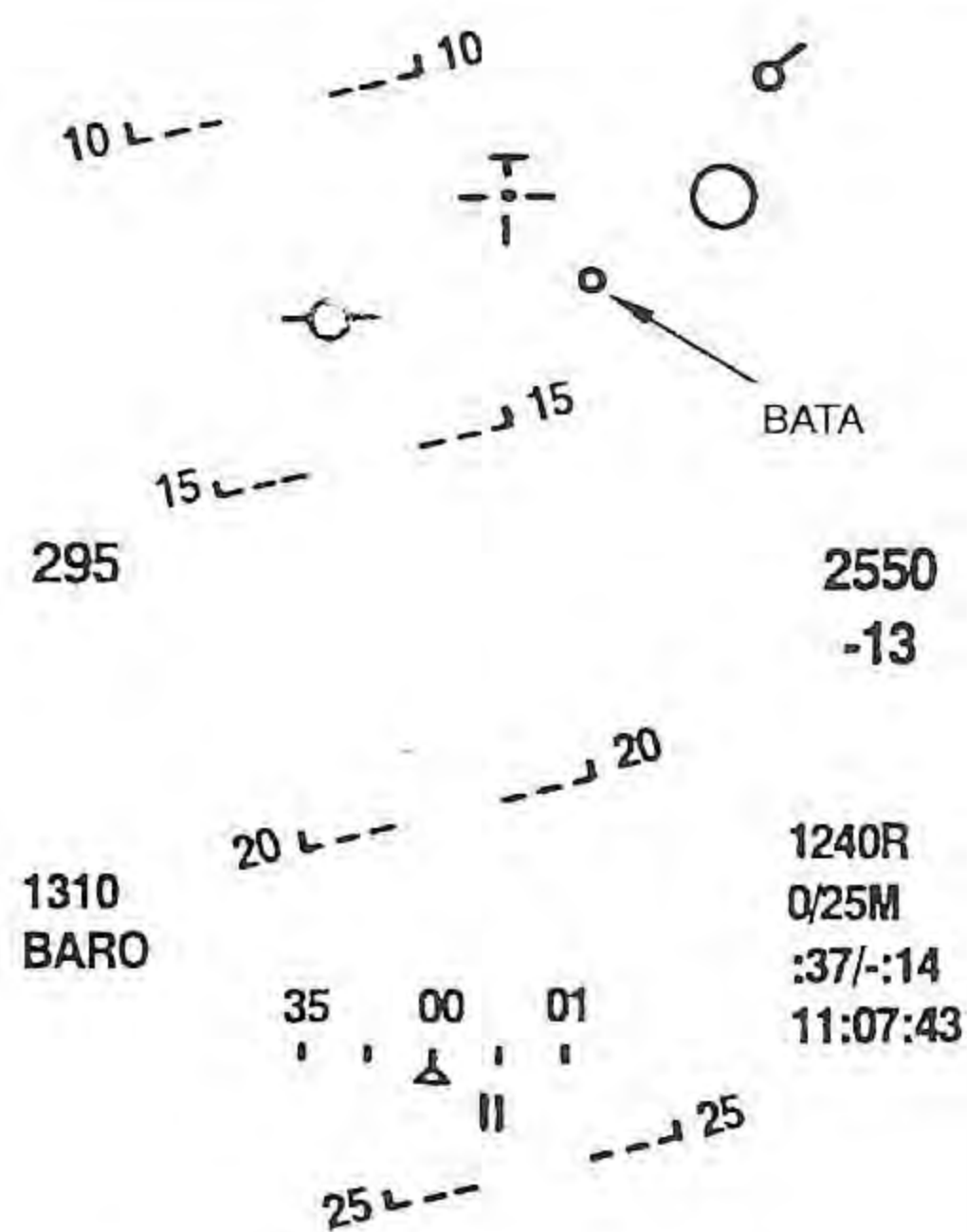
LASTE V4.0



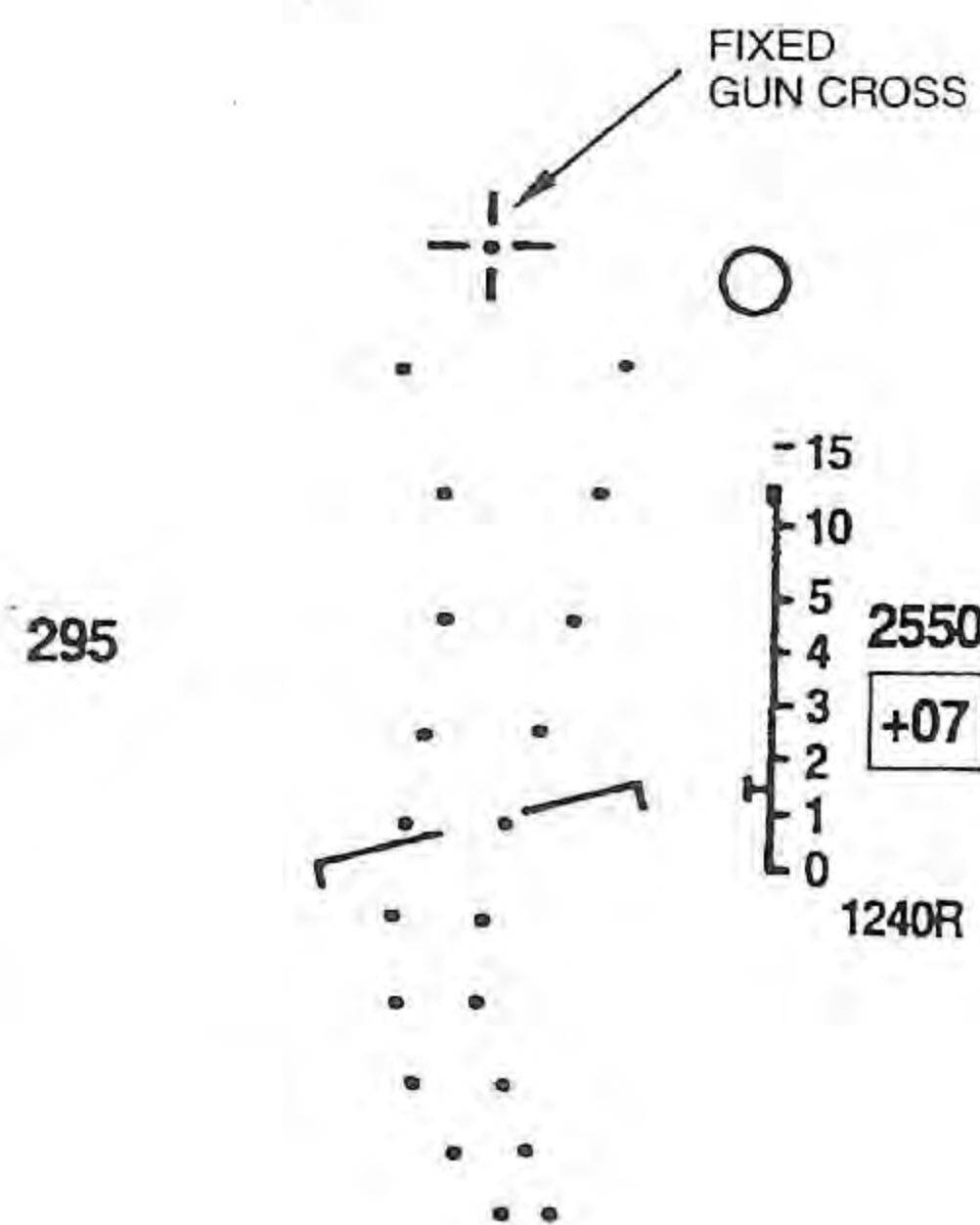
AIR-TO-AIR MODE, OPTION A (WITH TAPES)



AIR-TO-AIR MODE, OPTION B



AIR-TO-AIR MODE, OPTION C

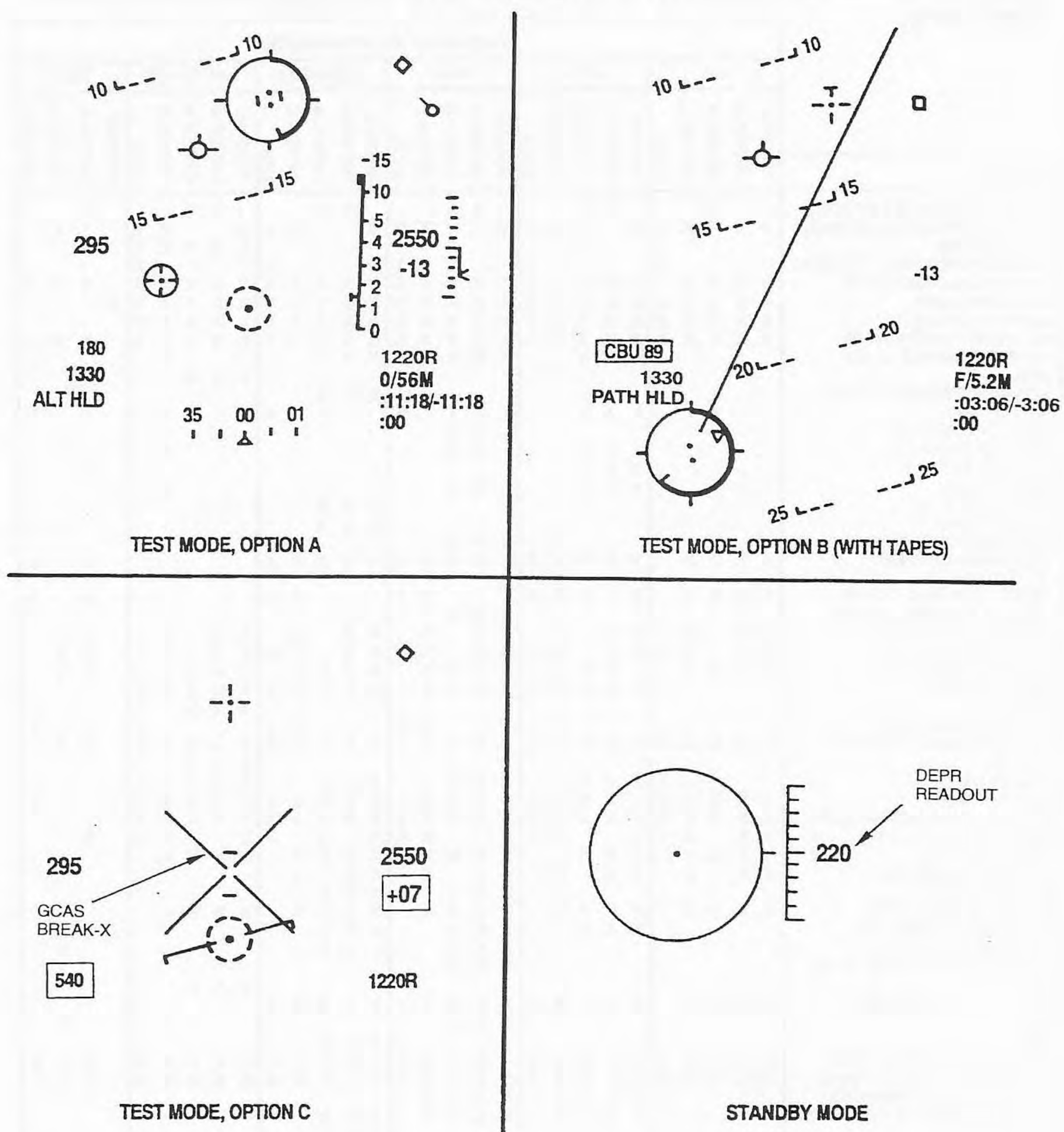


AIR-TO-AIR MODE, HARS

1A-10A-34-1-1-37

Figure 1-33. HUD System Displays (LASTE V4.0) (Sheet 10 of 11).

LASTE V4.0



1A-10A-34-1-1-38

Figure 1-33. HUD System Displays (LASTE V4.0) (Sheet 11 of 11).

HUD SYMBOLOGY DISPLAY MATRIX (LASTE V6.0 **136** NON-GPS AND **136** GPS)

SYMBOLS	SYMBOLOGY SELECTION MATRIX																			
	NAV					WD-1					WD-2					EXPANDED				
	NORMAL	OPTION A	OPTION B	OPTION C	HARS	NORMAL	OPTION A	OPTION B	OPTION C	HARS	NORMAL	OPTION A	OPTION B	OPTION C	HARS	NORMAL	OPTION A	OPTION B	OPTION C	HARS
2-BAR FLIGHT PATH LADDER(2)			X				X	X				X	X				X	X		
4-BAR FLIGHT PATH LADDER(2)	X	X		X	X	X			X	X	X			X	X	X		X	X	
AIM-9 SEEKER																	X	X	X	X
AIRCRAFT REFERENCE SYMBOL					X					X					X					X
AIRSPEED NUMERIC/TAPE	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
ALTITUDE ALERT	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
ALTITUDE DELTA (1)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
ALTITUDE NUMERIC/TAPE	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
ALTITUDE SOURCE (2), (3)						X	X	X			X	X	X			X	X	X		
AML																	X	X	X	
AZIMUTH STEERING LINE (4)																X	X	X		
BATA (5), (6)						X	X	X		X	X	X		X					X	X
CCIP BOMB RETICLE											X	X	X							
CCIP GUN CROSS (7)						X	X	X			X	X	X							
CCIP GUN RETICLE						X	X	X											X	
CCIP INVALID						X	X	X			X	X	X							
CCRP INVALID																X	X	X		
CCRP RETICLE																X	X	X		
COMPRESSION FACTOR											X	X	X							
DEPRESSIBLE PIPPER/RETICLE (8)	X	X	G	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
DEPRESSION READOUT (9)	X	X	X	X		X	X	X	X	X			X	X						
DESIRED RELEASE CUE (10)											X	X	X					X	X	
DESTINATION INDEX (11)	X	X		X		X	X		X		X	X		X		X	X		X	
DISTANCE TO GO	X	X		X	G	X	X		X	G	X	X		X	G	X	X		X	G
EAC MESSAGES (3), (12)	X	X	X	X		X	X	X	X		X	X	X	X		X	X	X	X	
EVENT MARKER						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
FEDS (5)											X	X		X	X	X	X	X	X	X
FIXED GUN CROSS (13)									X	X			X	X						
FLIGHT PATH ANGLE NUM (2)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
FUNNEL																				
GBL CROSS (14)					X	X	X	X			X	X	X			X	X	X	X	X
GCAS BREAK-X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
GCAS TRAINING MESSAGE (27)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
HEADING TAPE (2), (15)	X	X		X	G	X			X	G	X			X	G	X			X	G
HUD OPTION (3)	X	X	X	X		X	X	X	X		X	X	X	X		X	X	X	X	
INS HUD UPDATE (16)	X	X		X		X	X		X		X	X		X		X	X		X	
INVALID FUZING											X	X	X			X	X	X		
MARKPOINT ELEVATION	X	X	X	X		X	X	X	X		X	X	X	X		X	X	X	X	
MAVERICK SYMBOL (17)						X	X	X			X	X	X			X	X	X		
MIN RANGE CARET (10)											X	X	X			L	L	L		
MINIMUM RANGE STAPLE (10)											X	X	X							
MRGS																				
PAVE-PENNY CUE INDEX	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
PBIL (10)											X	X	X							
PBRL																X	X	X		
RADAR ALTITUDE NUMERIC	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
RADAR ALTITUDE SCALE (18)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
RANGE TO TDC NUMERIC(28)						X	X	X	X		X	X	X	X						
RELATIVE BEARING NUMERIC(20)						X	X	X	X		X	X	X	X		X	X	X		
RELEASE CUE																X	X	X		
RETICLE EYEBROWS (19)													X	X						
STEERPOINT DATABASE	G	G		G	G	G	G		G	G	G	G		G	G	G	G		G	G

"X" Indicates symbol may be displayed in this mode. "L" indicates for LUU deliveries only. "G" indicates symbol is displayed in GPS aircraft only.

NOTE: In standby mode a depression readout and pipper are displayed on the HUD.

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Figure 1-34. HUD Symbology Display Matrix (LASTE V6.0) (Sheet 1 of 5).

HUD SYMBOLOGY DISPLAY MATRIX (LASTE V6.0 136 NON-GPS AND 136 GPS)

SYMBOLS	SYMBOLOGY SELECTION MATRIX																			
	NAV					WD-1					WD-2					EXPANDED				
	NORMAL	OPTION A	OPTION B	OPTION C	HARS	NORMAL	OPTION A	OPTION B	OPTION C	HARS	NORMAL	OPTION A	OPTION B	OPTION C	HARS	NORMAL	OPTION A	OPTION B	OPTION C	HARS
STEERPOINT ID	X	X		X	G	X	X		X	G	X	X		X	G	X	X		X	G
TARGET DESIGNATION CUE(23)	X	X	X	X		X	X	X	X		X	X	X	X		X	X	X	X	
TARGET ELEVATION	X	X	X	X	G	X	X	X	X	G	X	X	X	X	G	X	X	X	X	G
TDC LINE	X	X	X	X		X	X	X	X		X	X	X	X		X	X	X	X	
TGT DES BOX (21), (22)	X	X		X		X	X		X		X	X		X						
TIME ON TARGET	X	X		X	G	X	X		X	G	X	X		X	G	X	X		X	G
TISL SPIDER (24)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
TOTAL VELOCITY VECTOR(11)	X	X	X	X		X	X	X	X		X	X	X	X		X	X	X	X	
USE CCRP MESSAGE (25)											X	X	X							
VERT VELOCITY SCALE		X		X																
WEAPON SELECT (26)											X	X	X			X	X	X	X	

"X" Indicates symbol may be displayed in this mode. "G" indicates symbol is displayed in GPS aircraft only.

NOTE: In standby mode a depression readout and pipper are displayed on the HUD.

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NOTES:

- (1) INCLUDES DELTA ALTITUDE AND DELTA RADAR ALTITUDE DISPLAYS.
- (2) IF THE LASTE SYMBOL GENERATOR ENCOUNTERS A WORST-CASE DISPLAY FORMAT DURING NORMAL OPERATION (NO TRANSIENT SYMBOLOGY) AND IS UNABLE TO DRAW ALL OF THE SELECTED SYMBOLOGY IN THE CURRENT FRAME TIME, IT WILL AUTOMATICALLY DETECT THIS DRAWING OVERFLOW AND WILL BLANK THE UNFINISHED OR UNDRAWN SYMBOLS UNTIL CONDITIONS INDICATE THAT THOSE SYMBOLS CAN AGAIN BE COMPLETELY DRAWN. THE FOLLOWING LOW PRIORITY SYMBOLOGY WILL BE BLANKED DURING ANY DRAWING OVERFLOWS IN THE ORDER SHOWN BELOW: (NOTE: BLANKING OF THE SYMBOLOGIES MAY OCCUR IN PAIRS.)
 - 1ST HDG TAPE SCALE
 - 2ND ALTITUDE SOURCE
 - 3RD FLIGHT PATH ANGLE NUMERIC
 - 4TH REPLACE FLIGHT PATH LADDER WITH TWO-BAR FLIGHT PATH LADDER
- (3) THE HUD OPTION, ALTITUDE SOURCE AND EAC MESSAGES ARE DISPLAYED IN THE SAME LOCATION ON THE HUD. WHEN EITHER THE HUD MODE OR OPTION IS CHANGED, THE HUD OPTION WILL BE DISPLAYED FOR TWO SECONDS. AFTER TWO SECONDS, THE EAC MESSAGES WILL BE DISPLAYED IF THE AUTOPILOT IS ENGAGED, OTHERWISE THE ALTITUDE SOURCE WILL BE DISPLAYED.
- (4) THE AZIMUTH STEERING LINE WILL BE OCCULTED BY THE CCRP RETICLE WHEN A ROCKET IS SELECTED.
- (5) FOR THE MANUAL HARS OPTION (INERTIAL DATA VALID) BATA, FEDS, AND PREDICTIVE GCAS WARNINGS ARE PROVIDED. IN AUTOMATIC HARS (INERTIAL DATA INVALID), IF THE RADAR ALTIMETER IS VALID, AN AURAL ALTITUDE ALERT WARNING IS STILL PROVIDED, BUT GCAS WARNINGS (BOTH AURAL AND FLASHING BREAK-X) ARE NOW ONLY PROVIDED FOR A HARD PENETRATION OF THE 90-FOOT GROUND PLANE. THE FEDS ALGORITHM IS INHIBITED WITH THE LAAP ENGAGED.
- (6) DISPLAYED AFTER GUN TRIGGER IS PRESSED TO 2ND DETENT AS FUNCTION OF BATA ALGORITHM. IN ALL MODES, THE BATA ALGORITHM IS INHIBITED WITH THE LAAP ENGAGED.
- (7) OCCULTATION WINDOW AROUND CCIP GUN CROSS IS ± 12 MILS IN AZIMUTH AND $+15/-12$ MILS IN ELEVATION.

Figure 1-34. HUD Symboology Display Matrix (LASTE V6.0) (Sheet 2 of 5).

NOTES:

- (8) IN GPS AIRCRAFT, THE DEPRESSIBLE PIPPER/RETICLE IS DISPLAYED IN NAV (ALL OPTIONS EXCEPT HARS) MODE ONLY IF THE HCP OPTION SELECTOR SWITCH IS IN THE MARK POSITION. IN NON-GPS AIRCRAFT, THE DEPRESSIBLE PIPPER/RETICLE IS DISPLAYED IN THE MODES AND OPTIONS LISTED ABOVE ONLY IF THE HCP OPTION SELECTOR SWITCH IS DEPRESSED (PUSH TO SET) WHILE IN THE MARK POSITION.
- (9) IN GPS AIRCRAFT, THE DEPRESSION READ OUT IS DISPLAYED IN NAV MODE (ALL OPTIONS EXCEPT HARS) ONLY IF THE HCP OPTION SELECTOR SWITCH IS IN THE MARK POSITION. IN NON-GPS AIRCRAFT, THE DEPRESSION READ OUT IS DISPLAYED IN THE MODES AND OPTIONS LISTED ABOVE ONLY IF THE HCP OPTION SELECTOR SWITCH IS DEPRESSED (PUSH TO SET) WHILE IN THE MARK POSITION..
- (10) NOT DISPLAYED WHEN ROCKETS ARE SELECTED. THE MINIMUM RANGE AND SAFE ESCAPE FUNCTIONS (AND THE MRS, DRC, AND MRC DISPLAYS) ARE INHIBITED WITH LAAP OR PAC ENGAGED. THE MINIMUM RANGE CARET WILL BE DISPLAYED IF A FLECHETTE ROCKET HAS BEEN SELECTED.
- (11) WILL BE OCCULTED INSIDE 12 MILLIRADIANS (MILS) OF CCIP GUN CROSS OR CCIP GUN RETICLE (INSIDE 10 MILS OF FIXED GUN CROSS OR 18 MILS OF CCIP BOMB RETICLE). OCCULTATION OF THE TVV IS PILOT SELECTABLE IN WD-2 MODE.
- (12) DISPLAYS "PATH HLD", "ALT HLD", OR "ALT/HDG", AS SELECTED, FOR ALL MODES EXCEPT TEST. IN TEST MODE, "ALT HLD" IS DISPLAYED IN OPTION A, AND "PATH HLD" IN OPTION B.
- (13) ONLY APPEARS WHEN THE DEPRESSIBLE PIPPER/RETICLE IS AT 50 MILS OR GREATER DEPRESSION, EXCEPT IN AIR-TO-AIR GUNSIGHT MODE (HARS OPTION). ALWAYS DISPLAYED IN AIR-TO-AIR MODE (HARS OPTION).
- (14) IN THE GUNS MODE, THE GBL CROSS IS OCCULTED BY THE CCIP GUN CROSS. IN CCIP MODE, THE GBL CROSS IS OCCULTED BY THE CCIP GUN CROSS AND THE CCIP BOMB RETICLE. IN CCRP MODE, THE GBL CROSS IS OCCULTED BY THE CCRP RETICLE.
- (15) WILL BE DELETED INSIDE 12 MILS OF DEPRESSIBLE PIPPER/RETICLE (OCCULTED INSIDE 18 MILS OF CCIP BOMB RETICLE).
- (16) APPEARS WHEN THE HCP OPTION SELECTOR SWITCH IS DEPRESSED (PUSH TO SET) WHILE IN THE MARK POSITION. IT IS REMOVED WHEN THE MARK IS TAKEN OR WHEN THE HCP OPTION SELECTOR SWITCH IS MOVED OUT OF THE MARK POSITION.
- (17) DISPLAYED ONLY WHEN MAVERICK IS SELECTED. IN CCIP MODE, THE CCIP BOMB RETICLE, PBIL, MRC, MRS, AND DRC ARE NOT DISPLAYED WHEN THE MAVERICK SYMBOL IS DISPLAYED. IN CCRP MODE, THE CCRP RETICLE, PBRL, MRC, RELEASE CUE, ASL AND RELATIVE BEARING NUMERIC ARE NOT DISPLAYED WHEN MAVERICK SYMBOL IS DISPLAYED.
- (18) ONLY DISPLAYED IF RDR ALT IS SELECTED ON HCP OPTION SELECTOR SWITCH, AIRSPEED/ALTITUDE TAPES ARE NOT SELECTED, AND THE AIRCRAFT IS BELOW 1500 FEET AGL ASCENDING OR BELOW 1200 FEET AGL DESCENDING.
- (19) ONLY APPEARS WHEN DEPRESSIBLE PIPPER/RETICLE IS AT 100 MILS OR GREATER DEPRESSION.
- (20) IN GUNS AND CCIP MODES, INDICATES RELATIVE BEARING TO THE TDC WHEN THE RELATIVE BEARING TO THE TDC EXCEEDS 10 DEGREES. IN CCRP MODE, INDICATES RELATIVE BEARING FROM THE CAP TO THE CCRP PIPPER WHEN THE TDC IS LIMITED IN AZIMUTH.
- (21) TD BOX APPEARS ONLY WHEN DESTINATION INDEX IS IN FOV, STEERPOINT ELEVATION HAS BEEN ENTERED, AND NO TDC IS DISPLAYED.
- (22) OCCULTATION OF THE TD BOX BY THE CCIP PIPPERS IS PILOT SELECTABLE VIA A LASTE SUB-MENU.
- (23) IN NON-GPS AIRCRAFT, THE TDC AND TDC LINE ARE DISPLAYED IN NAV MODE, IF THE DESIGNATION HAS PREVIOUSLY BEEN MADE IN A WEAPONS DELIVERY MODE.
- (24) ONLY APPEARS WITH TISL LOCK-ON FOR MODES OTHER THAN TEST. NOT PRESENT WHEN AIM-9 IS SELECTED.
- (25) DISPLAYED WHEN A LUU IS SELECTED IN CCIP MODE.
- (26) FOR GENERAL PURPOSE AND CLUSTER MUNITIONS, THE SELECTED WEAPON DISPLAY IS FOLLOWED BY A SLASH AND THE SELECTED SAFE ESCAPE MANEUVER FOR THAT WEAPON (E.G., 82LD/CLM), IF "NONE" IS SELECTED THEN "XXX" WILL BE DISPLAYED. IN AIR-TO-AIR GUNSIGHT MODE, FXD OR RTY IS DISPLAYED FOR FIXED OR ROTARY WING TARGET.
- (27) "GCAS" IS DISPLAYED IN THE HUD PRIORITY MESSAGE WINDOW WHENEVER A GCAS FALSE GROUND PLANE OF OTHER THAN "OFF" IS SELECTED.
- (28) DISPLAYED ONLY WHEN A TARGET HAS BEEN DESIGNATED IN GUNS AND CCIP MODES.

Figure I-34. HUD Symbology Display Matrix (LASTE V6.0) (Sheet 3 of 5).

LASTE SYMBOLOGY SIZE MATRIX

Symbol Names	LASTE Symbology Size (V6.0)		HUD Position (V6.0)	
	Azimuth [mils]	Elevation [mils]	Azimuth [mils]	Elevation [mils]
AIM-9 Seeker Circle	15	15	Dynamic	Dynamic
AMIL	N/A	10	Dynamic	Dynamic
Aircraft Reference Symbol	23.7	5.9	Dynamic	Dynamic
Airspeed Numeric	6.5	7.9	-70	0
Airspeed Tape	35.6	89.5	-74.5	Centered
Altitude Alert	6.5	7.9	Centered	13
Altitude Delta Update	6.5	7.9	Centered	13
Altitude Numeric	6.5	7.9	76.5	0
Altitude Source	5.25	6.3	-70	-89
Altitude Tape	29	89.5	74.5	Centered
Azimuth Steering Line	N/A	Variable	Dynamic	Dynamic
BATA	5	5	Dynamic	Dynamic
CCIP Bomb Reticle	50	50	Dynamic	Dynamic
CCIP Gun Cross	20	20	Dynamic	Dynamic
CCIP Gun Reticle	50	50	Dynamic	Dynamic
CCIP Invalid	6.5	7.9	Centered	13
CCRP Invalid	6.5	7.9	Centered	13
CCRP Reticle	50	50	Dynamic	Dynamic
Compression Factor	5.25	6.3	-70	-101.5
Depressible Pipper/Reticle	1 / 25	1 / 25	Centered	Dynamic
Depression Readout	5.25	6.3	-70	-64
Desired Release Cue	10	N/A	Dynamic	Dynamic
Destination Index	6	6	Dynamic	Dynamic
Distance To Go	5.25	6.3	70	-76.5
EAC Messages	5.25	6.3	-70	-89
Event Marker	5.25	6.3	80	102.5
FEDS	Variable	Variable	Dynamic	Dynamic
Fixed Gun Cross	20	20	0	89.6
Flight Path Angle Numeric	6.5	7.9	47 / 76.5	-16
Flight Path Ladder	70	2.5 (Tab)	Dynamic	Dynamic
Funnel	Variable	Variable	Dynamic	Dynamic
GBL Cross	5	5	0	99.2
GCAS Break X	100	100	Centered	Centered
GCAS Training Message	6.5	7.9	Centered	13
Hack Time	XX	XX	70	-101.5/-114
HUD Option	5.25	6.3	-70	-89
Heading Tape	122	24.7	Centered	-112
INS HUD Update	5.25	6.3	Centered	89.6
Invalid Fuzing	6.5	7.9	Centered	13
MRGS	Variable	Variable	Dynamic	Dynamic
Markpoint Elevation	6.5	7.9	Centered	-13
Maverick Symbol	20	20	Dynamic	Dynamic
Min Range Caret	5 mils each side	5 mils each side	Dynamic	Dynamic
Min Range Staple	20	5 (Tab)	Dynamic	Dynamic
Moving Target Index	Variable	5	Dynamic	Dynamic
Option Select Menu	5.25	6.3	Variable	Variable
PAVE-PENNY Cue Index	N/A	Variable	Dynamic	Dynamic
PBIL	N/A	Variable	Dynamic	Dynamic
PBRL	N/A	Variable	Dynamic	Dynamic
RADAR Altitude Numeric	5.25	6.3	70	-64
RADAR Altitude Scale	N/A	100	50	Centered

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Figure 1-34. HUD Symbology Display Matrix (LASTE V6.0) (Sheet 4 of 5).

LASTE SYMBOLOGY SIZE MATRIX – cont

Symbol Names	LASTE Symbology Size (V6.0)		HUD Position (V6.0)	
	Azimuth [mils]	Elevation [mils]	Azimuth [mils]	Elevation [mils]
Range to TDC Numeric	5.25	6.3	Dynamic	Dynamic
Relative Bearing Numeric	5.25	6.3	Dynamic	Dynamic
Release Angle Numeric	5.25	6.3	Dynamic	Dynamic
Release Cue	50	7 (Circle)	Dynamic	Dynamic
Reticle Eyebrows	6	N/A	Dynamic	Dynamic
Steerpoint Database ID*	5.25	6.3	70	-70.5
Steerpoint ID	5.25	6.3	70	-89
TD Box	7	7	Dynamic	Dynamic
TDC Line	N/A	Variable	Dynamic	Dynamic
TISL Spider	7	7	Dynamic	Dynamic
TVV	10	10	Dynamic	Dynamic
Target Designation Cue	7	7	Dynamic	Dynamic
Target Elevation	5.25	6.3	-70	-76.5
Time On Target	5.25	6.3	70	-101.5
Two-Bar Flight Path Ladder	70	2.5 (Tab)	Dynamic	Dynamic
Use CCRP Message	6.5	7.9	0	89.6
Vertical Velocity Scale	8	68.5	119.5	Centered
Weapon Select	5.25	6.3	-70	-64

Notes:

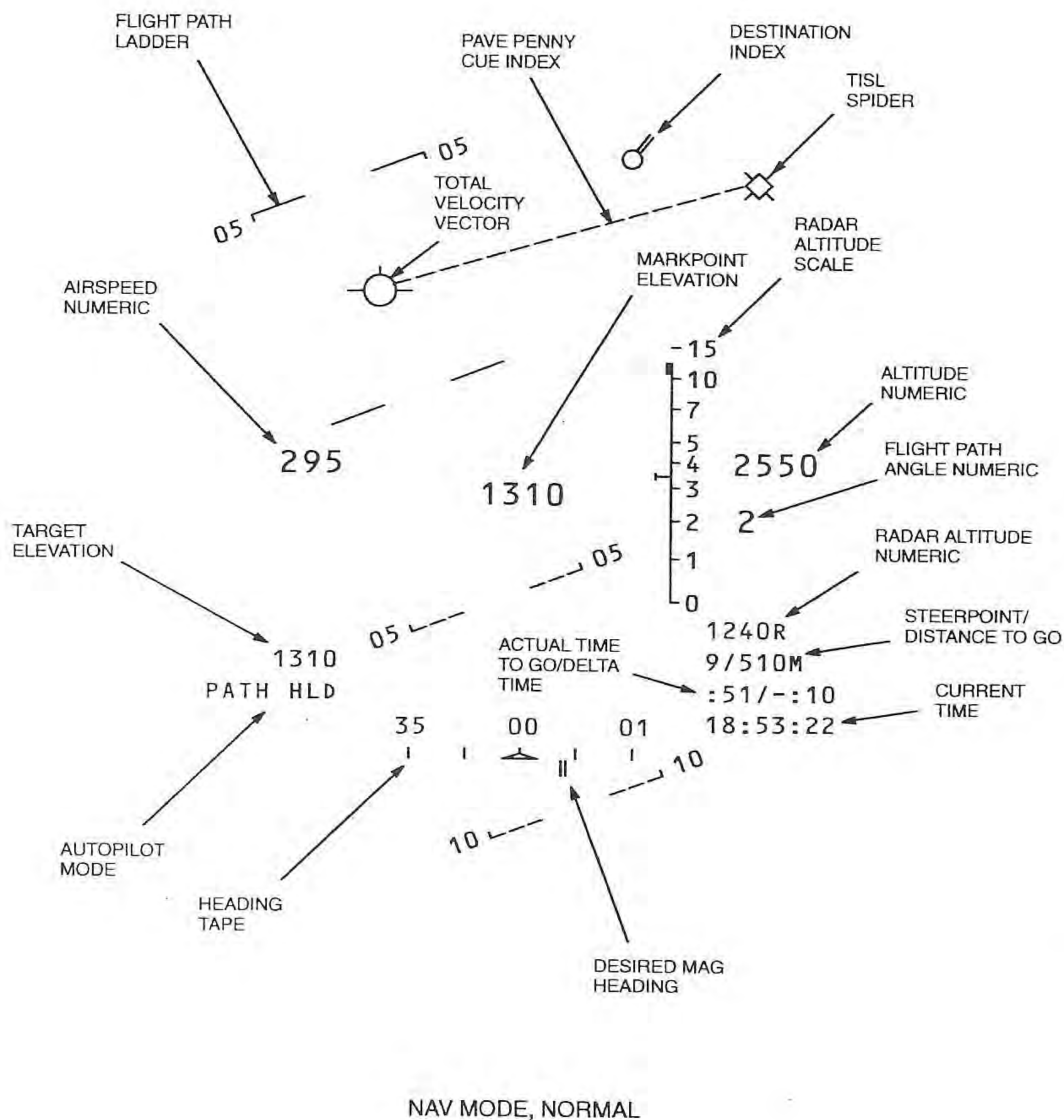
1. LASTE symbology size is not mode dependent.
2. The table contains symbol sizes; not occultation window sizes.
3. Symbol positions are measured in reference to HUD center.
4. Negative azimuth positions are measured from the y-axis to a point flush with right edge of symbol.
5. Positive azimuth positions are measured from the y-axis to a point flush with left edge of symbol.
6. Elevation positions are measured from the x-axis to a point flush with bottom edge of symbol.
7. Positions of crosses, tapes, and Break-X are measured from the x- or y-axis to the centers of the respective symbols.
8. Symbol size for text strings are for individual characters.

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*LASTE V6.0 only.

Figure 1-34. HUD Symbology Display Matrix (LASTE V6.0) (Sheet 5 of 5).

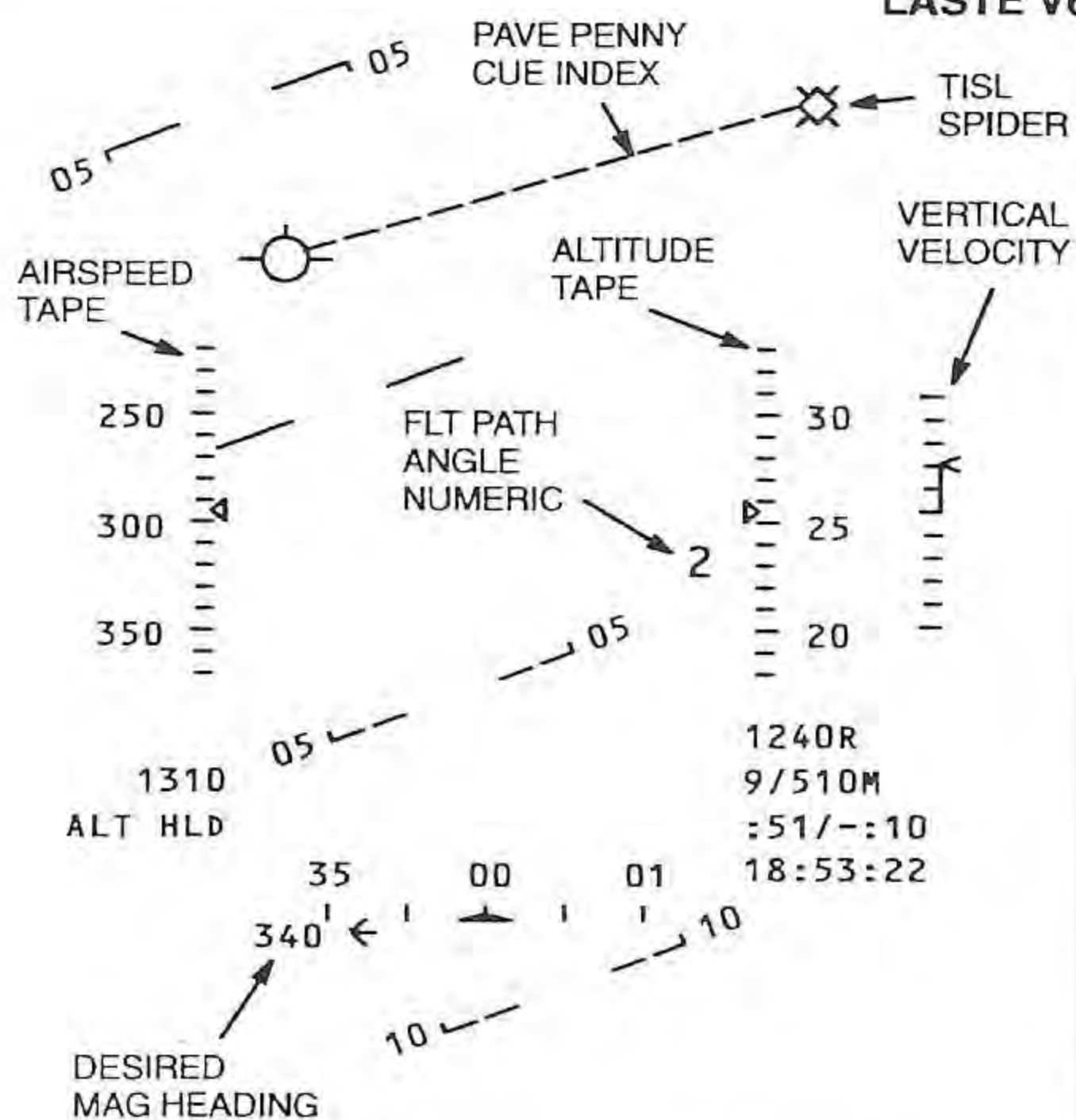
LASTE V6.0 NON GPS



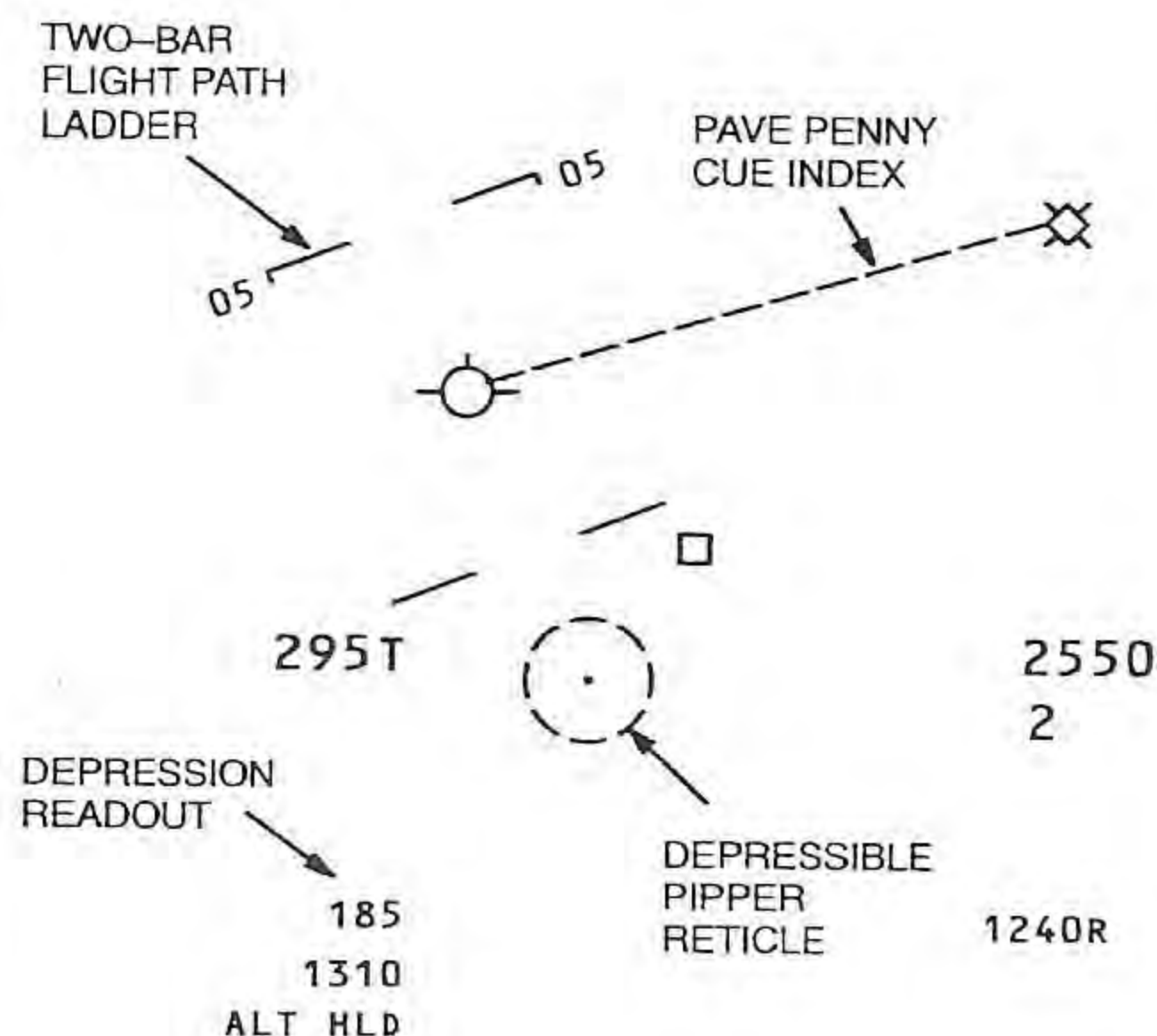
1A-10A-34-1-1-43

Figure 1-35. HUD Symbology Displays (LASTE V6.0 136 Non-GPS) (Sheet 1 of 11).

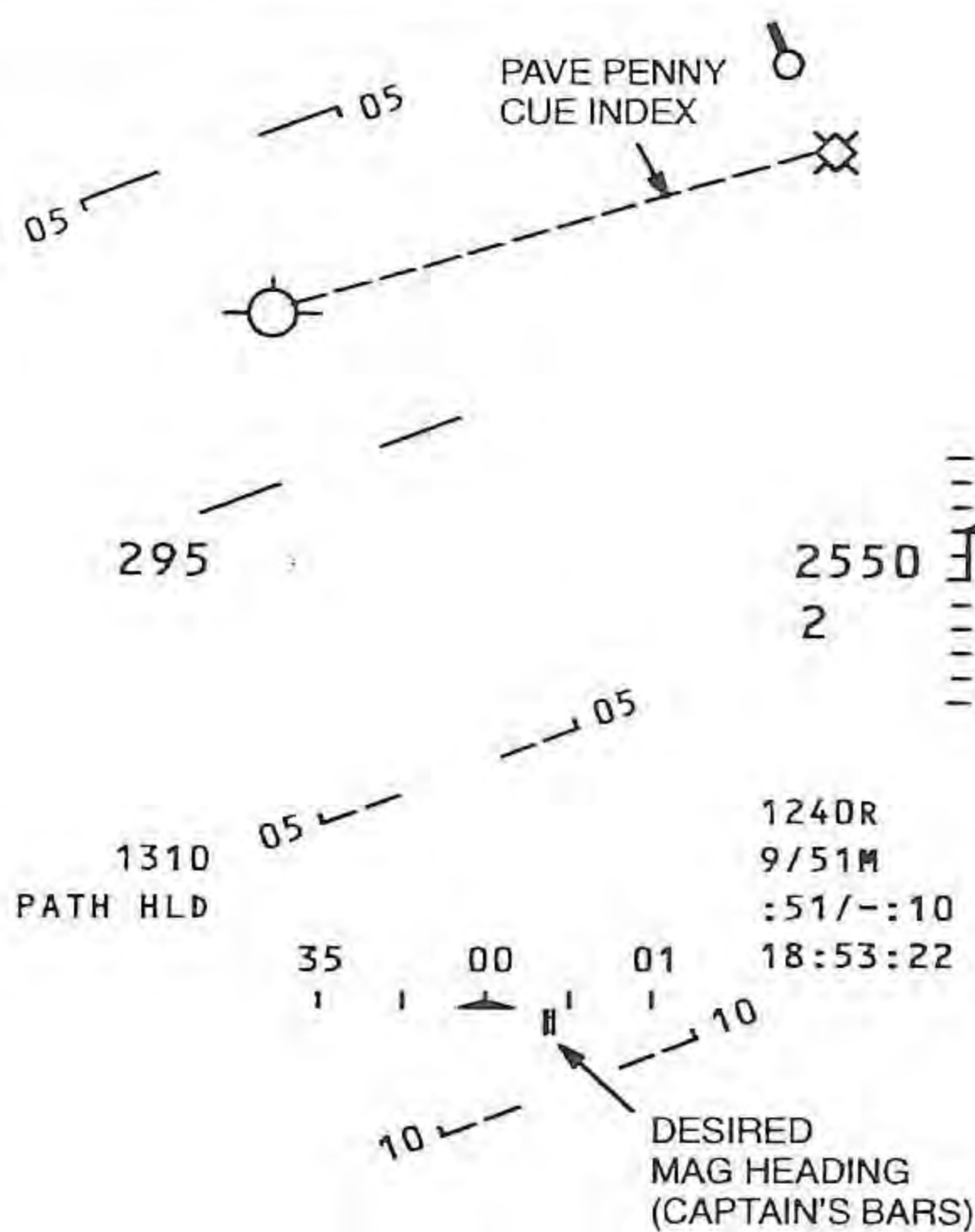
LASTE V6.0 NON GPS



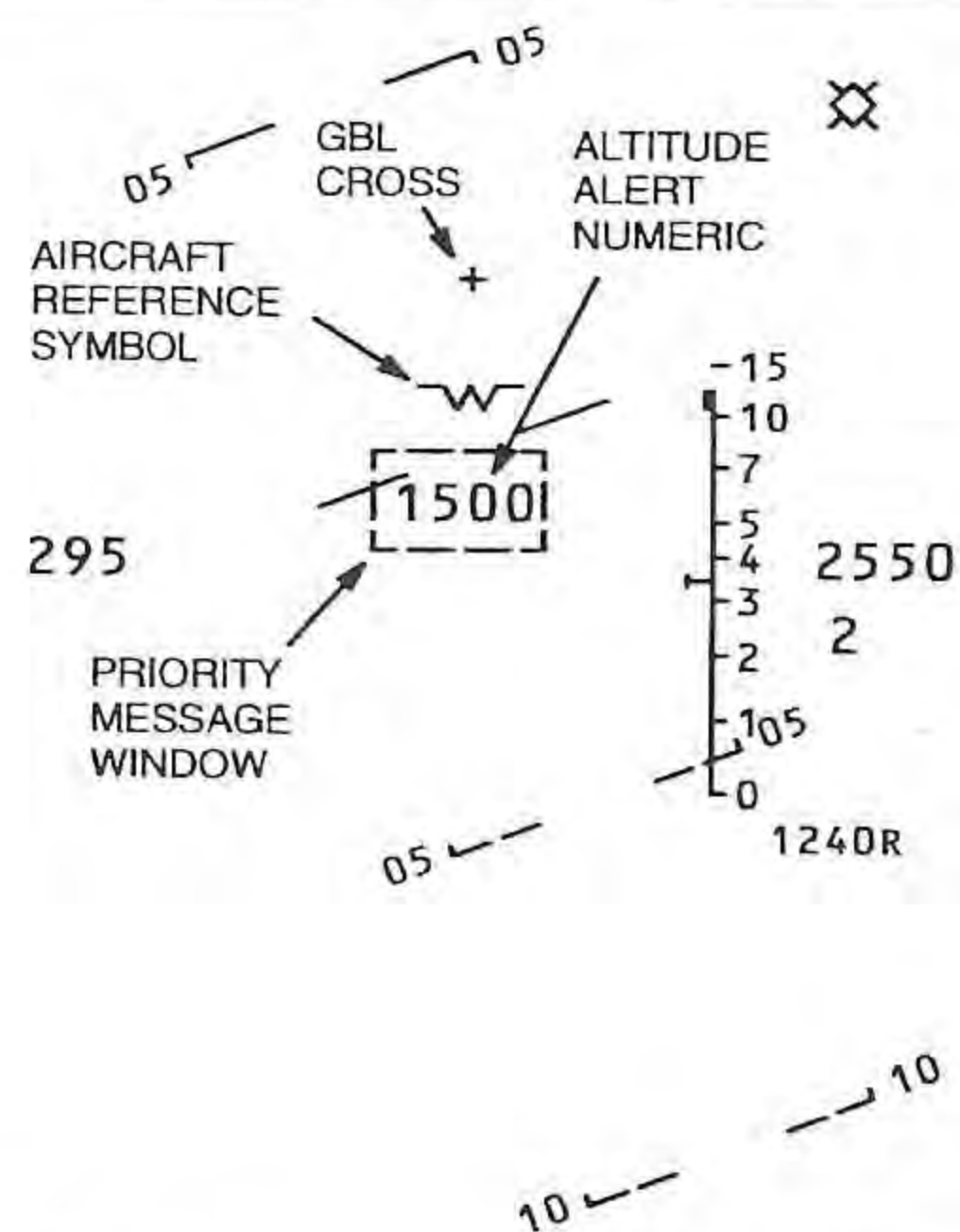
NAV MODE, OPTION A (WITH TAPES)



NAV MODE, OPTION B



NAV MODE, OPTION C

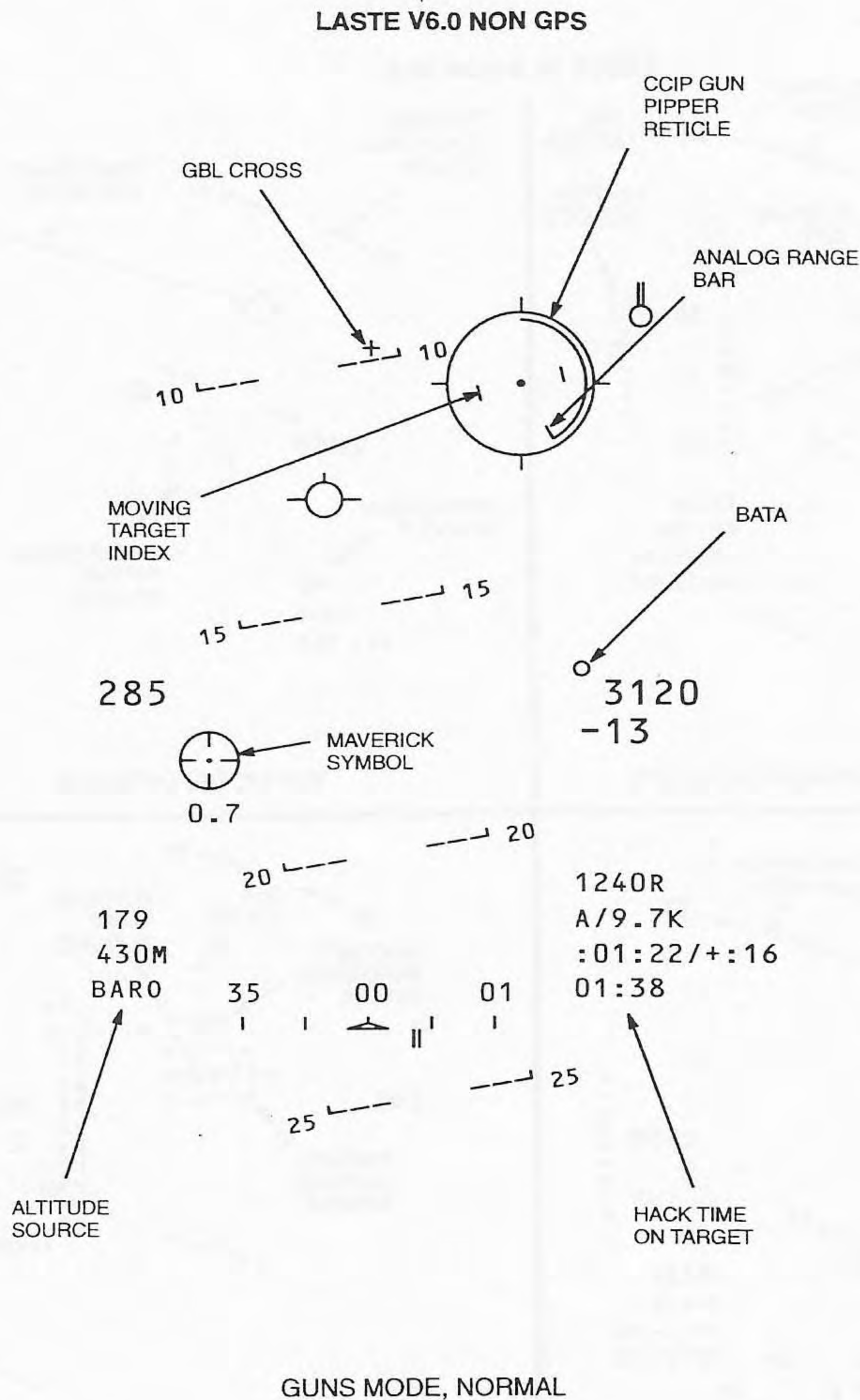


NOTE:
ALTITUDE ALERT NUMERIC IS DISPLAYED IN THE PRIORITY MESSAGE WINDOW FOR 2 SECONDS AFTER SWITCH RELEASE. DASHED LINES AROUND THE NUMERIC ARE SHOWN TO DEFINE BOUNDARIES OF THE WINDOW AND ARE NOT DISPLAYED ON THE HUD.

NAV MODE, HARS

1A-10A-34-1-1-44

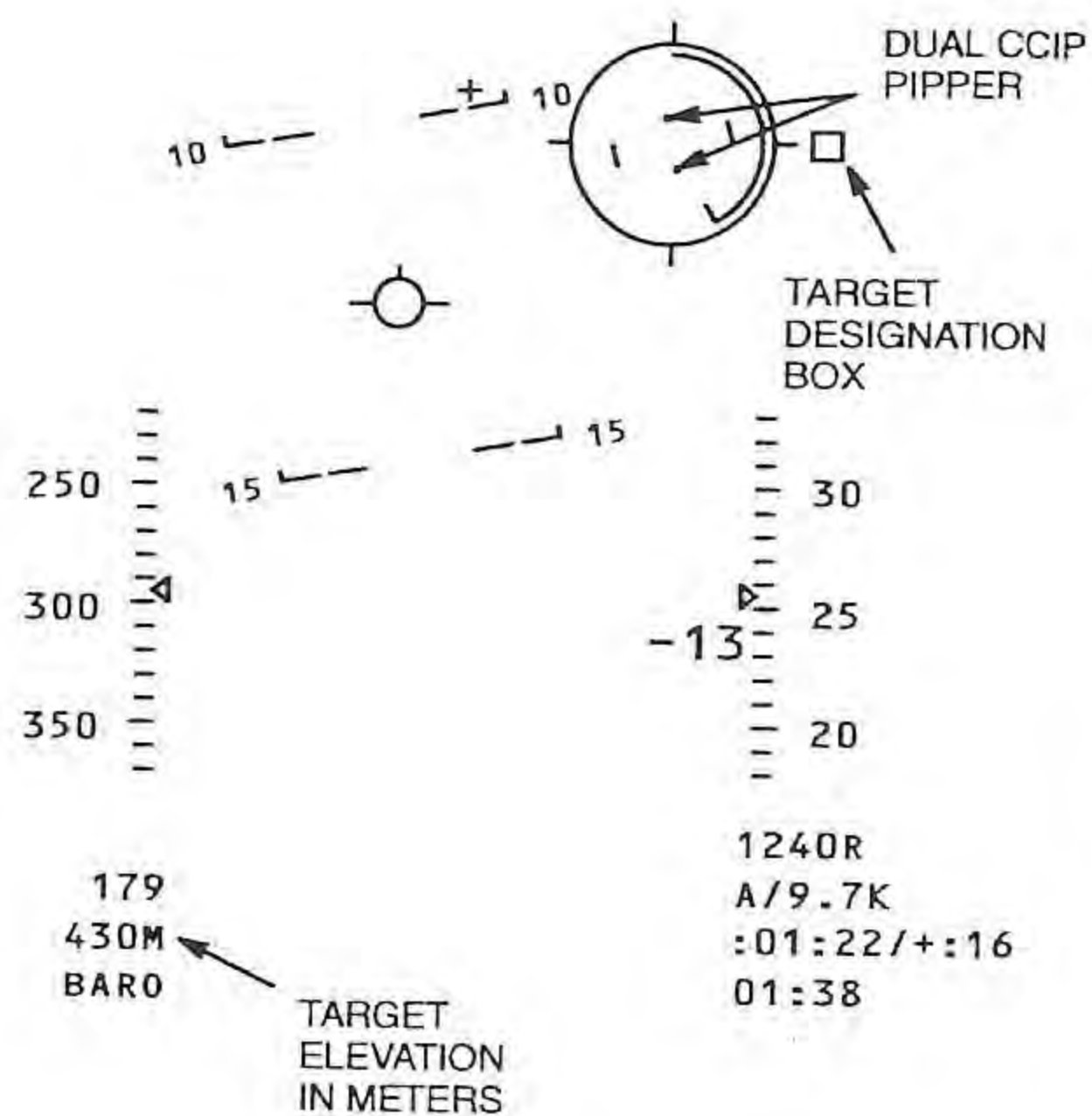
Figure I-35. HUD Symbology Displays (LASTE V6.0 136 Non-GPS) (Sheet 2 of 11).



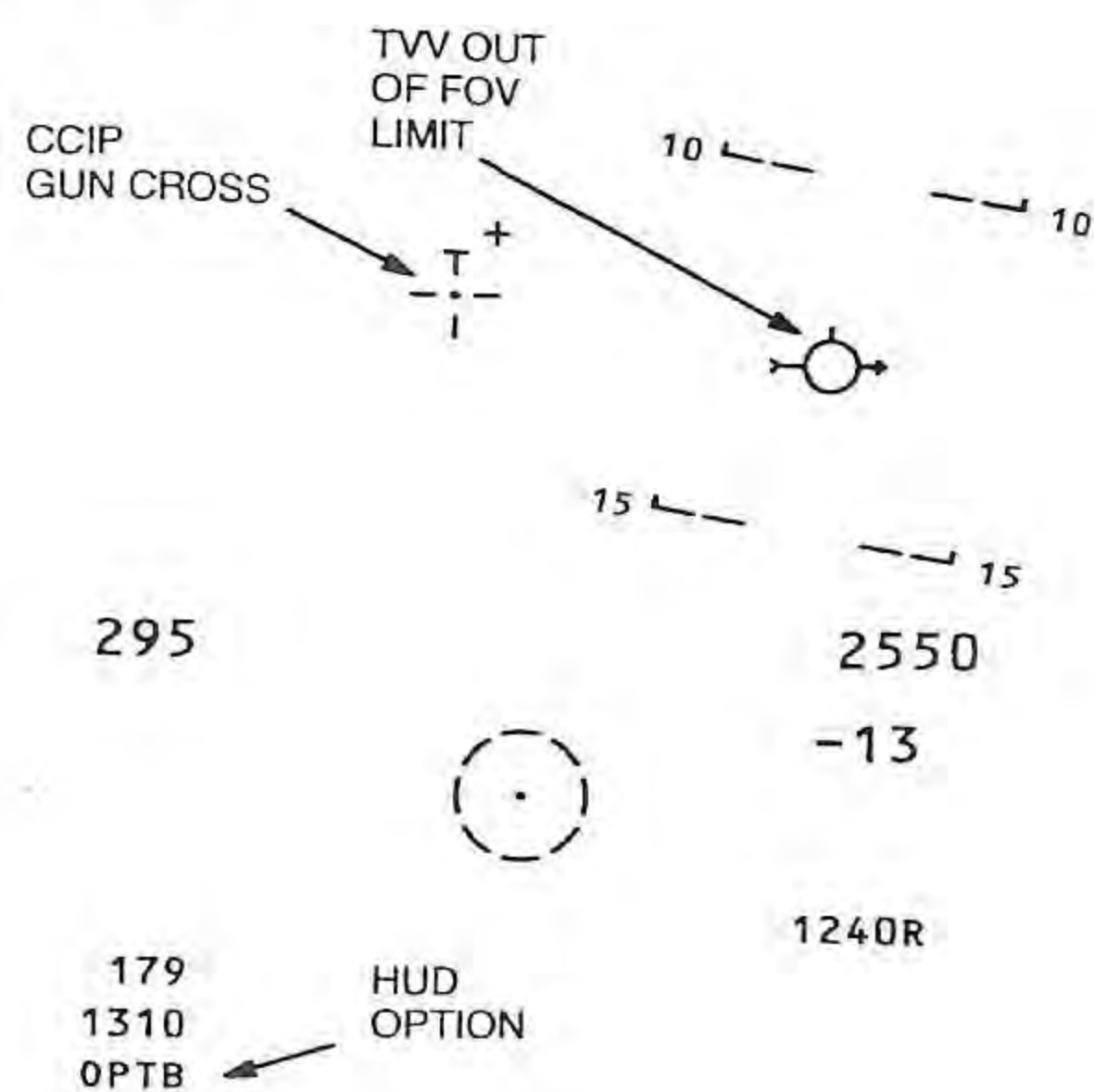
1A-10A-34-1-1-45

Figure 1-35. HUD Symbology Displays (LASTE V6.0 136 Non-GPS) (Sheet 3 of 11).

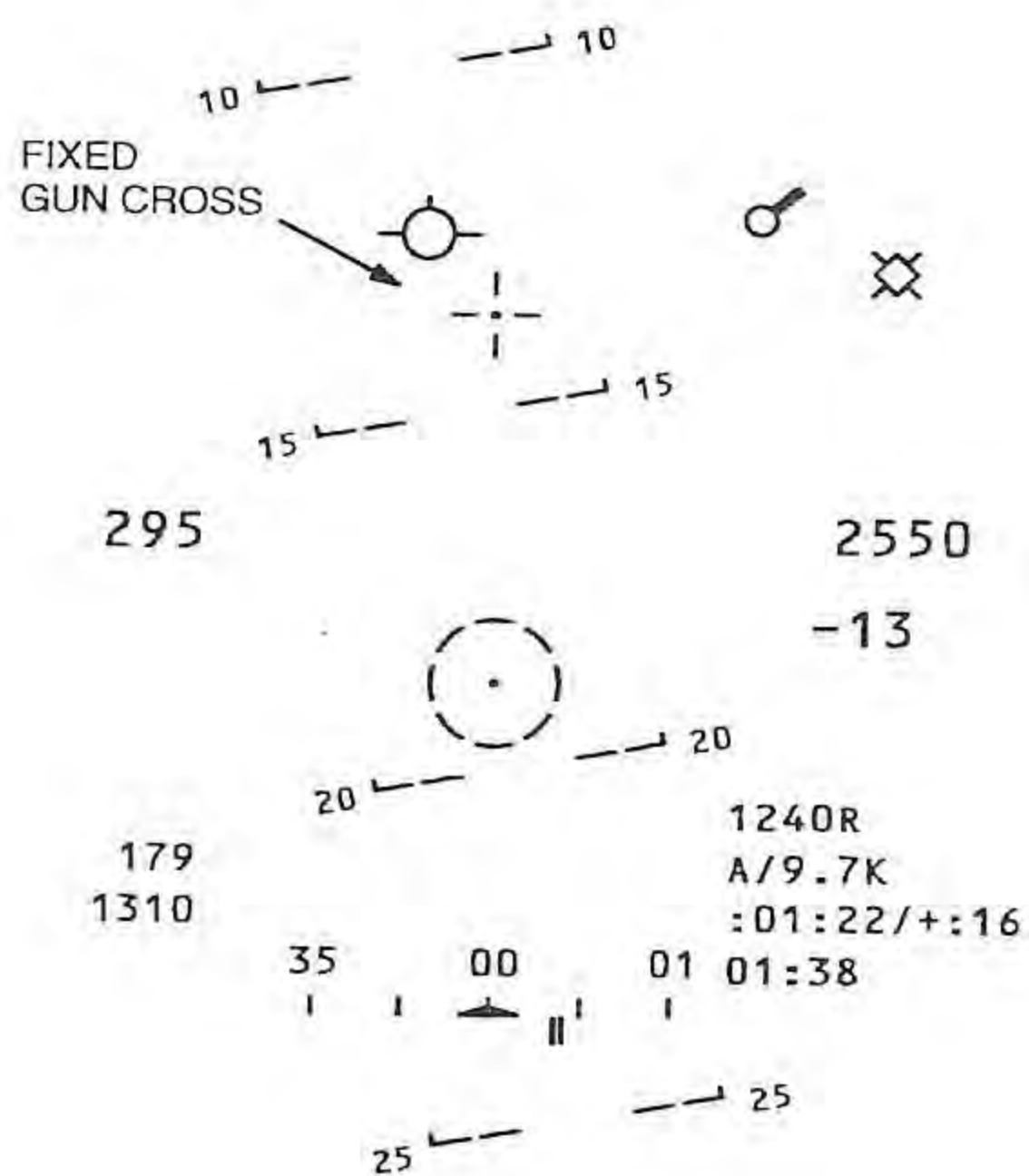
LASTE V6.0 NON GPS



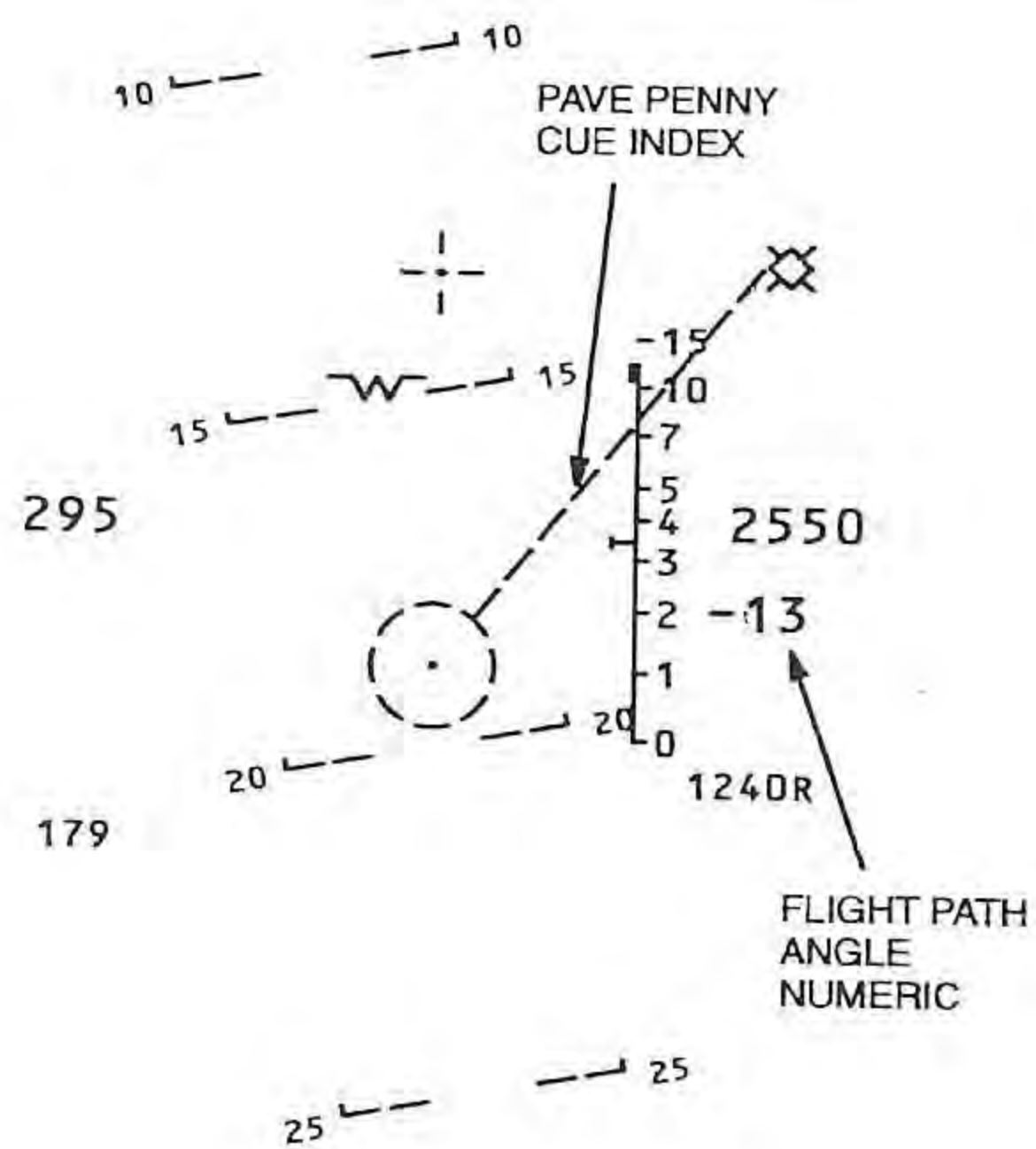
GUNS MODE, OPTION A (WITH TAPES)



GUNS MODE, OPTION B



GUNS MODE, OPTION C



GUNS MODE, HARS

1A-10A-34-1-1-46

Figure I-35. HUD Symbology Displays (LASTE V6.0 136 Non-GPS) (Sheet 4 of 11).

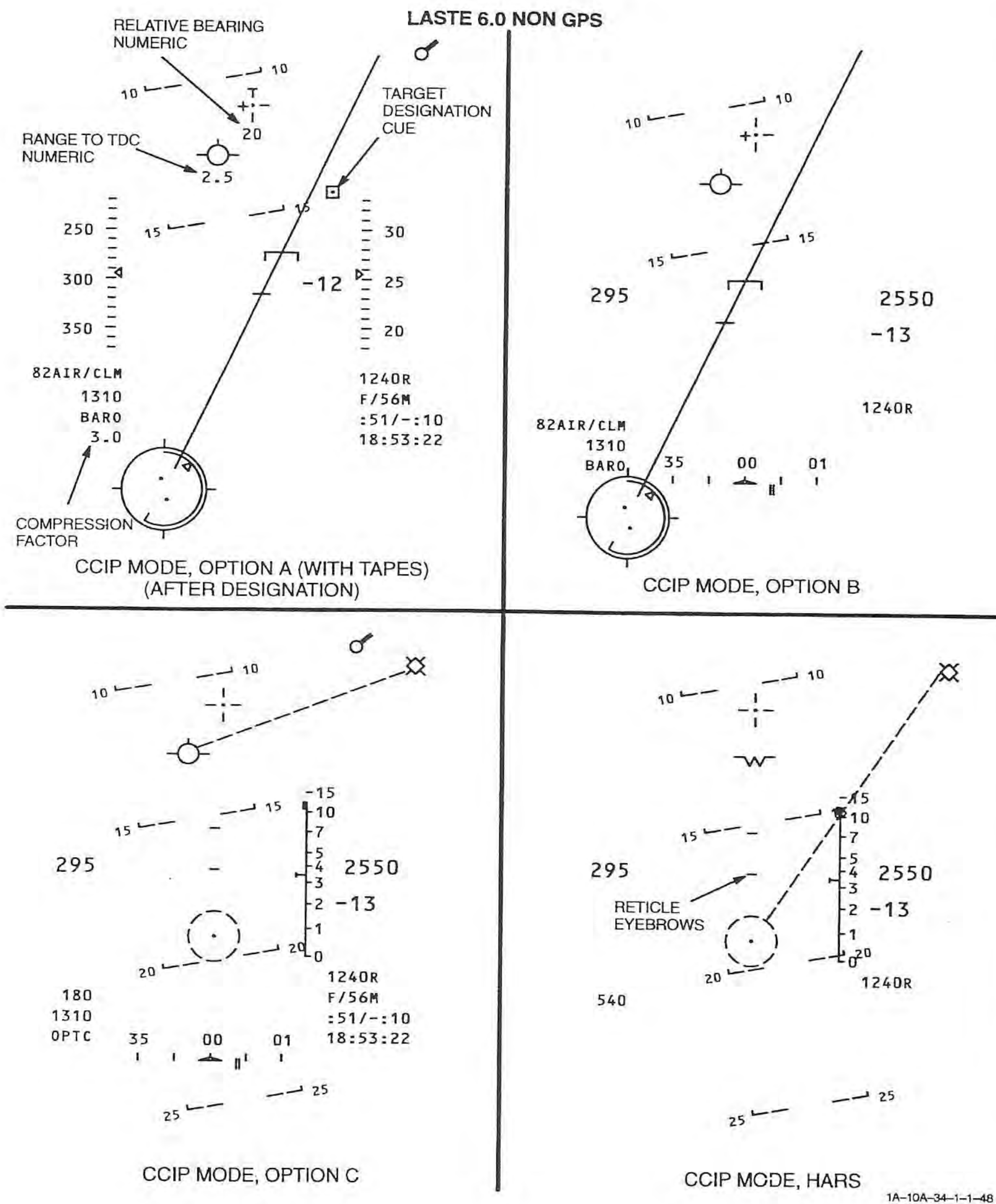
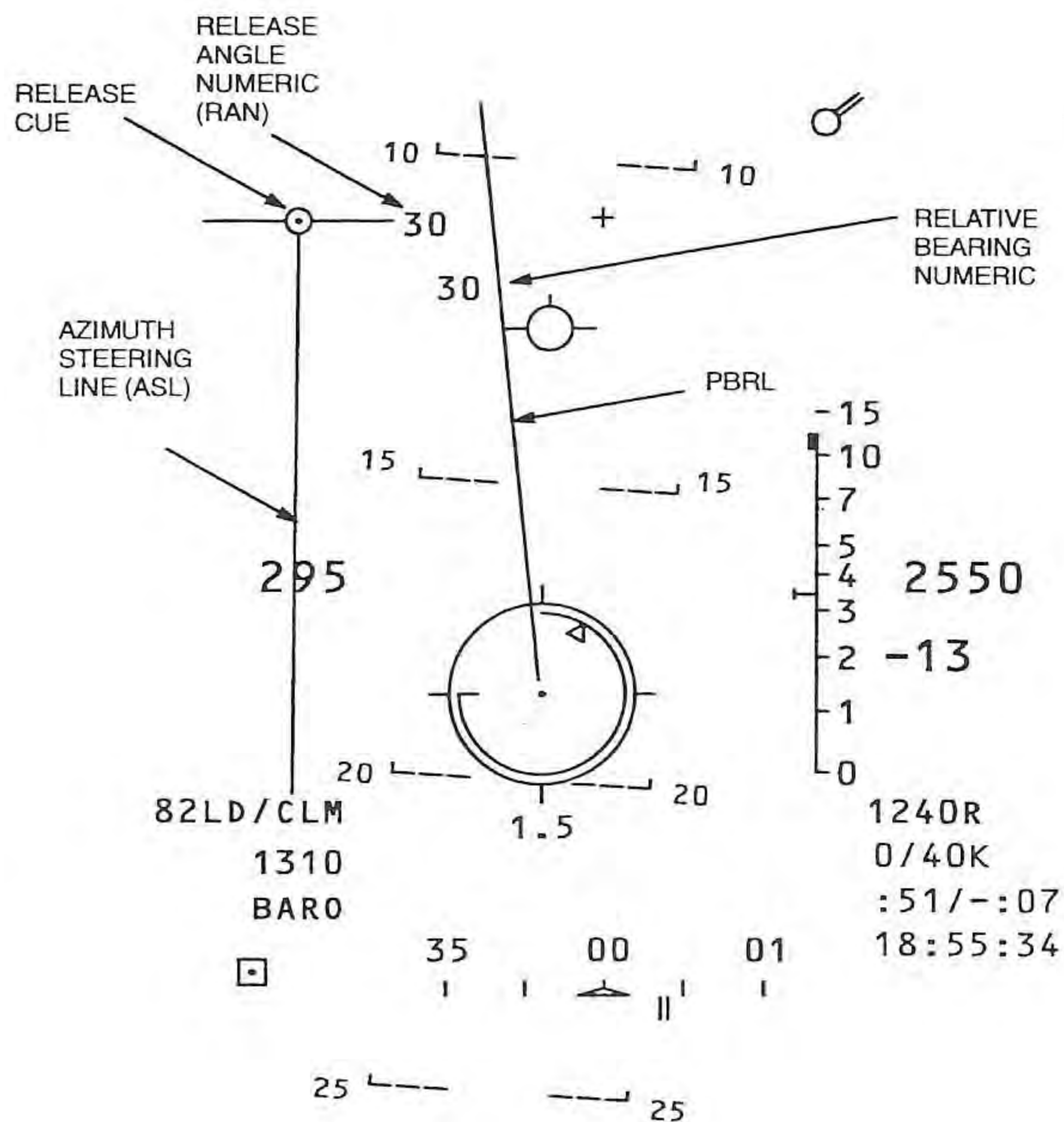


Figure I-35. HUD Symbology Displays (LASTE V6.0 136 Non-GPS) (Sheet 6 of 11).

LASTE V6.0 NON GPS



CCRP MODE, NORMAL

1A-10A-34-1-1-49

Figure I-35. HUD Symbology Displays (LASTE V6.0 136 Non-GPS) (Sheet 7 of 11).

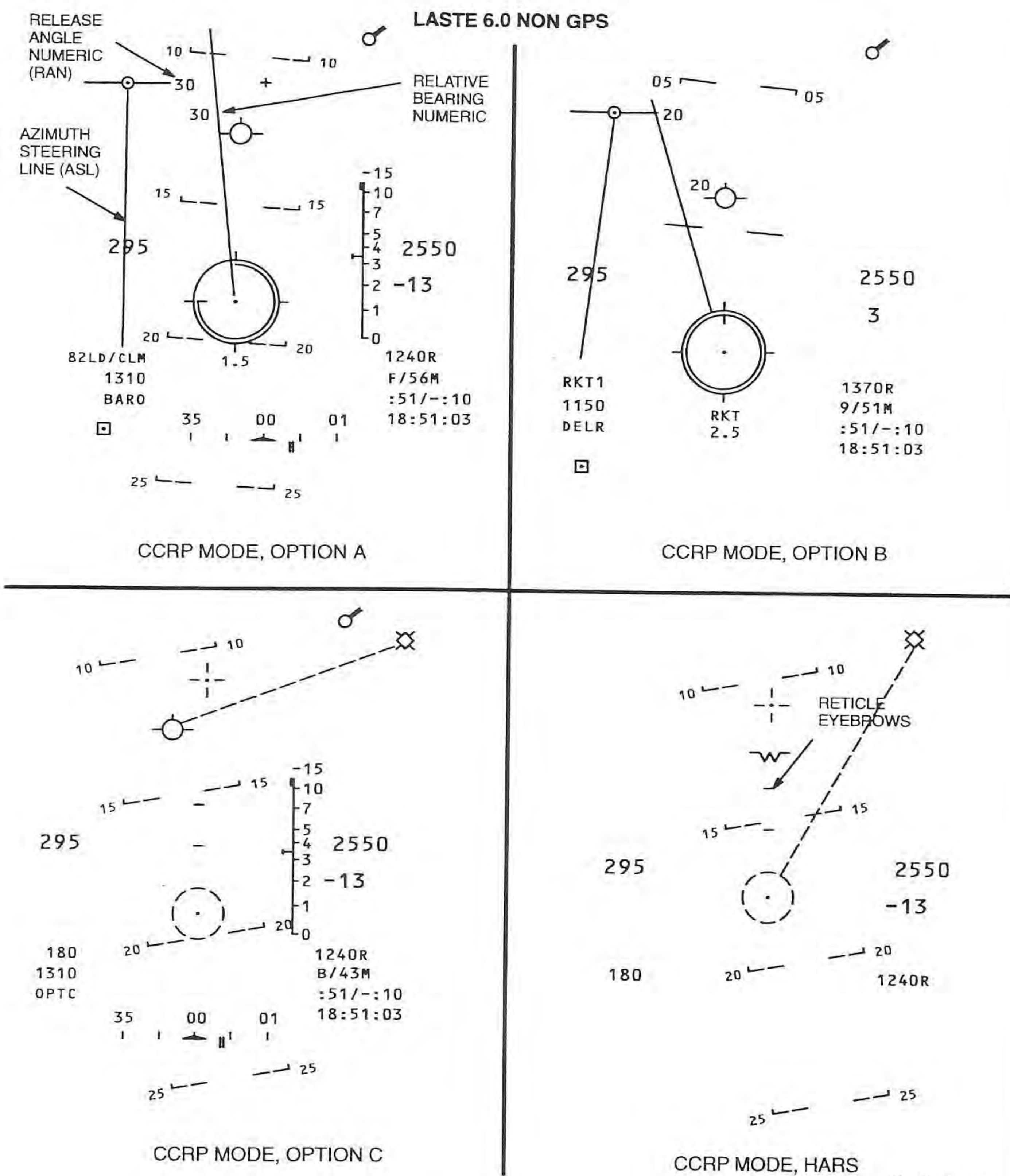
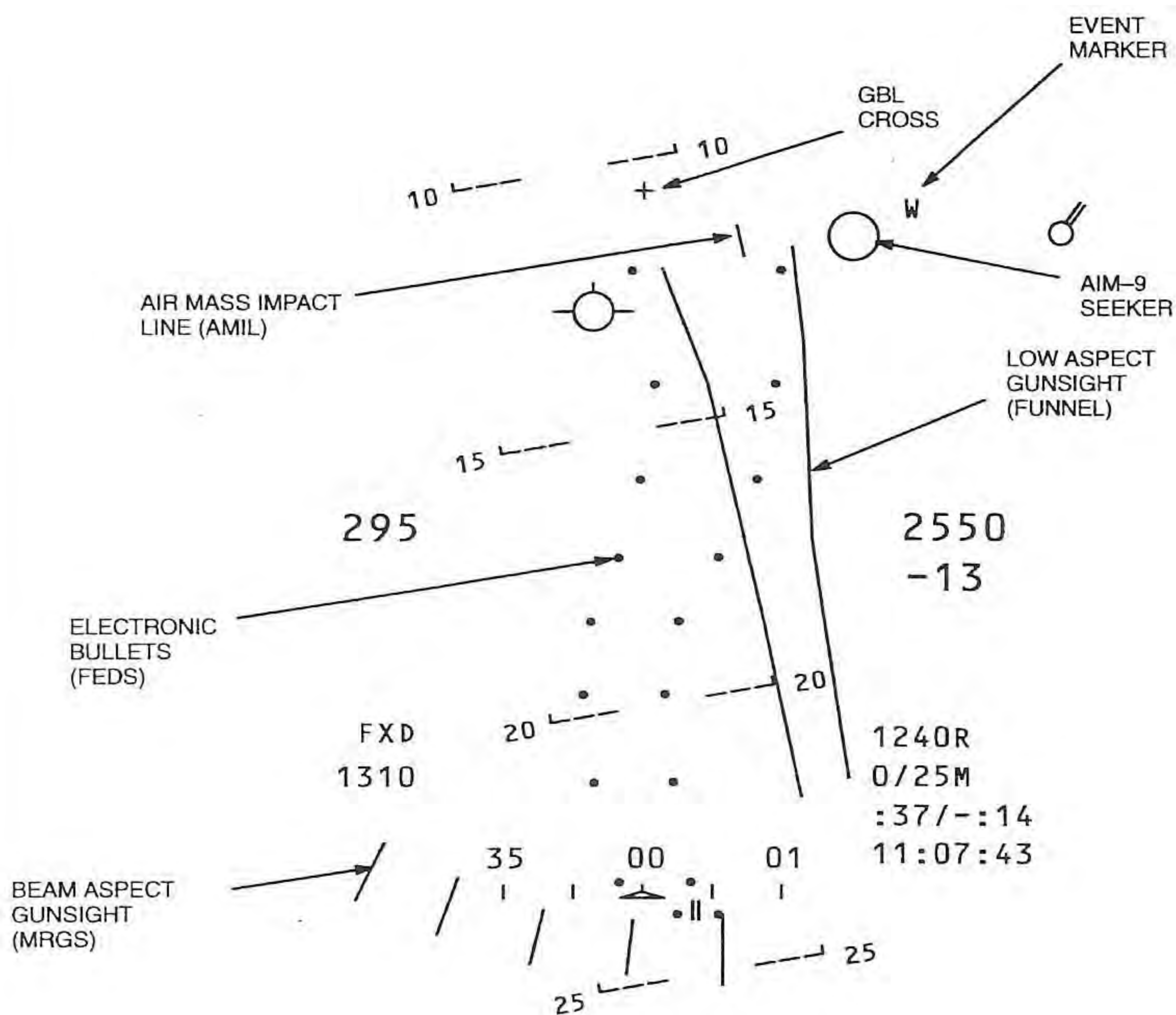


Figure 1-35. HUD Symbology Displays (LASTE V6.0 136 Non-GPS) (Sheet 8 of 11).

LASTE V6.0 NON GPS

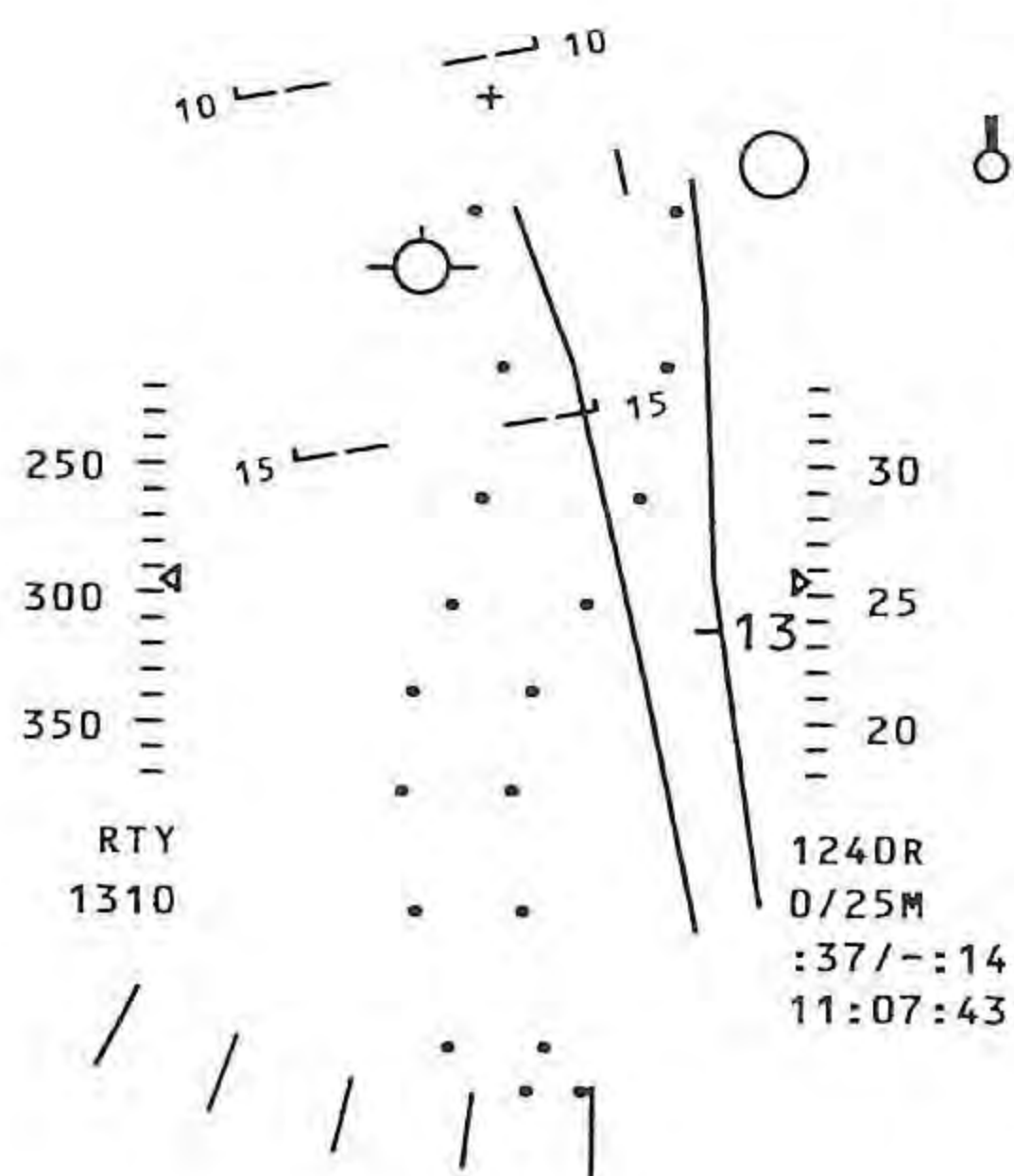


AIR-TO-AIR MODE, NORMAL

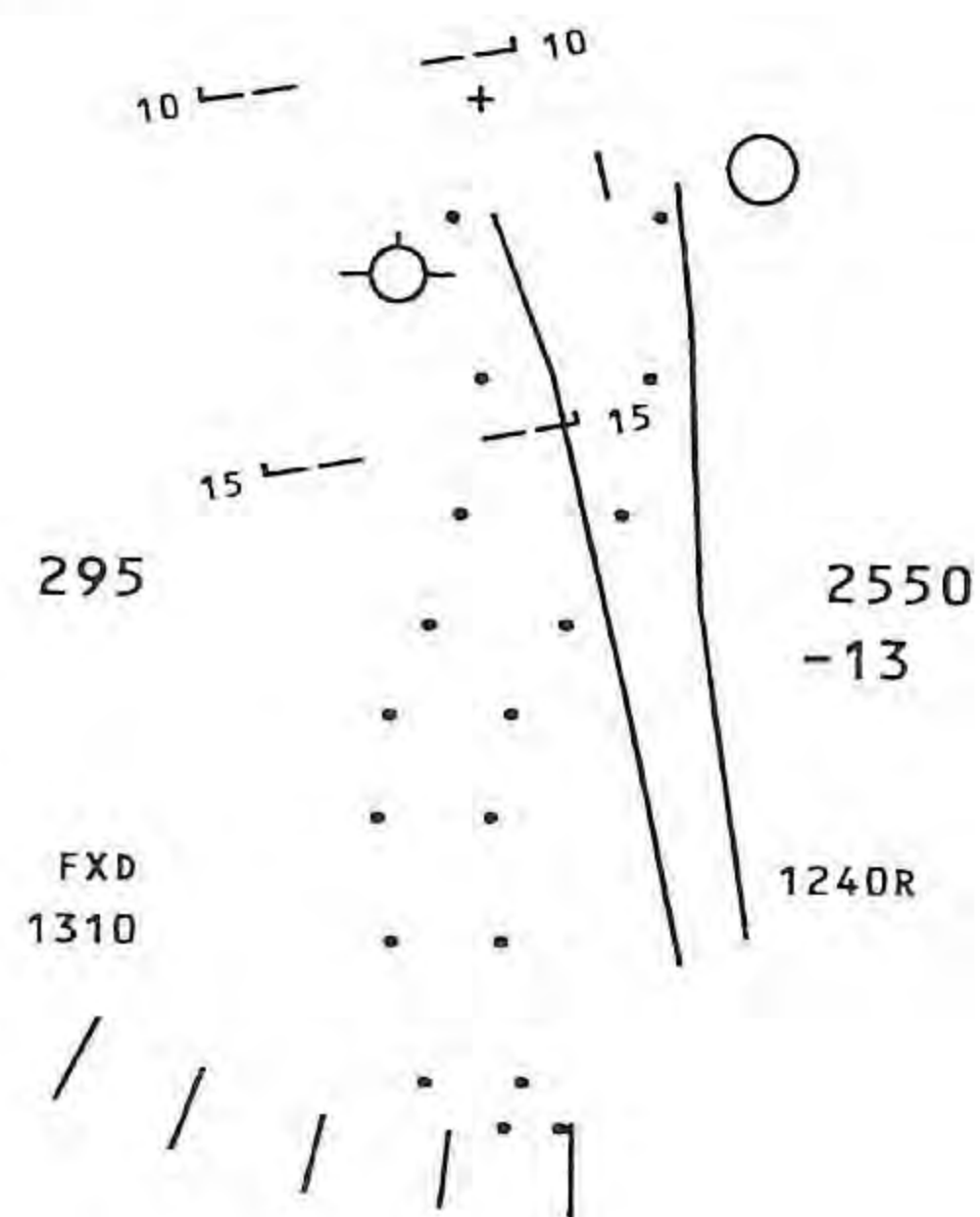
1A-10A-34-1-1-51

Figure 1-35. HUD Symbology Displays (LASTE V6.0 136 Non-GPS) (Sheet 9 of 11).

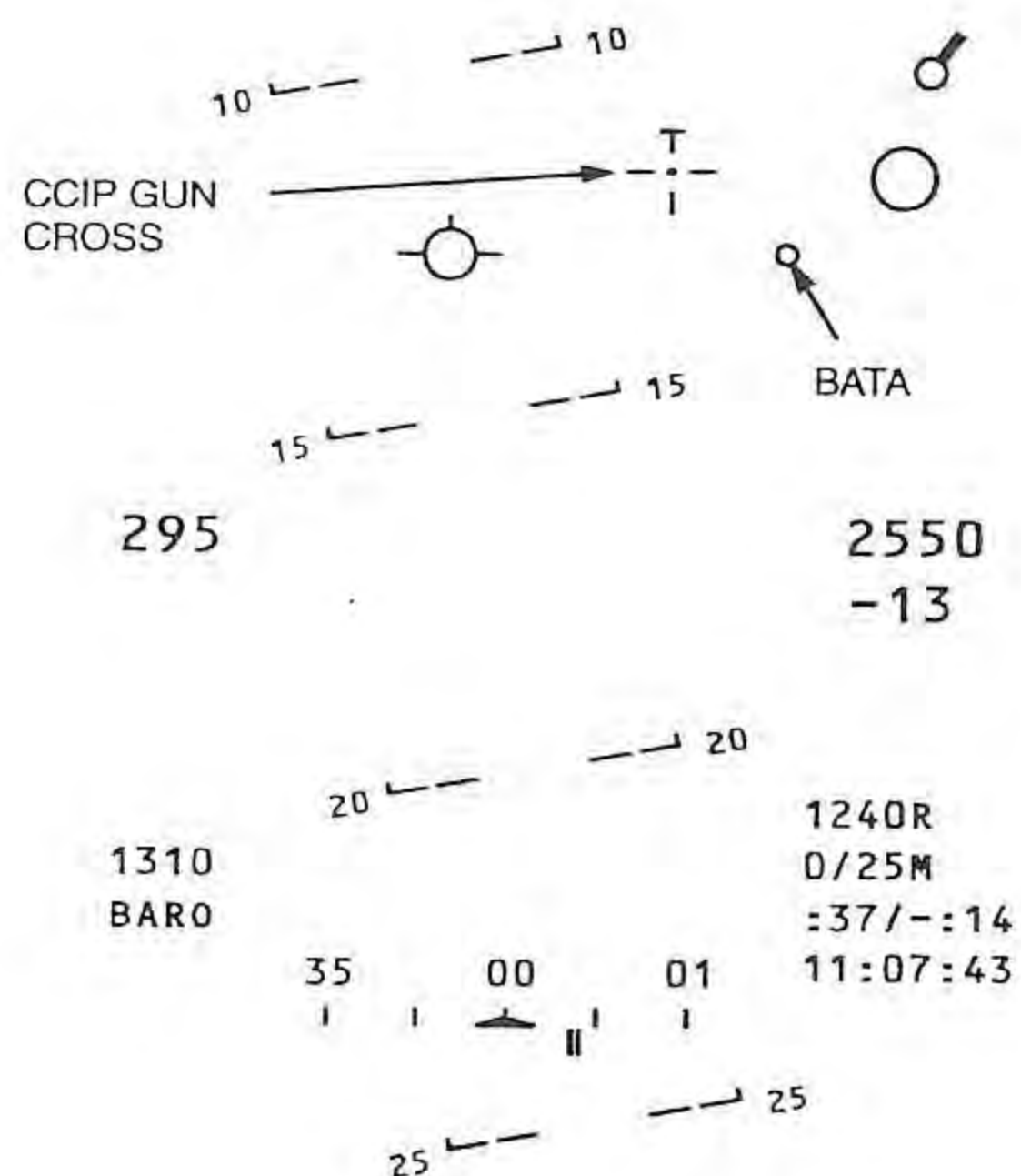
LASTE V6.0 NON GPS



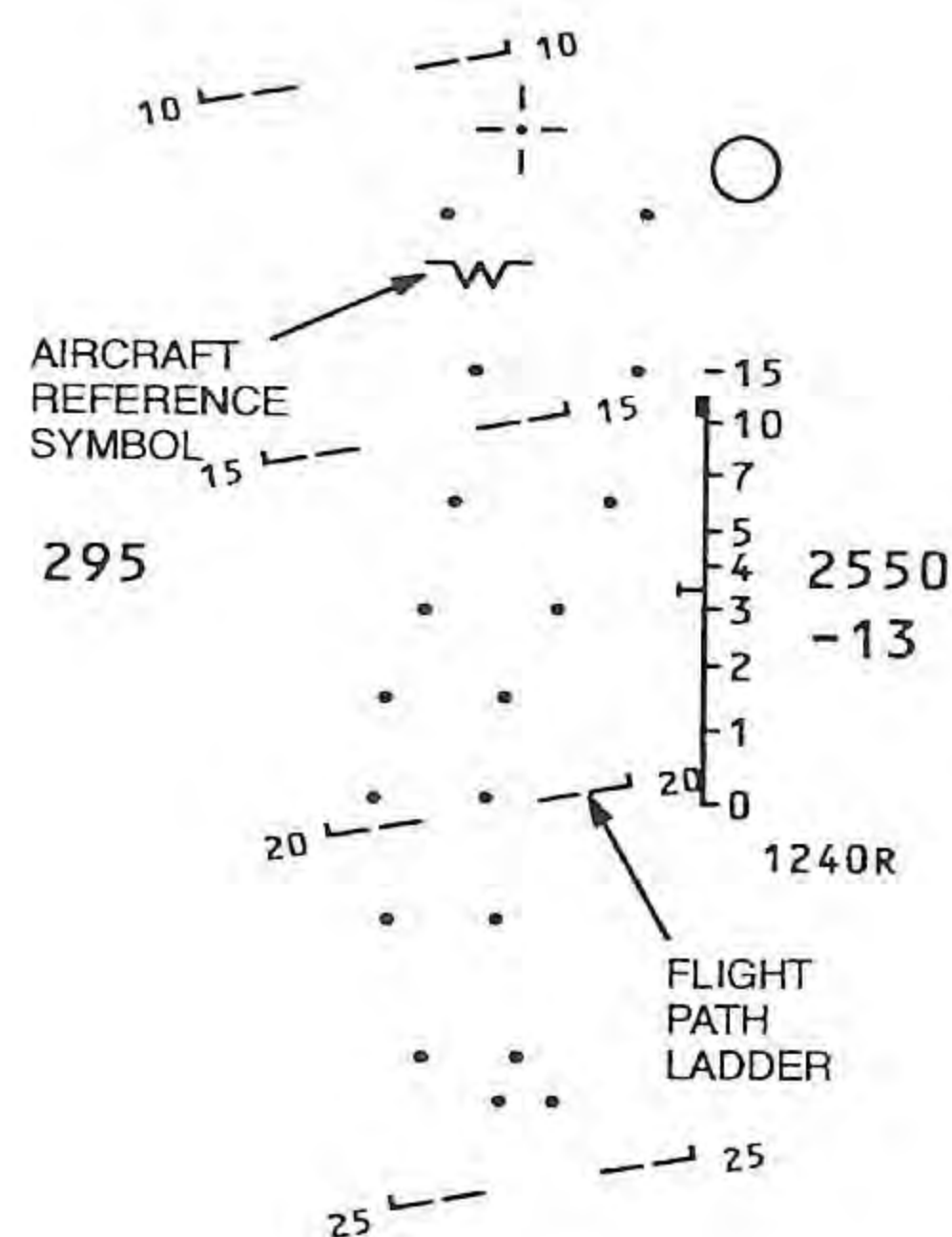
AIR-TO-AIR MODE, OPTION A (WITH TAPES)



AIR-TO-AIR MODE, OPTION B



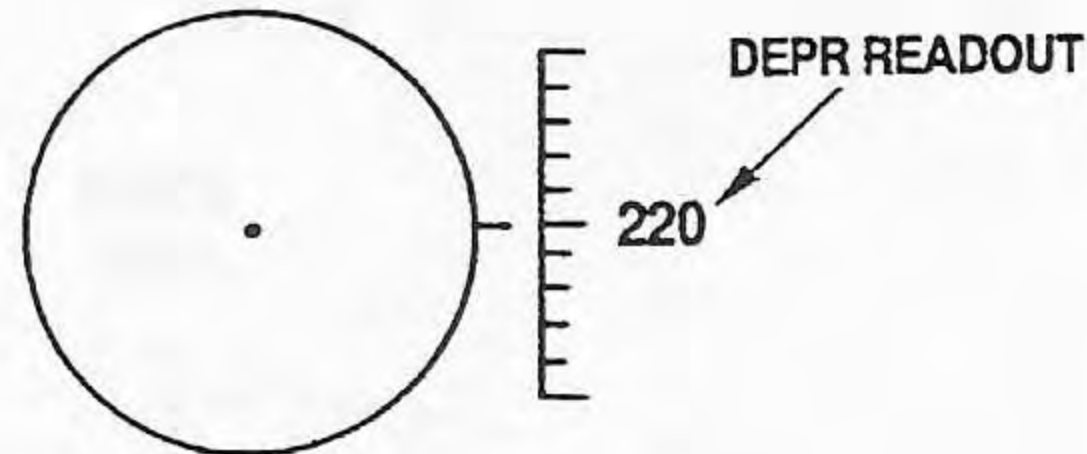
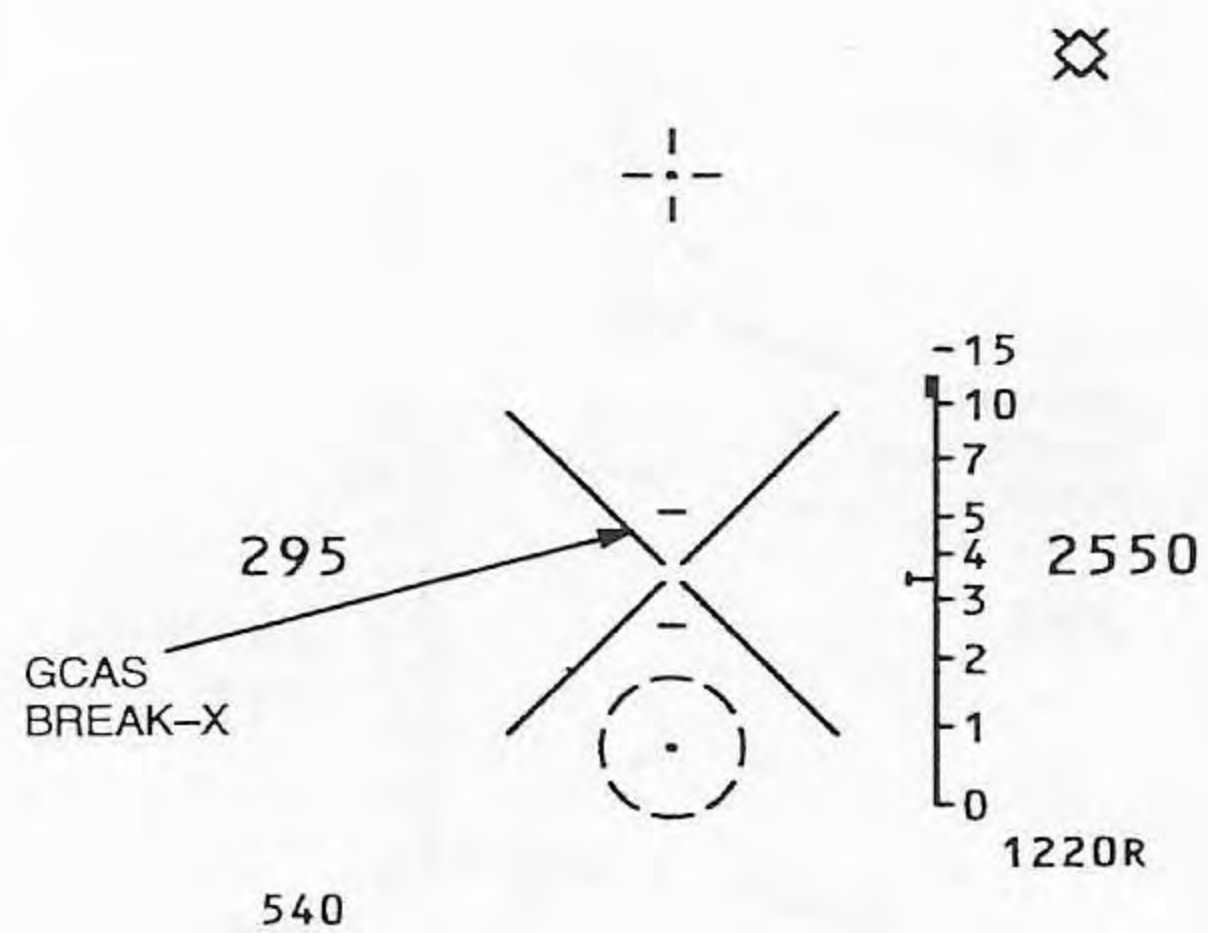
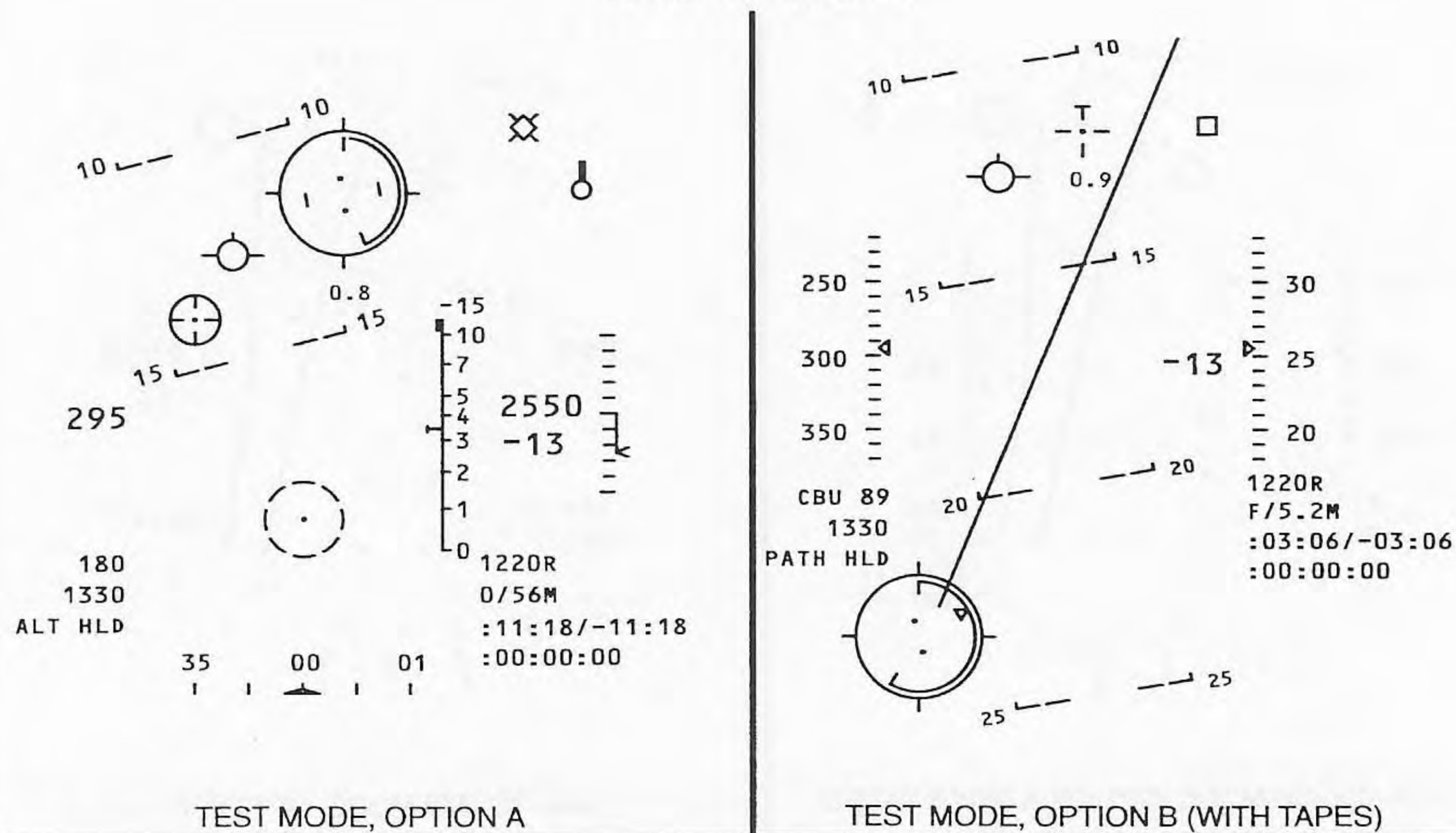
AIR-TO-AIR MODE, OPTION C



AIR-TO-AIR MODE, HARS) 1A-10A-34-1-1-52

Figure 1-35. HUD Symbology Displays (LASTE V6.0 136 Non-GPS) (Sheet 10 of 11).

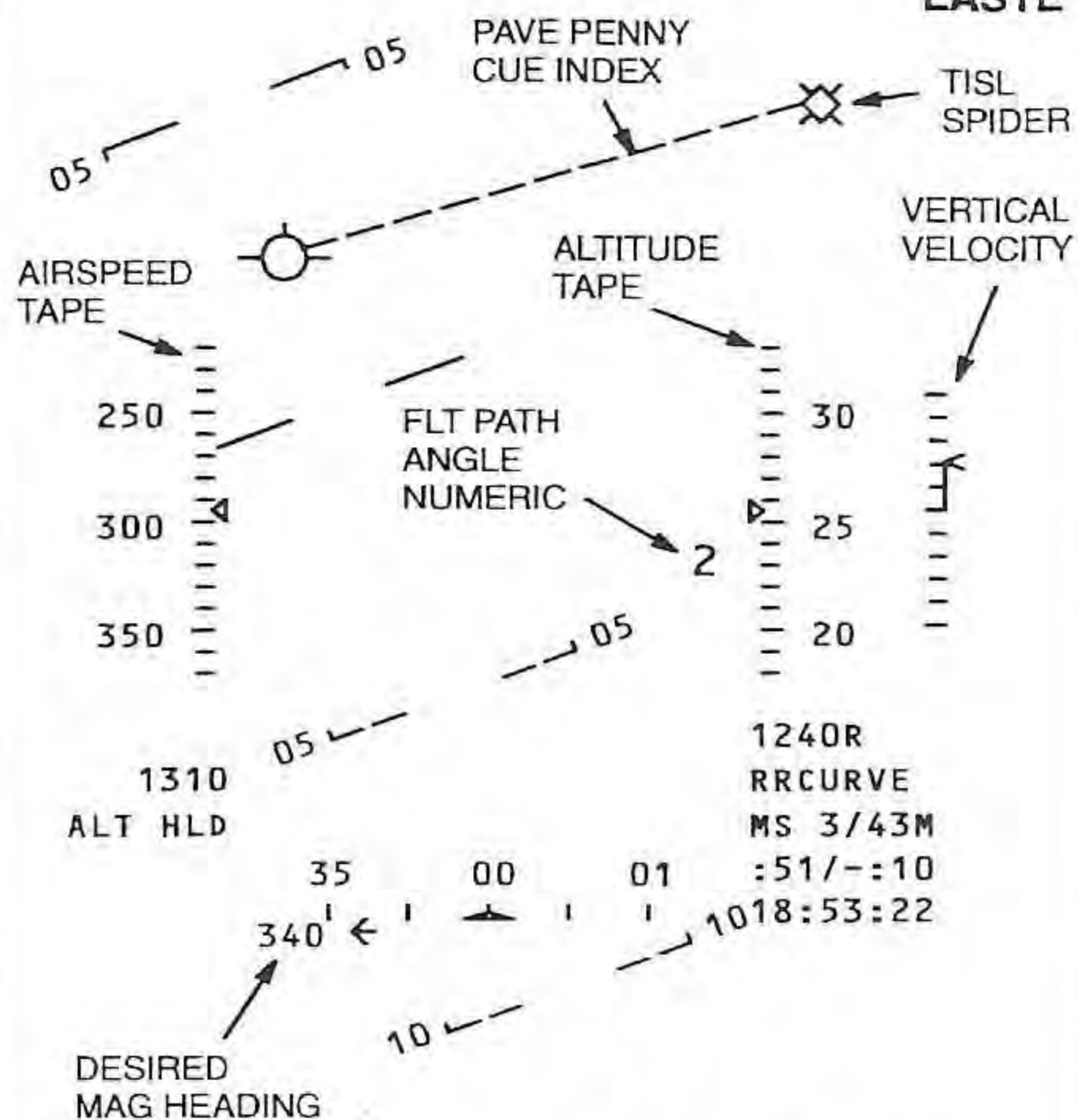
LASTE V6.0 NON GPS



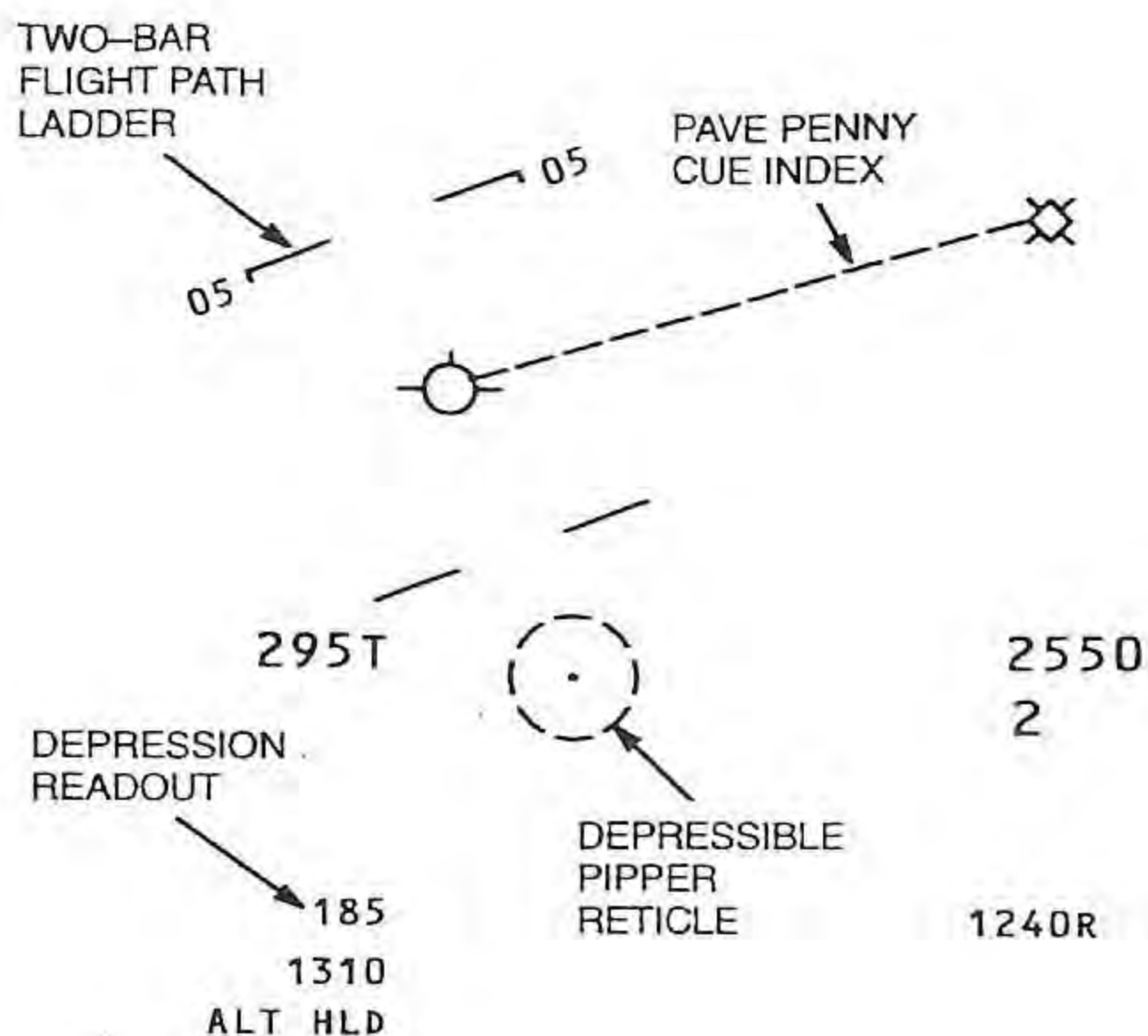
1A-10A-34-1-1-53

Figure 1-35. HUD Symbology Displays (LASTE V6.0 136 Non-GPS) (Sheet 11 of 11).

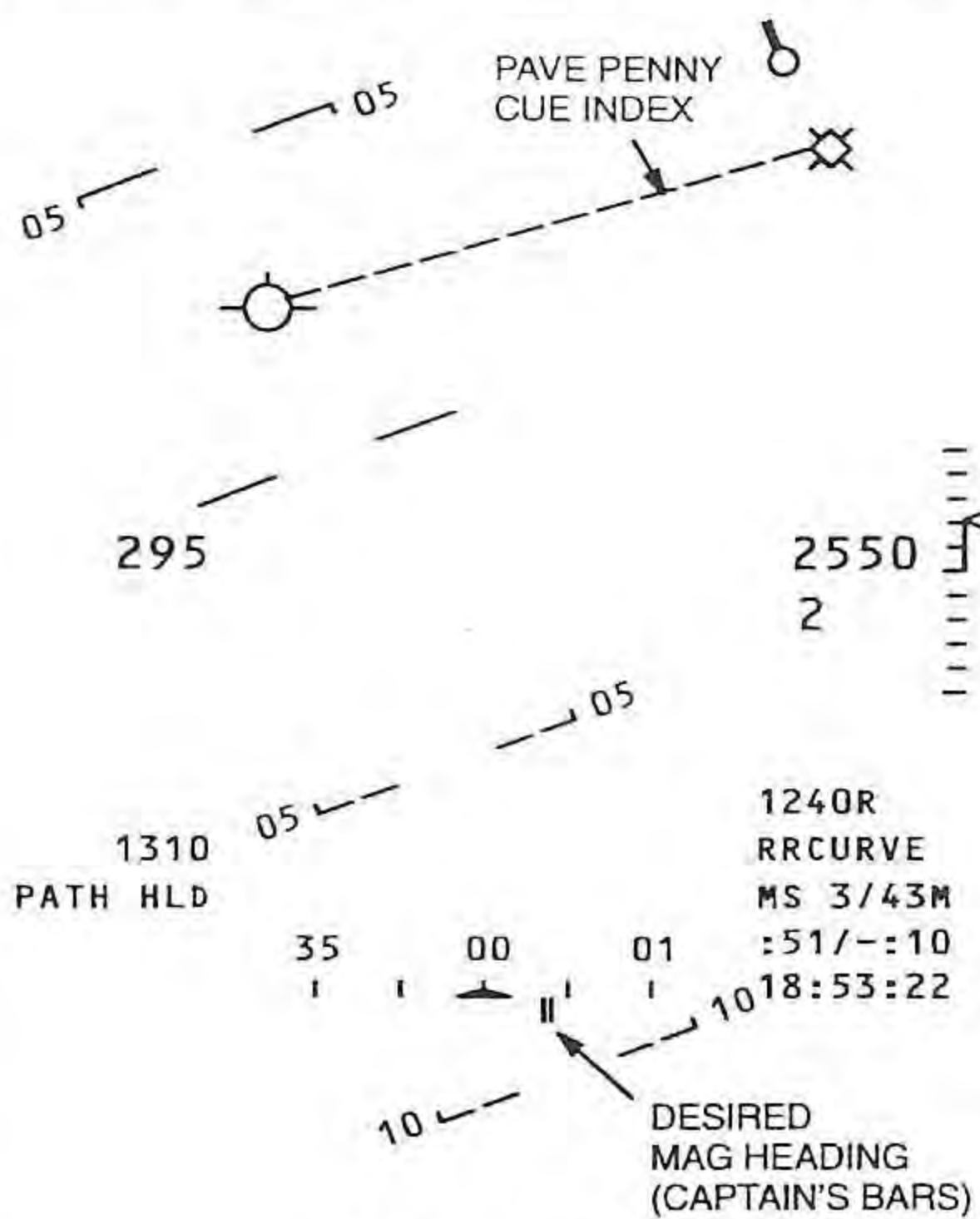
LASTE V6.0 GPS



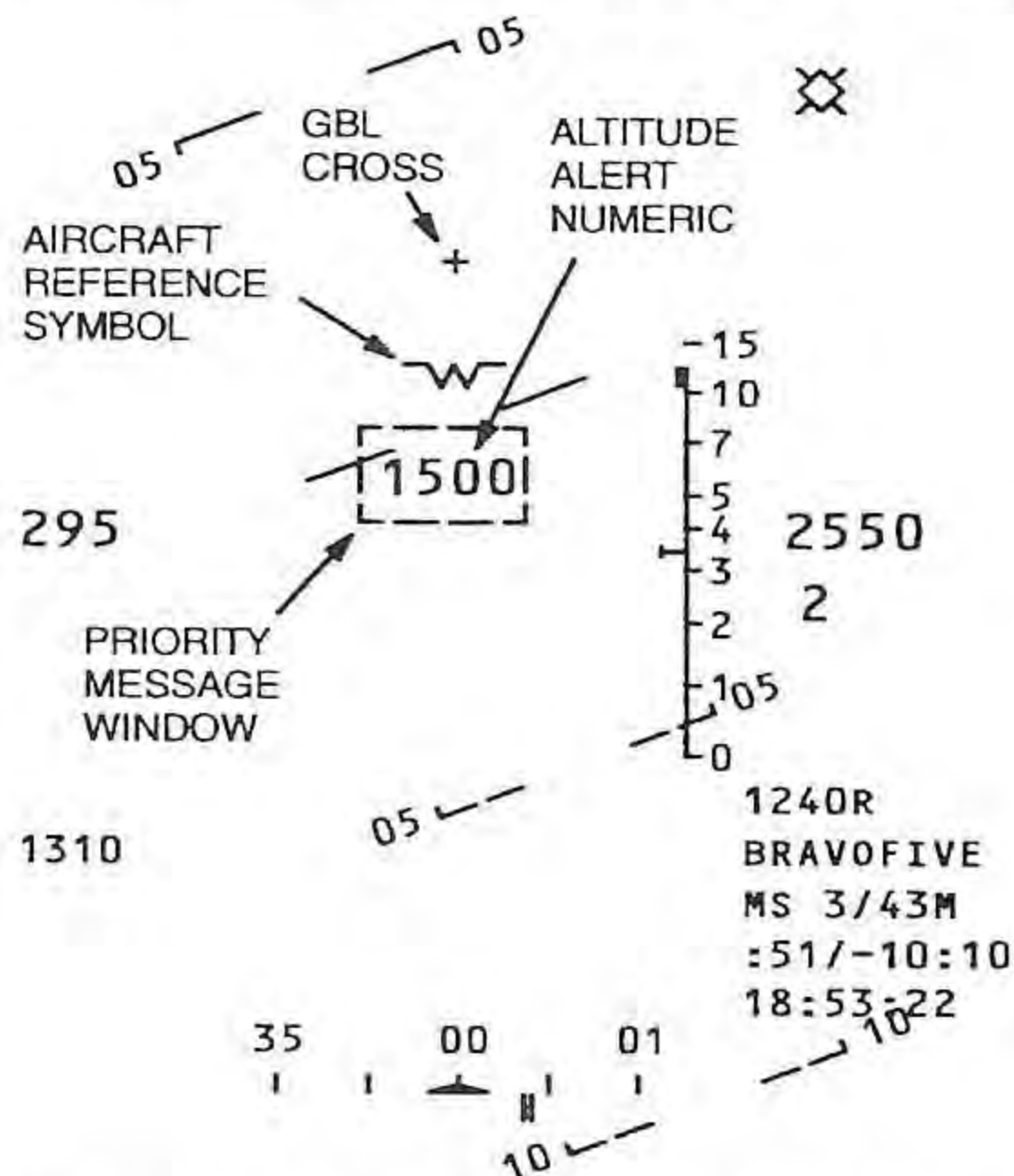
NAV MODE, OPTION A (WITH TAPES)



NAV MODE, OPTION B



NAV MODE, OPTION C

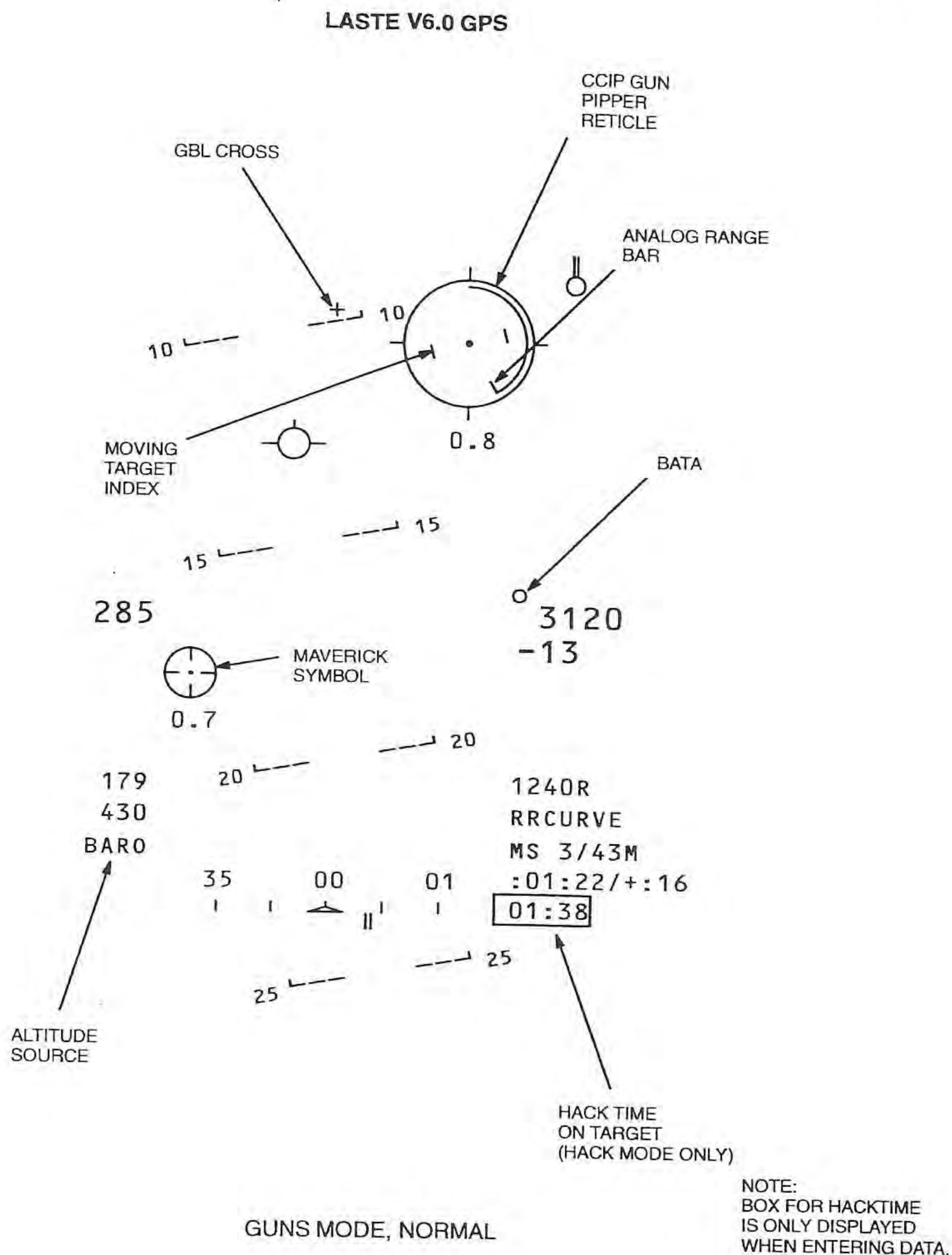


NAV MODE, HARS

1A-10A-34-1-1-55

NOTE:
ALTITUDE ALERT NUMERIC IS DISPLAYED IN THE PRIORITY MESSAGE WINDOW FOR 2 SECONDS AFTER SWITCH RELEASE. DASHED LINES AROUND THE NUMERIC ARE SHOWN TO DEFINE BOUNDARIES OF THE WINDOW AND ARE NOT DISPLAYED ON THE HUD.

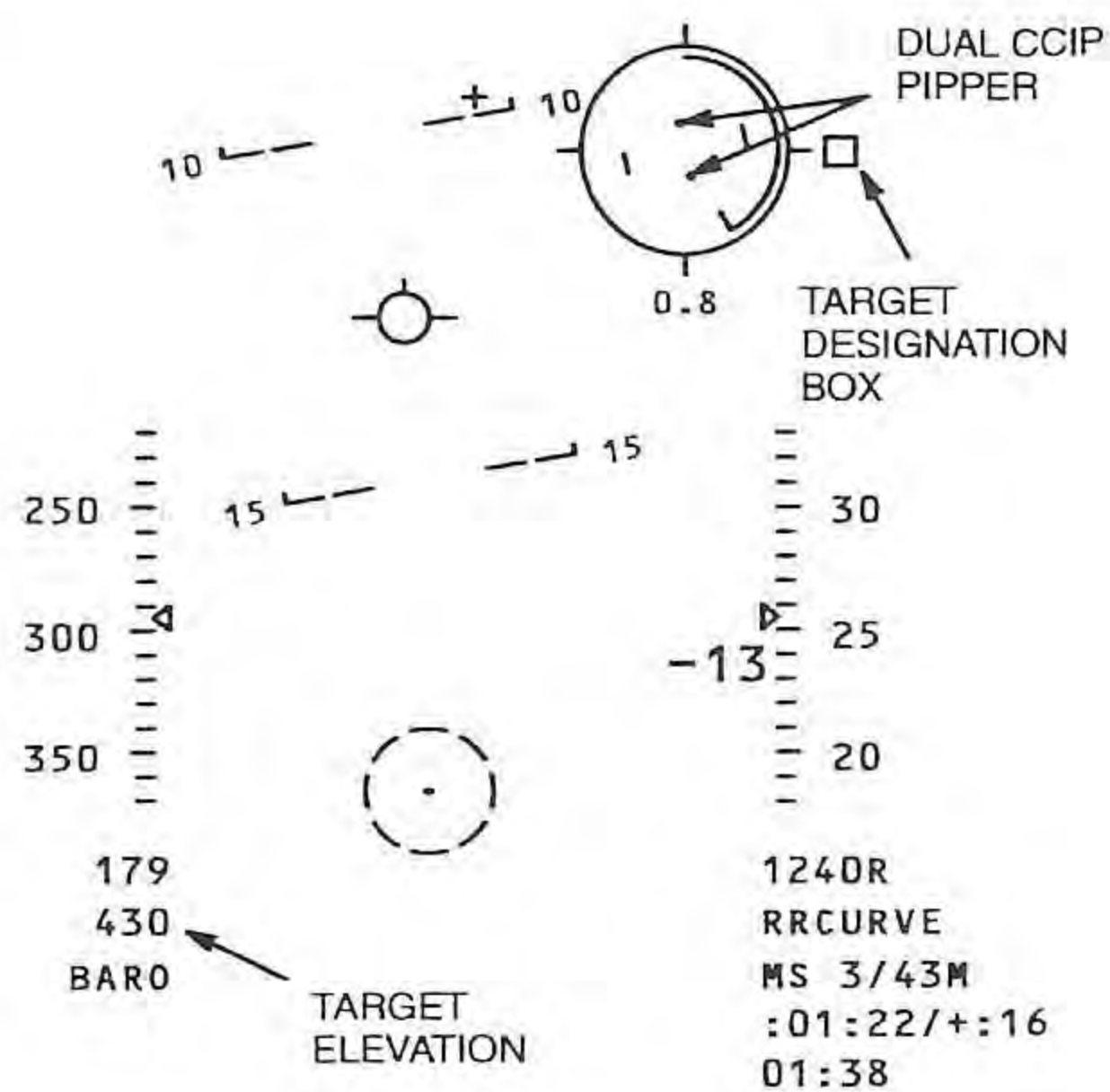
Figure 1-36. HUD Symbology Displays (LASTE V6.0 136 GPS) Sheet 2 of 11).



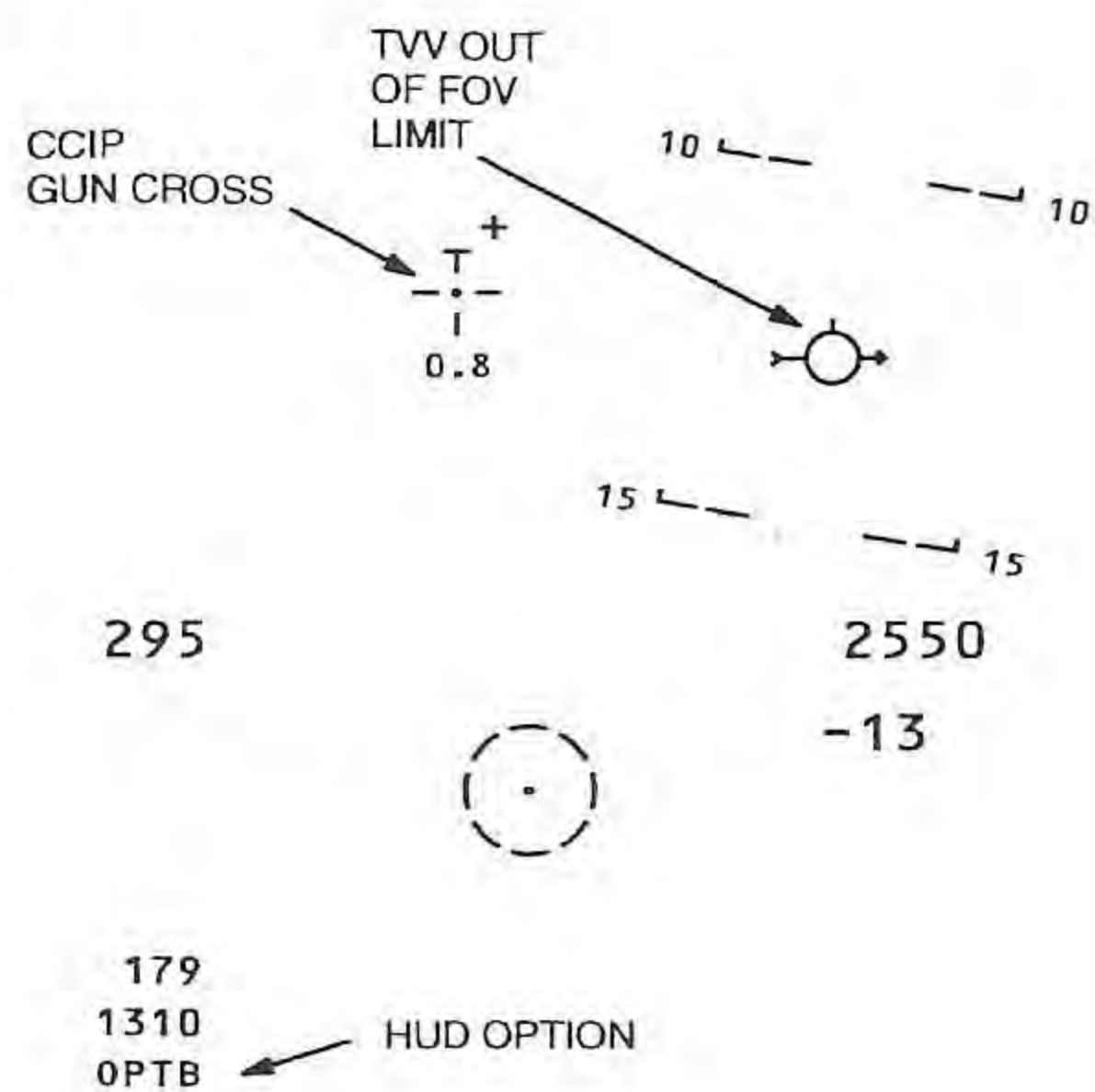
1A-10A-34-1-1-56

Figure 1-36. HUD Symbology Displays (LASTE V6.0 136 GPS) (Sheet 3 of 11).

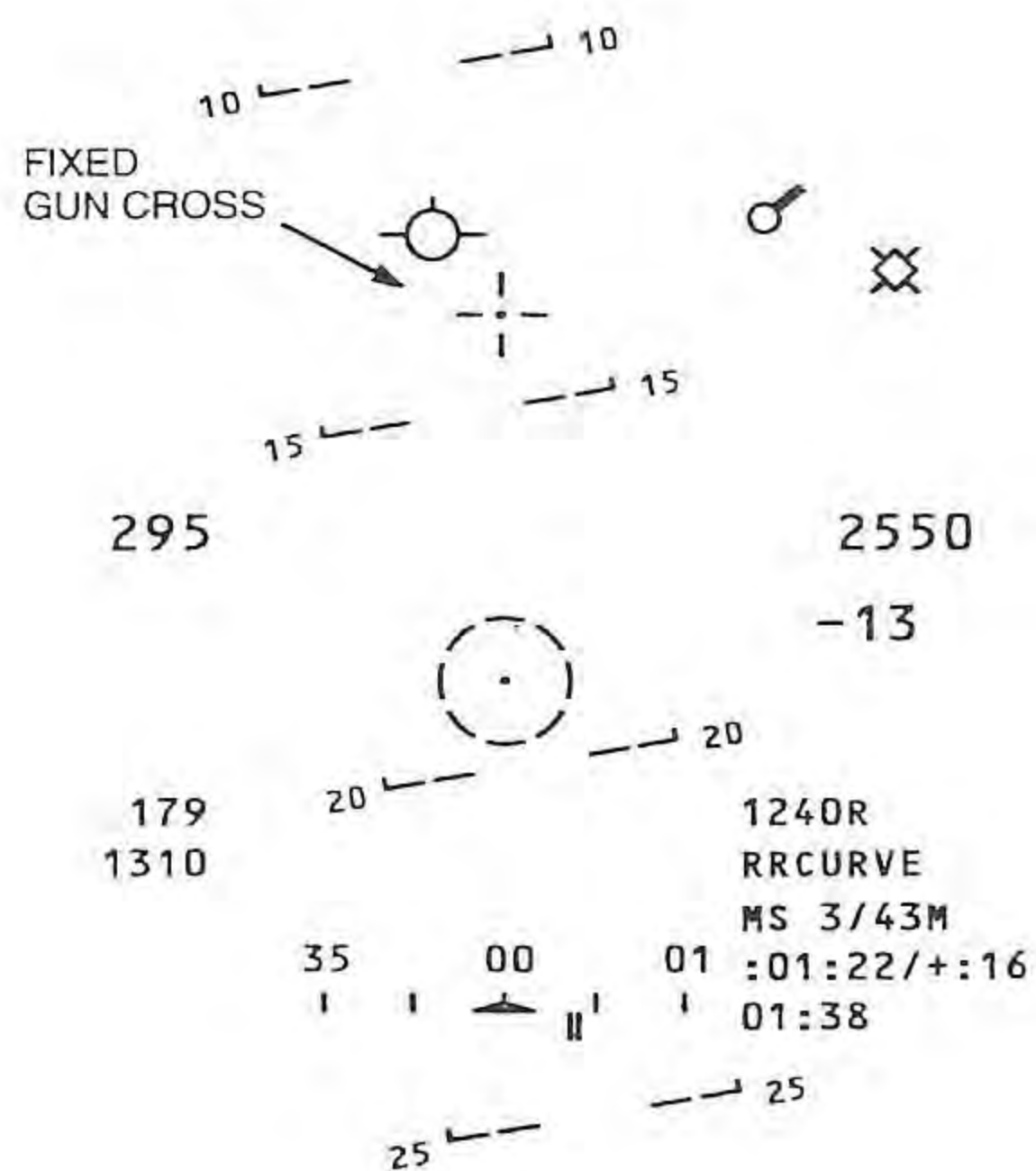
LASTE V6.0 GPS



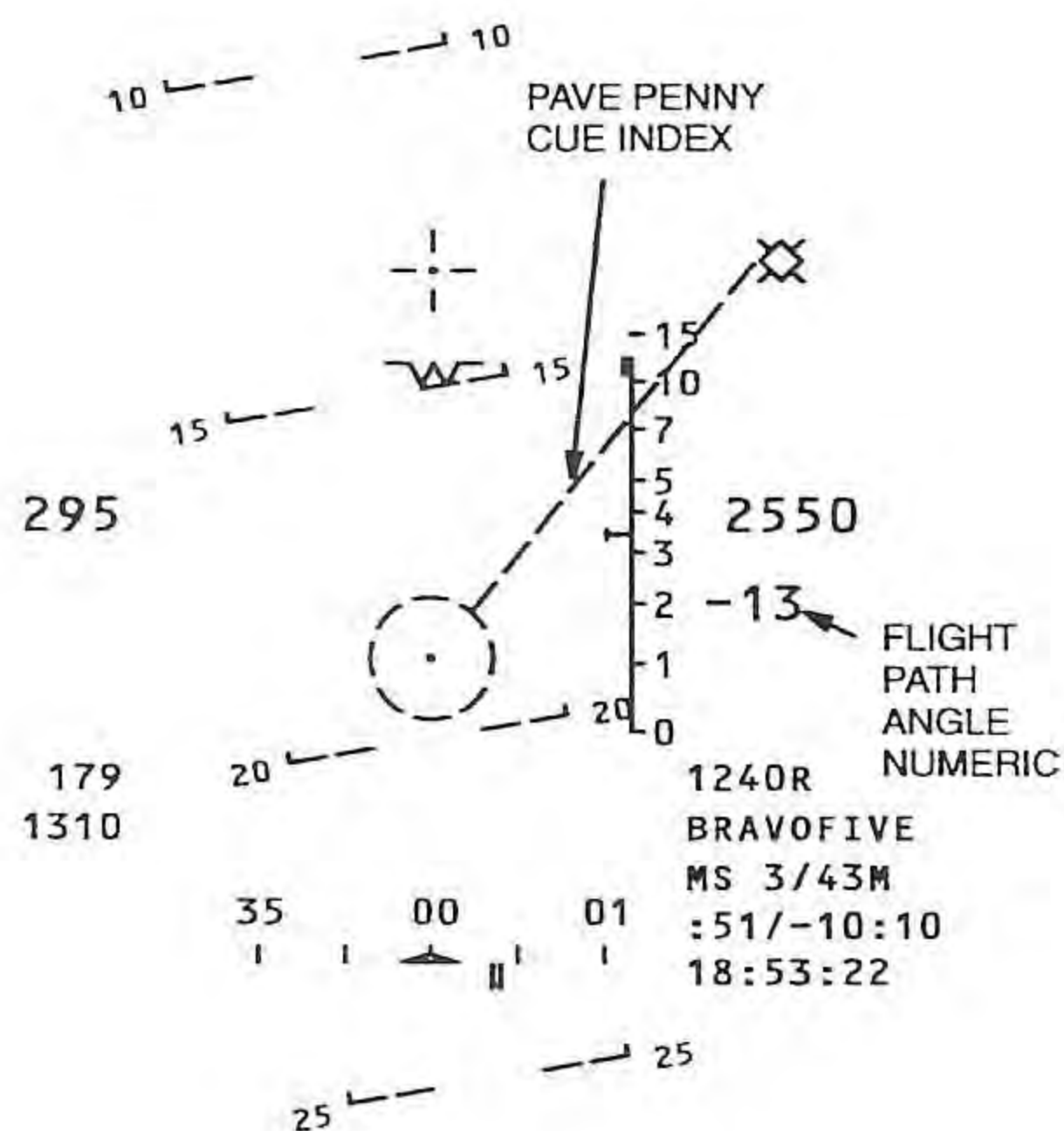
GUNS MODE, OPTION A (WITH TAPES)



GUNS MODE, OPTION B



GUNS MODE, OPTION C



GUNS MODE, HARS

1A-10A-34-1-1-57

Figure I-36. HUD Symbology Displays (LASTE V6.0 136 GPS) (Sheet 4 of 11).

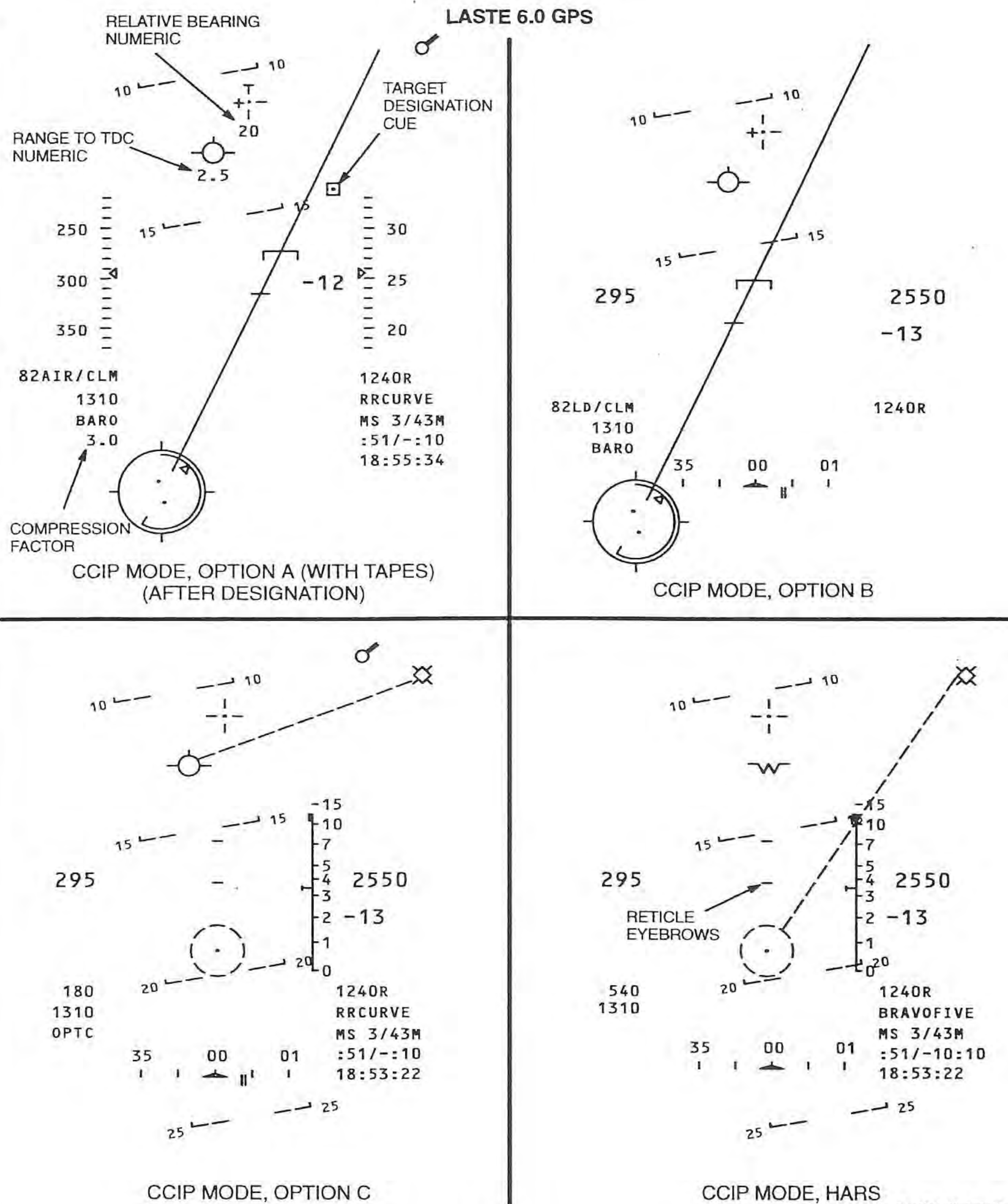
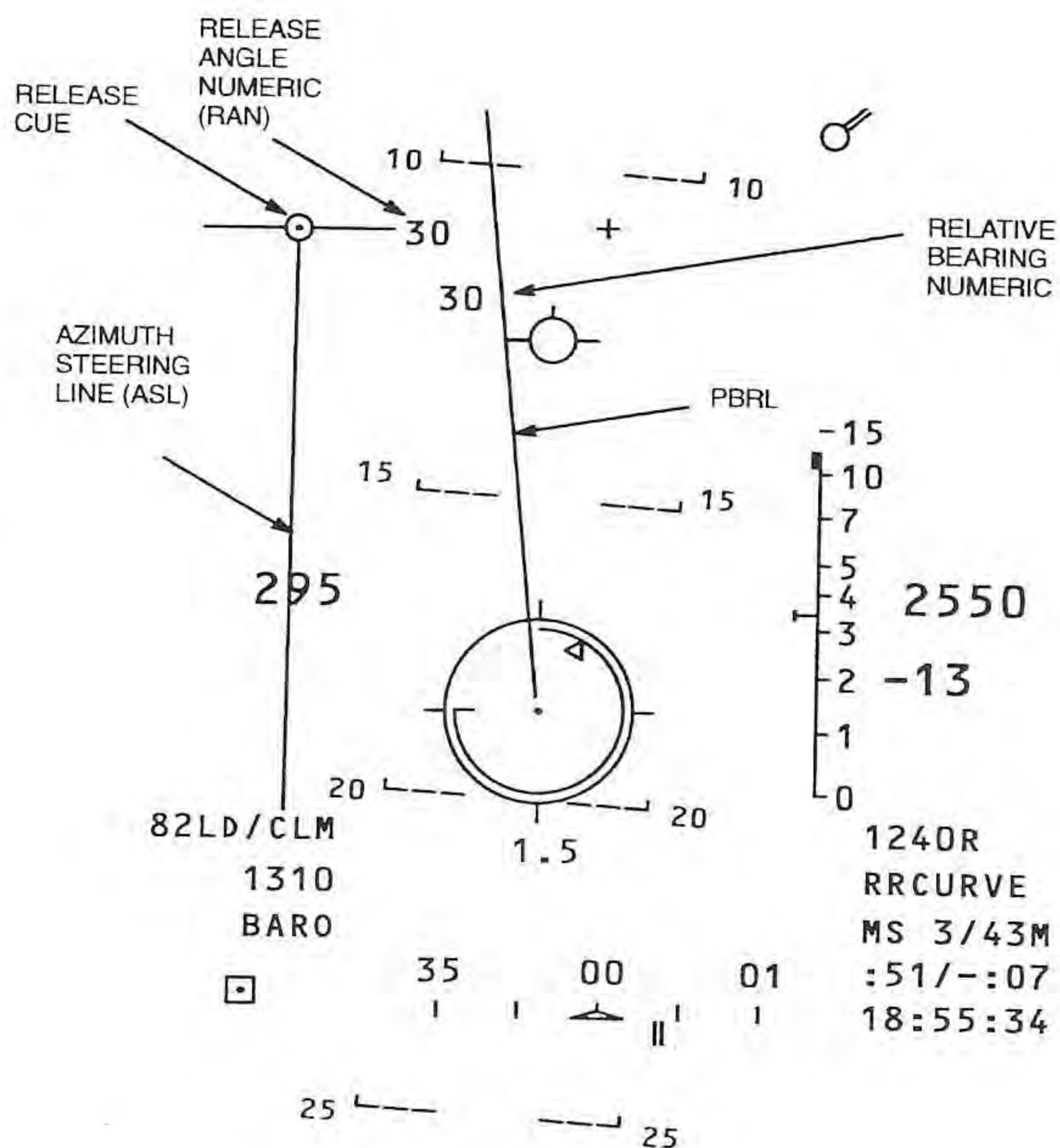


Figure 1-36. HUD Symbology Displays (LASTE V6.0 136 GPS) (Sheet 6 of 11).

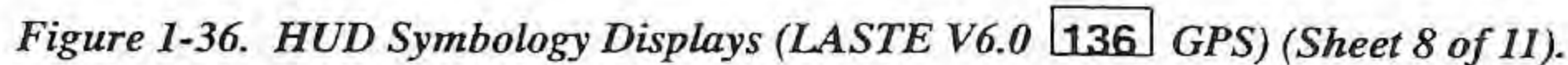
LASTE V6.0 GPS



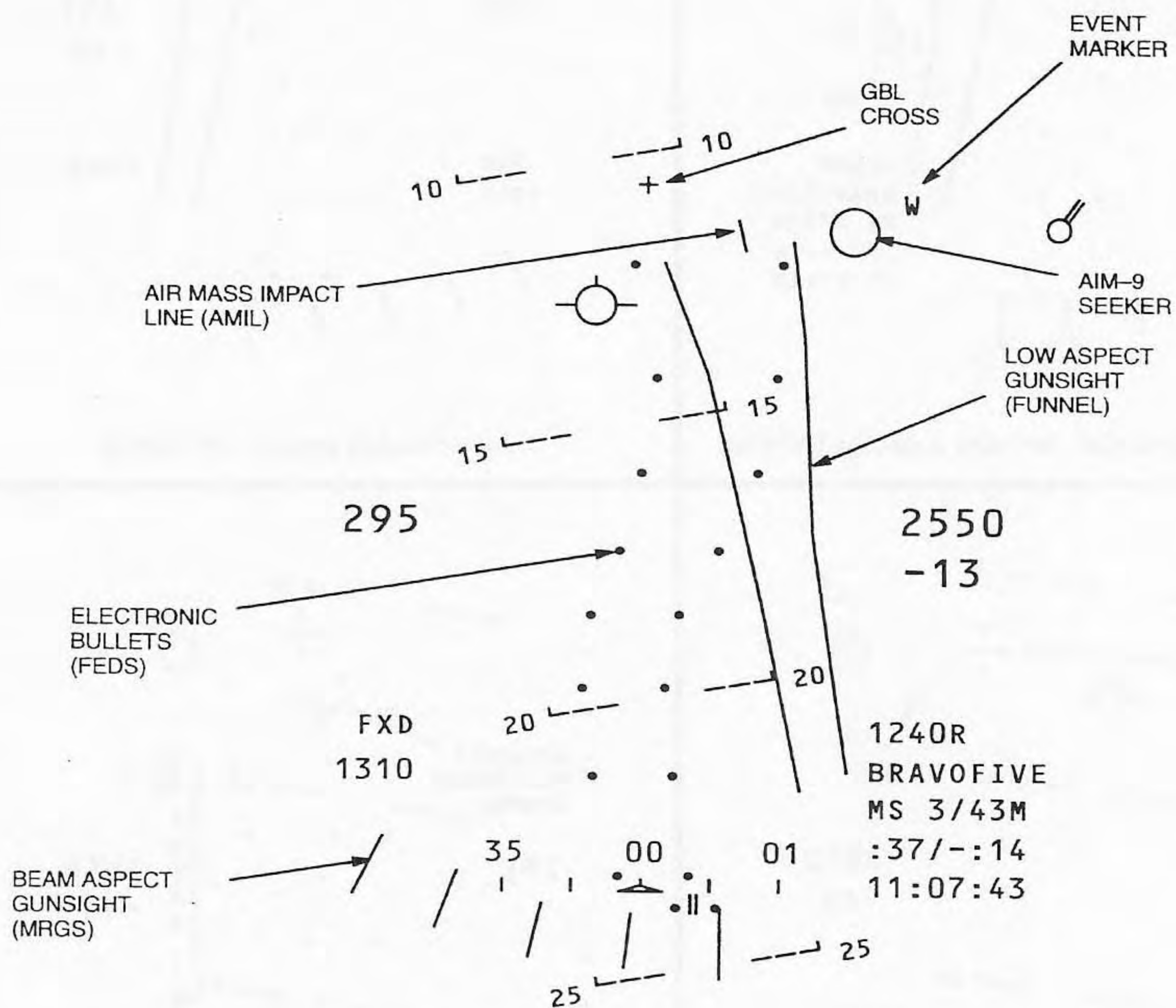
CCRP MODE, NORMAL

1A-10A-34-1-1-60

Figure 1-36. HUD Symbology Displays (LASTE V6.0 136 GPS) (Sheet 7 of 11).



LASTE V6.0 GPS

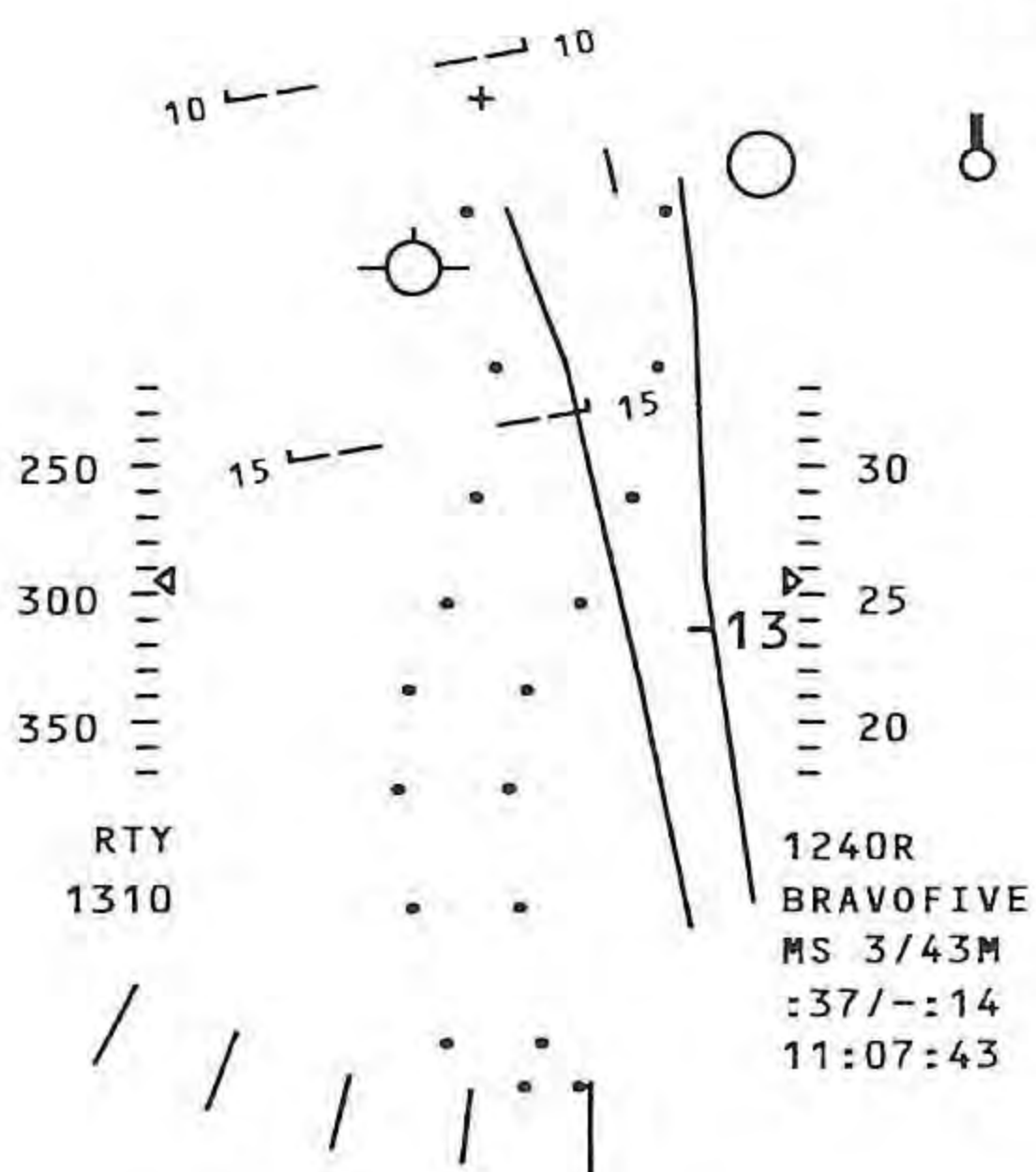


AIR-TO-AIR MODE, NORMAL

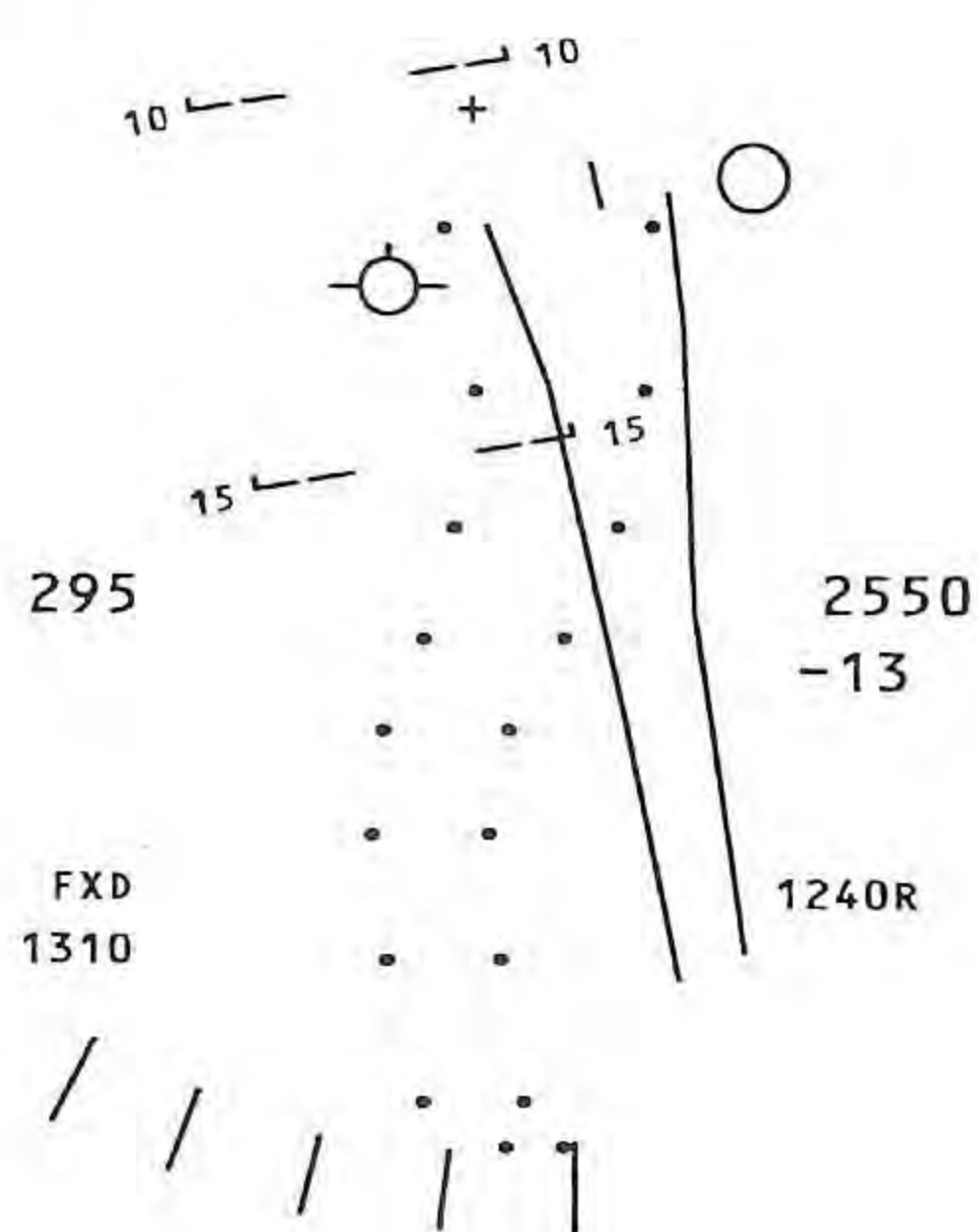
1A-10A-34-1-1-62

Figure 1-36 HUD Symbology Displays (LASTE V6.0 136 GPS) (Sheet 9 of 11).

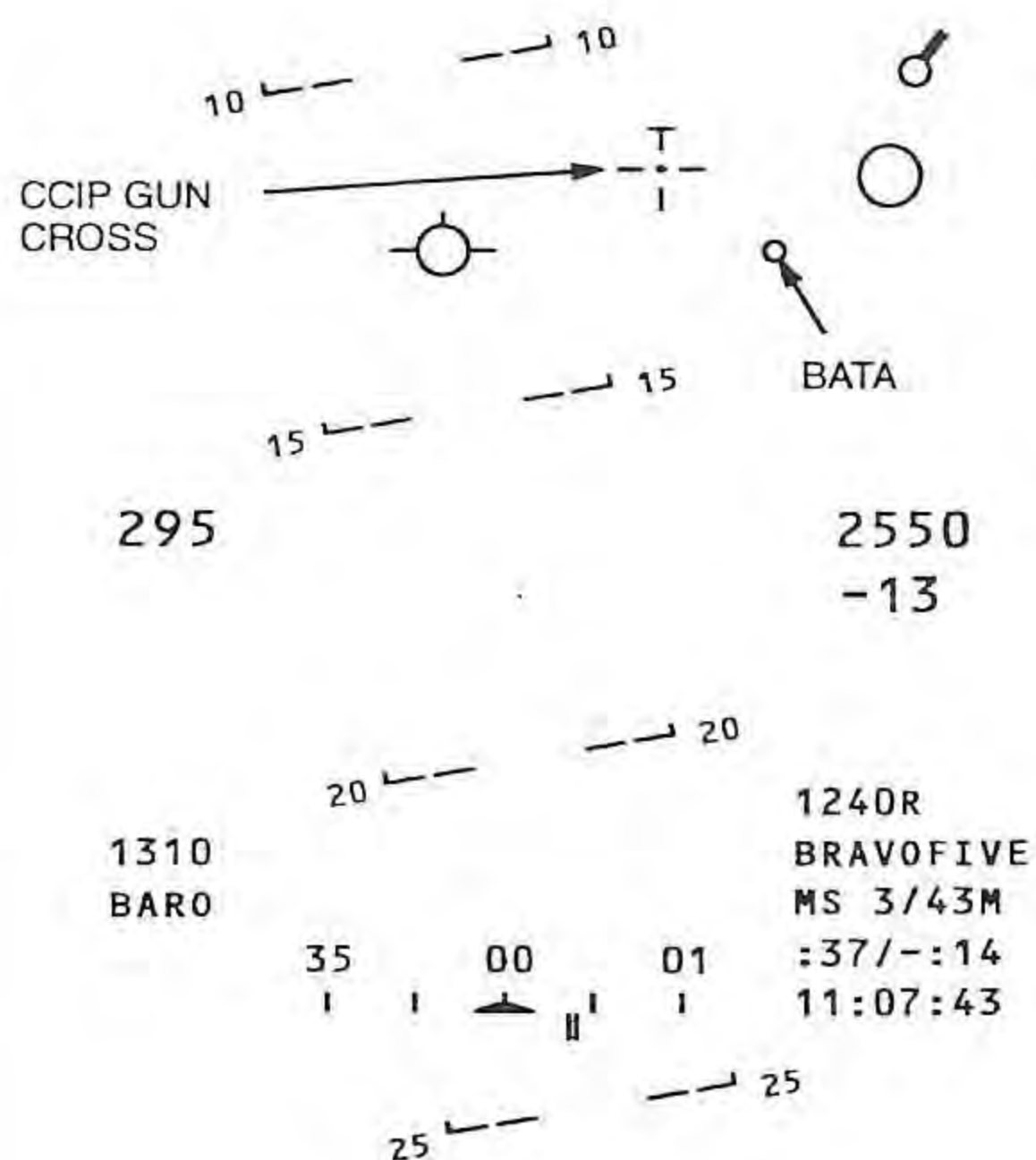
LASTE V6.0 GPS



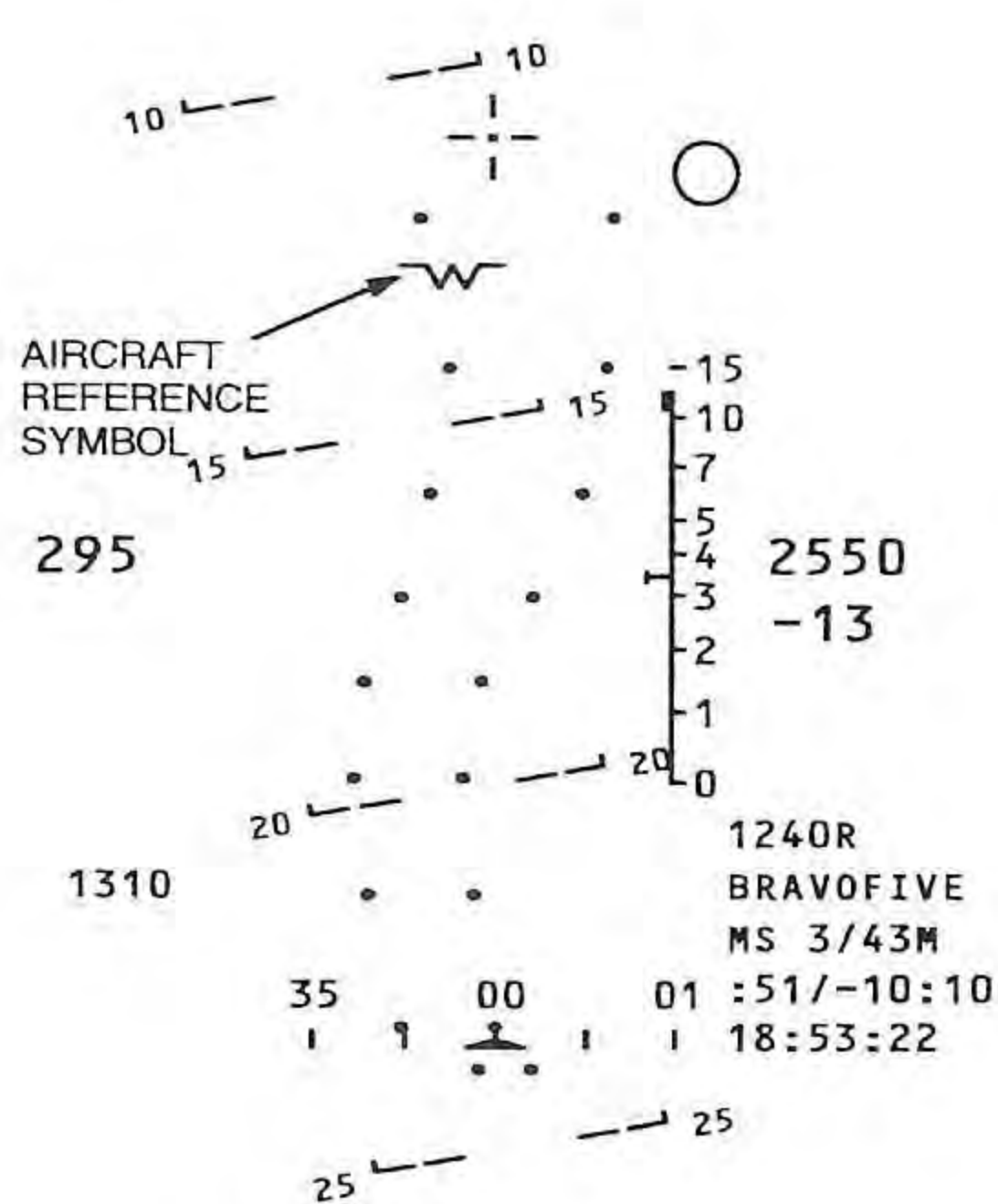
AIR-TO-AIR MODE, OPTION A (WITH TAPES)



AIR-TO-AIR MODE, OPTION B



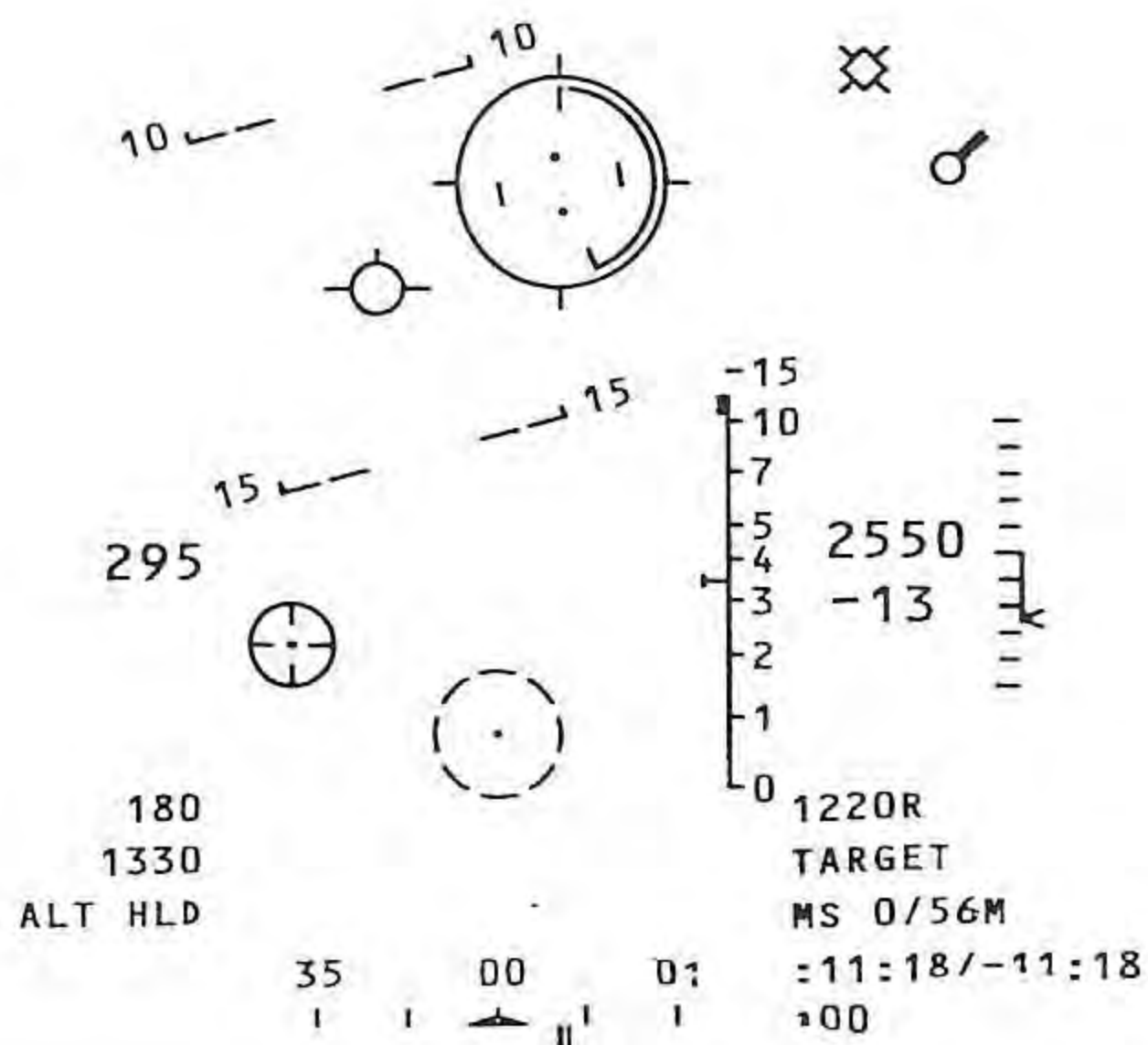
AIR-TO-AIR MODE, OPTION C



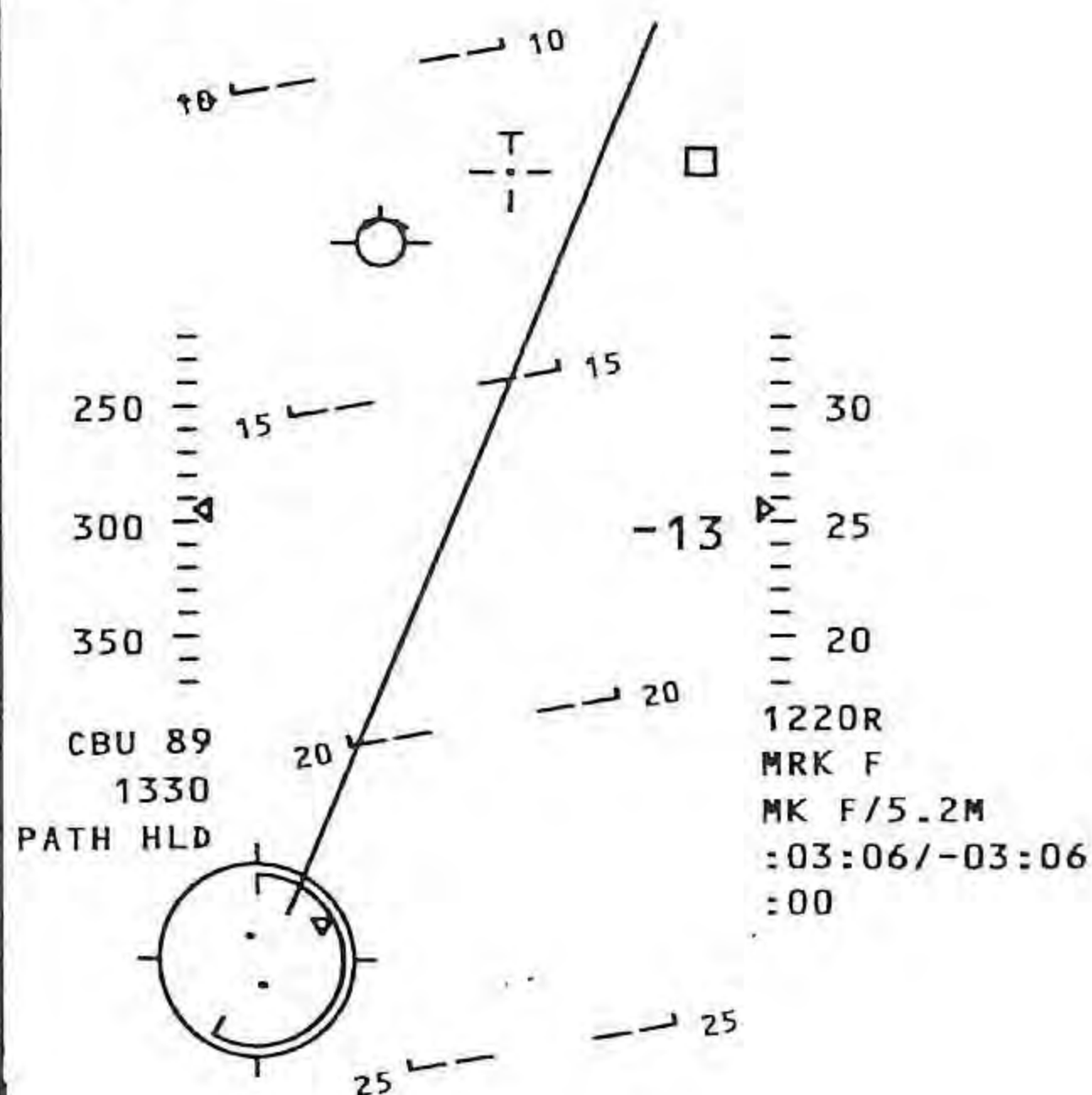
AIR-TO-AIR MODE, HARS) 1A-10A-34-1-1-63

Figure 1-36 HUD Symbology Displays (LASTE V6.0 136 GPS) (Sheet 10 of 11).

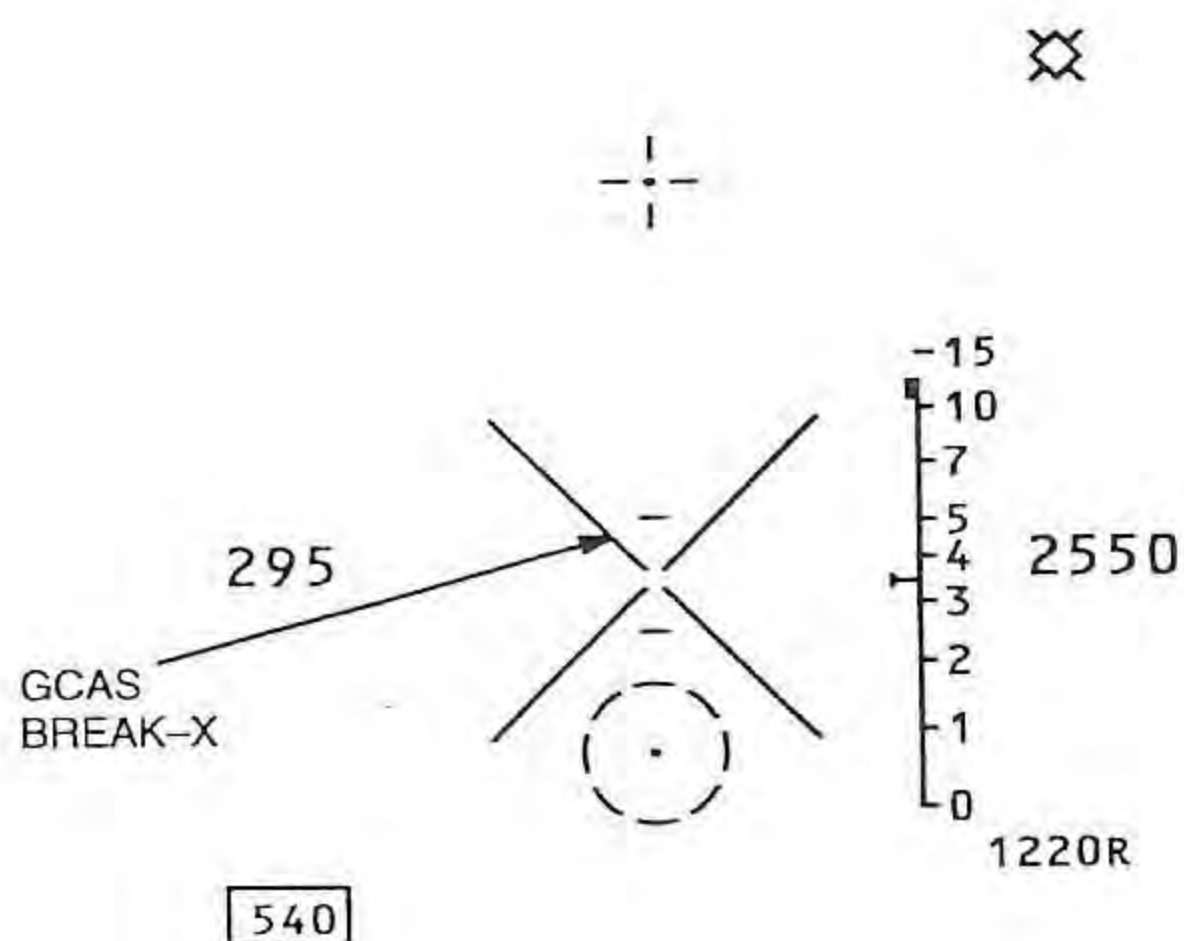
LASTE V6.0 GPS



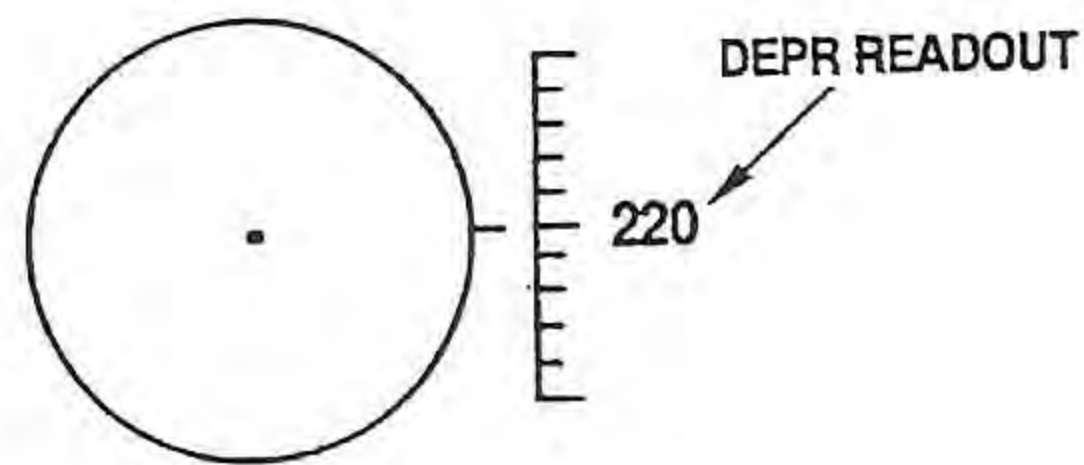
TEST MODE, OPTION A



TEST MODE, OPTION B (WITH TAPES)



TEST MODE, OPTION C (WITH RADAR SCALE)



STANDBY MODE

1A-10A-34-1-1-64

Figure I-36. HUD Symbology Displays (LASTE V6.0 136 GPS) (Sheet II of II).

LASTE DATA ENTRY

LASTE data entry is accomplished with the HUD mode selector switch set to TEST option normal. This will cause the HUD to display the MAIN MENU. The OSP select switch moves the cursor up and down the MAIN MENU. Depressing the OSP enter button with the cursor at a par-

ticular submenu will display the submenu. From the MAIN MENU, the pilot can access BIT, ELEV/ TIME (LASTE V4.0 and V6.0 [136] non-GPS only), AAS, WEAPONS, WPN REL DATA, DISPLAY MODES, MAINTENANCE, DELTA CAL and GCAS TRAINING (LASTE V6.0 [136] only) submenus.

Main Menus

LASTE V4.0		LASTE V6.0 [136] Non-GPS		LASTE V6.0 [136] GPS	
MAIN MENU	V4.00	MAIN MENU	V6.00	MAIN MENU	V6.00
> BIT		> BIT		> BIT	
ELEV/TIME		ELEV/TIME		AAS	
AAS		AAS		WEAPONS	
WEAPONS		WEAPONS		WPN REL DATA	
WPN REL DATA		WPN REL DATA		DISPLAY MODES	
DISPLAY MODES		DISPLAY MODES		MAINTENANCE	
MAINTENANCE		MAINTENANCE		DELTA CAL	
DELTA CAL		DELTA CAL		GCAS TRAINING	OFF
		GCAS TRAINING	OFF		

To select a submenu:

1. HUD Mode Selector - TEST (normal)
2. OSP SEL Switch - Toggle cursor to appropriate submenu.
3. OSP ENTR Button - Depress, HUD displays appropriate submenu.

The following paragraphs, illustrated menus, and tables describe in detail how to enter LASTE data along with definitions, and options for each submenu display (except BIT and Maintenance).

BIT SUBMENUS

LASTE system testing is performed via the GROUND BIT or INFLIGHT BIT submenus. For more information on LASTE system testing refer to LASTE System Testing in T.O. 1A-10A-1.

Ground and Inflight Bit Submenus (LASTE V4.0)

GROUND BIT

- > GCAS BIT
- VMU BIT
- PREFLIGHT BIT
- MAINT BIT - WARNING NVM INFO WILL BE LOST
- BIT FAULT DISPLAY
- EXIT

INFLIGHT BIT

- GCAS BIT
- > VMU BIT
- BIT FAULT DISPLAY
- EXIT

Ground and Inflight Bit Submenus (LASTE V6.0 136)

GROUND BIT

GCAS BIT

> VMU BIT

PREFLIGHT BIT

MAINT BIT - WARNING NVM INFO WILL BE LOST

MANUAL RADAR ALTIMETER SWITCH

BIT FAULT DISPLAY

EXIT

INFLIGHT BIT

GCAS BIT

> VMU BIT

BIT FAULT DISPLAY

EXIT

WEAPONS SUBMENU DATA ENTRY (LASTE V4.0)

The LASTE system is programmed with ballistics data for the weapons displayed on the HUD WEAPONS submenu. The pilot can access the individual weapon submenu (Figure 1-37) and enter variables such as fuze options, fuze times, Height Of Burst (HOB), Height Of Function (HOF), RPM, rocket warhead, and rocket motor as applicable to the selected store.

These variables will affect CCIP, the MRC/MRS or both, depending on the weapon. Refer to the table (Figure 1-37) on Weapons Data Effect on CCIP and MRC/MRS to determine how these variables affect the CCIP and MRC/MRS for specific weapons.

NOTE

LASTE MRC/MRS are an indication of slant range, not altitude. In this T.O., discussion of minimum acceptable release ranges corresponds to a planned minimum acceptable release altitude (abort altitude) for planned parameters.

Weapons Data Effect on CCIP and MRC/MRS (LASTE V4.0)

WEAPONS	DATA	VALUE TO ENTER	AFFECTS CCIP AND MRC/MRS (2)	AFFECTS MRC ONLY (3)
BDU-33	SERIES	D/B, B/B	X	
	MIN/TOF	Training Req TOF		X
GP BOMBS	MIN LD TOF MIN HD TOF	Highest of: - Fuze time + Tolerance + Inherent delay - Safe Escape TOF - TOF from release at desired ground clearance altitude plus altitude lost during pullout	X	X
	CONFIG	FIXDHI, FIXDLO, or PILOPT	X	
	FMU-139	Y for FMU-139 in Nose N for otherwise	(6)	
CBU-87/-89 (1) ("N/T" MECH FUZE SELECT)	FZU-39	Y, N	X	
	FUNCTION TIME	M-Z (Actual Fuze setting)	X(4)	
	HOF	300-3000 (Planned HOF setting)	X(5)	X(5)
	RPM (CBU-87 only)	0-2500 (Actual on CBU)	X	
CBU-87/-89 (1) ("N" MECH FUZE SELECT)	FZU-39	Y, N (Not Used)	No Effect	
	FUNCTION TIME	M-Z (Actual Fuze setting)	X	
	HOF	300-3000 (Not Used)	No Effect	
	RPM (CBU-87 only)	0-2500 (Actual on CBU)	X	
BLU-52	None	None		No MRC
All Rockets	Motor, Warhead	Actual Motor, Warhead	X	No MRC

NOTES

(1) For cluster weapons, value inputs which affect the MRC/MRS (Minimum Range Caret/Minimum Range Staple) only will not necessarily ensure a safe minimum release range (abort altitude). Minimum TOFs for safe escape and ground clearance should be set into the Desired Release Cue (DRC). Refer to WEAPONS SUBMENU DATA ENTRY to see how actual inputs affect the MRC/MRS.

(2) Anything that affects the CCIP will affect the MRC/MRS because the MRC/MRS use TOF information calculated for the CCIP position.

(3) All settings refer to the Minimum Range Caret and

Minimum Range Staple except DES TOF. For any weapon DES TOF affects only the DRC. Because of the consistent behavior of the DRC, it will not be listed in this table.

(4) The MRC/MRS will use the greater of 0.95 seconds (CBU-87), 1.28 seconds (CBU-89), or the FUNC TIME entered in the LASTE WEAPONS submenu.

(5) HOF is used for CCIP calculations only when FZU-39 is "Y". When FZU is "N", HOF is used only for calculating MRC/MRS.

(6) FMU-139 fuze in nose is used to determine invalid fuzing logic only. It has no effect on the CCIP or MRC/MRS.

Figure 1-37. Weapons Data Effect on CCIP and MRC/MRS (LASTE V4.0).

WEAPONS SUBMENU DATA ENTRY (LASTE V6.0 136)

The LASTE system is programmed with ballistics data for the weapons displayed on the HUD WEAPONS submenu. The pilot can access the individual weapon submenu and enter variables such as fuze options, fuze times, Height Of Burst (HOB), Height Of Function (HOF), RPM, rocket warhead, and rocket motor as applicable to the selected store.

The variables will affect the CCIP/CCRP, the MRC/MRS or both depending on the weapon. Refer to the table (Fig-

ure 1-38) on Weapons Data Effect on CCIP/CCRP and MRC/MRS to determine how these variables affect the CCIP/CCRP and MRC/MRS for specific weapons.

NOTE

LASTE MRC/MRS are an indication of slant range, not altitude. In this T.O., discussion of minimum acceptable release ranges corresponds to a planned minimum acceptable release altitude (abort altitude) for planned parameters.

Weapons Data Effect On CCIP/CCRP and MRC/MRS (LASTE V6.0 **136**)

WEAPONS	DATA	VALUE TO ENTER	AFFECTS CCIP, CCRP, MRC (2,8)	AFFECTS CCRP, MRC (2,8)	AFFECTS MRC ONLY (3,8)
BDU-33	SERIES	D/B, B/B	X		
	MIN/TOF	Training Req TOF			X
GP BOMBS	MIN LD TOF MIN HD TOF	- Highest of: - Fuze time + Tolerance + Inherent delay - Safe Escape TOF - TOF from release at desired ground clearance altitude plus altitude lost during pullout			X
	CONFIG	FIXDHI, FIXDLO, or PILOPT	X		
	NOSE FMU-139	Y for FMU-139 in Nose N for otherwise	(8)		
CBU-87/-89 ⁽¹⁾ /-97 ("N/T" MECH FUZE SELECT)	FZU-39	Y, N	X		
	FUNCTION TIME	M-Z (Actual Fuze Setting) CBU-87: N – Z CBU-89: O – Z CBU-97:M – Z	X ⁽⁴⁾		
	HOF	300-3000 (Planned Fuze Function if FZU-39 = N, actual Fuze setting FZU-39 = Y)	X ⁽⁵⁾		X ⁽⁵⁾
	RPM (CBU-87 only)	0-2500 (Actual on CBU)	X		
CBU-87/-89 ⁽¹⁾ /-97 ("N" MECH FUZE SELECT) CBU-87/-89 ⁽¹⁾ /-97 ("N" MECH FUZE SELECT) CBU-87/-89 ⁽¹⁾ /-97 ("N" MECH FUZE SELECT) CBU-87/-89 ⁽¹⁾ /-97 ("N" MECH FUZE SELECT)	FZU-39	Y, N (Not Used)	No Effect		
	FUNCTION TIME	M-Z (Actual Fuze Setting) CBU-87: N – Z CBU-89: O – Z CBU-97:M – Z	X		
	HOF	300-3000 (Not Used)	No Effect		
	RPM (CBU87 only)	0-2500 (Actual on CBU)	X		
BLU-52	None	None			No MRC
All Rockets	Motor, Warhead,(not selectable for WDU-4A/A)	Actual Motor, Warhead	X		MRC (WDU-4A Only)
	DES TOF (WDU-4A/A only)	Desired Time of Fall			X ⁽⁷⁾
	Station	Station Numbers			

Figure 1-38. Weapons Data Effect On CCIP/CCRP and MRC/MRS (LASTE V6.0 **136**) (Sheet 1 of 2).

Weapons Data Effect On CCIP/CCRP and MRC/MRS (LASTE V6.0 **136**)

WEAPONS	DATA	VALUE TO ENTER	AFFECTS CCIP, CCRP, MRC (2,8)	AFFECTS CCRP, MRC (2,8)	AFFECTS MRC ONLY (3,8)
LUU-1/-5/-6	Ejection Delay	Actual Fuze Ejection Delay		X	
	IGN Delay	Actual Fuse Ignition Delay		X	
	Station	Station Numbers			
LUU-2	Flare Type	LUU-2/8, LUU-2A/B or LUU-2B/B		X	
LUU-2	Delay (FT)	Actual Fuze Setting		X	
LUU-2	HGT OVR TGT	Desired Flare Height at Mid-Burn		X	X
	Station	Station Numbers			

NOTES

- (1) RTSE will display the higher of safe escape or fuze minimum release altitudes.
- (2) Anything that affects the CCIP/CCRP will affect the MRC/MRS because the MRC/MRS use TOF information calculated for the CCIP/CCRP position.
- (3) All settings refer to the MRC/MRS except DES TOF. For any weapon (except the WDU-4A Rocket) DES TOF affects only the DRC. Because of the consistent behavior of the DRC, it will not be listed in this table.
- (4) The MRC/MRS will use the greater of 0.95 seconds (CBU87), 1.28 seconds (CBU-89/-97), or the FUNC TIME entered in the LASTE WEAPONS sub-menu.
- (5) HOF is used for CCIP/CCRP calculations, only when FZU-39 is "Y". When FZU is "N", HOF is used only for calculating MRC/MRS.
- (6) FMU-139 fuze in nose is used to determine invalid fuzing logic only. It has no other effect on the CCIP/CCRP or MRC/MRS.
- (7) For the WDU-4A Flechette Rocket, the MRC is used to indicate desired release range for optimum dispersion.
- (8) In CCRP mode, the MRC may be unreliable for approximately two seconds after the analog range bar is initially displayed (indicating "in-range"). Specifically, the MRC may indicate higher than the correct minimum range, or cycle between zero range and the correct minimum range, before stabilizing on the correct minimum range for the selected weapon. This behavior can be minimized by adhering to the following CCRP menu entry rules:
 - Do not enter zero seconds for Desired Time-Of-Fall, and
 - Avoid using short fuze times. Specifically, use a minimum of 6.6 seconds for low drag weapons, and a minimum of 5.0 seconds for high drag weapons.

Figure 1-38. Weapons Data Effect On CCIP/CCRP and MRC/MRS (LASTE V6.0 **136**) (Sheet 2 of 2).

WEAPONS DATA SELECTION

Weapon data entry is accomplished with the HUD mode selector set to TEST option normal. The OSP select switch is used to move the cursor on the main menu.

Depressing the OSP ENTR button with the cursor at WEAPONS will display the WEAPONS submenu (Figure 1-39.)

The OSP select switch is then used to move the cursor to an individual weapon. When the OSP ENTR button is depressed the HUD displays the chosen individual weapon submenu. The SEL switch is used to position the cursor next to the line of the submenu that requires an entry. The data is entered using the OSP DATA switch.

When appropriate data appears on the HUD, the SEL switch is used to position the cursor at the next data line that requires an entry. When all data for the selected submenus has been entered, position the cursor at STORE, and depress the ENTR button. The HUD will return to the WEAPONS submenu with the cursor advanced to the next weapon on the WEAPONS submenu. A small letter "o" next to the weapon on the WEAPONS submenu indicates the data has been stored and the weapon preselected. Individual preselected weapons can be deselected at the submenu by positioning the cursor at CANCEL and depressing the ENTR button. The 30mm gun cannot be deselected.

The pilot can also select Offset Adjust from the WEAPONS submenu (Figure 1-39) by moving the cursor using the OSP SEL switch to Offset Adjust and depressing the ENTR Button. This menu allows the pilot to adjust the Gun and Bomb offset for any corrections necessary.

To enter offset adjust data:

1. HUD Mode Selector - TEST (HUD displays MAIN MENU)
2. OSP SEL Switch - toggle cursor to WEAPONS.
3. OSP ENTR Button - Depress, HUD displays WEAPONS submenu.
4. OSP SEL Switch - Toggle cursor to OFFSET ADJUST.
5. OSP ENTR Button - Depress, HUD displays OFFSET ADJUST submenu.
6. OSP SEL Switch - Change OFFSET ADJ from N to Y.
7. OSP SEL Switch - Toggle cursor to data line to be changed.
8. OSP DATA switch - Toggle until desired offset appears on the HUD. (+15 to -15).
9. Repeat steps 6 and 7 until both gun and bomb offset has been set.
10. After all offsets have been entered, depressing OSP ENTR Button with cursor at EXIT will return HUD to the WEAPONS submenu.
11. Depressing OSP ENTR button with cursor at EXIT will return HUD to the MAIN MENU.

Weapons Submenu (LASTE V4.0)

```

WEAPONS
> BDU33
MK82LD
MK82AIR
MK82SE
MK84LD
MK20
CBU52
CBU58
CBU71
CBU87
CBU89
BLU52
RKT1
RKT2
RKT3
° 30MM                HEI
  OFFSET ADJUST
  VAR TGT ELEV        10
  WPN CLR
  EXIT

```

Weapons Submenu (LASTE V6.0 136)

```

WEAPONS
> BDU33
MK82LD
MK82AIR
MK84LD
CBU87
CBU89
CBU97
BLU52
LUU
RKT
° 30MM                HEI
  OFFSET ADJUST
  VAR TGT ELEV        10
  WPN CLR
  EXIT

```

Figure 1-39. Weapons Submenus

BDU Submenu (LASTE V6.0 136)

```

BDU33
> BDU-1
BDU-2
BDU-3
EXIT

```

Figure 1-40. BDU Submenu

BDU Submenu (LASTE V4.0)

BDU33	
> SERIES	D/B
MIN TOF	2.0
DES TOF	3.0
BMB MNT	SUU-20
OFFSET ADJ	N
RT OFFSET	0
UP OFFSET	0
EJECT VEL	10
RACK DELAY	0.20
STORE	
CANCEL	

BDU-1 Submenu (LASTE V6.0 136) *

BDU-1	
> SERIES	D/B
MIN TOF	2.0
DES TOF	3.0
BMB MNT	SUU-20
OFFSET ADJ	N
RT	0
UP	0
EJECT VEL	10
RACK DELAY	0.20
STORE	
CANCEL	

* The same submenu exists for BDU-2 and BDU-3.

DISPLAY	OPTIONS	FUNCTION
SERIES	BDU33D/B and B/B with lugs are selectable.	Used to enter BDU33 series which affects the CCIP.
MIN TOF	Variable from 0.0 to 99.9 seconds.	Used to enter minimum time of fall which affects the Minimum Range Caret/Staple.
DES TOF	Variable from 0.0 to 99.9 seconds.	Used to enter desired time of fall which affects the Desired Range Cue.
BMB MNT	TER or SUU-20	Used to enter type of bomb mount which affects the CCIP/CCRP.
OFFSET ADJ	Y or N	Allows adjustment of offset.
RT OFFSET	Variable from -15 to 15 mils.	Adjusts the position of the CCIP/CCRP and related symbology horizontally.
UP OFFSET	Variable from -15 to 15 mils.	Adjusts the position of the CCIP/CCRP and related symbology vertically.
EJECT VEL	Variable from -10 to 30 feet per second.	Adjusts weapon ballistics by modifying the preset ejection velocity.
RACK DELAY	Variable from -0.40 to 0.40 seconds.	Adjusts weapon ballistics by modifying the preset rack delay.
STORE		Store data and preselect the weapon.
CANCEL		Deselect the weapon.

CCIP/CCRP

The CCIP/CCRP is affected by the SERIES, BMB MNT, and ballistics adjustment values.

MRC/MRS

The MRC/MRS correspond to the release range which will cause the bomb to fall for the time set in MIN TOF. This is independent of the mechanical fuzing selection. The DRC displays the range for the time set in DES TOF.

Figure 1-41. Individual Weapon Submenus (Sheet 1 of 17).

MK 82 LD (LASTE V4.0)

MK82LD	
> MIN TOF	4.0
DES TOF	5.0
BOMB MOUNT	TER
OFFSET ADJ	N
RT OFFSET	0
UP OFFSET	0
EJECT VEL	10
RACK DELAY	0.20
STORE	
CANCEL	

MK 82 LD (LASTE V6.0 136)

MK82LD	
> ESC MNVR	NONE
MIN TOF	4.0
DES TOF	5.0
BOMB MOUNT	TER
OFFSET ADJ	N
RT	0
UP	0
EJECT VEL	10
RACK DEL	0.20
STORE	
CANCEL	

DISPLAY	OPTIONS	FUNCTION
ESC MNVR (LASTE V6.0)	NONE, CLM, TRN, TLT	Used to select available maneuvers.
MIN TOF	Variable from 0.0 to 99.9 seconds.	Used to enter minimum time of fall which affects the Minimum Range Caret/Staple.
DES TOF	Variable from 0.0 to 99.9 seconds.	Used to enter desired time of fall which affects the Desired Range Cue.
BOMB MOUNT	TER or PYLON	Used to enter type of bomb mount which affects the CCIP/CCRP.
OFFSET ADJ	Y or N	Allows adjustment of offset.
RT OFFSET, RT (LASTE V6.0)	Variable from -15 to 15 mils.	Adjusts the position of the CCIP/CCRP and related symbology horizontally.
UP OFFSET, UP (LASTE V6.0)	Variable from -15 to 15 mils.	Adjusts the position of the CCIP/CCRP and related symbology vertically.
EJECT VEL	Variable from -10 to 30 feet per second.	Adjusts weapon ballistics by modifying the preset ejection velocity.
RACK DELAY, RACK DEL (LASTE V6.0)	Variable from -0.40 to 0.40 seconds.	Adjusts weapon ballistics by modifying the preset rack delay.
STORE		Store data and preselect the weapon.
CANCEL		Deselect the weapon.

CCIP/CCRP

The CCIP/CCRP is affected by the BMB MNT and ballistics adjustments only.

MRC/MRS (MINIMUM RANGE CARET/MINIMUM RANGE STAPLE)

The MRC/MRS correspond to the release range which will cause the bomb to fall for the time set in MIN TOF. This is independent of the mechanical fuzing selection. The DRC displays the range for the time set in DES TOF.

The MIN TOF should be set to the highest of:

1. Nose/Tail fuze arm time + Tolerance + Inherent Delay.
2. Safe escape from fragmentation TOF.
3. TOF for release altitude which allows pull out above minimum ground clearance.

Figure 1-41. Individual Weapon Submenus (Sheet 2 of 17).

MK 82 AIR (LASTE V4.0)

MK82AIR		
> CONFIG	FIXDHI	
NOSE FMU-139	Y	
MIN LD TOF	4.0	
MIN HD TOF	6.0	
DES LD TOF	5.0	
DES HD TOF	7.0	
BMB MNT	TER	
OFFSET ADJ	N	
RT OFFSET	0	
UP OFFSET	0	
EJECT VEL	10	
RACK DELAY	0.20	
STORE		
CANCEL		

MK 82 AIR (LASTE V6.0 136)

MK82AIR		
> ESC MNVR	NONE	
CONFIG	FIXDHI	
NOSE FMU-139	Y	
MIN LD TOF	4.0	
MIN HD TOF	6.0	
DES LD TOF	5.0	
DES HD TOF	7.0	
BMB MNT	TER	
OFFSET ADJ	N	
RT	0	
UP	0	
EJECT VEL	10	
RACK DEL	0.20	
STORE		
CANCEL		

DISPLAY	OPTIONS	FUNCTION
ESC MNVR (LASTE V6.0)	NONE, CLM, TRN, TLT	Used to select available maneuvers.
CONFIG	FIXDHI, FIXDLO, or PILOPT	In conjunction with the mechanical fuzing, determines whether the CCIP/CCRP uses high drag or low drag ballistics.
NOSE FMU-139	Y or N	Used to select FMU-139 fuze in nose which affects invalid fuzing logic.
MIN LD TOF	Variable from 0.0 to 99.9 seconds	Used to enter weapon minimum low drag time of fall which affects the Minimum Range Caret/Staple.
MIN HD TOF	Variable from 0.0 to 99.9 seconds	Used to enter weapon minimum high drag time of fall which affects the Minimum Range Caret/Staple.
DES LD TOF	Variable from 0.0 to 99.9 seconds	Used to enter weapon desired low drag time of fall which affects the Desired Range Cue.
DES HD TOF	Variable from 0.0 to 99.9 seconds	Used to enter weapon desired high drag time of fall which affects the Desired Range Cue.
BMB MNT	TER or PYLON	Used to enter type of bomb mount which affects the CCIP/CCRP.
OFFSET ADJ	Y or N	Allows adjustment of offset.
RT OFFSET, RT (LASTE V6.0)	Variable from -15 to 15 mils.	Adjusts the position of the CCIP/CCRP and related symbology horizontally.
UP OFFSET, UP (LASTE V6.0)	Variable from -15 to 15 mils.	Adjusts the position of the CCIP/CCRP and related symbology vertically.
EJECT VEL	Variable from -10 to 30 feet per second.	Adjusts weapon ballistics by modifying the preset ejection velocity.
RACK DELAY, RACK DEL (LASTE V6.0)	Variable from -0.40 to 0.40 seconds	Adjusts weapon ballistics by modifying the preset rack delay.
STORE		Store data and preselect the weapon.
CANCEL		Deselect the weapon.

Figure 1-41. Individual Weapon Submenus (Sheet 3 of 17).

CCIP/CCRP

The mechanical fuzing switch setting and configuration entered in the menu determine whether the high drag or low drag CCIP/CCRP is used. The CCIP/CCRP is also affected by the ballistics adjustment values and BMB MNT. NOSE FMU-139 is set to Y if there is a FMU-139 in the nose of the bomb regardless of the tail fuze. This information is used only for determining valid mechanical fuze settings.

MRC/MRS (MINIMUM RANGE CARET/MINIMUM RANGE STAPLE)

The MRC/MRS automatically select between the high drag or low drag times to match the bomb configuration at release. The staple and caret correspond to the release range which will cause the bomb to fall for the time set in MIN LD TOF or MIN HD TOF. The DRC displays the range for the time set in the DES LD TOF or DES HD TOF.

The MIN HD TOF and MIN LD TOF should be set individually to the highest of:

1. Appropriate Nose/Tail fuze arm time + Tolerance + Inherent Delay.
2. Safe escape from fragmentation TOF.
3. TOF for release altitude which allows pull out above minimum ground clearance.

The following charts show the effects of configurations and mechanical fuzing options. Low drag and high drag options affect the CCIP/CCRP, MRC/MRS and the actual weapon function:

MK-82A1R

Mech Fuzing	Configuration		
	FLXDHI	FIXEDLO	PILOPT
Nose	Invalid Fuzing	Low Drag	Low Drag
Tail	High Drag	Low Drag (1)	High Drag (1)
N/T	High Drag	Low Drag	High Drag

1. If FMU-139 is used as the nose fuze, this fuze setting will result in an invalid fuzing option.
2. If FMU-139 is not used as the nose fuze, this fuze setting will result in an invalid fuzing option.

Figure 1-41. Individual Weapon Submenus (Sheet 4 of 17).

MK 84 LD (LASTE V4.0)

MK84LD		
> MIN TOF	4.0	
DES TOF	5.0	
BOMB MOUNT	PYLON	
OFFSET ADJ	N	
RT OFFSET	0	
UP OFFSET	0	
EJECT VEL	10	
RACK DELAY	0.20	
STORE		
CANCEL		

MK 84 LD (LASTE V6.0 136)

MK84LD		
> ESC MNVR	NONE	
MIN TOF	4.0	
DES TOF	5.0	
BOMB MOUNT	PYLON	
OFFSET ADJ	N	
RT	0	
UP	0	
EJECT VEL	10	
RACK DEL	0.20	
STORE		
CANCEL		

DISPLAY	OPTIONS	FUNCTION
ESC MNVR (LASTE V6.0)	NONE, CLM, TRN, TLT	Used to select available maneuvers.
MIN TOF	Variable from 0.0 to 99.9 seconds.	Used to enter minimum time of fall which affects the Minimum Range Caret/Staple.
DES TOF	Variable from 0.0 to 99.9 seconds.	Used to enter desired time of fall which affects the Desired Range Cue.
BOMB MOUNT	TER or PYLON	Used to enter type of bomb mount which affects the CCIP/CCRP.
OFFSET ADJ	Y or N	Allows adjustment of offset.
RT OFFSET, RT (LASTE V6.0)	Variable from -15 to 15 mils.	Adjusts the position of the CCIP/CCRP and related symbology horizontally.
UP OFFSET, UP (LASTE V6.0)	Variable from -15 to 15 mils.	Adjusts the position of the CCIP/CCRP and related symbology vertically.
EJECT VEL	Variable from -10 to 30 feet per second.	Adjusts weapon ballistics by modifying the preset ejection velocity.
RACK DELAY, RACK DEL (LASTE V6.0)	Variable from -0.40 to 0.40 seconds.	Adjusts weapon ballistics by modifying the preset rack delay.
STORE		Store data and preselect the weapon.
CANCEL		Deselect the weapon.

CCIP/CCRP

The CCIP/CCRP is affected by the BMB MNT and ballistics adjustments only.

MRC/MRS (MINIMUM RANGE CARET/MINIMUM RANGE STAPLE)

The MRC/MRS correspond to the release range which will cause the bomb to fall for the time set in MIN TOF. This is independent of the mechanical fuzing selection. The DRC displays the range for the time set in DES TOF.

The MIN TOF should be set to the highest of:

1. Nose/Tail fuze arm time + Tolerance + Inherent Delay.
2. Safe escape from fragmentation TOF.
3. TOF for release altitude which allows pull out above minimum ground clearance.

Figure 1-41. Individual Weapon Submenus (Sheet 5 of 17).

CBU-87 (LASTE V4.0)

CBU87	
> FZU-39	Y
FUNC TIME	0.95 N
HOF	300 A
RPM	500 2
DES TOF	4.0
BMB MNT	TER
OFFSET ADJ	N
RT OFFSET	0
UP OFFSET	0
EJECT VEL	10
RACK DELAY	0.20
STORE	
CANCEL	

CBU-87 (LASTE V6.0 136)

CBU87	
> ESC MNVR	NONE
FZU-39	Y
FUNC TIME	0.95 N
HOF	300 A
RPM	500 2
DES TOF	4.0
BMB MNT	TER
OFFSET ADJ	N
RT	0
UP	0
EJECT VEL	10
RACK DEL	0.20
STORE	
CANCEL	

NOTE

If FUNC TIME is out of range when the FZU-39 line is toggled to Y, the FUNC TIME line will be reset to 0.

DISPLAY	OPTIONS	FUNCTION
ESC MNVR (LASTE V6.0)	NONE, CLM, TRN, TLT	Used to select available maneuvers.
FZU-39	Y or N	Determines which values are used to calculate CCIP/CCRP and MRC/MRS.
FUNC TIME	N through Z in accordance with T.O. 1-1M-34.	Adjusts CCIP/CCRP to match actual weapon fuze settings.
HOF	300 to 3000 in 50 ft increments. Letters appear when values match available fuze settings.	With FZU-39, adjusts CCIP/CCRP and MRC/MRS to match fuze setting. Without FZU-39 adjusts MRC/MRS only.
RPM	0 to 2500 RPM in 500 RPM increments. The second number denotes the fuze setting.	Used to adjust CCIP/CCRP to match fuze setting.
DES TOF	Variable from 0.0 to 99.9 seconds.	Used to enter desired time of fall which affects the Desired Range Cue.
BMB MNT	TER or PYLON	Used to enter type of bomb mount which affects the CCIP/CCRP.
OFFSET ADJ	Y or N	Allows adjustment of offset.
RT OFFSET, RT (LASTE V6.0)	Variable from -15 to 15 mils.	Adjusts the position of the CCIP/CCRP and related symbology horizontally.
UP OFFSET, UP (LASTE V6.0)	Variable from -15 to 15 mils.	Adjusts the position of the CCIP/CCRP and related symbology vertically.
EJECT VEL	Variable from -10 to 30 feet per second.	Adjusts weapon ballistics by modifying the preset ejection velocity.
RACK DELAY, RACK DEL (LASTE V6.0)	Variable from -0.40 to 0.40 seconds.	Adjusts weapon ballistics by modifying the preset rack delay.
STORE		Store data and preselect weapon.
CANCEL		Deselect the weapon.

Figure 1-41. Individual Weapon Submenus (Sheet 6 of 17).

CBU-89 (LASTE V4.0)

CBU89		
> FZU-39	Y	
FUNC TIME	1.28 0	
HOF	300 A	
DES TOF	4.0	
BMB MNT	TER	
OFFSET ADJ	N	
RT OFFSET	0	
UP OFFSET	0	
EJECT VEL	10	
RACK DELAY	0.20	
STORE		
CANCEL		

CBU-89 (LASTE V6.0 136)

CBU89		
>ESC MNVR	NONE	
FZU-39	Y	
FUNC TIME	1.28 0	
HOF	300 A	
DES TOF	4.0	
BMB MNT	TER	
OFFSET ADJ	N	
RT	0	
UP	0	
EJECT VEL	10	
RACK DEL	0.20	
STORE		
CANCEL		

NOTE

If FUNC TIME is out of range when the FZU-39 line is toggled to Y, the FUNC TIME line will be reset to 0.

DISPLAY	OPTIONS	FUNCTION
ESC MNVR (LASTE V6.0)	NONE, CLM, TRN, TLT	Used to select available maneuvers.
FZU-39	Y or N	Determines which values are used to calculate CCIP/CCRP and MRC/MRS.
FUNC TIME	N through Z in accordance with T.O. 1-1M-34.	Adjusts CCIP/CCRP to match actual weapon fuze settings.
HOF	300 to 3000 in 50 foot increments. Letters appear when values match available fuze settings.	With FZU-39, adjusts CCIP/CCRP and MRC/MRS to match fuze setting. Without FZU-39 adjusts MRC/MRS only.
DES TOF	Variable from 0.0 to 99.9 seconds.	Used to enter desired time of fall which affects the Desired Range Cue.
BMB MNT	TER or PYLON	Used to enter type of bomb mount which affects the CCIP/CCRP.
OFFSET ADJ	Y or N	Allows adjustment of offset.
RT OFFSET, RT (LASTE V6.0)	Variable from -15 to 15 mils.	Adjusts the position of the CCIP/CCRP and related symbology horizontally.
UP OFFSET, UP (LASTE V6.0)	Variable from -15 to 15 mils.	Adjusts the position of the CCIP/CCRP and related symbology vertically.
EJECT VEL	Variable from -10 to 30 feet per second.	Adjusts weapon ballistics by modifying the preset ejection velocity.
RACK DELAY, RACK DEL (LASTE V6.0)	Variable from -0.40 to 0.40 seconds.	Adjusts weapon ballistics by modifying the preset rack delay.
STORE		Store data and preselect weapon.
CANCEL		Deselect the weapon.

Figure 1-41. Individual Weapon Submenus (Sheet 7 of 17).

■ CCIP/CCRP and MRC/MRS

The CCIP/CCRP and MRC/MRS for the CBU-89 are dependent on the FZU-39 setting and the mechanical fuze switch setting. Nose fuzeing will always cause the bomb and LASTE to operate in a time only mode. N/T fuzeing will force a HOF mode-radar controlled HOF if the bomb has an FZU-39 or a LASTE controlled minimum release for HOF based on fuze time if the bomb has no FZU-39. The following table lists the four possible combinations of fuze settings:

CASE	FZU-39	MECH FUZE	FUZE FUNCTION
1	Y	NOSE	TIME
2	Y	N/T	RADAR
3	N	NOSE	TIME
4	N	N/T	TIME AT HOF

NOTE

Tail fuzeing is not a valid option for CBU87, 89 and will cause an INVALID FUZING message to appear on the HUD.

Radar Mode

Case 2 is the only radar fuze option for CBU87, 89. In this situation, LASTE uses HOF and RPM (for CBU87) to compute the CCIP/CCRP. Actual HOF fuze settings must be entered into the menus. BMB MNT and ballistics adjustments also affect the CCIP/CCRP.

The MRC/MRS show the release range which will cause the bomb to fall three seconds (minimum radar function time) prior to reaching the set HOF. If submunition arm time is not sufficient, LASTE will place an X across the MRC.

CAUTION

In this case the MRC may not guarantee release beyond the minimum acceptable release range (abort altitude). Pilots may use the DRC for an abort cue or use abort altitude; however, abort altitudes are much more sensitive to release parameter errors than the DRC. See section V, PLANNING PROCEDURES AND SAMPLE PROBLEMS, LASTE MINIMUM RANGE CUES PLANNING, for more information.

Time Mode

In cases 1 and 3, the FZU-39 on the weapon is not used and LASTE disregards the HOF setting for CCIP/CCRP and MRC calculations. Actual fuze function times and RPM (CBU87) must be entered into the LASTE menu for correct CCIP/CCRP operation.

The MRC/MRS show the release range which will cause the weapon to fall for the set fuze time, open, then allow the submunitions to arm before impact.

Figure 1-41. Individual Weapon Submenus (Sheet 8 of 17).

CAUTION

In the above case the MRC does not represent acceptable cues for actual minimum acceptable release range (abort altitude). Pilots may use the DRC for an abort cue or use abort altitude; however, abort altitudes are much more sensitive to release parameter errors than the DRC.

In V6.0 the MRS/MRC will give Safe Escape from an intact 'Can' going off high order.

Time at HOF Mode

In case 4, the CCIP/CCRP operated just as in cases 1 and 3. However the MRC/MRS now consider the set HOF. The MRC/MRS will show the greater of two conditions: first, the release range for the weapon to fall for the set fuze time prior to reaching the set HOF. second, the release range for the weapon to fall for the set fuze time, open, then allow for submunition arming prior to impact.

CAUTION

In the above case the MRC does not represent acceptable cues for actual minimum acceptable release range (abort altitude).

Pilots may use the DRC for an abort cue or use abort altitude; however, abort altitudes are much more sensitive to release parameter errors than the DRC.

In V6.0 the MRS/MRC will give Safe Escape from an intact 'Can' going off high order.

Figure 1-41. Individual Weapon Submenus (Sheet 9 of 17).

CBU-97 LASTE V6.0 136

CBU97		
>ESC MNVR		NONE
FZU-39		Y
FUNC TIME		1.28 0
HOF		300 A
DES TOF		4.0
BMB MNT		TER
OFFSET ADJ		N
RT		0
UP		0
EJECT VEL		10
RACK DEL		0.20
STORE		
CANCEL		

NOTE

If FUNC TIME is out of range when the FZU-39 line is toggled to Y, the FUNC TIME line will be reset to 0.

DISPLAY	OPTIONS	FUNCTION
ESC MNVR (LASTE V6.0)	NONE, CLM, TRN, TLT	Used to select available maneuvers.
FZU-39	Y or N	Determines which values are used to calculate CCIP/CCRP and MRC/MRS.
FUNC TIME	M through Z in accordance with T.O. 1-1M-34.	Adjusts CCIP/CCRP to match fuze settings.
HOF	300 to 3000 in 50 foot increments. Letters appear when values match available fuze settings.	With FZU-39, adjusts CCIP/CCRP and MRC/MRS to match fuze setting. Without FZU-39 adjusts MRC/MRS only.
DES TOF	Variable from 0.0 to 99.9 seconds.	Used to enter desired time of fall which affects the Desired Range Cue.
BMB MNT	TER or PYLON	Used to enter type of bomb mount which affects the CCIP/CCRP.
OFFSET ADJ	Y or N	Allows adjustment of offset.
RT OFFSET, RT (LASTE V6.0)	Variable from -15 to 15 mils.	Adjusts the position of the CCIP/CCRP and related symbology horizontally.
UP OFFSET, UP (LASTE V6.0)	Variable from -15 to 15 mils.	Adjusts the position of the CCIP/CCRP and related symbology vertically.
EJECT VEL	Variable from -10 to 30 feet per second.	Adjusts weapon ballistics by modifying the preset ejection velocity.
RACK DELAY, RACK DEL (LASTE V6.0)	Variable from -0.40 to 0.40 seconds.	Adjusts weapon ballistics by modifying the preset rack delay.
STORE		Store data and preselect weapon.
CANCEL		Deselect the weapon.

Figure 1-41. Individual Weapon Submenus (Sheet 10 of 17).

CCIP/CCRP and MRC/MRS

The CCIP/CCRP and the MRC/MRS for the CBU-97 are dependent on the FZU-39 setting and the mechanical fuzeing switch setting. Nose fuzeing will always cause the bomb and LASTE to operate in a time only mode. N/T fuzeing will force a HOF mode--radar controlled HOF if the bomb has an FZU-39 or a LASTE controlled minimum release for HOF based on fuze time if the bomb has no FZU-39. The following table lists the four possible combinations of fuze settings:

<u>CASE</u>	<u>FZU-39</u>	<u>MECH FUZE</u>	<u>FUZE FUNCTION</u>
1	Y	NOSE	TIME
2	Y	N/T	RADAR
3	N	NOSE	TIME
4	N	N/T	TIME AT HOF

NOTE

Tail fuzeing is not a valid option for CBU-97 and will cause an INVALID FUZING message to appear on the HUD.

Radar Mode

Case 2 is the only radar fuze option for CBU97. In this situation, LASTE uses HOF to compute the CCIP/CCRP. Actual HOF fuze settings must be entered into the menus. BMB MNT and ballistics adjustments also affect the CCIP/CCRP.

The MRC/MRS show the release range which will cause the bomb to fall three seconds (minimum radar function time) before reaching the set HOF. If CCIP is used and submunition arm time is not sufficient, LASTE will place an X across the MRC.

CAUTION

In this case the MRC may not guarantee release beyond the minimum acceptable release range (abort altitude). Pilots may use the DRC for an abort cue or use abort altitude; however, abort altitudes are much more sensitive to release parameter errors than the DRC. See section V, PLANNING PROCEDURES AND SAMPLE PROBLEMS, LASTE MINIMUM RANGE CUES PLANNING, for more information.

Time Mode

In cases 1 and 3, the FZU-39 on the weapon is not used and LASTE disregards the HOF setting for CCIP and MRC calculations. Actual fuze function times must be entered into the LASTE menu for correct CCIP operation.

The MRC/MRS show the release range which will cause the weapon to fall for the set fuze time, open, then allow the submunitions to arm before impact.

CAUTION

In this case the MRC may not guarantee release beyond the minimum acceptable release range (abort altitude). Pilots may use the DRC for an abort cue or use abort altitude; however, abort altitudes are much more sensitive to release parameter errors than the DRC. See section V, PLANNING PROCEDURES AND SAMPLE PROBLEMS, LASTE MINIMUM RANGE CUES PLANNING, for more information.

Figure 1-41. Individual Weapon Submenus (Sheet 11 of 17).

Time at HOF Mode

In case 4, the CCIP operated just as in cases 1 and 3. However, the MRC/MRS now consider the set HOF. The MRC/MRS will show the greater of two conditions: first, the release range for the weapon to fall for the set fuze time before reaching the set HOF; second, the release range for the weapon to fall for the set fuze time, open, then allow for submunition arming before impact.

CAUTION

In the above case the MRC does not represent acceptable cues for actual minimum acceptable release range (abort altitude). Pilots should use abort altitude.

BLU-52 Data Menu

BLU52
> STORE
CANCEL

NOTE

BLU-52 uses the same ballistics algorithms for BLU-52/B and BLU-52A/B.

DISPLAY	FUNCTION
STORE	Preselect weapon.
CANCEL	Deselect the weapon.

Figure I-41. Individual Weapon Submenus (Sheet 12 of 17).

LUU Submenu (LASTE V6.0 136)

LUU
> o LUU 1/5/6
LUU 2
EXIT

NOTE

A circle left of LUU 1/5/6 and/or LUU 2 indicates which flare(s) are selected.

DISPLAY	FUNCTION
LUU	Name of weapons submenu selected.
LUU-1/-5/-6	Specific type of flare (illumination unit) that can be selected. Selects submenu.
LUU-2	Specific type of flare (illumination unit) that can be selected. Selects submenu.
EXIT	Exit LUU Submenu.

LUU 1/5/6 Submenu (LASTE V6.0 136)

LUU 1/5/6	
> STATION	2
EJECT DELAY	15
IGN DELAY	20
STORE	
CANCEL	

NOTE

Ranges for delays are independent; invalid combinations are not possible.

DISPLAY	OPTIONS	FUNCTION
STATION	2, 3, 9, 10	Used to enter station number, which affects CCRP and related symbology.
EJECT DELAY	5, 10, 15, 20, 25, 30 (seconds)	Used to select ejection delay time from a series of independent ranges.
IGN DELAY	10, 15, 20, 25, 30 (seconds)	Used to select ignition delay time from a series of independent ranges.
STORE		Store data
CANCEL		Cancel data.

Figure I-41. Individual Weapon Submenus (Sheet 13 of 17).

LUU-2 Submenu (LASTE V6.0 136)

LUU 2	
> STATION	2
FLARE TYPE	LUU-2A/B
DELAY <FT>	3000
HGT OVR TGT	1700
STORE	
CANCEL	

DISPLAY	OPTIONS	FUNCTION
STATION	2, 3, 9, 10	Used to enter station number, which affects CCRP and related symbology.
FLARE TYPE	LUU-2/B, -2A/B, -2B/B	Used to select specific type of LUU 2 flare from a series of types.
DELAY <FT>	For LUU-2/B: 500,1500, 3000, 4000, 5000, 6500, 7500, and 8500. For LUU-2A/B: 500, and 1000 to 1100 in increments of 1000. For LUU-2B/B: 250, 500, 1000, 1500, and 2000 to 11000 in increments of 1000.	Used to select values in feet for free-fall distance delay for selected flare type.
HGT OVR TGT	1700 to 10000 in increments of 100.	Used to enter height in feet at which selected flare type will reach optimum illumination over target before reaching burnout altitude.
STORE		Store data
CANCEL		Cancel data.

NOTES

DELAY field is dynamic and allows user to select from values valid for current FLARE TYPE.

If an invalid fuzing combination occurs by changing FLARE TYPE, the DELAY value will immediately default to 500 feet.

When the DELAY setting defaults to 500 feet, it remains at that setting until manually changed.

The HGT OVR TGT data entry item utilizes the same scroll rates that are used for all other LASTE data entry items.

Figure I-41. Individual Weapon Submenus (Sheet 14 of 17).

Rocket Submenu (LASTE V6.0 136)

RKT
> RKT1
RKT2
RKT3
EXIT

DISPLAY	FUNCTION
RKT1	Used to enter RKT1 menu.
RKT2	Used to enter RKT2 menu.
RKT3	Used to enter RKT3 menu.
EXIT	Exit submenu.

Figure 1-41. Individual Weapon Submenus (Sheet 15 of 17).

Rockets - 2.75 FFAR Data Menus (LASTE V4.0)

RKT1		RKT2		RKT3	
> WARHEAD	WDU4A	> WARHEAD	M151/156/WTU1B	> WARHEAD	MK1/5/61
MOTOR	MK4/40	MOTOR	MK66	MOTOR	MK4/40
STA NO	8	STA NO	8	STA NO	3
DES TOF	4.0				
OFFSET ADJ	N	OFFSET ADJ	N	OFFSET ADJ	N
RT OFFSET	0	RT OFFSET	0	RT OFFSET	0
UP OFFSET	0	UP OFFSET	0	UP OFFSET	0
STORE		STORE		STORE	
CANCEL		CANCEL		CANCEL	

Rockets - 2.75 FFAR Data Menus (LASTE V6.0)

RKT1		RKT2		RKT3	
> WARHEAD	WDU4A	> WARHEAD	M151/156/WTU1B	> WARHEAD	MK1/5/61
MOTOR	MK4/40	MOTOR	MK66	MOTOR	MK4/40
STA NO8		STA NO	8	STA NO	3
DES TOF	4.0				
OFFSET ADJ	N	OFFSET ADJ	N	OFFSET ADJ	N
RT	0	RT	0	RT	0
UP	0	UP	0	UP	0
STORE		STORE		STORE	
CANCEL		CANCEL		CANCEL	

NOTES

The same menu exists for RKT1, RKT2, and RKT3.

The pilot must ensure that the rocket submenus (RKT1, 2, and 3) selected in the HUD correspond to the desired rocket configuration.

The DES TOF entry will be selectable only for a type WDU-4A warhead. Otherwise, the line will be blank, and scrolling will skip over the entry.

Station number does not affect CCIP/CCRP computations.

DISPLAY	OPTIONS	FUNCTION
WARHEAD	M151/156/WTU1B, MK 1/5/61, WDU-4A	Used to enter rocket warhead designation.
MOTOR	MK 4/40, MK 66	Used to enter rocket motor designation.
STA NO	2, 3, 4, 8, 9, 10	Confirms correct CCIP/CCRP selection if different rocket motors/warheads are loaded on different stations.
DES TOF (for WDU-4A only)	Variable from 0.0 to 99.9 seconds.	Used to enter desired time of fall which affects the Desired Range Cue.
OFFSET ADJ	Y or N	Allows adjustment of offset.
RT OFFSET	Variable from -15 to 15 mils.	Adjusts the position of the CCIP/CCRP and related symbology horizontally.
UP OFFSET	Variable from -15 to 15 mils.	Adjusts the position of the CCIP/CCRP and related symbology vertically.
STORE		Store data and preselect weapon.
CANCEL		Deselect the weapon.

Figure 1-41. Individual Weapon Submenus (Sheet 16 of 17).

NOTE

LASTE V6.0 will only allow valid combinations of motors and warheads to be selected:

MOTOR

MK 4/40

MK 66

WARHEADSM151/156/WTU-1B
MK1/5/61, WDU-4A/AM151/156/WTU-1B
MK 1/5/61

Whenever the MK 4/40 motors and the WDU-4A warhead (valid combination) are selected, the motor cannot be changed until another warhead is selected. This prevents invalid combinations from being selected.

30MM Data Menu V6.0

30MM	
> AMMO TYPE	HEI
AMMO MFG	OLIN
o RECOIL RESET	Y
STORE	

30MM Data Menu V4.0

30MM	
> AMMO TYPE	HEI
AMMO MFG	OLIN
o RECOIL RESET	Y
STORE	

NOTE

The presence of a small "o" to the left of the RECOIL RESET line indicates the use of the nominal recoil value. The small "o" will remain until the recoil correction is updated by Precision Attitude Control (PAC), i.e. after a pass longer than two seconds.

DISPLAY	OPTIONS	FUNCTION
AMMO TYPE	HEI (high explosive incendiary), TP (target practice) and CM (combat mix)	Used to enter ammunition type.
AMMO MFG	OLIN, ALLT, AVE	Used to enter ammunition manufacturer.
RECOIL RESET	Y or N	Used to reset correction to the nominal value.
STORE		Store data.

Figure 1-41. Individual Weapon Submenus (Sheet 17 of 17).

OFFSET ADJUST DATA MENU

OFFSET ADJUST		
> OFFSET ADJ		N
GUN RT		-15
GUN UP		12
BOMB RT		-5
BOMB UP		15
EXIT		

DISPLAY	OPTIONS	FUNCTION
OFFSET ADJ	Y or N	Allows adjustment of Offset values.
GUN RT	-15 TO +15 mil (1 mil Inc)	Pilot selectable horizontal gun offset.
GUN UP	-15 TO +15 mil (1 mil Inc)	Pilot selectable vertical gun offset.
BOMB RT	-15 TO +15 mil (1 mil Inc)	Pilot selectable horizontal bomb offset.
BOMB UP	-15 TO +15 mil (1 mil Inc)	Pilot selectable horizontal bomb offset.

Figure 1-42. Offset Adjust Submenu.

AIR-TO-AIR SIGHT (AAS) MENU DATA ENTRY

The AAS submenu (Figure 1-43) provides one set of three parameters for air-to-air gunnery against fixed wing aircraft, and one set of three parameters for air-to-air gunnery against rotary wing aircraft.

The three parameters are target wingspan, length, and anticipated maximum target speed. The pilot can cycle between the two sets of parameters in the air-to-air mode, using the select switch on the OSP.

AAS		
> FXD WNGSPN		40
FXD LENGTH		60
FXD TGTSPEED		460
RTY WNGSPN		30
RTY LENGTH		50
RTY TGTSPEED		180
EXIT		

DISPLAY	OPTIONS	FUNCTION
FXD WNGSPN	Variable from 0 to 99 feet in 1 foot increments.	Adjusts width of funnel sight.
FXD LENGTH	Variable from 10 to 200 feet.	Adjusts length of MRGS sight.
FXD TGTSPEED	Variable from 50 to 500 knots.	Adjusts depression of MRGS sight.
RTY WNGSPN	Variable from 0 to 99 feet in 1 foot increments.	Adjusts width of funnel sight.
RTY LENGTH	Variable from 10 to 200 feet.	Adjusts length of MRGS sight.
RTY TGTSPEED	Variable from 50 to 500 knots.	Adjusts depression of MRGS sight.
Exit		Used to exit submenu and return to MAIN MENU.

Figure 1-43. AAS Submenu.

ELEV/TIME SUBMENU DATA ENTRY (LASTE V4.0)

The ELEV/TIME submenu (Figure 1-44 sheet 1 of 2) allows target elevations, desired Time On Target (TOT), and current time to be entered into the LASTE computer. The submenu contains 16 steerpoints, numbered 0 through F corresponding to the INS steerpoints. Steerpoints A

through F are used to store mark points entered by pilots. LASTE steerpoints have the capacity for storing target elevations and desired TOT's. The steerpoint selected on the CDU is used by LASTE to select the corresponding target elevation from the ELEV/TIME submenu. The selected steerpoint and target elevations are displayed on the HUD in NAV, WD-1, WD-2, EXP, and air-to-air modes.

ELEV/TIME		
> S-0	1040	00:30:01
S-1	560	10:00:00
S-2		
S-3		
S-4		
CLEAR		TIME
o CUR TIME		00:05:31
EXIT		

NOTE

A small "o" preceding a steerpoint indicates the current markpoint. Steerpoints A through F are markpoints.

The presence of a small "o" to the left of the CUR TIME line indicates that the clock is running.

DISPLAY	OPTIONS	FUNCTION
CLEAR	TIME, ELEV OR BOTH	Clears (blanks) selected time, elevation, or both.
CUR TIME		Displays current time, allows current time to be set.
EXIT		Exits the submenu and causes a return to MAIN MENU.

Figure 1-44. Elev/Time Submenu (Sheet 1 of 2).

ELEV/TIME SUBMENU DATA ENTRY**(LASTE V6.0 136 Non-GPS)**

The ELEV/TIME submenu (Figure 1-44 sheet 2 of 2) allows target elevations, desired Time On Target (TOT), and current time to be entered into the LASTE computer. The submenu contains 16 steerpoints, numbered 0 through F corresponding to the INS steerpoints. Steerpoints A

through F are used to store mark points entered by pilots. LASTE steerpoints have the capacity for storing target elevations and desired TOTs. The steerpoint selected on the CDU is used by LASTE to select the corresponding target elevation from the ELEV/TIME submenu. The selected steerpoint and target elevations are displayed on the HUD in NAV, GUNS, CCIP, CCRP, and air-to-air modes.

ELEV/TIME		
> S-0	1040	00:30:01
S-1	560	10:00:00
S-2		
S-3		
S-4		
TIME ADJ		00:00:00
CLEAR		TIME
o CUR TIME		00:05:31
EXIT		

NOTE

The ELEV/TIME submenu is not available on HUD for LASTE V6.0 136 GPS.

When a TIME ADJ is entered, all times on the steerpoints will shift by that amount.

A positive TIME ADJ corresponds to a late arrival, meaning the adjustment will be added to all steerpoints.

A negative TIME ADJ corresponds to an early arrival, meaning the adjustment will be subtracted from all steerpoints.

A small "o" preceding a steerpoint indicates the current markpoint. Steerpoints A through F are markpoints.

The presence of a small "o" to the left of the CUR TIME line indicates that the clock is running.

DISPLAY	OPTIONS	FUNCTION
TIME ADJ	-23:59:59 to 23:59:59 HRS (1 sec increments)	Adjusts time to all steerpoints.
CLEAR	TIME, ELEV OR BOTH	Clears (blanks) selected time, elevation, or both.
CUR TIME		Displays current time, allows current time to be set.
EXIT		Exits the submenu and causes a return to MAIN MENU.

Figure 1-44. Elev/Time Submenu (Sheet 2 of 2).

Target Elevation

Target elevations are variable -990 to 16380 feet in 10-foot increments. A zero elevation entry is displayed as 0 and "no entry" is displayed as a blank in the ELEV/TIME submenu, and as "XXXX" in the HUD operational modes (NAV, [WD-1, WD-2, EXP(V4.0)], [GUNS, CCIP, CCRP(V6.0)], and A/A). Target elevations are entered into the ELEV/TIME submenu by toggling the OSP SEL switch until the cursor is at the desired steerpoint, then toggling the DATA switch until the appropriate elevation is shown. Only five steerpoints are displayed in the ELEV/TIME submenu at any one time. The OSP SEL switch will scroll through all sixteen steerpoints before reaching CLEAR. The OSP DATA switch can be toggled until the desired elevation is displayed on the HUD.

NOTE

The ELEV/TIME submenu is not available on HUD for LASTE V6.0 **136** GPS.

Time on Target

The Time On Target (TOT) is the desired time to reach the steerpoint. After the steerpoint elevation is selected, pressing ENTR will store the steerpoint elevation and cause the hours field of the desired TOT to flash. Using the OSP DATA switch will change the hours field. Consecutive ENTR depressions will step through remaining fields (minutes, seconds), allowing them to be changed using the OSP DATA switch.

"No entry" is set by entering 24 in the hours field regardless of the minutes and seconds settings. After the "no entry" setting is completed the time field will blank.

Current Time

Current time must be set every time LASTE is powered up. If the current time is not set the LASTE system clock will start from 00:00:00 (midnight), at power on.

To enter current time:

1. OSP Sel Switch - Move cursor to CUR TIME.
2. OSP ENTR Button - Depress, the hour field for CUR TIME will flash.
3. OSP DATA Switch - Toggle value to appropriate hour.
4. OSP ENTR Button - Depress, hours value is stored and the minute field for CUR TIME will flash.
5. OSP DATA Switch - Toggle value to appropriate minute.

6. OSP ENTR Button - Depress, minutes value is stored and the second field for CUR TIME will flash.
7. OSP DATA Switch - Toggle value to appropriate second.
8. OSP ENTR Button - Depress, starts clock and displays small "o" next the CUR TIME.

Clearing Displays

With the cursor at CLEAR, toggling the DATA switch up or down allows the pilot to reset ELEV, TIME, or BOTH to "NO ENTRY" by depressing the ENTR switch. All target elevations stored in the ELEV/TIME submenu are retained in LASTE memory when electrical power is turned off. If EXIT is selected and the enter button on the OSP is depressed, the HUD display will return to the MAIN MENU.

DISPLAY MODES MENUS DATA ENTRY

The DISPLAY MODES submenus (Figure 1-45) provide the option to automatically display weapon release parameters, TD Box occultation by the CCIP (LASTE V6.0 only), TVV occultation by the WD-2(V4.0), [CCIP(V6.0)] gun cross, HUD UPDATE (LASTE V6.0 **136** Non-GPS only) and clearing of all HUD updates. (LASTE V6.0 **136** Non-GPS only) Setting the cursor to AUTO DATA DISP and toggling the DATA button to Y will automatically flash the weapon release parameter pages on the HUD once within three seconds after each weapon release. If another release occurs during the three seconds, the system will store the first release, but abandon its autodisplay on the HUD. In this case, it will flash the data from the second release. AUTO DATA DISP also allows the display of the GCAS training mode parameters. The pilot can elect to occult the TD Box with the CCIP by placing the cursor at CCIP OCCULT TD BOX (LASTE V6.0 **136** only) and toggling the DATA button to YES. The pilot can also elect to occult the TVV with the gun cross by placing the cursor at CCIP Mode GUN OCCULT and toggling the DATA button to YES. The initial state of both occultations is always NO and must be toggled to YES for occultation to take place. HUD UPDATE (LASTE V6.0 **136** Non-GPS only) with a "donut" on the side indicates that there is a HUD steerpoint correction applied. Setting the cursor to CLEAR HUD UPDATE (LASTE V6.0 **136** Non-GPS only) and pressing the ENTR button clears all HUD steerpoint updates made by LASTE.

Display Modes Menus Data

LASTE V4.0	LASTE V6.0 136 Non-GPS	LASTE V6.0 136 GPS
DISPLAY MODES > AUTO DATA DISP N WD-2 GUN OCCULT N EXIT	DISPLAY MODES > AUTO DATA DISP N CCIP OCCULT TD BOX N WD-2 GUN OCCULT N o HUD UPDATE CLEAR HUD UPDATE EXIT	DISPLAY MODES > AUTO DATA DISP N CCIP OCCULT TD BOX N WD-2 GUN OCCULT N EXIT

DISPLAY	OPTIONS	FUNCTION
AUTO DATA DISP	Y or N	Allows automatic display of 1) weapon release data 2) GCAS training data (LASTE V6.0 only).
CCIP OCCULT TD BOX (LASTE V6.0 only)	Y or N	Allows option of TD Box occultation by CCIP/CCRP pipper.
WD-2(V4.0), [CCIP(V6.0)] GUN OCCULT	Y or N	Allows option of Total Velocity Vector (TVV) occultation by gun cross.
HUD UPDATE (LASTE V6.0 136 Non-GPS only)		Donut indicates that there is a HUD steerpoint correction applied.
CLEAR HUD UPDATE (LASTE V6.0 136 Non-GPS only)	Y or N	Allows option of clearing all HUD steerpoints updates made by LASTE.
EXIT		Exits the submenu and causes a return to MAIN MENU.

Figure 1-45. Display Modes Submenus.

WEAPON RELEASE DATA MENUS

The WEAPON RELEASE DATA submenu allows the option to automatically scroll through all the weapon delivery parameter pages or manually scroll through each bomb and gun data page (Figure 1-46). When the WEAPON RELEASE DATA submenu is selected, the pilot can toggle the DATA switch to YES for auto scroll or NO for manual mode. If YES is selected all of the passes will be automatically scrolled through at a rapid rate for recording on the VTR. After the data pages have been recorded, the first data page will be displayed. If NO is selected, the first data page will be displayed and can be manually scrolled using the OSP ENTR button.

With the master arm switch in ARM, LASTE stores selected weapons delivery parameters when the weapons release button is pressed or the trigger is pulled to the second detent. With the master arm switch in CAMERA, LASTE stores gun data delivery parameters when the trigger is pulled to the second detent. The system will store the data of the first 20 passes for any combination of gun or bomb deliveries. Additional passes can still be recorded from the auto data display but will not be stored in memory.

NOTE

For the best display of the weapon delivery data, select the AUTOSCROLL option with a dark and solid HUD background.

To manually scroll data:

NOTE

This menu is used for information of bomb and gun data only. There is no data entry involved in this submenu.

1. OSP SEL Switch - Move cursor to NEXT PAGE.
2. OSP ENTR Button - Depress, HUD displays next data page.
3. Repeat steps 1 and 2 until all data has been scrolled.
4. After all data has been viewed depressing OSP ENTR Button with cursor at EXIT will return HUD to the MAIN MENU.

Bomb Release Data Menus (LASTE V4.0)

BOMB -1	
PASS/TIME	1/13:52:32
WPN/TYPE	BDU33
REL MODE	SGL/N/T
MIN/DES TOF	20.0/25.9
HOB/HOF	
QTY/MSEC	10/150
KIAS	300.0
DIVE	15.03
AGL ALT/SCE	4593/RDR
> NEXT PAGE	
EXIT	

BOMB -2	
PASS/TIME	1/13:52:32
SL RNG	3405
BMB RNG	2152
SDFP	72
TTGD/TFALL	20.30/39.95
TTGM/MINRNG	18.33/2980
DPLOYTIM/ALT	50.55/5440
BANK	L10.53
HDG	234.66
> NEXT PAGE	
EXIT	

DISPLAY	FUNCTION
Bomb-1	
PASS/TIME	Pass number and current time when release occurred.
WPN/TYPE	Weapon selected fuze type/series if any applicable.
REL MODE	Indicates fuzing and release mode.
MIN/DES TOF	Minimum time to impact or burst and desired time to impact in seconds as set in weapons submenu.
HOB/HOF	Height of burst or height of function (depending on weapon) in feet.
QTY/MSEC	Ripple release quantity and ripple release interval.
KIAS	Indicated airspeed in knots.
DIVE	Dive angle in degrees.
AGL ALT/SCE	Altitude above ground level in feet and altitude source.
NEXT PAGE	Shows next page of bomb data.
EXIT	Used to exit submenu and return to MAIN MENU.
Bomb-2	
SL RNG	Slant range in feet.
BMB RNG	Bomb range in feet.
SDFP	CCIP depression from flight path in mils.
TTGD/TFALL	Time to go until reaching the Desired Range Cue and Time Of Fall in seconds.
TTGM/MIN RNG	Time to go until reaching the MRC/MRS in seconds and minimum range in feet.
DPLOYTIM/ALT	Deploy time and deploy altitude for cluster weapons.
BANK	Direction of bank (L or R) and angle in degrees.
HDG	Magnetic heading in degrees.

Figure 1-46. Data Submenus (Sheet 1 of 10).

Bomb Release Data Menus (LASTE V4.0)

BOMB -3	
PASS/TIME	1/13:52:32
KTAS	315.6
GND SPD	320.4
RDR ALT	2011
MSL ALT	3561
TGT ELV	2000
WIND-N	23.2
WIND-E	43.2
WIND-UP	3.3
> NEXT PAGE	
EXIT	

DISPLAY	FUNCTION
	Bomb-3
KTAS	True airspeed in knots.
GND SPD	Ground speed in knots.
RDR ALT	Radar altitude in feet.
MSL ALT	Altitude above mean sea level in feet.
TGT ELEV	Target elevation in feet (hot elevation in BARO/DELTA, MSL-RDR ALT in RADAR).
WIND-N	Wind velocity in knots, north.
WIND-E	Wind velocity in knots, east.
WIND-UP	Wind velocity in knots, down.
NEXT PAGE	Shows next page of bomb data.
EXIT	Used to exit submenu and return to MAIN MENU.

Figure I-46. Data Submenus (Sheet 2 of 10).

Bomb Release Data Menus (LASTE V6.0 136)

BOMB - 1	
PASS/TIME	1/13:52:32
WPN/TYPE	BDU33
REL MODE	SGL/N/T
HOB/HOF	
QTY/MSEC	10/150
TRUE HDG	180.0
KIAS/DIVE	50/15.03
MSL ALT	3561
TGT ELV	2000
> NEXT PAGE	
EXIT	

BOMB - 2	
VWINDX	175.4
VWINDY	84.1
VWINDZ	-3.0
VIX	-950.0
VIY	-874.2
VIZ	-247.6
VAU	239.0
VAV	54.0
VAW	312.4
> NEXT PAGE	
EXIT	

DISPLAY	FUNCTION
Bomb - 1	
PASS/TIME	Pass number and current time when release occurred.
WPN/TYPE	Weapon selected based on ID number and fuze type/series if any applicable.
REL MODE	Indicates fuzing and release mode.
HOB/HOF	Height of burst or height of function (depending on weapon) in feet.
QTY/MSEC	Ripple release quantity and ripple release interval in msec.
TRUE HDG	Smoothed heading attitude in degrees from true north.
KIAS/DIVE	Indicated airspeed in knots / Dive angle in degrees.
MSL ALT	Altitude above mean sea level in feet.
TGT ELEV	Target elevation in feet (hot elevation in BARO/DELTA, MSL-RDRALT in RADAR).
NEXT PAGE	Shows next page of bomb data.
EXIT	Used to exit submenu and return to MAIN MENU.
Bomb - 2	
VWINDX	Wind velocity in ft/sec, north.
VWINDY	Wind velocity in ft/sec, east.
VWINDZ	Wind velocity in ft/sec, down.
VIX	Aircraft inertial velocity in ft/sec, north.
VIY	Aircraft inertial velocity in ft/sec, east.
VIZ	Aircraft inertial velocity in ft/sec, down.
VAU	Aircraft true airspeed in ft/sec, U-axis (longitudinal).
VAV	Aircraft true airspeed in ft/sec, V-axis (lateral).
VAW	Aircraft true airspeed in ft/sec, W-axis (vertical) (DN POS).

Figure 1-46. Data Submenus (Sheet 3 of 10).

Bomb Release Data Menus (LASTE V6.0 136)

BOMB - 3	
AU	-43.5
AV	21.9
AW	-112.0
QBARC	486.4
MACH	0.21
THE	-0.0353
PHI	-0.1846
BMB RNG	2152
TFALL	39.9
> NEXT PAGE	
EXIT	

BOMB - 4	
HFILTER	24628
NSATMADJ	1347
TFAT	593
HFPRESS	755
MAX HT	5440
DPLOYTIM/ALT	50.55/5440
MIN/DES TOF	20.0/25.9
ATL ALT / SCE	4593/RDR
RDR ALT	2011
> NEXT PAGE	
EXIT	

DISPLAY	FUNCTION
Bomb - 3	
AU	Aircraft inertial acceleration in ft/sec/sec, U-axis (longitudinal).
AV	Aircraft inertial acceleration in ft/sec/sec, V-axis (lateral).
AW	Aircraft inertial acceleration in ft/sec/sec, W-axis (vertical) (DN POS).
QBARC	Dynamic pressure, lb/ft/ft.
MACH	Mach number of aircraft.
THE	Smoothed pitch attitude in radians.
PHI	Bank angle in radians (POS CW).
BMB RNG	Bomb (ground) range in feet.
TFALL	Time of fall in seconds.
NEXT PAGE	Shows next page of bomb data.
EXIT	Used to exit submenu and return to MAIN MENU.
Bomb - 4	
HFILTER	Smoothed altitude above MSL in feet.
NSATMADJ	Nonstandard atmosphere altitude adjustment in feet.
TFAT	Free air temperature in degrees R.
HFPRESS	Filtered pressure altitude in feet.
MAX HT	Bomb trajectory maximum height MSL in feet.
DPLOYTIM/ALT	Deploy time in seconds / Deploy altitude in feet.
MIN/DES TOF	Minimum time to impact or burst in seconds / Desired time to impact in seconds.
ATL ALT/SCE	Altitude above target level in feet / Altitude source.
RDR ALT	Radar altitude in feet.

Figure I-46. Data Submenus (Sheet 4 of 10).

Bomb Release Data Menus (LASTE V6.0 ☐ Non-GPS) (LASTE V6.0 ☐ GPS)

BOMB - 5

SL RNG	3405
LAMW	300
LAMV	-236
SDFP	72
TTGD	20.30
TTGM/MNRNG	18.33/2980
HDG	234.66
KTAS	315.6
GND SPD	320.4

> NEXT PAGE
EXIT

BOMB - 5

SL RNG	3405
LAMW/LAMV	300/-236
SDFP	72
TTGD	20.30
TTGM/MNRNG	18.33/2980
HDG	234.66
SAFE ESC	FUZE
KTAS	315.6
GND SPD	320.4

> NEXT PAGE
EXIT

DISPLAY	FUNCTION
	Bomb - 5
SL RNG	Slant range in feet.
LAMW/LAMV (Separate entries for LASTE V6.0 ☐ Non-GPS)	LAMW – CCIP bomb lead angle with respect to aircraft <u>azimuth</u> (longitudinal axis)/ LAMV – CCIP bomb lead angle with respect to aircraft <u>elevation</u> (longitudinal axis).
SDFP	Slight depression with respect to flight path in mils.
TTGD	Desired time to go in seconds.
TTGM/MNRNG	Minimum time to go in seconds / Minimum range in feet.
HDG	Magnetic heading in degrees.
SAFE ESC (V6.0 ☐ GPS only)	Safe Escape—FUZE/CLM/TRN/TLT
KTAS	True airspeed in knots.
GND SPD	Ground speed in knots.
NEXT PAGE	Shows next page of bomb data.
EXIT	Used to exit submenu and return to MAIN MENU.

Figure 1-46. Data Submenus (Sheet 5 of 10).

CCRP Release Data Menu (1 of 3) (LASTE V6.0 **136**)

CCRP - 1

PASS/TIME	1/13:52:32
WPN/TYPE	BDU33
REL MODE	SGL/N/T
HOB/HOF	
QTY/MSEC	10/150
TRUE HDG	180.00
KIAS/DIVE	300/15.03
MSL ALT	3561
TGT ELV	2000

> NEXT PAGE
EXIT

CCRP - 2

VWINDX	26.7
VWINDY	10.3
VWINDZ	-3.0
VIX	-482.9
VIY	-0.2
VIZ	-129.4
VAU	499.7
VAV	0.1
VAW	17.5

> NEXT PAGE
EXIT

DISPLAY	FUNCTION
CCRP - 1	
PASS/TIME	Pass number and current time when release occurred.
WPN/TYPE	Weapon selected based on ID number and fuze type/series if any applicable.
REL MODE	Indicates fuzing and release mode.
HOB/HOF	Height of burst or height of function (depending on weapon) in feet.
QTY/MSEC	Ripple release quantity and ripple release interval in msec.
TRUE HDG	Smoothed heading attitude in degrees from true north.
KIAS/DIVE	Indicated airspeed in knots / Dive angle in degrees.
MSL ALT	Altitude above mean sea level in feet.
TGT ELEV	Target elevation in feet (hot elevation in BARO/DELTA, MSL-RDRALT in RADAR).
NEXT PAGE	Shows next page of CCRP data.
EXIT	Used to exit submenu and return to MAIN MENU.
CCRP - 2	
VWINDX	Wind velocity in ft/sec, north.
VWINDY	Wind velocity in ft/sec, east.
VWINDZ	Wind velocity in ft/sec, down.
VIX	Aircraft inertial velocity in ft/sec, north.
VIY	Aircraft inertial velocity in ft/sec, east.
VIZ	Aircraft inertial velocity in ft/sec, down.
VAU	Aircraft true airspeed in ft/sec, U-axis (longitudinal).
VAV	Aircraft true airspeed in ft/sec, V-axis (lateral).
VAW	Aircraft true airspeed in ft/sec, W-axis (vertical) (DN POS).

Figure 1-46. Data Submenus (Sheet 6 of 10).

CCRP Release Data Menu (2 of 3) (LASTE V6.0 136)

CCRP - 3	
AU	-3.5
AV	-1.9
AW	-60.7
QBARC	263.9
MACH	0.45
THE	-0.0353
PHI	-0.1846
BMB RNG	4152
TFALL	9.9
> NEXT PAGE	
EXIT	

CCRP - 4	
HFILTER	3713
NSATMADJ	1347
TFAT	503
HFPRESS	3012
MAX HT	3560
DPLOYTIM/ALT	50.55/5440
RX	4500
RY	-16
RZ	1476
> NEXT PAGE	
EXIT	

DISPLAY	FUNCTION
CCRP - 3	
AU	Aircraft inertial acceleration in ft/sec, U-axis (longitudinal).
AV	Aircraft inertial acceleration in ft/sec, V-axis (lateral).
AW	Aircraft inertial acceleration in ft/sec, W-axis (vertical) (DN POS).
QBARC	Dynamic pressure in lb/ft/ft.
MACH	Mach number of aircraft.
THE	Smoothed pitch attitude in radians.
PHI	Bank angle in radians (POS CW).
BMB RNG	Bomb range in feet.
TFALL	Time of fall in seconds.
NEXT PAGE	Shows next page of CCRP data.
EXIT	Used to exit submenu and return to MAIN MENU.
CCRP - 4	
HFILTER	Smoothed altitude above MSL in feet.
NSATMADJ	Nonstandard atmosphere altitude adjustment in feet.
TFAT	Free air temperature in degrees R.
HFPRESS	Filtered pressure altitude in feet.
MAX HT	Bomb trajectory maximum height in feet.
DPLOYTIM/ALT	Deploy time in seconds / Deploy altitude in feet.
RX	Range to target in feet, north.
RY	Range to target in feet, east.
RZ	Range to target in feet, down.

Figure 1-46. Data Submenus (Sheet 7 of 10).

CCRP Release Data Menu (3 of 3) (LASTE V6.0 136)

CCRP - 5	
TRKECCRP	0.1000
RMD	20
RMC	54
RSTABAZ	0.0030
RSTABEL	-0.0020
PHIF	-0.18
PHIFI	-0.22
PHIFSQ	-0.2031
SINXIR	0.183
> NEXT PAGE	
EXIT	

CCRP - 6	
GAMMAC	-15.25
GAMHATC	-0.262
PSIBAHC	1.570
DLAMDGAM	0.294
VXBFEND	348
VZBFEND	23
GAMCDOT	-0.026
PSIBCDOT	0.002
RSB	4315
> NEXT PAGE	
EXIT	

DISPLAY	FUNCTION
CCRP - 5	
TRKECCRP	Tracking error in radians for CCRP (perpendicular from CAPt to PBRL).
RMD	Downrange miss distance in feet without pilot error (required velocity vector system error).
RMC	Crossrange miss distance in feet without pilot error (required velocity vector system error).
RSTABAZ	Roll stabilized azimuth in radians pilot error (azimuth error from CAPt to CCRP pipper).
RSTABEL	Roll stabilized elevation in radians pilot error (elevation error from CAPt to CCRP pipper).
PHIF	Flight path bank angle in radians.
PHIFI	Flight path inertial bank angle in radians.
PHIFSQ	Complementary filtered flight path angle in radians.
SINXIR	Sine of angle in radians from HUD vertical to PBRL.
NEXT PAGE	Shows next page of CCRP data.
EXIT	Used to exit submenu and return to MAIN MENU.
CCRP - 6	
GAMMAC	Inertial flight path angle in degrees required for solution.
GAMHATC	Required air mass flight path angle in radians, estimate.
PSIBAHC	Required air mass bearing (course) in radians from true north, estimate.
DLAMDGAM	Derivative of lead angle with respect to flight path angle.
VXBFEND	Bomb final downrange ballistic velocity in ft/sec in bomb fall plane.
VZBFEND	Bomb final vertical ballistic velocity in ft/sec in bomb fall plane.
GAMCDOT	Derivative of required air mass flight path angle in rad/sec.
PSIBCDOT	Derivative of required air mass bearing in rad/sec.
RSB	Air mass slant range in feet to bomb impact.

Figure 1-46. Data Submenus (Sheet 8 of 10).

■ Gun Release Data Menus (LASTE V4.0)

GUN-1	
PASS/TIME	2/14:00:34
AMMO	HEI
PAC	Y
OPEN	1200
CEASE	990
BURST	2.5
KIAS	320.2
DIVE	-5.30
AGL ALT/SCE	542/DELT
> NEXT PAGE	
EXIT	

GUN-2	
PASS/TIME	2/14:00:34
RNDS	210
TOF OPEN	1.9
PAC PK/FNL	1.5/0.5
RDR ALT	1243
MSL ALT	3153
TGT ELV	90
BANK	0.00
KTAS	342.1
> NEXT PAGE	
EXIT	

DISPLAY	FUNCTION
GUN-1	
PASS/TIME	Pass number and current time when release occurred.
AMMO	Ammunition type used, either HEI, TP, or CM.
PAC	Indicates PAC mode engaged.
OPEN	Range at which firing opened in feet.
CEASE	Range at which firing ceased in feet.
BURST	Length of burst in seconds.
KIAS	Indicated airspeed in knots.
DIVE	Dive angle in degrees.
AGL ALT/SCE	Altitude above ground level in feet and altitude source.
NEXT PAGE	Shows next page of bomb data.
EXIT	Used to exit submenu and return to MAIN MENU.
GUN-2	
RNDS	Approximate number of rounds released.
TOF OPEN	Bullet open fire time of flight in seconds.
PAC PK/FNL	Peak and final PAC errors from aimpoint in mils.
RDR ALT	Radar altitude in feet.
MSL ALT	Altitude above mean sea level in feet.
TGT ELEV	Target elevation in feet.
BANK	Direction of bank (L or R) and angle in degrees.
KTAS	True airspeed in knots.

Figure 1-46. Data Submenus (Sheet 9 of 10).

Gun Release Data Menus (LASTE V6.0 136)

GUN WD1 - 1	
PASS/TIME	2/14:00:34
AMMO	HEI
PAC	Y
OPEN	1200
CEASE	990
BURST	2.5
KIAS	320.2
DIVE	-5.30
AGL ALT/SCE	542/DELT
> NEXT PAGE	
EXIT	

GUN WD1 - 2	
PASS/TIME	2/14:00:34
RNDS	210
TOF OPEN	1.9
PAC PK/FNL	9.5/1.2
RDR ALT	1243
MSL ALT	3153
TGT ELV	90
BANK	0.00
KTAS	342.1
> NEXT PAGE	
EXIT	

DISPLAY	FUNCTION
GUN-1	
PASS/TIME	Pass number and current time when release occurred.
AMMO	Ammunition type used, either HEI, TP, or CM.
PAC	Indicates PAC mode engaged.
OPEN	Range at which firing opened in feet.
CEASE	Range at which firing ceased in feet.
BURST	Length of burst in seconds.
KIAS	Indicated airspeed in knots.
DIVE	Dive angle in degrees.
AGL ALT/SCE	Altitude above ground level in feet and altitude source.
NEXT PAGE	Shows next page of bomb data.
EXIT	Used to exit submenu and return to MAIN MENU.
GUN-2	
RNDS	Approximate number of rounds released.
TOF OPEN	Bullet open fire time of flight in seconds.
PAC PK/FNL	Peak and final PAC errors from aimpoint in mils.
RDR ALT	Radar altitude in feet.
MSL ALT	Altitude above mean sea level in feet.
TGT ELEV	Target elevation in feet.
BANK	Direction of bank (L or R) and angle in degrees.
KTAS	True airspeed in knots.

Figure 1-46. Data Submenus (Sheet 10 of 10).

DELTA CAL MENU DATA ENTRY

The DELTA CAL submenu (Figure 1-47) allows verification and adjustments to the delta calibration data. After a delta altitude update is accomplished, the DELTA ALT (RDR DELTA ALT in LASTE V6.0) and MSL CAL values are stored and can be verified by selecting the DELTA CAL submenu from the MAIN MENU. These values can also be adjusted so aircraft that are unable to accomplish a delta update can receive the DELTA ALT (RDR DELTA ALT in LASTE V6.0) and MSL CAL values from another aircraft and enter it into the DELTA CAL submenu. The manually changed values can be restored to their previous values by toggling the cursor to CANCEL and depressing the ENTR button.

Upon power up all values in the DELTA CAL submenu are zero.

Delta Cal Menus Data

LASTE V4.0		LASTE V6.0 136 Non-GPS		LASTE V6.0 136 GPS	
DELTA CAL		DELTA CAL		DELTA CAL	
> DELTA ALT	-36	> RDR DELTA ALT	-36	> RDR DELTA ALT	-36
RDR MSL CAL	5764	RDR MSL CAL	5764	RDR MSL CAL	5764
STORE		STORE		GPS DELTA ALT	140
CANCEL		CANCEL		GPS MSL CAL	7490
				SELECTED MODE	GPS
				STORE	
				CANCEL	

To enter DELTA CAL data:

1. OSP SEL Switch - Toggle cursor to DELTA ALT (RDR DELTA ALT in LASTE V6.0) or RDR MSL CAL.
2. OSP DATA Switch - Toggle cursor for appropriate value.
3. OSP SEL Switch - Toggle cursor to STORE.
4. OSP ENTR Button - Depress; DELTA ALT (RDR DELTA ALT in LASTE V6.0) and MSL CAL are stored.

NOTE

The new Delta is only entered and accepted when the cursor is toggled to STORE and the OSP ENTR button is pressed.

DISPLAY	OPTIONS	FUNCTION
DELTA ALT (RDR DELTA ALT in LASTE V6.0)	Variable for -9999 to 9999 feet in 1 foot increments.	Used to enter delta between pressure altitude and RDR MSL CAL.
RDR MSL CAL	Variable from -1000 to 32767 feet in 1 foot increments.	Used to enter reference altitude that the delta is taken at. (Pressure altitude – (Radar altitude + target altitude))
GPS DELTA ALT (LASTE V6.0 136 GPS only)	Variable for -9999 to 9999 feet in 1 foot increments.	Used to enter delta between pressure altitude and GPS MSL CAL.
GPS MSL CAL (LASTE V6.0 136 GPS only)	Variable from -1000 to 32767 feet in 1 foot increments.	Used to enter reference altitude that the delta is taken at. (Pressure altitude – GPS altitude)
SELECTED MODE (LASTE V6.0 136 GPS only)	GPS, RDR	Identifies DELTA CAL mode selected.
STORE		Stores entered data and exits the submenu.
CANCEL		Cancels manually changed data and exits the submenu.

Figure 1-47. Delta Cal Submenu.

GCAS TRAINING SUBMENU DATA ENTRY (LASTE V6.0 [136])

The GCAS TRAINING submenu allows the pilot to select and store a false ground plane for GCAS training and also allows entry into the CAPTURE DATA submenus. Selection of a false ground plane is enabled when the pilot places the cursor opposite GND PLANE. The OSP DATA switch is used to toggle between the following false ground plane options: OFF, 2000, or 3000 ft above ground level (AGL).

The pilot can select the CAPTURE DATA submenu by placing the cursor opposite AUTO SCROLL and depressing the OSP ENTR button. Pressing the OSP ENTR button with the cursor next to STORE causes the selected false ground plane to be stored in RAM and allows return to the MAIN MENU. Selecting CANCEL and depressing OSP ENTR button will reset the false ground plane to OFF. The HUD message "GCAS" is displayed while in GCAS training mode.

GCAS TRAINING	
GND PLANE	2000
> AUTO SCROLL	YES
STORE	
CANCEL	

DISPLAY	OPTIONS	FUNCTION
GND PLANE	OFF, 2000, 3000 ft	Used to select AGL altitude of false ground plane (OFF for normal GCAS operation)
AUTO SCROLL	YES, NO	Initiate autoscroll/manual display of GCAS data capture parameters.
STORE		Causes the selected false ground plane to be stored in RAM, and allows return to the main menu.
CANCEL		Causes the false ground plane to be set to OFF.

Figure I-48. GCAS Training Submenu.

GCAS CAPTURE DATA SUBMENUS (LASTE V6.0 [136])

The CAPTURE DATA submenu displays (1) aircraft state parameters at the time of GCAS warning, and (2) key performance parameters from the subsequent recovery. The first twenty GCAS events are stored in RAM (cleared during power-on and the start of a new flight) and are flashed on the HUD for video capture. Delivery passes exceeding twenty are flashed on the HUD for video capture, but not stored in RAM. When the OSP ENTR key is depressed in the GCAS TRAINING submenu with the cursor on AUTO SCROLL, a CAPTURE DATA submenu is displayed.

This prompt provides an option to automatically scroll the display through all of the recorded data for video capture. Selecting "NO" via the DATA key provides the option to manually page through the recorded data. When manually scrolling, the ENTR key allows changing the data page when the cursor is on NEXT PAGE, the SEL key scrolls

the cursor between NEXT PAGE and EXIT. The DATA switch increments the GCAS call being displayed. An EXIT selection is displayed to allow returning to the GCAS TRAINING submenu.

In LASTE V6.0 [136] GPS-configured aircraft, the GCAS event data is transferred to the Data Transfer Cartridge (DTC) via the MIL-STD-1553 data bus for storage and post mission analysis via the PFPS. The page containing aircraft state parameters at the time of the GCAS warning is transferred to the DTC immediately after the GCAS "break-X" appears on the HUD. The page containing key performance parameters from the subsequent recovery is transferred to the DTC immediately after the recovery is complete (when the flight path angle exceeds the terrain slope). Passes can be stored in the DTC until it is full (approximately 100). Once the DTC is full, subsequent passes can continue to be stored, but each additional pass will overwrite the previous stored pass.

GCAS CAPTURE DATA SUBMENUS (LASTE V6.0 136)

GCAS-1	
CALL/TIME	1/13:52:32
KIAS	325
DIVE	15
BANK	5 R
ROLL RT	12 R
RDR ALT	2900
GND SLOPE	4
A/C G	4.2
VVI	90
> NEXT PAGE	
EXIT	

GCAS-2	
CALL/TIME	1/13:52:32
MIN RDR ALT	2113
TIME TO MAX G	2.5
MAX G	5.5
RECOVERY BANK	3 R
MAX ROLL RT	95
RECOVERY TIME	4.1
GND PLANE	2000
> NEXT PAGE	
EXIT	

DISPLAY	FUNCTION
GCAS-1	
CALL/TIME	Pass number and LASTE current time when page was captured.
KIAS	Indicated airspeed.
DIVE	Dive angle in degrees (+ nose down).
BANK	Bank angle in degrees (R - Right, L - Left).
ROLL RT	Roll rate (degrees/sec).
RDR ALT	Smoothed radar altitude in feet (corrected).
GND SLOPE	Terrain slope in degrees (+ up).
A/C G	Load factor.
VVI	Inertial vertical velocity in feet per second (+ up)
NEXT PAGE	SEL key scrolls cursor between NEXT PAGE and EXIT, and the DATA key increments the pass being displayed.
EXIT	Exit submenu and return to MAIN MENU.
GCAS-2	
CALL/TIME	Call number / LASTE current time when page was captured.
MIN RDR ALT	AGL recovery altitude
TIME TO MAX G	Time in seconds from call to time at which the lesser of 4 Gs or max Gs are achieved.
MAX G	Maximum load factor achieved.
RECOVERY BANK	Bank angle in degrees at time of recovery (R - Right, L - Left).
MAX ROLL RT	Maximum roll rate achieved in degrees/second.
RECOVERY TIME	Time in seconds from call to recovery (Recovery = FPA >= Terrain Slope)
GND PLANE	AGL altitude of false ground plane in feet.
*NEXT PAGE and EXIT	Same functions as those in GCAS-1 menu.

Figure 1-49. GCAS Capture Data Submenus.

PART 3 WEAPONS SUPPORT SYSTEMS

ARMAMENT RECORDING SYSTEM

The A-10A is equipped with an armament recording capability that consists of a video tape recorder system.

COCKPIT TELEVISION SENSOR/ AIRBORNE VIDEOTAPE RECORDER SYSTEM (CTVS/AVTR) 139

The CTVS/AVTR (Figure 1-50) is a gunsight tape recording unit capable of immediate viewing of HUD or TV monitor data after flight. The system consists of a Cockpit Television Sensor (CTVS), an Airborne Video Tape Recorder (AVTR), and a CTVS/AVTR control panel. The CTVS is installed in place of the gunsight camera system.

The CTVS is located in a recessed area above and forward of the main instrument panel, and is mounted on the HUD unit. The AVTR is located in the aft fuselage behind access door F57, which has a smaller door for quick installation and removal of the tape cassette. The CTVS/AVTR control panel is located on the left console (Figure 1-50).

CTVS/AVTR Control Panel

The CTVS/AVTR control panel (Figure 1-50) has an elapsed time indicator, power switch, control knob, and three indicator lights. The AVTR power switch is placarded OFF, STBY, and RECORD. The video control knob is placarded OFF, TVM, and CTVS. Lighting for the CTVS/AVTR control panel is controlled by the console lights control on the lighting control panel.

Cockpit Television Sensor (CTVS)

The CTVS provides a video signal of a real world scene with HUD symbology superimposed upon it to the AVTR. Video coverage through the CTVS is 16° in elevation by 20° in azimuth. The CTVS has a BIT check button to verify function operation of the CTVS: green light - functional (GO); yellow light - nonfunctional (NO GO).

Airborne Video Tape Recorder (AVTR)

The AVTR in the aft fuselage records video input from either the CTVS or the TV monitor on a tape cassette, depending on the position of the AVTR Power Switch No. 2. The AVTR also records all audio signals received in the pilot's headset during video recording.

AVTR Operation

AVTR operation works in conjunction with the gun trigger switch, the weapons release button, and the CTVS/AVTR control panel. Operation in regard to these modes is as follows:

Gun Trigger Switch - The gun trigger switch works in conjunction with the MASTER armament switch on the armament control panel, and the video control knob and AVTR power switch, both on the CTVS/AVTR control panel. When the MASTER armament switch is set to CAMERA, the video control knob is set to CTVS, and the AVTR power switch is set to STBY, the AVTR will record video from the CTVS whenever the gun trigger switch is depressed to either the first or second detent. The AVTR will record video from the CTVS in the following manner whenever the gun trigger switch is operated:

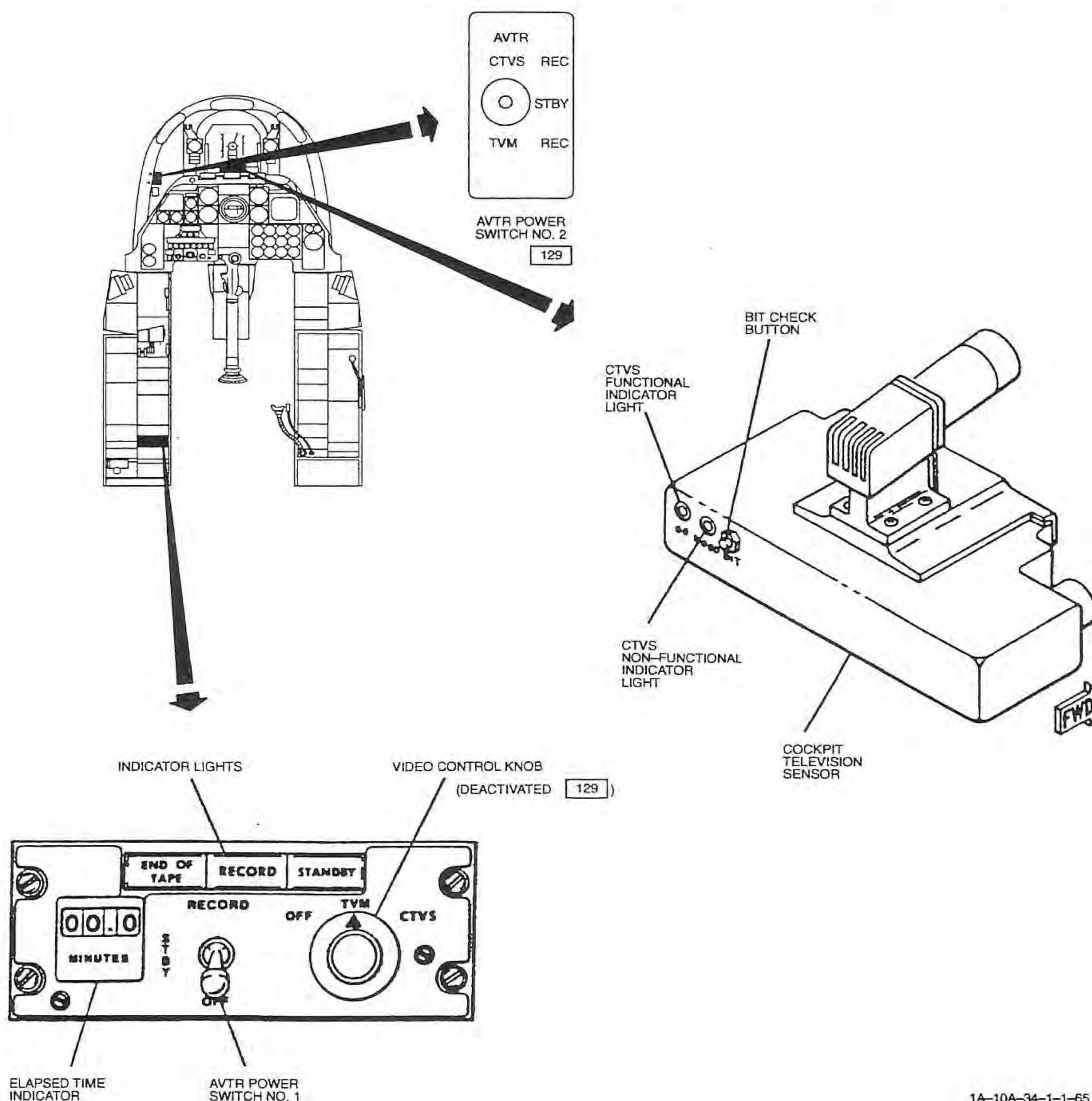
- **Trigger first detent** - The AVTR will record video from the CTVS as long as the gun trigger switch is held in first detent and will stop recording immediately upon release of the gun trigger switch.
- **Trigger second detent** - The AVTR will record video from the CTVS as long as the gun trigger switch is held in second detent and will continue recording for 12 seconds after release of the gun trigger switch provided the landing gear handle is up (or the ARM GND SAFETY switch is set to O'RIDE). In addition, a gun firing event marker will be recorded while the gun trigger switch is held in the second detent.

Weapons Release Button - The weapons release button works in conjunction with the AVTR power switch and video control knob on the CTVS/AVTR control panel. When the AVTR power switch is in STBY and the video control knob is set to CTVS, the weapons release button, when depressed, will activate the AVTR. The AVTR will operate for 12 seconds after release of the weapons release button. In addition, an event marker will be recorded while the weapons release button is held down.

When the weapons release button is depressed in AGM/TGM-65 operations with the AVTR power switch in STBY and the video control knob in TVM, the AVTR will record

a picture of the TVM going blank plus 12 seconds more of the TV monitor screen (usually blank also). To record AGM/TGM-65 slewing and tracking, the AVTR power switch must be positioned to RECORD with the video con-

trol knob set to TVM. This provides a continuous record of the TV monitor whether video is present or not. Event markers are not currently displayed or recorded by the AVTR whether carrying a film capable TGM or not.



1A-10A-34-1-1-65

Figure 1-50. CTVS/AVTR Control Panel (Sheet 1 of 3). 139

CONTROL OR INDICATOR	POSITION OR DISPLAY	FUNCTION
Elapsed Time Indicator (DEACTIVATED 129)	ON	Indicates the accumulated AVTR recording time in minutes and tenths of minutes. When the AVTR power switch is set to OFF, the display will go off and reset to zero.
END OF TAPE Light	ON (yellow)	Indicates the AVTR tape has been recorded and the end-of-tape sensor has been detected.
RECORD Light	ON (green)	Indicates the AVTR is in the RECORD mode.
STBY Light (DEACTIVATED 129)	ON (green)	Indicates the AVTR is in the STBY mode.
AVTR Power Switch No. 1	OFF	Removes AC power from the CTVS immediately, and DC power from the AVTR after a 10-second delay to allow the tape to unthread. It also shuts off the display of the elapsed time indicator while resetting the digital display to zero.
AVTR Power Switch No. 2	STBY	Added in series with switch No. 1 to provide "HEAD-UP" manual circuit activation. CAUTION Removing aircraft power prior to positioning the AVTR power switch to OFF, or removing aircraft power without allowing the unthread time (10 seconds) to elapse will result in the inability of the cassette door on the AVTR to open for removal of the tape cassette. If this occurs, ground power may be applied to the aircraft and the cassette unthreaded by depressing the UNTHREAD pushbutton on the AVTR for removal of the cassette. NOTE Cassette cannot be removed without damaging tape, unless unthreading is completed.
AVTR Power Switch No. 1	STBY	Activates the CTVS and sets the AVTR to a standby condition awaiting activation by the gun trigger switch or weapons release button. STBY can also be used in the TVM mode, when RECORD is not required.
AVTR Power Switch No. 2	CTVS REC or TVM REC	
AVTR Power Switch No. 1	RECORD	System operates the same as STBY with the option of activation by the AVTR power switch No. 2.
AVTR Power Switch No. 2	STBY	

Figure I-50. CTVS/AVTR Control Panel (Sheet 2 of 3) 139.

CONTROL OR INDICATOR	POSITION OR DISPLAY	FUNCTION
AVTR Power Switch No. 1	RECORD	Activates the CTVS and enables the AVTR to record either CTVS or TVM video, independent of the gun trigger switch or weapons release button.
AVTR Power Switch No. 2	CTVS REC or TVM REC	
Video Control Knob (DEACTIVATED 129)	OFF	Prevents video from either the TV monitor or CTVS from being recorded by the AVTR.
	TVM	Enables video on the TV monitor to be recorded by the AVTR.
	CTVS	Enables video on the CTVS to be recorded by the AVTR.

Figure 1-50. CTVS/AVTR Control Panel (Sheet 3 of 3) 139.

Color Cockpit Television Sensor/Color Airborne Videotape Recorder System (CCTVS/CAVTR) **140**

The CCTVS/CAVTR (Figure 1-51) is a video tape recording unit capable of immediate, post-mission viewing of HUD and TV monitor (TVM) data. The system consists of a Color Cockpit Television Video Sensor (CCTVS), a Color Airborne Video Tape Recorder (CAVTR), and a CAVTR Remote Control Panel. The CCTVS installs in place of the previously installed CTVS. The system has the following three components:

- Color Airborne Video Tape Recorder
- Color Cockpit Television Video Sensor
- Remote Control Panel

All components are installed in the cockpit to afford easy access for both operation and maintenance. The system uses commercially available 2-hour Hi-8mm video cassettes. These cassettes can be changed in flight when exhausted and easily removed for immediate viewing for mission debriefings.

The CCTVS is located in a recessed area above and forward of the main instrument panel, and is mounted on the HUD unit. The CAVTR is installed in the aft-most position in the right console. The CAVTR Remote Control Panel is located on the lower section of the left canopy bow.

CAVTR Control Panel

The CAVTR control panel (Figure 1-51) has a rotary function switch, tape eject button, power indicator, and connectors to monitor video and audio during maintenance. The positions of the function switch include Off, Standby, Record, Rewind, Fast Forward, and Play.

Cockpit Color Television Sensor (CCTVS)

The CCTVS is a self-contained color television camera system that supplies a Y-C video signal of the HUD flight data display and the pilot's view through the windscreen. The CCTVS video output goes to the CAVTR where the CAVTR switches between it and the TVM video. Setting the CAVTR to STBY powers on the CCTVS. The field of view through the HUD is a minimum of -305mr to $+5\text{mr}^\circ$ vertically and a maximum of -330mr to $+20\text{mr}$ horizontally as seen by the pilot.

Color Airborne Video Tape Recorder (CAVTR)

The CAVTR houses the system electronics (except for the camera electronics) and tape transport. Its function switch is the primary power control for the system. The CAVTR interface circuits determine which video signal the CAVTR records: CCTVS signal or the TVM

(AGM-65). The CAVTR records the voice signal from the aircraft audio intercom system.

Because of the convenient location of the CAVTR, the pilot can easily change tapes while in flight. After opening the latch on the CAVTR access door, pressing the EJECT button ejects the tape cartridge from the tape transport. After inserting a fresh tape, pressing the flat knob on the front of the CAVTR closes the tape transport mechanism.

CAVTR Remote Control Panel

The Remote Control Panel (Figure 1-52) has two 3-position toggle switches and two visual indicators. The upper toggle switch has positions that include OFF, STBY, and REC. The lower toggle switch has positions that include HUD, AUTO, and TVM. Except for the OFF position, the Remote Control Panel switches override the function select switch on the CAVTR. Indicators on the Remote Control Panel light green to indicate when the CAVTR is in record mode and when the tape cartridge has reached the end of the tape.

CAVTR Operation

The CAVTR has two function switches, one on the CAVTR and the other on the remote control panel (the Remote Control Panel switch overrides all but the OFF position of the CAVTR switch). However, because the function switch on the CAVTR is used for maintenance purposes, the following describes the operation of the system from the Remote Control Panel.

Video recording can be initiated manually by setting the Video Selector switch to HUD or TVM and the Control switch to Record. Recording the TVM signal can also be initiated automatically by setting the Video Selector switch to Auto. When TVM video is active and the pilot selects the track command or enables the slew command (right throttle grip), the CAVTR switches from HUD video to TVM video. The CAVTR switches back to the HUD video signal when one of the following conditions occurs:

- Weapons release or trigger to the 2nd detent position.
- Trigger released to 1st detent position.
- Loss of AGM-65 (TVM) video.

When the Remote Control Panel function switch is set to STBY (and a tape loaded in the CAVTR), the CAVTR is powered on and the tape is threaded. When the pilot presses the gun trigger to its 1st detent, +28 Vdc from the Armament Relay Box is applied to pin E of the Aircraft Recorder Interface Connector. Sensed by the interface circuits of the CAVTR, CCTVS video and cockpit audio recording begins, overriding the

STBY position of the function switch. This is provided as fail safe method to insure only HUD recording.

When the function switch is set to REC, recording begins according to the position of the video select switch: HUD, TVM, or AUTO. When the video select switch is set to AUTO, HUD video recording begins.

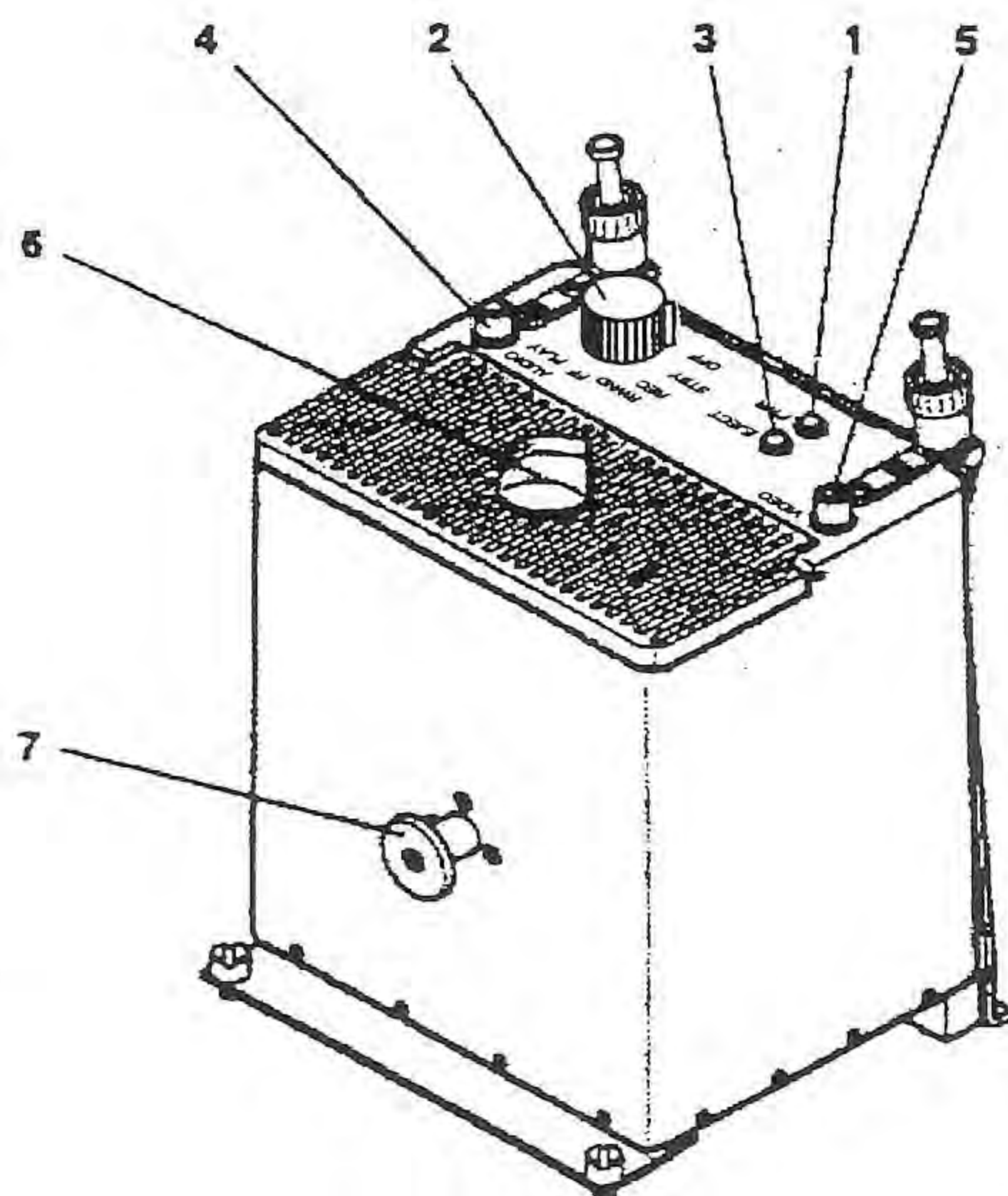
In AUTO, video switches from HUD to TVM when the following occurs:

- Video is present on the video line from the TVM to the CAVTR.
- Pilot selects the track command on the stick or enables the slew command on the right throttle grip.

In AUTO, video switches back to HUD from TVM when one of the following occurs:

- Pilot presses gun trigger to 1st detent. (Release of the trigger causes the video selection to revert back to TVM).
- Weapons release or pilot presses gun trigger to 2nd detent.
- Video ceases to be present on the video line from the TVM to the CAVTR.

The weapons release signal and the gun trigger 2nd detent also causes an event marker to be recorded in the upper left corner of the video frame and an audio tone.



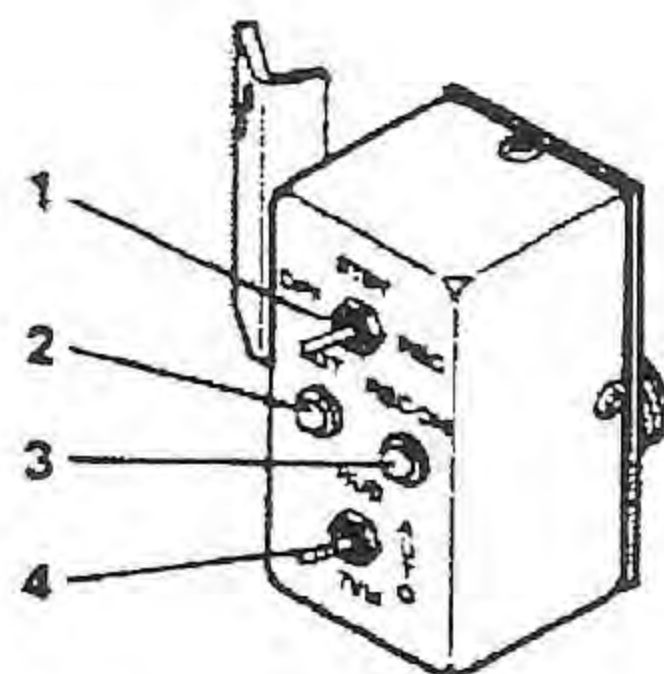
1A-10A-34-1-1-66

Figure 1-51. CCTVS/CAVTR Control Panel 140
(Sheet 1 of 2)

INDEX NO.	CONTROL OR INDICATOR	CONDITION OR POSITION	FUNCTION
1	POWER indicator	On (green)	Lights green when the CAVTR is powered on.
2	Function rotary switch*	OFF	Turns off power to the CAVTR.
		STBY	+28Vdc is applied to the CAVTR and the tape is threaded around the scanner, but is not tensioned.
		REC	Sets CAVTR to record mode. +28Vdc aircraft power is applied to the CAVTR and the tape is threaded around the scanner. The tape is tensioned and the selected signal is recorded. (Selected video is a function of the position of the video selector on the Remote Control Panel.)
		RWND	Rewinds tape.
		FF	Fast forwards tape.
		PLAY	Sets CAVTR to playback mode.
3	EJECT	Button momentary switch	Eject tape from CAVTR tape transport.
4	AUDIO	BNC connector	Audio jack for maintenance test.
5	VIDEO	BNC connector	Video output jack for maintenance test.
6	Tape access latch knob		Rotate clockwise to latch, counterclockwise to open.
7	Tape transport latch knob		After inserting tape, push to latch tape transport.

* The position of the controls on the Remote Control Panel override any settings of the CAVTR function switch except OFF.

Figure 1-51. CCTVS/CAVTR Control Panel (Sheet 2 of 2). 140



1A-10A-34-1-1-67

INDEX NO.	CONTROL OR INDICATOR	CONDITION OR POSITION	FUNCTION
1	Function control toggle switch	OFF	Turns off the Remote Control Panel to the CAVTR and control is returned locally to the CAVTR. The Airborne Recorder must be turned off both at the Remote Control Panel and locally on the CAVTR to remove power from the CAVTR.
		STBY	+28Vdc is applied to the CAVTR, the tape is threaded around the scanner, but is not tensioned.
		REC	+28Vdc is applied to the CAVTR, the tape is threaded around the scanner and is tensioned. (Selected video is a function of the position of the video selector on the Remote Control Panel.)
2	EOT	indicator	Lights when the video tape cartridge has reached the end of the tape.
3	RECORD	indicator	Lights when the CAVTR is in record mode.
4	Video selector toggle	HUD toggle switch	Selects the video signal from the CCTVS.
		AUTO	Selects the video signal from the CCTVS until the signal from the AGM-65 is active.†
		TVM	Selects the video signal from the TVM (AGM-65).

† Certain other signal conditions must exist for the switch from gun television camera to the AGM-65.

NOTE: Due to the location of the Remote Control Panel, a pilot may inadvertently change the video selector switch when changing the HCP settings.

Figure 1-52. Remote Control Panel. 140

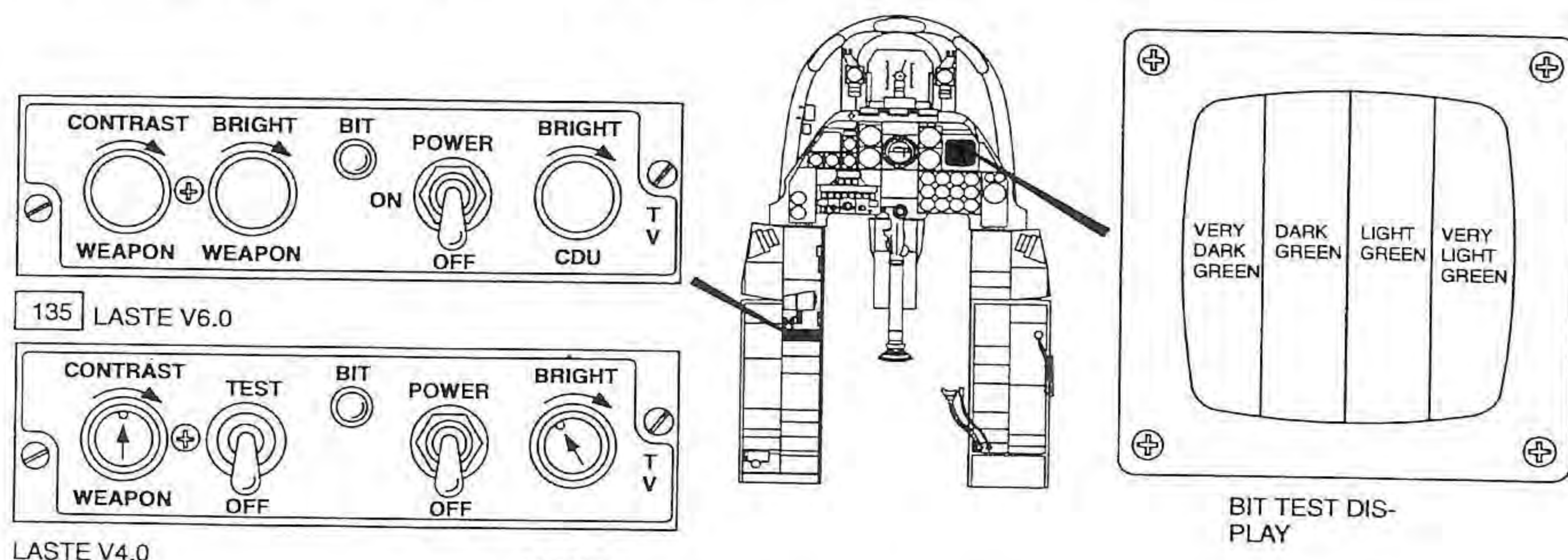
COCKPIT TELEVISION MONITOR SYSTEM

The TV Monitor (TVM) system (Figure 1-53) is composed of a TV display unit and a TVM control unit. The display unit on the instrument panel presents a typical TV picture but includes the tracking gates used for target lock-on. The TVM control unit, placarded TV, is located on the left console. When a TV or IR weapon is selected and activated by the pilot, the TV sensor in the weapon transmits a video

signal for display on the TVM. In effect, the TVM displays what the weapons TV sensor sees.

The pilot can then align the target with the tracking gates on the TVM display and, when the target is under the tracking gate, initiate lock-on. Following weapon lock-on and launch/release, the weapon guides itself to the target using its own TV sensor, and the TVM is blanked until another EO or IR weapon is selected.

TVM Control Panel LASTE V4.0/V6.0 Non GPS



NOTE:

DURING THE BUILT-IN-TEST (BIT), RETRACE LINES MAY APPEAR ON THE DISPLAY.

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TVM Control Panel LASTE V4.0/V6.0 Non GPS		
CONTROL OR INDICATOR	POSITION OR DISPLAY	FUNCTION
CONTRAST control		Adjusts the contrast of the TV image.
TEST switch	TEST	Activates the TV monitor Built-In-Test (BIT) subsystem when the POWER switch is ON. The BIT generates test signals for display on the TV monitor. The BIT indicator light comes on.
	OFF	Power removed from the BIT subsystem.
BIT indicator lamp	ON (green)	Indicates the BIT subsystem is active.
Power switch	POWER	AC armament bus power is applied.
	OFF	AC armament bus power is disconnected.
BRIGHT control		Adjusts the brightness of the TV image.

Figure 1-53. Television Monitor System.

Cockpit TV Monitor Controls

The cockpit TV Monitor Control panel has a contrast control knob, test switch, BIT indicator, power switch, and a

bright control knob. Refer to Figure 1-53 for a functional description of each control.

TV Monitor Operation (LASTE V4.0 and V6.0 136 Non-GPS)

To arrive at a good control setting prior to obtaining weapon video, the following procedure is recommended:

1. Brightness control - Fully CW.
2. Contrast control - Fully CCW.
3. Power switch - POWER.
4. Test switch - TEST.
5. Observe fully lit screen.

6. Brightness control - CCW until screen becomes dark (black).
7. Contrast control - CW until shades of gray appear to be in equal steps, and black is still black.
8. Test switch - OFF.

TV monitor is now ready to accept input video.

TVM Display Unit Operation (LASTE V6.0 136 GPS)

In EGI, use the following table (Figure 1-54) to arrive at a good control setting prior to obtaining weapon video.

TVM Control Panel Operation LASTE V6.0 GPS		
CONTROL OR INDICATOR	CONDITION OR POSITION	FUNCTION
OFF/ON/TEST switch	OFF	Disconnects power from TVM display unit.
	ON	Applies power to TVM display unit, connects BIT indicator to aircraft lamp test circuit, and routes selected weapon composite video to AVS.
	TEST	Activates TVM system BIT circuit which generates a video test signal for display on TVM display unit, and causes the BIT indicator to light.
BIT indicator	Green	Lights during lamp test and during BIT.
CONTRAST WEAPON control	—	Adjusts contrast of weapon video displayed on TVM display unit.
Bright WEAPON control	—	Adjusts brightness of weapon video displayed on TVM display unit.
BRIGHT CDU control	—	Adjusts the brightness of the CDU video display on TVM display unit. (Actually adjusts contrast of CDU video.) TVM MON control located on interior lighting balance control panel sets brightness or displayed CDU video..

Figure 1-54. TVM Display Unit Operation (LASTE V6.0 136 GPS)

TARGET IDENTIFICATION SET, LASER (TISL) SYSTEM

The target identification set, laser, AN/AA-35(V)1, is a forward-looking laser seeker and tracker system. The system consists of a laser illumination detector pod, adapter control detector (ACD), and control panel. The detector pod is attached to the lower right fuselage on an adapter pylon and weighs 32 pounds. The ACD is located in panel F10.

The control panel (Figure 1-55) is mounted on the pilot's pedestal. The TISL system function is to search for coded laser energy reflected from a target illuminated by a coded laser designator, to lock-on and track, and to provide target location information to the aircraft avionics systems. The target location information is presented on the HUD and the ADI to aid the pilot during ordnance delivery. The TISL is powered by the AC and DC armament busses.

TISL System Operation

Power is supplied to the TISL system when the rotary mode selector is set to CAGE. This places the system in a ready standby status and positions the pod optical seeker head along the aircraft 0 mil fuselage reference line. The TISL will neither acquire nor track a target while in CAGE. The TISL system requires approximately 30 seconds for gyro spin-up.

CAUTION

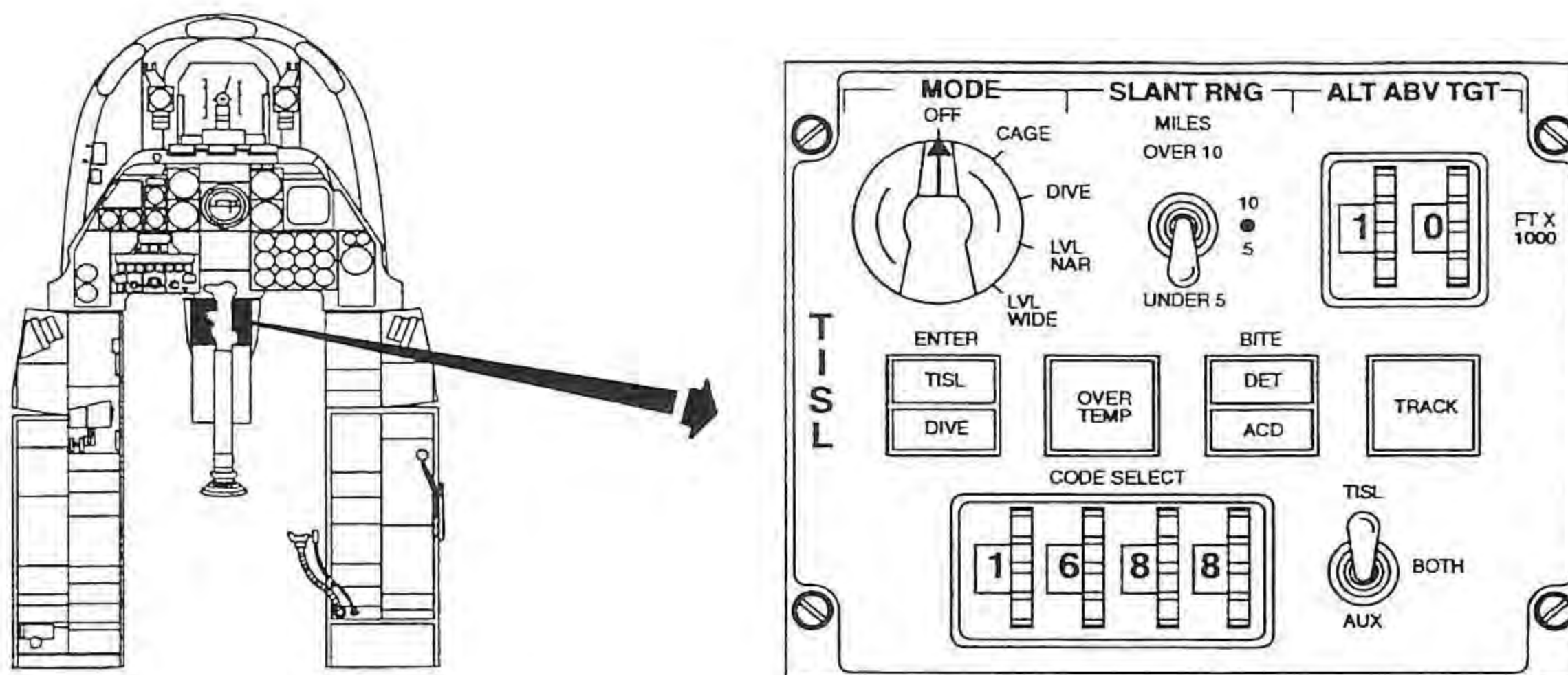
With a detector pod installed, do not move the aircraft with the TISL mode switch in OFF or damage to the seeker head may result.

BITE Check

The Built-In-Test Equipment (BITE) sequence tests the operational status of the TISL system. The BITE sequence is initiated by depressing the BITE pushbutton located on the control panel. The DET and ACD lights will come on during the BITE sequence. Equipment failure is indicated if one or both lights remain on longer than 20 seconds. If the system BITE checks successfully, it will automatically enter and accept the code displayed in the code select windows.

NOTE

- The TISL BITE check may be performed in flight; however, the aircraft must be held straight and level. Angular rates must not exceed 2° per second during the entire BITE sequence.
- If the system is BITE checked with the toggle switch in BOTH or AUX but only a detector pod is present (i.e., no laser munitions), it will fail the check. Reposition the toggle switch to TISL and reaccomplish check.
- The BITE check can complete its sequence with no ACD or DET failure light, but with the TISL spider starting at a position other than the 0 mil reference. The system will function normally; however, the TISL diamond/spider will be displayed in the HUD from the laser illuminated target the same mil distance and direction as BITE check position from the 0 mil reference. This indicates that the detector pod is not mounted properly to the pylon.



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CONTROL OR INDICATOR	POSITION OR DISPLAY	FUNCTION
MODE selector	CAGE	Supplies power to the TISL system components, with a 30-second gyro spin-up. The CAGE position places the system in a ready-standby status and positions the seeker optical reference axis along the aircraft fuselage reference line. The TISL will not acquire or track a target in CAGE.
	DIVE	Directs the TISL to scan in a narrow azimuth ($\pm 10^\circ$) along the gun and the HUD line of sight at 41 mil depression angle.
	LVL NAR	Directs the TISL to scan in a narrow azimuth ($\pm 10^\circ$).
	LVL WIDE	Directs the TISL to scan in a wide azimuth ($\pm 20^\circ$).
SLANT RNG switch		In conjunction with the ALT ABV TGT control, determines the depression of the seeker head.
	Over 10 NM	Set in accordance with desired range to target.
	5 - 10 NM	Set in accordance with desired range to target.
	Under 5 NM	Set in accordance with desired range to target.
ALT ABV TGT thumbwheel control		Used to set the aircraft's altitude above the target in thousands of feet. The ALT ABV TGT selector, in conjunction with the slant range toggle switch, determines the depression of the seeker head. NOTE The ALT ABV TGT and SLANT RNG controls are not functional in the DIVE mode.

Figure 1-55. TISL Control Panel (Sheet 1 of 2).

CONTROL OR INDICATOR	POSITION OR DISPLAY	FUNCTION
ENTER push button		The push button switch is used to enter the code selected by the CODE SELECT thumbwheel switches into the TISL system.
	TISL on, then off	Indicates the selected code has been entered and verified in the detector.
	AUX on, then off	Indicates the selected code has been entered and verified in the AUX system.
TRACK light	ON	Indicates the TISL system is tracking a laser-designated target.
BITE pushbutton switch		Used to initiate a BITE test sequence. If one or both lights remain on for more than 20 seconds following test sequence, an equipment failure is indicated. Observe the following: • BITE DET/ACD switch legends come on. • TISL diamond (LASTE V4.0)/spider (LASTE V6.0) appears on combining glass at zero mil position and traces a pattern that resembles an X through each of the quadrants. Symbol then traces path out through fourth quadrant. • Vertical and horizontal steering needles on ADI move in relation to motion of laser target diamond. • After approximately 20 seconds, BITE DET/ACD switch legends go off, signifying completion of BIT sequence.
	DET on longer than 20 seconds	Indicates a detector failure.
	ACD on longer than 20 seconds	Indicates an adapter control detector failure.
OVER TEMP light	ON	Indicates an unacceptable temperature level within the TISL detector. Operation of the system with OVER TEMP light on will result in degraded TISL system performance.
CODE SELECT thumbwheel		Provides for selection of a four-digit code.
Code-enter TISL toggle switch	TISL	Provides capability together with the ENTER pushbutton to enter a code into the TISL system.
	BOTH	Provides capability together with the ENTER pushbutton to enter a code into the TISL system and other laser coded equipment, such as laser Maverick missile.
	AUX	Provides capability together with the ENTER pushbutton to enter code into other laser coded equipment, such as laser Maverick missile.

Figure I-55. TISL Control Panel (Sheet 2 of 2).

Code Select

The four-digit code present on the thumbwheels when power is applied is automatically entered. The pilot reprograms the TISL system by changing the thumbwheels then TISL, AUX, or BOTH on the toggle switch and accomplishing a BITE check or depressing the ENTER pushbutton. When the TISL ENTER light goes off, the code has been entered and verified within the TISL system.

Search Mode, Level

Selection of LVL NAR or LVL WIDE on the mode selector directs the detector to scan an area below the aircraft while in level flight. The area to be scanned may be a short distance ahead of the aircraft, or several miles ahead, depending on the TISL control panel switch settings. Prior to entering the target area, the ALT ABV TGT selector and the SLANT RNG switch must be set to correspond with the estimated slant range from the target (Reference MCM 3-1, Volume III). As a rule, the SLANT RANGE switch should be set less than or equal to air to ground visibility or actual slant range to target, whichever is less. This will ensure the Pave Penny pod is searching at optimum depression to acquire laser energy. The aircraft must be held straight and level for the depression angle to be correct. The ALT ABV TGT selector and SLANT RNG switch determine the depression of the seeker head.

NOTE

If the actual slant range to the target is less than the setting on the SLANT RNG switch, the seeker head may not acquire the target.

Meteorological visibility also affects the lock-on range of the TISL system. If the meteorological visibility is less than the setting on the SLANT RNG switch, the seeker head may not acquire the target.

The azimuth scan is 20° in LVL NAR, and 40° in LVL WIDE. In either LVL NAR or LVL WIDE, the TISL system automatically switches to TRACK mode after acquisition of a properly coded signal.

The area to be scanned by the TISL can also be referenced off the HUD with the SLANT RNG switch set "less than 5". The center of scan and the scan window are displayed in Figure 1-56 for each selected altitude above target.

Search Mode, Dive

Selection of DIVE on the MODE switch positions the seeker head along the 41-mil line-of-sight. The DIVE mode is normally used when the specific target area has been identified. To acquire a target in the DIVE mode, the HUD gun cross target symbol should be aimed at the known target area. Until the TISL lock-on, the seeker will search 10° left and right of the nose. After lock-on, the TISL will automatically switch to TRACK mode.

ALTITUDE Ft x 1000	MILS CENTER SCAN	MILS SCAN WINDOW
00	108	73 to 143
01	134	99 to 169
02	159	124 to 194
03	185	150 to 220
04	209	174 to 244
05	236	201 to 275
06	262	227 to 297
07	288	253 to 323
08	314	279 to 349
09	338	303 to 373
10	366	331 to 401
DIVE	41	6 to 76

NOTE: Slant range switch set at "less than 5".

Figure 1-56. TISL Scan Areas.

Track Mode

WARNING

Pave Penny is primarily a target acquisition aid. Due to the possibility of false target indications, attack heading should avoid plus or minus 10 degrees of the laser target line. Pave Penny should not be used as the sole source for target identification.

Upon signal acceptance, the TISL system automatically switches to TRACK mode and the TRACK light comes on. In TRACK mode, the seeker head ceases scanning, and the optical tracking axis is maintained along the line-of-sight to the target. In TRACK mode, the TISL system supplies information to the HUD and ADI. The TISL shows the actual position of the target on the HUD (except expanded mode), and the pitch and bank steering bars indicate the relative position of the target on the ADI. For LASTE V6.0 **136**, a Cue Index (dotted line) from the TVV to the TISL spider aids in symbol acquisition. (During HARS mode the Cue Index appears between the depressible pipper and TISL spider.) If the TISL spider is

within the HUD FOV, the Cue Index appears for two seconds and then disappears. If the TISL spider is outside the HUD FOV the Cue Index remains until the TISL spider enters the HUD FOV. Loss of TRACK mode is apparent by loss of TISL HUD symbology (diamond) or when the TRACK light goes off. If TRACK mode is lost, the TISL system automatically switches back to the mode selected at the MODE switch after a 3-second delay.

AIRCRAFT INSTRUMENTATION SUBSYSTEM (AIS) POD

The AIS pod (Figure 1-57) is carried on all flights using an Air Combat Maneuvering Instrumentation (ACMI) system. It consists of an AIM-9 missile shell which contains a transponder, a digital interface unit, an air data sensor unit, and a digital data link receiver and transmitter. These units measure flight data which are transmitted to the tracking instrumentation subsystem for computation of space positioning of all pod-carrying aircraft on the ACMI range. The AIS pod weighs 123 lbs.

AIS pods can be carried on either the LAU-114 or LAU-105 missile rail launchers loaded on dual rail adapters on either station 1 or 11. With the AIS pod loaded on a LAU-114, however, the capability to score AIM-9 shots or air to ground bombing is not available, furthermore, the aircraft will treat the AIS pod as another AIM-9. Thus, after the first AIM-9 is fired (or simulated fired for captive

AIM-9s) symbology will come up on the HUD indicating a second missile is ready to fire but it will not have a good tone nor will it lock on to targets. To get the AIM-9 back, the pilot should simply pickle again. This fools the system into thinking the AIS pod has fired and will switch back to the AIM-9. If possible, the AIS pod should be loaded on LAU-105 launchers, this will enable full capability to score AIM-9 air-to-air shots and air-to-ground bombing. However, for the AIS pod to function properly on the LAU-105 launcher, it must be fitted with a modified umbilical. The modified umbilical will be stenciled "LAU-105" on the AIS body where the umbilical enters. The older, unmodified umbilical will be stenciled "Serial Data Only". If the AIS pod is loaded on a LAU-105 launcher with the unmodified umbilical, the problems will be identical to the problems associated with the LAU-114 described above.

The AIS pod operates from standard aircraft power and it receives electrical power any time that electrical power is on the aircraft. No specific pod switches are used to operate the AIS pod. There are two lights on the back of the AIS pod which indicate the pod is receiving electrical power. If both lights are not lit with full DC and AC power available, the pod will not function properly.

NOTE

Pilots should provide the ACMI operator with AIS pod number and aircraft station number prior to flight.

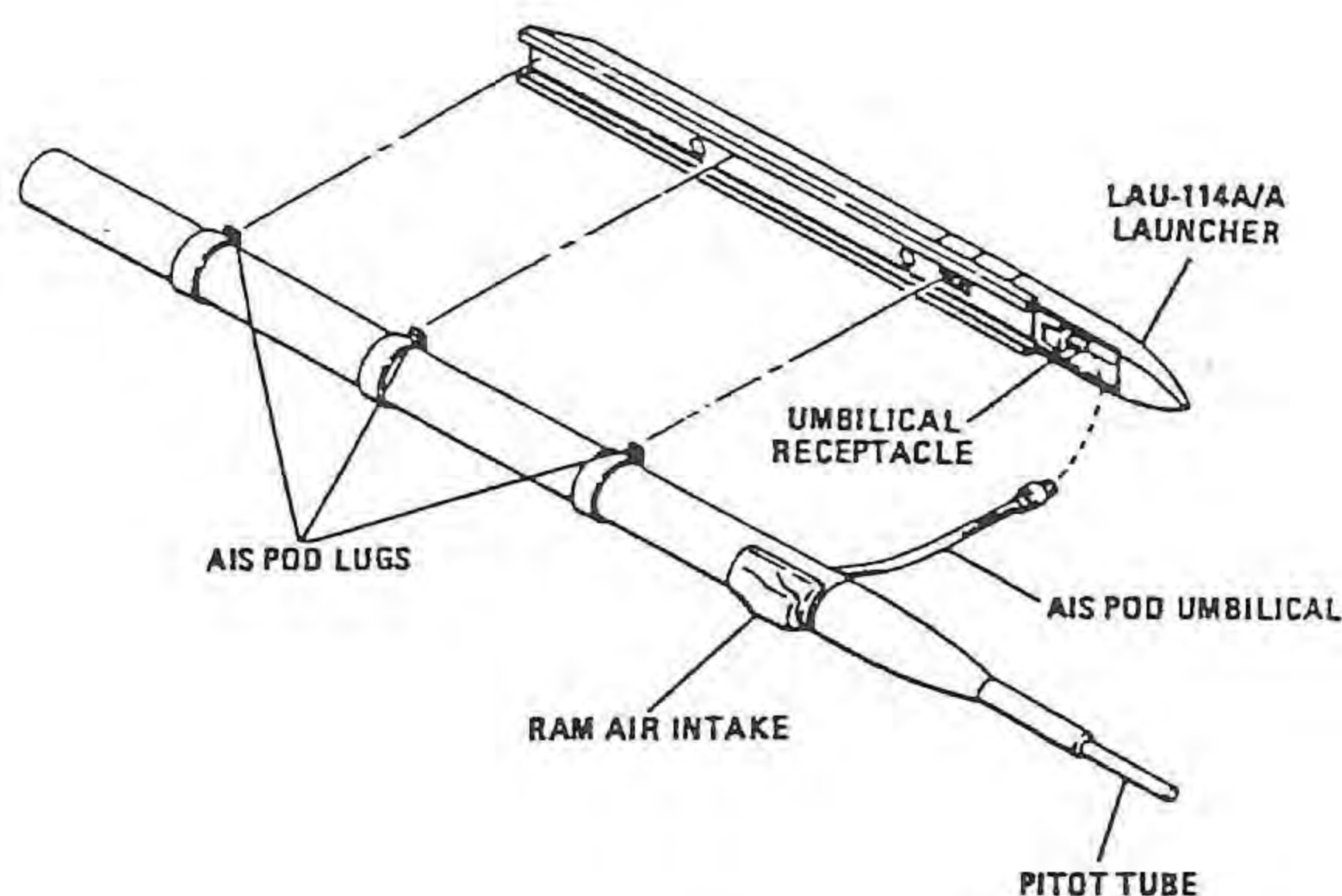


Figure 1-57. AIS POD.

1A-10A-34-1-1-70

PART 4.1

RADAR WARNING AND THREAT COUNTERMEASURES SYSTEMS 137

RADAR WARNING SYSTEMS GENERAL COMPONENTS

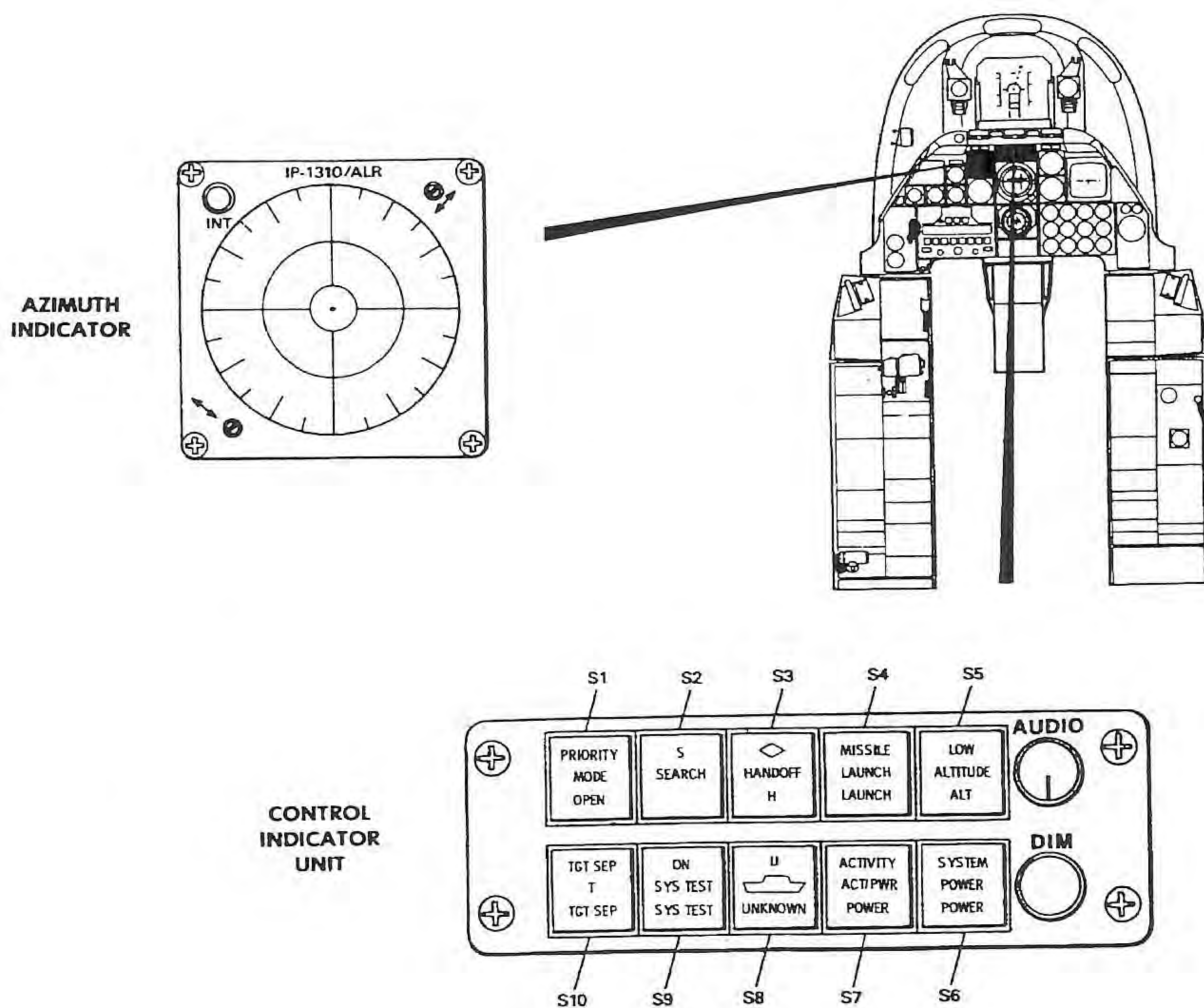
The AN/ALR-69(V) system detects the presence of radar emissions and provides visual and aural indications of threat radar emitters, operating in E through J and C/D RF band regions. Visual indications of threat signals are displayed on the azimuth indicator and control indicator unit (Figure 1-58), located on the main instrument panel. The azimuth indicator displays symbols indicative of type of threat and threat lethality level. Position of symbol is representative of threat signal relative bearing. The control indicator unit contains switch-indicator lights that control system functions and the azimuth indicator display. An audio signal, heard in the headset and characteristic of threat signal, is generated in conjunction with any diamond enhancement displayed on the azimuth indicator.

The AN/ALR-69(V) system consists of the following components:

- IP-1310/ALR azimuth indicator for alphanumeric display of the threat environment.
- C-10371 control indicator unit, which controls and displays the modes of the system while giving an additional indication of missile activity and missile launch.
- AM-6971 Compass Sail amplifier detector, which receives guidance signals in the low (C/D) band.
- CM-479 signal processor, which processes threat and guidance signals in the low and high bands, output signals for threat warning, initiates system self-test, and commands the frequency selective receiver system (FSRS) to search and analyze RF signals.
- C-10373 FSRS receiver controller, which provides control of the FSRS receiver, measurement functions and high-speed data bus (HSDB) communications with the signal processor.

- R-2094 FSRS superheterodyne receiver providing high band coverage for pulse and continuous wave threat RF.
- SA-2283 FSRS antenna switch provides commutating connection to the quadrant antennas..
- Impedance coupler CU-2220, which provides a common node among the CM-479, C-10372, and ECM pod over the HSDB.
- AM-639 high band amplified detectors provide wide band measurement of pulsed RF to the signal processor.
- Power splitters used to provide RF energy from the quadrant antennas to the FSRS and AM-6639 receivers.
- Two aft antennas and two forward multipurpose antennas (AM457-1) for high band reception, and a preamplifier(AM-6639) for each antenna, which separates the high bands into three sub-bands that overlap the skirts to provide continuous coverage. The multipurpose antennas, in addition to providing signals to their respective preamplifier, also supply signal paths, through a power divider, to the FSRS.
- One radome containing five antennas (AS-3262) for reception of C/D band (missile guidance) signals, which are applied to the low band receiver (AM-6971).

The AN/ALR-69(V) radar warning receiver systems provide the capability to detect missile activity and missile launch conditions, and provide the following functions: search radar, emitter audio handoff, symbol separation for ID, emitter relative bearing, altitude prioritization, reduction, multiple ID databases. These multiple databases (maximum of three) are presently programmed with LAND (normal default), and training.



1A-10A-34-1-1-71

Figure 1-58. Radar Warning System (Sheet 1 of 2).

ALR-69 CONTROL INDICATOR UNIT BUTTON DESCRIPTION		
CONTROL OR INDICATOR	POSITION OR DISPLAY	FUNCTION
MODE switch-indicator light (S1)	Depress	Controls number of emitters to be displayed on the azimuth indicator. OPEN—up to 16 displayed. PRIORITY—up to 5 displayed.
SEARCH switch-indicator light (S2)	Depress	Controls system operation to allow search emitters to be displayed on azimuth indicator in addition to previously displayed emitters.
HANDOFF switch-indicator light (S3)	Depress	Controls placement of diamond on azimuth indicator and simultaneously controls audio presentation.
LAUNCH switch indicator light (S4)	Depress	Indicates when a hostile missile launch condition exists.
ALTITUDE switch-indicator light (S5)	Depress	Controls the selection of low or high altitude threat priorities to be displayed on the azimuth indicator.
POWER switch-indicator light (S6)	Depress	Controls and indicates application of primary power to system.
ACT/PWR switch-indicator light (S7)	Depress	ACTIVITY—indicates hostile missile condition exists.
UNKNOWN switch-indicator light (S8)	Depress	The U legend flashes to indicate presence of unknown signals. Depressing the switch allows unknown emitters to be displayed on azimuth indicator.
SYS TEST switch indicator light (S9)	Depress	Depressing initiates system built-in-test (BIT).
TGT SEP switch-indicator light (S10)	Depress	Provides a separation of emitters on azimuth indicator for ease of identification. Emitters remain separated as long as switch-indicator light (S10) is depressed.
AUDIO control knob	Rotate	Controls volume level of audio alert signals supplied to the headsets.
DIM control knob	Rotate	Controls illuminating intensity of all switch indicator light legends except LAUNCH and ACTIVITY.
INT control knob	Rotate	Controls illuminating intensity of azimuth indicator presentations.

Figure 1-58. Radar Warning System (Sheet 2 of 2).

AN/ALR-69(V) CONDITIONS AND FUNCTIONS

Missile Activity Condition

The azimuth indicator display for a detected missile(s) and associated threat radar consists of a steady illuminated circle around a numeric symbol (Figure 1-59). The numeric symbol represents the type of tracking radar, and the steadily illuminated circle indicates that guidance information collected by the tracking system is being transmitted. Activity light (S7) will be illuminated steadily. Tick arcs or "ears" represent uncorrelated activity, i.e. tracker absence or special tracker.

Missile Launch Condition

The azimuth indicator display for a detected missile(s) and associated threat radar consists of a flashing illuminated circle around a numeric symbol (Figure 1-59). The numeric symbol represents the type of tracking radar, and the flashing circle indicates that guidance information collected by the tracking radar is being transmitted and used to guide the missile in flight. These symbols will be accompanied by seven beeps of 1000Hz of headset audio as an alert.

Search Function

The search function is used display EW, GCI, and acquisition-type radars on the azimuth indicator. The symbol S will be displayed (Figure 1-59) as a means of identification when the SEARCH switch-indicator (S2) (Figure 1-58) is depressed.

Unknown Function

Detection of an unknown threat(s) is indicated by a flashing U legend on the UNKNOWN switch-indicator (S8) (Figure 1-58). Depressing S8 allows U symbols to be displayed on the azimuth indicator with one, two, three, or no (E/F, G/H, I/J, C/D) dots designating the band in which the threat is operating (Figure 1-59).

Handoff Function

The handoff function is used to select a lower priority threat displayed on the azimuth indicator. Depressing the HANDOFF switch-indicator (S3) (Figure 1-58) will move the diamond from the default highest priority threat to the next lower priority threat. This process will continue as long as the HANDOFF switch-indicator is depressed. The HANDOFF switch-indicator also controls the audio presentation.

Altitude Priority Function

The altitude priority function is used to change the display priority as the mission flight profile changes. At low altitudes, short-range threats like AAA can be given display priority; while at high altitudes, display priorities can be assigned to AIs and SAMs. This function is accomplished by the use of the ALT switch-indicator light (S5) (Figure 1-58). LOW light illumination indicates low altitude display priorities.

Target Separate Function

The target separate function is used to expand collocated targets displayed on the azimuth indicator (Figure 1-59). This function is accomplished by the use of the TGT SEP switch-indicator light (S10) (Figure 1-58). Target separation is a latched function and is active as long as the top TGT SEP legend (S10) is illuminated. This function retains the highest priority emitter display position in the group. The function continues by separating the lower priority symbols radically outward to the edge of the azimuth indicator. At the edge, separation continues clockwise around the azimuth indicator.

Mode Function

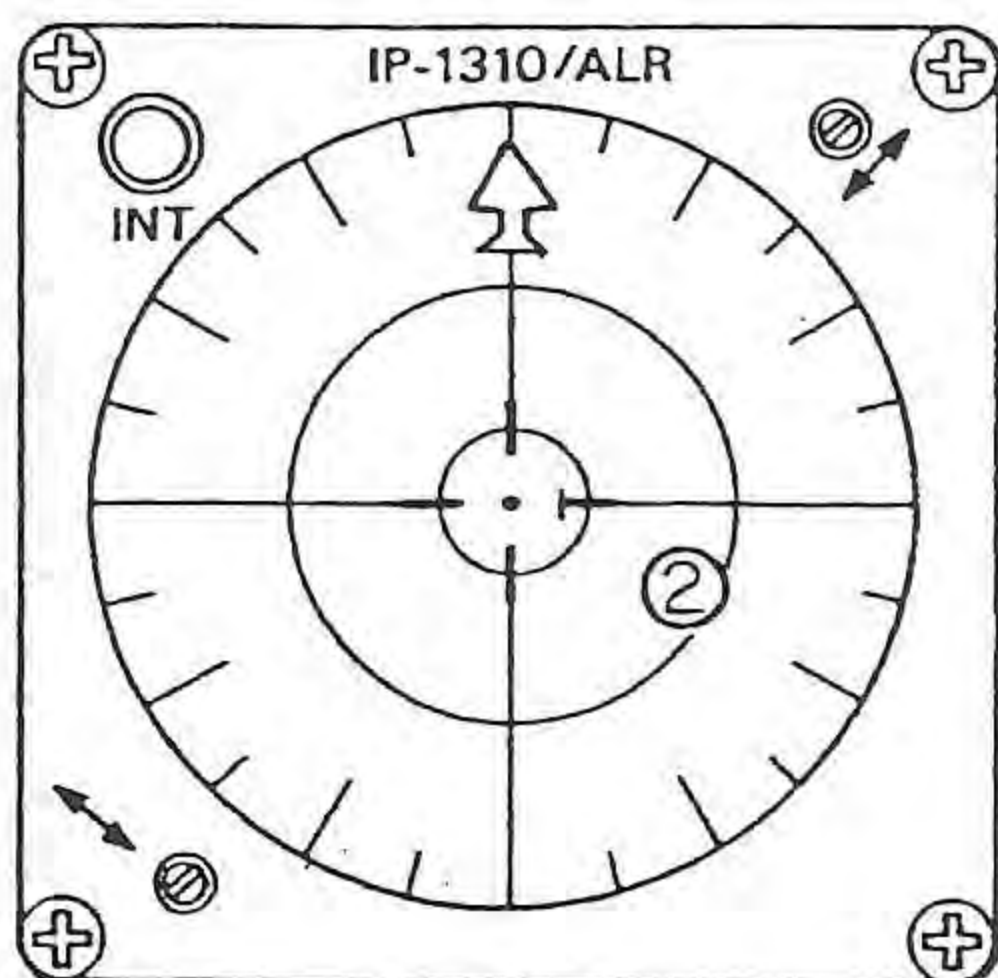
Two mode functions are available for system operation, OPEN and PRIORITY, with OPEN mode used for normal operation. OPEN mode allows display of up to 16 threats on the azimuth indicator, whereas PRIORITY mode only allows the present top five highest priority threats to be displayed (Figure 1-59). If there are more than five above the program priority, the PRIORITY light (S1) (Figure 1-58) will blink. The mode function is accomplished by the use of the MODE switch-indicator light (S1) (Figure 1-58).

Audio Function

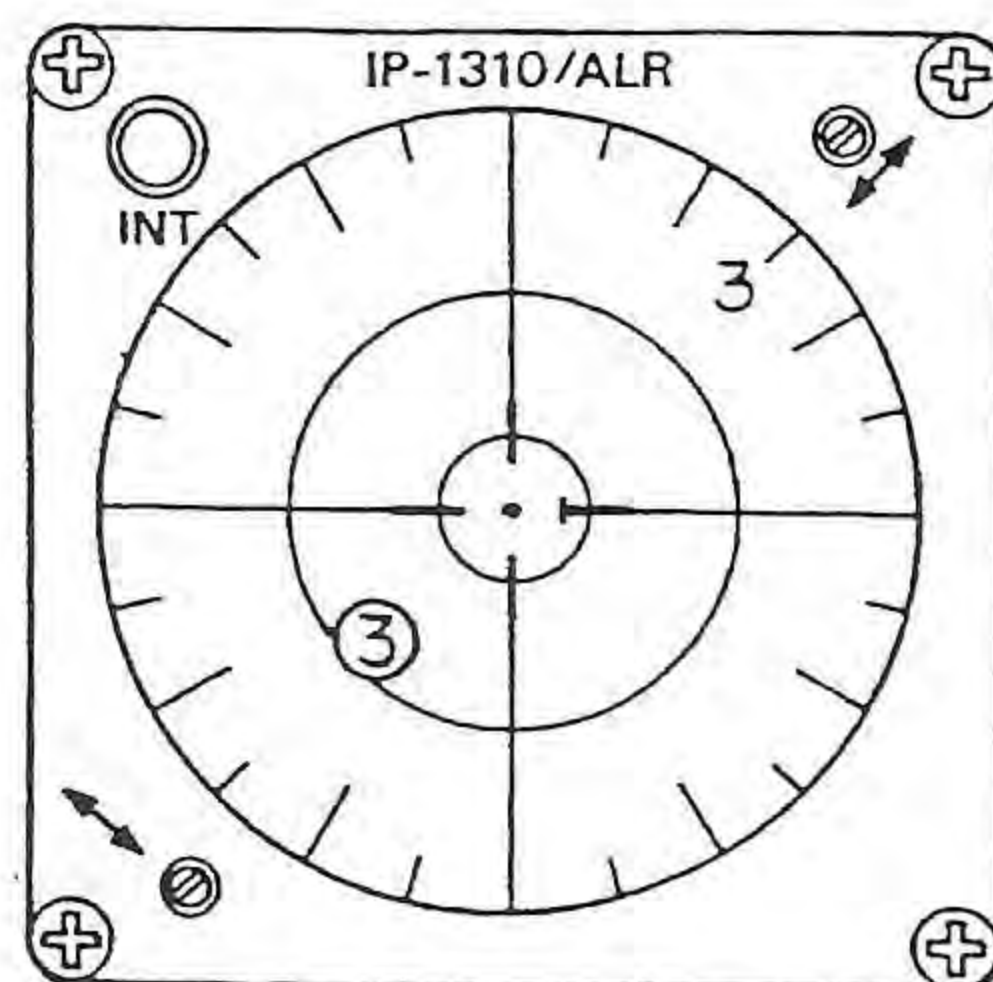
The audio is controlled by moving the HANDOFF diamond (S3) causing the diamond audio automatically to be engaged or by selecting no continuous audio. No audio is selected by depressing and releasing SYS TEST (S9) and within one second depressing HANDOFF (S3). Continuous diamond audio function is denoted to be an illuminated diamond legend (S3).

Annunciation Function

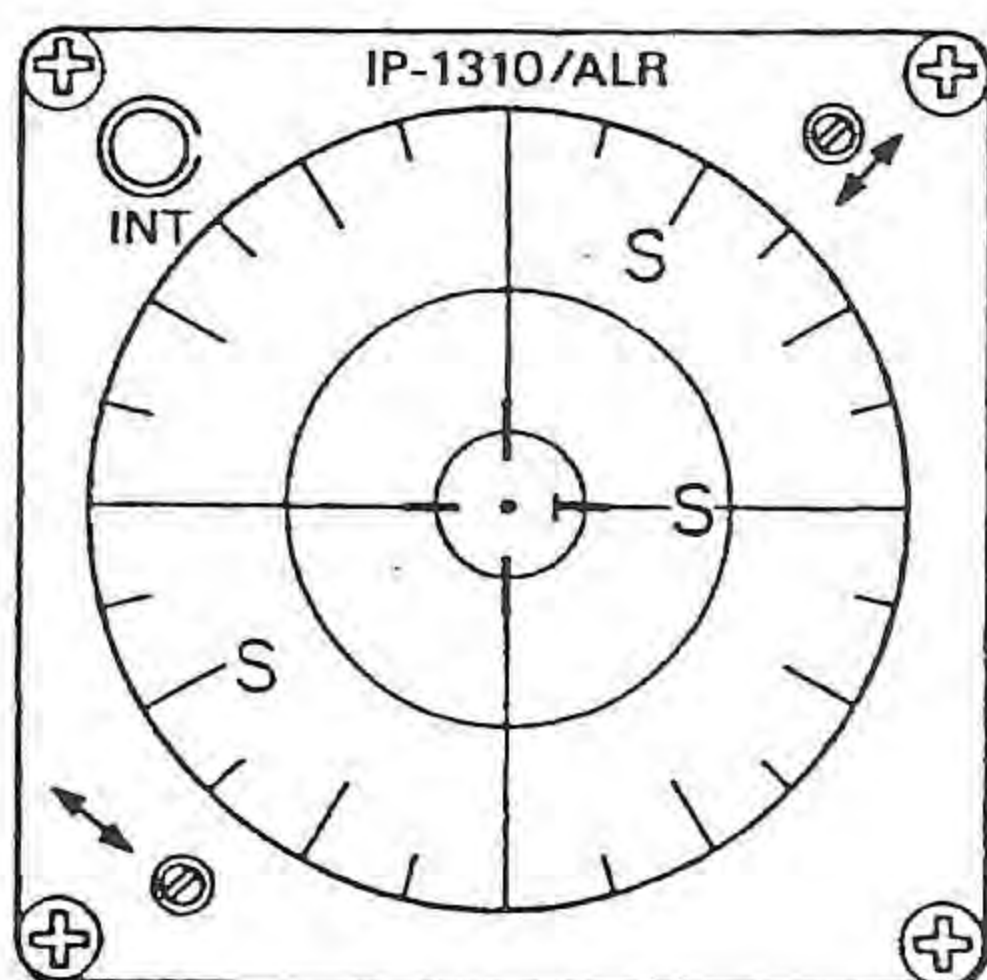
This function is used to provide aural and visual designation of new emitter symbology (new guys) found by the RWR. Audio will be provided at the real PRF of the emitter or be synthetically produced. Three beeps of this audio will be used as an alert. New symbology on the azimuth indicator display will also be designated with a dash or broken diamond for the first five seconds (Figure 1-59).



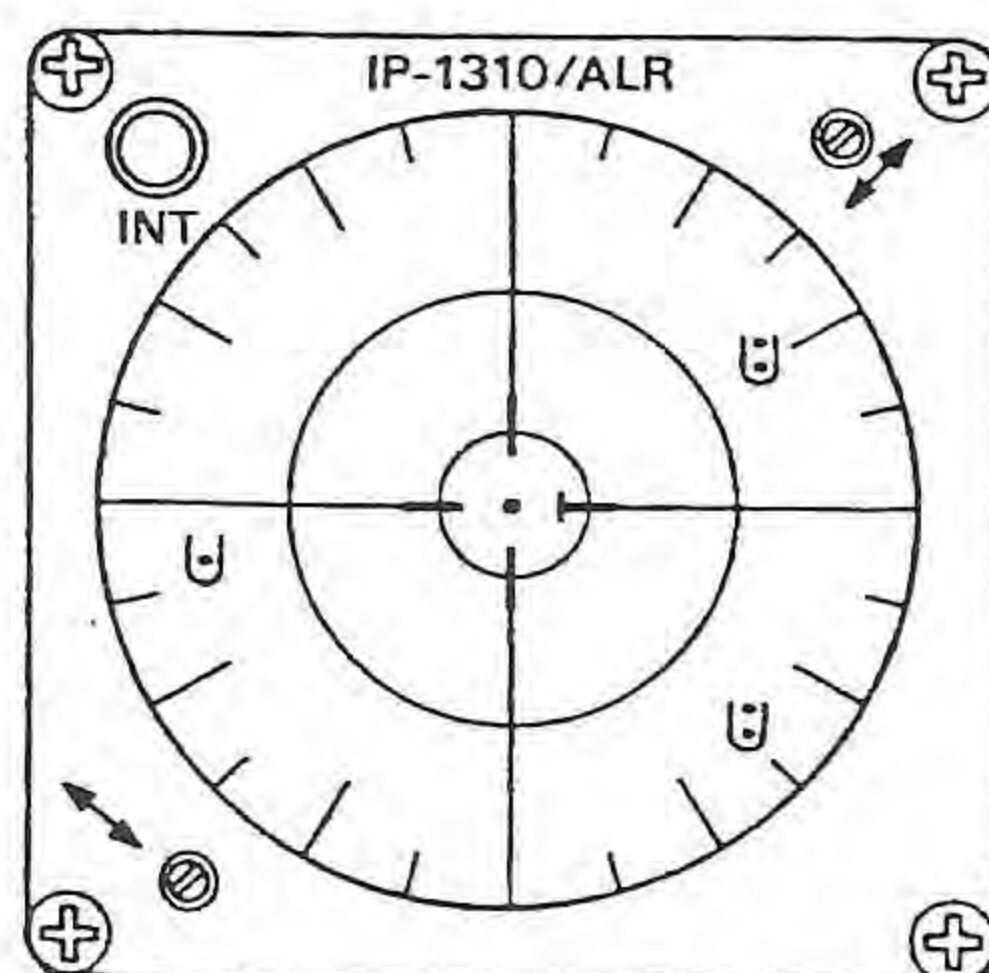
**MISSILE ACTIVITY CONDITION
(STEADY CIRCLE AROUND RADAR)**



**MISSILE LAUNCH CONDITION
(FLASHING CIRCLE AROUND RADAR)**



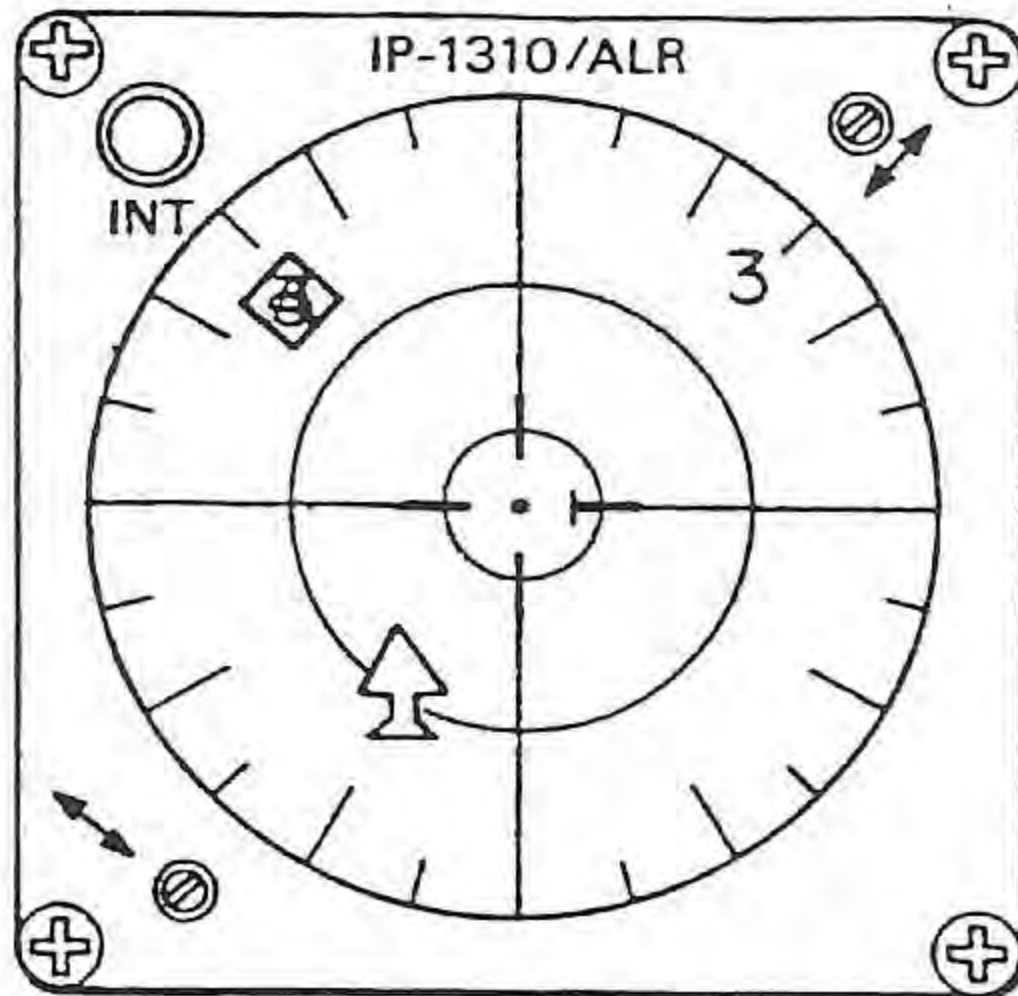
SEARCH FUNCTION



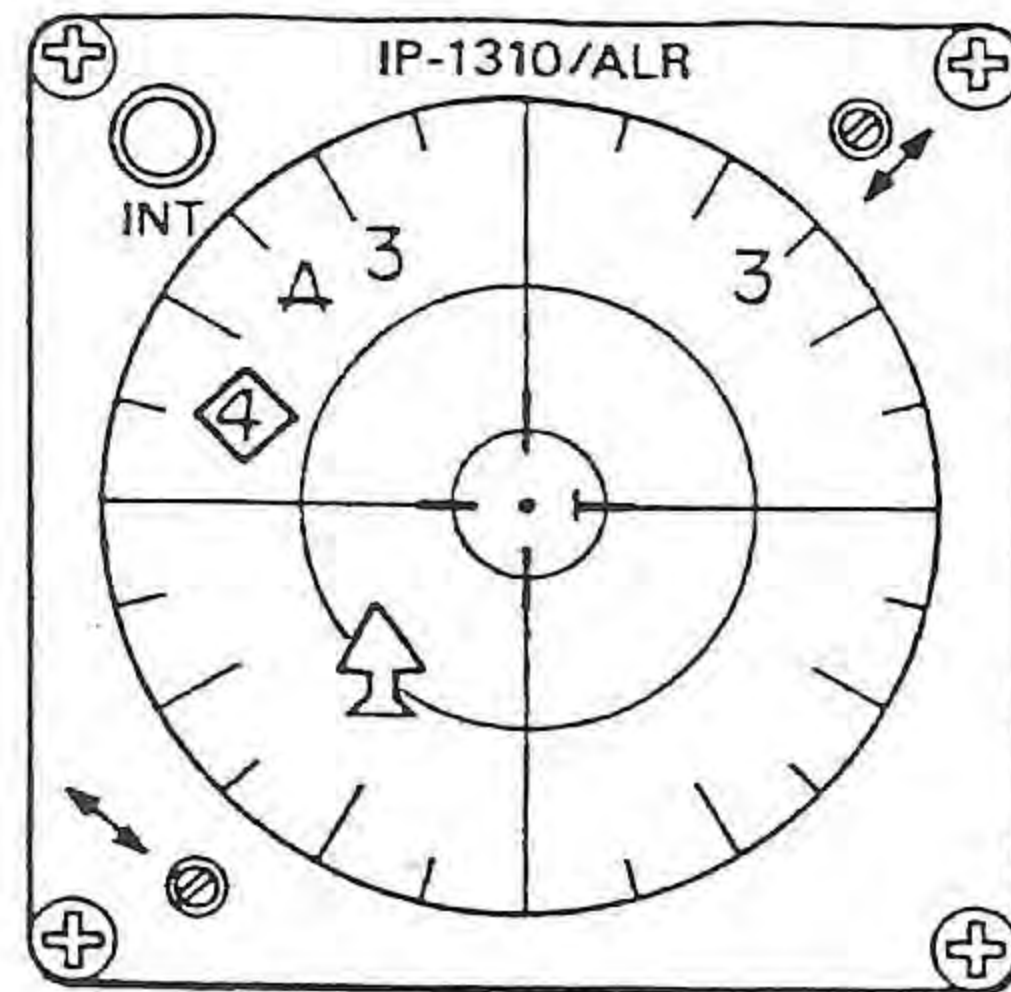
UNKNOWN FUNCTION

1A-10A-34-1-1-72

*Figure 1-59. AN/ALR-69(V) Radar Warning Systems Azimuth Indicator
Functional Displays (Sheet 1 of 2).*

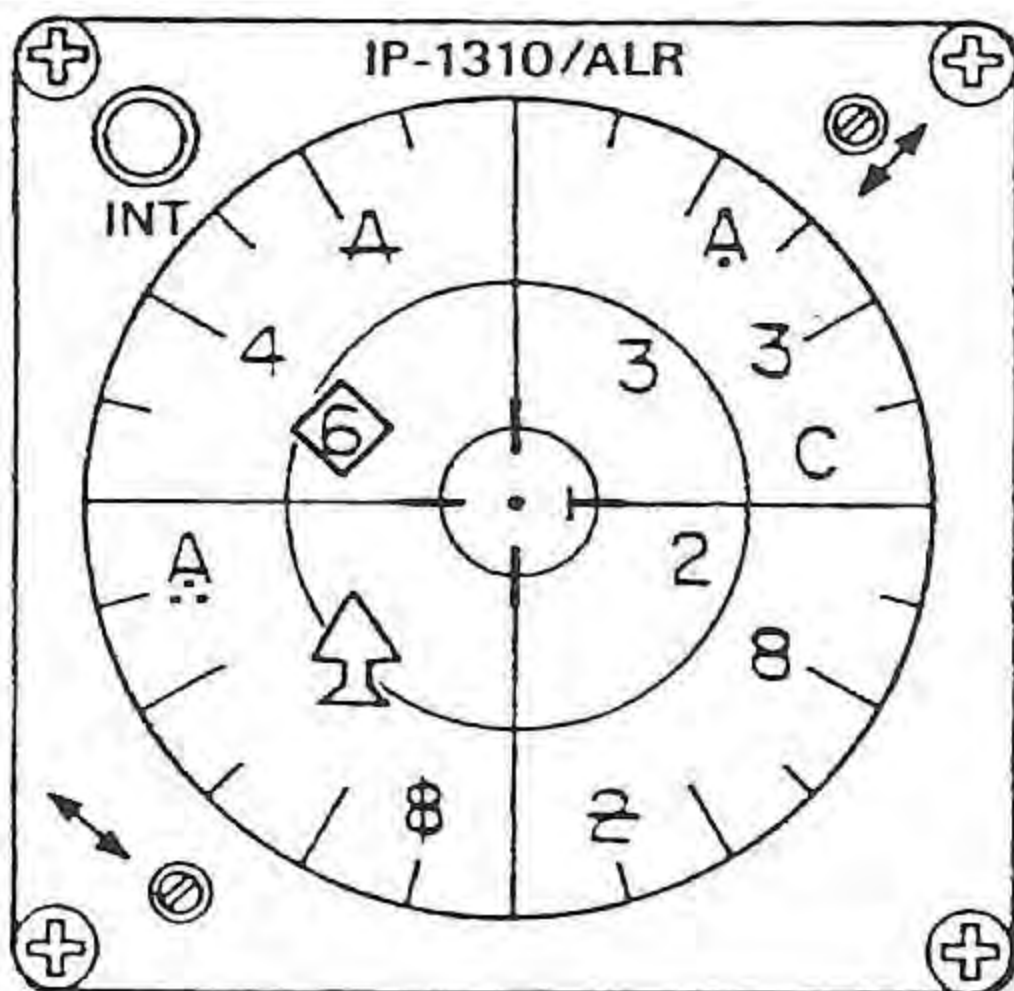


TARGETS COLLOCATED

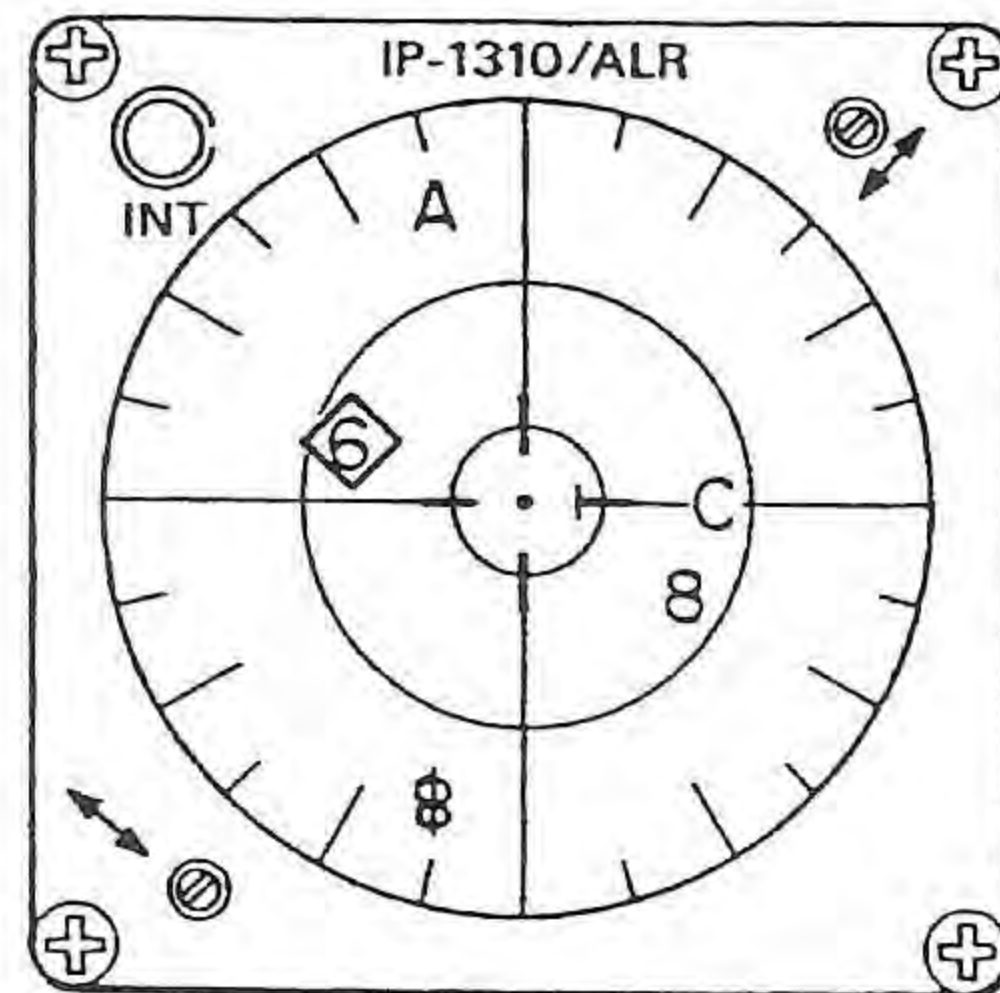


TARGETS SEPARATED

TARGET SEPARATE FUNCTION



OPEN MODE



PRIORITY MODE

MODE FUNCTION

1A-10A-34-1-1-73

Figure 1-59. AN/ALR-69(V) Radar Warning Systems Azimuth Indicator
Functional Displays (Sheet 2 of 2).

AN/ALR-69(V) RADAR WARNING DATABASE FILES**Land File**

This mission database table (MDT) (Figure 1-60) or file contains land- and water-based surface-to-air missile systems, airborne interceptors, and land- and water-based AAA radars. The RWR processor automatically defaults to this MDT file.

Sea File

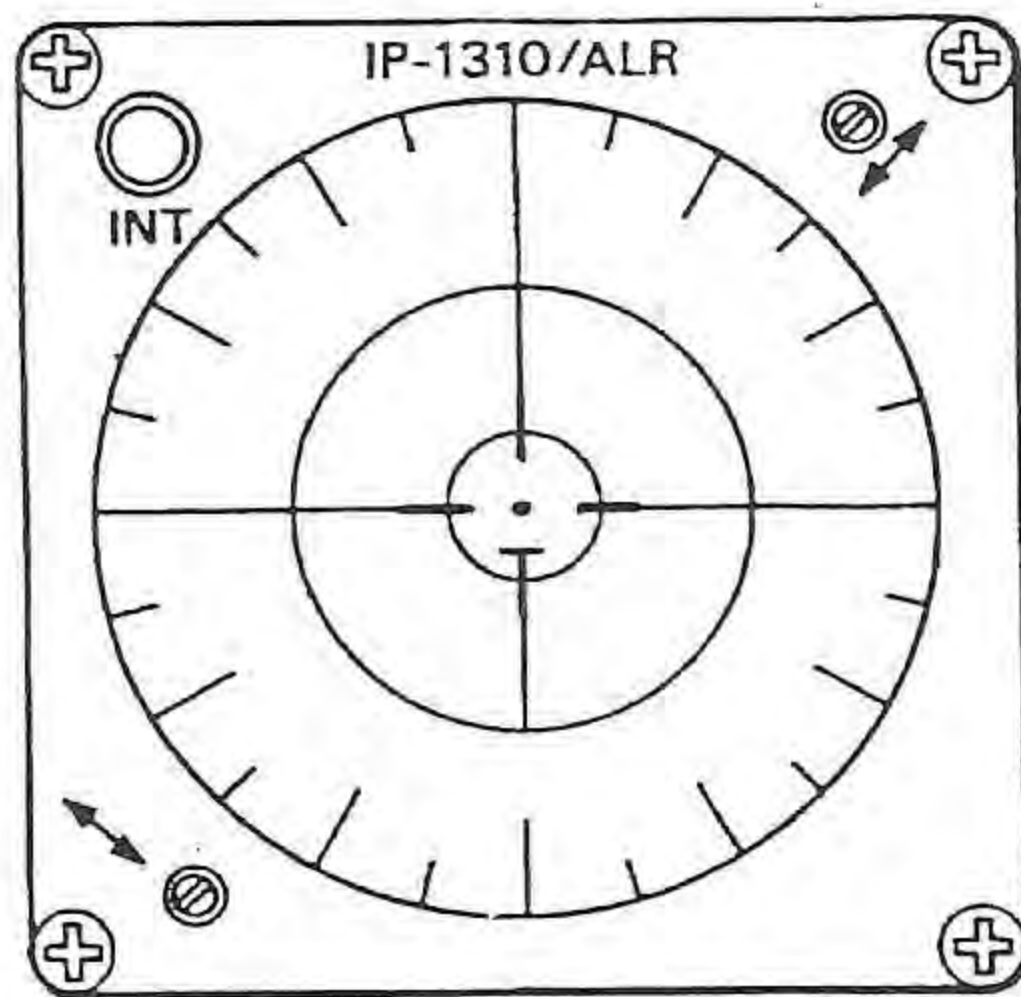
This portion of the MDT is not enabled. This is selected by depressing and releasing SYS TEST switch-indicator light (S9) and within one second depressing UNKNOWN switch-indicator light (S8) (Figure 1-58)

TRAINING FILE

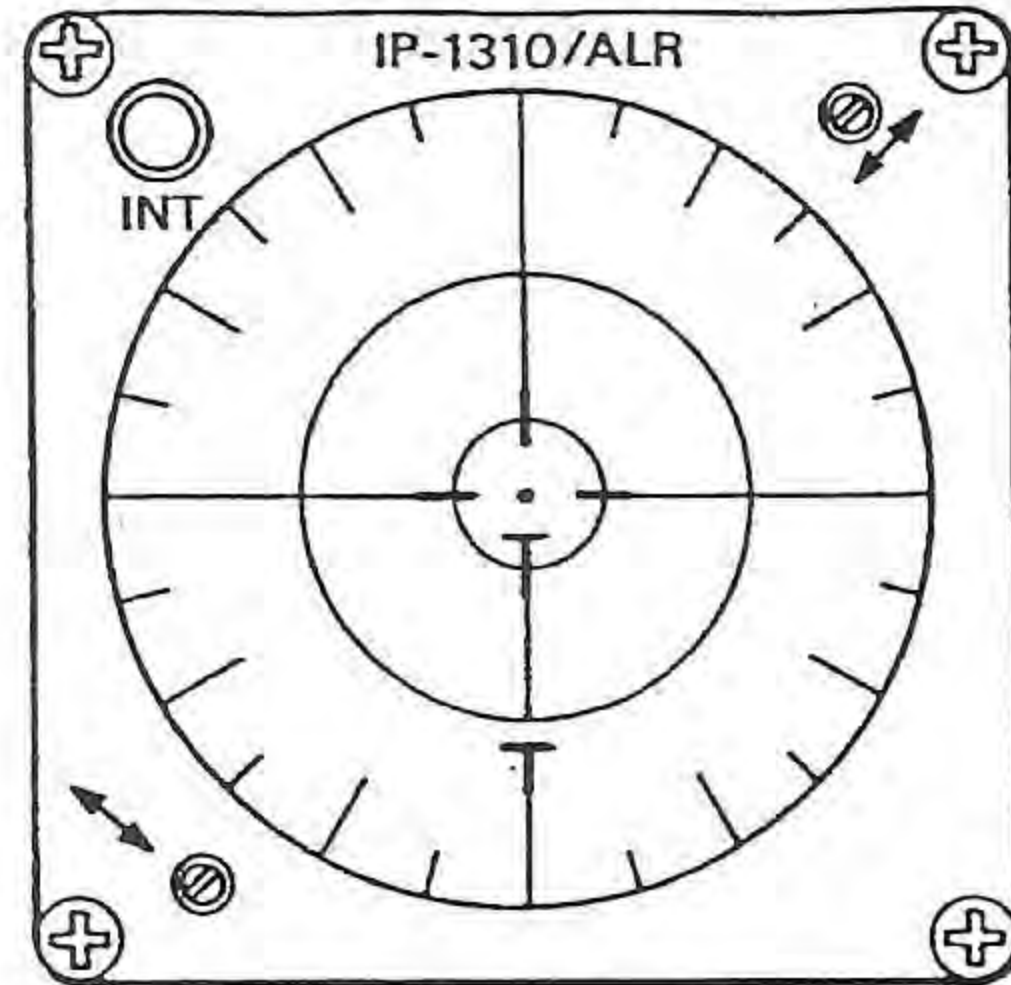
The MDT file contains many threat simulators plus selected land-, water-, and air-based friendly radars. This file is selected by pressing and releasing SYS TEST switch-indicator light (S9) and within one second depressing TGT SEP switch-indicator light (S10) (Figure 1-58). A T symbol will be displayed on the azimuth indicator (Figure 1-58) when in the training file. The system is returned to normal default (land) file by depressing S9 and S10 (Figure 1-58) as before or by depressing power switch-indicator light (S6) to turn the system off.

WARNING

Training file shall not be used in combat.



LAND FILE

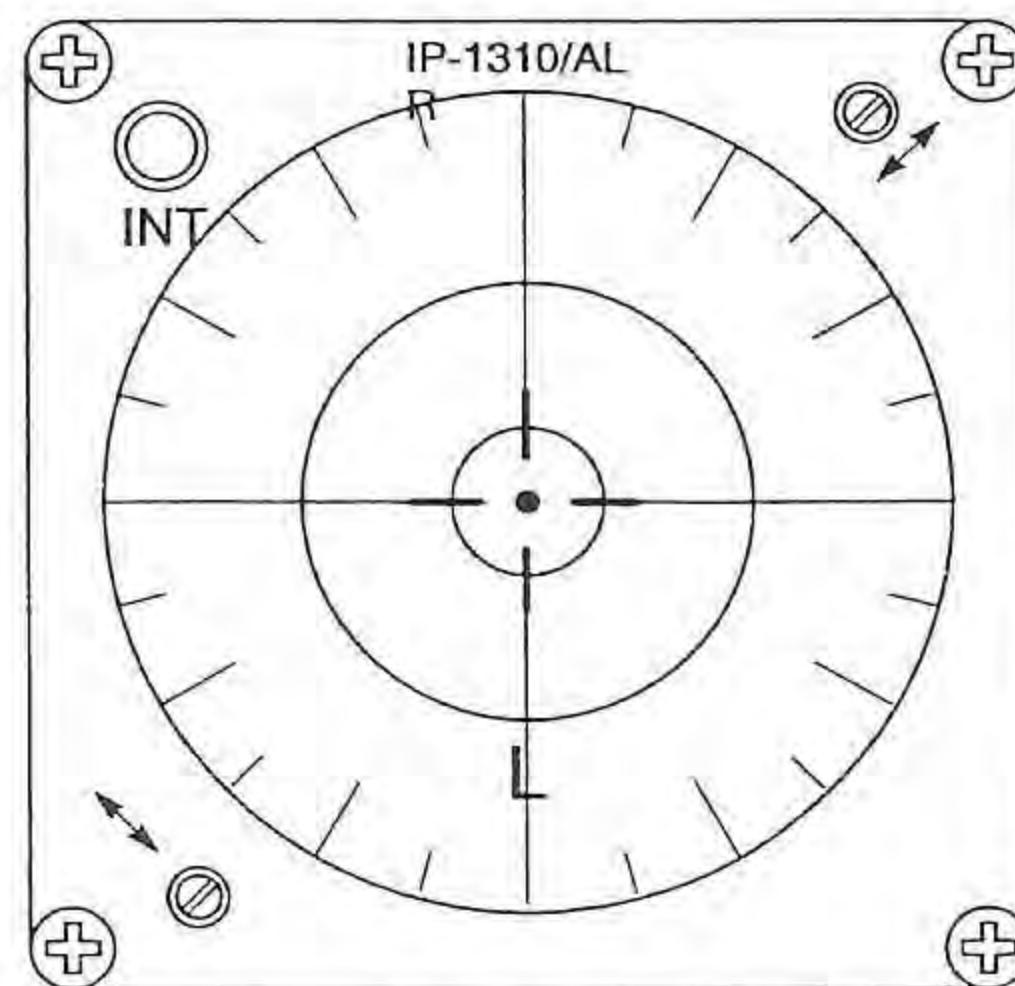


TRAINING FILE

1A-10A-34-1-1-74

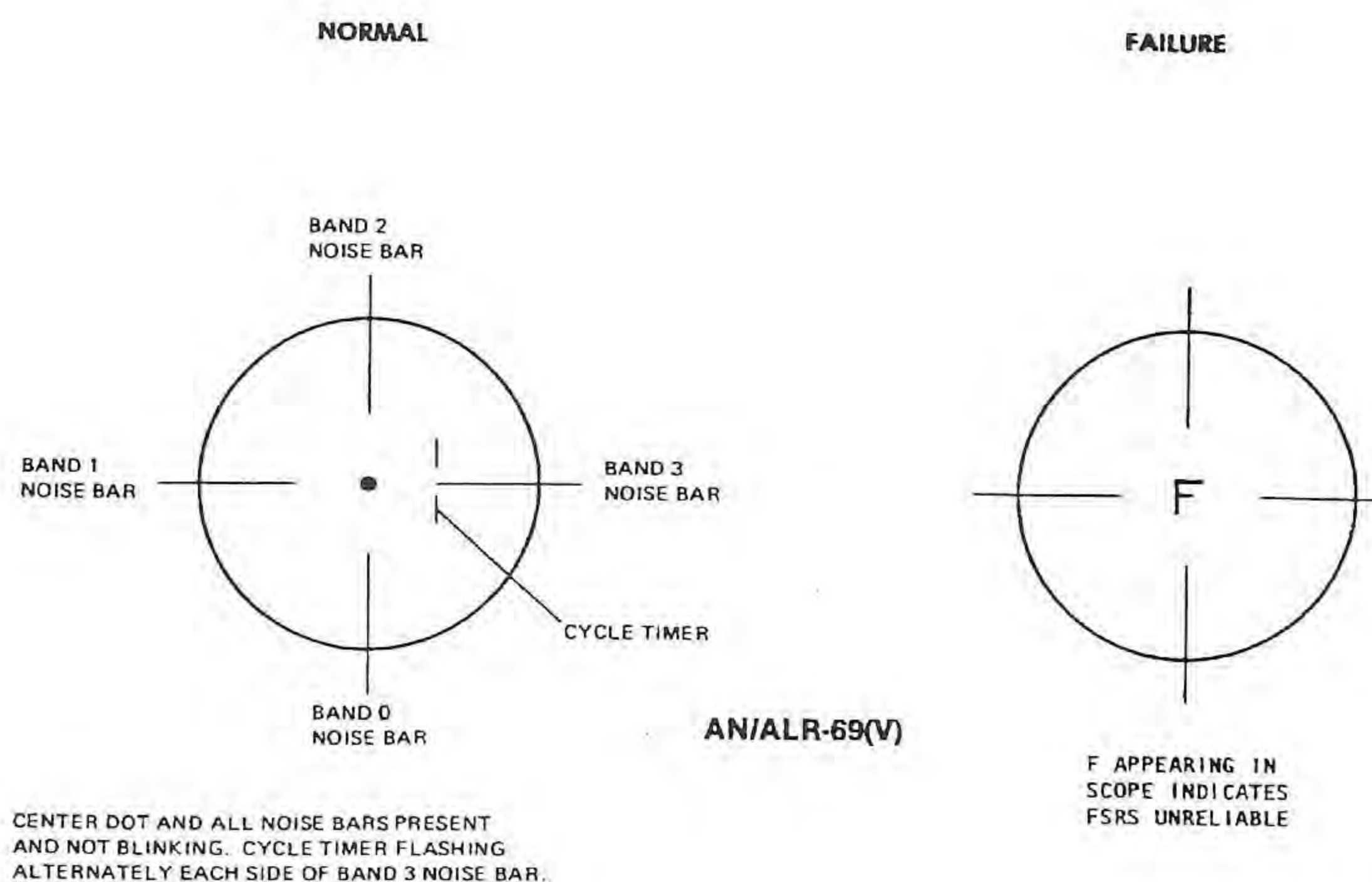
*Figure 1-60. AN/ALR-69(V) Radar Warning System Long Scan Mode.***LONG SCAN MODE**

This processing state for the RWR is designed to improve detection of EW, GCI, and height finder type radars. This mode can be selected first. For further explanation see "Tactical Multicommand Radar Warning Receiver Handbook." This mode is selected by pressing and releasing SYS TEST switch-indicator light (S9) and within one second, the SEARCH switch-indicator (S2), (Figure 1-58). An L symbol will be displayed superimposed on any file mode designator symbol on the azimuth indicator (Figure 1-61) when in long scan state. The system is returned to the current MDT file by depressing S9 and S2 as before.



1A-10A-34-1-1-75

Figure 1-61. Long Scan.



1A-10A-34-1-1-76

Figure 1-62. Radar Warning System Health Status Displays.

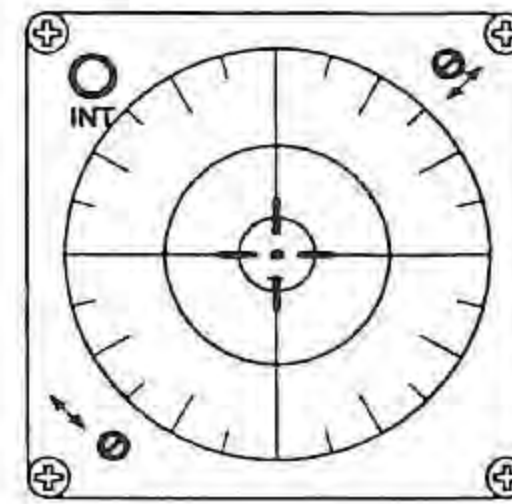
AN/ALR-69(V) RADAR WARNING RECEIVER OPERATIONAL CHECKOUT

NOTE

- During auto self-test, a low frequency audio tone lasting approximately one second will be heard. If receiver or receiver controller failure occurs, an F symbol will appear at the center of the azimuth indicator and remain until fault is cleared.
- A system self-test must be performed if an actual fault exists in the system. An F symbol caused by an actual fault will remain displayed in the center of the azimuth indicator until the fault is cleared. An F symbol that is software generated will clear when the system self-test is performed.
- An operator-initiated self-test completes in 5 seconds and may be repeated as often as necessary to verify proper operation. Good self-test results are indicated by an "OK" symbol. Operators should be familiar with the self-test prior to test start.
- System test NOGO will be highlighted by flashing "BAD" symbol on azimuth indicator.
- Since the system continues to receive radar signals during self-test, radars operating in the vicinity may cause erroneous results.
- Maintenance (Extended Self-Test) gives an expanded display of system self-test detected faults and should be performed if an F appears at the end of the system self-test or if a fault is indicated.

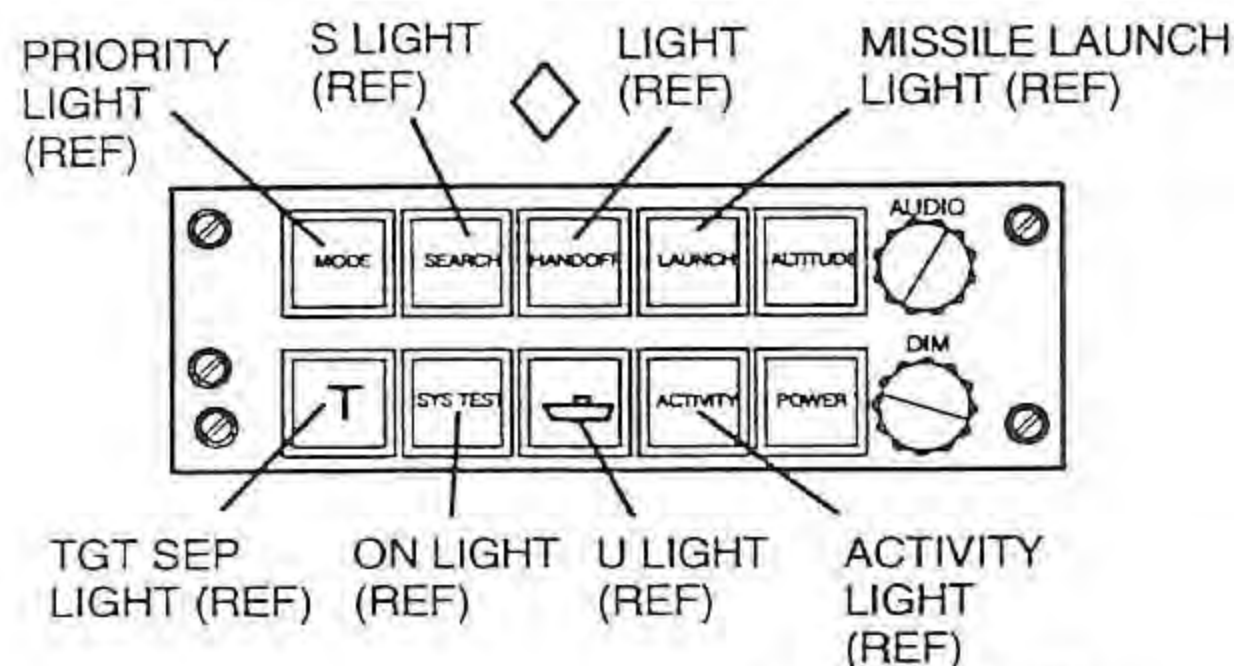
SYSTEM SELF TEST

1. Depress circuit breakers. Set audio control to mid-range. Depress the power switch on indicator control to apply power and check the following.
 - a. The system power, ACT/PWR power and all lower legends except LAUNCH and SEARCH illuminate steadily and some or all of the remaining legends illuminate briefly to indicate that the computer is resetting all switches to normal mode of operation. (LOW and ALT switch will be illuminated if the system was last used in that mode).
 - b. After 10 seconds warm-up, observe that noise bars are the only presentation on azimuth indicator.
 - c. Verify airflow is being drawn into R2094 receiver.
 - d. Allow 2-minute warm-up for the FSRS oscillators to warm-up the system. After warm-up, the system is ready for system test. Observe that the OPEN, SYSTEM POWER, UNKNOWN, SYS TEST, TGT SEP, H, and ALT legends are illuminated. (LOW on the ALT switch will be illuminated if the system was last used in that mode).
- e. Observe Azimuth Indicator shows normal indication (noise bars only).

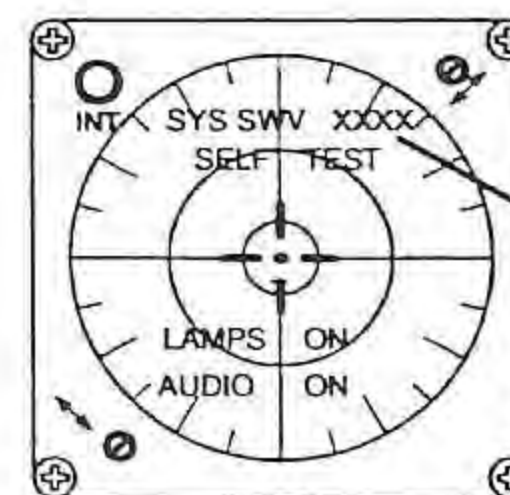
SOFTWARE RESTARTED
ALR-69 NORMAL
AZ INDICATOR DISPLAY
(TYPICAL)

1A-10A-34-1-1-78

2. Depress and hold SYS TEST switch on TDU until noise bars disappear on Azimuth Indicator.
 - a. Azimuth Indicator flashes first screen showing version number, then advances to second screen.

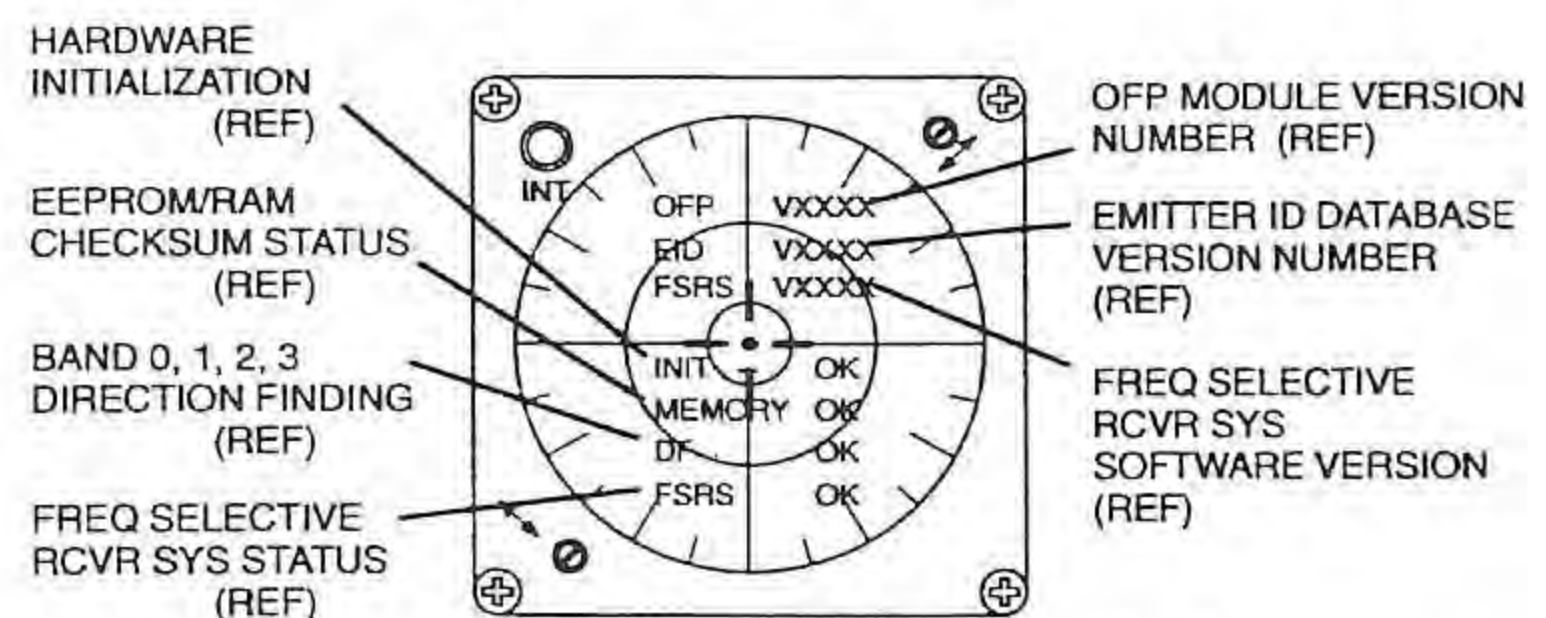


1A-10A-34-1-1-77

SYSTEM SOFTWARE
VERSION NUMBER (REF)

1A-10A-34-1-1-79

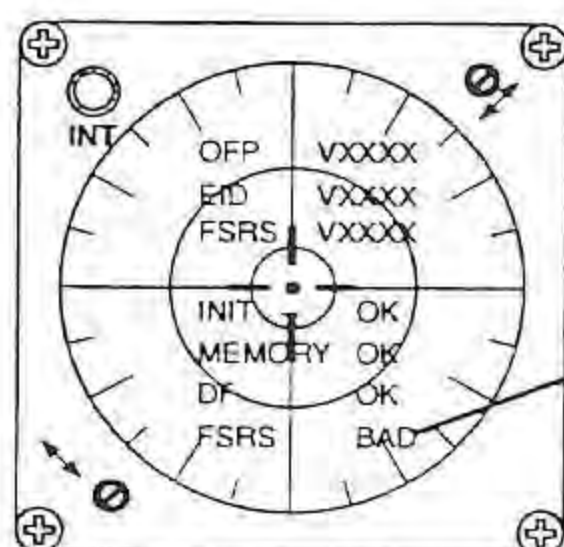
- b. Azimuth Indicator flashes second screen indicating OFF, EID, and FSRS version number.



1A-10A-34-1-1-80

NOTE

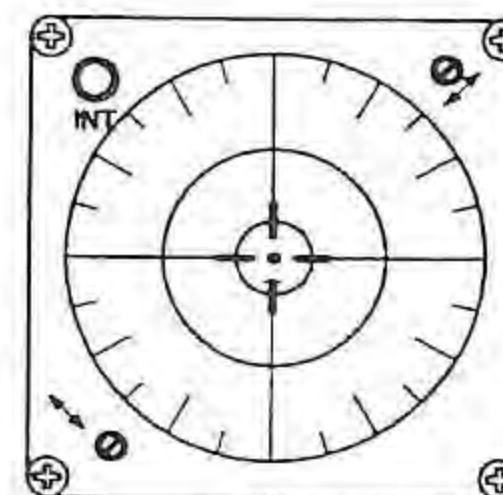
- System NOGO will be highlighted by a flashing "BAD" symbol on azimuth indicator.
- **INIT** summary provides hardware logic verification. CM-479, CCA, A4, CCA A6, and CCA A8.
- **MEMORY** summary provides CM-479 RAM check and EEPROM software load checksum status.
- **DF** summary provides AM-6639/AM-6971 video/receiver status.
- **FSRS** summary provides R-2094/C-10373 hardware, HSDB communication and software load checksum status.



DEGRADE PERFORMANCE
WILL FLASH (REF)

1A-10A-34-1-1-81

- c. Azimuth indicator displays normal screen (noise bars only).



SOFTWARE RESTARTED
ALR-69 NORMAL
AZ INDICATOR DISPLAY
(TYPICAL)

1A-10A-34-1-1-82

3. At the conclusion of the self test, the system returns to its normal operating mode. Depress SYSTEM POWER (S6) on control indicator unit. All legends will go off.

AUTOMATIC SYSTEM TEST

An Automatic System Test occurs approximately every 10 minutes in light threat density and absence of "LAUNCH" or "ACTIVITY" conditions. Indications that system has entered an automatic condition are momentary illumination of "SYS TEST" Lamp and short burst of self test audio. A failure is indicated by an "F" in center of Azimuth indicator and will remain until a good pilot/maintenance "BIT" check is performed. If the "F" disappears, the ALR-69 is operational.

Detailed classified data on the operational use and employment of the radar warning system is contained in Tactical Air Warfare Center (TAWC) Radar Warning Receiver (RWR) Handbook AN/ ALR-69 (Secret).

AN/ALE-40(V) CHAFF/FLARE DISPENSING SYSTEM

The AN/ALE-40(V) chaff/flare dispensing system provides a means to deploy expendable chaff and flare payloads as a countermeasure against radar and infrared controlled threats, respectively. This is accomplished by ejection of track-break chaff or infrared decoy flares from 16 internally mounted dispenser units. Each dispenser consists of a housing, which is loaded with a magazine containing either 30 chaff or 30 flare cartridges or 15 flare cartridges. All magazines are interchangeable. The ALE40(V) system consists of the following components:

- Chaff/flare control panel
- Chaff and flare dispensing buttons

- C-10286/ALE40(V) programmer
- EMI filter switch
- Chaff/flare select switches
- Chaff single/double switch
- Sequencer switches
- Chaff/flare dispenser

CHAFF/FLARE Control Panel

The chaff/flare control panel (Figure 1-63), located on the right console, contains the controls and indicators to dispense chaff and flare payloads.

WARNING

- Do not arm the ALE-40 chaff/flare system for release until mission requirements dictate arming the system.
- Depressing the signal lights test-button with AC power present will provide full power to the ALE-40 system independent of the armament ground safety override switch. Ensure all ALE-40 switches are OFF/SAFE during ground operations.

NOTE

A filter installed in the chaff/flare-control panel prevents inadvertent firing.

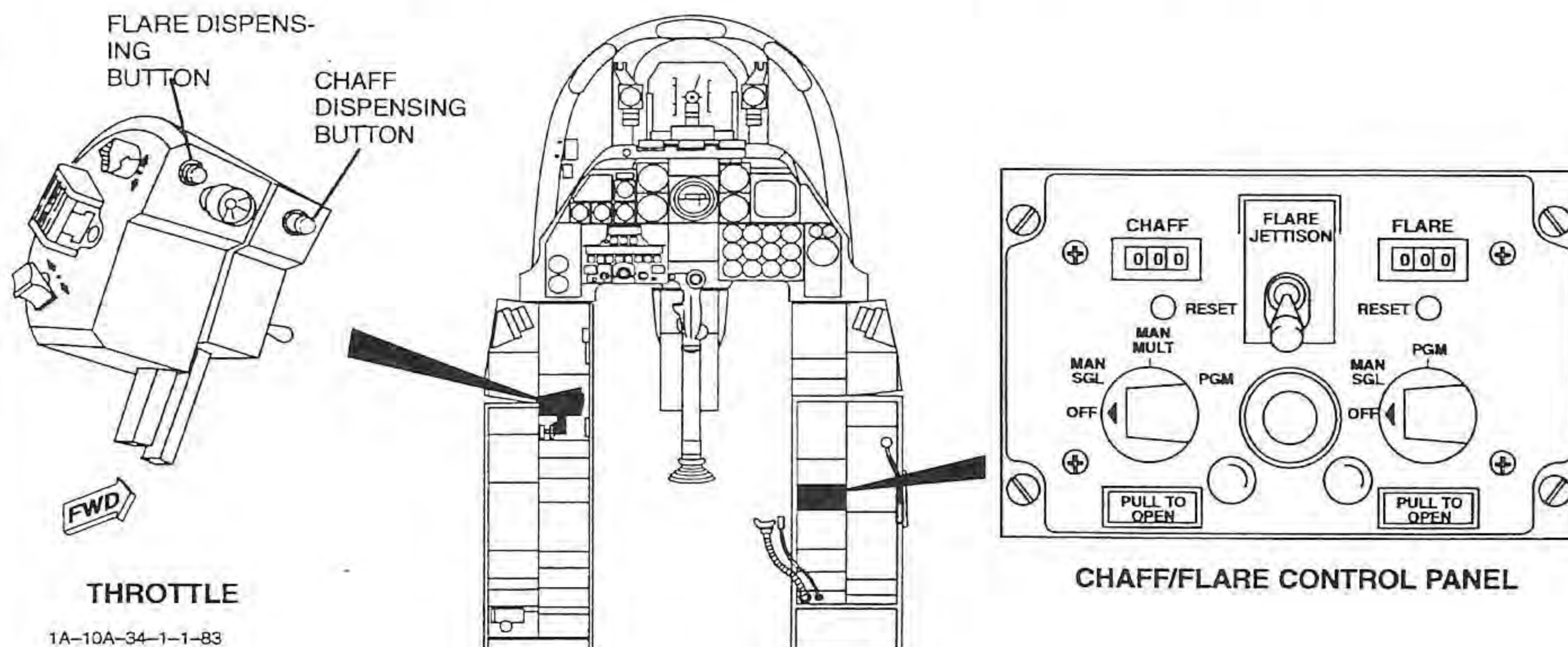
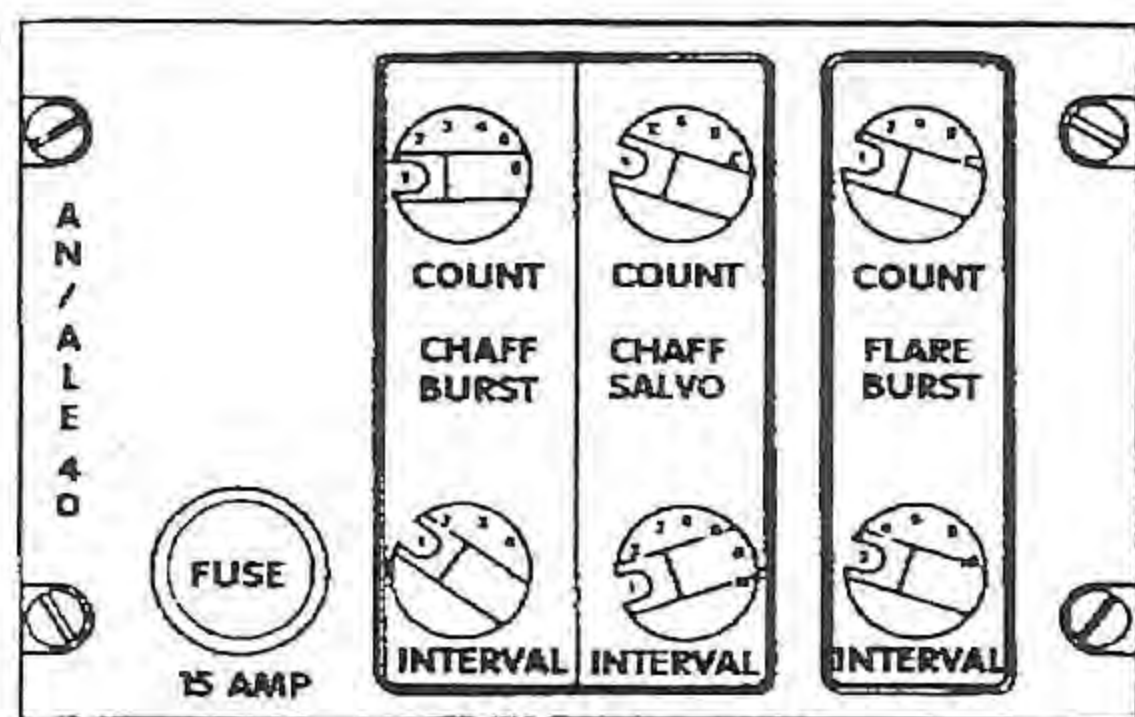
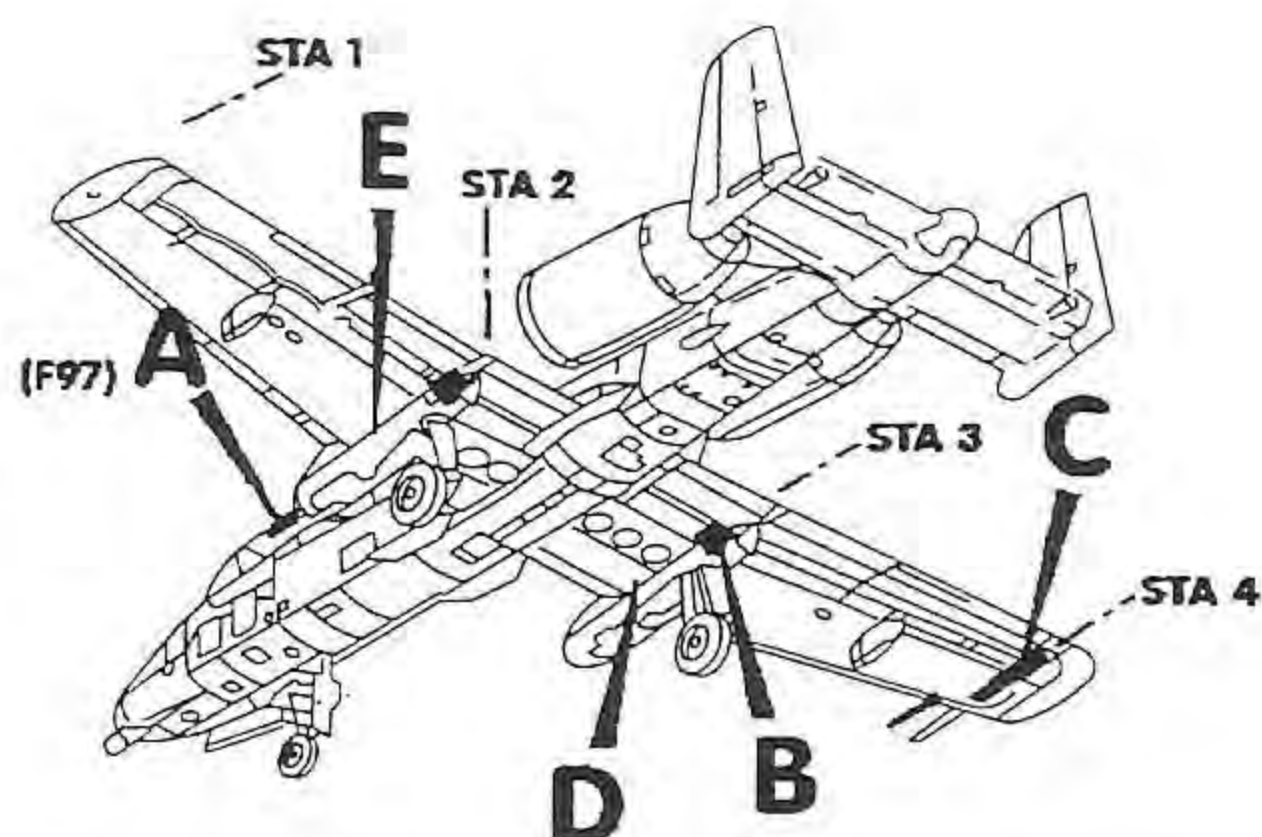
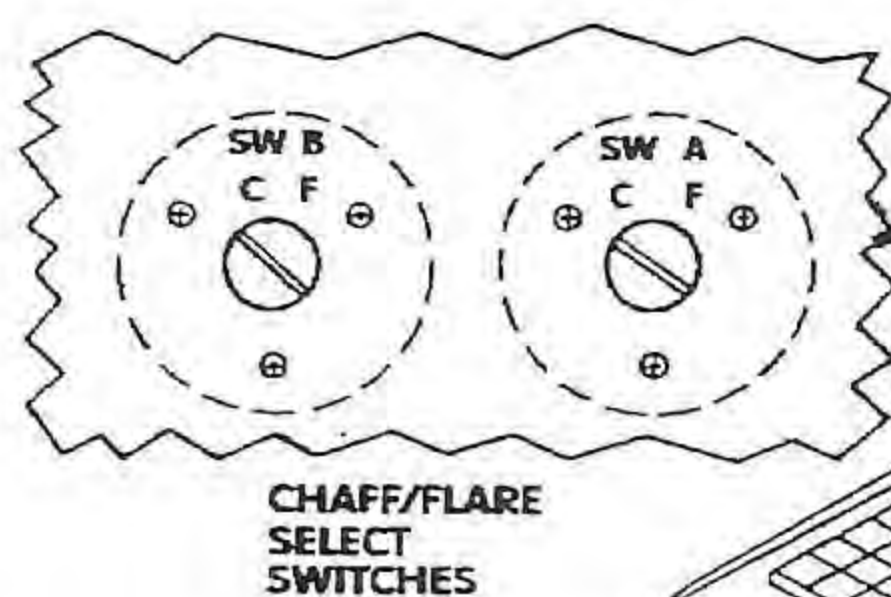


Figure 1-63. Chaff/Flare Dispensing System (Sheet 1 of 3).

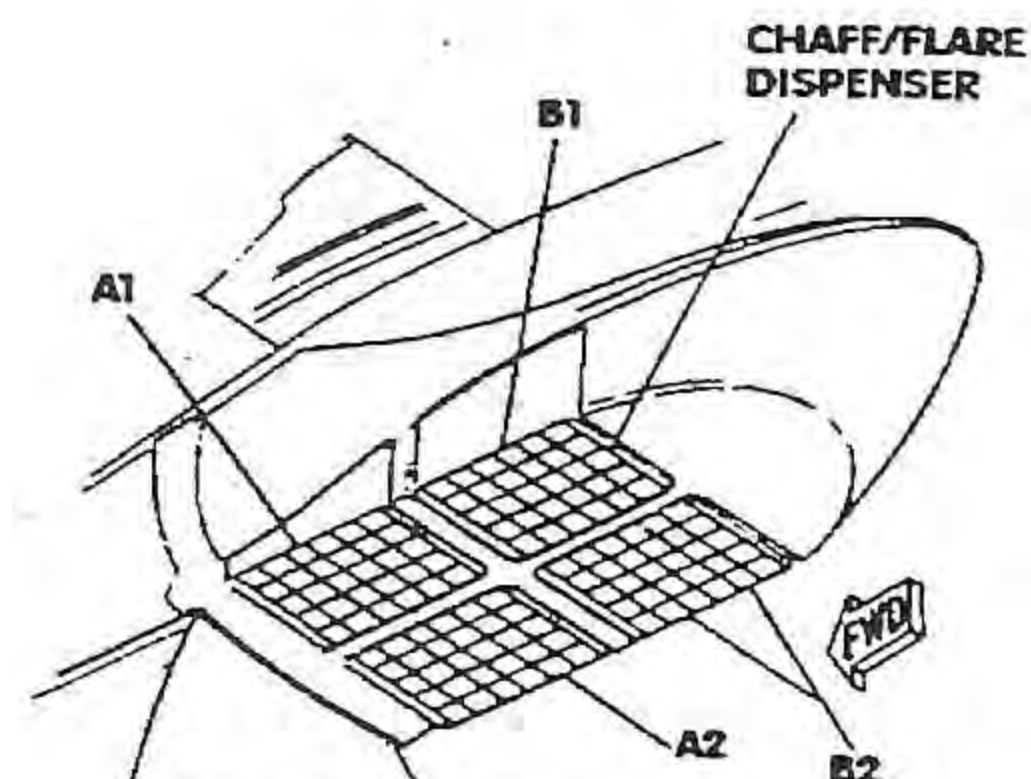


PROGRAMMER C-10286/ALE-40(V)

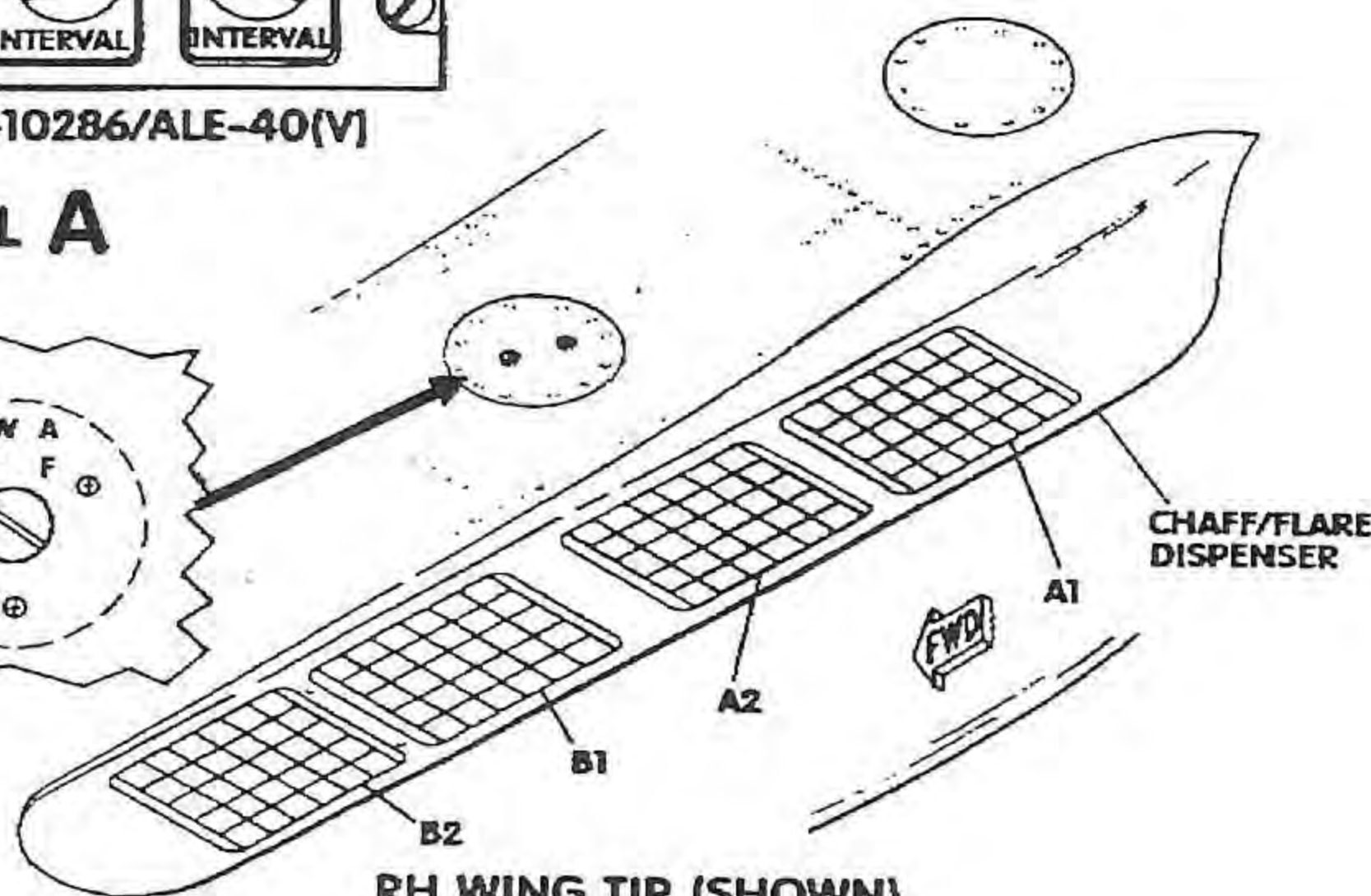
DETAIL A

CHAFF/FLARE
SELECT
SWITCHES

NOTE:
ROTATE SELECT SWITCHES
CW FOR FLARES OR
CCW FOR CHAFF

RH MLG POD (SHOWN)
LH MLG POD (MIRROR IMAGE)

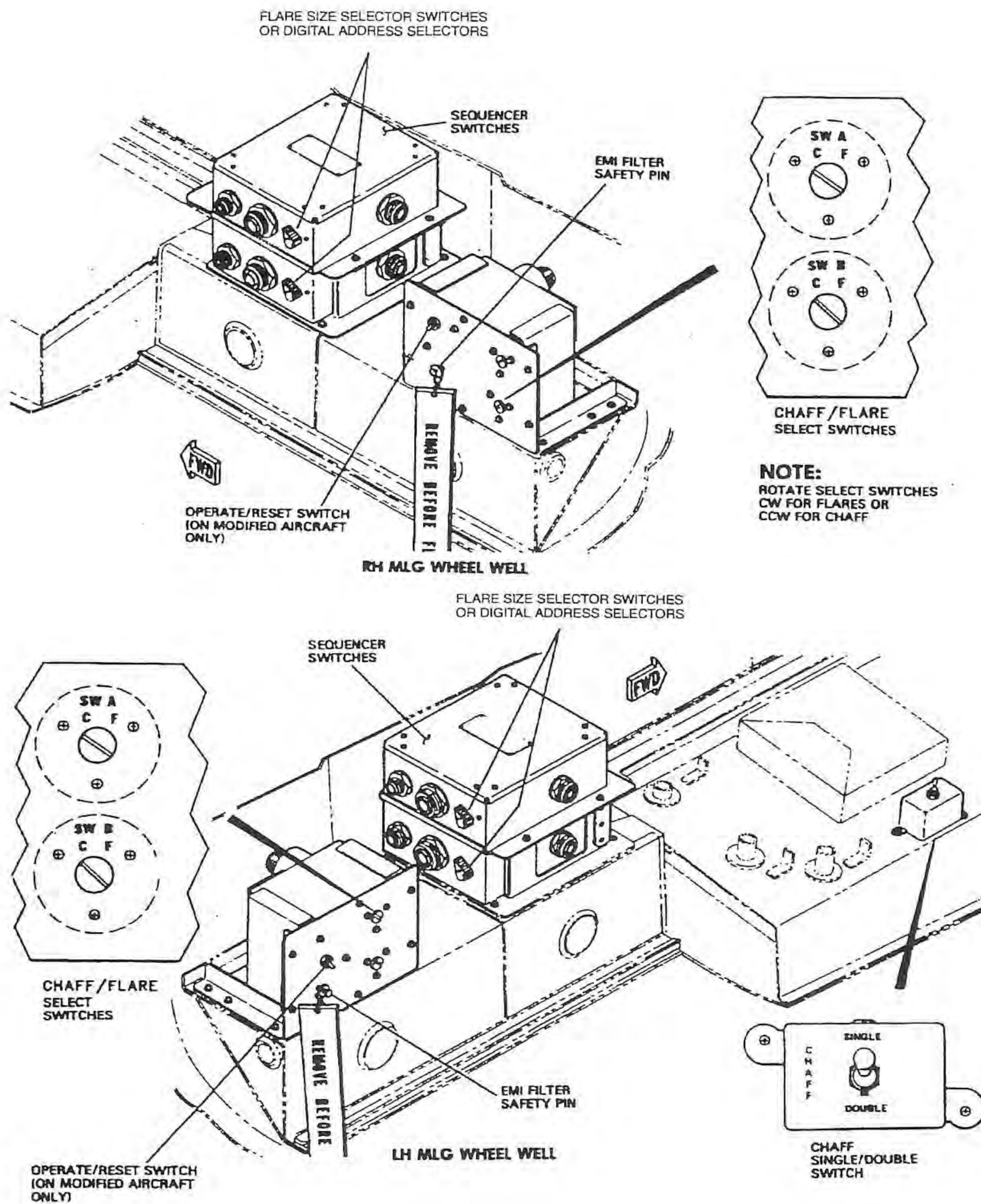
DETAIL B

RH WING TIP (SHOWN)
LH WING TIP (MIRROR IMAGE)

DETAIL C

1A-10A-34-1-1-84

Figure 1-63. Chaff/Flare Dispensing System (Sheet 2 of 3).



1A-10A-34-1-1-85

Figure 1-63. Chaff/Flare Dispensing System (Sheet 3 of 3).

Chaff Mode Selector Knob

The chaff mode selector knob has four positions placarded OFF, MAN SGL, MAN MULT, and PGM.

- OFF-Interrupts 28 VDC power to programmer. An active program will continue after OFF is selected.
- OFF-In conjunction with flare mode selector knob in OFF, removes all 28 VDC power to ALE-40 system.
- MAN SGL-Bypasses programmer to dispense one chaff payload (two if in chaff doubles), for each depression of the chaff dispensing button.
- MAN MULT-Routes dispense command signals through programmer, to dispense a single salvo of chaff payload(s) for each depression of the chaff dispensing button. The number of chaff payload(s) per salvo corresponds to the CHAFF BURST COUNT setting on the programmer.
- PGM-Routes dispense command signals through programmer, to dispense a programmed number of chaff payload salvos for each depression of the chaff dispensing button. The number of chaff payloads per salvo and the number of salvos per program correspond to the CHAFF BURST COUNT and CHAFF SALVO COUNT settings on the programmer.

Flare Mode Selector Knob

The flare mode selector knob has three positions placarded OFF, MAN SGL, and PGM.

- OFF-Makes flare mode selection inoperative. (Programmer function is not affected.)
- OFF-In conjunction with chaff mode selector knob in OFF, removes all 28 VDC to ALE-40 system.
- MAN SGL-Bypasses programmer to dispense one flare payload for each depression of the flare dispensing button.
- PGM-Routes dispense command signals through programmer to dispense a programmed number of flare payloads for each depression of the flare dispensing button. The number of flare payloads per program corresponds to the FLARE BURST COUNT setting on the programmer.

Flare Jettison Switch

The FLARE JETTISON switch is a lever-lock, two-position toggle switch. When the switch is pulled out and positioned forward, all remaining flares will be jettisoned, regardless of flare mode selector knob position. Jettison occurs in the normal release sequence in ripple single at 0.1-second intervals. Flares are ignited during jettison. Chaff payloads cannot be jettisoned.

Stop Program Button

The STOP PGM button, when depressed, terminates the programmer operation until reinitiated by depressing the chaff and flare dispensing buttons. A 3-second delay is required before reinitiation of the programmed operation. Reinitiation of the programmed operation will cause the programmer to revert back to the original programmed input. If reinitiation is attempted with less than a 3-second delay, a single chaff/flare payload will be dispensed.

Chaff Remaining Indicator and Reset Control

The chaff remaining indicator indicates the number of chaff payloads remaining in the dispensers. However, when chaff is dispensed in doubles, the chaff remaining indicator should be set to 1/2 the number of chaff bundles actually loaded. The RESET control is used to set in the total number of chaff payloads loaded in the dispensers.

Flare Remaining Indicator and Reset Control

The flare remaining indicator indicates the number of flare payloads remaining in the dispensers. The RESET control is used to set in the total amount of flare payloads loaded in the dispensers.

Chaff and Flare Ready Lights

The chaff and flare ready lights come on (green) whenever the chaff and flare mode selector knobs are in any position other than OFF and the gear handle is up or the armament ground safety override switch is in O'RIDE. These lights indicate that the chaff and/or flare system is activated and ready for use. The intensity of the chaff and flare ready lights is controlled by the SIGNAL LTS switch on the EXT INTR LIGHTS control panel. The lights are tested by depressing the SIGNAL LIGHTS LAMP TEST button on the AUX LTG control panel.

Chaff and Flare Dispensing Buttons

The chaff dispensing button is on the left throttle. When depressed, a circuit is completed for release of chaff payload(s). The flare dispensing button (Figure 1-63) is on the right throttle. When depressed, a circuit is completed for release of flare payload(s).

C-10286/ALE-40(V) Programmer

The C-10286/ALE-40(V) programmer (Figure 1-63), in the left forward avionics compartment, is used to generate dispense signals to the chaff/flare payloads in response to dispense commands from the chaff/flare control panel. Therefore, the programmer, in conjunction with the chaff/flare control panel, determines the number of chaff/flare payloads per salvo, the number of salvos, and the interval of dispense.

Chaff Burst Count Control

The CHAFF BURST COUNT control is used to select the quantity of chaff payloads to be dispensed per salvo. The quantity selections are 1, 2, 3, 4, 6, and 8.

Chaff Burst Interval Control

The CHAFF BURST INTERVAL control is used to select the interval between bursts. The time interval selections are 0.1, 0.2, 0.3, and 0.4 second.

Chaff Salvo Count Control

The CHAFF SALVO COUNT control is used to select the quantity of salvos to be dispensed. The quantity selections are 1, 2, 4, 8, and C (continuous).

Chaff Salvo Interval Control

The CHAFF SALVO INTERVAL control is used to select the interval between salvos. The time interval selections are 1, 2, 3, 4, 5, 8, and R (random) seconds. Random rate intervals are 3, 5, 2, and 4 seconds, in that order.

Flare Burst Count Control

The FLARE BURST COUNT control is used to select the quantity of flare payloads to be dispensed. The quantity selections are 1, 2, 4, 8, and C (continuous).

Flare Burst Interval Control

The FLARE BURST INTERVAL control is used to select the interval between bursts. The time interval selections are 3, 4, 6, 8, and 10 seconds.

EMI Filter Switch

An EMI FILTER switch (Figure 1-63) is contained in the filter assembly for each dispenser station. The function of the EMI filter switch is to remove 28 VDC from the respective gear pod or wing tip dispenser. The switch is activated by the insertion of the EMI filter safety pin into the respective filter assembly.

NOTE

Inserting the EMI filter safety pin into the gear pod EMI filter removes power from both the gear pod and wing tip sequencers for the respective side of the aircraft.

Operate/Reset Switch

The operate/reset switch is a two-position toggle type circuit breaker that is used to reset (rehome) the sequence switches to the first firing position.

On unmodified aircraft, the operate/reset switch (Figure 1-64) is inside the EMI filter assembly. The sequencers are reset each time the EMI filter safety pin is inserted in the gear pod EMI filter assembly.

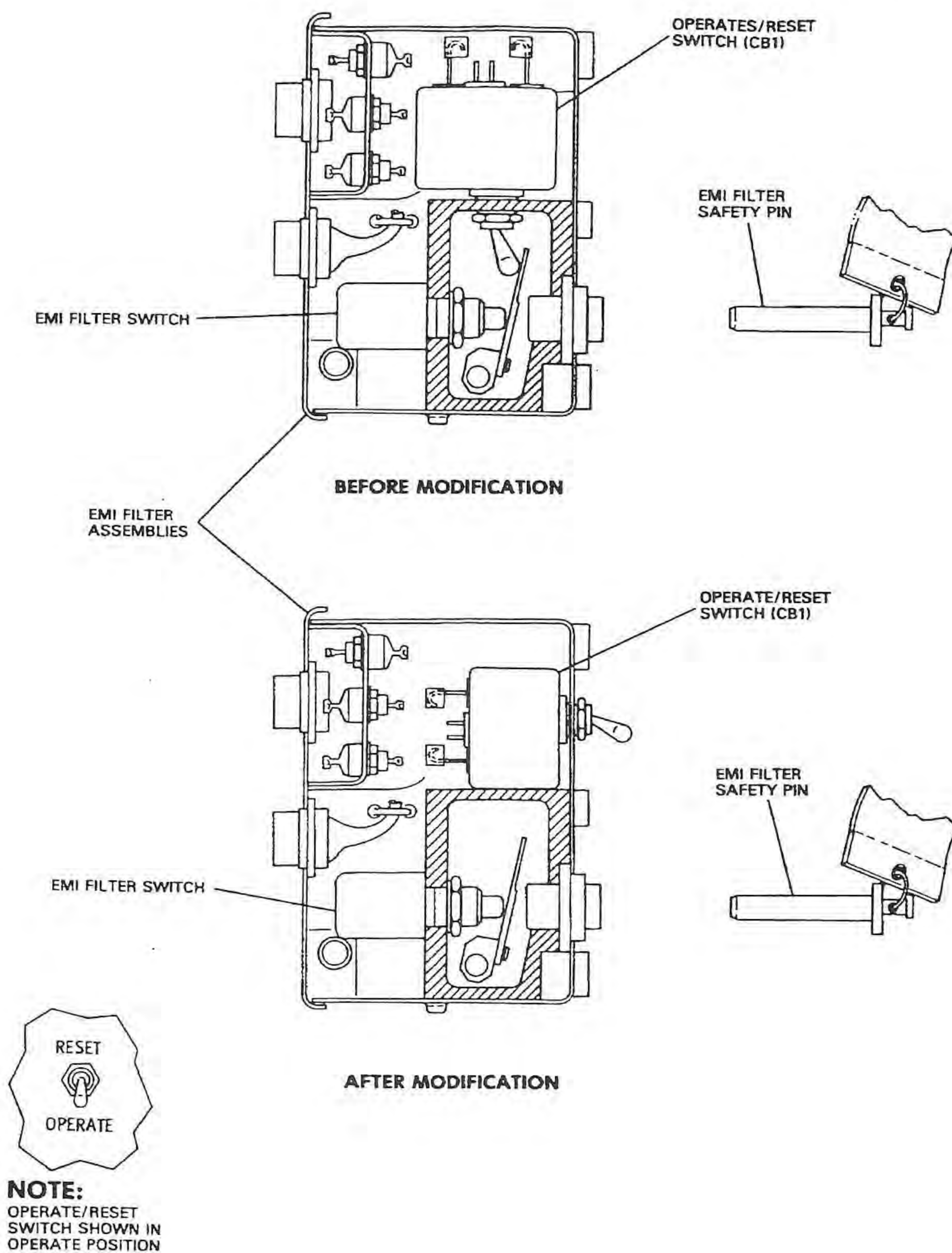
On modified aircraft, the operate/reset switch (Figure 1-64) is mounted externally on the side of the EMI filter assembly. This location provides the option of selecting either OPERATE or RESET. For a full load of chaff or flares, the RESET position should be selected. For a partially expended load (i.e., no reload), OPERATE should be selected.

NOTE

- Failure to reset with a full load will result in unexpended chaff or flares.
- Resetting with a partial load will result in no expenditures until the sequencer cycles through the previously expended cartridges.

Chaff/Flare Select Switches

Two select switches (A and B) (Figure 1-63) are located at each wing tip and each main landing gear pod. Switch A controls the circuitry for A1 and A2 dispensers; switch B controls the circuitry for B1 and B2 dispensers. The switch positions are C (chaff) and F (flare), to match the type payload installed in the two dispensers controlled by that switch.



1A-10A-34-1-1-86

Figure 1-64. Modified And Nonmodified EMI Filter Switch Configurations.

Chaff Single/Double Switch

The CHAFF SINGLE/DOUBLE switch (Figure 1-63) is located in the left main landing gear pod. The switch positions are SINGLE and DOUBLE. When the switch is set to SINGLE, chaff will be dispensed, according to programmer settings, from stations 1, 4, 2, and 3, in that order. When the switch is set to DOUBLE, chaff will be dispensed in pairs from stations 1 and 4, 2 and 3, in that order.

Sequencer Switches

Two sequencer switches (Figure 1-63) are installed in each main landing gear pod and each wing tip. The sequencer switches convert chaff and flare dispense signals into, a squib fire signal and route this fire signal to the breech plate assembly in the dispensers. Each sequencer switch contains a three-position flare size selector switch (1x1, 1x2, and 2x2.5) to match the size of the cartridges loaded in the magazine. The A/OA-10 aircraft is certified to dispense 1x1 CHAFF and 1x1 and 1x2 Flare Cartridges.

Chaff/Flare Dispensers

Four chaff/flare dispensers (Figure 1-63) are installed in each main landing gear pod and each wing tip. Each dispenser contains a breech plate assembly that mates with either a chaff or a flare payload magazine. The breech plate assembly provides electrical impulses to detonate the cartridge squibs contained in the magazine. The magazine (MJU-II/A) is a fiberglass container with provisions to carry 30 1 - x 1 -inch chaff (RR-170A/AL) or flare (M-206) cartridges. The cartridges are retained in the magazine with a retaining plate. To specifically identify the type of cartridge loaded in the magazine, the following may be observed at the bottom end of the magazine: the bottom end of the chaff cartridge has a brown end cap, and the bottom end of the flare cartridge has an F placarded on a red end cap.

M-206 Flare Cartridge and M-796 Squib

The M-206 flare cartridge (Figure 1-65) consists of a square metal tube containing a receptacle for the M-796 squib, a piston, a flare pellet payload, and a red plastic end cap. The M-796 squib contains an explosive charge that produces the necessary gas pressure to dispense the flare pellet payload from the flare cartridge.

MJU-7 Flare and BLU-36/B Squib

The MJU-7 flare consists of a metal outer sleeve containing a receptacle for BLU-36/B squib, a flare pellet, a safety and initiation (S&I) device, and a plastic end cap. It is 1 by 2 inches. The BLU-36/B squib contains an explosive charge that produces the necessary

gas pressure to dispense the flare pellet payload from the flare cartridge.

RR-170 A/AL Chaff Cartridge and BBU-35/B Squib

The RR-170 VAL chaff cartridge (Figure 1-65) consists of a square plastic tube containing a receptacle for the BBU-35/B squib, a piston, a chaff dipole payload, and a brown plastic end cap. The BBU-35/B squib contains an explosive charge that produces the necessary gas pressure to dispense the chaff dipole payload from the chaff cartridge.

ALE-40 Release Sequence And Loading

The ALE-40 release sequence is depicted in Figure 1-66. To avoid interfering with the chaff doubles capability, flares should be loaded in paired stations in corresponding A1 A2 and/or B1 B2 positions. Release logic circuitry of the chaff/flare sequencer switches (Figure 1-63) does not permit chaff/flare mixing within the A and B positions. For example, full chaff magazine in A1 cannot be loaded with a full flare magazine in A2 on any single station. Thus, when chaff doubles is desired, load flares in multiples of 120 in their appropriate stations. If partial flare loads are desired, substitute empty flare magazines with the chaff/flare select switch set to F.

NOTE

Each of the four dispensers of each station must have as a minimum, an empty magazine installed. If a magazine cannot be installed in a particular station, then that entire station should be down-loaded and a cover panel installed.

Each empty chaff/flare magazine weighs 5.5 pounds. A full magazine of RR-170 chaff weighs 15.5 pounds, while the same magazine full of M206 flares weighs 20.5 pounds. The following table list weights for some ALE-40 configurations.

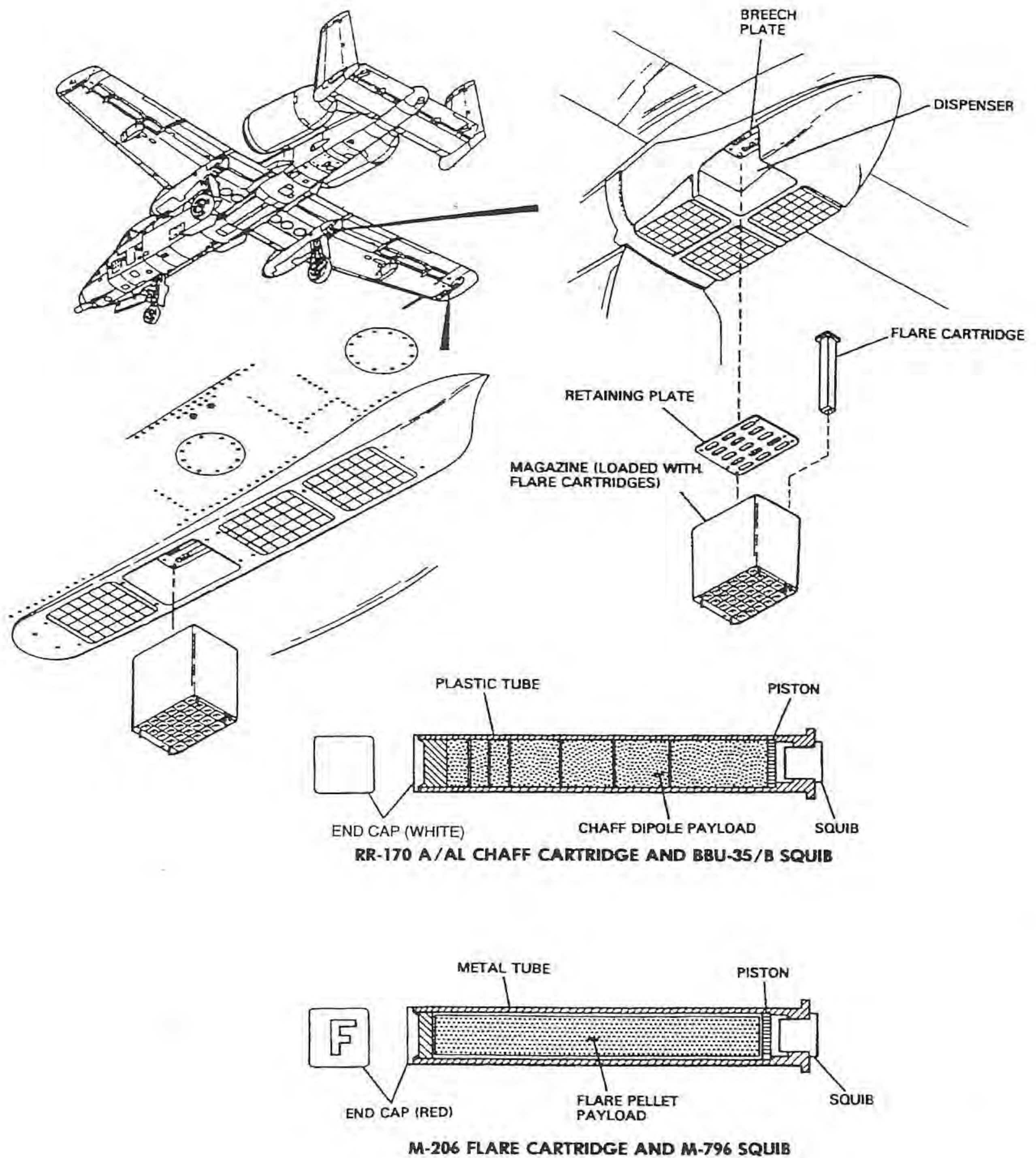
Flares (480)-	328 pounds
Chaff (480)-	248 pounds
Chaff/flare (240/240)-	288 pounds
Chaff/flare (360/120)-	268 pounds

NOTE

On modified aircraft, the OPERATE/ RESET switch should be positioned as follows:

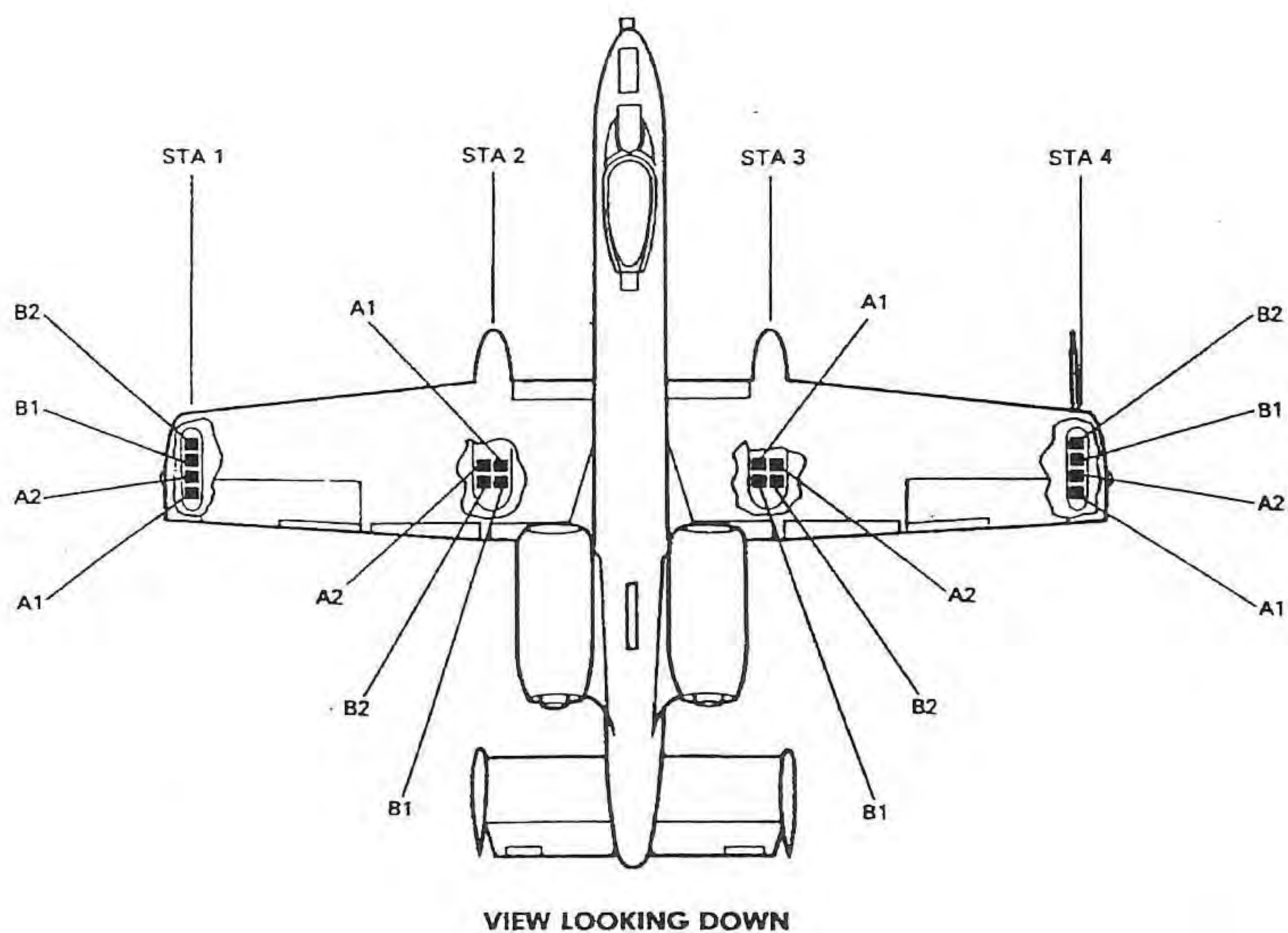
Full chaff/flare load - RESET

Partial chaff/flare load - OPERATE.



1A-10A-34-1-1-87

Figure 1-65. AN/ALE-40(V) Chaff/Flare Dispenser.



STORES	RELEASE SEQUENCE (STATIONS)
RR-170 A/AL CHAFF CARTRIDGE (SINGLE)	1, 4, 2, 3
RR-170 A/AL CHAFF CARTRIDGE (DOUBLE)	1 AND 4, 2 AND 3
M-206 FLARE CARTRIDGES	3, 2, 4, 1
MJU-7 FLARE CARTRIDGES	3, 2, 4, 1
NOTE: EACH STATION WILL RELEASE ITS STORES IN THE ORDER A1, A2, B1, B2.	

1A-10A-34-1-1-ES

Figure 1-66. Chaff/Flare Dispensing System Release Sequence.

ALE-40 System Operation

Prior to entering the cockpit, the desired program settings of chaff burst, salvo, and flare burst must be set on the chaff/flare programmer. Chaff single or double should also be selected. Enter the correct amount of chaff and flare into the chaff/flare remaining indicators. If double chaff has been selected, set in only half of total number of chaff cartridges loaded to keep track of the number of paired chaff impulses remaining.

Once airborne, the system is armed by turning the chaff and flare mode selector knobs to the desired position. The system will dispense chaff and/or flares in the selected mode by activating the chaff and/or flare dispensing buttons. Depressing the STOP PROGRAM button will terminate a chaff or flare program at any time. To reinitiate the program, the appropriate dispensing button must be depressed.

If a chaff program is in progress and the chaff mode selector knob is turned OFF, the program will immediately cease, provided flare mode selector knob is also OFF. To reinitiate chaff program, chaff mode selector knob must be set to either MAN MULT or PGM, and chaff dispense button actuated twice. The first actuation will result in only one dispense, while the second will result in programmed dispenses. If flare mode selector knob is not OFF when the chaff program is interrupted, the program will continue until the program cycle is completed. Similarly, if a flare program is in progress and the flare mode selector knob is OFF, the program will immediately cease, provided chaff mode selector knob is also OFF. To reinitiate the flare program, the flare mode selector knob must be set to PGM, and the flare dispense button actuated twice. The first actuation will result in only one dispense, while the second will result in programmed dispenses. If the chaff mode selector knob is not OFF when flare program is interrupted, the program will continue until the program cycle is completed.

Additional chaff or flares may be dispensed during any programmed mode by depressing the appropriate dispenser button. This will dispense single cartridges of flares or chaff, but will not stop or affect the remainder of the program.

From the cockpit, the only positive method to determine if a program is still in progress is to observe if the chaff/flare

remaining indicators are still counting down. The system is empty when the indicators count through 000, assuming the proper quantity was entered on the indicators during preflight (1/2 chaff quantity entered if in double). Additional activation of the chaff/flare buttons will cause the system to count down from 999, although no chaff or flares are being dispensed.

ELECTRONIC COUNTERMEASURES SYSTEM

The A-10A ECM system consists of the following components:

- ECM pod
- ECM pod control panel.

Electronics Countermeasures Pod

The A-10A is designed and certified to carry ECM pods on stations 1 and/or 11. When carried, ECM pods are pinned and safety wired to the MAU-50/ A, making them nonjettisonable. See T.O. 1A-10A1, Section V, for carriage limits. Two basic pods are available, AN/ ALQ-131(V) and AN/ ALQ-184(V).

WARNING

In manual reversion single-engine flight, an ECM pod on the dead engine side will decrease the full aileron roll rate into the good engine to less than 50 degrees per second, which may be inadequate to retain control of the aircraft during gusty conditions.

NOTE

Some ECM pod activation modes can cause degradation of the radar warning system.

Additional ECM Pod Information

Refer to TCM-Tactical Electronic Warfare Equipment Setting Handbook AN/ALQ-131(V)/AN/ALQ-184(V)ECM Pod (Secret) for detailed classified data on ECM pod settings and operation.

Refer to standard manual T.O. 1-1M-34 and 1-1M34-1 for additional descriptive information, AN/ALQ-131(V), and AN/ALQ-184(V).

PART 4.2

RADAR WARNING AND THREAT COUNTERMEASURES SYSTEMS 138

RADAR WARNING SYSTEMS GENERAL COMPONENTS

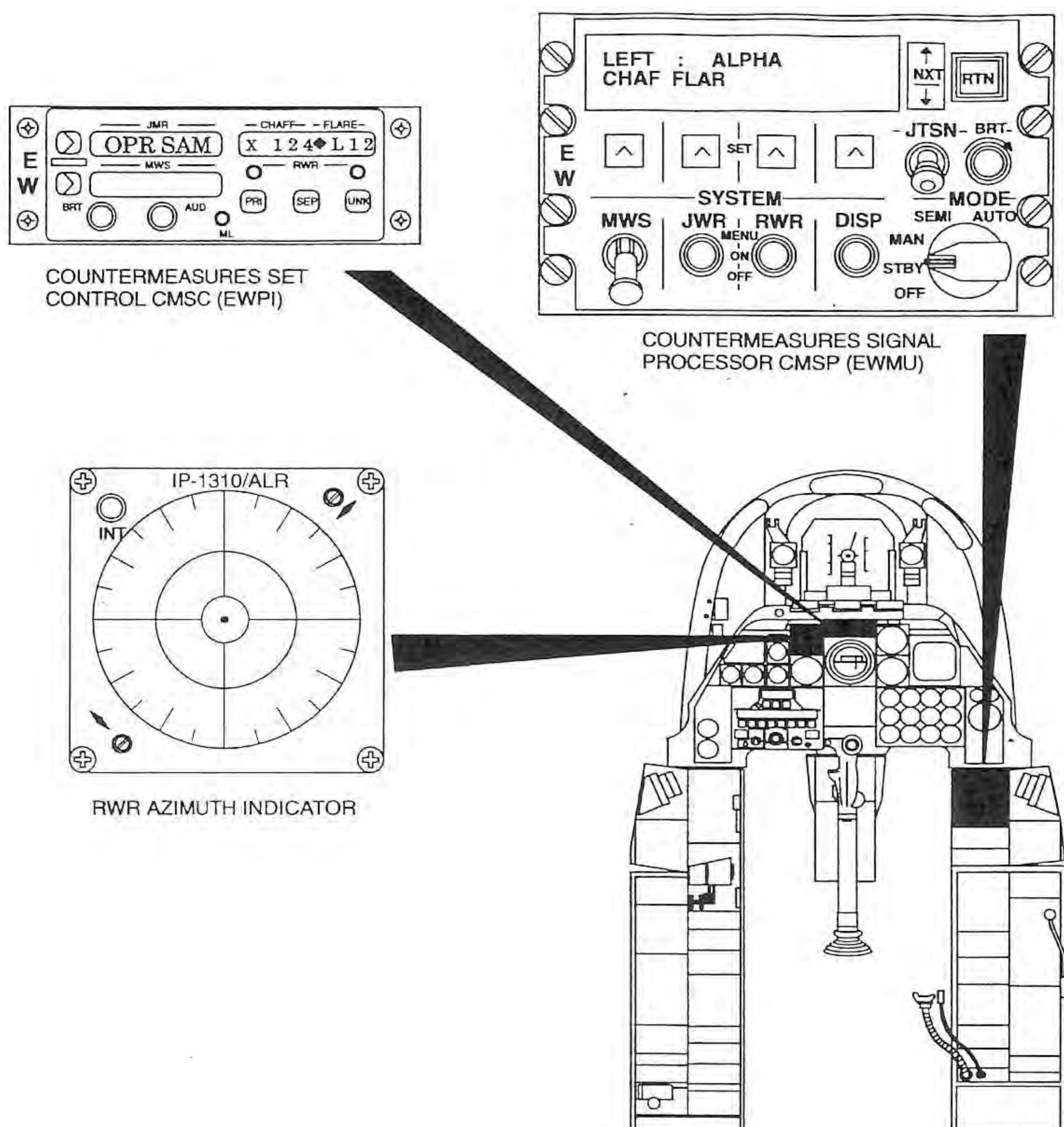
The AN/ALR-69(V) is an integrated part of the Countermeasure Set CMS (EWMS) [Refer to Countermeasures Set (CMS) for additional information]. The AN/ALR-69(V) system detects the presence of radar emissions and provides visual and aural indications of threat radar emitters, operating in E through J and C/D RF band regions. Visual indications of threat signals are displayed on the azimuth indicator and the Countermeasures Set Control CMSC (EWPI) (Figure 1-67), located on the main instrument panel. The azimuth indicator displays symbols indicative of type of threat and threat lethality level. Position of symbol is representative of threat signal relative bearing. The CMSC (EWPI) contains switch-indicator lights that control system functions and the azimuth indicator display. The Countermeasures Signal Processor (CMSP) (Figure 1-67) provides for the selection of countermeasures programs and options. An audio signal, heard in the headset and characteristic of threat signal, is generated in conjunction with any diamond enhancement displayed on the azimuth indicator.

The AN/ALR-69(V) system consists of the following components:

- IP-1310/ALR azimuth indicator for alphanumeric display of the threat environment.
- Countermeasures Signal Processor (CMSP) provides controls and displays the modes of the system while giving indications of missile activity and missile launch. [For additional information refer to Countermeasures Set (CMS).]
- Countermeasures Set Control (CMSC) provides controls and indicators of status of the JMR, RWR, and the Chaff/Flare systems. [For additional information refer to Countermeasures Set (CMS).]
- AM-6971 Compass Sail amplifier detector, which receives guidance signals in the low (C/D) band.
- CM-479 signal processor, which processes threat and guidance signals in the low and high bands, output signals for threat warning, initiates system self-test, and commands the frequency selective receiver system (FSRS) to search and analyze RF signals.

- C-10373 FSRS receiver controller, which provides control of the FSRS receiver, measurement functions and high speed data bus (HSDB) communications with the signal processor.
- R-2094 FSRS superheterodyne receiver providing high band coverage for pulse and continuous wave threat RF.
- SA-2283 FSRS antenna switch provides commutating connection to the quadrant antennas.
- Impedance coupler CU-2220, which provides a common node among, the CM479, C-10372, and ECM pod over the HSDB.
- AM-6639 high band amplified detectors provides wide band measurement of pulsed RF to the signal processor.
- Power splitters used to provide RF energy from the quadrant antennas to the FSRS and AM-6639 receivers.
- Two aft antennas and two forward multipurpose antennas (AM457-1) for high band reception, and a preamplifier (AM-6639) for each antenna, which separates the high bands into three sub-bands that overlap the skirts to provide continuous coverage. The multipurpose antennas, in addition to providing signals to their respective preamplifier, also supply signal paths, through a power divider, to the FSRS.
- One radome containing five antennas (AS-3262) for reception of C/D band (missile guidance) signals, which are applied to the low band receiver (AM-6971).

The AN/ALR-69(V) radar warning receiver systems provide the capability to detect missile activity and missile launch conditions, and provide the following functions: search radar, emitter audio handoff, symbol separation for ID, emitter relative bearing, altitude prioritization, reduction, multiple ID databases. These multiple databases (maximum of three) are presently programmed with LAND (normal default), and training.



1A-10A-34-1-1S-1-53A-BCC1

Figure 1-67. Radar Warning System Cockpit Controls and Indicators.

AN/ALR-69(V) CONDITIONS AND FUNCTIONS

Missile Activity Condition

The azimuth indicator display for a detected missile(s) and associated threat radar consists of a steady illuminated circle around a numerical symbol (Figure 1-68). The numeric symbol represents the type of tracking radar, and the steady illuminated circle indicates that guidance information collected by the tracking system is being transmitted. Tick marks or "ears" represent uncorrelated activity, i.e. tracker absence or special tracker. Tracking radar indication is displayed by the CMSC (EWPI) when the PRI button has been pressed. The green indicator light in the button is on in priority mode and off in open mode. Flashing light indicates threat can not be displayed on the RWR.

Missile Launch Condition

The azimuth indicator display for a detected missile(s) and associated threat radar consists of a flashing illuminated circle around a numeric symbol (Figure 1-68). The numeric symbol represents the type of tracking radar, and the flashing circle indicates that the guidance information collected by the tracking radar is being transmitted and used to guide the missile in flight. These symbols will be accompanied by seven beeps of 1000 HZ headset audio as an alert. The CMSC (EWPI) ML light comes on and flashes when missile activity is detected. Audio volume control is provided using the AUD knob on the CMSC (EWPI).

Search Function

The search function is used to display EW, GCI, and the acquisition-type radars on the azimuth indicator. The symbol S will be displayed (Figure 1-68) as a means of identification when the search mode is selected on the CMSP (EWMU) in the RWR rotary.

Unknown Function

Detection of an unknown threat(s) is indicated by a flashing U on the azimuth indicator. Selection of unknown function on the CMSP (EWMU) in the RWR rotary enables display of the U symbols on the azimuth indicator. The U symbols are displayed on the azimuth indicator with one, two, three, or none (E/F, G/H, I/J, C/D) dots designating the band in which the threat is operating (Figure 1-68).

Handoff Function

The handoff function is used to select a lower priority threat displayed on the azimuth indicator. Depressing OSB 2 on the CMSP (EWMU) in the RWR rotary will move the diamond from the default highest priority threat to the next lower priority threat. A long time period activation of the OSB steps the diamond to the next priority threat. Short activations of the OSB toggles diamond audio on and off. This process continues as long as the OSB is depressed.

Altitude Priority Function

The altitude priority function is used to change the display priority as the mission flight profile changes. At low altitudes short range threats, like AAA, can be given display priority, while at high altitudes display priorities can be assigned to AIs and SAMS. This function is accomplished using the CMSP (EWMU) in the RWR rotary. Depressing OSB 3 toggles between LOW and HGH altitude priority threat displays.

Target Separate Function

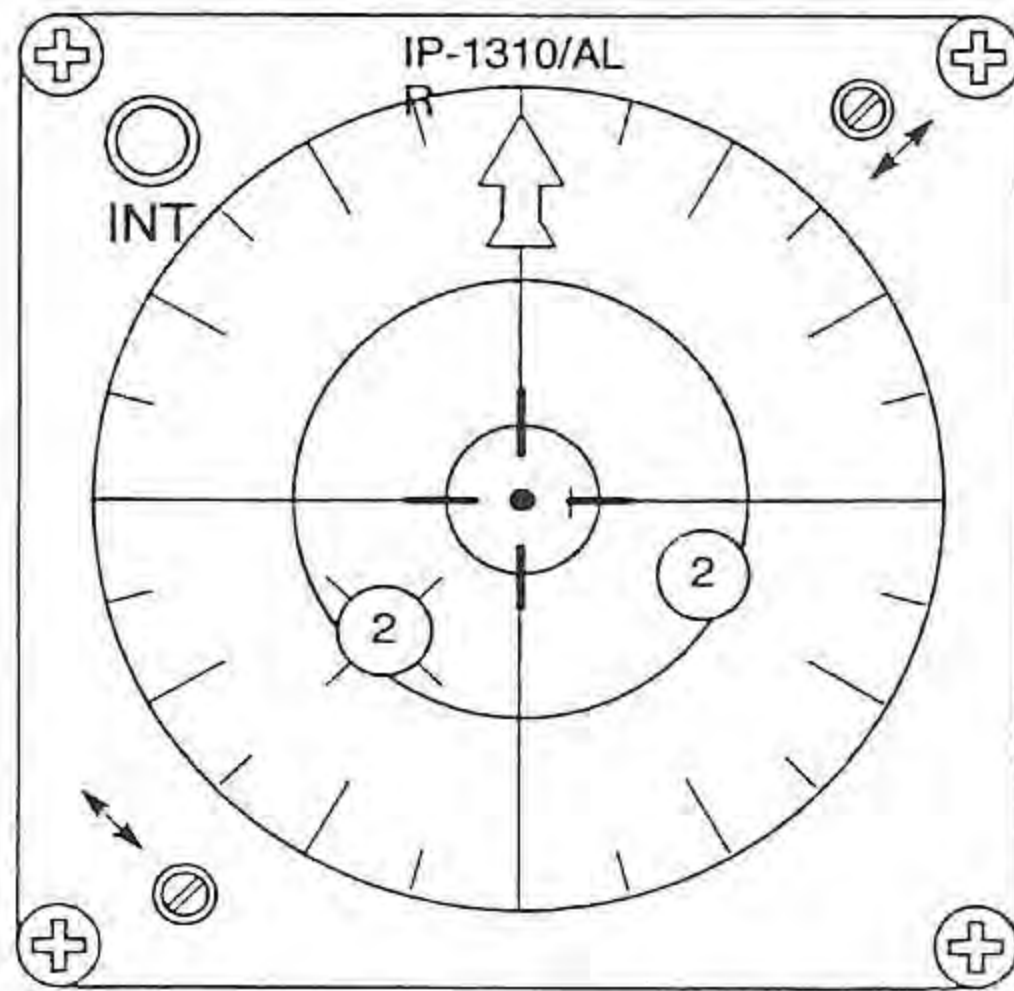
The target separate function is used to expand collocated targets displayed on the azimuth indicator (Figure 1-68). This function is selected on the CMSC (EWPI) using the SEP button or at the CMSP (EWMU) in page 2 of the RWR rotary using OSB 2. The function retains the highest priority emitter display position in the group. The function continues by separating the lower priority symbols radially outward to the edge of the azimuth indicator. At the edge separation continues clockwise around the azimuth indicator.

Mode Function

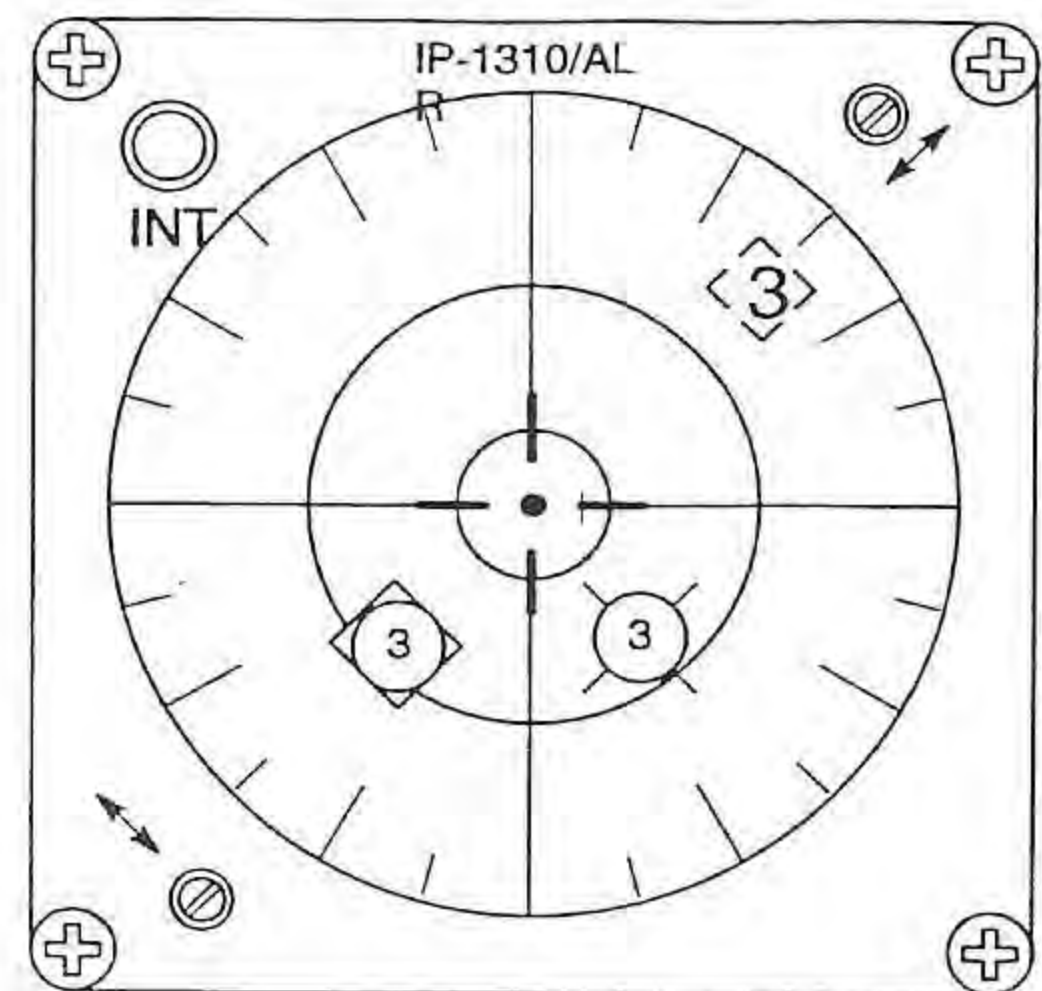
Two mode functions are available for system operation, OPEN and PRIORITY, with OPEN mode used for normal operation. OPEN mode allows display of up to 16 threats on the azimuth indicator; whereas, PRIORITY mode only allows the present top five highest priority threats to be displayed (Figure 1-68). If there are more than five threats above the program priority the light in the PRI button on the CMSC (EWPI) comes on and flashes. The mode function is accomplished by pressing OSB 1 on the CMSP (EWMU) in page 2 of the RWR rotary.

Audio Function

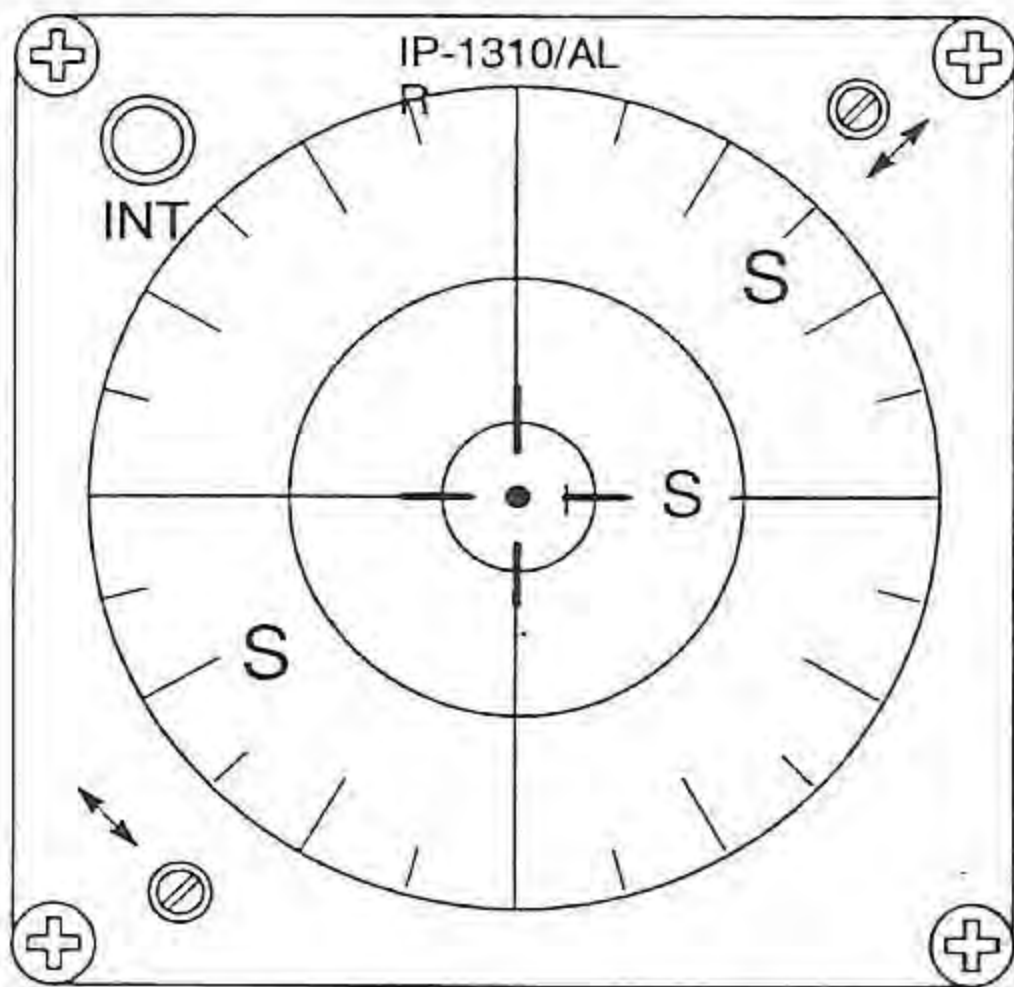
The audio is controlled by the CMSP (EWMU) using OSB 2 in the RWR rotary. This OSB performs all functions of the handoff button on **137** equipped aircraft.



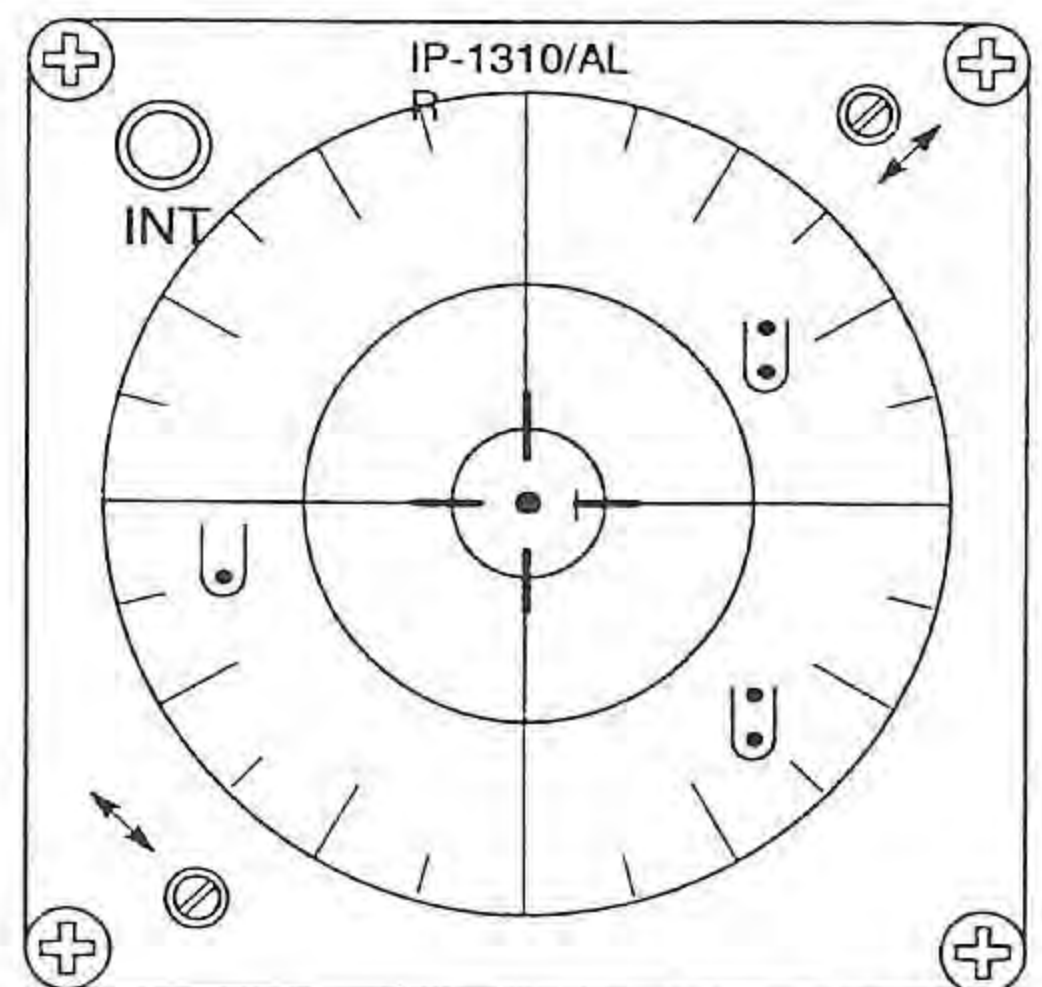
MISSILE ACTIVITY CONDITION
(STEADY CIRCLE AROUND RADAR)



MISSILE ACTIVITY CONDITION
(FLASHING CIRCLE AROUND RADAR)



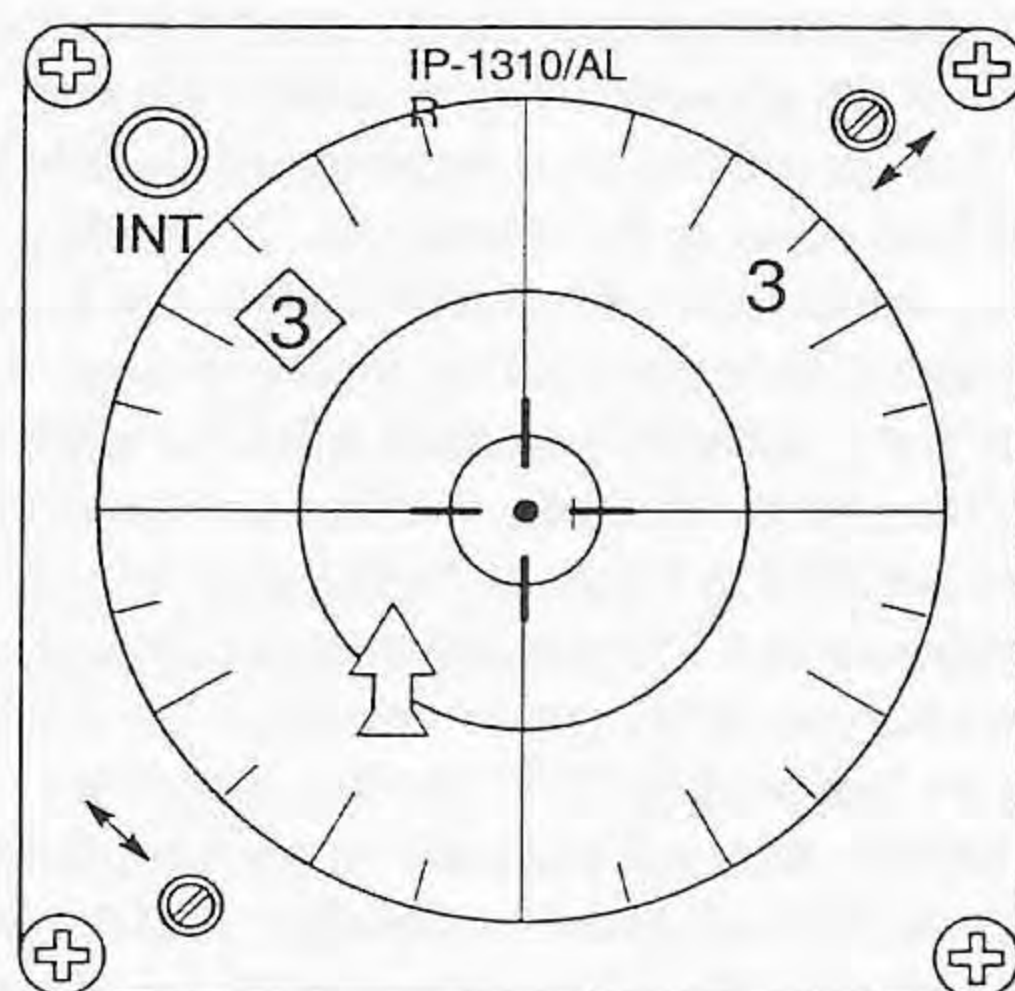
SEARCH FUNCTION



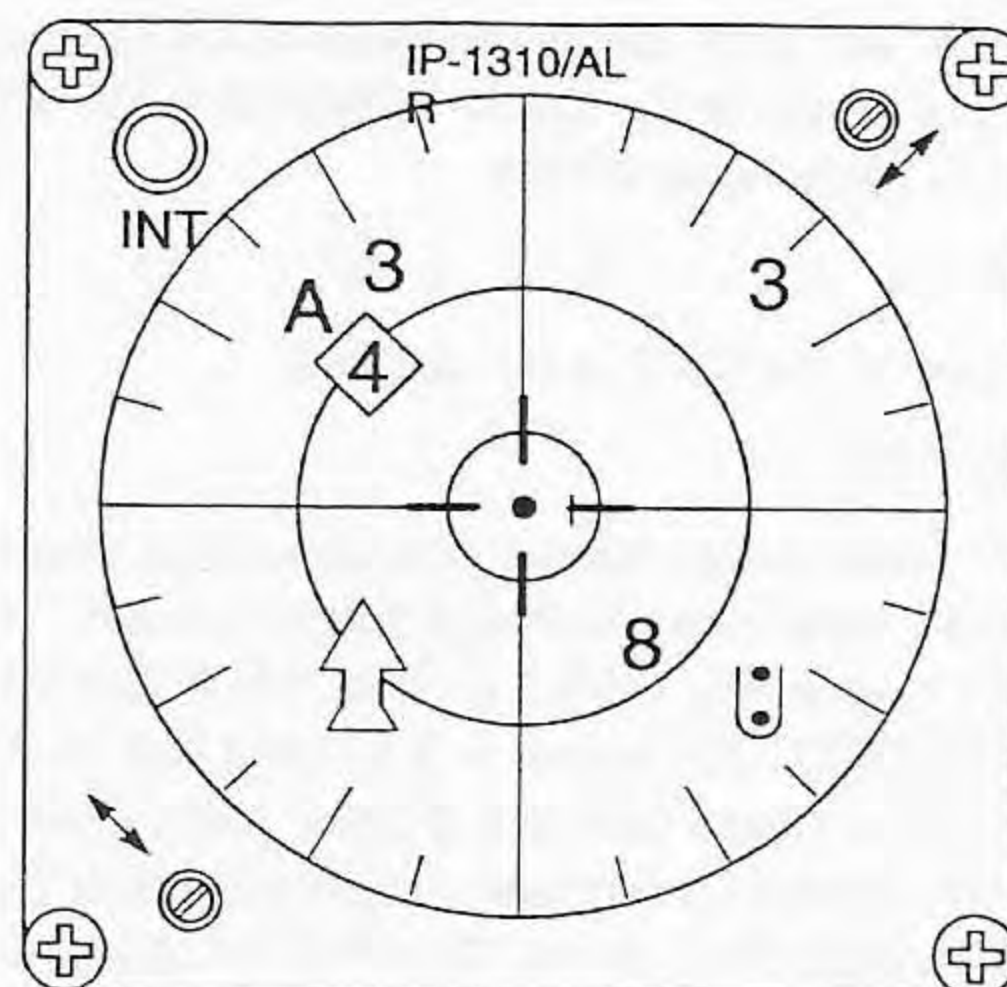
UNKNOWN FUNCTION

1A-10A-34-1-1G-1-53B-1-BCC1

Figure 1-68. AN/ALR-69(V) Radar Warning Systems Azimuth Indicator
Functional Displays (Sheet 1 of 2).

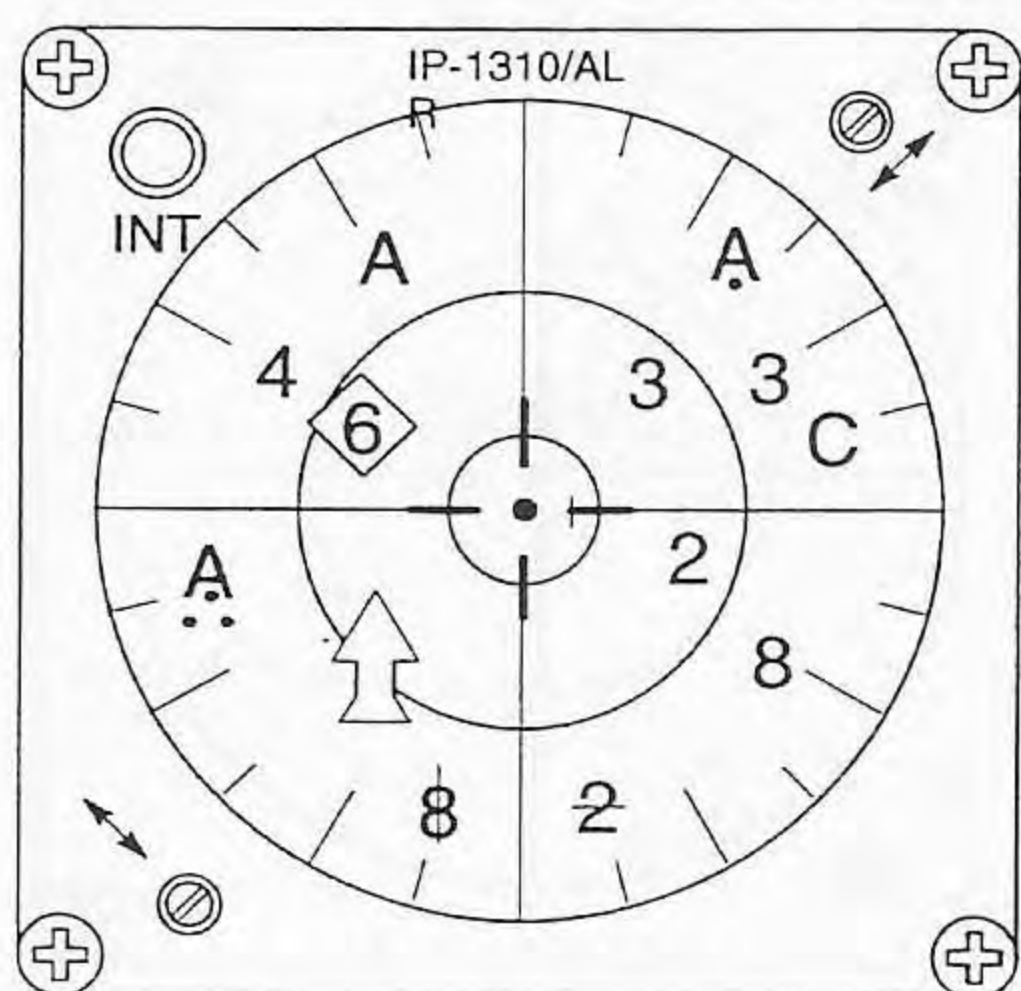


TARGETS COLLOCATED

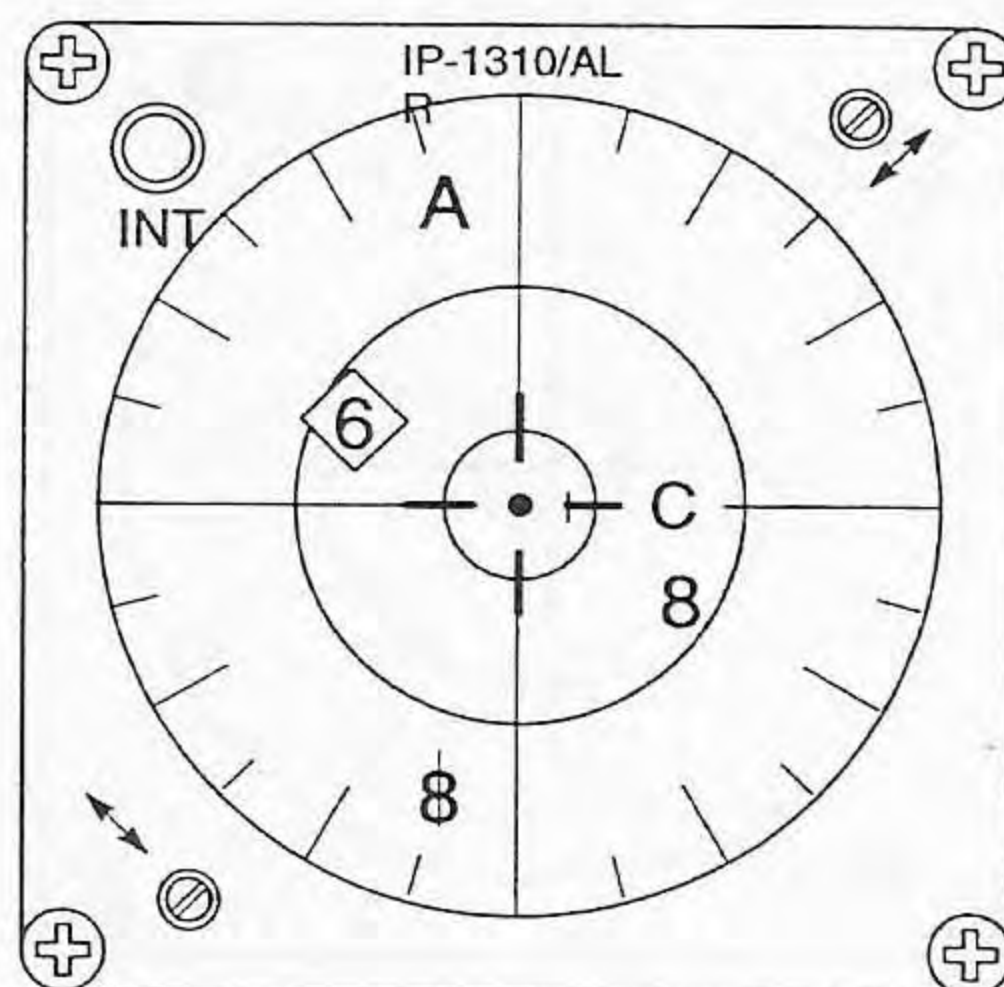


TARGETS SEPARATED

TARGETS SEPARATE FUNCTION



OPEN MODE



PRIORITY MODE

MODE FUNCTION

1A-10A-34-1-1S-1-53B-2-BCC1

Figure I-68. AN/ALR-69(V) Radar Warning Systems Azimuth Indicator Functional Displays (Sheet 2 of 2).

AN/ALR-69(V) RADAR WARNING MISSION DATABASE FILES

Threat File

This mission database table (MDT) or file contains land- and water-based surface-to-air missile systems, airborne interceptors, and land- and water-based AAA radars. The land file is selected at the CMSP (EWMU) in the RWR CONTROL menu using OSB 1.

Sea File

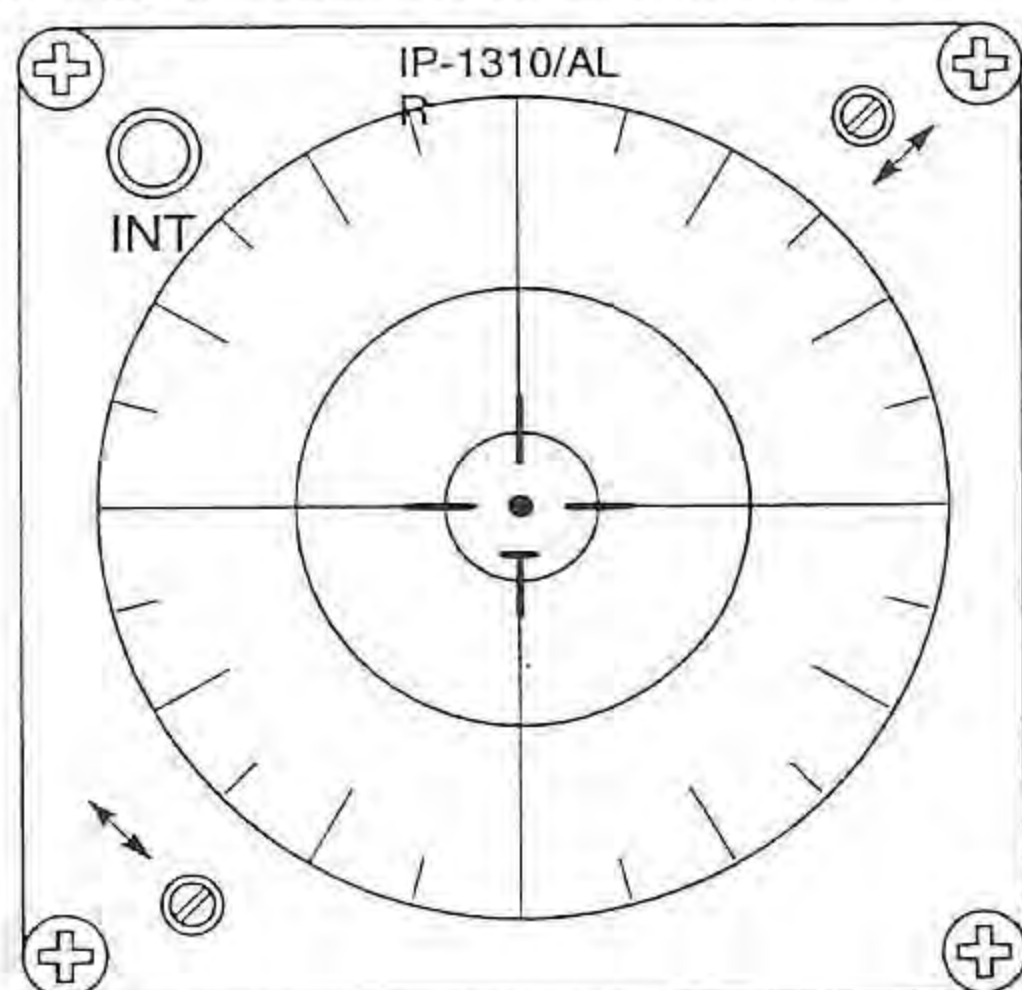
This portion of the MDT is not enabled.

Training File

The MDT file contains many threat simulators plus selected land-, water-, and air-based friendly radars. This file is selected by pressing OSB 3 on the CMSP (EWMU) in the EMBEDDED TRN menu. A T symbol will be displayed on the azimuth indicator (Figure 1-69) when in training file. System is returned to normal default (land) file by pressing OSB 3 on the CMSP (EWMU) in the EMBEDDED TRN menu a second time.

WARNING

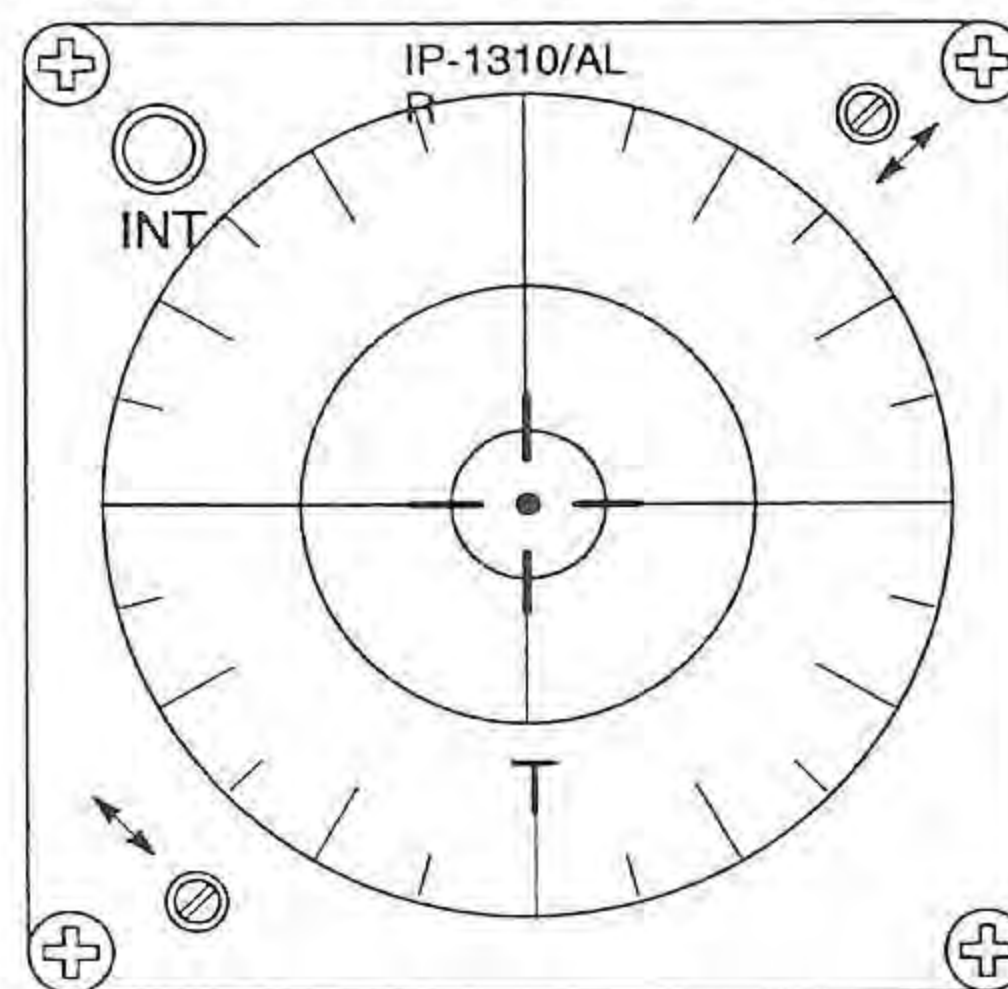
Training file shall not be used in combat.



THREAT FILE

AN/ALR-69(V) RADAR WARNING RECEIVER OPERATIONAL CHECKOUT

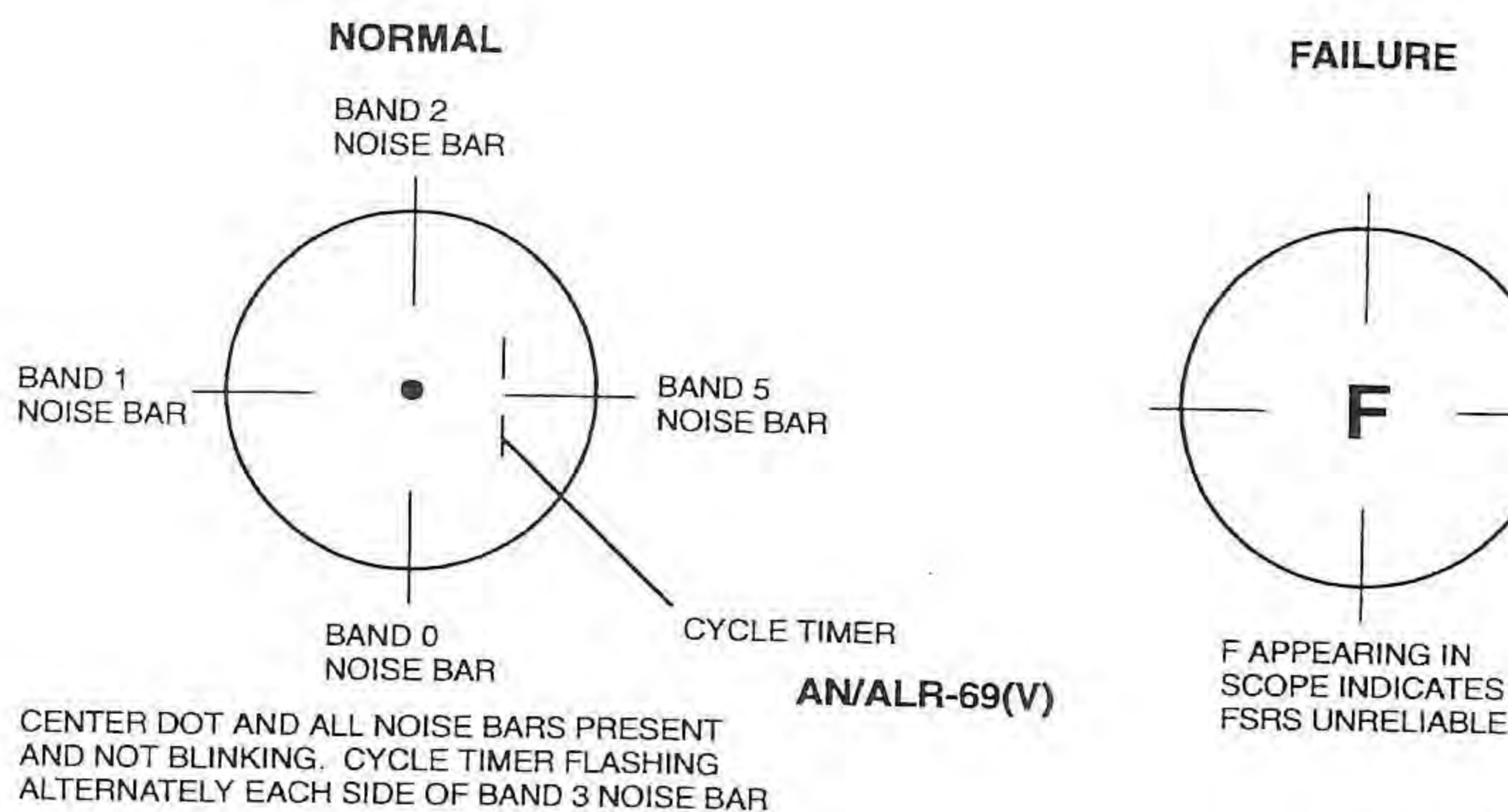
During auto self-test, a low frequency audio tone lasting approximately one second will be heard. If receiver or receiver controller failure occurs, an "F" symbol will appear at the center of the azimuth indicator and remain until fault is cleared. System self-test must be performed to determine if an actual fault exists in the system. An "F" symbol caused by an actual fault will remain displayed in the center of the azimuth indicator until the fault is cleared. An "F" symbol that is software generated will clear when system self-test is performed. Radar warning and health status displays are provided in Figure 1-70. Operator initiated self-test completes in 5 seconds and may be repeated as often as necessary to verify proper operation. Good self-test results are indicated by "OK" symbol. Operators should be familiar with self-test prior to test start. System test NOGO will be highlighted by flashing "BAD" symbol on azimuth indicator. Since the system continues to receive radar signals during self-test, radars operating in the vicinity may cause erroneous results. Maintenance (Extended Self-Test) gives an expanded display of system self-test detected faults and should be performed if an F appears at the end of system self-test or if a fault is indicated.



TRAINING FILE

1A-10A-34-1-1S-1-53C-BCC1

Figure 1-69. AN/ALR-69(V) Radar Warning Systems Health Status Displays.



1A-10A-34-1-1S-1-53D-BCC1

Figure 1-70. Radar Warning System Health Status Displays.

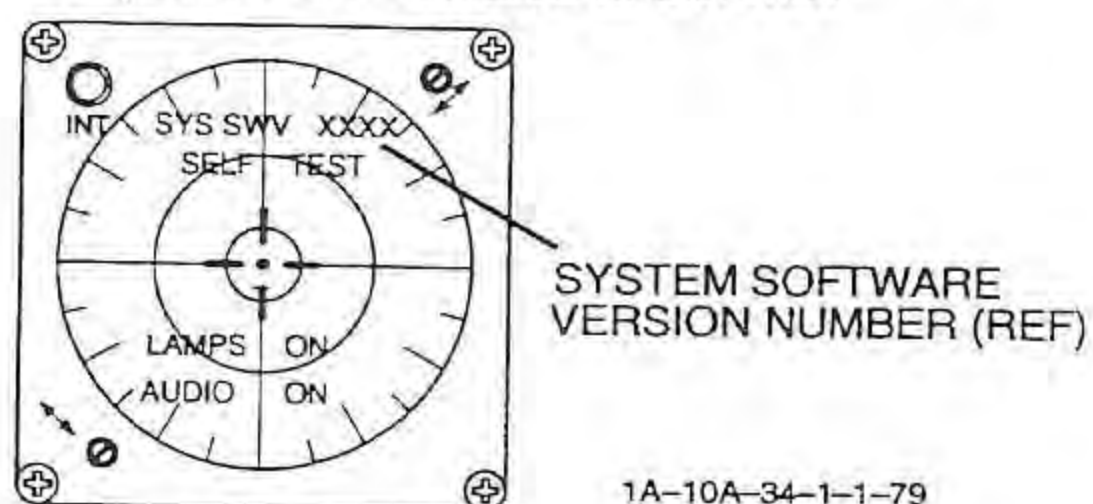
SYSTEM SELF TEST

1. On CMSP (EWMU), select SYSTEM TEST menu. Set audio to mid-range.
 - a. The RWR system is ready for self test when the CMSP (EWMU) displays RDY above RWR.
 - b. CMSP (EWMU) displays BIT above RWR when BIT is in progress.

NOTE

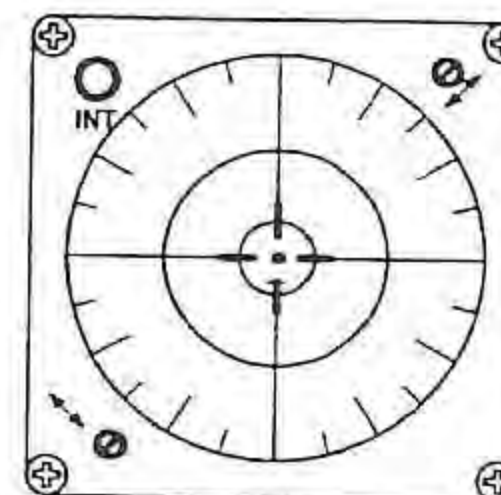
If RWR system select switch is moved from OFF to ON while OSB is depressed, the CMSP (EWMU) will enter an idle state for the RWR in order to enable load/verify function for reprogramming RWR OFP and EID files.

On CMSP (EWMU) SYSTEM TEST menu page 2, pressing OSB 2 (ERWR) initiates extended RWR BIT. At the A4 STATUS window of extended BIT, CMSC UNK button must be depressed and released to advance.



1A-10A-34-1-1-79

- c. Observe azimuth indicator show normal indication (noise bars only)
- d. After 10 seconds warm-up, observe noise bars only presentation on azimuth indicator.



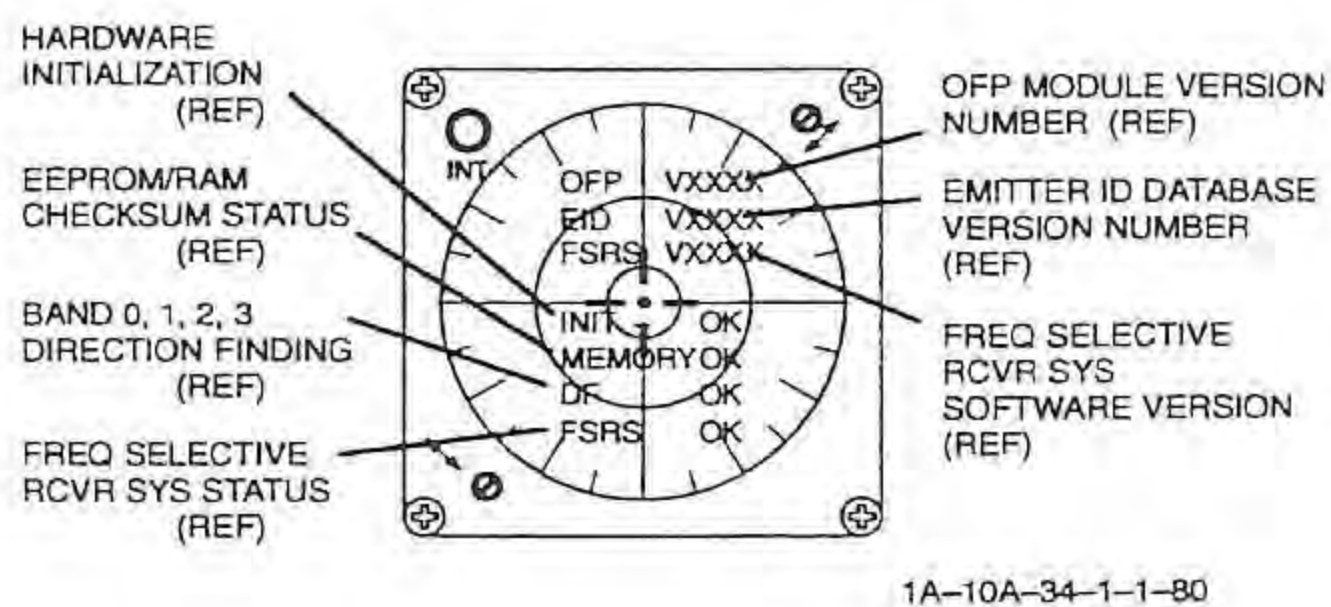
SOFTWARE RESTARTED
ALR-69 NORMAL
AZ INDICATOR DISPLAY
(TYPICAL)

1A-10A-34-1-1-78

2. At CMSP (EWMU), SYSTEM TEST menu, depress OSB 3 to initiate RWR system BIT.
 - a. Azimuth indicator flashes first screen showing version number, then advances to second screen.

T.O. 1A-10A-34-1-1

- b. Azimuth indicator flashes second screen indicating OFF, EID, and FSRS version number.



NOTE

System NOGO will be highlighted by a flashing "BAD" symbol on azimuth indicator.

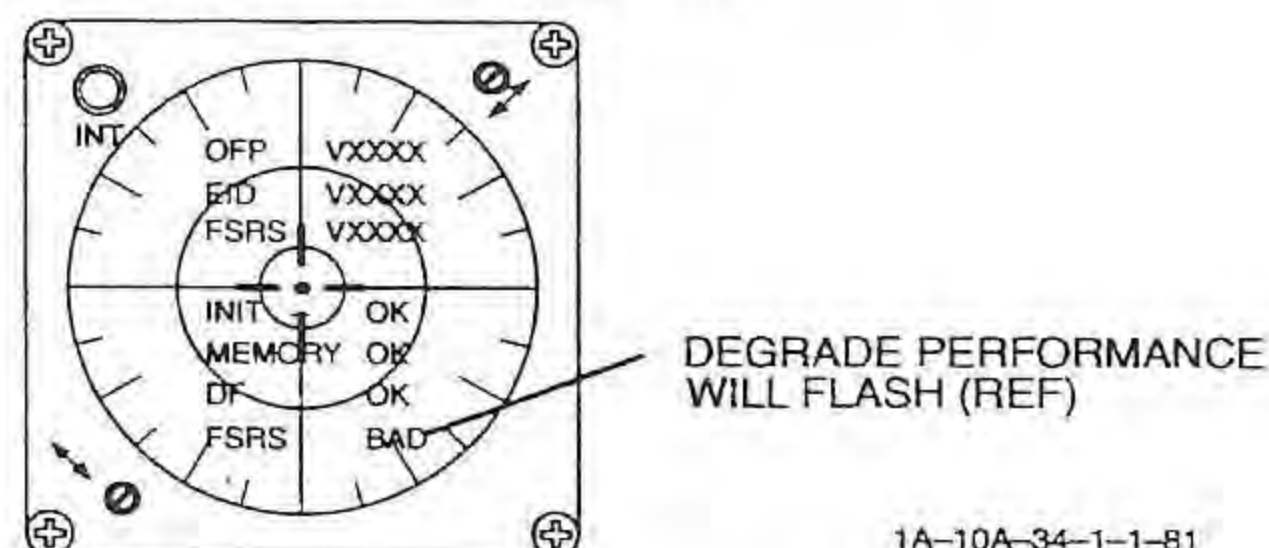
INIT summary provides hardware logic verification. CM-479, CCA A4, CCA A5, CCA A6, and CCA A8.

MEMORY summary provides CM-479 RAM check and EEPROM software load checksum status.

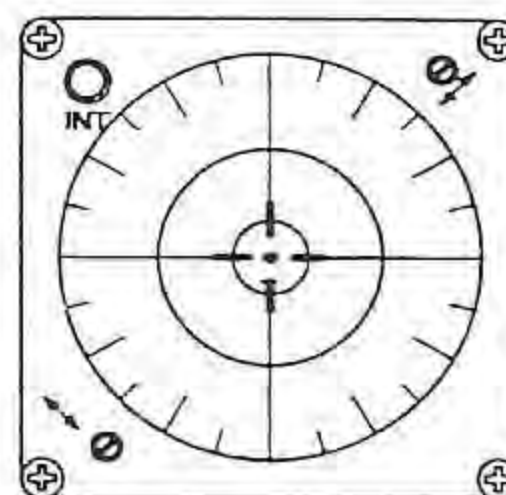
DF summary provides AM-6639/AM-6971 video/receiver status.

FSRS summary provides R-2094/C-10373 hardware, HSDB communication and software load checksum status.

If ERR is displayed on the CMSP (EWMU) SYSTEM TEST menu, an error was detected in the RWR system. [Refer to Countermeasures Set (CMS) for additional information.]



- c. Azimuth indicator displays normal screen (noise bars only)



SOFTWARE RESTARTED
ALR-69 NORMAL
AZ INDICATOR DISPLAY
(TYPICAL)

1A-10A-34-1-1-82

CHAFF/FLARE DISPENSING SYSTEM 138

The chaff/flare dispensing system is an integrated part of the CMS (EWMS) and is referred to as the Countermeasures Dispensing System (CMDS). The CMDS provides a means of deploying expendable chaff and flare payloads against radar and infrared controlled threats, respectively. This is accomplished by ejection of track-break chaff or infrared decoy flares from 16 internally mounted dispenser units. Each dispenser consists of a housing, which is loaded with a magazine containing either 30 chaff or 30 flare cartridges or 15 flare cartridges. All magazines are interchangeable. The CMDS consists of the following components:

- Countermeasures Signal Processor CMSP (EWMU)
- Countermeasures Set Control CMSC (EWPI)
- Payload dispensing buttons
- Safety switches
- Chaff single/double switch (No Function)
- Sequencers
- Chaff/flare dispensers

COUNTERMEASURES SIGNAL PROCESSOR CMSP (EWMU)

The CMSP (EWMU) (Figure 1-71) is part of the Countermeasures Set CMS (EWMS). The CMSP (EWMU) located on the right console, contains the controls and indicators for selecting quantity and intervals of burst and salvos for all chaff/flare payloads as determined by the parameters of the CMSP (EWMU) Mission Data File (MDF). [For additional information, refer to Countermeasures Set (CMS).]

COUNTERMEASURES SET CONTROL CMSC (EWPI)

The CMSC (EWPI) (Figure 1-71) is part of the Countermeasures Set CMS (EWMS). The CMSC (EWPI) is located on the main instrument panel and provides a display of the chaff and flare payloads remaining, an indication that dispensing is occurring (a flashing diamond), a lower limit indication when the preset lower limit number of payloads is reached (the letter L), and a single character indication of the CMS (EWMS) master mode of operation. [For additional information, refer to Countermeasures Set (CMS).]

PAYLOAD DISPENSE BUTTONS

The payload dispense buttons (Figure 1-71) are located on the forward face of the left and right throttles. Actuation of

the buttons initiates chaff and/or flare dispense programs that are pre-loaded in the CMSP (EWMU) by maintenance personnel and selected by the pilot.

SAFETY SWITCHES

A safety switch (Figure 1-72) is located in each wheel well. The safety switches are located in the main landing gear pod. The safety switches provide for the safing of the dispensers. A safety pin is inserted into the switch to interrupt the firing voltage to the dispensers for ground operations to preclude inadvertent chaff/flare dispensing. Installation of the inboard safety pin in the landing gear pod will safe both the inboard and outboard dispensers on that wing.

SEQUENCERS

The sequencers (Figure 1-72) are located in each main landing gear pod and wing tip. A sequencer is provided for each dispenser station. The sequencers perform payload inventory, monitor misfires, accomplish jettison, and dispense expendables in accordance with signals sent by the CMSP (EWMU). Each sequencer accepts independent chaff, flare, other1, other 2, dispense commands over a special serial digital sequencer link and provides sequenced power to each of the firing pins in the associated station dispenser. The aircraft is certified to dispense 1-inch by 1-inch chaff cartridges and 1-inch by 1-inch and 1-inch by 2-inch flare cartridges. Digital address selectors are present on the outside of each sequencer. These are set by maintenance and are not pilot selectable.

CHAFF/FLARE SELECT SWITCHES

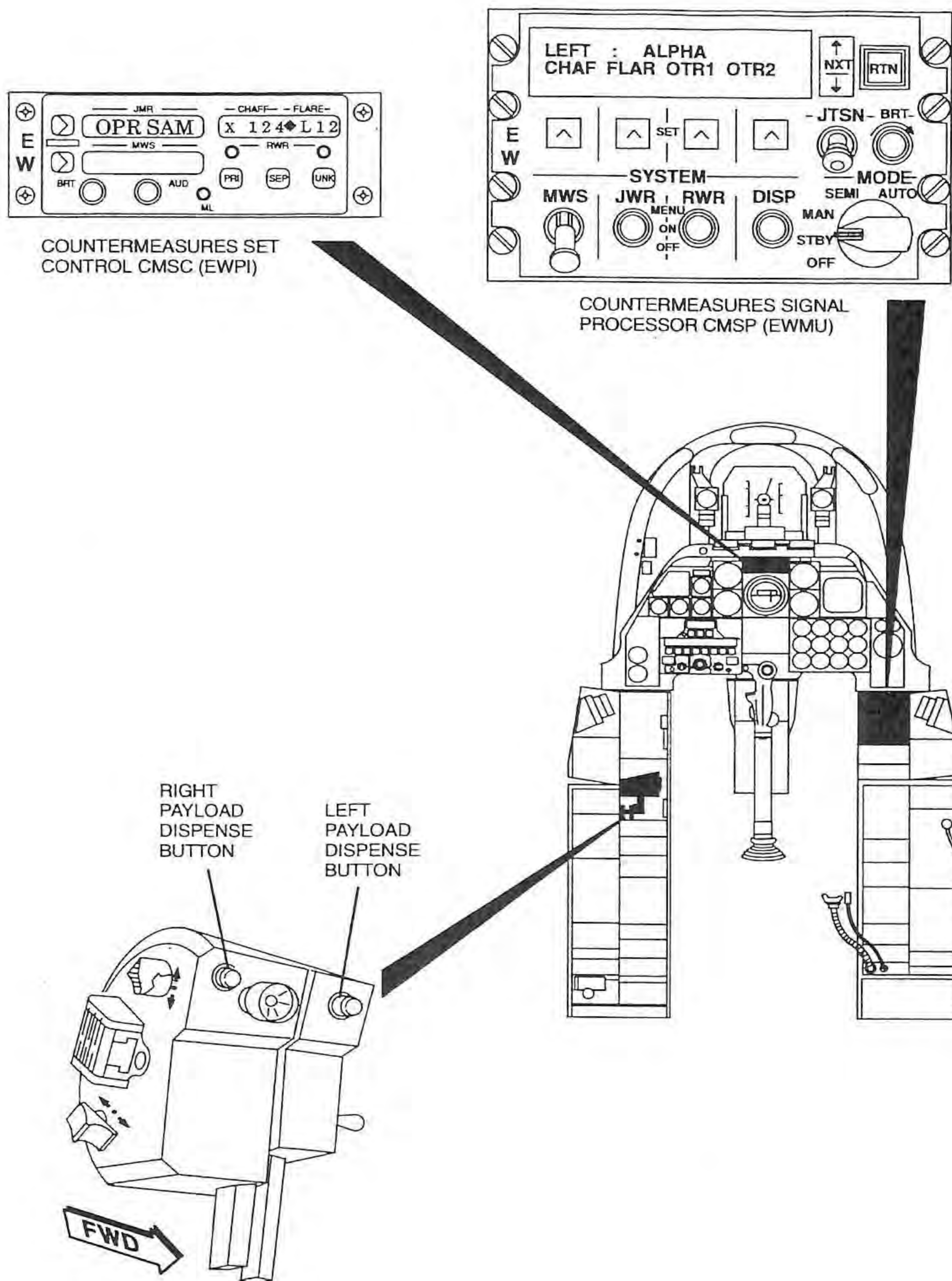
Two select switches (A and B) (Figure 1-72) are located at each wing tip and each main landing gear pod. Switch A controls the circuitry for A1 and A2 dispensers; switch B controls the circuitry for B1 and B2 dispensers. The switch positions are C for chaff and F for flare and each switch is set to match the type payload installed in the two dispensers controlled by the switch are set by maintenance personnel.

NOTE

CMS (EWMS) uses different station identifications. See Figure 1-74.

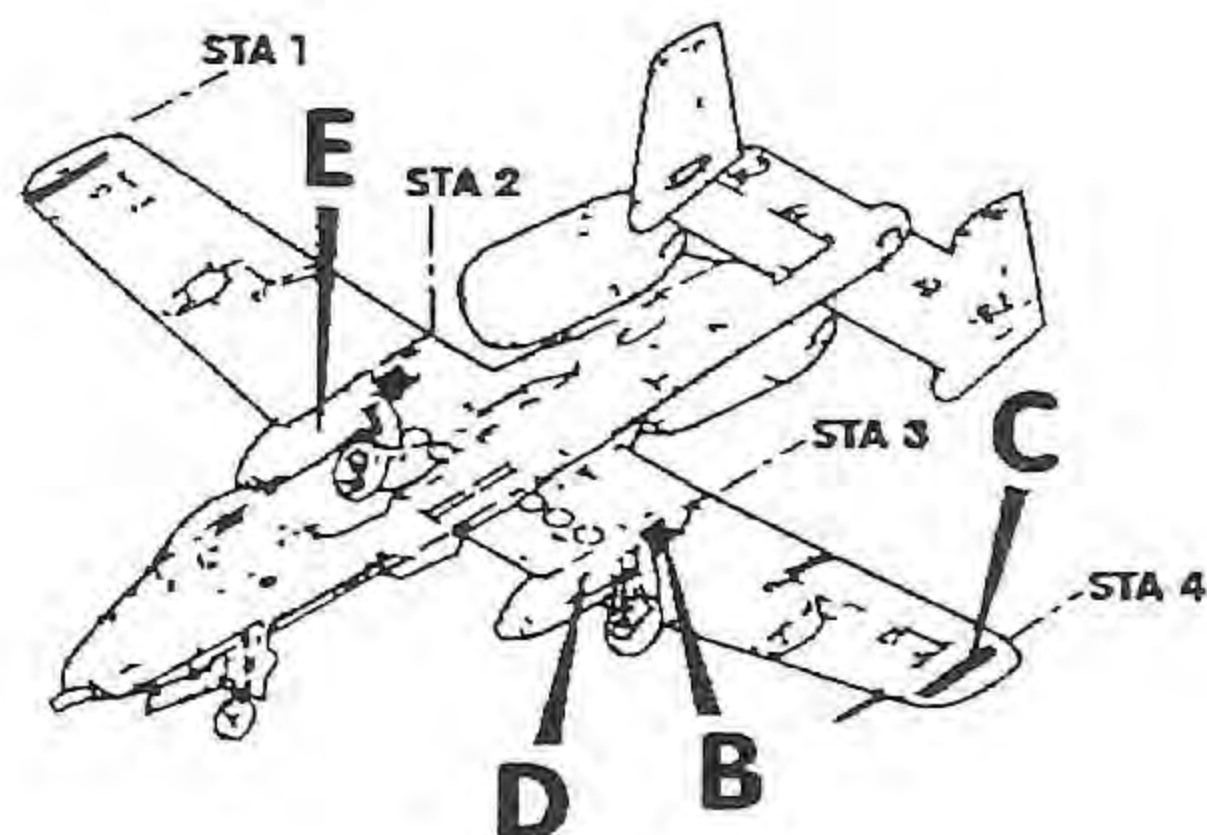
Chaff Single/Doubles Switch

The CHAFF SINGLE/DOUBLE switch (Figure 1-72) is located in the left main landing gear pod. The switch is inactivated and no longer used by the chaff/flare system.

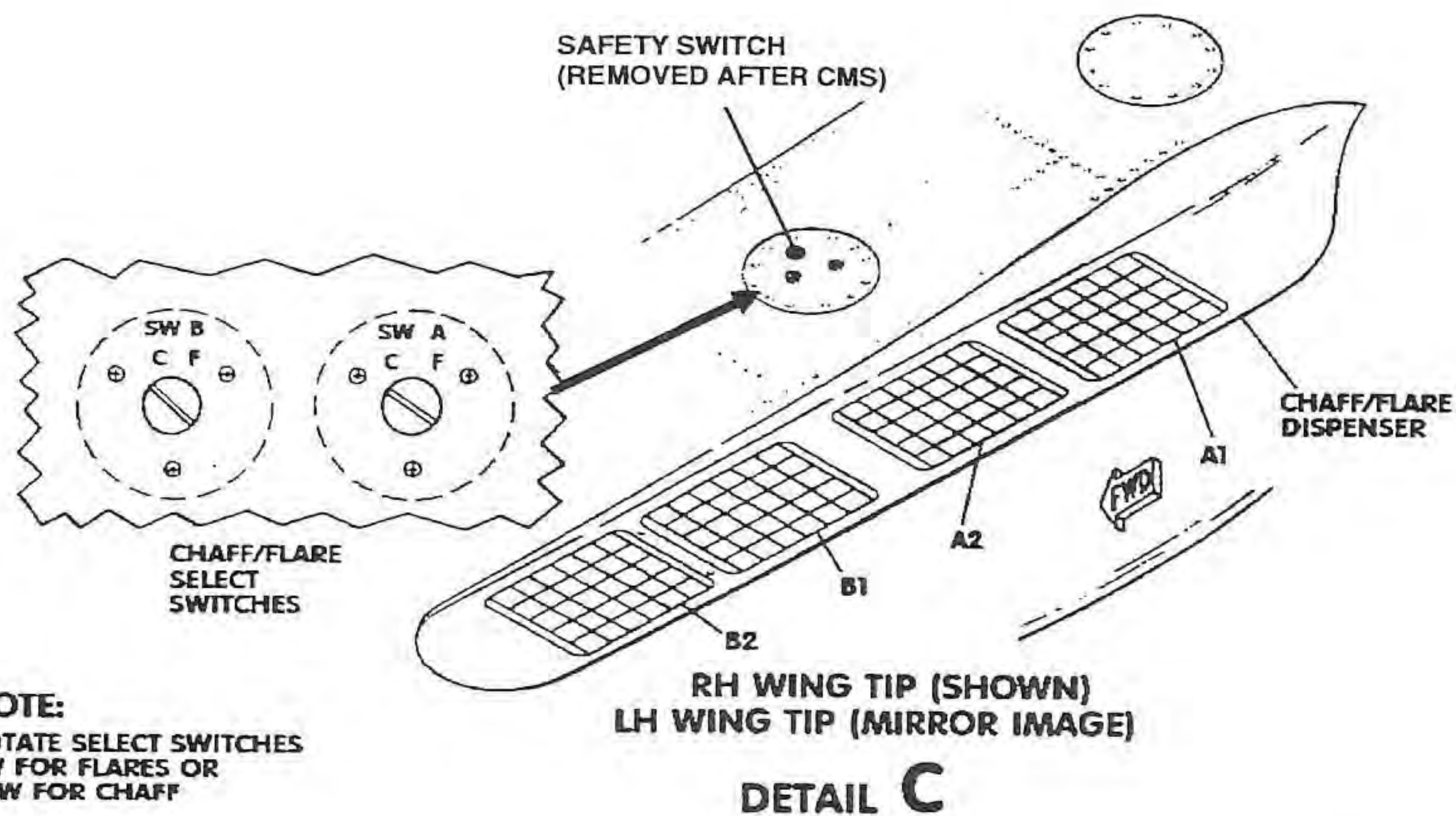
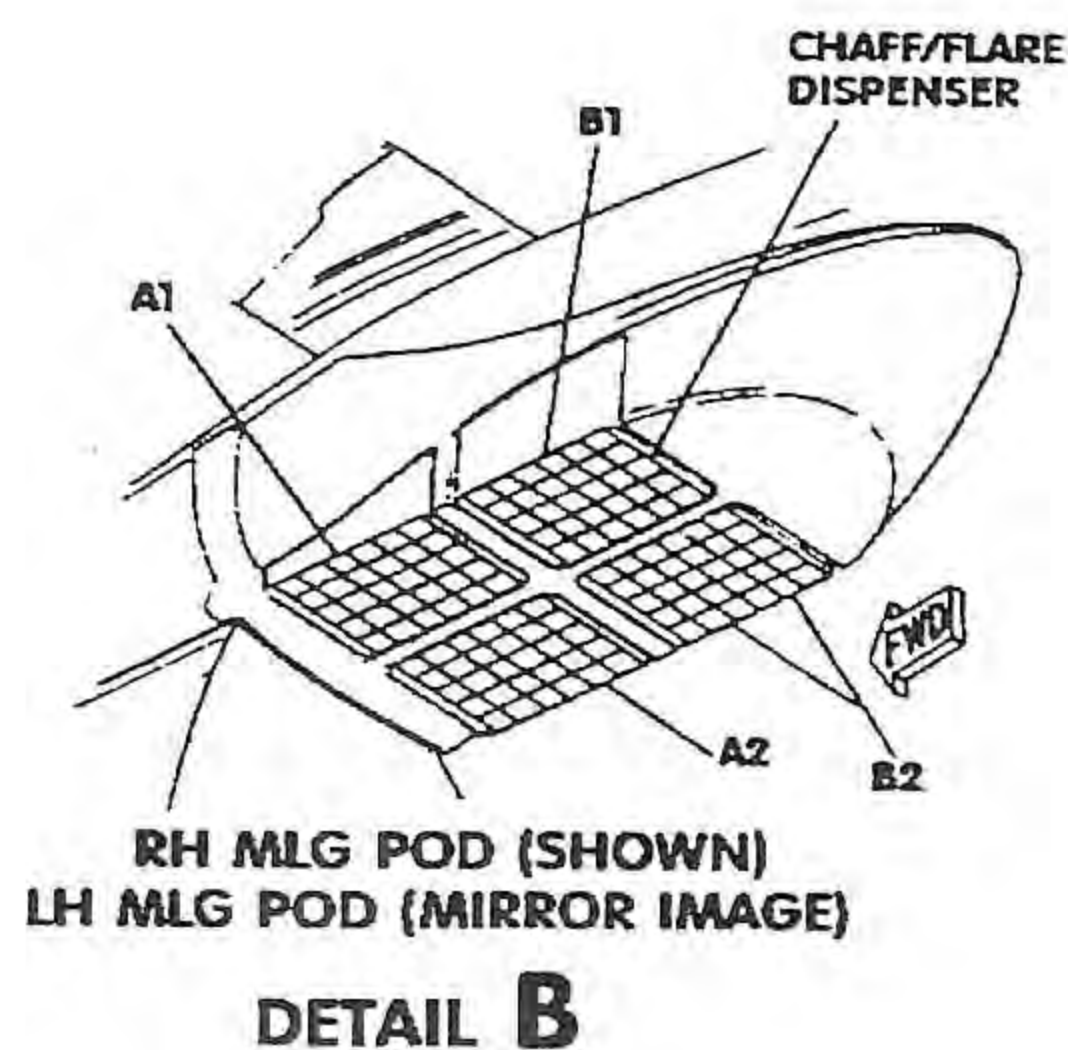


1A-10A-34-1-1S-1-53E-BCC1

Figure 1-71. Chaff/Flare Dispensing System Controls and Indicators.



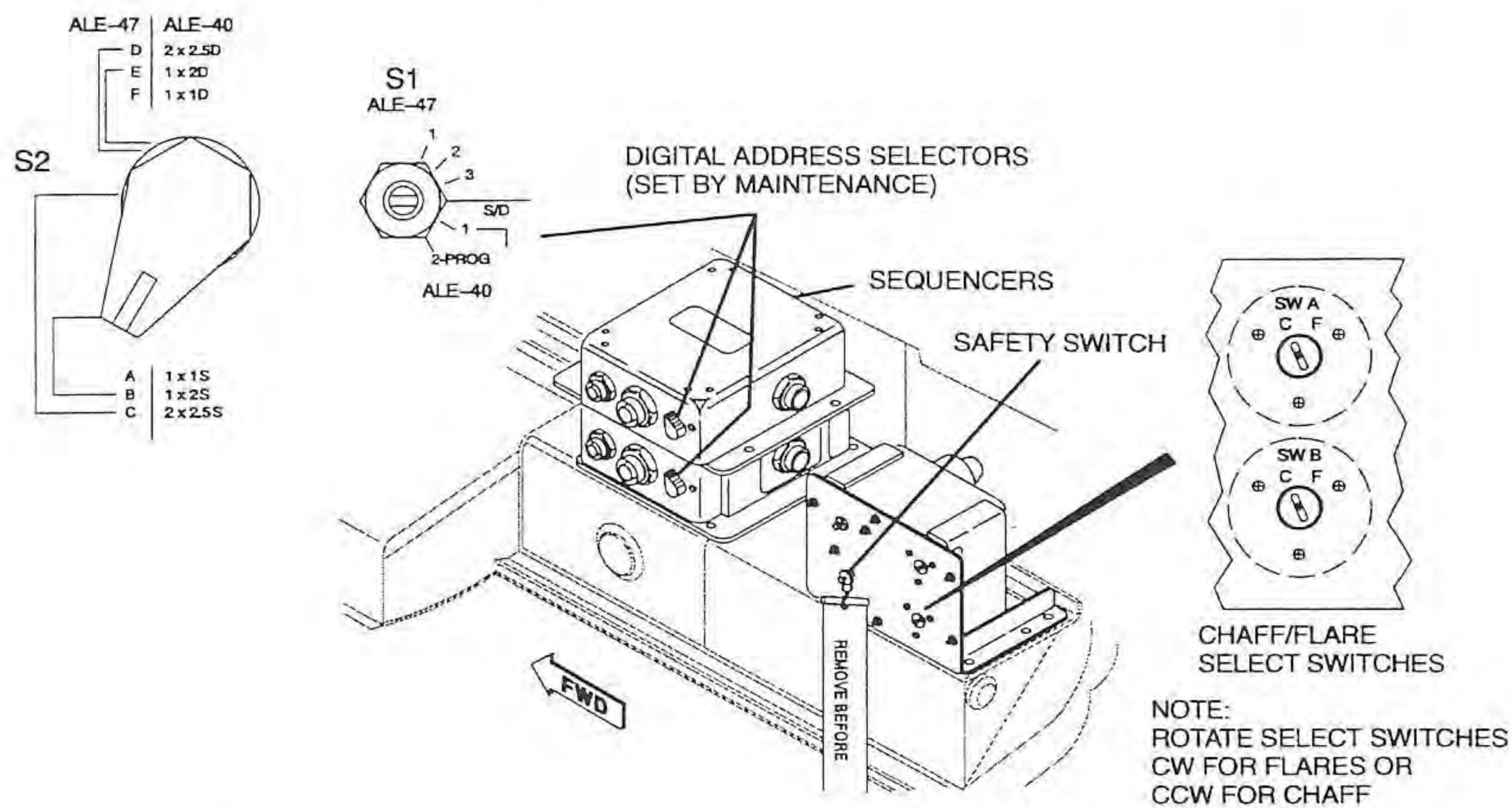
NOTE:
CMS (EWMS) USES
DIFFERENT STATION
IDENTIFICATIONS.
SEE FIGURE 1-74.



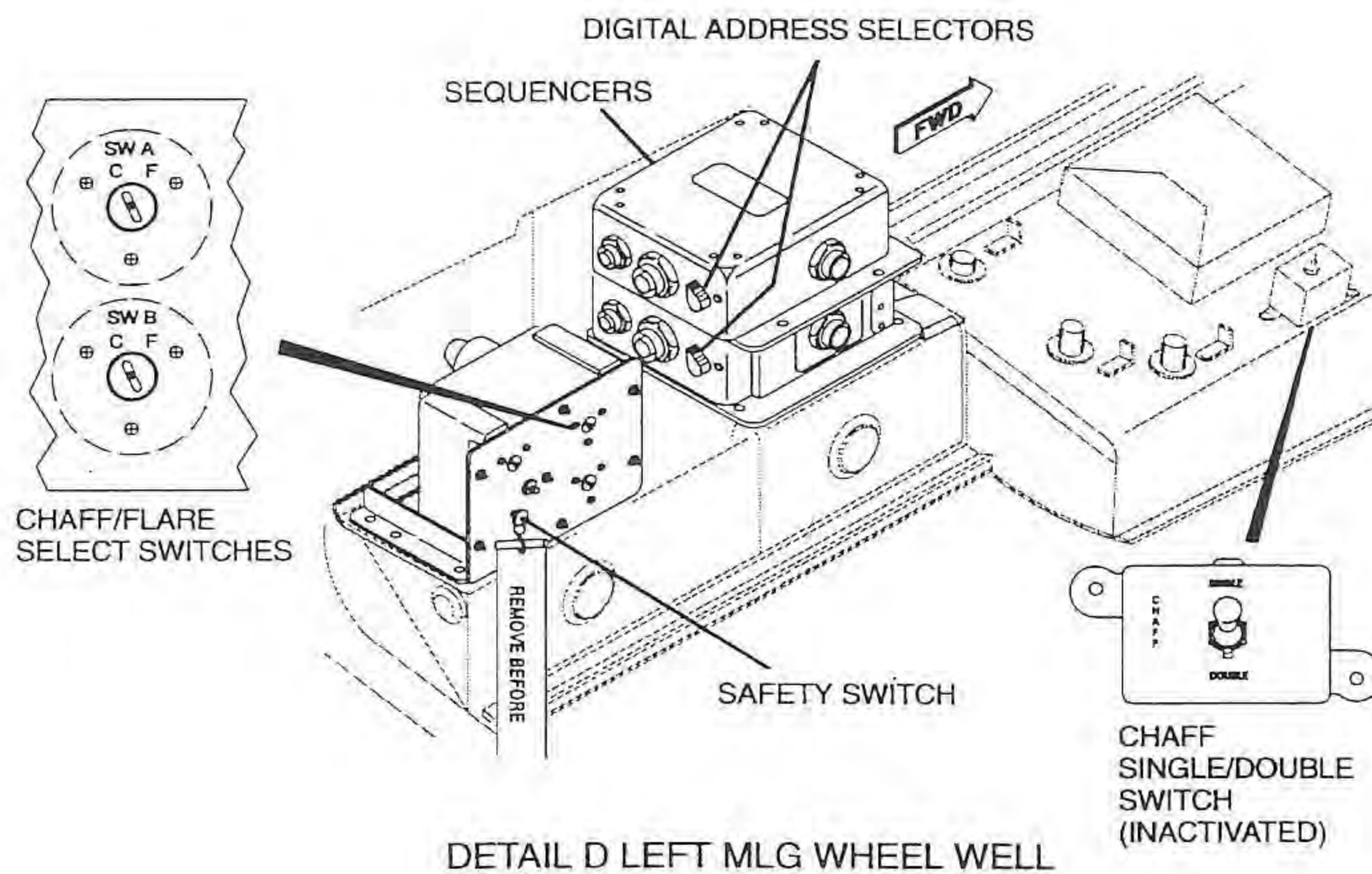
NOTE:
ROTATE SELECT SWITCHES
CW FOR FLARES OR
CCW FOR CHAFF

1A-10A-34-1-1-B4

Figure 1-72. Chaff/Flare Dispensing System Components (Sheet 1 of 2).



DETAIL C RIGHT MLG WHEEL WELL



DETAIL D LEFT MLG WHEEL WELL

1A-10A-34-1-1-1-53F-2-BCC1

Figure 1-72. Chaff/Flare Dispensing System (Sheet 2 of 2).

Chaff/Flare Dispensers

There are four chaff /flare dispensers (Figure 1-74) located in each main landing gear pod and each wing tip. The MJU-11/A magazine has provisions to carry (30) 1 inch by 1 inch chaff (RR-170A/AL) or flare (M-206) cartridges. The MJU-12/A magazine has provisions to carry (15) 1 inch by 2 inch MJU-7 flare cartridges. To specifically identify the type of cartridge loaded in the magazine, the following may be observed at the bottom of the magazine: the bottom end of the chaff cartridges have brown end caps, and the bottom end of the flare cartridges have an F placarded on a red end caps. The cartridges are retained in the magazine with a retaining plate.

CMDS Release Sequence And Loading

The CMDS release sequence is MDF dependent. Release logic circuitry of the chaff/flare sequencers does not permit chaff/flare mixing within the A and B positions. For example, full chaff magazine in A1 (3A) cannot be loaded with a full flare magazine in A2 (3B) on any single station. If partial loads are required, empty magazines are installed.

NOTE

Each of the four dispensers of each station must have as a minimum, an empty magazine installed. If a magazine cannot be installed in a particular station, the entire station should be downloaded and a cover panel installed.

CMDS Operation

The CMDS operation is controlled by the CMS (EWMS). The CMSP (EWMU) is the processing unit for the CMDS. The CMSP (EWMU) is pre-programmed with up to 16 dispense program routines by maintenance personnel using the EW bus 1553 load port. The programmed dispense routines and the lower limits are stored in the CMS (EWMS) Mission Data File (MDF).

When the aircraft is airborne with the landing gear handle up, the system can be armed by setting the DISP switch on the CMSP (EWMU) to ON and the MODE selector switch to MAN, SEMI, or AUTO.

NOTE

With landing gear handle in the down position, CMDS operation can be accomplished by placing the armament ground safety override switch to O'RIDE.

CMDS status is displayed on the CMSC (EWPI). CMDS status can also be displayed on the CMSP (EWMU) by setting the DISP switch to MENU. The CMSP (EWMU) will then enter the DISP rotary. The DISP rotary allows the display of the PAYLOAD STATUS menu. At the PAY-

LOAD STATUS menu, payload category can be enabled or inhibited using the Option Select Button below the display field. The PAYLOAD STATUS menu also displays the payload inventory for chaff and flare if they are enabled. The CMSP (EWMU) uses a different designation for dispenser station position identification. Refer to Figure 1-74 for dispenser station identification. If payload category has reached a pre-set lower limit, the top line of the display will indicate the quantity remaining preceded by the letter L. The DISP rotary also allows display of the LEFT SW MANUAL and RIGHT SW MANUAL menus. Each of these menus time-out to the PAYLOAD STATUS sub-menu that displays the payload dispense routine for the left or right payload dispense button. The dispense routine stored in MDF can be scrolled through using the OSB below the display field. If a dispense routine other than the routine displayed at the MAIN menu is to be, the CMS (EWMS) must be left in the MANUAL SW menu.

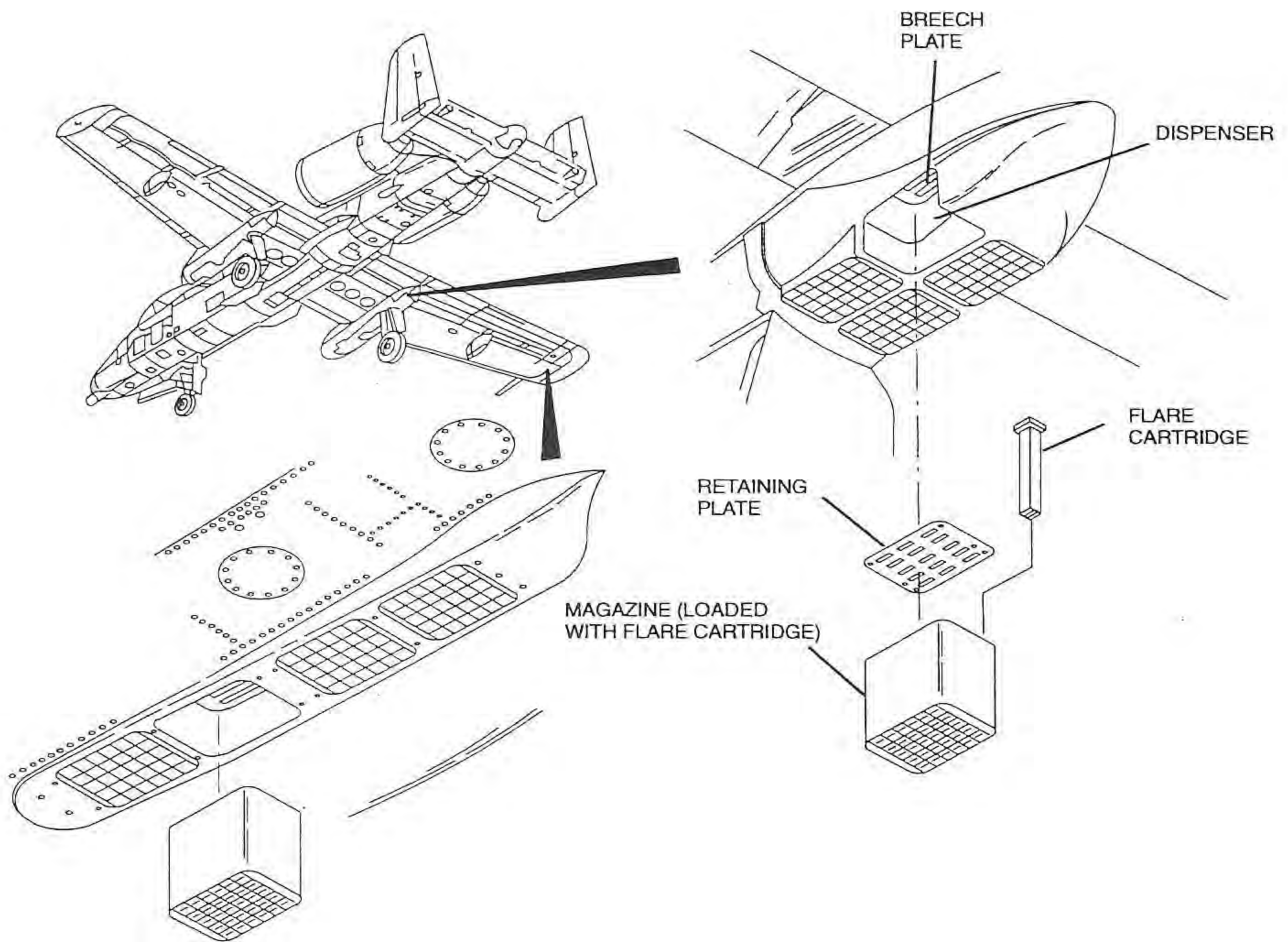
The dispenser loading can be checked by pressing the NXT switch on the CMSP (EWMU) from the PAYLOAD STATUS menu until DISP LOADING ? is displayed. The CMSP (EWMU) will time-out to the DISP LOADING menu. At the DISP LOADING menu, the payload inventory can be updated, each magazine loading can be viewed, and each magazine payload continuity can be checked.

The DISP rotary also provides a DISP SUB-MODE ? menu. The DISP SUB-MODE ? menu times out to a menu that allows selection of the CMDS response for jettison and test using the OSB below the display field to select either JETTISON SETUP ! menu or TEST MODE SETUP ! menu. The JETTISON SETUP ! menu allows enable or inhibit of chaff and flare payloads using the OSB below the display field. The TEST MODE ! menu allows selection of NORMAL or TEST mode using the OSB below the display field. The TEST MODE SETUP ! menu also allows dispense trigger test indication in the display field above OSB3. Dispense trigger test indications can be blank (no dispense switches active), LFT (left payload dispense button activated), RGT (right payload dispense button activated) and MLT (both payload dispense buttons activated).

If the CMSP (EWMU) MODE switch is set to any position other than OFF, power is supplied to the CMDS. The weight-on-wheels switch interrupts firing voltage to the dispensers preventing inadvertent chaff/flare dispensing on the ground.

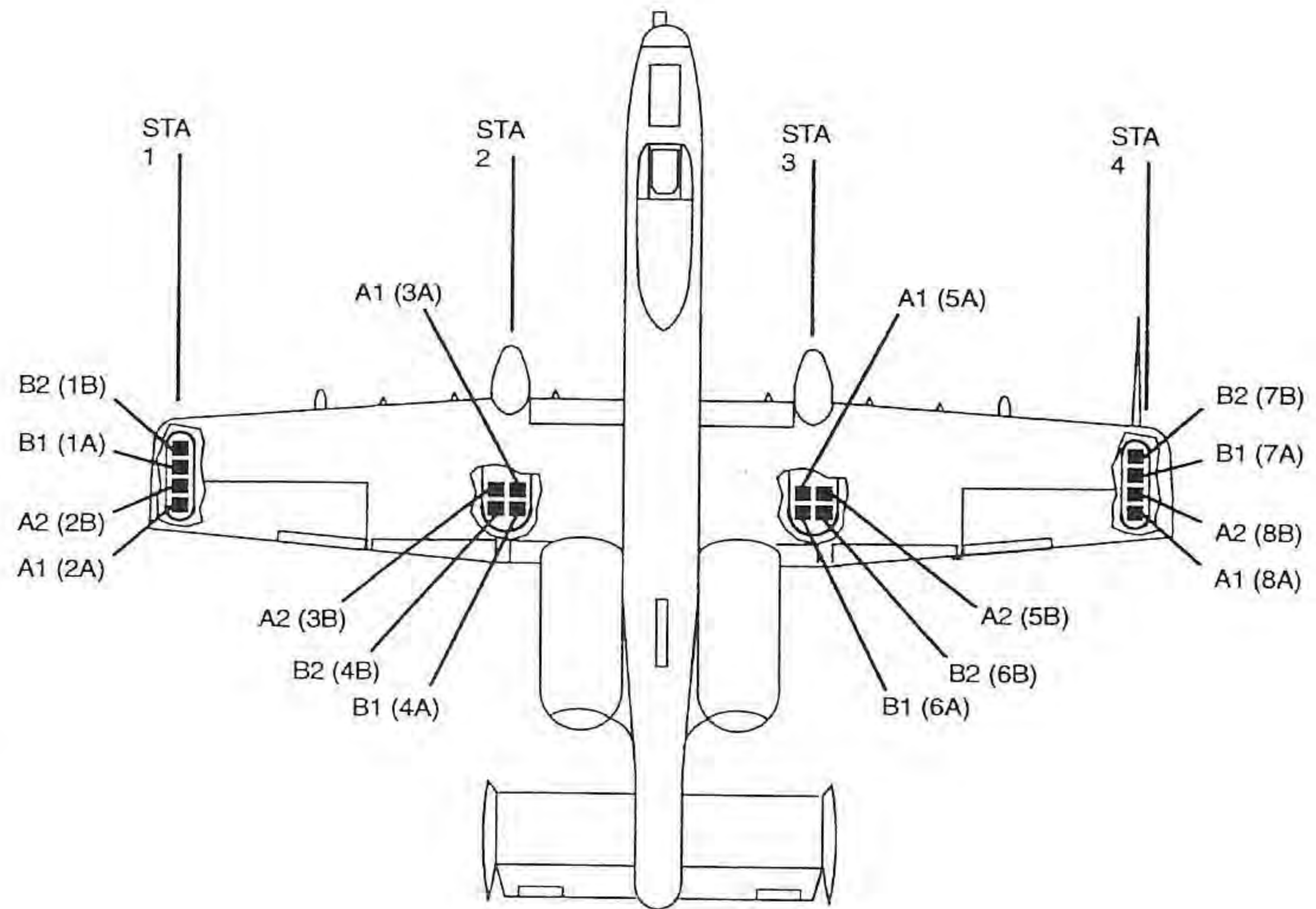
NOTE

With landing gear handle in the down position, CMDS operation can be accomplished by placing the armament ground safety override switch to O'RIDE.



1A-10A-34-1-1S-1-53G-BCC1

Figure 1-73. AN/ALE-40(V) Magazines and Cartridges



VIEW LOOKING DOWN

NOTE 138

NUMBERS IN PARENTHESIS
REPRESENT THE STATION
IDENTIFICATION USED BY THE
EWMS/CMS.

STORES	RELEASE SEQUENCE (STATIONS)
RR-170 A/AL CHAFF CARTRIDGE (SINGLE)	1, 4, 2, 3
RR-170 A/AL CHAFF CARTRIDGE (DOUBLE)	1 AND 4, 2 AND 3
M-206 FLARE CARTRIDGES	3, 2, 4, 1
MJU-7 FLARE CARTRIDGES	3, 2, 4, 1
NOTE: EACH STATION WILL RELEASE ITS STORES IN THE ORDER A1, A2, B1, B2	

1A-10A-5-6

*Figure 1-74. Chaff/Flare Dispensing System Release Sequence
and Dispense Station (DS) Identification.*

During normal operations each actuation of the left and/or right payload dispense switch provides a dispense command signal to the CMSP (EWMU). The CMSP (EWMU) receives the signal and provides the appropriate dispense commands based on the selected dispense program to the appropriate sequencers. The sequencers provide a 20ms fire pulse to the squibs in the dispenser and fire the squibs. The CMSC (EWPI) displays a flashing diamond when a dispense program is occurring. The sequencer determines if the squibs have fired. If the squibs have fired, the sequencer decrements the CMSP (EWMU) and the CMSC (EWPI) counter displays. If the squib(s) do not fire, the sequencer sends a message to the CMSP (EWMU). The status and

inventory of the system can be checked at the CMSP (EWMU) DISP menu.

CMDS JETTISON FUNCTION

The CMDS provides the ability to jettison all chaff/flare payloads. Jettison is initiated using the JTSN switch on the CMSP (EWMU). Setting the switch to JTSN will provide 28 VDC from the left DC bus to the sequencers. The sequencers provide a 1/50 millisecond pulse to each of the squibs in the dispensers. Jettison of all chaff/flare payloads occurs at the rate of 20 per second until all payloads are jettisoned or the JTSN switch on the CMSP (EWMU) is set to OFF.

COUNTERMEASURES SET CMS (EWMS) 138

The CMS (EWMS) provides consolidated crew controls and indicators for the Electronic Warfare (EW) subsystems. The EW subsystems controlled by the EWMS include:

- Countermeasures Dispenser System (CMDSD)
- AN/ALR-69 Radar Warning Receiver (RWR)
- Electronic Countermeasures (ECM) jammer (JMR)(AN/ALQ-131 or AN/ALQ-184 JMR)
- Provisions for control of a Missile Warning System.

The CMS (EWMS) subsystem interface block diagram is provided in Figure 1-75.

CMS (EWMS) Components

The CMS (EWMS) consists of two cockpit control units, the Countermeasures Signal Processor CMSP (EWMU) and the Countermeasures Set Control CMSC (EWPI). The two units provide control of the integrated EW system. The CMS (EWMS) cockpit controls and indicators for operating the EW suite are the CMSP (EWMU), CMSC (EWPI), RWR azimuth indicator, left payload dispense button, and the right payload dispense button. All programmable functions are determined by the Mission Data File (MDF) software that is loaded by maintenance personnel into the system. Pilot interface to the system is via menus and groups of menus (rotaries). The CMS (EWMS) cockpit controls and indicators are provided in Figure 1-76.

Countermeasures Signal Processor CMSP (EWMU)

The CMSP (EWMU) (Figure 1-77) is the main EW pilot control panel and is the system computer. The CMSP (EWMU) front panel has controls for mode and system selection, operator select buttons for menu and program setup, and an alphanumeric display window. The CMSP (EWMU) provides real-time control of operation, mode selection, and management of each EW system including manual mode, semi-automatic mode, and automatic threat reactive functions for coordinated EW system response. It also provides command and control of the CMDSD system for dispensing countermeasures payloads.

Countermeasures Set Control CMSC (EWPI)

The CMSC (EWPI) (Figure 1-78) provides the EW system head-up indicator for EW notifications, warnings, and status displays. The CMSC (EWPI) front panel has prime controls for the JMR and the RWR, three alphanumeric display windows and three indicator lamps. All lamps are

dedicated to the RWR and the displays present overall system status, JMR menus, and Chaff/Flare payload remaining counts.

CMSP (EWMU) and CMSC (EWPI) Panel Lighting

Control of the CMSP (EWMU) and CMSC (EWPI) panel lights is accomplished using individual controls on the lighting control panel. The controls on the lighting control panel do not affect the intensity of the CMSP (EWMU) and CMSC (EWPI) display windows. The intensity of the CMSP (EWMU) and CMSC (EWPI) display windows is controlled by a separate control on each panel.

Left and Right Payload Dispense Buttons

The functions of the left payload dispense button and the right payload dispense button are variable in the CMS (EWMS). Each button actuates chaff and/or flare dispensing programs as selected by the pilot through the CMSP (EWMU).

CMS (EWMS) Subsystem Functional Interface

The CMS (EWMS) subsystem functional interface is described in the following paragraphs. All programmable functions are determined by the Mission Data File (MDF) software that is loaded by maintenance personnel into the system.

Countermeasures Dispenser System (CMDSD) DISP

The countermeasures dispenser system (CMDSD) is an integrated part of the CMS (EWMS). The CMDSD is enabled by the DISP switch on the CMSP (EWMU). The CMDSD includes countermeasures dispenser assemblies (DA), a new digital sequencer switch (DSS), and safety switches. The CMDSD provides multiple dispense modes for 4 different payload categories: chaff, flare, other-1, and other-2. The other -1 and other -2 categories are provisions for future payloads. Dispensing chaff and/or flare cartridges are determined by selection of a program stored in the CMSP (EWMU) MDF. The CMSP (EWMU) contains 16 manual dispense programs and a jettison program. A dispense program is a predetermined dispense response consisting of a specific quantity of payloads dispensed at specified intervals for a specified period of time to provide countermeasures effective against an associated threat type of category. The dispense and jettison programs are a part of the MDF. The MDF is capable of being revised or updated to meet changing threats. The CMS (EWMS) controls the eight dispenser stations containing up to 16 payload magazines equivalent to a maximum of 480 payloads of up to four different categories.

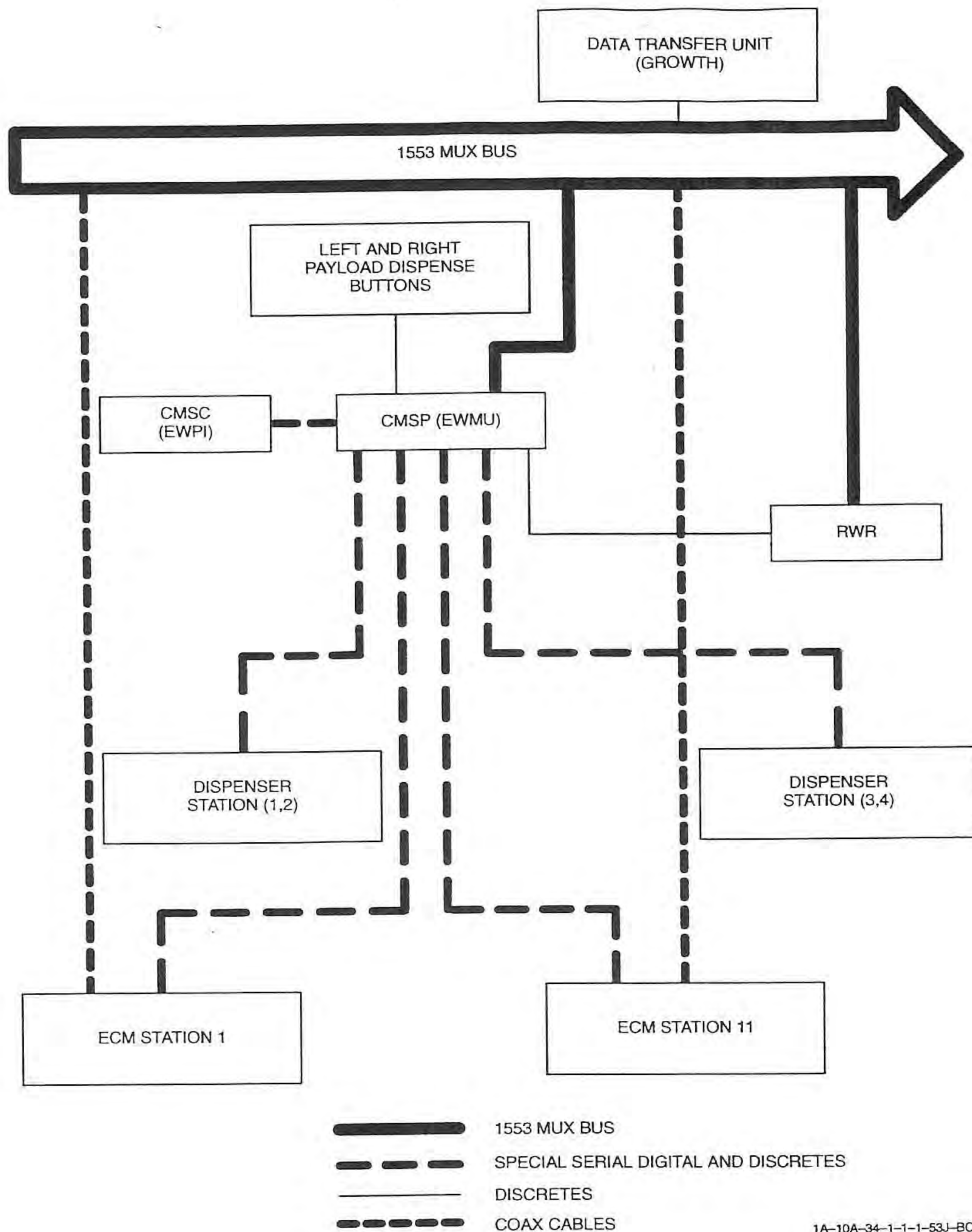
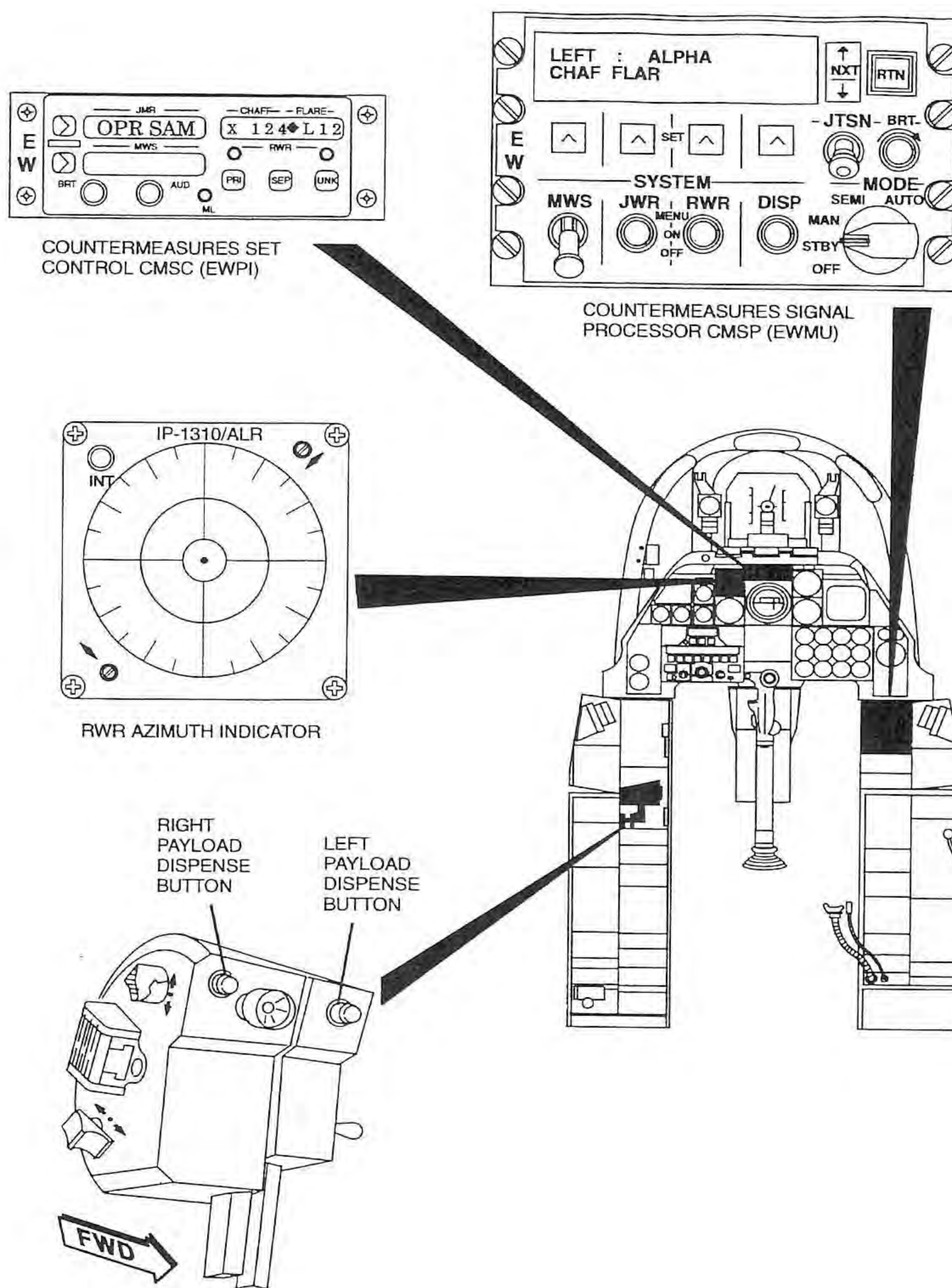
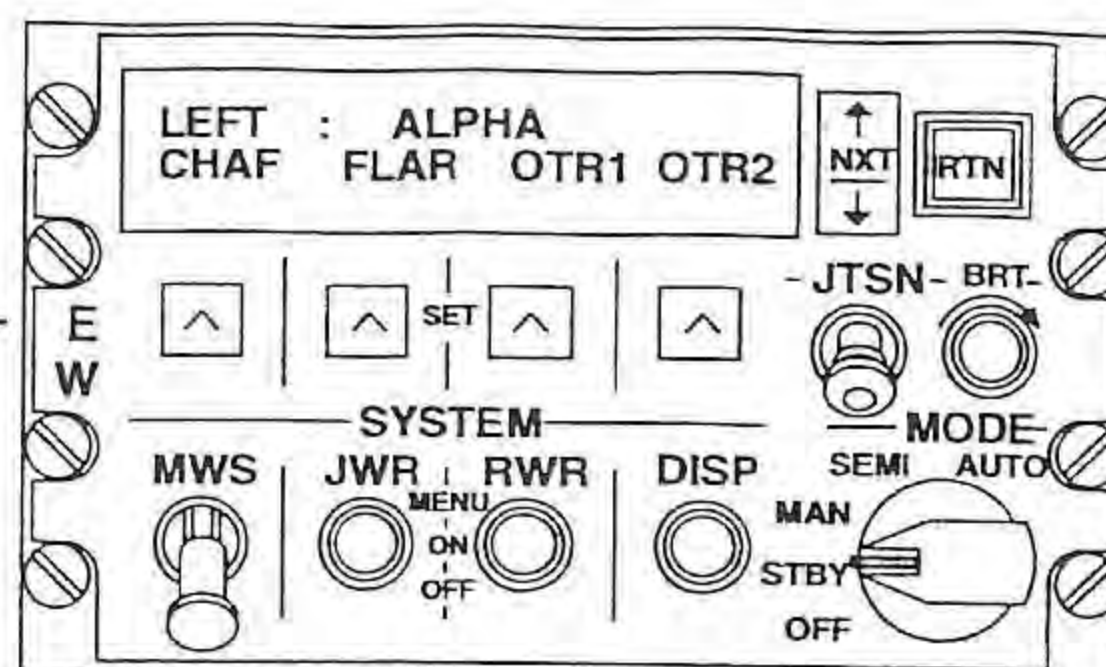


Figure 1-75. CMS (EWMS) Interface Block Diagram.



1A-10A-34-1-1S-1-53K-BCC1

Figure I-76. CMS (EWMS) Cockpit Controls and Indicators.

OPTION SELECT
BUTTONS

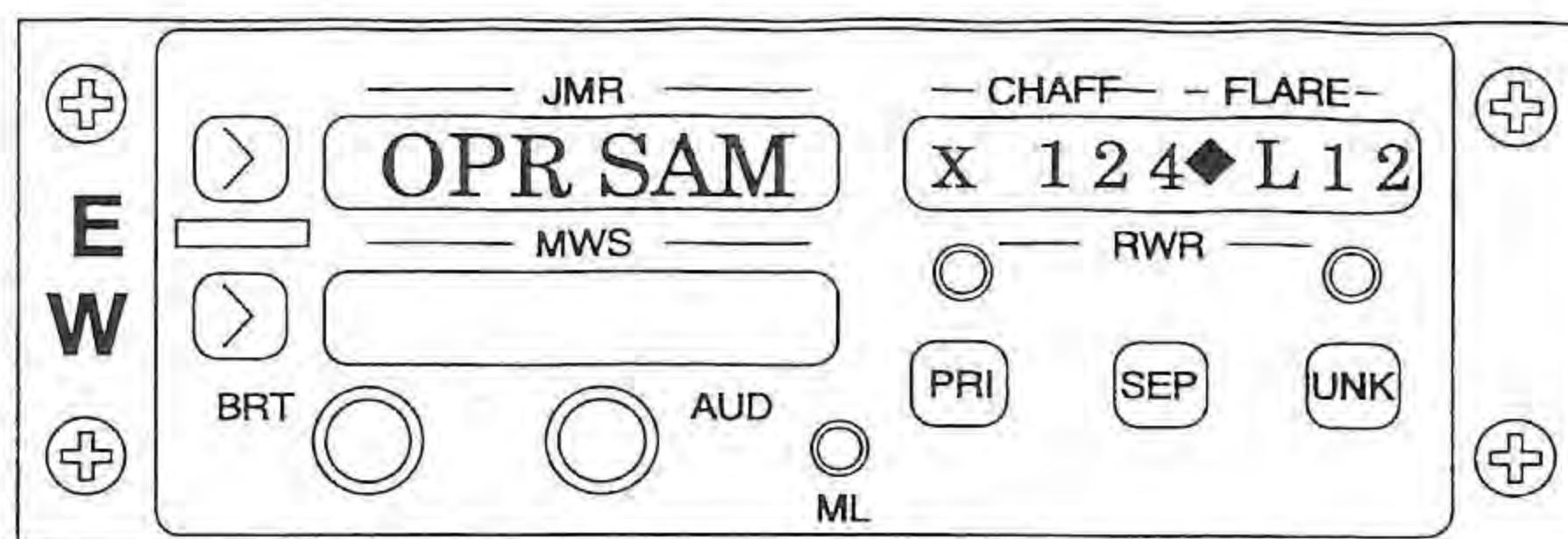
1A-10A-34-1-1S-1-53I-BCC1

CONTROL OR INDICATOR	POSITION OR DISPLAY	FUNCTION
MODE selector switch		Five position rotary switch that controls and selects the modes of operation.
	OFF	Removes power from the CMS (EWMS) except for the JTSN switch.
	STBY	NOTE Transition between OFF and ON position requires a pull-to-lock action. Selects the stand by mode of operation. Enables power to the EMWU/CMSP. The CMSP (EWMU) is fully functional except the DISP system is not armed and the JMR transmission is inhibited.
	MAN	Selects the manual mode of operation. On the ground the system will automatically go into the standby mode. In flight with the landing gear up, the system goes into the manual mode of operation.
	SEMI – Not currently programmed.	Selects the semi-automatic mode of operation when programmed. The semi-automatic mode enables the same functions as the manual mode except that the semi-automatic mode adds a semi-automatic threat response which requires pilot consent prior to dispensing.
	AUTO – Not currently programmed.	Selects automatic mode when programmed. The automatic mode allows all functions of the manual mode and enables an automatic threat response.
SYSTEM Switches – MWS, JMR, RWR, DISP	OFF	Removes power from individual subsystems.
	ON	NOTE Transition between OFF and ON position requires a pull-to-lock action. Applies power to the individual subsystems.

Figure 1-77. CMSP (EWMU) Controls and Indicators (Sheet 1 of 2).

CONTROL OR INDICATOR	POSITION OR DISPLAY	FUNCTION
	MENU	Momentary action switch that returns to ON. Activation causes system to enter applicable subsystem rotary.
Option Select Buttons (OSB)	Momentary actuation	Each OSB is used to control the one fourth of the field of the display located directly above the OSB. The OSBs are used to select functions/options in accordance with the menu or rotary as displayed above each button. For identification purposes, the OSBs are considered to be numbered as OSB1 through OSB4 from left to right.
NXT switch	Momentary actuation up or down	Used during rotary selections to scroll CMSP (EWMU) rotary and menu options.
RTN switch	Momentary actuation	Used at all menu levels to abort the current menu and return to the last selected MAIN rotary.
JTSN switch	JTSN	Two position pull-to-unlock switch that initiates rapid jettison of all MDF programmed EW payloads in flight regardless of MODE selector switch position including OFF.
Display	—	The upper part of the display provides 16 character alphanumeric readout menus, payload inventory, and pilot warnings. The lower part of the display provides 4-character alphanumeric displays of the function of the respective SET/OSB and displays individual data segments.
BRT knob	—	Increases intensity of all display legends when rotated clockwise. Decreases intensity of all display legends when rotated counterclockwise.

Figure 1-77. CMSP (EWMU) Controls and Indicators (Sheet 2 of 2).



1A-10A-34-1-1S-1-53M-1-BCC1

CONTROL OR INDICATOR	POSITION OR DISPLAY	FUNCTION
JMR display	Display Window	Display provides an 8-character alphanumeric display that displays the selected jammer program and operational status. The push-button to the left of the display is used to scroll through and select the JMR operational program. NOTE The first actuation of the push-button will change JMR mode from STBY to OPR independent of CMSP (EWMU) switch settings.
CHAFF-FLARE	Display window	Displays the chaff and flare remaining payload counts and a single character indication of the selected EWMS master mode. CMS (EWMS) master mode indicators are as follows: • <u>X</u> – STBY • <u>M</u> – MAN • <u>S</u> – SEMI • <u>A</u> – AUTO A flashing diamond in the center of the display indicates dispensing is occurring. The display also provides an MDF selected low payload warning indication.
MWS display	Display Window – Not currently programmed.	Display provides an 8-character alphanumeric display that provides provisions for display of MWS program and operational status. The push-button to the left of the display will be used to scroll through and select the MWS operational mode/program.
RWR switches:	—	Provide RWR controls.
PRI switch (Priority Mode)	—	Toggles between RWR open or priority modes. A green indicator light is off in open mode. In priority mode the light comes on steady or flashing if a threat which can not be displayed on the RWR is detected.
SEP switch (Target Separate)	—	Separates targets colocated at the RWR azimuth indicator.

Figure I-78. CMSP (EWPI) Controls and Indicators (Sheet 1 of 2).

CONTROL OR INDICATOR	POSITION OR DISPLAY	FUNCTION
RWR switches (cont):	—	Provide RWR controls.
UNK switch	—	Enables display of unknown emitters in the event that RWR can not make a positive identification. When selected, provides a steady green light in indicator above the switch. When an unknown emitter is detected, the green light will flash.
ML indicator lamp	—	Lamp comes on and flashes (NVIS compatible red) when a missile launch is detected.
BRT knob	—	Increases intensity of displays and indicators when rotated clockwise.
AUD knob	—	Increases volume of RWR audio warning when rotated clockwise.

Figure 1-78. CMSP (EWPI) Controls and Indicators (Sheet 2 of 2).

AN/ALR-69 RWR

The CMS (EWMS) and the azimuth indicator provide all the controls and indicators for the AN/ALR-69 RWR. The CMSC (EWPI) provides the RWR indicators and main controls used during flight. The CMSP (EWMU) provides the RWR power control, basic mode selectors and status indications.

AN/ALQ-131 and AN/ALQ-184 JMR Systems

The CMSC (EWPI) provides JMR status indication and mode control. The CMSP (EWMU) provides JMR power control, basic mode selectors and status indications. The AN/ALQ-184(V9) includes two menus for the AN/ALQ-184(V)-9 pod (including the AN/ALE-50 towed decoy system), which are not applicable to the A-10.

Missile Warning System (MWS)

The CMS (EWMS) includes provisions for future integration with a Missile Warning System (MWS).

EC STORES SETUP

The CMS (EWMS) includes a dynamic station store capability for weapon station 1 and 11. This function enables flight line reconfiguration of the following ECM stores without loading a new Mission Data File (MDF):

- AN/ALQ-131
- AN/ALQ-184

The CMS (EWMS) supports ferry flight of one additional ECM pod. The pod ferry function applies power only to the applicable station, no operational control is provided. This function is implemented using the last menu in the MAIN rotary: EC STORES SETUP. This menu requires all CMSP (EWMU) system select switches in the off position prior to changing the station stores. The EC STORES SETUP menu enables dynamic selection of pod stores on STA 1 and STA 11. This includes AN/ALQ-131 JMR (131), AN/ALQ-184 JMR (184), JMR Pod Ferry (FRY), and non-EW store (—). All CMSP (EWMU) entries are validated against MDF, disabling invalid stores menu entries (e.g. selecting ALQ-131 control with ALQ-184 loaded in the MDF). The following limitations are used when the CMSP (EWMU) validates stores selection:

- One operational JMR only.
- Pod ferry flight option will only be available when another JMR has been selected.

All pilot entries through the EC STORES SETUP menu must be saved in order to be permanently stored in the CMSP (EWMU) MDF. If the changes are saved, any change to the pre-installed MDF will be indicated in the MAIN rotary CONFIGURATION menu under the [MDF] option by an asterisk “*”. The “*” indication clears when original MDF parameters are selected.

Embedded Training

The CMS (EWMS) includes Embedded Training (ET) capabilities for the DISP and JMR subsystems. The ET capability for the RWR subsystem is growth capability enabled by interface between data transfer equipment and the 1553 mux bus. The CMSP (EWMU) is responsible for overall control (enable/inhibit) of the ET function for each individ-

ual subsystem. Selection is made using a dedicated menu in the MAIN rotary. All ET displays are identical to the operational displays of the individual subsystems. In ET mode a "T" is the first character in the CMSC (EWPI) JMR display if the ET function is selected for any subsystem. ET related parameters are programmable using the MDF.

DISP ET

The ET function for DISP includes synthetic simulation of all dispense related functions. During execution of DISP ET function all power is removed from dispenser stations. The MDF parameters include the following data for each individual dispenser magazine:

- Magazine loading status – Loaded/Not loaded.
- Payload category/type – Payload category 1 – 4 (typical Chaff/Flare/Other 110ther 2) of type 1 – 8 (e.g. Flare type M206, MJU-7).
- Payload quantity – 15, 30, 60.

RWR ET (ENABLED WITH DATA TRANSFER EQUIPMENT)

The CMS (EWMS) acts as a control function only for RWR ET, all simulation tasks are provided by the RWR and the BC. The RWR operates in three operational modes: NRM: (Real mode) – RWR presents real threats only. TRN: (Pseudo mode) – RWR presents simulated threats only. BTH: (Pseudo + Real mode) – RWR presents both simulated and real threats.

JMR ET

The ET function of the AN/ALQ-131 includes synthetic simulation of all JMR status indications for band 3 through 5. The CMS (EWMS) MDF parameters include the following data for each individual JMR program – band 3 through 5 status: S – Standby, T – Transmit, F – Fault and (blank) – No band indication (See Figure 1-82 for additional information). During execution of the JMR ET function power is applied to the ECM pod for cooling purposes. There is no other communication between the CMSP (EWMU) and the JMR pod. All JMR ET indications are based on simulated functions internal to the CMSP (EWMU).

GENERAL CMS (EWMS) OPERATION

When the CMSP (EWMU) MODE selector switch is set to STBY, power is supplied to the CMS (EWMS). The CMSP

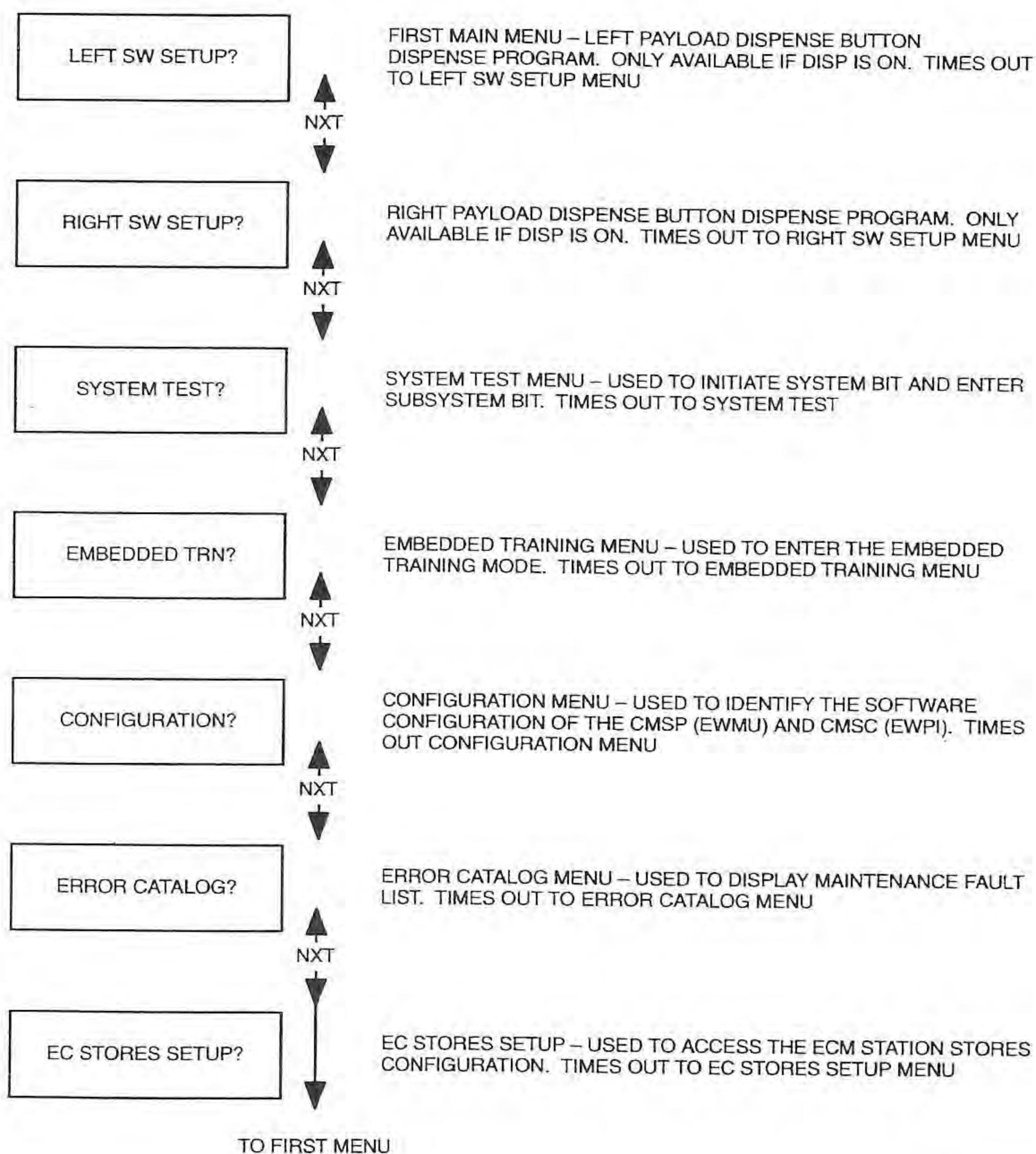
(EWMU) operator interface is implemented through display-guided selectable functions using rotaries and menus. A menu is a group of options displayed at the same time. Selection of the options are done using the OSBs. A rotary is a special type of menu where the group of options only will be displayed one at a time with each depression of the same OSB. Five different rotaries are used to control the entire CMSP (EWMU) operation. The CMS (EWMS) uses the MAIN rotary for overall system operation. Selectable from any rotary are four unique subsystem rotaries, the DISP rotary, JMR rotary, RWR rotary, and MWS rotary. Each rotary provides for selection of the available options for each subsystem. The CMSP (EWMU) display window momentarily displays WARM-UP ! and enters the MAIN rotary immediately after warm-up. The four subsystem rotaries are entered by actuating the applicable SYSTEM select switch to the MENU-position. Each rotary contains options, that are displayed on the display upper line, one at a time. The options in the rotary are messages followed by a question mark (?). The [NXT]-button is used to scroll through the different options. The options are automatically selected after being displayed for 2 seconds (time-out). The selected option, in the MAIN rotary, or a subsystem rotary, may include more menus and rotaries that define further options. These submenus or subrotaries are displayed on the lower display line and identify options above the respective OSBs. Selection and initiation of an option is provided by a momentary activation of the corresponding OSB. The [RTN] button is used within the MAIN menu to return to the start of the MAIN rotary. Within a subsystem rotary, the [RTN] button causes the CMSP (EWMU) to return to the previous selected option in the MAIN rotary.

Menu Overview

The CMSP (EWMU) uses five different rotaries to control the CMS (EWMS) and subsystem operations. All menus are programmed using the MDF. The MDF can be programmed to display any menu in standby mode only, in both standby and operate modes, or the menu may be inhibited during all modes of operation. The MAIN rotary is selected automatically after warm-up and can be accessed at any time by pressing RTN button twice. The CMSP (EWMU) displays a momentary warm-up and a standby message after which the menus are displayed. The MAIN rotaries are provide in Figure 1-79. The MAIN rotary contains a number of menus for dispense program selection, initiation of system self test, and maintenance selections.

MAIN ROTARY

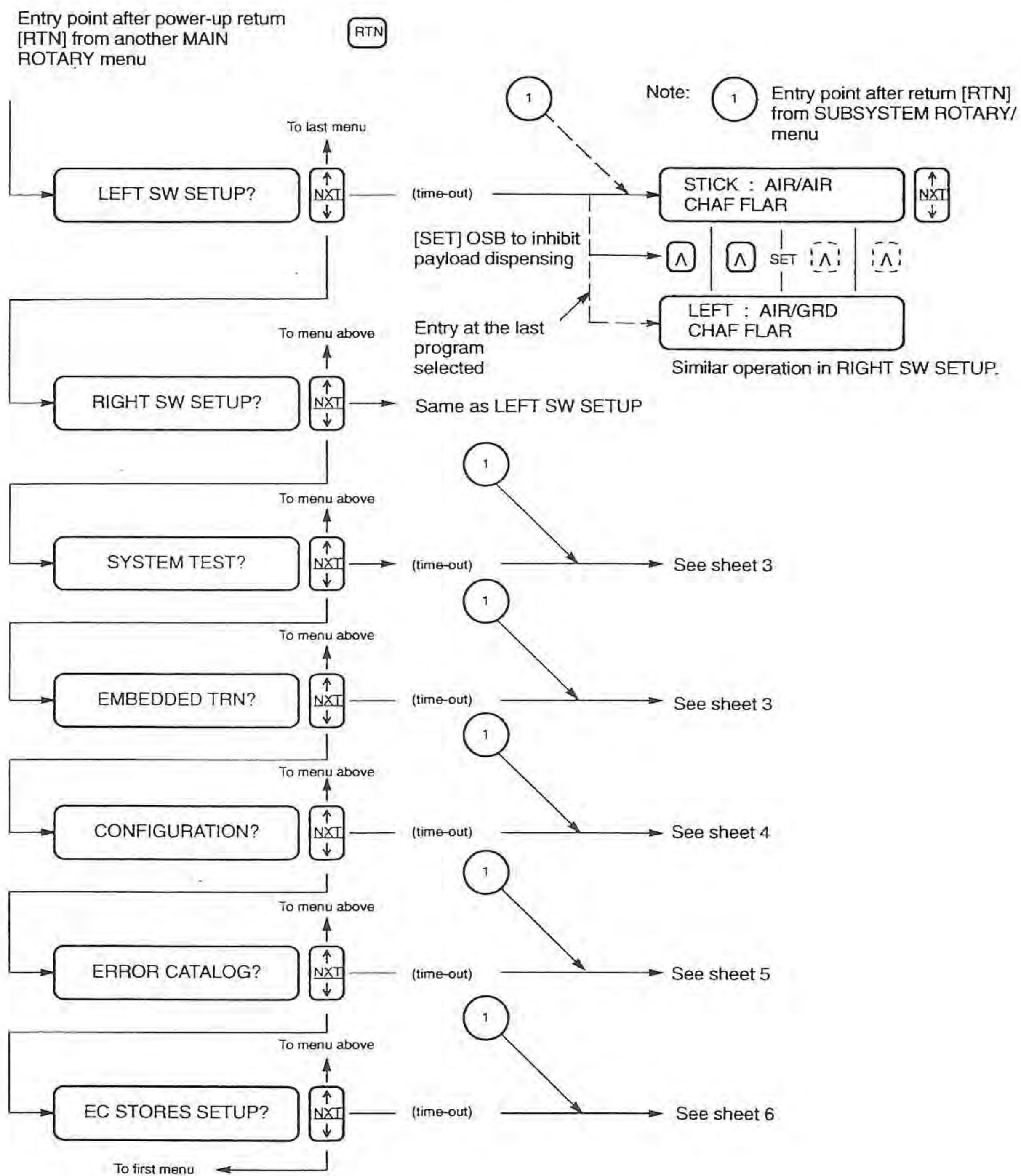
DISPLAYED BY SETTING MODE SWITCH TO STBY AND PRESSING RTN BUTTON. WARMUP/TIME-IN STATUS MESSAGES ARE TEMPORARILY DISPLAYED BEFORE MAIN ROTARY IS DISPLAYED. CAN BE DISPLAYED AT ANY TIME BY PRESSING RTN TWICE



1A-10A-34-1-1-1-53N-1-BCC1

Figure 1-79. Main Rotary (Sheet 1 of 6).

MAIN ROTARY



1A-10A-34-1-1-1-53N-2-BCC1

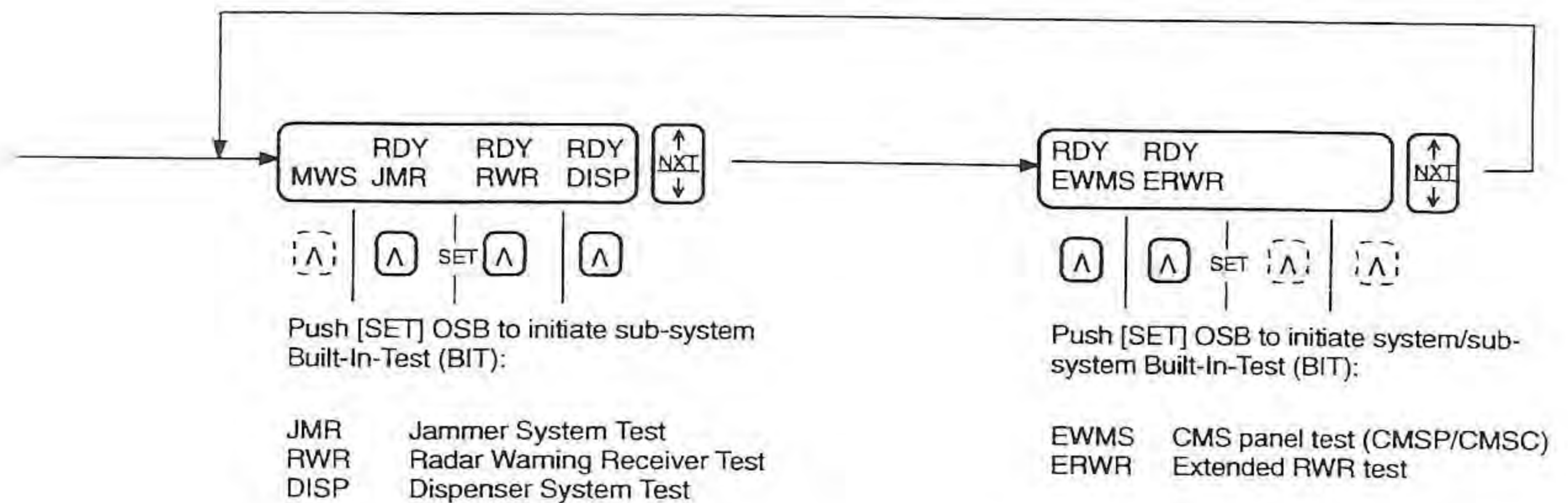
Figure 1-79. Main Rotary (Sheet 2 of 6).

MAIN ROTARY

Any activation of [RTN] will cause the CMSP to re-enter MAIN ROTARY

[RTN]

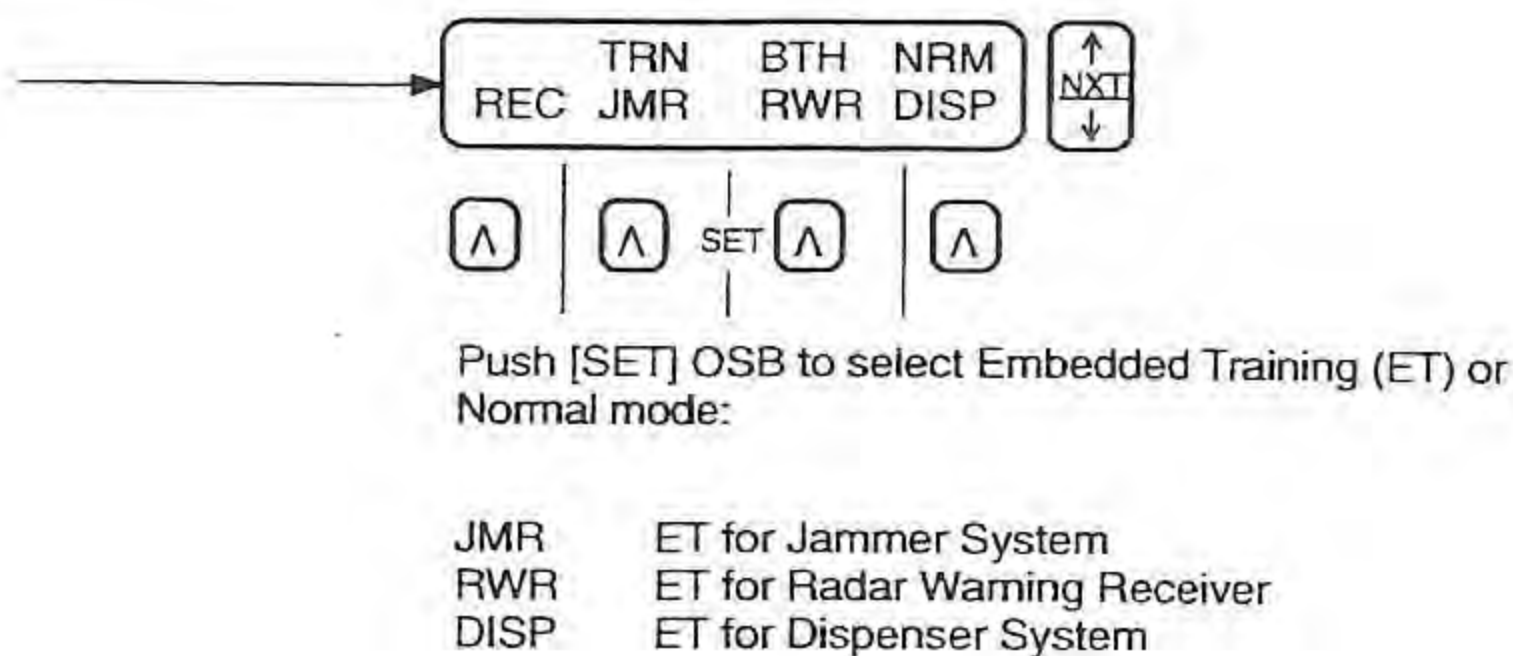
SYSTEM TEST:



System Test indications:

OFF, RDY, BIT, — — — , N/A, ERR, or (blank)

EMBEDDED TRAINING:



Embedded Training indications:

JMR NRM/TRN
RWR NRM/TRN/BTH
DISP NRM/TRN

1A-10A-34-1-1-1-53N-3-BCC1

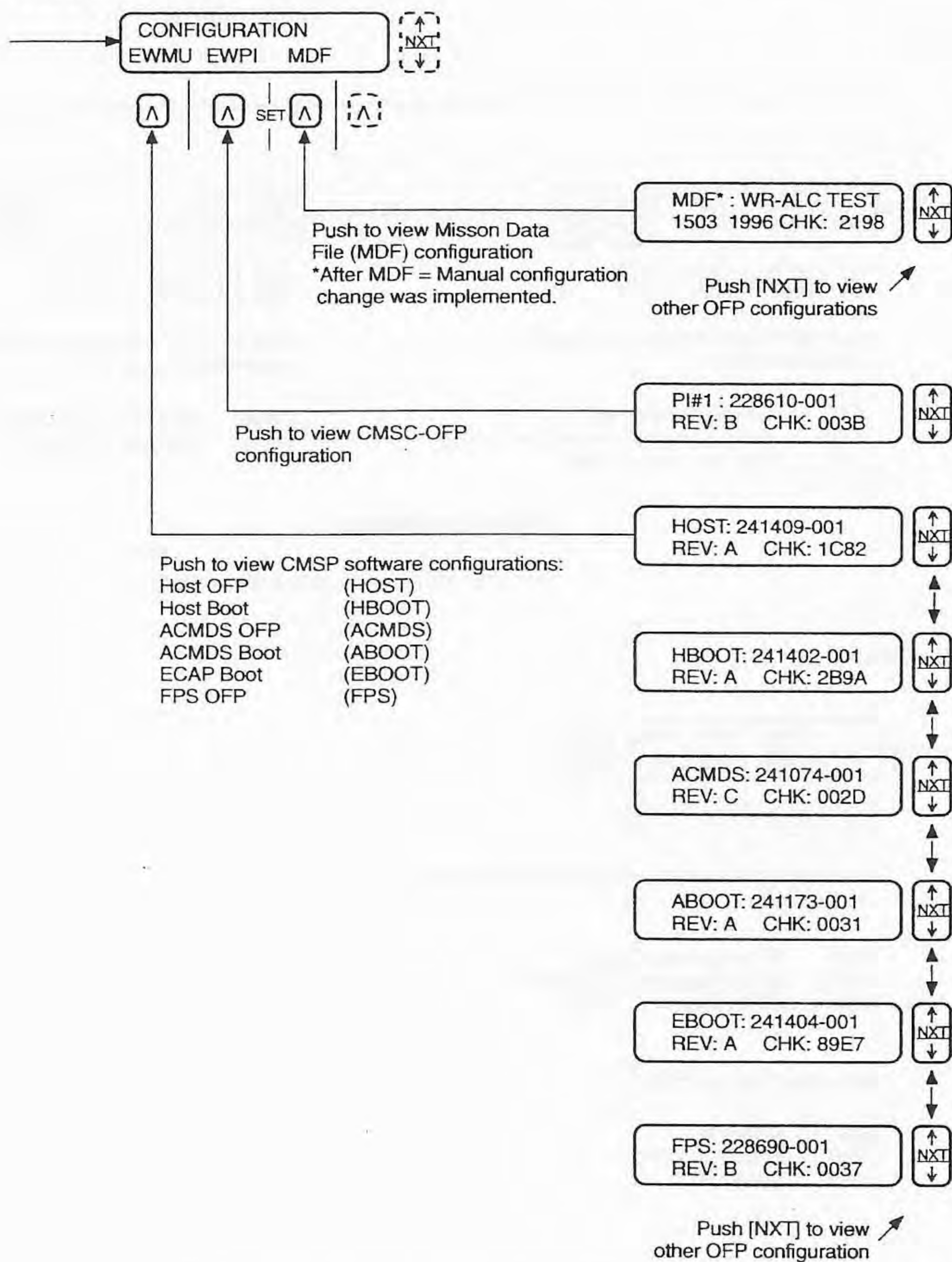
Figure 1-79. Main Rotary (Sheet 3 of 6).

MAIN ROTARY

Any activation of [RTN] will cause the CMSP to re-enter MAIN ROTARY

[RTN]

CONFIGURATION:



1A-10A-34-1-1-1-53N-4-BCC1

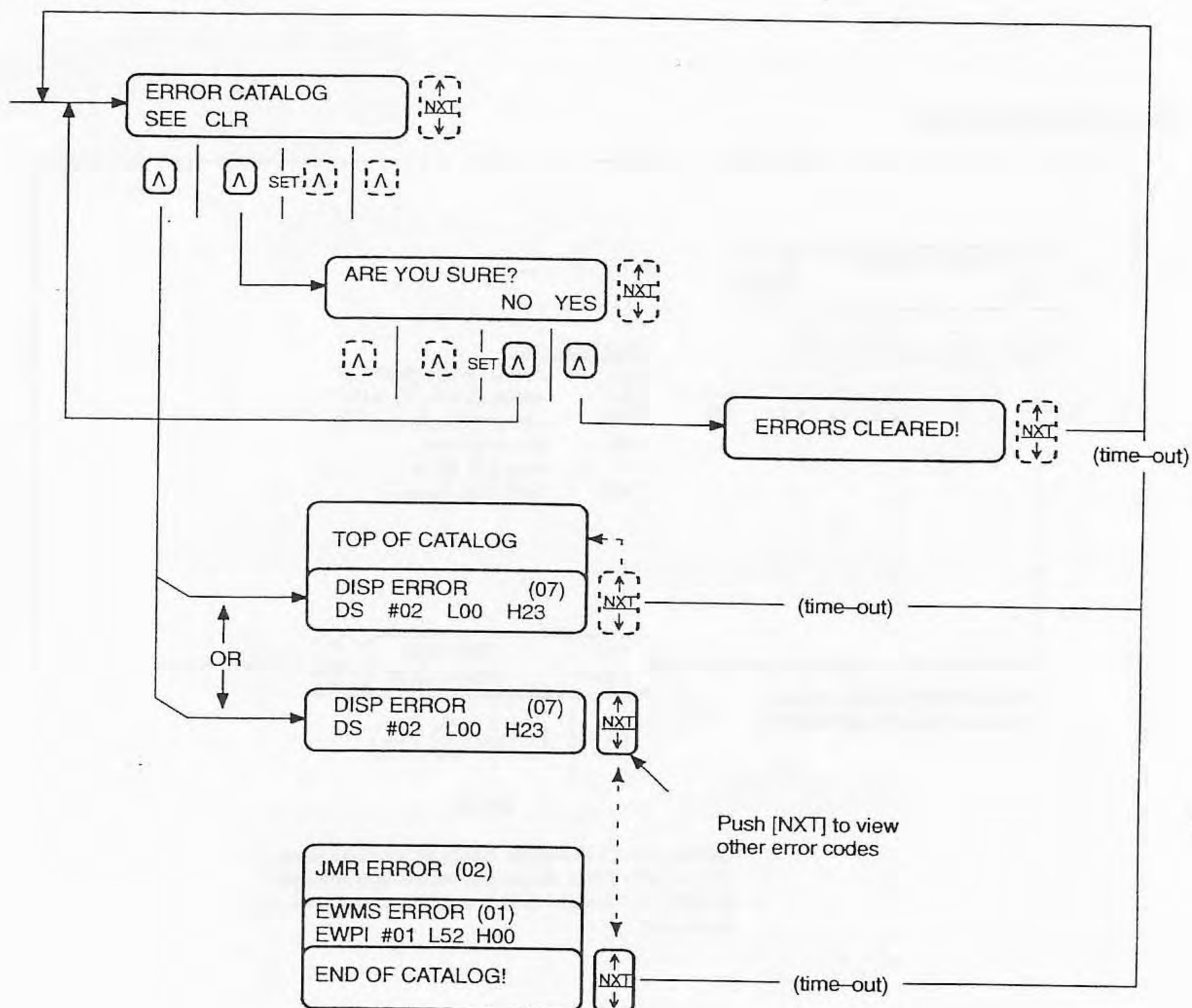
Figure I-79. Main Rotary (Sheet 4 of 6).

MAIN ROTARY

Any activation of [RTN] will cause the CMSP to re-enter MAIN ROTARY

RTN

ERROR CATALOG:



1A-10A-34-1-1-1-53N-5-BCC1

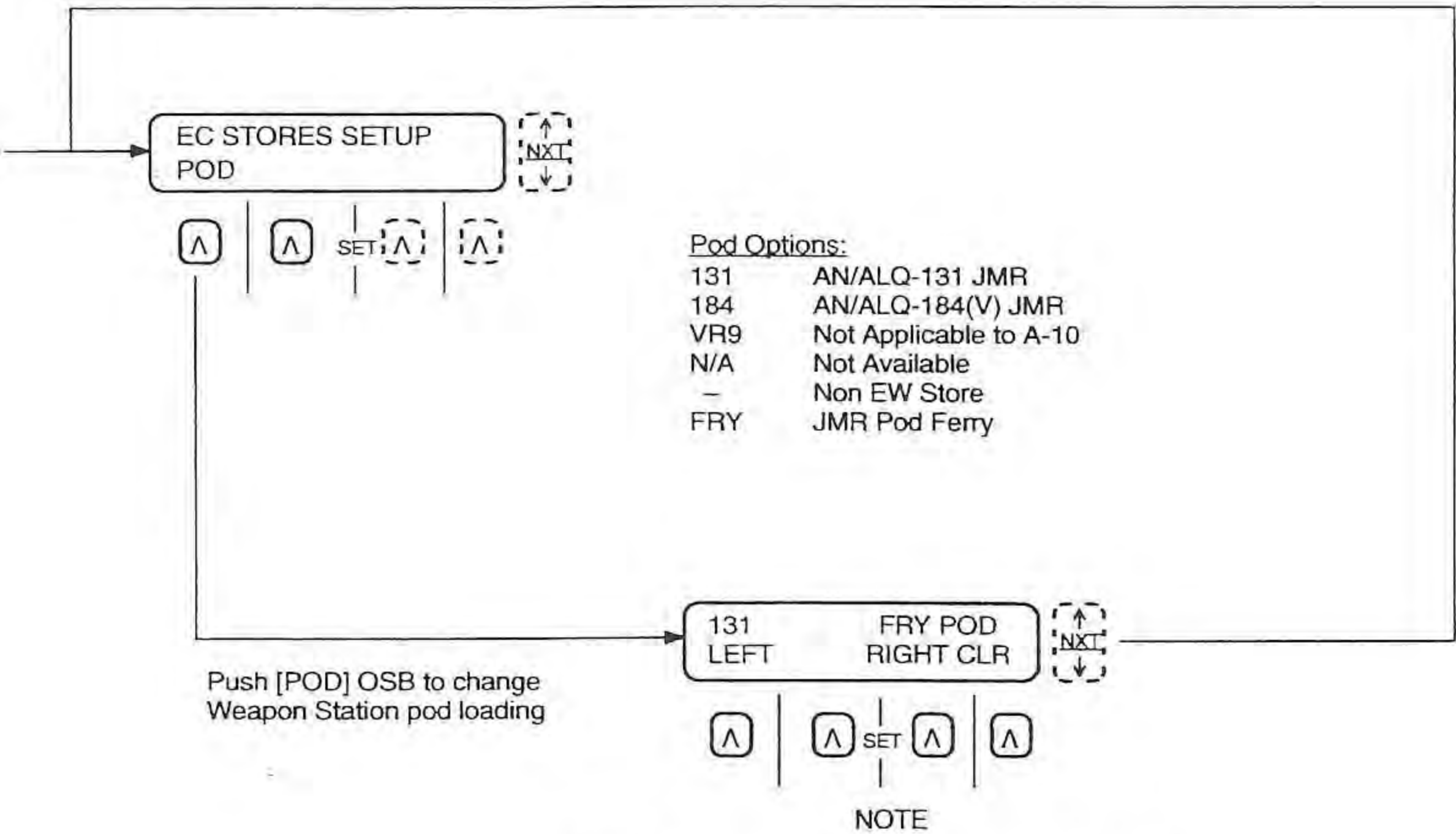
Figure 1-79. Main Rotary (Sheet 5 of 6).

MAIN ROTARY

Any activation of [RTN] will cause the CMSP (EWMU) to re-enter MAIN ROTARY



EC STORES SETUP:



1A-10A-34-1-1-53N-6-BCC1

Figure 1-79. Main Rotary (Sheet 6 of 6).

MAIN Rotary

The main rotary consists of the following menus:

NOTE

DISP system must be on to display the LEFT SW SETUP or RIGHT SW SETUP menus.

- LEFT SW SETUP – Dispense program selection for left payload dispense button.
- RIGHT SW SETUP – Dispense program selection for right payload dispense button.
- SYSTEM TEST – System self test initiation and sub-system BIT.
- EMBEDDED TRN – Embedded training selection for individual subsystems.
- CONFIGURATION – OFP and MDF identification read-out.
- ERROR CATALOG – Maintenance Fault List read-out.
- EC STORES SETUP – ECM Station Stores configuration.

DISP Rotary

The DISP Rotary (Figure 1-80) provides payload quantity read-out, special dispense routine selection, and maintenance. The menus are as follows:

PAYLOAD STATUS – Chaff, Flare, Other1, Other2 payload status/quantity read-out.

LEFT SW MANUAL – Manual dispense routine selection for left payload dispense button.

RIGHT SW MANUAL – Manual dispense routine selection for right payload dispense button.

DISP LOADING – Detailed readout of DISP loading data.

DISP SUB-MODE – Special DISP test selections.

RWR Rotary

The RWR rotary (Figure 1-81) provides the basic system setup and status indications. This rotary also has an CMSC (EWPI) backup menu. The first menu is for basic RWR system setup, file selection, threat data handoff and altitude selection. The second menu has controls for unknown-, priority mode, and target separate selection. The menu serves as a back up for the CMSC (EWPI).

JMR Rotary

The JMR Rotary provides basic system setup and back-up indications for CMSC (EWPI) JMR display. JMR program back-up changes are accomplished using the JMR push-

button on the CMSC (EWPI). Two different rotaries are used depending on the jammer installed on the aircraft. The ALQ-131 JMR rotary is provided in Figure 1-82. The ALQ-184 JMR rotary is provided in Figure 1-83.

- ALQ131 CONTROL – The basic JMR control for selection of JMR operational mode, JMR program, and antenna tilt. Second menu is a detailed JMR program menu for selection of Transmit mode and special JMR techniques. Jammer Band status is also in this menu. Third menu includes Mission Tape Identification
- ALQ131 CONFIG – ALQ-131 OFP identification read out.
- ALQ184 CONTROL – The first menu is basic JMR control for selection of JMR operational mode, MR program, and antenna tilt. The second menu is a detailed JMR program menu for selection of transmit mode and special JMR technique. This menu also includes Jammer Band status. The ALQ-184 CONTROL menu includes two menus for AN/ALQ-184(V)-9 pod (including the AN/ALE-50 towed decoy system), which are not applicable to the A-10.

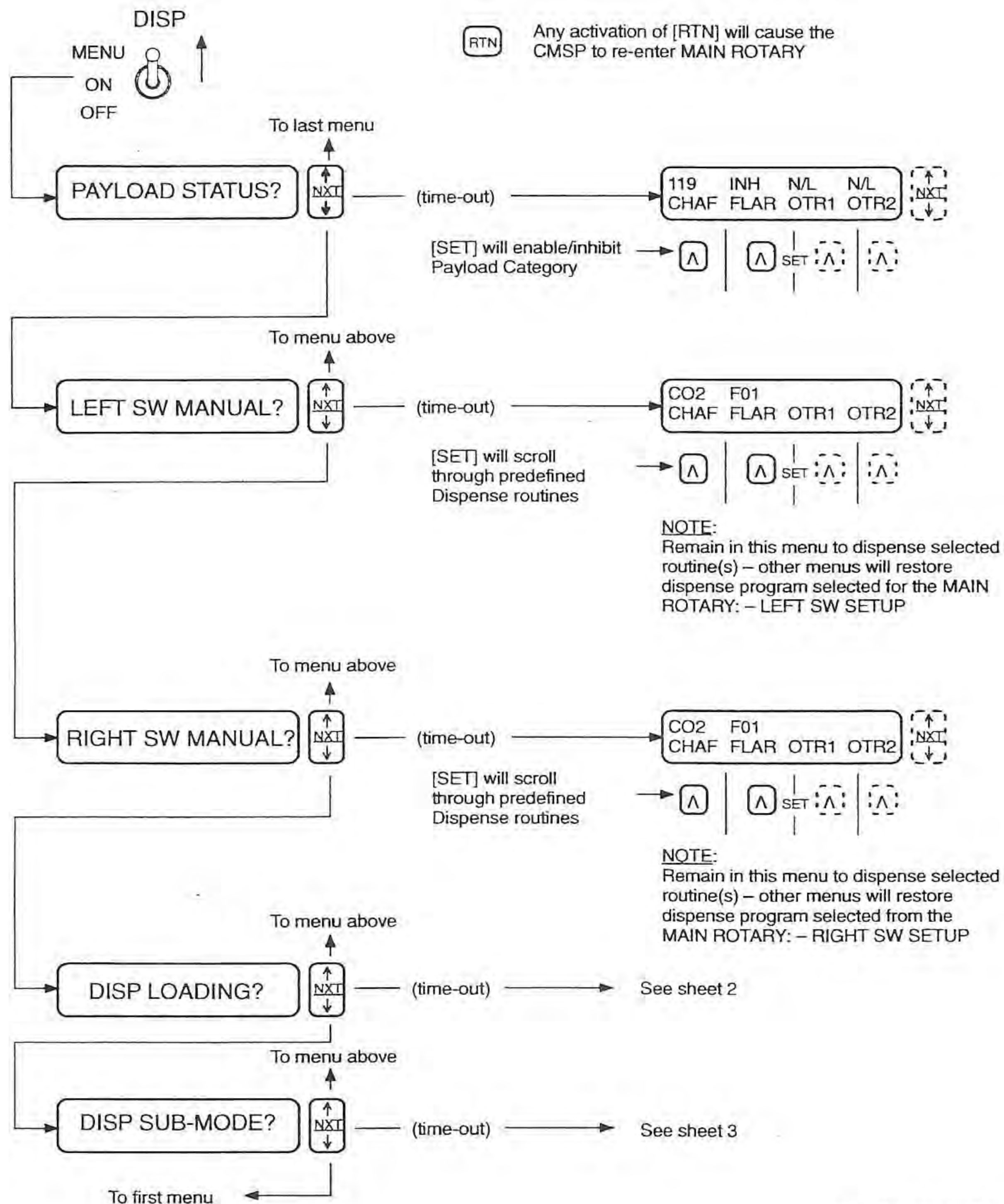
MWS Rotary

The MWS rotary is reserved for future installation of a missile warning system. The CMSP (EWMU) provides a temporary display message if the MWS rotary is entered and returns to the previous rotary/menu. The temporary MWS message is NO APPLICATION ! All menus are displayed with a question mark meaning they may be selected on a 2 second time-out basis. The menu is selected automatically, if no controls are activated within the 2 second period after the menu option has been selected.

SYSTEM ERROR INDICATION

The CMS (EWMS) provides extensive built-in-test (BIT) functions. The executive BIT is software controlled and operated in three modes; power-up BIT (PBIT), continuous BIT (CBIT), and an initiated BIT (IBIT). Power-up BIT is a thorough test of the CMS (EWMS) hardware and is completed during initial warm-up. Continuous BIT (CBIT) is a restricted test of EWMS hardware. CBIT occurs on a non-interference basis during operational spare time. Initiated BIT tests the applicable system/subsystem and is activated using the SYSTEM TEST menu options. All hardware errors detected by BIT operational software are assigned a maintenance level failure code. Errors that require pilot action or reduce capability are reported via the pilot fault list and stored in CMSP (EWMU) NVM (MFL) and reported via the ERROR CATALOG menu (Figure 1-85) for read-out on the ground. All other errors are stored directly in the CMSP (EWMU) NVM Maintenance Fault List.

DISP ROTARY

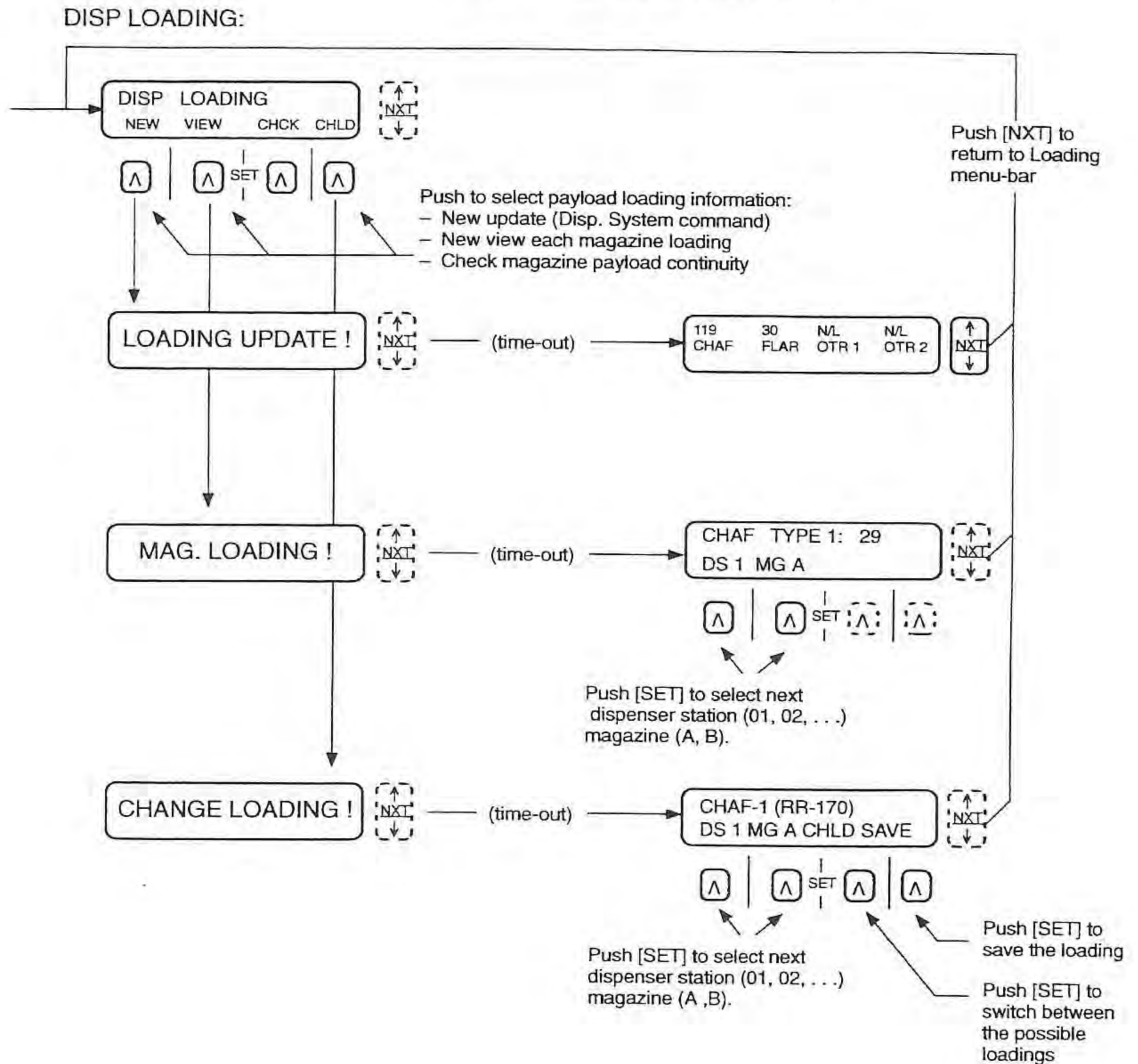


1A-10A-34-1-1-53P-1-BCC1

Figure 1-80. DISP Rotary (Sheet 1 of 3).

DISP ROTARY

RTN Any activation of [RTN] will cause the CMSP to re-enter MAIN ROTARY



1A-10A-34-1-1-53P-2-BCC1

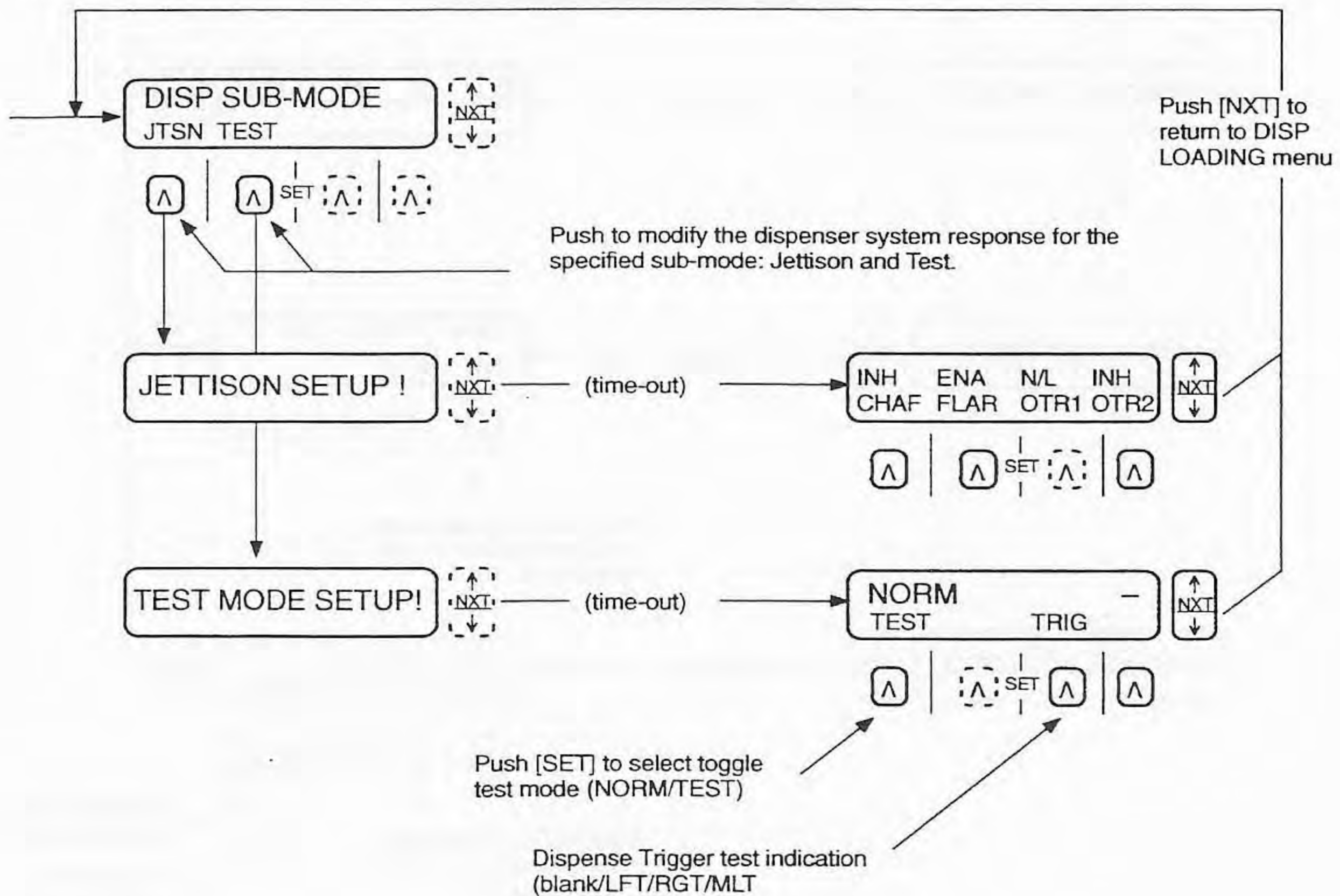
Figure 1-80. DISP Rotary (Sheet 2 of 3).

DISP ROTARY



Any activation of [RTN] will cause the CMSP to re-enter MAIN ROTARY

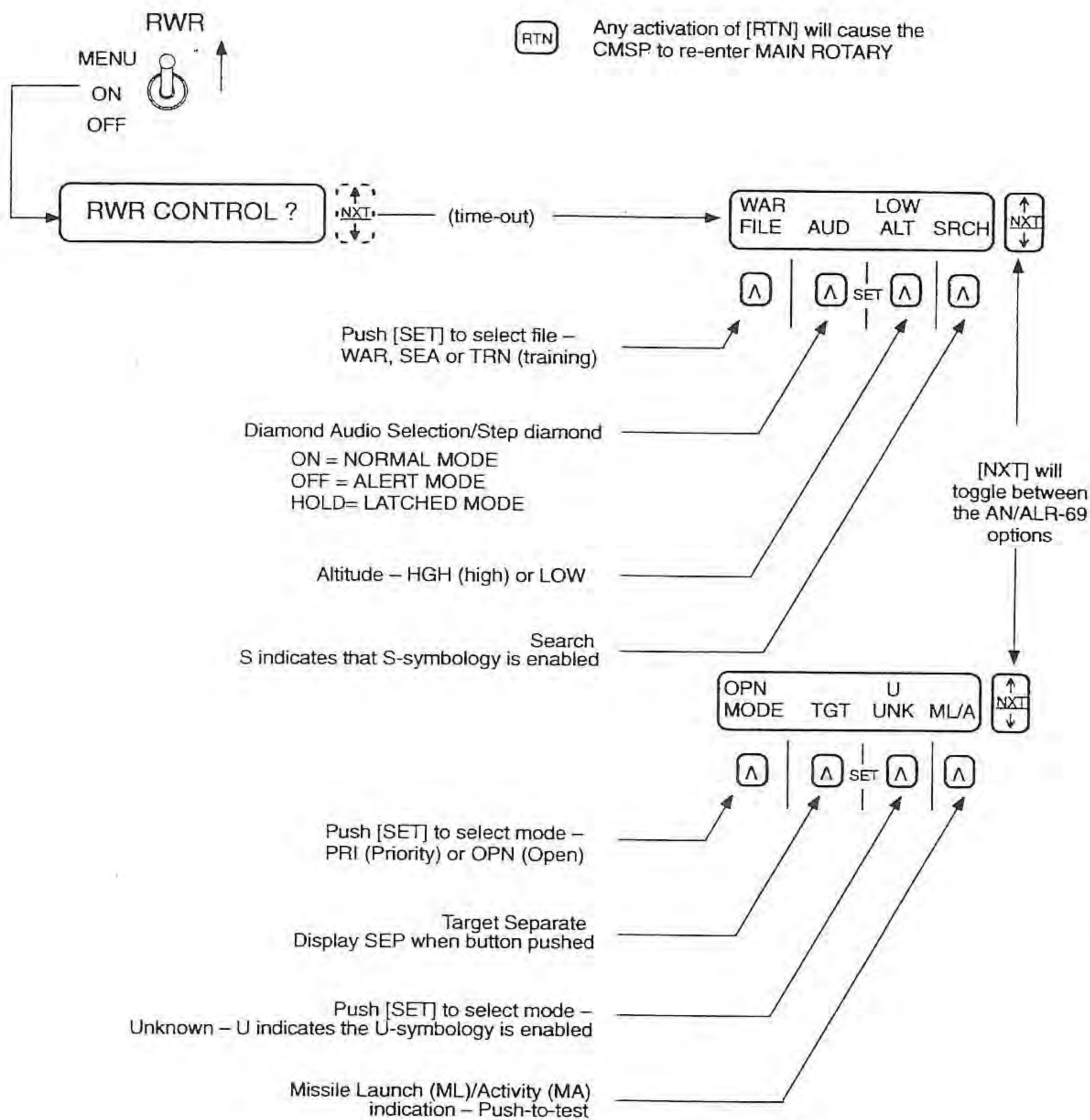
DISP SUB-MODE:



1A-10A-34-1-1-53P-3-BCC1

Figure 1-80. DISP Rotary (Sheet 3 of 3).

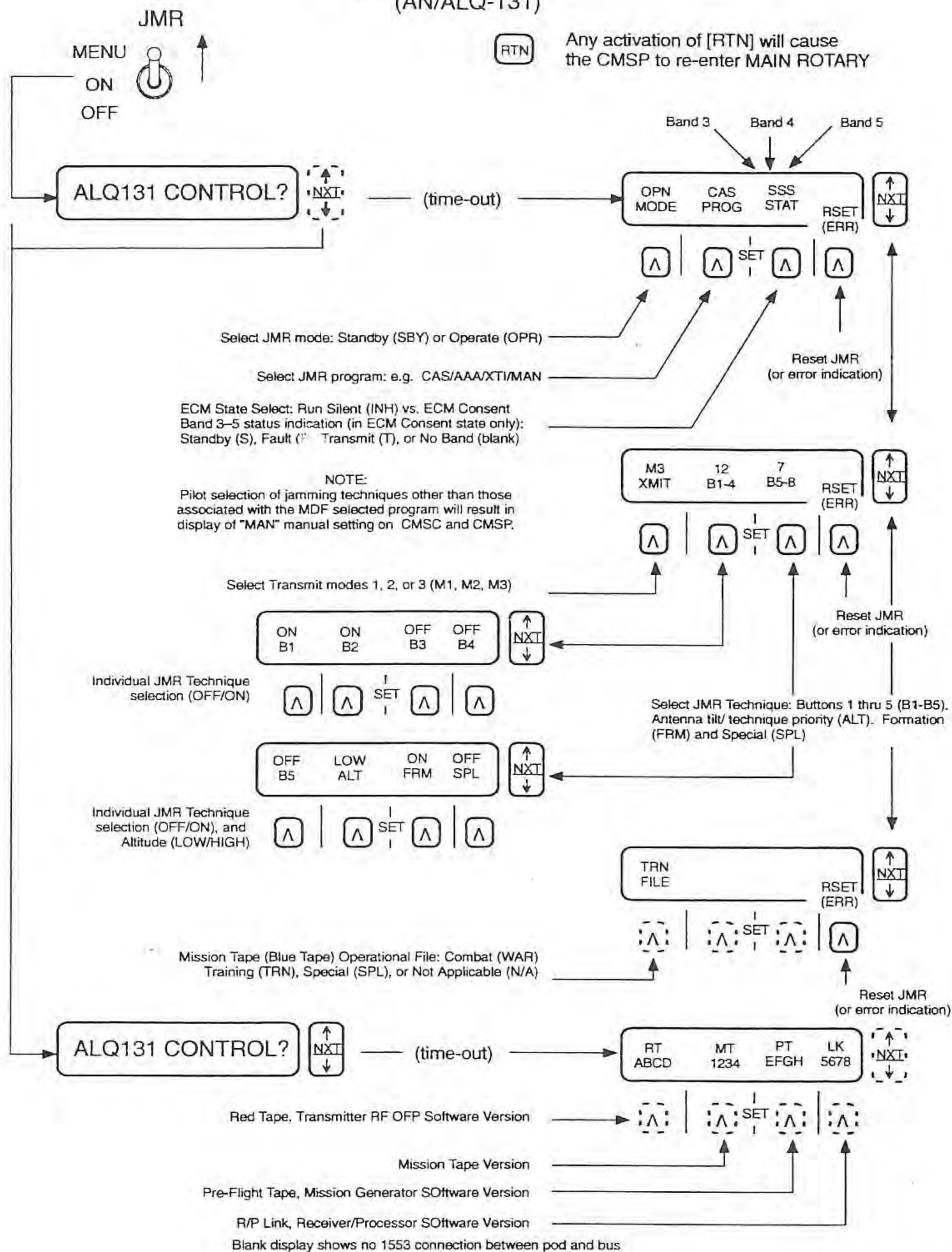
RWR ROTARY



1A-10A-34-1-1-53Q-BCC1

Figure I-81. RWR Rotary.

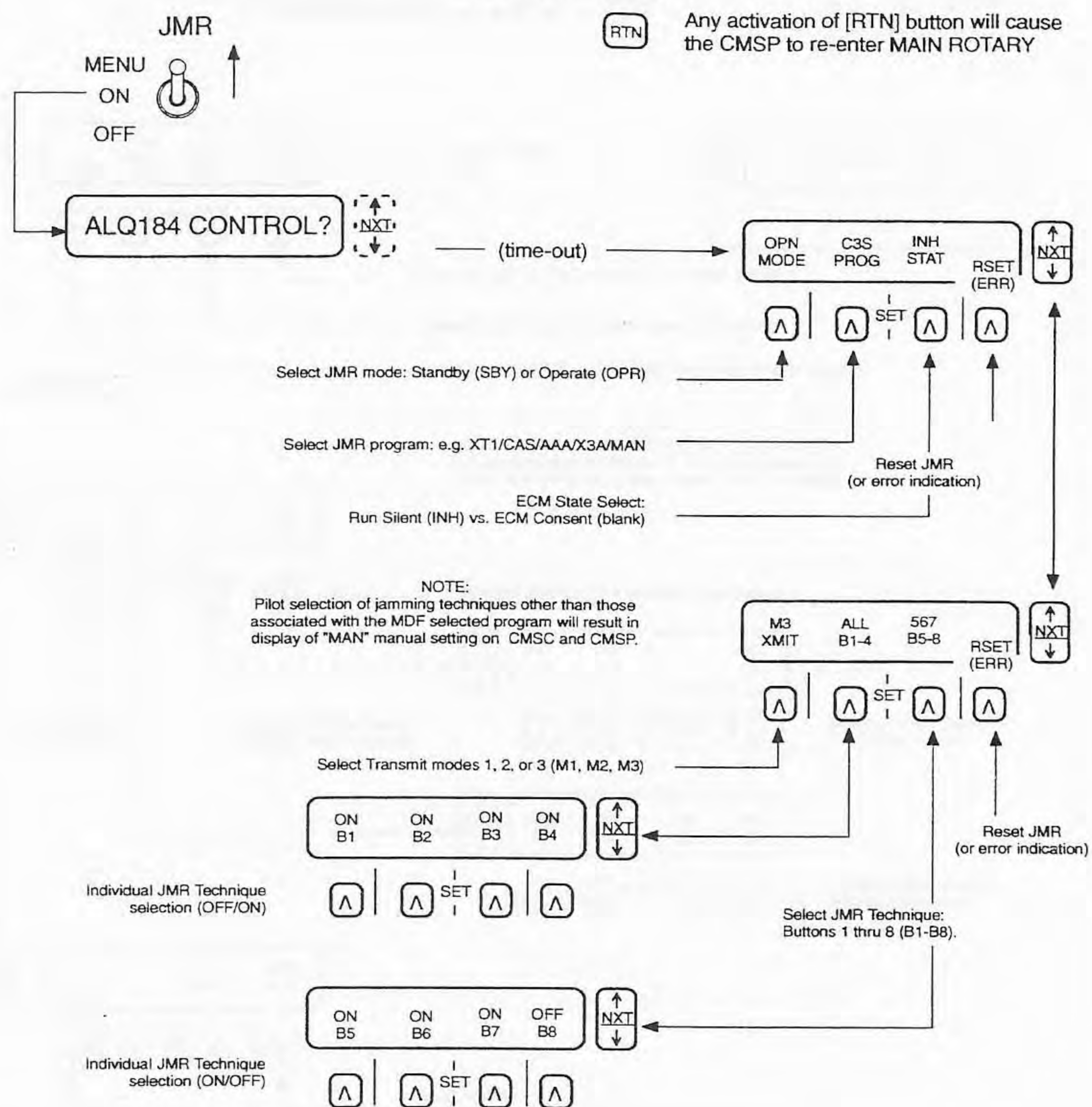
JMR ROTARY
(AN/ALQ-131)



1A-10A-34-1-1-1-53R-BCC1

Figure 1-82. ALQ-131 JMR Rotary.

JMR ROTARY (AN/ALQ-184(V))

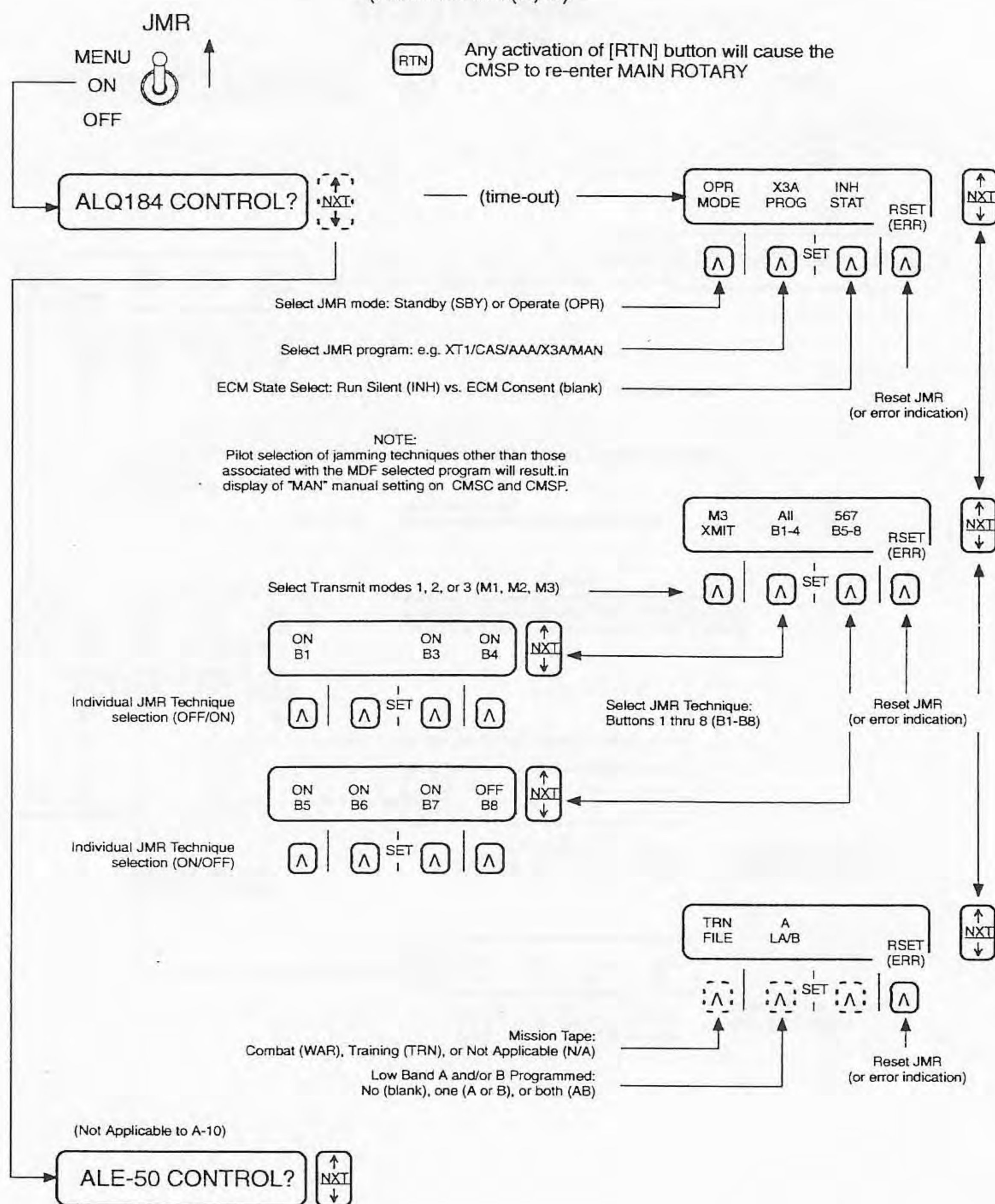


1A-10A-34-1-1-53S-1-BCC1

Figure 1-83. ALQ-184 JMR Rotary (Sheet 1 of 2).

JMR ROTARY

(AN/ALQ-184(V)-9)



1A-10A-34-1-1-1-53S-2-BCC1

Figure 1-83. ALQ-184 JMR Rotary (Sheet 2 of 2).

Pilot Fault List (PFL)

The pilot fault list is displayed immediately when a CMS (EWMS) or subsystem error is detected. PFL error requires pilot to either investigate the error and return to normal operation or inhibit further display of the specific error. All ET indications are based on simulated functions loaded in the MDF. ET loaded errors can be displayed in the PFL but will not be retained in the MFL. Any possible hardware error, as detected by the BIT operational software, is assigned an error code and stored in the CMS (EWMS) non-volatile memory and reported in the Maintenance Fault List (MFL) corresponding to the ERROR CATALOG menu for read-out on the ground. The pilot fault list display is provided in Figure 1-84.

The RTN button can be pressed or the mode selector can be set to any position other than STBY to return to the selected menu/rotary.

Maintenance Fault List (MFL) Pilot Notification

The MFL pilot notification is displayed when the CMS (EWMS) mode selector switch is set from MAN to STBY if there are any errors detected or stored in the MFL.

CMS (EWMS) Operational Indications

The CMS (EWMS) provides operational indications, warnings, and notifications during system operation. The CMSC (EWPI) warnings are the same as for the CMSP (EWMU) but are spread across both display windows. The warnings, notifications, and indications are shown in Figure 1-86.

PILOT FAULT LIST (PFL) INDICATION

ERROR:	INTERFACE
DISP.	INH SEE

OSB FUNCTIONS:

OSB 1 – DISPLAYS MALFUNCTIONING SYSTEM/SUBSYSTEM IDENTIFICATION [CMS (EWMS), DISP, RWR, OR JMR]

OSB – NOT ACTIVE

OSB 1 – SELECTS INHIBIT DISABLES SUBSEQUENT REPORTING OF THIS PARTICULAR FAILURE AND RESUMES NORMAL OPERATION. CMSP (EWMU) RETURNS TO PREVIOUS OPERATIONAL ROTARY/MENU.

OSB 4 – SELECTS CMS DISPLAY OF MAINTENANCE LEVEL FAILURE CODES.

1A-10A-34-1-1-53T-BCC1

Figure 1-84. Pilot's Fault List.

CMS DISPLAY OF MAINTENANCE LEVEL FAILURE CODES.

DISP	ERROR	(01)
DS	#01	L42 H00

NXT RETURNS DISPLAY TO PILOTS FAULT LIST
RTN RESUMES NORMAL OPERATION

OSB FUNCTIONS:

OSBS ARE NOT ACTIVE IN THIS MODE.

THE TOP LINE OF DISPLAY INDICATES FAILED SYSTEM/SUBSYSTEM. THE NUMBER IN PARENTHESIS IS NUMBER OF FAILURE OCCURRENCES (01-99). BOTTOM DISPLAY LINE ABOVE OSB1 AND OSB2 PROVIDES FAILURE SUBSYSTEM IDENTIFICATION. THE BOTTOM LINE DISPLAY ABOVE OSB 3 AND

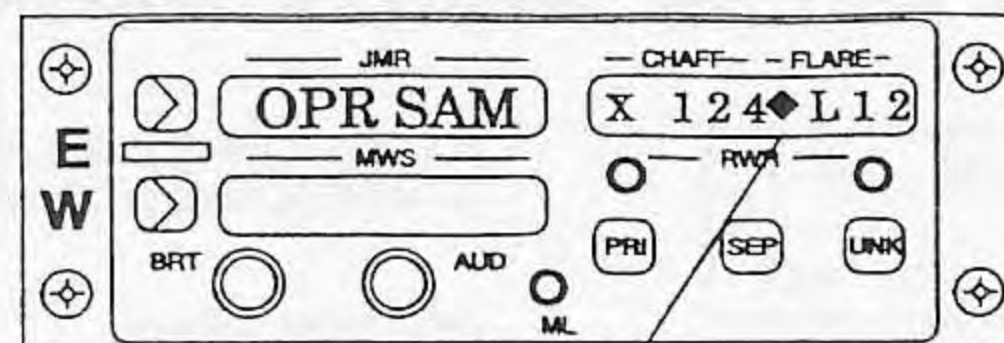
SUBSYS- TEM	IDENTIFICATION USED
EWMS	EWMU HOST, EWMU CMDS, EWMU FPS, EWPI #01/#02
DISP	DS FOLLOWED BY # AND DISPENSER STATION NUMBER
RWR	PRC 479, C/D 6971
JMR	ALQ 131, ALQ 184
RECCE	REC
MWS	N/A

OSB 4 INDICATES ERROR PRIORITY CODE LXX IS LOW PRIORITY CODE AND HXX IS A HIGH PRIORITY CODE. WHERE XX IS A NUMBER FROM 01 TO 99

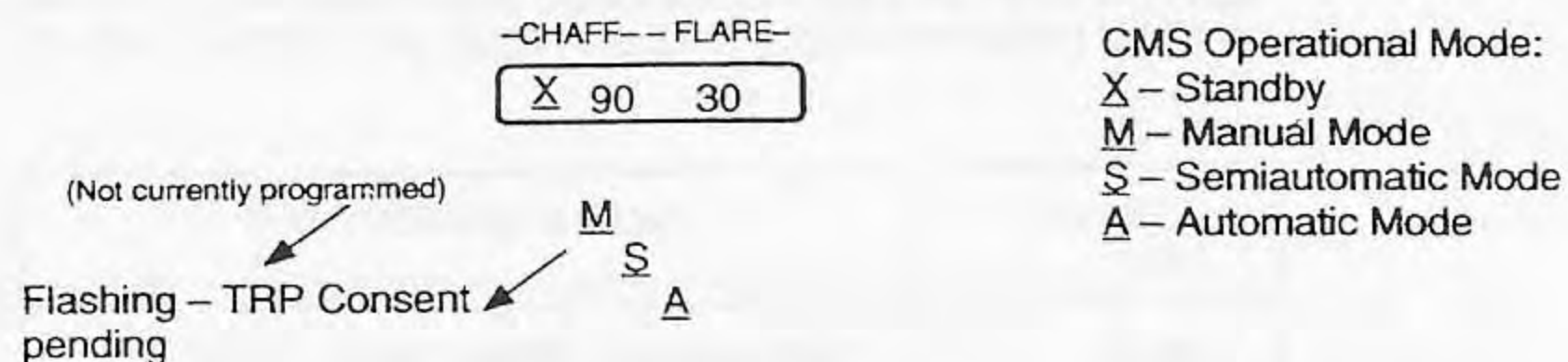
1A-10A-34-1-1-53U-BCC1

Figure 1-85. Maintenance Level Failure Codes.

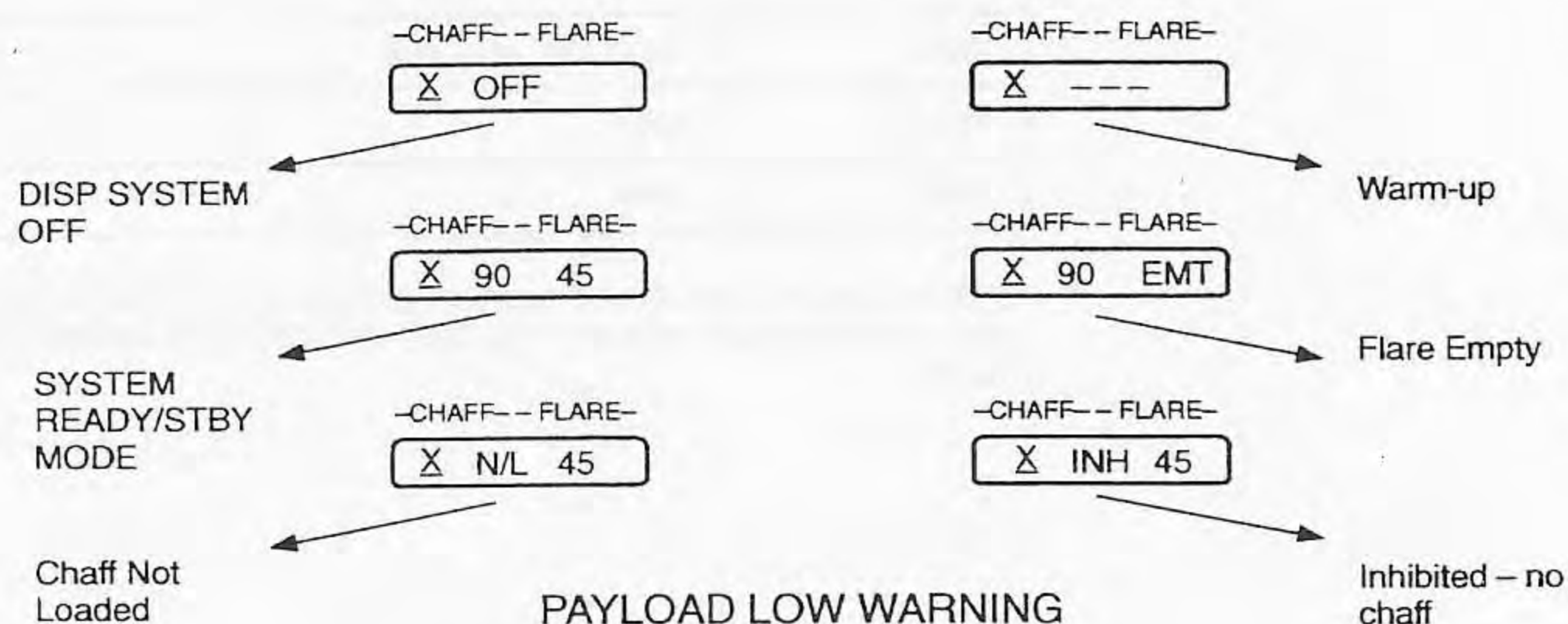
CMSC INDICATIONS DISP



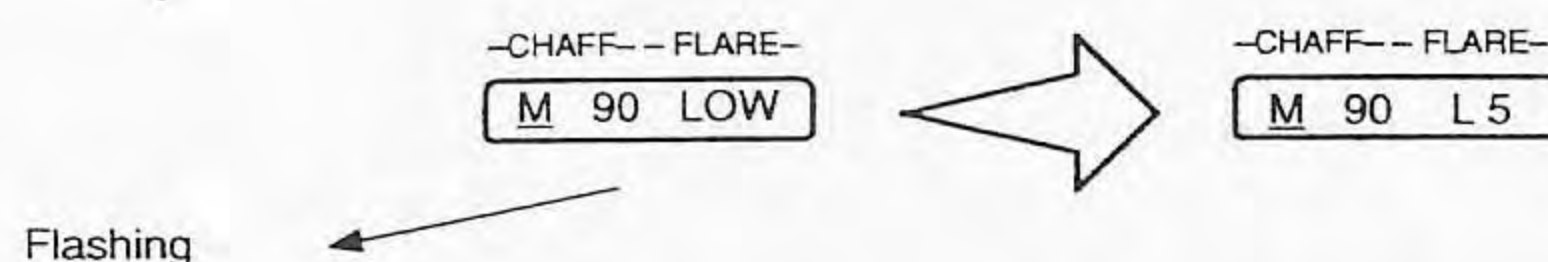
CMS OPERATIONAL MODE INDICATION



DISP STATUS & INVENTORY INDICATIONS



PAYLOAD LOW WARNING



DISPENSE NOTIFICATION

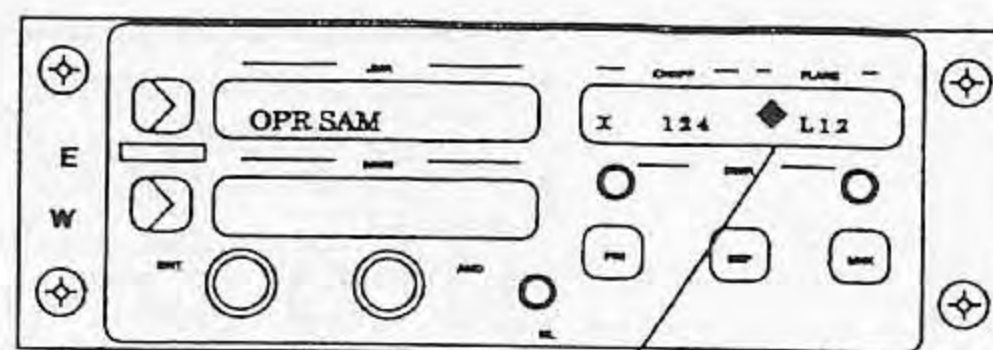


1A-10A-34-1-1-53V-1-BCC1

Figure 1-86. Operational Indications and Warnings (Sheet 1 of 6).

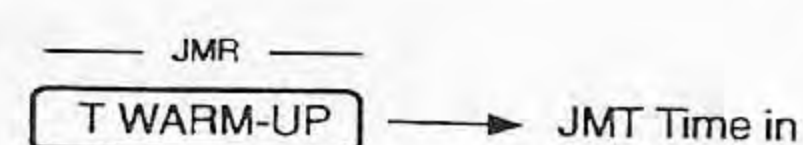
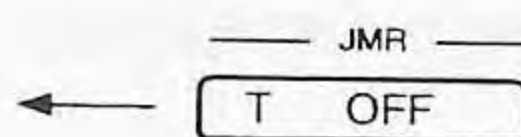
CMSC INDICATIONS JMR

AN/ALQ-184(V)/AN/ALQ-184(V)-9



JMR OFF and TIME IN MESSAGES

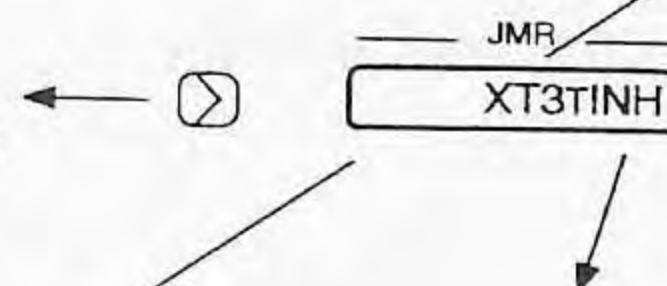
T: One or more subsystems are in Training mode.
(blank): All subsystems are in normal mode. RWR may be in either Normal mode or Both



JMT Time in

JMR MODE AND STATUS

JAMMER MODE SELECTOR:
Push  button to scroll/change JMR program/select operate mode.



T: JMR Training file installed.
(blank): JMR Training file not installed or AN/ALQ-184(V) selected.

JAMMER MODE/PROGRAM:

JAMMER STATUS:

SBY	STANDBY MODE
X1A	XMIT1 ALL
XT3	XMIT3
AAA	ANTI AIRCRAFT ARTILLERY
MAN	MANUAL

(BLANK)	INHIBIT(RUN SILENT)
Char.	
Pos.	AN/ALQ-184(V)-9 only:
6	Low Band A and/or B installed (L) or not installed (blank)
7	Decoys remaining (0-4)
8	Decoy status: Standby (S) or Active (A)

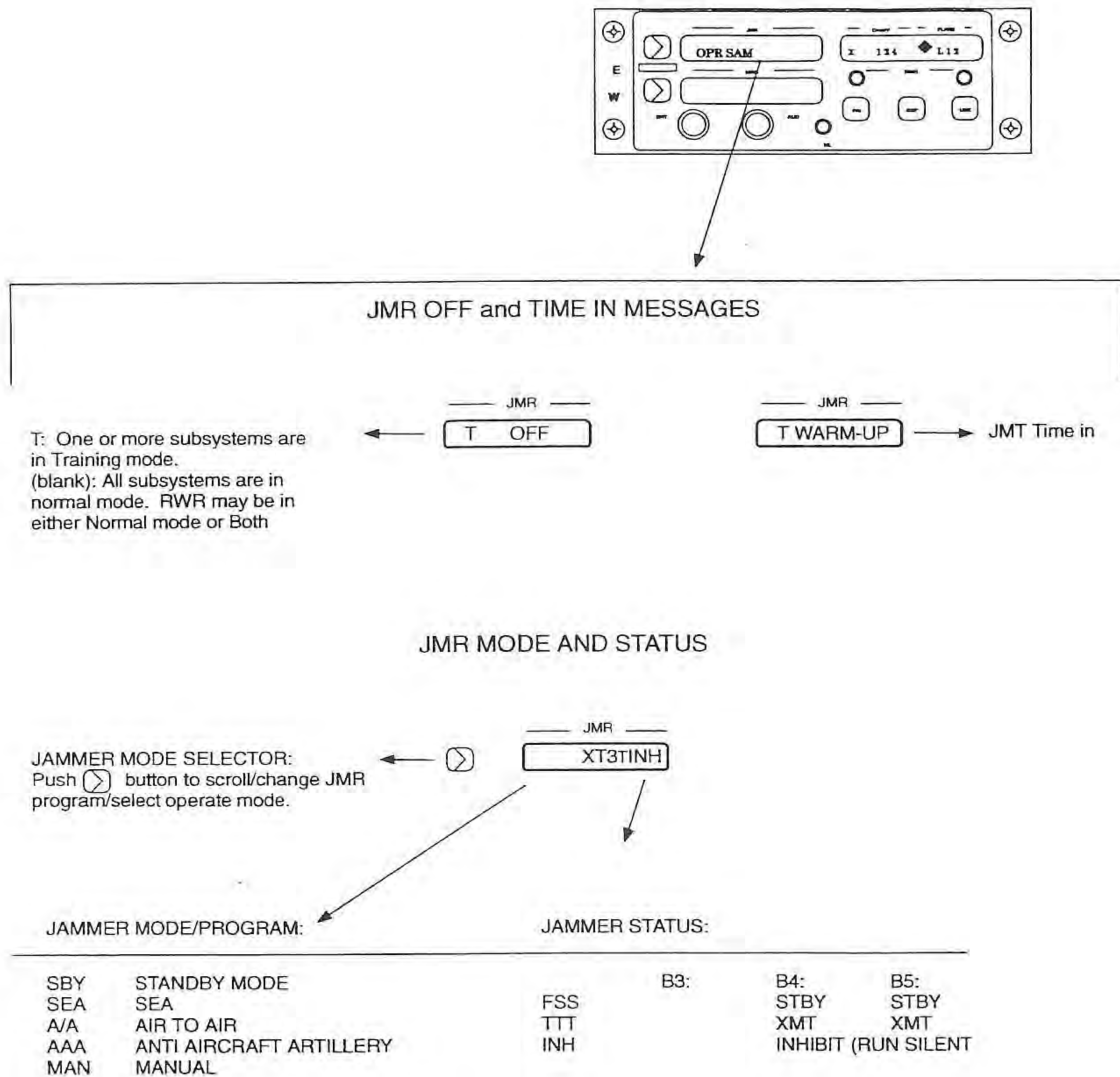
1A-10A-34-1-1-53V-2-BCC1

Figure 1-86. Operational Indications and Warnings (Sheet 2 of 6).

CMSC INDICATIONS JMR

AN/ALQ-131

(A-10)

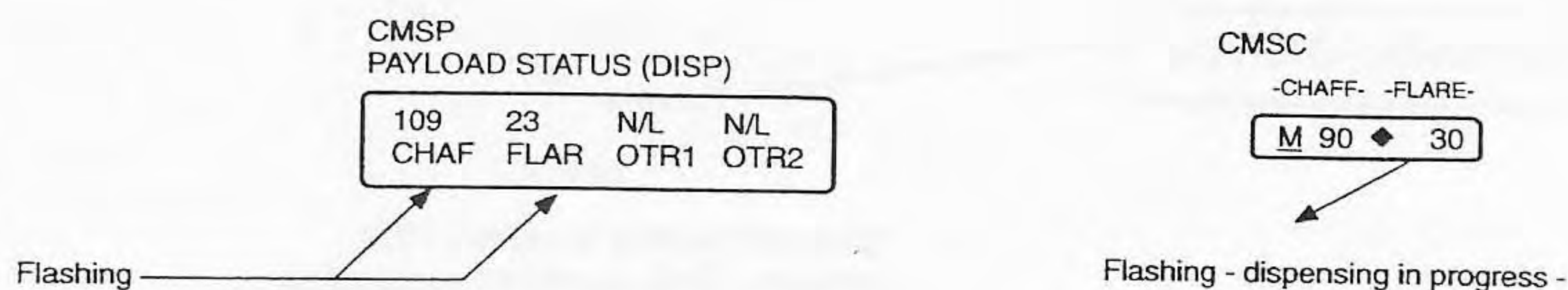


1A-10A-34-1-1-1-53V-3-BCC1

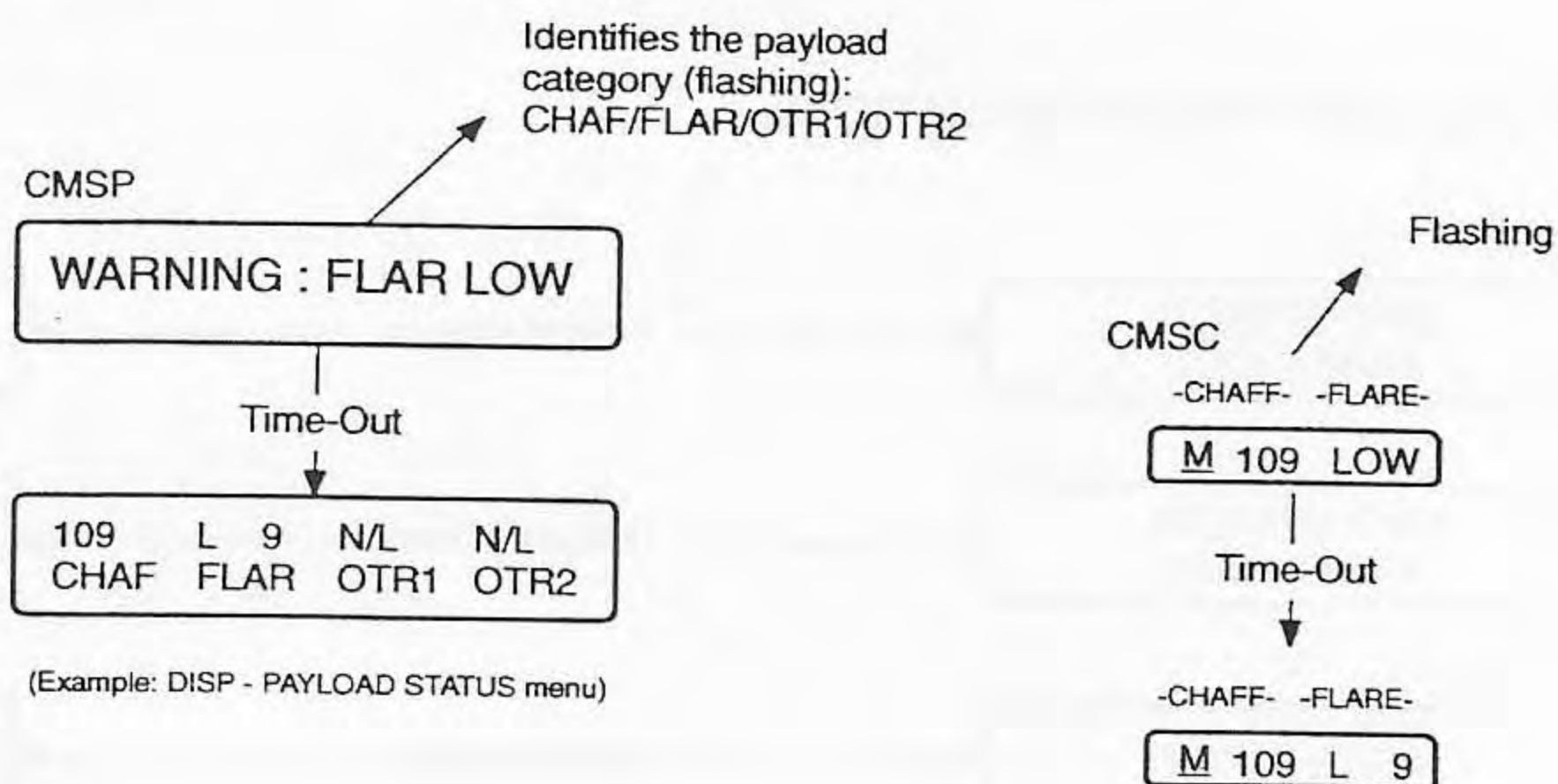
Figure 1-86. Operational Indications and Warnings (Sheet 3 of 6).

WARNING & NOTIFICATIONS

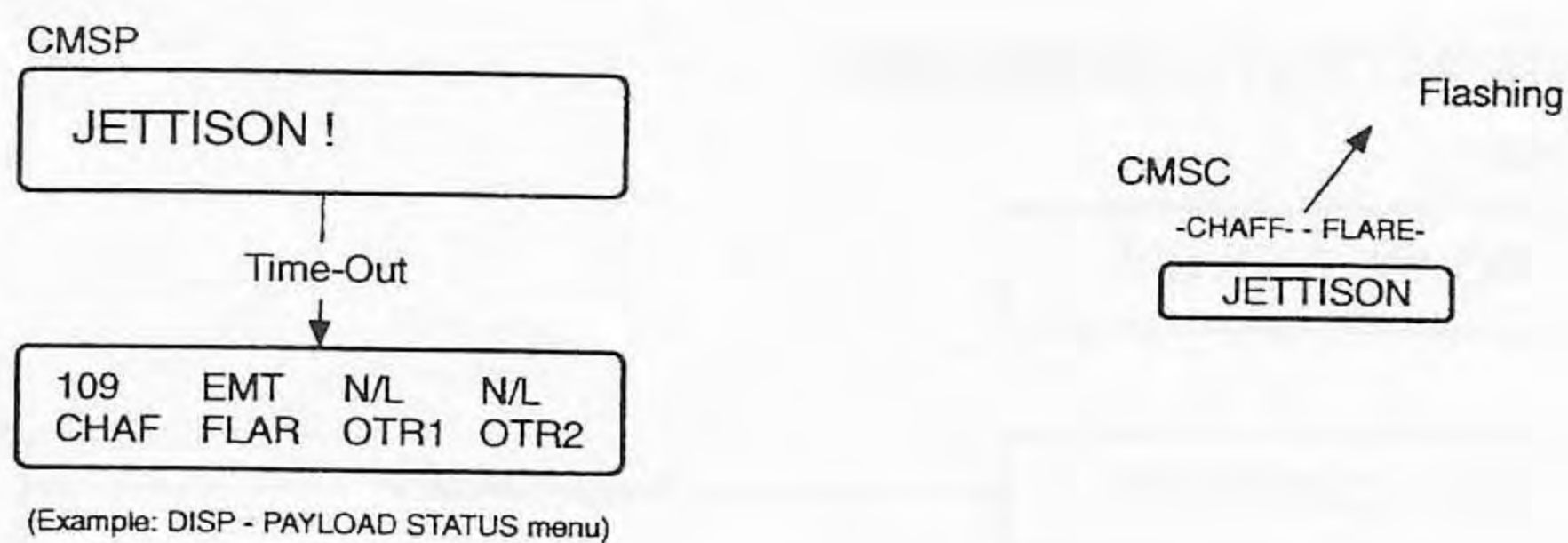
DISPENSE NOTIFICATIONS:



PAYLOAD LOW WARNINGS:



JETTISON NOTIFICATION:



1A-10A-34-1-1-53V-4-BCC1

Figure I-86. Operational Indications and Warnings (Sheet 4 of 6).

WARNING & NOTIFICATIONS

PILOT WARNINGS:

CMSP

WARNING: JTSN ON

CMSC

— JMR —

WARNING:

-CHAFF- -FLARE-

JTSN ON

Flashing

NOTE

If jettison switch is set to JTSN position, CMS operation is disabled and system jettison function will not operate until jettison switch is cycled.

INVALID OFP/MDF NOTIFICATIONS:

CMSP

OFP ERROR
EWMU HOST

Displayed alternately

PLEASE LOAD

OFP ERROR
EWMU CMDS

Displayed alternately

PLEASE LOAD

MDF ERROR

Displayed alternately

PLEASE LOAD

INTERMITTENT LOAD MESSAGE:

CMSP

DOWNLOADING !

LOAD COMPLETE

Displayed alternately

RESTART EWMU

1A-10A-34-1-1-53V-5-BCC1

Figure 1-86. Operational Indications and Warnings (Sheet 5 of 6)

CMSP (EWMU) OPERATIONAL INDICATIONS

WARM UP !	THE WARM-UP INDICATION IS DISPLAYED MOMENTARILY WHEN THE CMSP (EWMU) MODE SELECTOR IS INITIALLY SET TO ANY POSITION FROM THE OFF POSITION.
SYSTEM ARMED !	THE SYSTEM ARMED INDICATION IS DISPLAYED WHEN THE CMS OPERATIONAL STATE CHANGES FROM STANDBY TO OPERATE. THE OPERATIONAL STATE IS DEPENDENT ON THE CMSP (EWMU) MODE SELECTOR POSITION AND THE WEIGHT-ON WHEELS INPUT (NO WEIGHT ON WHEELS).
STANDBY MODE !	THE STANDBY INDICATION IS DISPLAYED WHEN THE AIRCRAFT WEIGHT ON WHEELS IS PRESENT OR THE CMSP (EWMU) MODE SELECTOR IS SET TO STBY.

1A-10A-34-1-1-1-53V-6-BCC1

Figure 1-86. Operational Indications and Warnings (Sheet 6 of 6).

PART 5 WEAPONS SUSPENSION SYSTEMS

ARMAMENT PYLONS

The A-10A aircraft has 11 external pylon stations housing either MAU-40/A or MAU-50/A ejector racks. The ejector racks are designed to carry and eject auxiliary suspension equipment, free-fall ordinance, and other stores. The seven inboard stations (3 through 9) house the MAU-40/A ejector rack and are capable of multiple bomb loadings. The four out board pylons (1, 2, 10, and 11) carry the MAU-50/A ejector rack. Additional station capabilities are as follows:

- Stations 1 and 11 carry ECM pods and/or AIM-9 missiles.
- Stations 4, 6, and 8 carry external fuel tanks.
- Stations 3 and 9 carry AGM-65 missiles.

TER 9/A TRIPLE EJECTOR RACK (TER)

The TER 9/A is an auxiliary suspension rack used to increase the number of munitions that aircraft pylons (with MAU racks installed) can carry. A TER can carry and sequentially eject up to three stores, each weighing up to 1,000 pounds and measuring 16 inches in diameter. The rack consists of a structural unit (strongback) with three ejector units and associated wiring.

Each ejector unit has provisions for suspension, sway-bracing, sensing, electromechanical arming, and munition ejection to operate functionally the same as a MAU rack. The TER strongback attaches to a pylon with 30-inch spaced lugs and provides a 14-inch suspension hook spacing on the ejector units. The ejector unit has a gas operated ejector foot to forcibly eject the munition. The gas is supplied to by a cartridge installed in the rear of the unit, which is electrically fired through an umbilical cable.

A control panel at the aft end of the TER has a CBU/rocket switch, an electrical safety pin receptacle, and a manual stepper switch. The CBU/rocket switch should be in the rocket position for firing from SUU-25 series flare dispensers and rocket launchers. All other weapons are released in the CBU position. The electrical safety pin is used for ground safing, and when inserted in the receptacle, interrupts the electrical circuit. The manual stepper switch is used only during maintenance.

Store release/ejection is accomplished sequentially by fire-and-step logic. Each pulse fires one station (ejector unit) and causes the stepper switch to select the next station in firing order and wait for the next fire-and-step pulse. Firing order for the TER is centerline, left, and right station. Within this order, circuitry in the rack assemblies automati-

cally skips unloaded stations; therefore, every fire-and-step signal will fire a loaded store.

AIR-TO-GROUND MISSILE LAUNCHERS AGM/TGM-65

LAU-88/A Launcher

The LAU-88/A launcher is designed to carry, control and launch AGM-65 missiles from aircraft stations 3 and 9. The TGM-65 training missile can be carried and controlled on the LAU-88/A. The ACS will not automatically sequence between aircraft station 9 and 3 after missile launch if both stations are selected. In this case, all missiles loaded on station 9 must be expended or station 9 must be deselected prior to transfer to station 3. If one or more missiles are rejected on the station 9 launcher, the ACS will not sequence to station 3 after the last missile on that launcher is rejected or launched because the ACS will not sense an empty launcher. If station 3 is selected prior to station 9, the sequence will not automatically transfer from station 3 if station 9 is subsequently selected, until station 3 is expended/deselected. The cycling of either the MASTER armament switch from ARM and then back to ARM, or the release mode selector from SGL and then back to SGL, will reset the automatic sequencer such that the sequence will again start at station 9.

NOTE

- On ferry missions a maximum of three missiles per TER can be loaded on a LAU-88. On tactical missions a maximum of two missiles per ter can be loaded on a LAU-88.
- Due to high initial power requirement for internal VTR equipped TGM-65D only two missiles can be loaded on a LAU-88.
- The AGM-65G cannot be used on multiple rail launcher due to missile weight constraints.

LAU-88A/A Missile Launcher

The LAU-88A/A is identical to the LAU-88/A except for the Launcher Electronics Unit (LEU). See TO 1-1M-34 for detailed descriptive information.

LAU-117A(V)1/A Missile Launcher

LAU-117A(V)1/A missile launcher when attached to station 3 and 9 pylons only, provides AGM/TGM-65 missile suspension and launch capabilities. See TO 1-1M-34 for detailed descriptive information.

AIR-TO-AIR MISSILE LAUNCHERS

Launcher System

The system provides means for selection, arming, and launch of AIM-9 missiles from the A-10A aircraft in an automatically controlled repetitive series. System is configured to accommodate a Dual Rail Adapter (DRA) with LAU-105 launchers loaded with missiles on station 1 and/or station 11. Mixed loading of AIM-9 type missiles is permitted.

Present ACS safety interlocks are maintained on the A-10A aircraft. Selective jettison and emergency jettison of missiles, and racks are provided by existent ACS circuitry. Only a complete missile station (DRA, Launchers, and Missiles present) can be jettisoned when the pylon is carted.

The AIM-9 Missile Control System consists of four line replaceable units, the Digital Data Processing Unit (DDPU), Electrical Test Panel (ETP), Guided Missile Interface Unit (GMIU), and Dual Rail Adapter assembly.

The DDPU, located in F14, accepts input signals from the cockpit, status signals from the aircraft and operational data from the missile. These signals are analyzed and action taken on them is based on a stored software program of rigid rules and operational sequences to provide via the GMIU, missile guidance control, release signals and feedback to the pilot through an output to the HUD.

The DDPU also communicates with a AIM-9 system test panel which is used by ground screws to initiate internal bit checks.

The ETP, located inside the quick access door of F12. Communicates directly with the Digital Data Processing Unit via a biphasic digital link. By setting a toggle switch position on the panel, the-system can be operated in a live missile or training missile mode. The ETP is used to initiate internal built-in-test (IBIT), indicates visually the results and identifies a defective Line Replaceable Unit by turning on an LED.

The GMIU, located in the DRA, provides the interface between the DDPU and the AIM-9 missiles. It contains all of the circuitry necessary to control and monitor two missiles or one missile and one AIS pod. Missile audio tone is processed by the GMIU and delivered to the DDPU. Missile seekerhead "look" angles are also transmitted and received by the GMIU. High current outputs required for missile launch are provided by the GMIU in response to data received from the DDPU via a biphasic data link. The GMIU passes 115v 400 Hz to the launcher for use as required. The DRA is designed for pylon mounted parent rack carriage on stations 1 and/or 11 and provides the mounting and electrical interface for two LAU-105 AIM-9 missile launchers. DRA is suspended from a parent rack through bail lugs threaded into integral lug fittings

mounted on 14 inch centers. The DRA is equipped with identical composite fairings at the forward and aft ends to provide an aerodynamic shape.

The Integral wire harness assembly receptacle mates with a pylon umbilical cable and provides the electrical interface between the aircraft AIM-9 Missile Control System, the GMIU mounted within the DRA, and the LAU-105 launchers. Electrical components of the DRA consist of the GMIU, and the electrical harness. The GMIU mounts within the electrical bay to rails attached to the structure. The Harness consists of four connectors that mate with the LAU-105 launchers (two per launcher), the GMIU interface connector, and the input receptacle that launcher, the GMIU interface connector, and the input receptacle that mates the DRA to the pylon via an adapter cable. A dummy connector (attached to DRA) is provided at each of the four connector locations for stowing harness connectors when LAU-105's are not attached.

ROCKET LAUNCHERS

WARNING

- If a rocket pod is loaded on a TER, the CBU/ROCKET switch must be set to ROCKET. This routes the firing voltage through a resistor to limit the voltage applied to the intervalometer. If the switch is set to CBU, the resistor is bypassed. This will cause the high voltage to operate the intervalometer at a rate that produces a near salvo fire effect, and the rockets may collide upon leaving the launcher. Also, if the switch is set to CBU, stray voltage may enter the circuit and possibly result in inadvertent firing.
- The proper electrical harness must also be used. The rocket and CBU harness appear to be identical. The harness marked ROCKET is the proper harness. If the CBU harness is inadvertently used, stray voltage might cause the launcher to salvo fire when power is applied or when the weapons selector knob is positioned to fire rockets and all other aircraft criteria for launch have been met.

NOTE

- The interface of the LAU-68/131 intervalometer and the ACS RIP SGL or RIP PRS mode causes system anomalies. When the launcher is mounted on a TER-9/A, these anomalies may cause hung rockets. In this case, if a ripple mode is desired, select RIPPLE on the LAU-68/131 SINGLE/RIPPLE switch and use the SGL mode of the ACS. When the launcher is parent mounted, the RIP SGL or

RIP PRS mode of the ACS may be used; however, pending results of engineering study, a minimum of 220 msec in the RIP INTVL selector is recommended to prevent possibility of hung rockets.

- RIP SGL release of rockets with paired stations selected may result in hung munitions, as the ACS may not automatically sequence between pods.

SUU-20 SERIES BOMB DISPENSER DESCRIPTION

The SUU-20 series dispenser (Figure 1-87 (Sheet 1 of 2)) 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 practice bombs. The six practice bombs are carried in a recessed open bay and held in individual bomb ejector racks by retention arms, swaybraces, and ejector pistons.

The SUU-20A(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-20A(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 swaybracing the practice bombs has been changed.

The practice bomb ejector racks consist of bomb retaining arms, swaybraces, and an ejector piston assembly. The bomb retaining arms are adjustable for 3-inch or 4-inch bombs. The forward swaybrace is a bolt with a metal inverted V on the lower end. On the SUU-20A(M) and SUU-20A/A, the aft swaybrace is a spring-loaded wedge. The forward swaybrace is screwed down to level the bomb horizontally and the aft swaybrace is moved forward to wedge the bomb snugly in place. On the SUU-20B/A, one swaybrace is a bolt with a saddleback pad on the lower end. Both swaybraces 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 swaybrace 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-20A(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 elec-

trically 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 insure it does not vibrate loose in flight.

The dispenser has two intervalometers located forward in the recessed bomb bay in front of the practice bomb racks. On the SUU-20A(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 insures that in setting the intervalometers during arming area checks, the intervalometer does not have to be cycled through any loaded stations.

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.

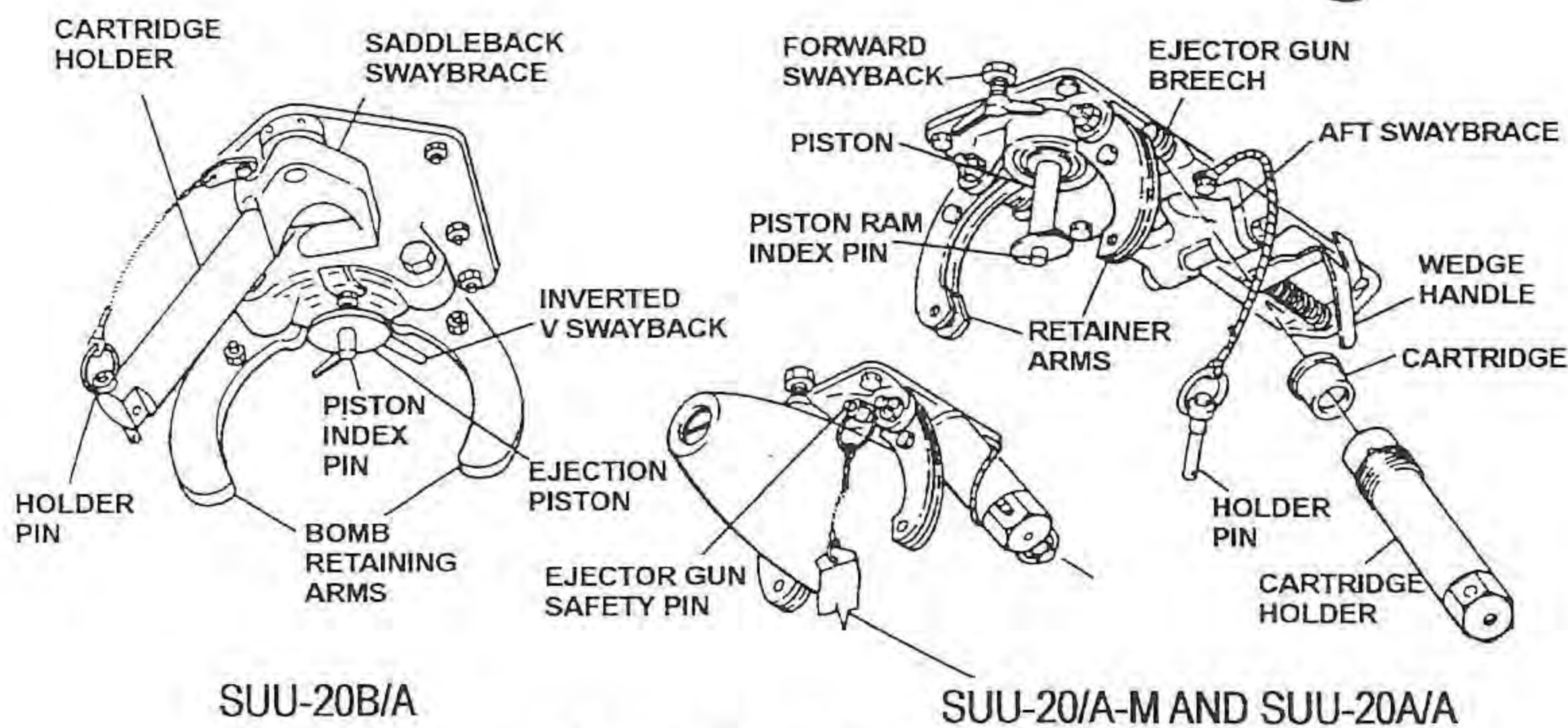
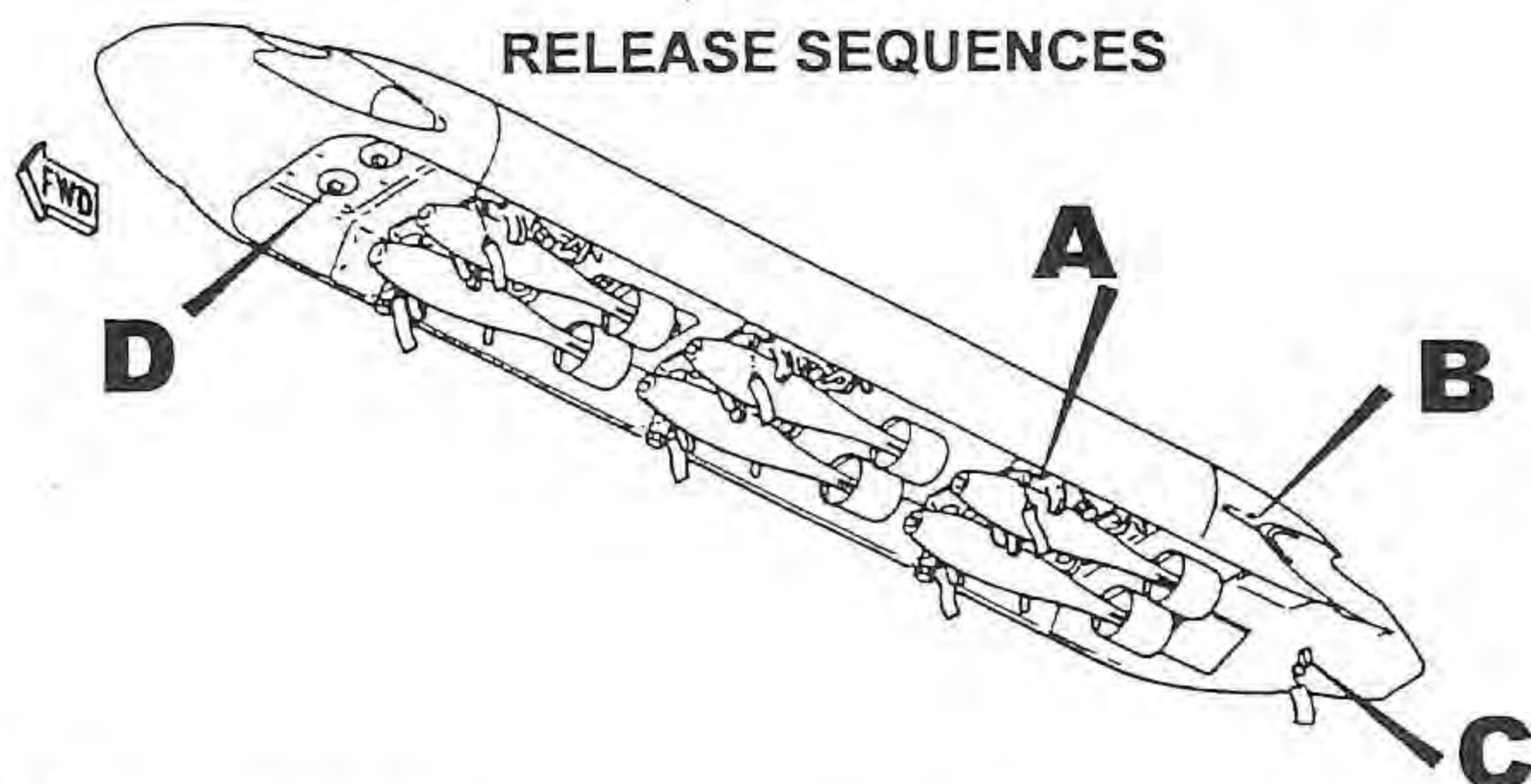
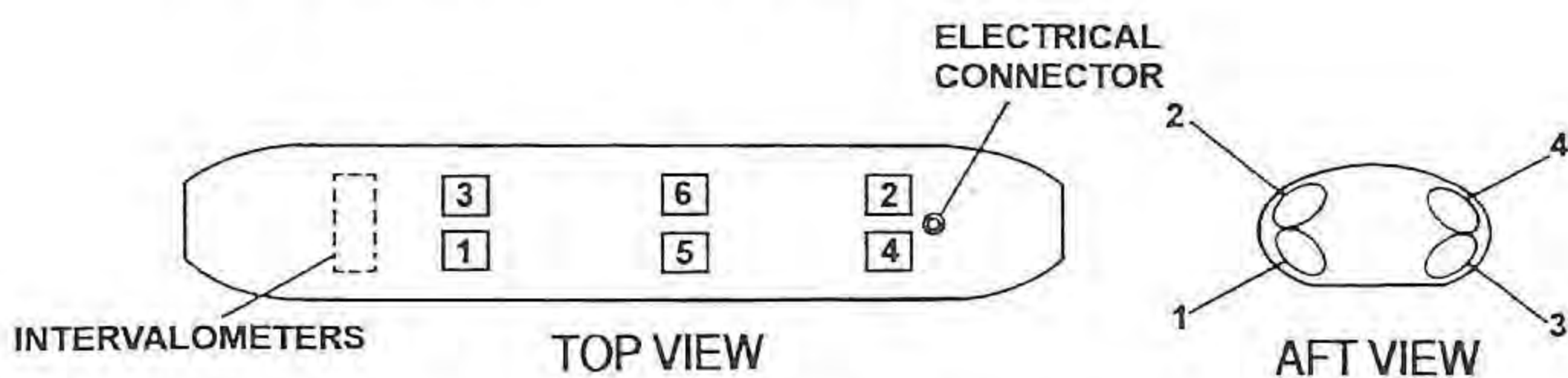
NOTE

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.

PRACTICE BOMBS BDU-33 SERIES PRACTICE BOMBS

The BDU-33 series practice bombs (Figure 1-88) are 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 TER carriage, this lug is replaced with a MK-14 suspension lug.

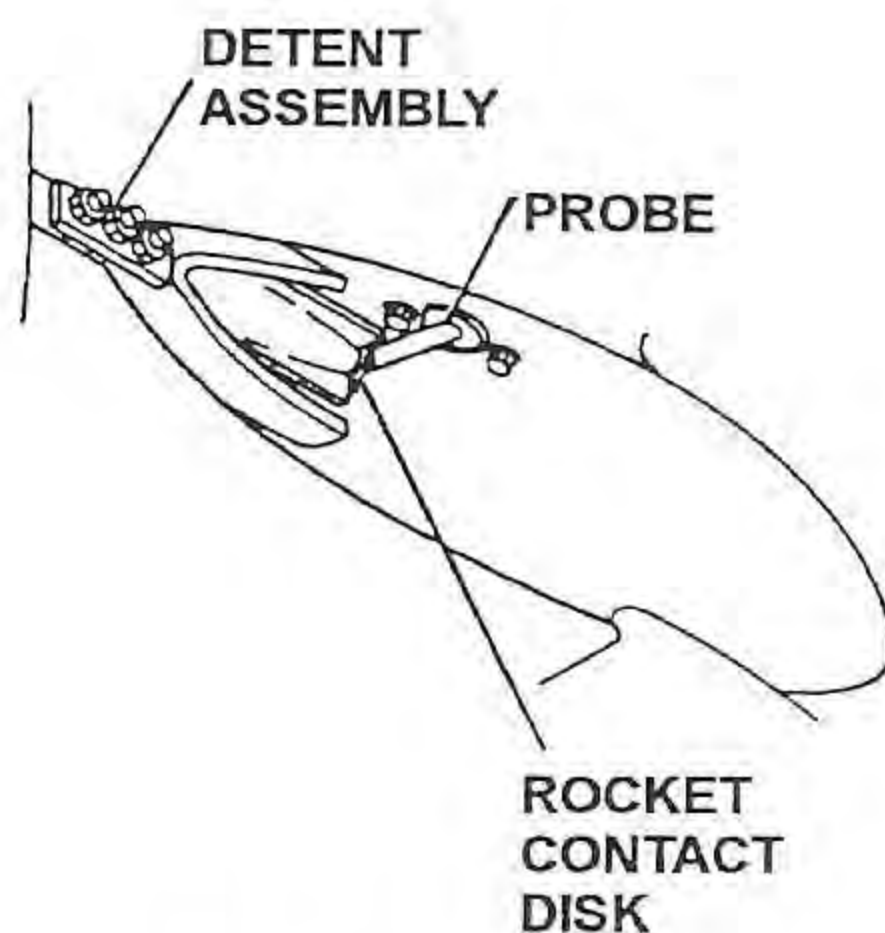
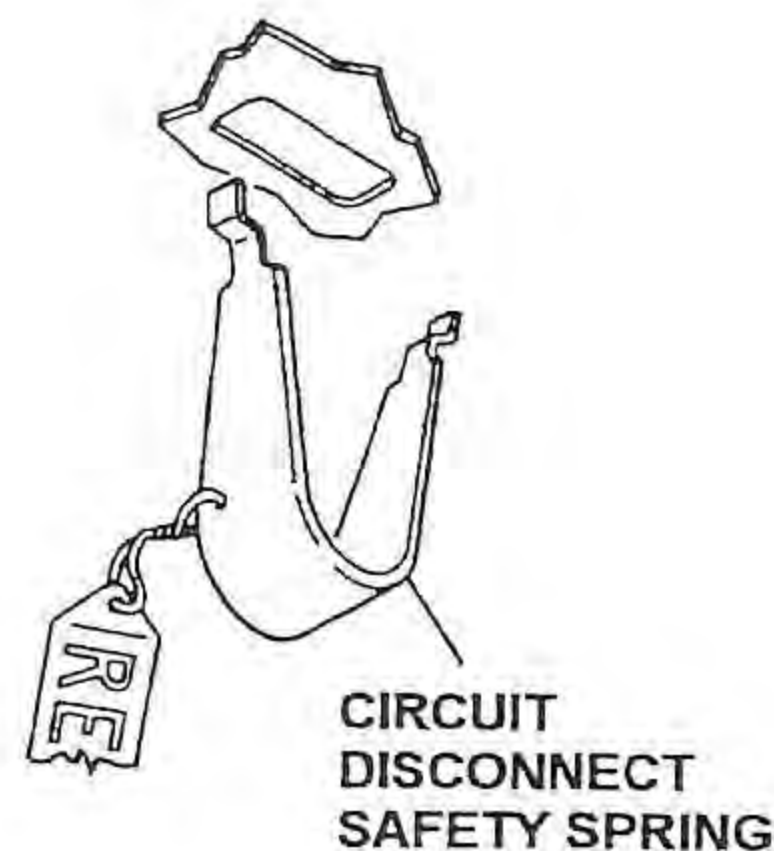
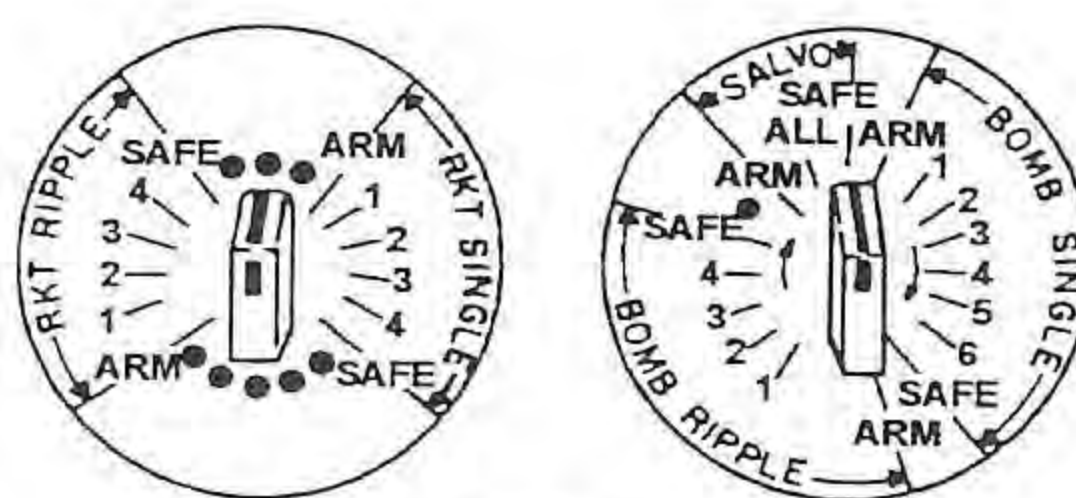
WEIGHT (FULLY LOADED) — 502 POUNDS
 WEIGHT (EMPTY) — 276 POUNDS
 LENGTH — 122 INCHES
 DIAMETER (ELLIPTICAL) — 19 x 12 INCHES



BOMB EJECTOR RACK DETAIL A

1A-10A-34-1-1-89

Figure 1-87. SUU-20 Series Bomb and Rocket Dispenser (Sheet 1 of 2).

**DETAIL B****DETAIL C****INTERVALOMETERS****DETAIL D**

1A-10A-34-1-1-90

Figure 1-87. SUU-20 Series Bomb and Rocket Dispenser (Sheet 2 of 2).

The signal cavity of an assembled bomb contains, from nose to tail, an MK-1 Mod 0 firing pin assembly, an MK 4 Mod 3 or a MK 4 Mod 4 signal cartridge, an inertia tube, and a cotter pin.

Impact of the bomb drives the single 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.

The differences between types of practice bombs are as follows:

BDU-33B/B - Cruciform type fin, firing pin assembly, signal cartridge, and inertia tube inserted in tail end of bomb.

BDU-33D/B - Same as BDU-33B/B except pin assembly, signal cartridge and inertia tube inserted in nose end of bomb.

CTU-2/A RESUPPLY CONTAINER

The CTU-2/A is a parachute retarded container used to deliver combat supplies to ground forces (Figure 2-32). The container may be loaded with any equipment up to a maximum weight of 500 pounds, provided the equipment can be loaded to maintain the container center of gravity (CG) within allowable limits.

NOTE

The parachute system limits the delivery speed to 450 KCAS maximum and the delivery altitude to 300 feet AGL minimum.

The CTU-2/A consists of three basic assemblies: the fin stabilized container, a cartridge-actuated parachute release assembly, and the parachute assembly. At release, the initiator cable attached to the bomb rack causes detonation of the cartridge-actuated release assembly. After a 0.3-second delay, the release assembly ejects the tail cone and deploys the pilot parachute. The pilot parachute, in turn, deploys the main parachute to a reefed diameter of 36 inches. Explosive cutters then part a reefing line and initiate blossoming to full diameter. Container descent is controlled to an impact velocity of approximately 30 fps and at a nearly vertical impact angle.

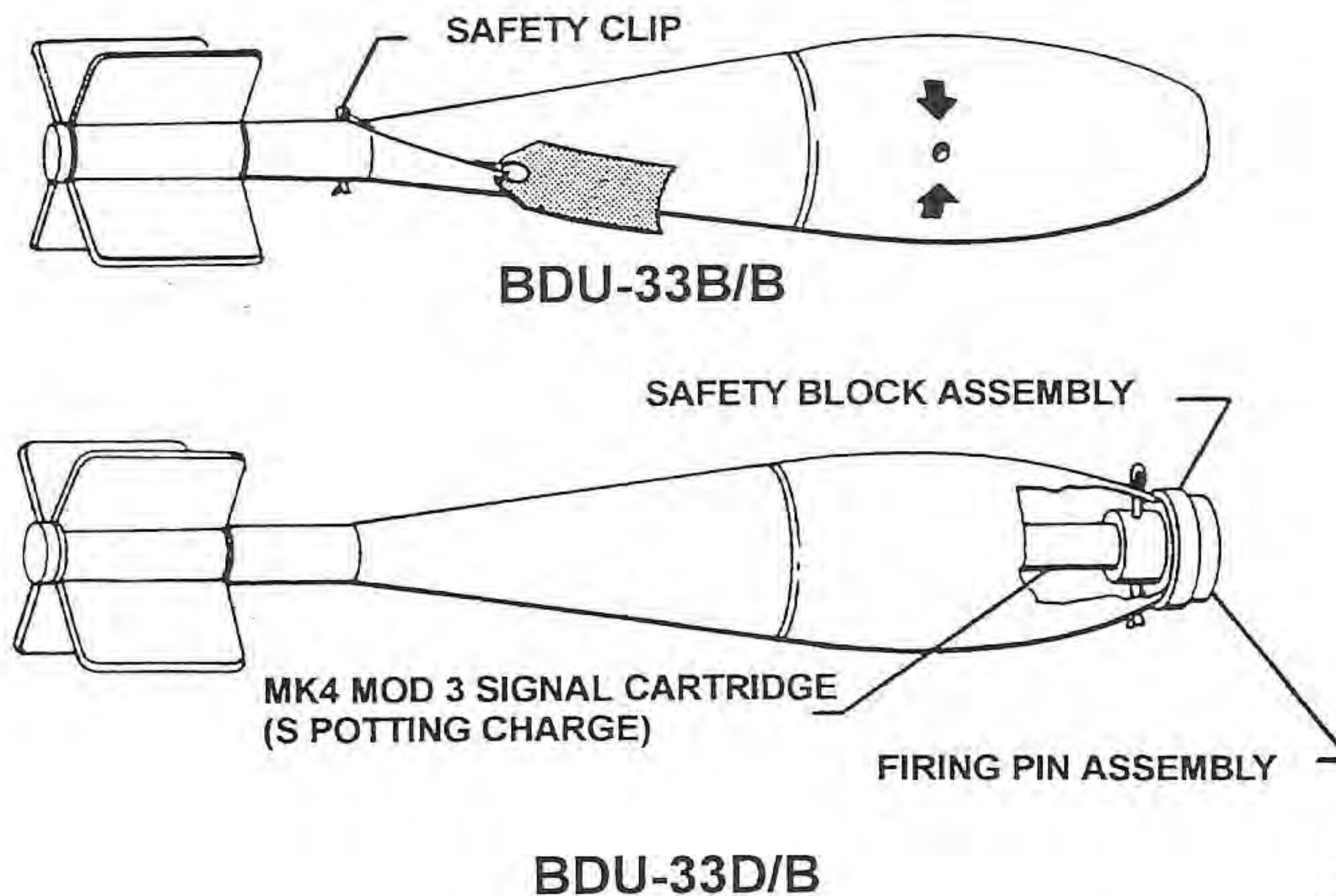
At release, the aerodynamic stability of the loaded container is specifically dependent on maintaining the loaded container CG within specified limits.

The chart in Figure 2-32 is provided to establish a CTU-2/A CG limit in order to verify container stability at release. The chart locates the most aft allowable CG position as a function of container payload weight and release calibrated airspeed (CAS). The measurement is expressed as the distance between the leading edge of the gravity center section (station 20) and the most aft CG. The allowable CG therefore includes any point forward of the aft limit. The allowable CG is obtained from the chart in the following manner: (1) locate the planned payload weight on the chart, (2) project to the planned release CAS and then down to arrive at the aft limit; the actual CG must be forward of this point.

CAUTION

If the actual CG is aft of the chart measurement, the release speed and/or payload weight must be adjusted to establish an acceptable CG position. Failure to observe the required CG limits can result in unstable separation characteristics.

WEIGHT — 23 POUNDS
LENGTH — 23 INCHES
DIAMETER — 4 INCHES



1A-10A-34-1-1-91

Figure 1-88 Practice Bombs.

PART 6 NON-NUCLEAR WEAPONS (COMBAT)

AIRCRAFT GUNNERY SYSTEMS

GAU-8/A 30MM Gun

The gun (Figure 1-89) is a seven-barrel Gatling type, weighing 679 pounds. It has a double-ended linkless feed system with a capacity for up to 1,174 rounds of percussion primed ammunition. The gun system retains all spent cases or dud rounds. The installation of the gun system is such that it positions the firing barrel approximately on the aircraft centerline. The gun muzzle protrudes at the fuselage nose with the gun mechanism located under the cockpit and the ammunition drum located in the area just behind the cockpit. Firing rate is 3,900 +200, -600.

System drive is provided by a gearbox with two separately controlled hydraulic drive motors and control valves mounted on the support structure between the gun and ammunition storage system, and is connected by a mechanical transmission. Electrical power from the DC armament bus is required to operate the gun. At least one aircraft generator or the APU generator must be on the line. Both hydraulic systems are required to fire the gun in HI rate. If one aircraft hydraulic system fails or one hydraulic drive motor is inoperative, low rate operation can be obtained with the operating hydraulic drive motor by selecting HI.

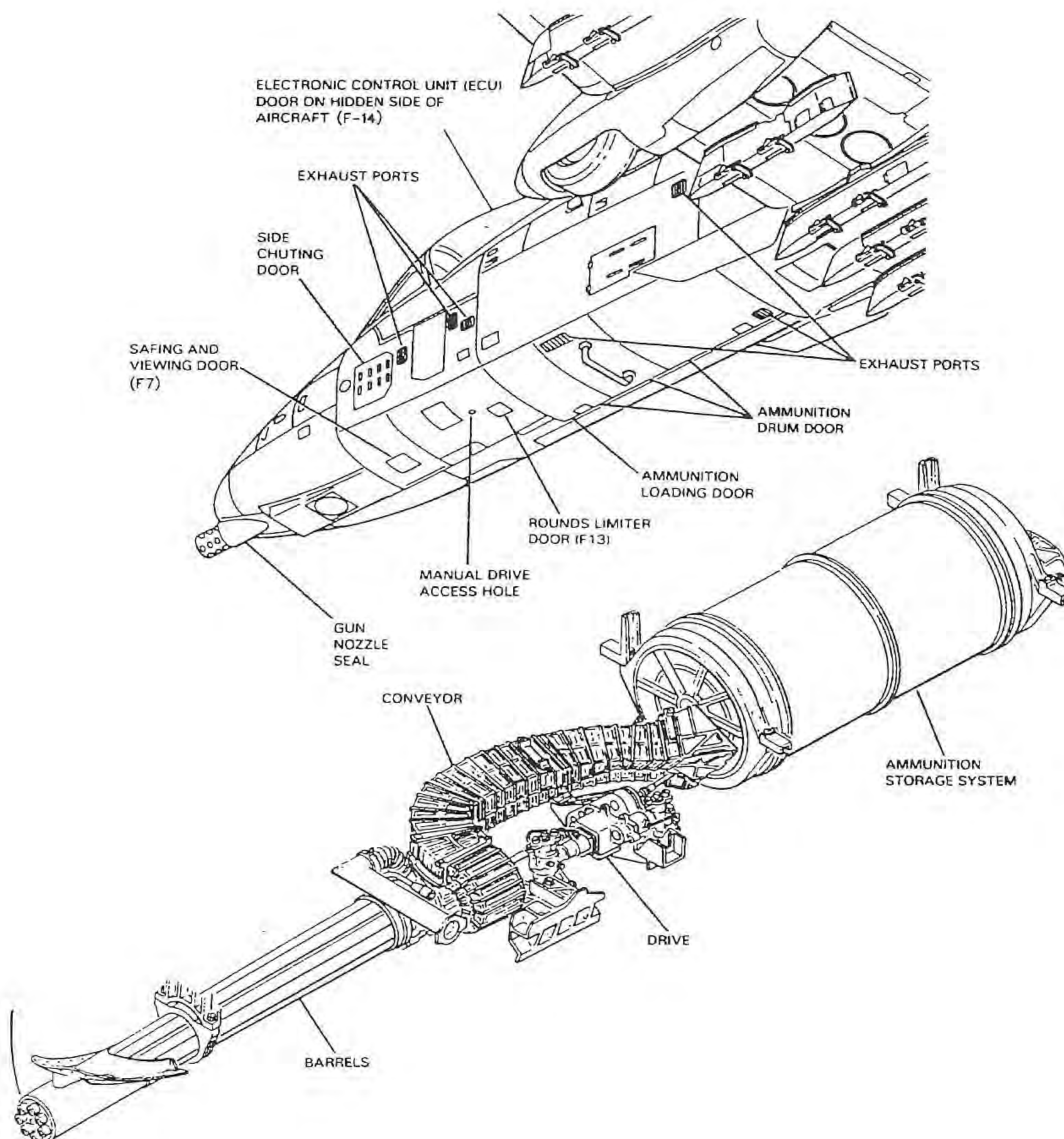
CAUTION

Failure of either hydraulic system or gun drive motor will revert the gun to LO rate firing, (2,100± 200). Firing in LO rate will be inaccurate due to aircraft vibration, could cause system damage, and should be used only in an emergency.

To arm the gun, the MASTER armament switch is set to ARM and the gun rate switch is moved from SAFE to HI. The landing gear handle must be up or the ARM GND SAFETY switch in O'RIDE. A firing command from the trigger switch, located on the control stick grip, actuates the system drive. The gun then accelerates to the preselected firing rate. In high rate, approximately 50 rounds are fired in the first second and 70 rounds per second thereafter. Ammunition is cycled from the drum, through the exit unit, to the conveyor element. The elements carry the rounds through flexible and fixed chuting to the transfer unit, where they are removed from the element and fed into the gun. After firing, the empty cartridge cases are conveyed back into the drum for storage. The gun is then cleared by automatic reverse rotation. If the clearing operation is not complete in 2.5(±0.05) seconds, the GUN UNSAFE light will come on. After the gun clearing operation is complete, four 180° clockwise and counterclockwise gun rotation reversal cooling cycles will occur at approximately (±3 sec) at 24 sec, 60 sec, 100 sec, and 150 sec. These cycles may be interrupted at any time to restart firing. Loading and downloading of ammunition is accomplished through the access unit at the bottom of the drum. The loading mechanism is attached to the access unit. It can be driven by either the aircraft hydraulic drive or external power at the gearbox. The GAU-8/A is boresighted to 41 mils below zero sight line, and is harmonized for 4,000 feet slant range under the following conditions:

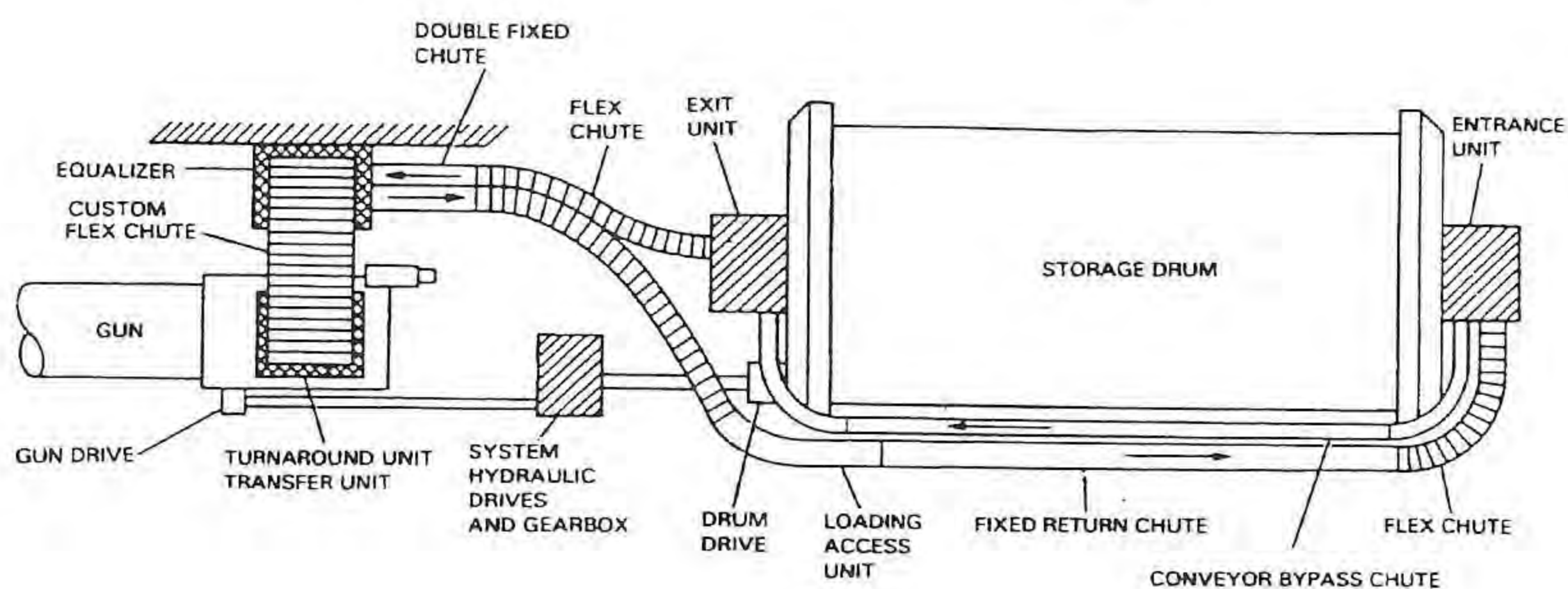
29,700 lb aircraft
30° dive
250 KIAS
HIGH rate

Due to gun acceleration characteristics of the "gatling effect", a short burst will normally hit to the right of the aiming index.

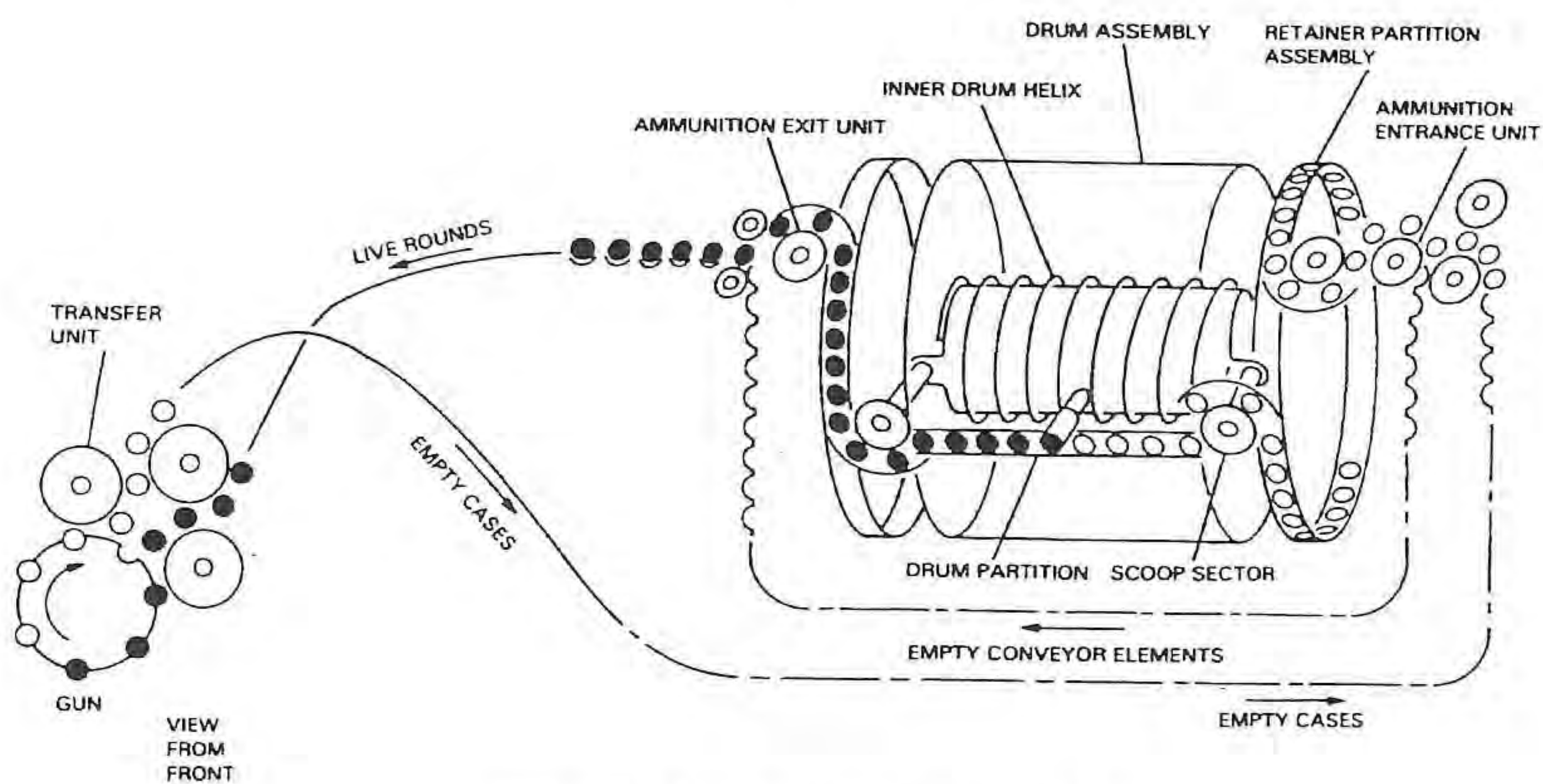


1A-10A-34-1-1-92

Figure 1-89 A/A 49E-6 Armament Subsystem (Sheet 1 of 2).



FEED AND STORAGE SUBSYSTEM SCHEMATIC



FEED AND STORAGE SUBSYSTEM OPERATION

1A-10A-34-1-1-93

Figure 1-89. A/A 49E-6 Armament Subsystem (Sheet 2 of 2).

SECTION II

NORMAL PILOT PROCEDURES

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INTRODUCTION

This section contains pilot procedures for delivery of munitions from preflight through after landing. Preflight procedures include exterior inspections of chaff/flare system, gun, suspension equipment, and munitions. Also included in preflight procedures are interior inspections. All steps that are considered safety of flight items are coded with an asterisk (*). Abbreviated pilot procedures from this section are also contained in Weapons Delivery Checklist, T.O. 1A-10A-34-1-1CL-1.

PREFLIGHT PROCEDURES

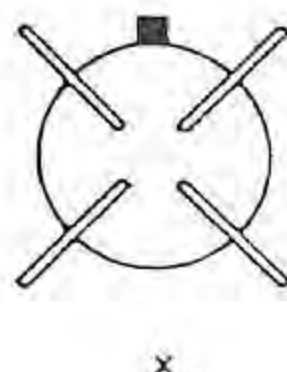
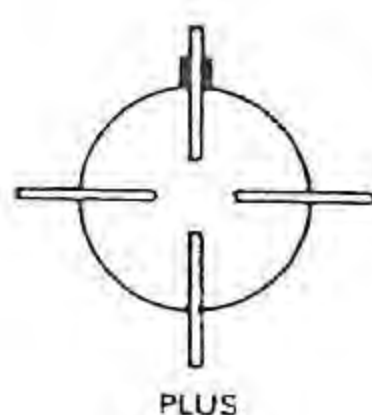
These exterior and interior inspection items are in addition to items required by the Flight Manual. The preflight requirements of the flight Manual are not repeated here. It is recommended that the pilot perform weapons preflight separately from aircraft preflight to ensure thoroughness and avoid confusion.

NOTE

Actual arming wire configurations may vary slightly with the diagrams shown in this section. If doubt exists, call the munitions crew chief.

During alert, certain safety pins may be removed, electrical cable plugs may be connected and switches armed as directed by Major Command or local commander during combat conditions. Checklist items assigned to be performed in arming area may be performed in any designated area when aircraft is on alert status.

Fin configuration is defined in relation to the bomb suspension lugs. (See Figure 2-1).



1A-10A-34-1-1-2-1

FIN CONFIGURATION

Figure 2-1.

INTERIOR COCKPIT CHECK

- *1. Mission card, ammo placard, and munitions loaded — compare with ACS thumbwheels:

THUMBWHEEL DISPLAY	MUNITION
LDGP	MK 82, MK 84, BDU-33, BDU-50/-56, CTU-2/A, M117, M-129
CW	SUU-64/-65/-66 BL-755
SMOKE	NONE
SPL	BLU-52
DISP	AIM-9, EMPTY TER
ECM	ALQ-131, ALQ-184
RKT	LAU-68/-131
FLARE	SUU-25
E/O	AGM/TGM-65
LASER	GBU
GUN	NONE
FUEL	EXTERNAL TANKS
HDGP	MK 36, MK 82 AIR, BDU-50 AIR
(BLANK)	NONE

WARNING

Incorrect thumbwheel display can result in unintentional release of suspension equipment.

The armament control system will send a bomb release signal to a selected station that has a blank in the display window when any other station with LDGP in the store loading display is selected, a fuzing option is selected, and the pickle button is depressed.

- Battery switch — OFF.
- *3. ARM GND SAFETY switch — SAFE.
- INTERCOM control panel HF switch — ON (if AIM-9 loaded).

T.O. 1A-10A-34-1-1

*5. Armament control panel:

- a. MASTER armament switch — SAFE.
- b. EO PWR switch — OFF.
- c. Gun rate switch — SAFE.
- d. AIM-9 MODE switch — OFF.
- e. Release mode selector — OFF.
- f. Mechanical fuzing selector — SAFE.
- g. GAU-8A rounds remaining display
Checked:
 - (1) Rounds remaining — Checked.
 - (2) Set knob — Fully extended.

*6. Chaff/flare control panel — Set. **137**

- a. Flare jettison switch — Aft, safe position.

WARNING

If flare jettison switch is in JETTISON, the flares will jettison when weight is off wheels.

- b. Chaff mode selector knob — OFF.
- c. Flare mode selector knob — OFF.
- d. Chaff and flare remaining indicators — Set.

*7. CMSP/(EWMU) — Set. **138**

WARNING

If JTSN switch is set to jettison position, jettison of all payloads will occur when the weight is off wheels regardless of mode selector switch position including the off position.

- a. JTSN switch — Down.
- b. System switches — OFF.
- c. Mode selector switch — OFF.

EXTERIOR INSPECTION

GAU-8/A 30MM GUN (Figure 2-2)

- *1. GAU-8/A ground safety pin — Installed.

2. Ammunition - loaded (upper conveyor, panel F7).
 - a. Rounds visible.
 - b. Correct type — (Blue-TP, Yellow-HEI, Black-API).
 - c. Rounds limiter — Checked.

NOTE

If the rounds limiter quantity is set between 899 and 999 by winding down from 0, and LIMIT-NO LIMIT switch is set to LIMIT, the gun may not fire. Either set a quantity up from 0, or set LIMIT-NO LIMIT switch to NO LIMIT.

AN/ALE40 CHAFF/FLARE SYSTEM (Figure 2-3)

137

1. Landing gear pod EMI filter safety pins — Installed.
2. Reset/operate switch (if installed):
 - a. Full chaff/flare load — RESET.
 - b. Partial chaff/flare load — OPERATE.
3. Chaff single/double switch — Set.
4. Flare size selector switches — Set
5. Chaff/flare magazine — Checked.
6. Chaff/flare select switch — Set.
7. C-10286/ALE40(V) programmer control — Set.

CHAFF/FLARE DISPENSING SYSTEM (Figure 2-3)

138

1. Safety pins — installed.
2. Chaff/Flare selector switches — Set.
3. Digital address selectors — Set.

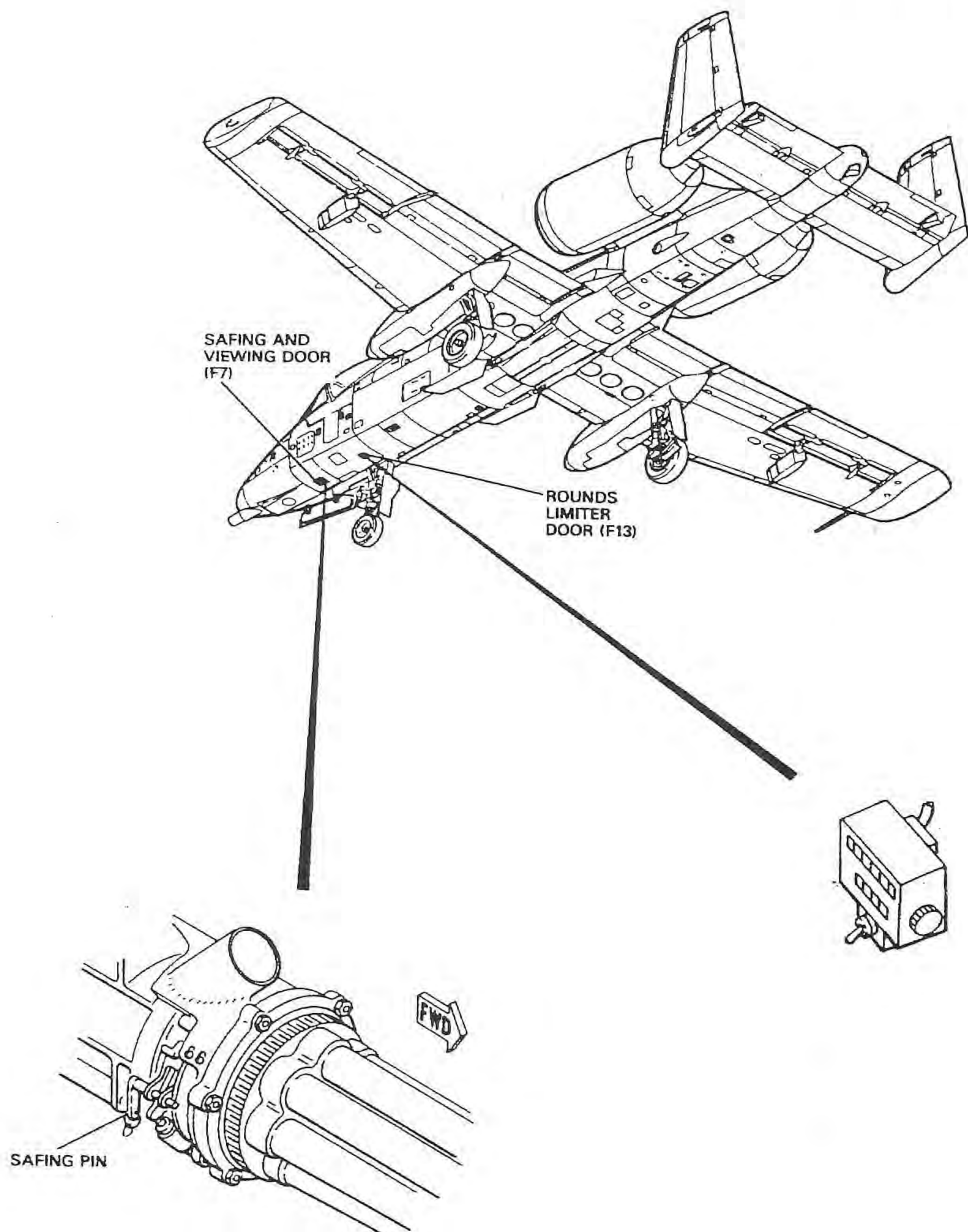
AIRBORNE VIDEO TAPE RECORDER

139 (Figure 2-5)

1. Film cartridge — Installed.

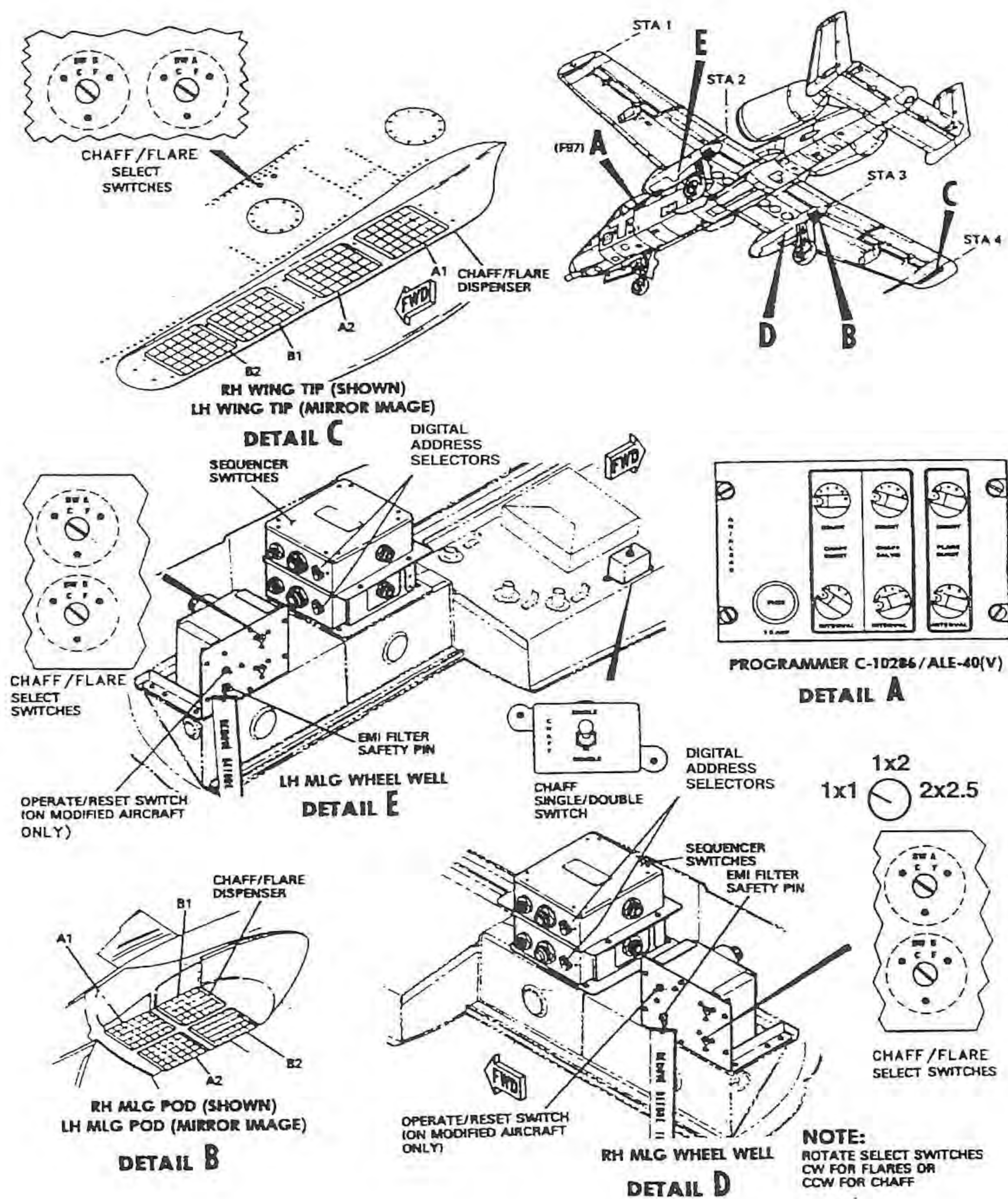
TISL (PAVE PENNY POD) (Figure 2-6)

1. Pod — Securely mounted to pylon.
2. Umbilical connector — Secured.
3. Dome cover — Removed.
4. Lens — Clean.



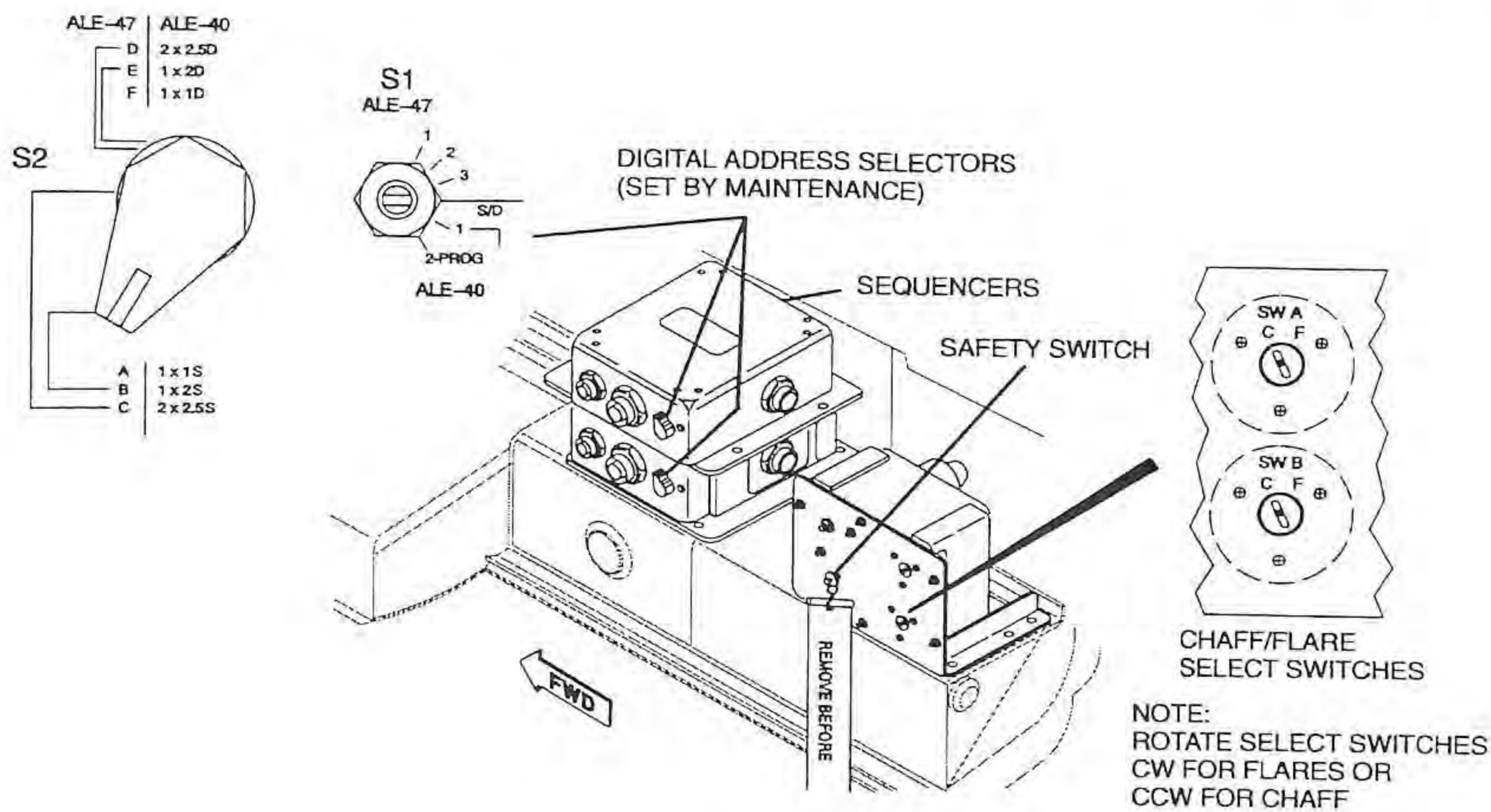
1A-10A-34-1-1-2-2

Figure 2-2. GAU-9/A 30 MM GUN

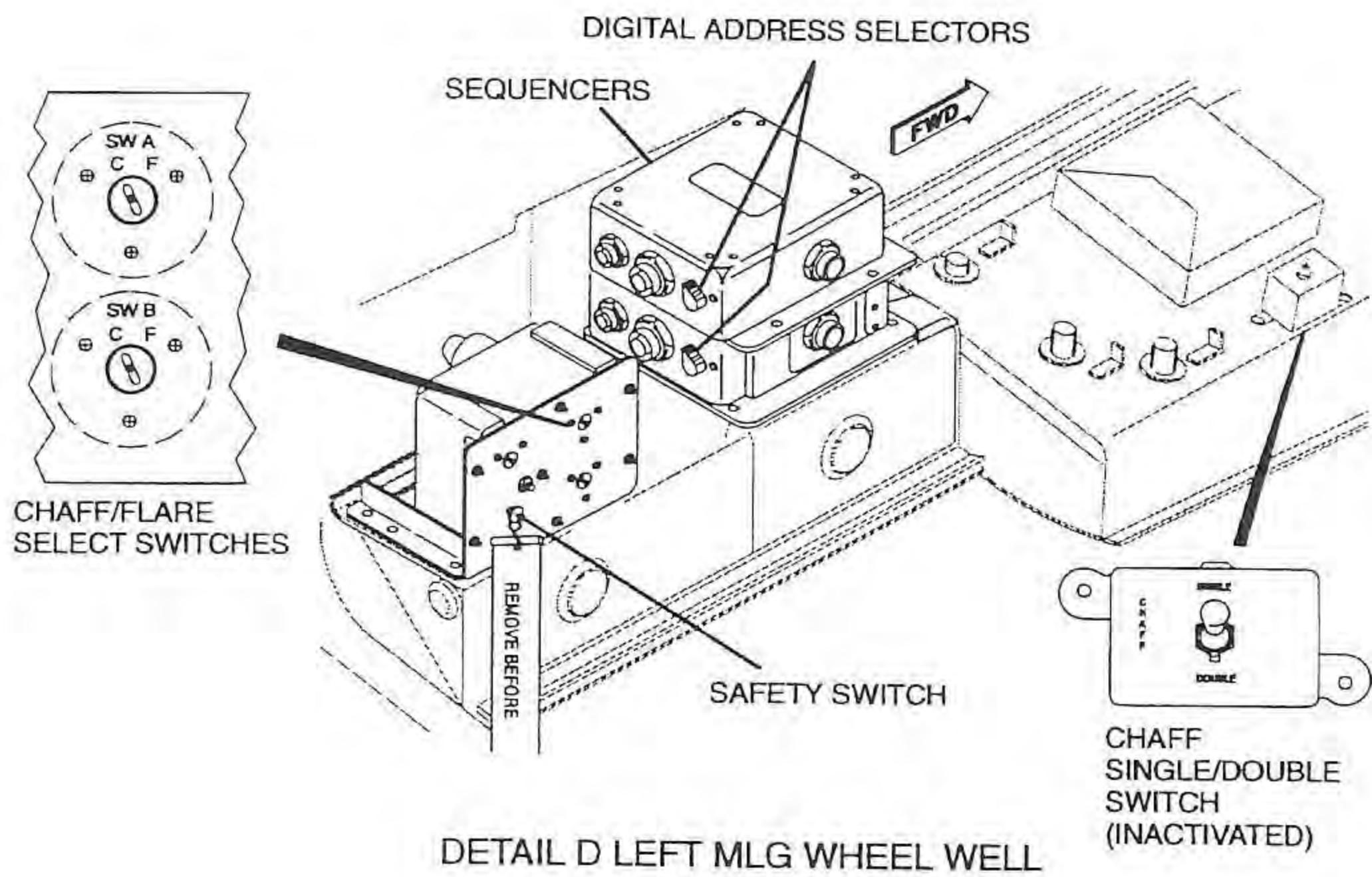


1A-10A-34-1-1-2-3

Figure 2-3. AN/ALE-40 CHAFF/FLARE SYSTEM



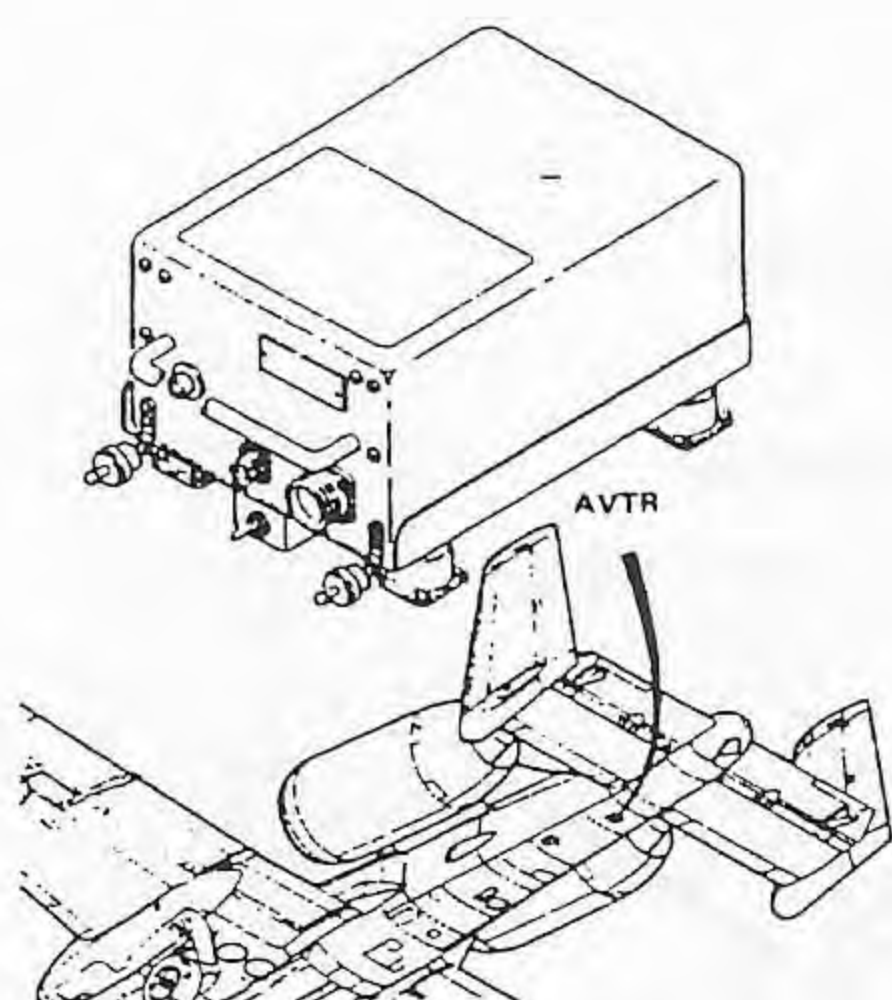
DETAIL C RIGHT MLG WHEEL WELL



DETAIL D LEFT MLG WHEEL WELL

1A-10A-34-1-1-53F-2-BCC1

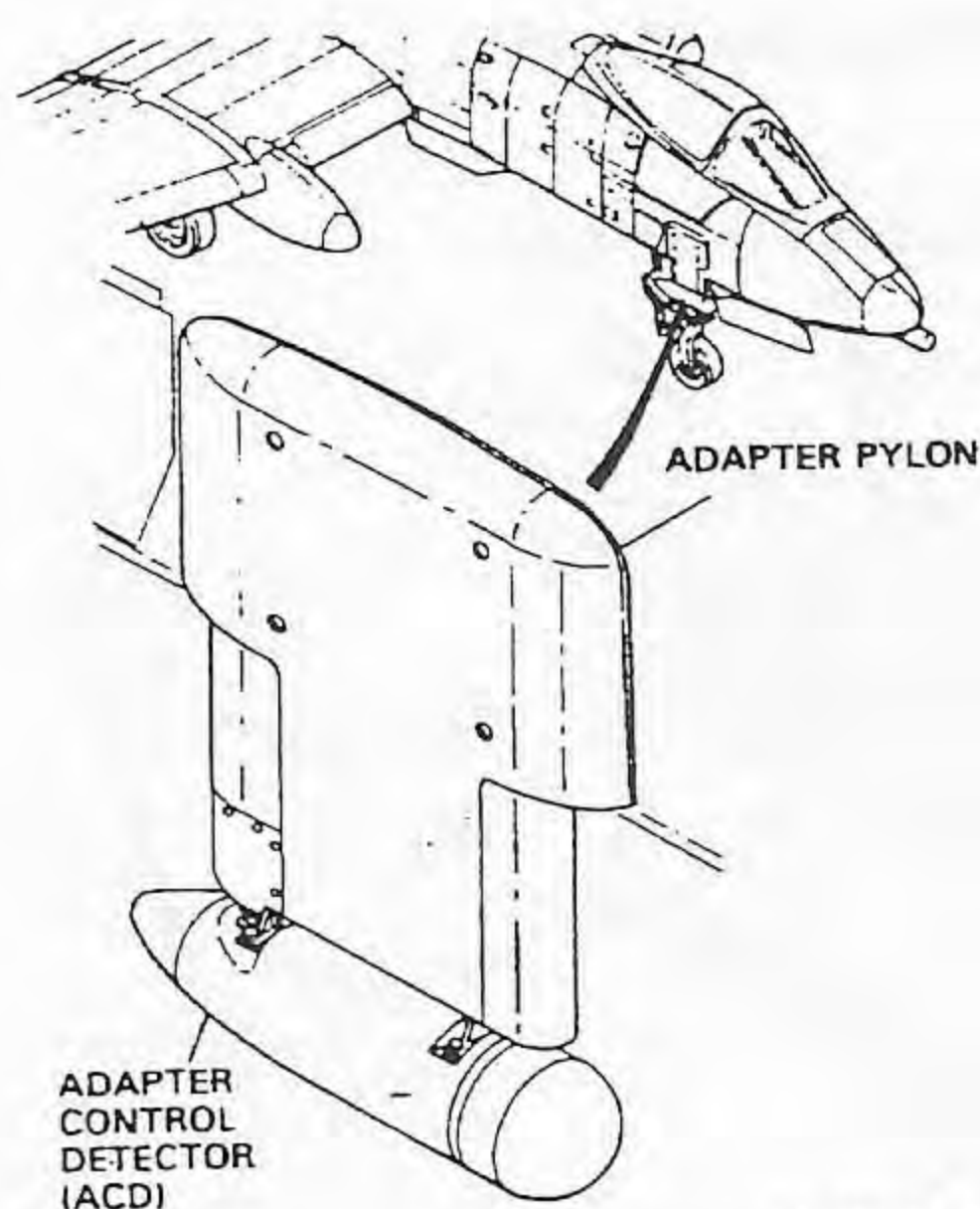
Figure 2-4. CHAFF/FLARING DISPENSING COMPONENTS



1A-10A-34-1-1-2-4

AIRBORNE VIDEO TAPE RECORDER 139

Figure 2-5.



1A-10A-34-1-1-2-5

TISL (PAVE PENNY POD)

Figure 2-6.

PYLONS - MAU-40/A AND MAU-50/A (Figures 2-7 and 2-8)

NOTE

Stores cannot be installed on station 5 or 7 simultaneously with station 6.

1. Bomb rack ground safety pin - Installed (removed prior to takeoff).
2. Bomb racks - Locked (red linkage shaft not visible) (Figure 2-7).
3. Ejector cartridges - Checked.

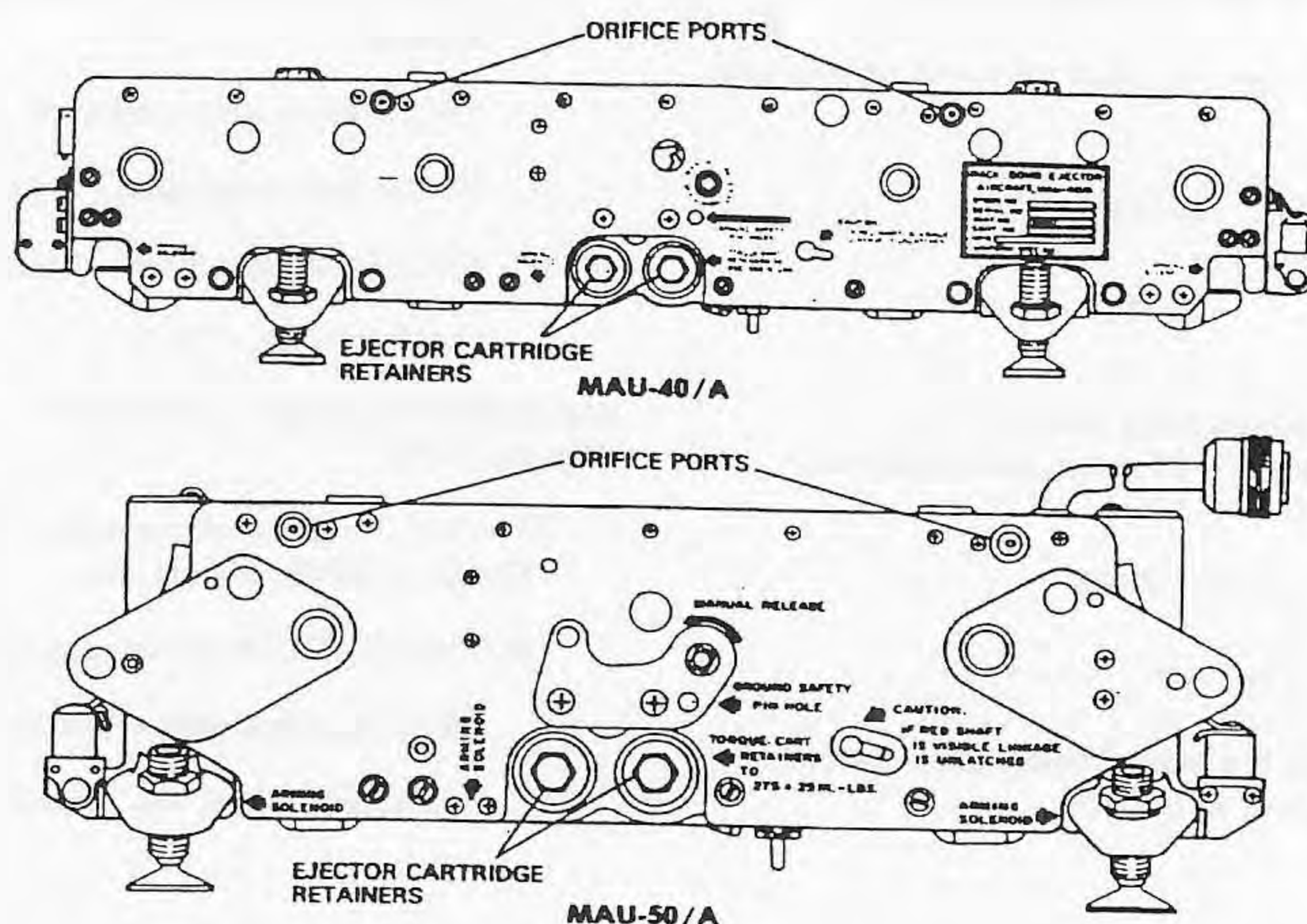
NOTE

- Cartridges may not be installed for stores not requiring cartridge installation in accordance with Major Command directives.
 - Local commanders have the option of installing and safety wiring empty cartridge retainers. Cartridge retainers found in this condition may be assumed to be empty.
4. Swaybraces - Tight.
 5. Ejector feet - Seated against store.
 6. Nose/center/tail arming solenoids - As required.
 7. Orifices - Installed and correct (Figure 2-8).

WARNING

Incorrect orifice settings may result in undesirable weapons separation characteristics.

8. Sensing switch - Seating (Munitions/LAU-68/-131).



1A-10A-34-1-1-2-6

Figure 2-7. BOMB EJECTOR RACKS

MUNITION/ ACCESSORY	FWD	AFT
ECM PODS	SAFETY	WIRED
BDU-50	7	7
BDU-50 AIR	7	7
BDU-56	7	7
BL-755 CLUSTER BOMB	7	7
BLU-52 CHEM. BOMB	7	7
CTU-2/A	7	7
FUEL TANK (ROYAL/ SARGENT FLETCHER)	7	3
GBU-10 LGB	7	A
GBU-12 LGB	7	7
LAU-68/-131 (RKT)	7	7
LAU-88, LAU-117	7	7
LAU-105 (DRA)	7	5
M-129	SAFETY	WIRED
MK 36 DESTRUCTOR	7	7
MK 82, LDGP	7	7
MK 82 AIR	7	7
MK 84 LDGP	7	7
MXU-648 CARGO POD	7	7
SUU-25 FLARE POD	SAFETY	WIRED
SUU-64/-65/-66	7	7
TER-9/A	7	5

Figure 2-8. MAU-40, MAU-50 ORIFICE SETTINGS

T.O. 1A-10A-34-1-1

TER-9/A EJECTOR RACKS (Figure 2-9)

1. Electrical safety pin - Installed (removed prior to take-off).
2. CBU/rocket switch - As required.

NOTE

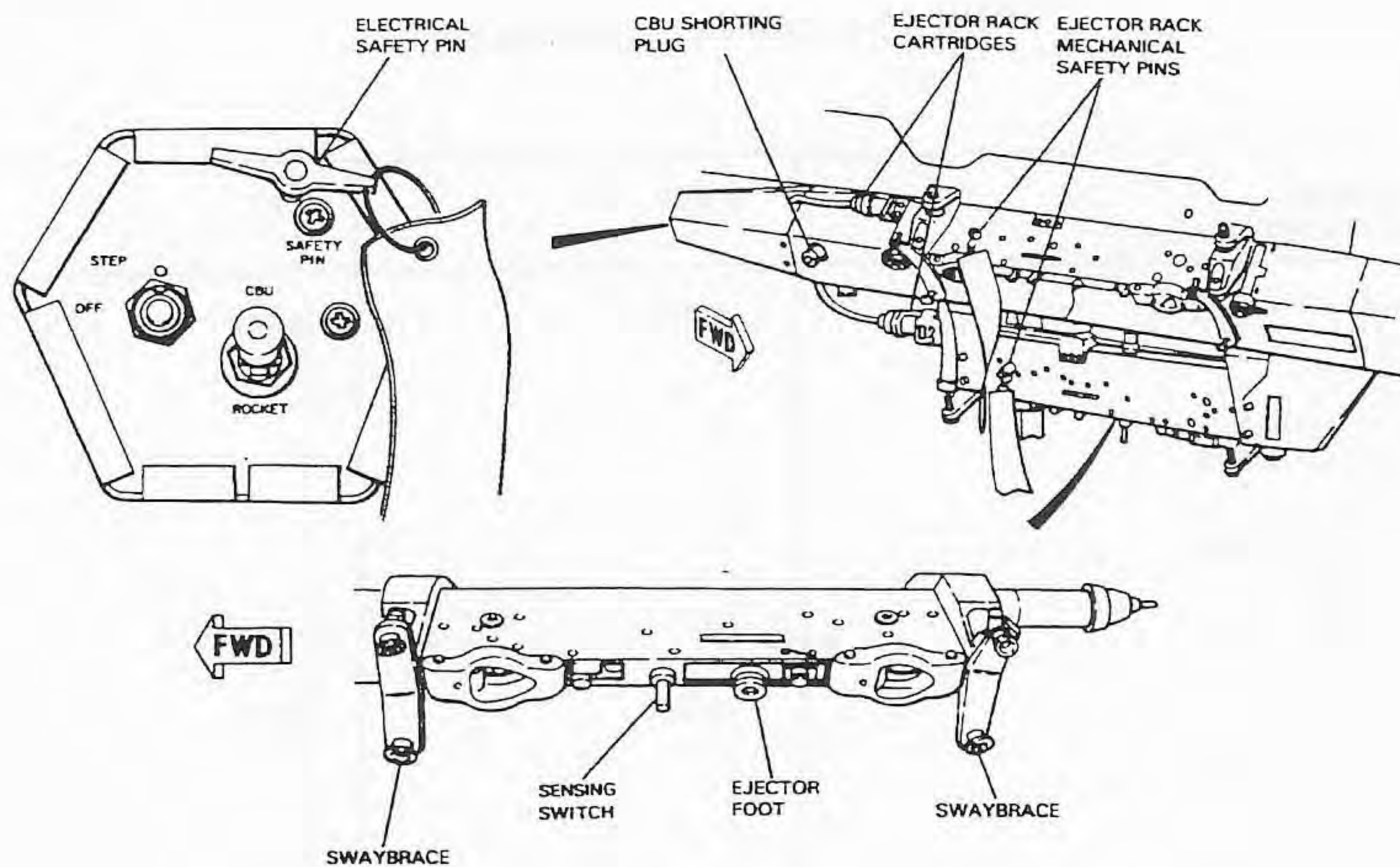
Switch should always be in ROCKET for LAU-68/-131 and SW-25 series flare dispensers. All other weapons use CBU.

3. Manual stepper switch - OFF.
- *4. Ejector racks - Checked:
 - a. Ejector rack mechanical safety pins - Installed (removed prior to takeoff).

- b. Ejector rack cartridges - Installed; breech caps - secured.
- c. CBU shorting plug - Installed.
- d. Ejector rack swaybraces - Tight.
- e. Ejector rack ejector feet - Seated against munition.
- f. Sensing switch - Check.

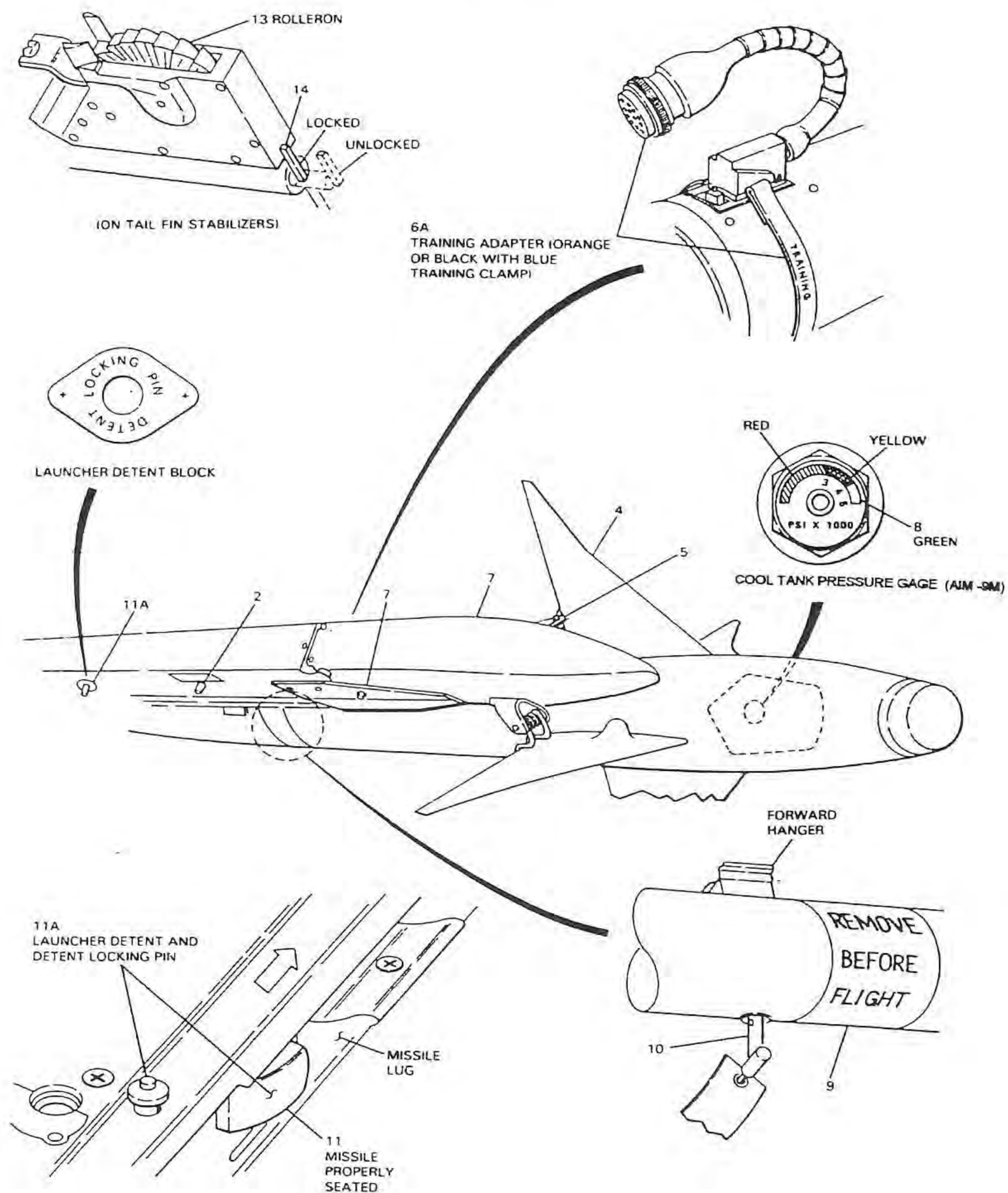
AIM-9 MISSILE AND LAUNCHER (Figure 2-10)

1. Electrical Test Panel toggle switch (Panel F-12) - TRAIN or LIVE. (Figure 2-11).
2. DRA with LAU-105 and missile(s) - Installed.
 - a. DRA Umbilical cable - Installed.
 - b. Launcher(s) Safety Pin - Installed.



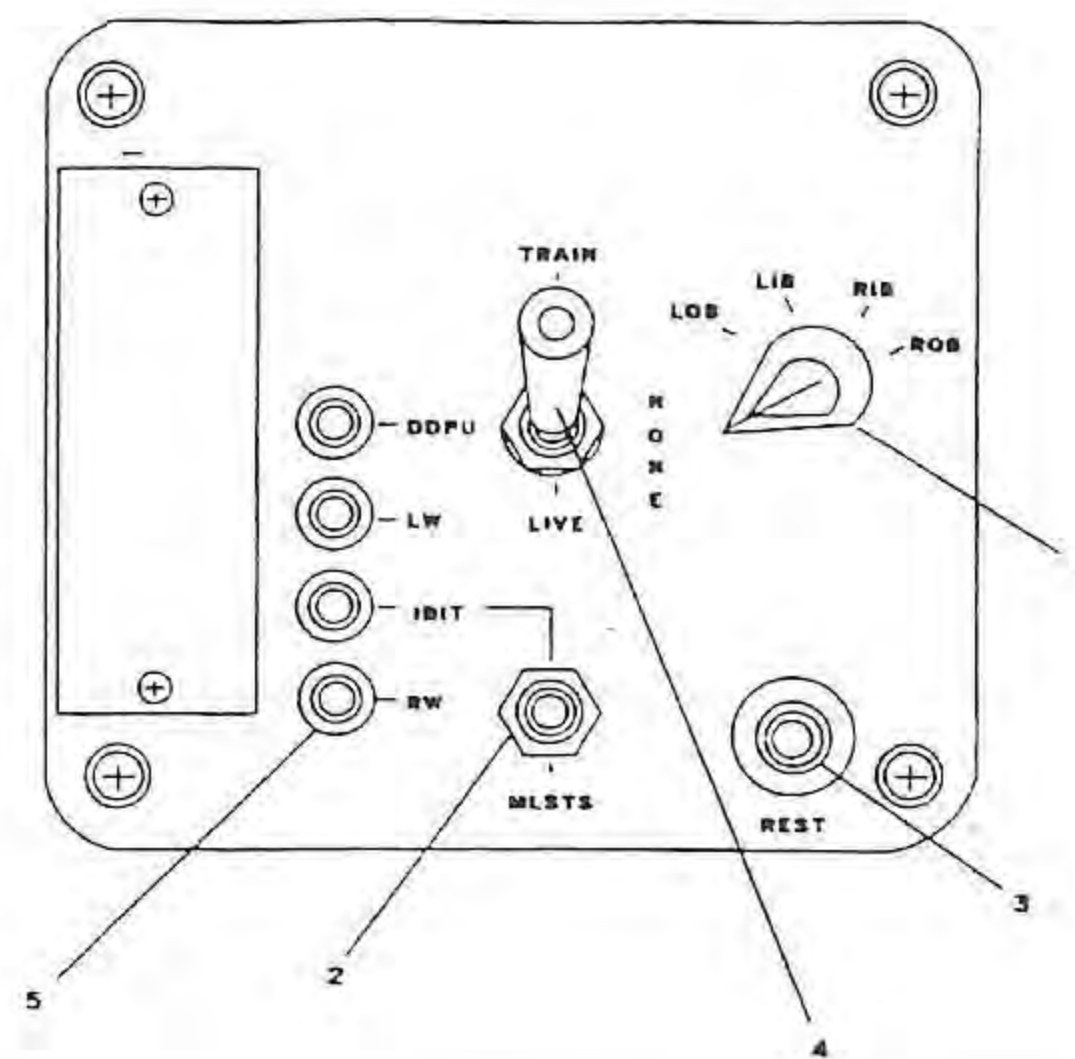
1A-10A-34-1-1-2-7

Figure 2-9. TER-9/A



1A-10A-34-1-1-2-8

Figure 2-10. AIM-9 MISSILE (TYPICAL)



1A-10A-34-1-1-2-9

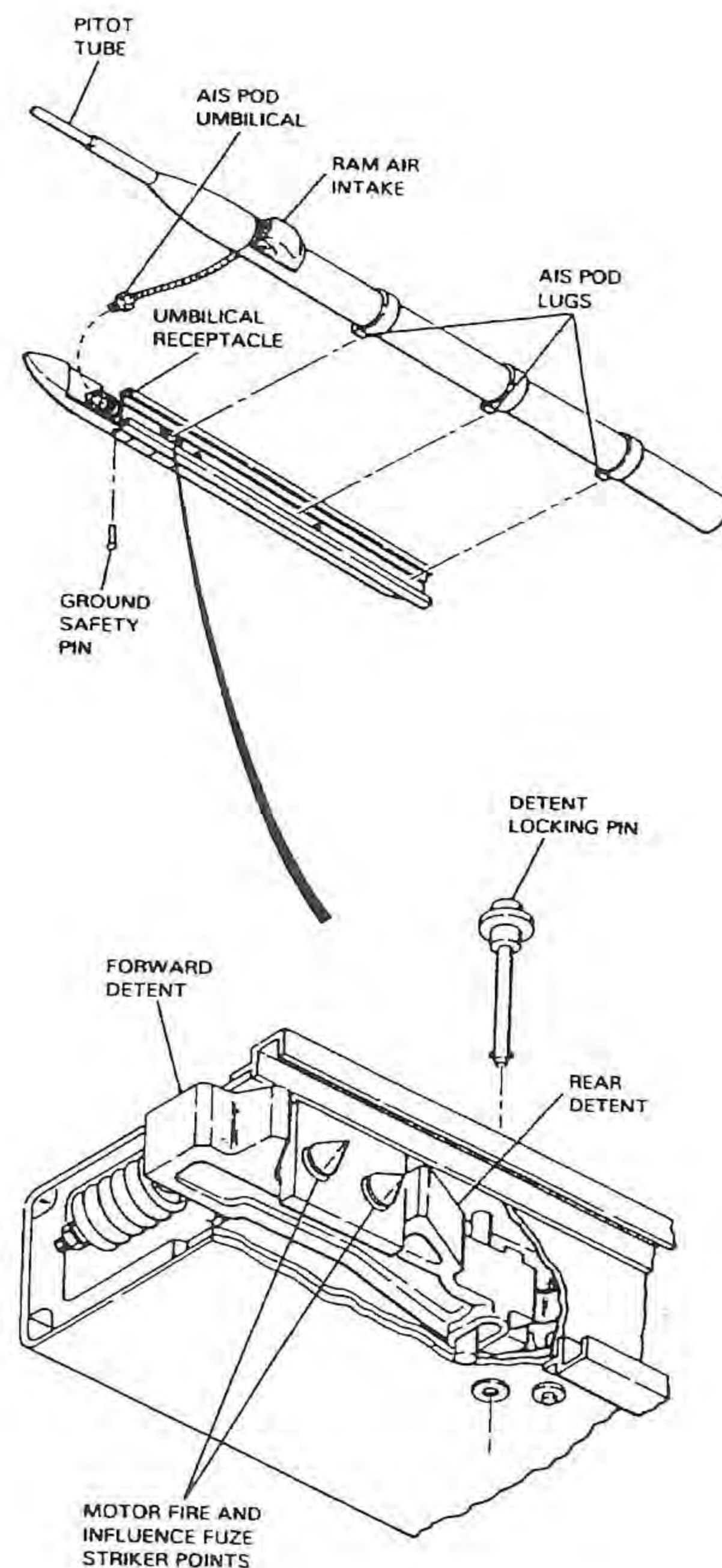
FIG REF.	CONTROL/INDICATOR	NOMENCLATURE	FUNCTION
1	Station Select Switch	NONE, LOB, LIB, RIB, ROB	This five (5) position rotary switch selects a specific station that is to be tested during the Interruptive Built-In-Test (BIT) routines. In the "NONE" position land NO DRAs installed, only the DDPU will tested.
2	Test Switch	IBIT, MLSTS	Actuation of this switch to IBIT initiates Built-In-Test routines of the missile control system. The MLSTS position is used when a Missile Launch System Test Set is placed on a pylon station to verify the proper operation of the AIM-9 system through the launcher.
3	Reset Button	RESET	The Reset button is used at the completion of testing to reset the system for its next phase of operation.
4	Mode Switch	TRAIN, LIVE	The MODE switch allows a Live fire mode in which a missile launch will occur and a Training mode in which the launching sequence is simulated.
5	Indicator Lights	DDPU	When lit, indicates a fault was found in the DDPU.
		LW, RW	When lit indicates a fault was found at the left (station 1) or right (station 11) wing pylon station.

Figure 2-11. Electrical Test Panel (ETP)

3. IR dome - Clean, undamaged, no chips/cracks (replace cover).
4. Fins - Undamaged.
5. Fin retaining springs - Engaged on fins.
6. Umbilical plug - Connected to launcher:
 - a. Training missile - Orange or black with blue training clamp.
 - b. Live missile - Black.
7. Launcher nose fairing - Secure.
8. Coolant tank pressure gage - Check:
 - a. For combat - An green area.
 - b. For training - Out of red area.
9. Target detector cover - Installed.
10. MK 36 MOD 8 motor arming key - Installed safe.
11. Missile - Check:
 - a. Secure and properly seated in launcher detent.
 - b. Detent locking pin - Installed.
12. Rear wings - Clean, undamaged.
13. Rollerons - Spin freely.
14. Caging assembly - Locked.

AIS-POD (Figure 2-12)

- *1. Launcher ground safety pin - Installed (remove prior to flight).
- *2. Launcher detent locking pin - Installed.
3. Umbilical plug - Connected.
4. Pod serial number - Record.



1A-10A-34-1-1-2-10

Figure 2-12. AIS POD

T.O. 1A-10A-34-1-1

BDU-33 PRACTICE BOMB

TER-9/A

WARNING

During exterior inspection, do not touch a leaking or contaminated practice bomb. The corrosive CXU material may cause injury upon contact with skin. Call EOD personnel.

1. Swaybrace adapters - Installed.
- *2. Bomb- Secured:
 - a. Suspension lug attached to forward suspension hook - Checked.
 - b. Bomb seated tight against swaybrace adapter bracket - Checked.
 - c. Bomb aligned with rack - Checked.
 - d. Sensing switch seated against bomb Checked.
 - e. Bomb safety pins - Removed (if applicable).
3. Rear swaybrace bolts installed with pads up - Checked.

SUU-20 Series

1. Intervalometers — SAFE.
2. Bomb/rocket safety clip — Installed.
3. Bomb retaining arms — Locked.
4. Electrical connectors — Connected.

MK 82/MK 84/M117 LDGP BOMBS

(Figures 2-13 and 2-14)

NOTE

The M117 and MK-84 are is certified for parent pylon carriage only.

- *1. Fin configuration/X (Figure 2-1).
2. Fin assembly/access covers - Secured, not damaged.

3. Nose fuze/ATU-35 ground safety devices — Removed.
4. Nose plug - Installed (if tail fuze only).
5. (DSU-33A/B) Nose fuse radome — Clean and not damaged.
- *6. Fuze settings - Checked.

NOTE

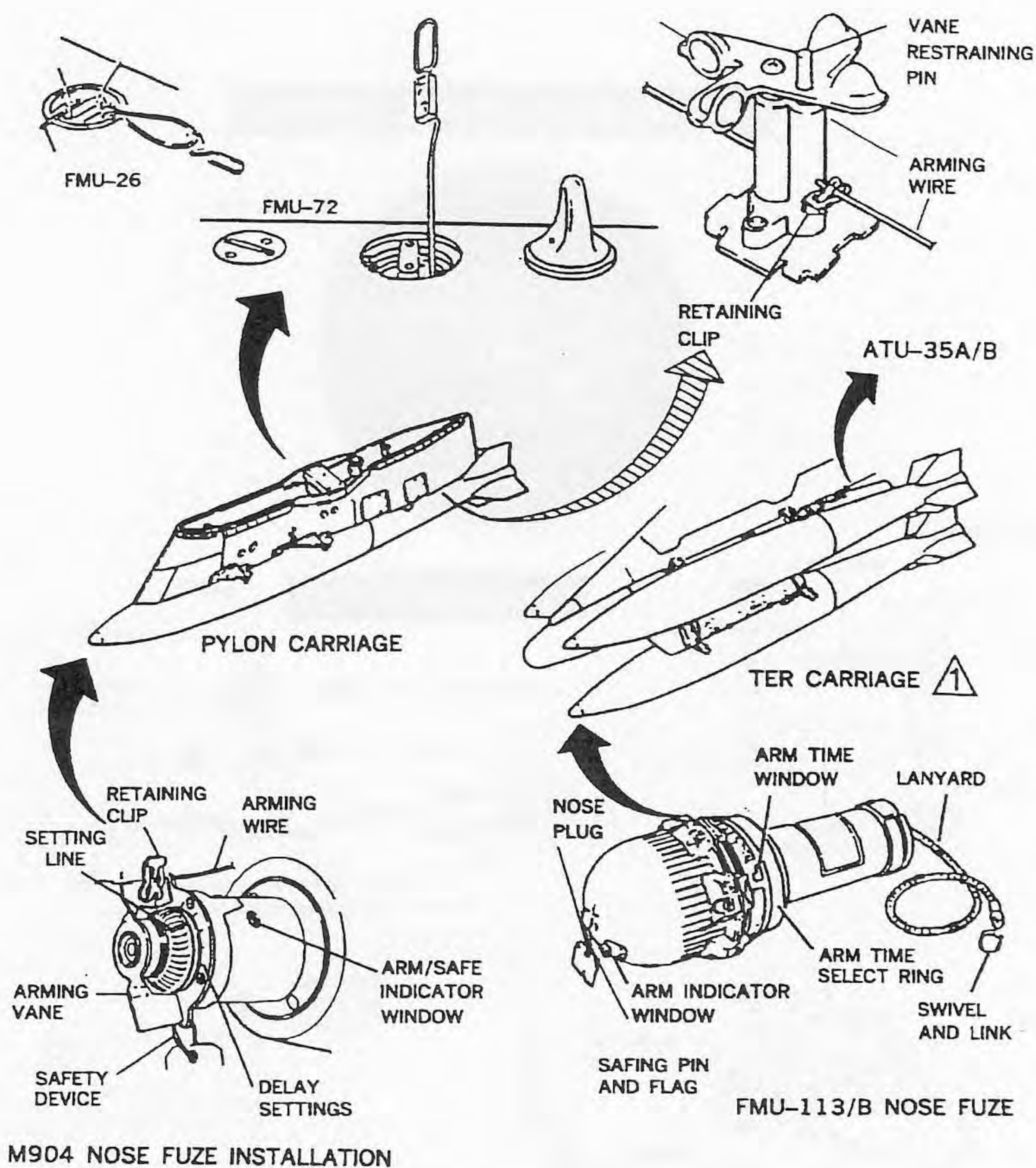
Fuze settings/delay element settings should be marked on side of bomb for those fuze setting/delay elements not visible to pilot.

- *7. Fuzes - Checked safe.

WARNING

If window in fuze body shows full red (M904E2/M-905) or black A on red background (M904E3), fuze is armed. Call EOD immediately.

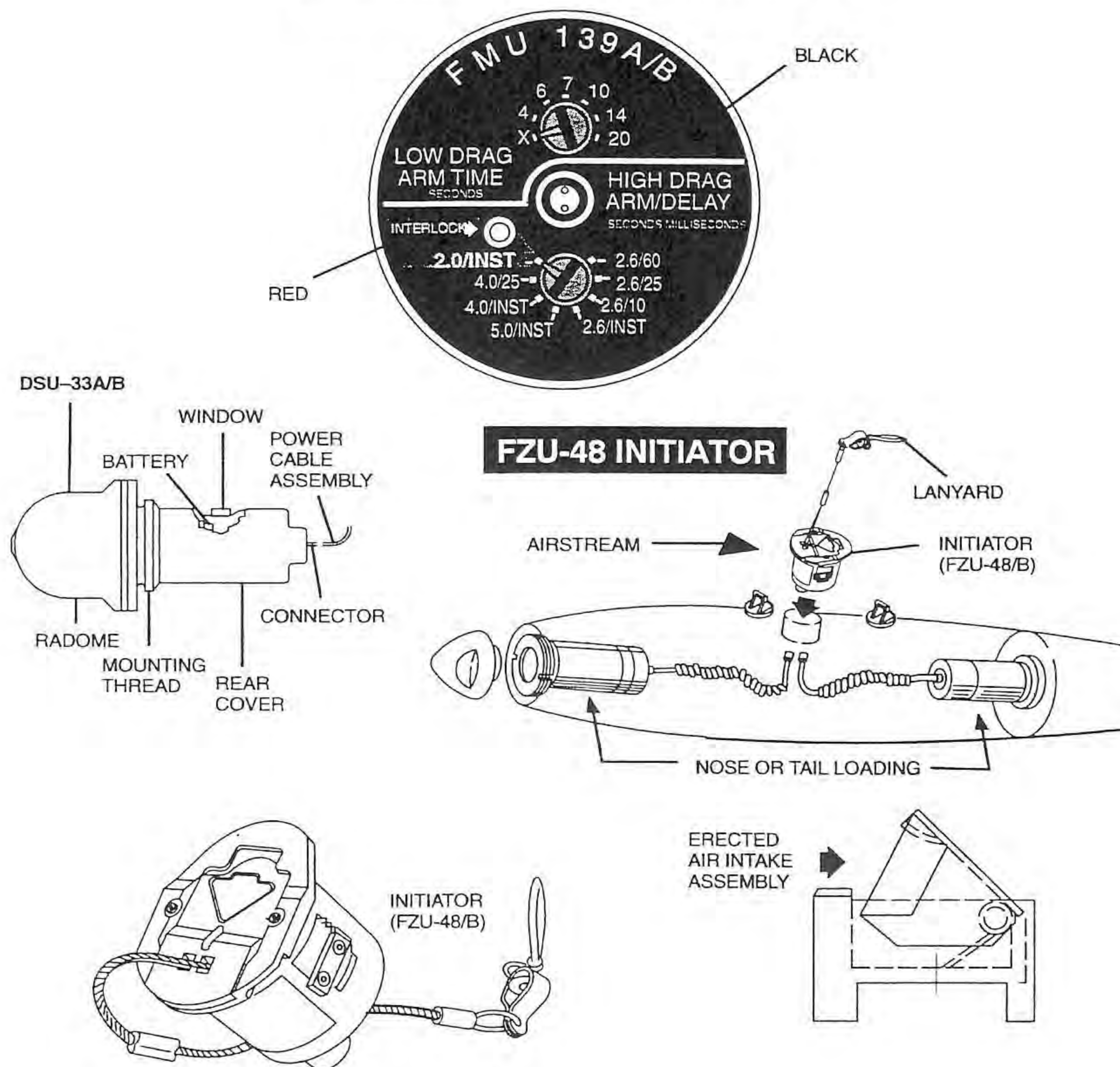
- *8. Arming wires/lanyards - Installed and secured:
 - a. M904 series fuze arming wire protrudes 1.5 to 2 inches beyond arming vane with one retaining clip per fuze - Checked (Figure 2-14).
 - b. M905 arming wire protrudes 1.5 to 2 inches beyond ATU-35 drive with one retaining clip installed - Checked (Figure 2-14).
 - c. FMU series - Check swivel and link/MAU-162:
 - (1) Nose fuze - Secured from charging well to nose solenoid (Pylon or TER carriage).
 - (2) Tail fuze - Secured from charging well to tail solenoid (Pylon or TER carriage).
 - (3) (FMU-139A/B and DSU-33A/B) Nose and/or tail fuze - Lanyard secured to center solenoid (pylon)/nose solenoid (TER).
 - d. Arming wire/lanyard, loop/cord swivel and link - Connected to solenoids.



1A-10A-34-1-1-2-11

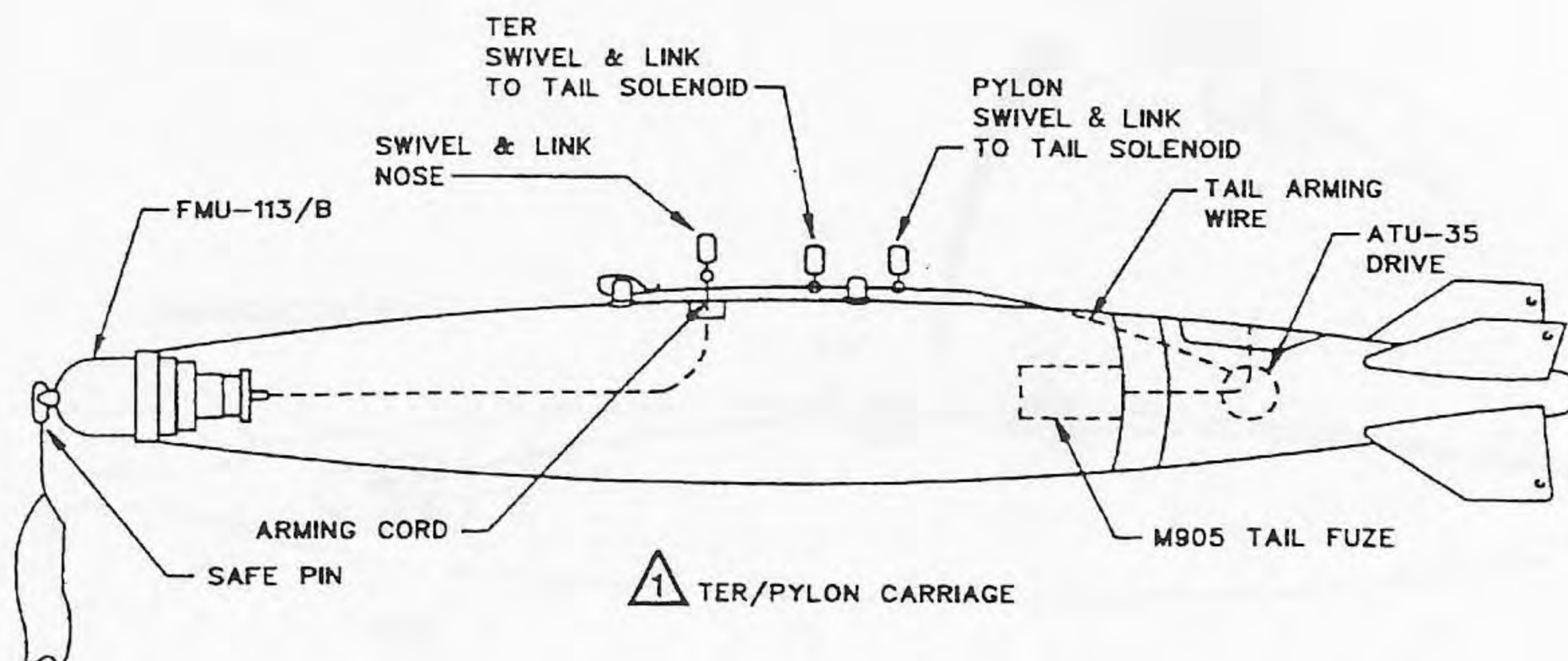
Figure 2-13. MK 82/84/M117 LDGP FUZING (Sheet 1 of 2)

FMU-139A/B FACE PLATE (TYPICAL)



1A-10A-34-1-1-2-12-2-BCC1

Figure 2-13. MK 82/84/M117 LDGP FUZING (Sheet 2 of 2)



FMU-113/B NOSE FUZE AND M905 TAIL FUZE

ARM SWITCH	FUZE ARM		DRAG
NOSE	113	ARM	LOW
	905	DUD	
NOSE & TAIL	113	ARM	LOW
	905	ARM	
TAIL	113	DUD	LOW
	905	ARM	

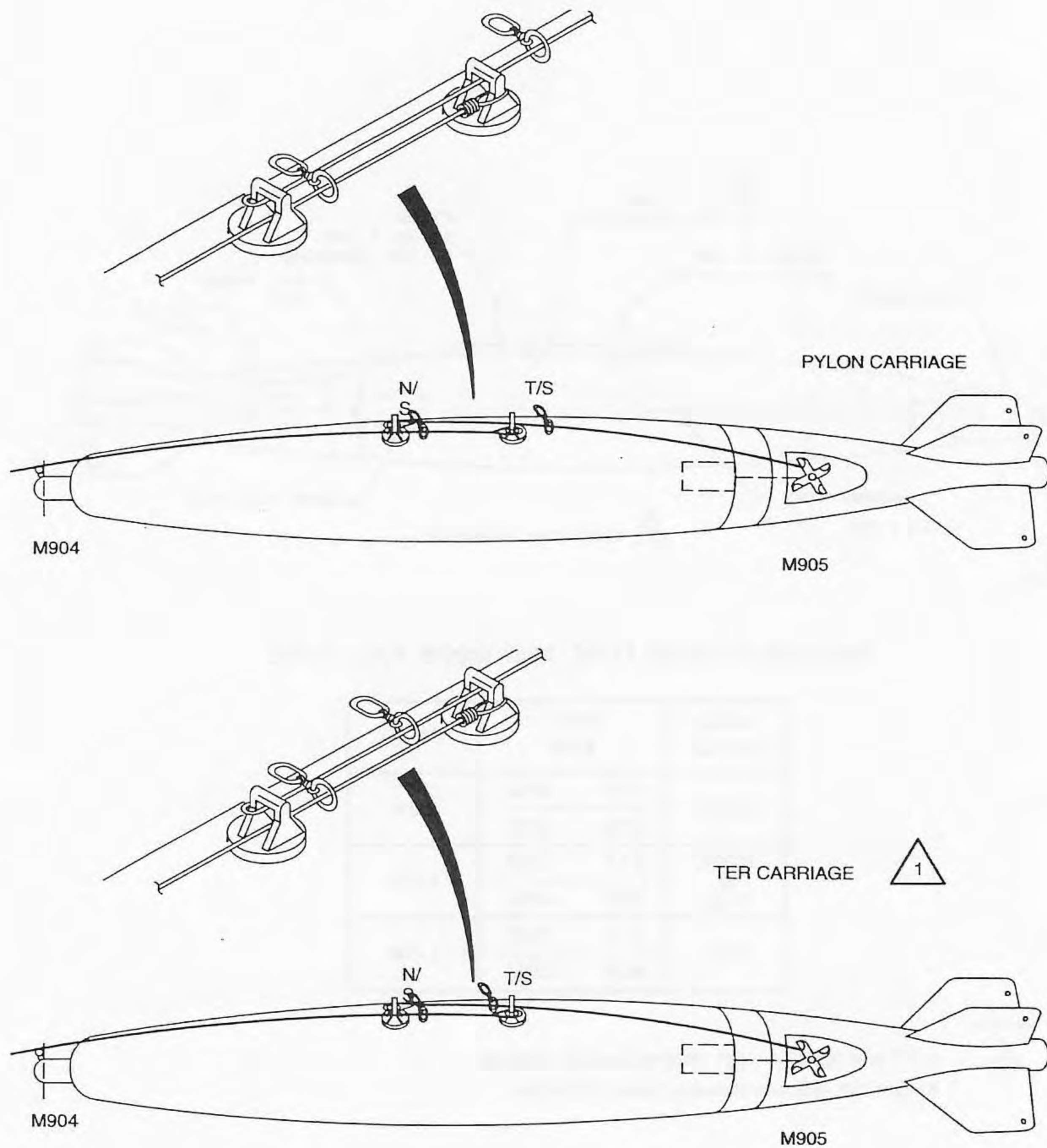
NOTE:



- M117 and MK-84 are not certified for TER carriage.
- FMU-113/B min Arm Release Speed: 250 KIAS.

1A-10A-34-1-1-2-13

Figure 2-14. MK 82/84/M117 LDGP BOMBS (Sheet 1 of 2)



NOTE



• M117 AND MK-84 ARE NOT CERTIFIED FOR TER CARRIAGE.

1A-10A-34-1-1-2-14

Figure 2-14. MK 82/84/M117 LDGP BOMBS (Sheet 2 of 2)

MK 36 Destructor

- *1. Fin configuration-(X) (Figure 2-1).
- 2. Fins — Secured, not damaged.
- *3. Fin release band:
 - a. Fin release wire — Installed.
 - b. Fin release safety pin — Removed (if applicable).
- *4. MK 32 arming device — Checked (Figure 2-15):
 - a. Fuze indication — Safe.

WARNING

If window in fuze body shows black A on red background, fuze is armed. Call EOD immediately.

- b. Fuze setting — Checked.
- c. Nose fuze ground safety device — Removed.
- d. Arming wire retaining clip(s) — Installed and secured.
- e. Fuze arming wires — Installed.
- *5. Arming wires, fin release lanyards — Checked (Figure 2-16).
 - a. Fin release lanyard:
 - (1) Secured through fin release band latch with retaining clip.

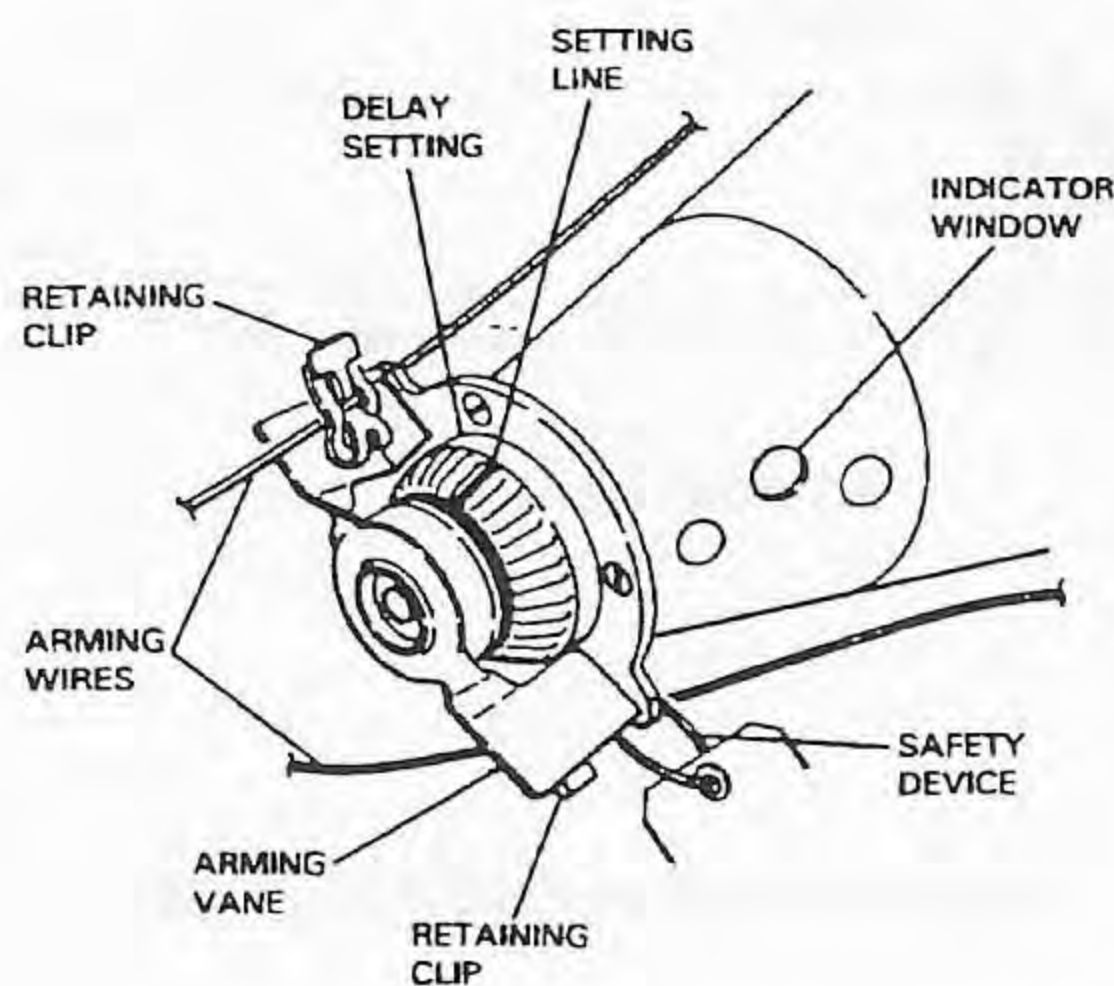
- (2) Washer — Forward of fin release band latch.
- (3) Excess lanyard — Safety wired to link pin.
- (4) Lanyard — Routed through aft bomb lug.
- (5) MAU-162 — Secured to NOSE (TER)/Center (Pylon) solenoid.

- b. MK 42 firing mechanism arming wire — Installed (Figure 2-16):

- (1) Wire secured to top fin link pin.
- (2) Routed through hole in top fin drag plate.
- (3) Cut flush with bottom fin drag plate.

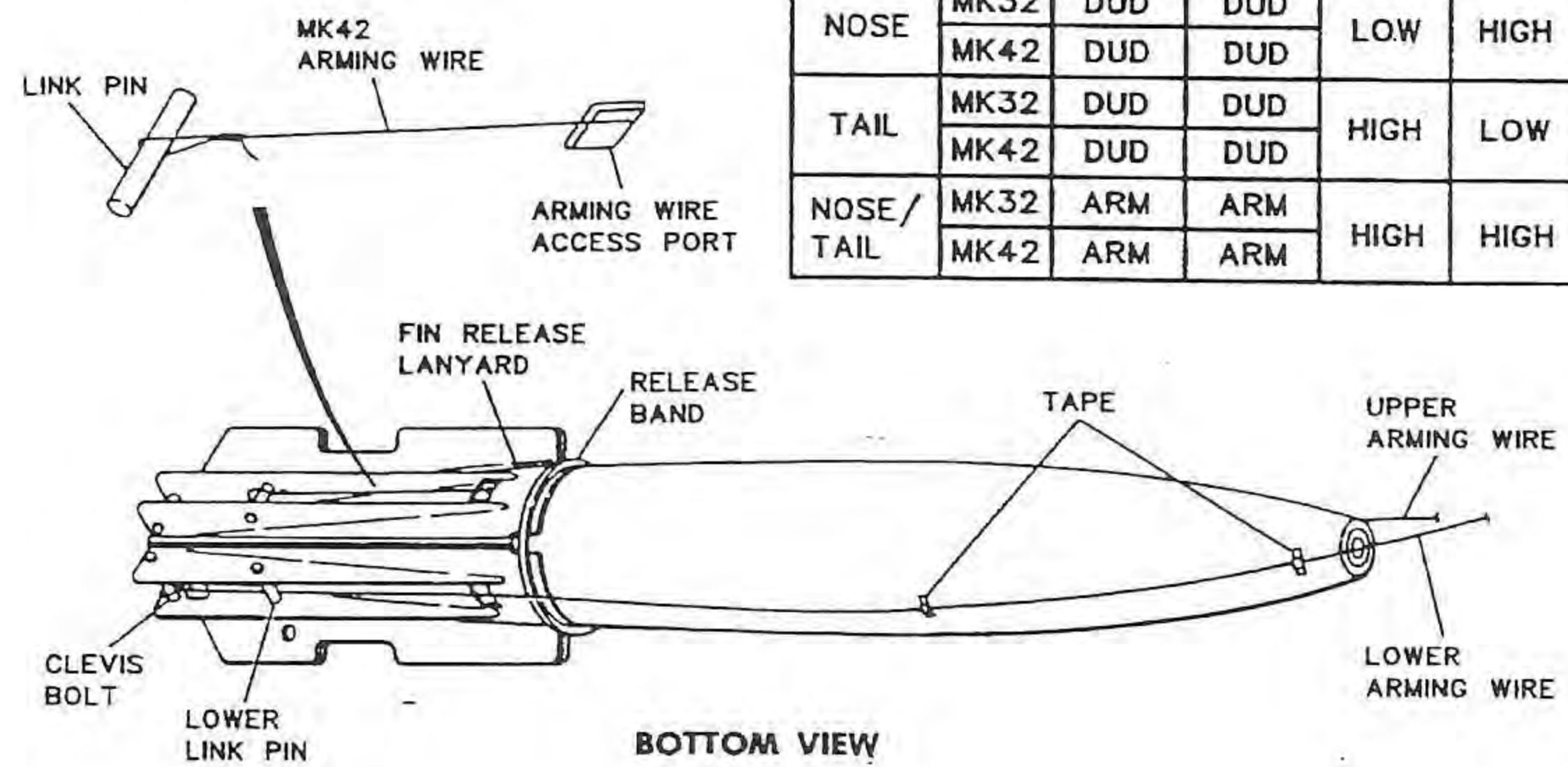
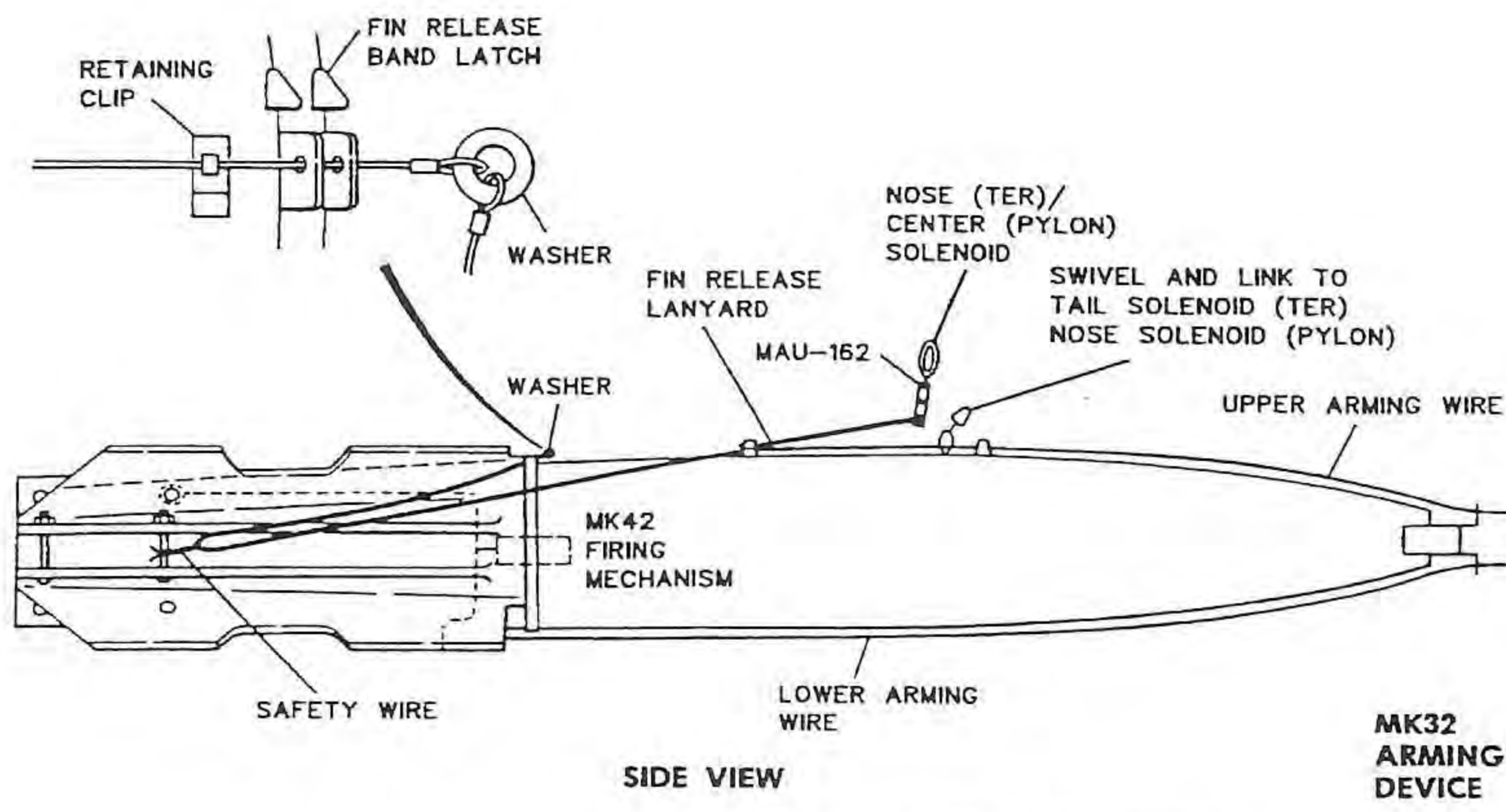
- c. MK 32 arming device arming wires — Installed (Figure 2-16):

- (1) Upper arming wire — Secured:
 - (a) Routed through forward lug.
 - (b) Swivel and link — Secured to Tail (TER) or Nose (Pylon) solenoid.
- (2) Lower arming wire — Secured:
 - (a) Tied to bottom fin clevis bolt.
 - (b) Routed under link pin.
 - (c) Excess slack removed — No kinks or burrs.



1A-10A-34-1-1-2-15

Figure 2-15. MK32 ARMING DEVICE



ARM SWITCH	FUZE	ARM		DRAG	
		PYLON	TER	PYLON	TER
NOSE	MK32	DUD	DUD	LOW	HIGH
	MK42	DUD	DUD		
TAIL	MK32	DUD	DUD	HIGH	LOW
	MK42	DUD	DUD		
NOSE/TAIL	MK32	ARM	ARM	HIGH	HIGH
	MK42	ARM	ARM		

1A-10A-34-1-1-2-16

Figure 2-16. MK 36 FIXED HIGH DRAG

MK 82 AIR**(Figure 2-17)**

- *1. Fin configuration — (X) (Figure 2-1).
- *2. Retarder assembly — Checked (Figure 2-17).
 - a. Latch assembly — Installed over aft cover tang.
 - b. Lanyard clip — Installed through latch assembly.
 - c. Safety latch pin — Installed through safety latch and aft cover tang.
 - d. Cover retainers — Installed over aft cover tang.
 - e. AIR lanyard — Secured to lanyard clip and safety latch pin.
 - f. Fuze access cover — Secured.

g. ATU-35 cover — Installed (if ATU-35 is not used).

h. Safety pin and flag assembly — Removed.

3. Nose plug — Installed, if tail fuze only.

4. Nose fuze/ATU-35 ground safety devices Removed.

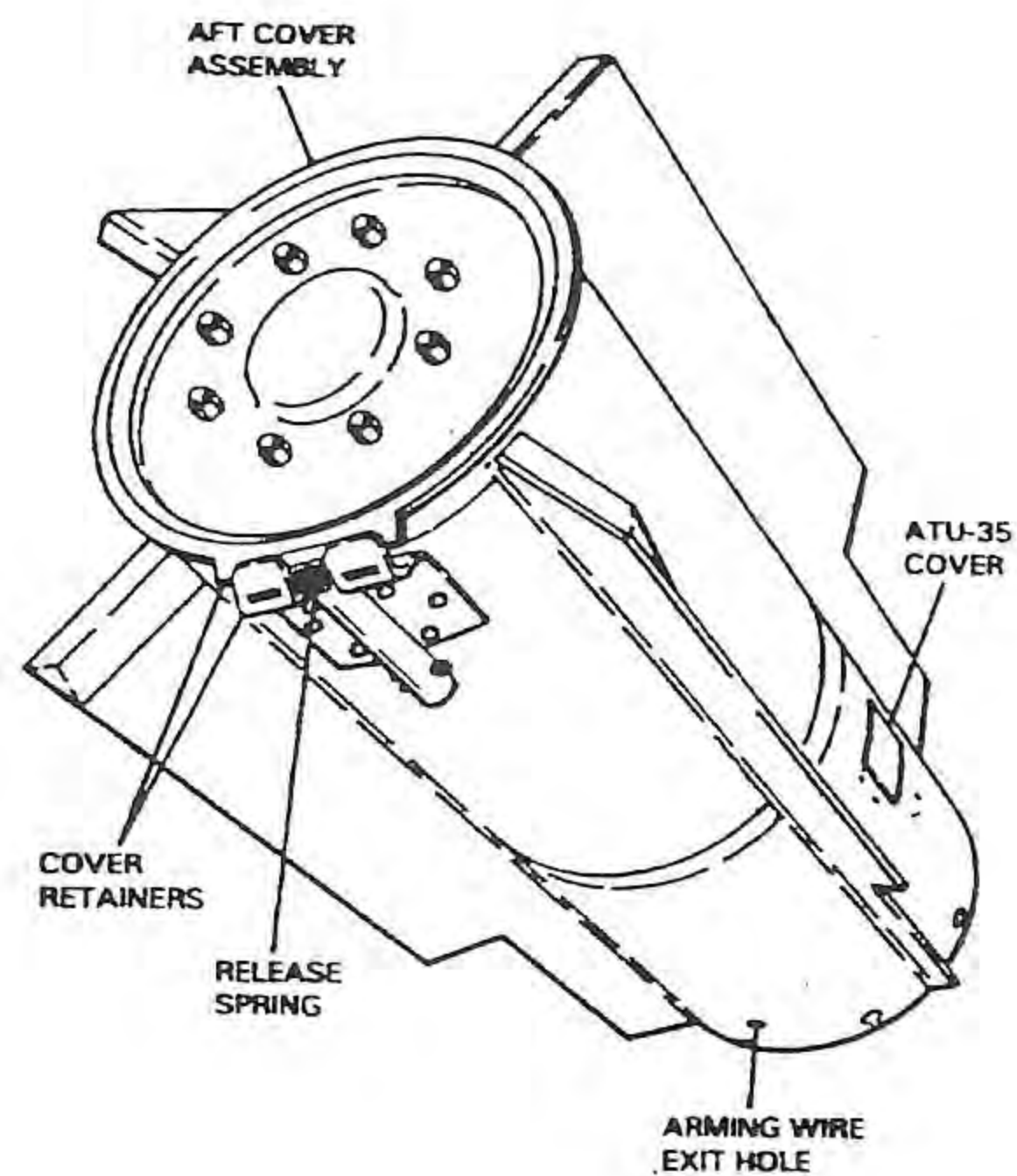
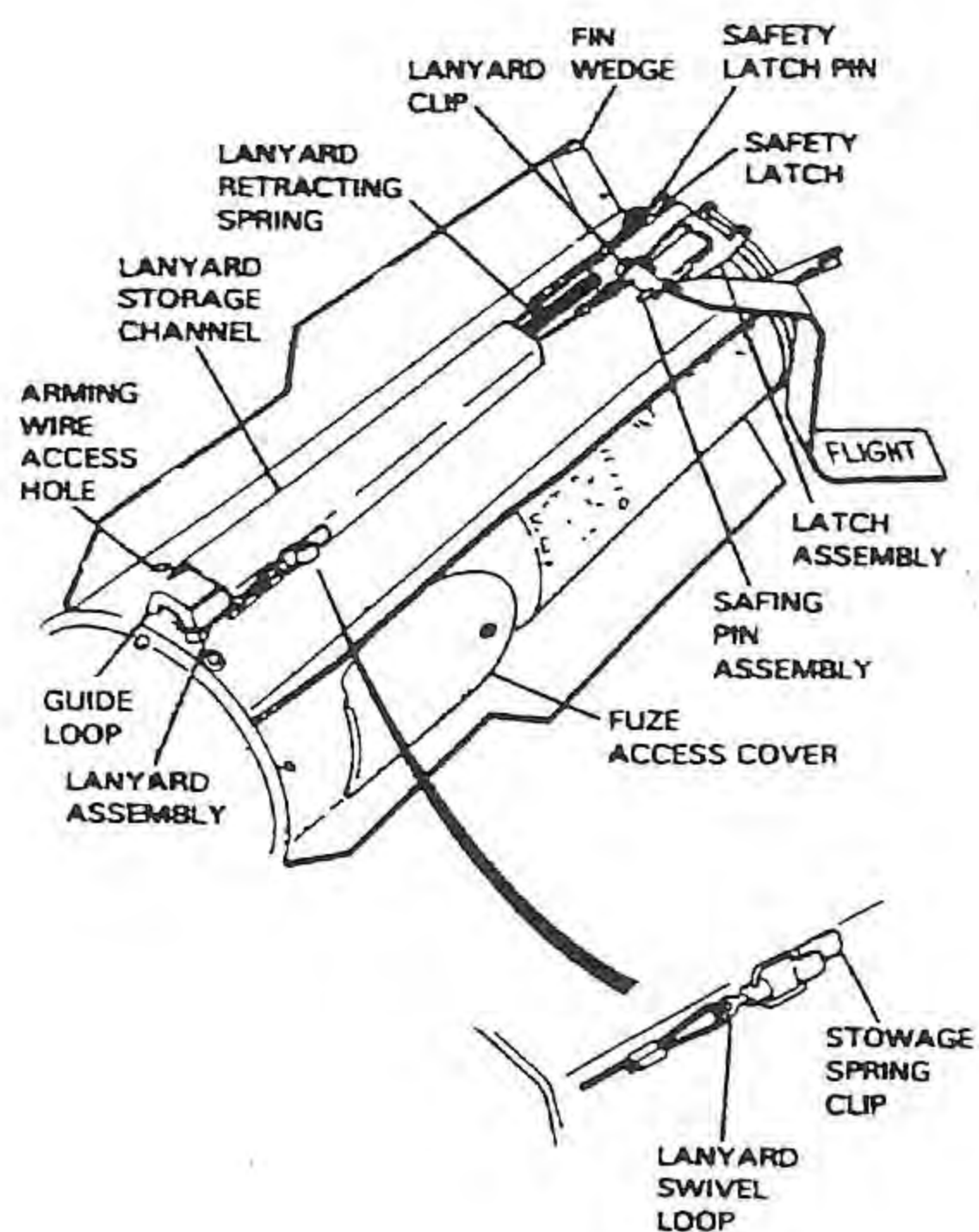
5. MK 82 AIR fuze preflight (Figure 2-18):

*a. M904 series fuze — Checked safe (if installed):

(1) Fuze indication - Safe.

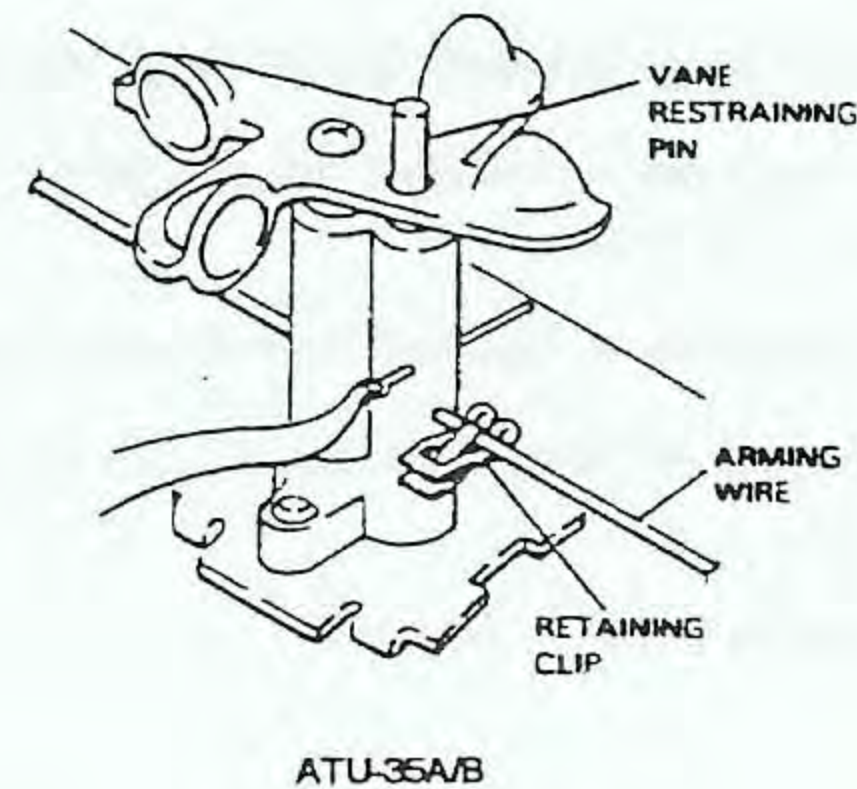
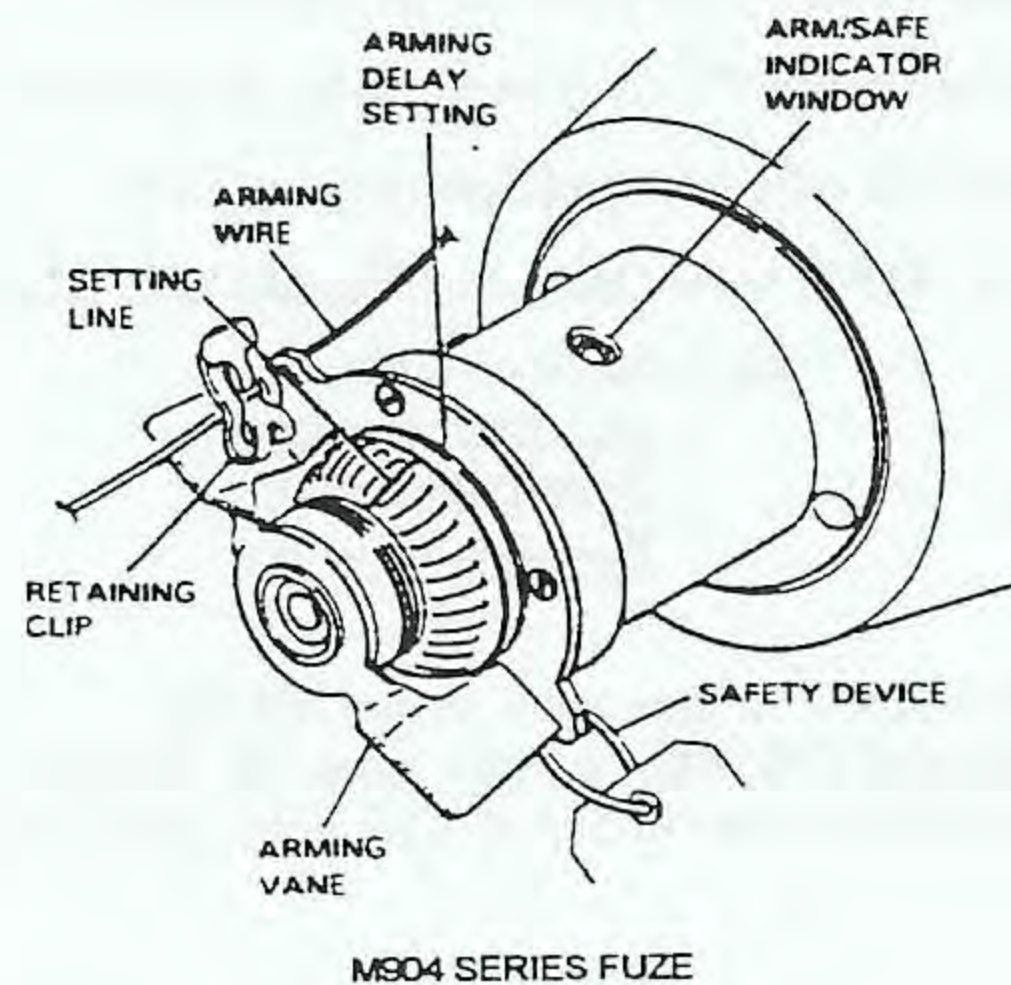
WARNING

If window in fuze body shows full red (M904E2/M-905) or black A on red background (M904M), fuze is armed. Call EOD immediately.



1A-10A-34-1-1-2-17

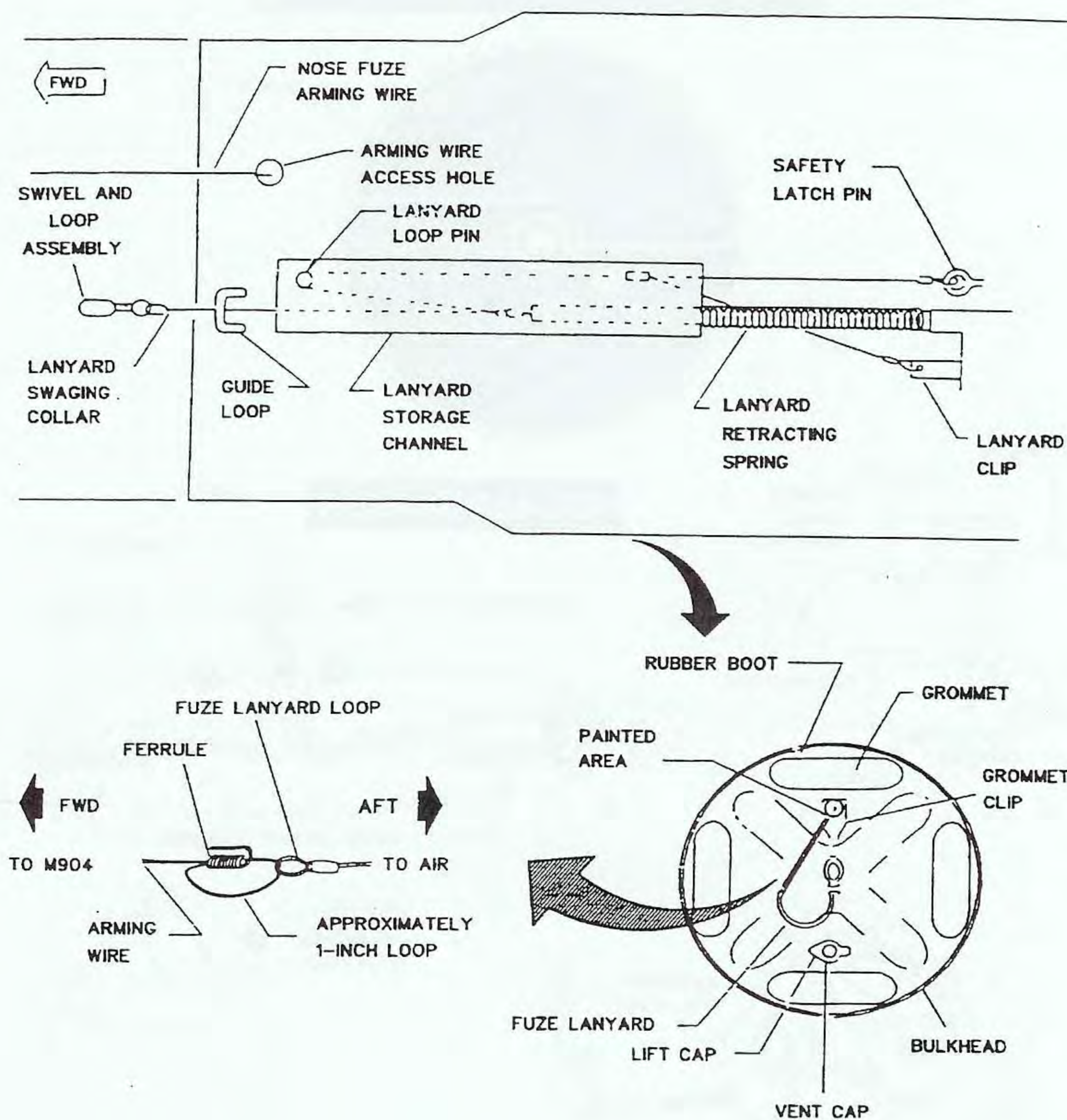
Figure 2-17. BSU 49/B AIR INFLATABLE RETARDER



1A-10A-34-1-1-2-18

Figure 2-18. MK 82 AIR FUZE WIRING

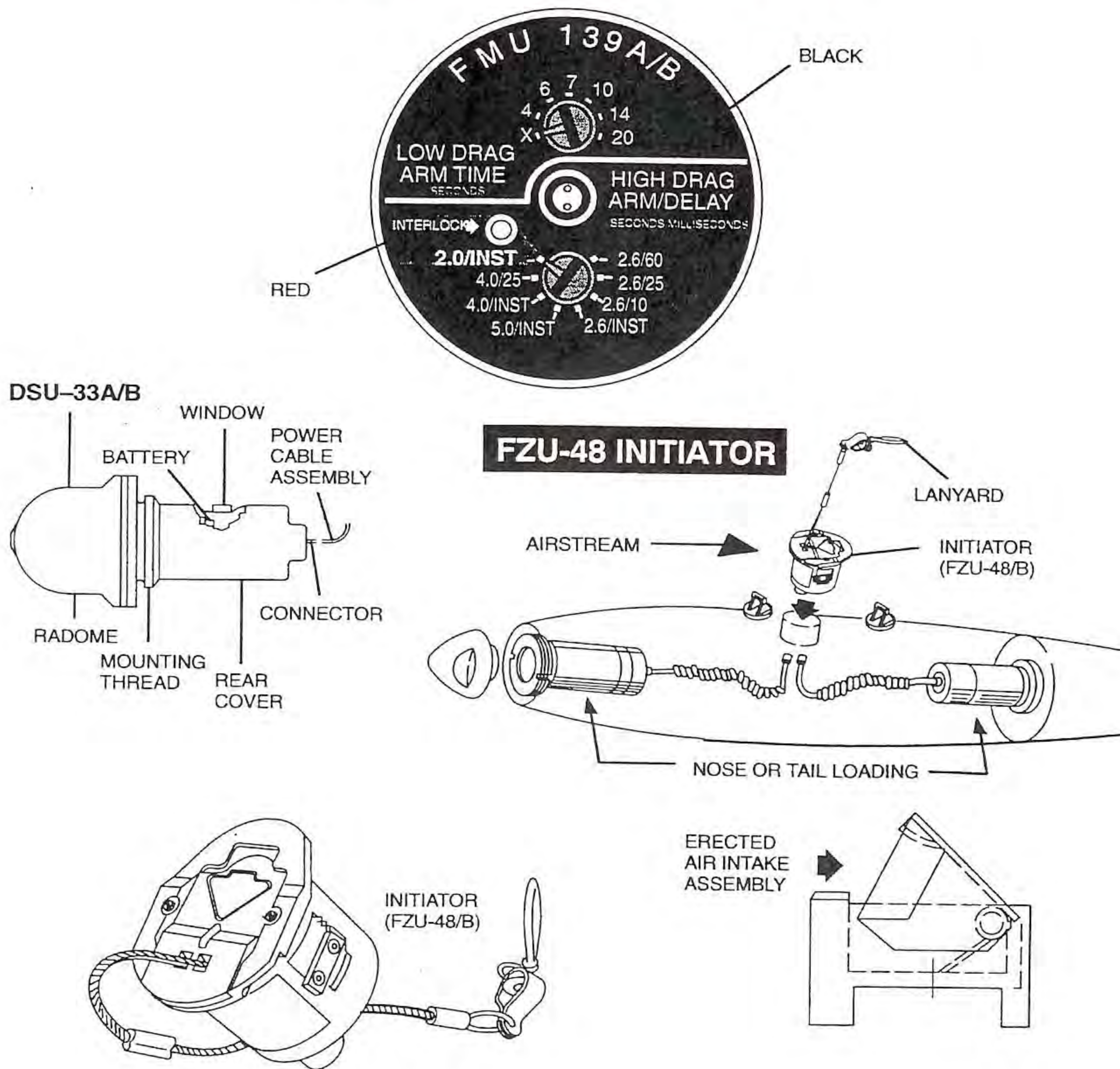
- (2) Arming wire retaining clip — Installed and secured (wire protrudes 1.5 to 2.0 inches beyond vane).
- (3) Fuze setting — Checked.
- b. M905 series fuze with ATU-35 (if installed):
 - (1) Arming wire protrudes 1.5 to 2.0 inches beyond drive.
 - (2) Fuze setting — Marked on bomb.
- c. FMU-54 tail fuze — Setting marked on bomb.
- d. DSU-33A/B Radome — Clean and not damaged.
6. BSU-49 lanyards — Checked (Figure 2-19):
 - a. AIR lanyard — Check routing:
 - (1) Attached to safety latch pin and lanyard clip.
 - (2) Lanyard retracting spring — Tight.
 - (3) Routed through guide loop.
 - b. Check arming wire tight through arming wire access hole.
- *7. Retarder release lanyard and fuze arming lanyards/wires — Properly routed and secured to solenoids (Figure 2-21).



1A-10A-34-1-1-2-19

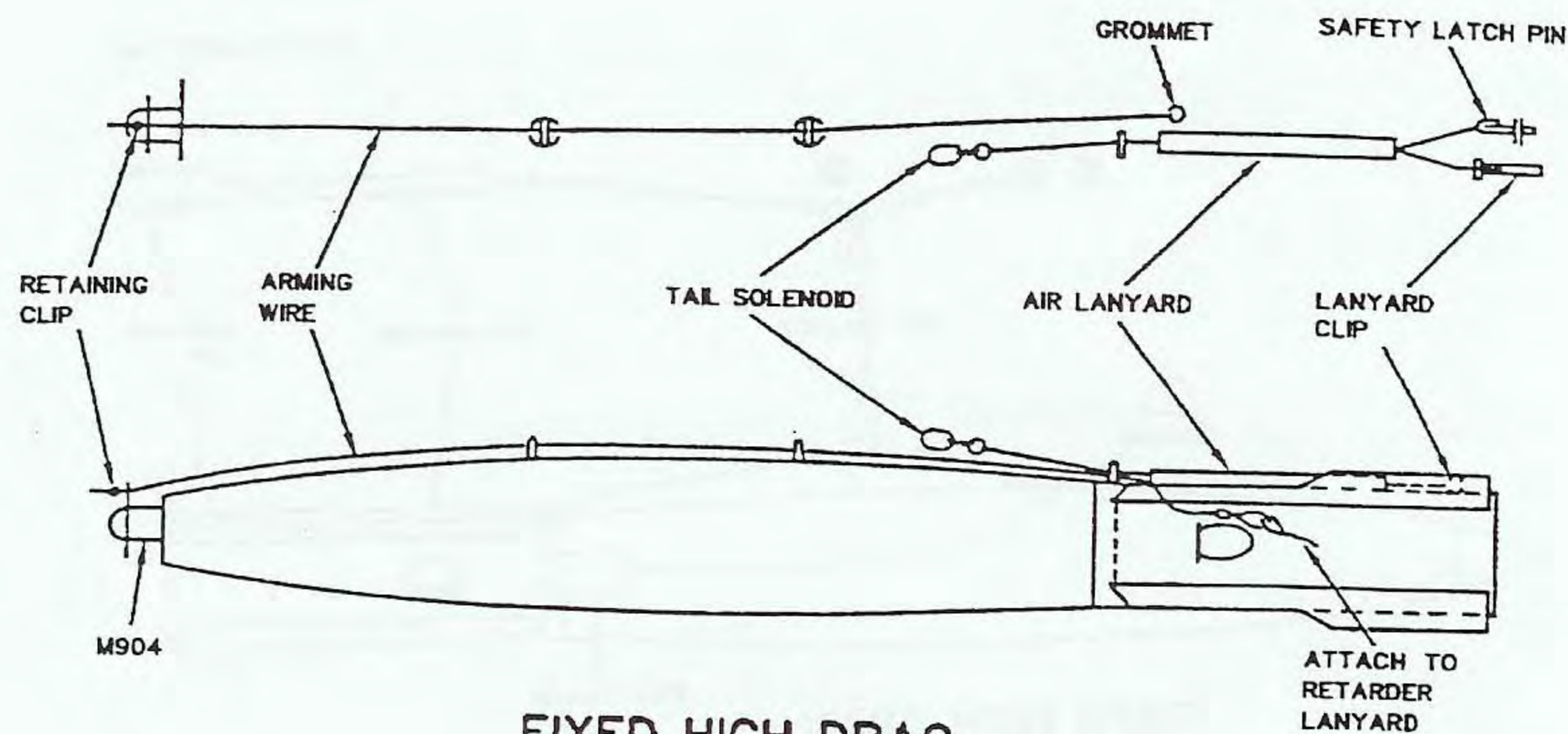
Figure 2-19. AIR LANYARD AND ARMING ROUTING

FMU-139A/B FACE PLATE (TYPICAL)



1A-10A-34-1-1-2-20-BCC1

Figure 2-20. MK 82 AIR FUZING (FMU-139A/B)

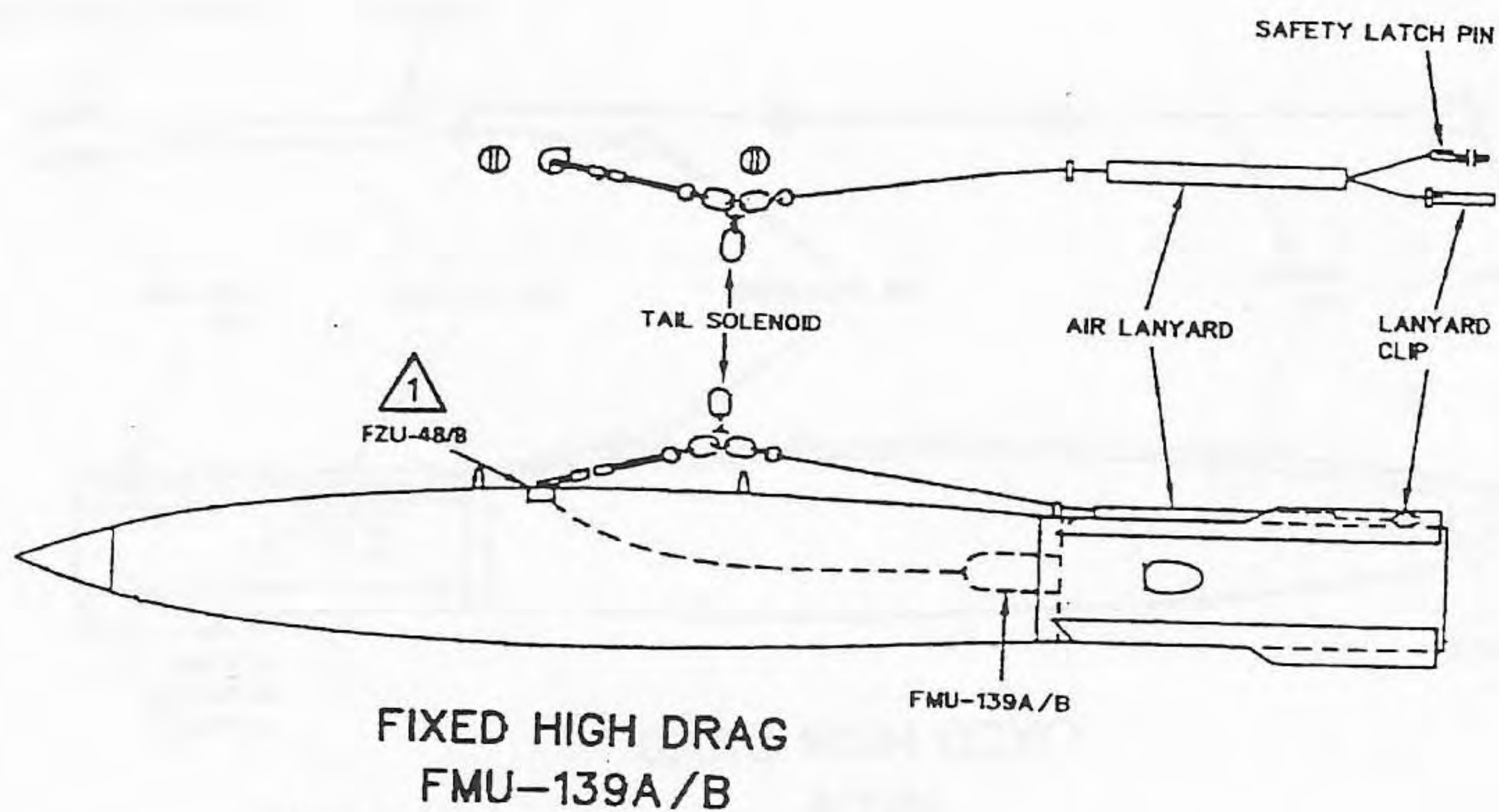


FIXED HIGH DRAG
M904

ARM SWITCH	FUZE ARM	DRAG
NOSE	DUD	LOW
N/T	ARM	HIGH
TAIL	ARM	HIGH

1A-10A-34-1-1-2-21

Figure 2-21. MK 82 AIR ARMING CONFIGURATIONS (Sheet 1 of 9)



ARM SWITCH	FUZE ARM		DRAG
NOSE	139(T)	DUD	LOW
N/T	139(T)	ARM	HIGH
TAIL	139(T)	ARM	HIGH

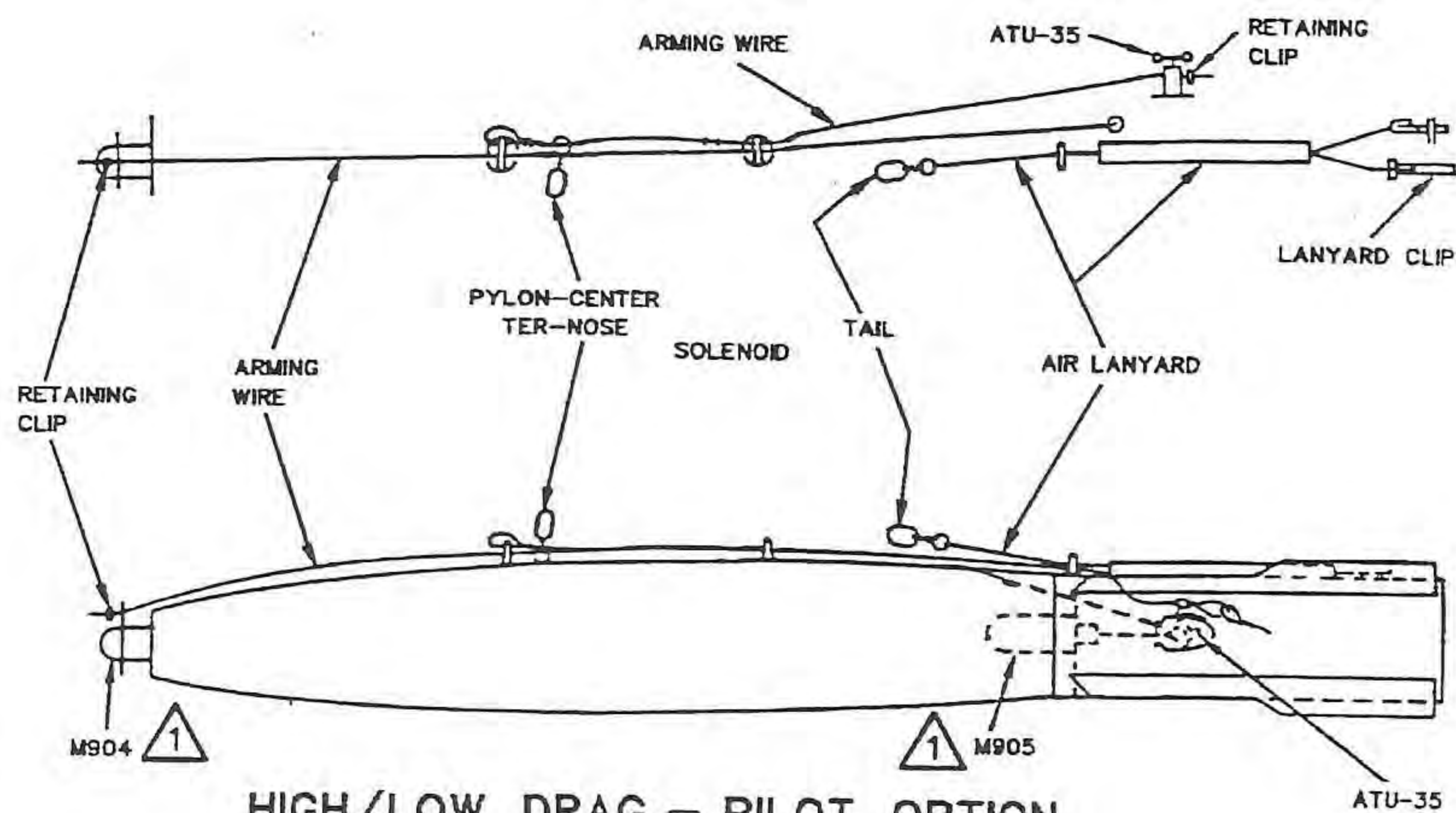
NOTE:



- FZU-48/B minimum speed for high-drag mode: 280 KCAS.

1A-10A-34-1-1-2-22

Figure 2-21. MK 82 AIR ARMING CONFIGURATIONS (Sheet 2 of 9)



HIGH/LOW DRAG - PILOT OPTION M904 & M905

ARM SWITCH	FUZE ARM	DRAG
NOSE	M904 - DUD	LOW
	M905 - ARM	
N/T	M904 - ARM	HIGH
	M905 - ARM	
TAIL	M904 - ARM	HIGH
	M905 - DUD	

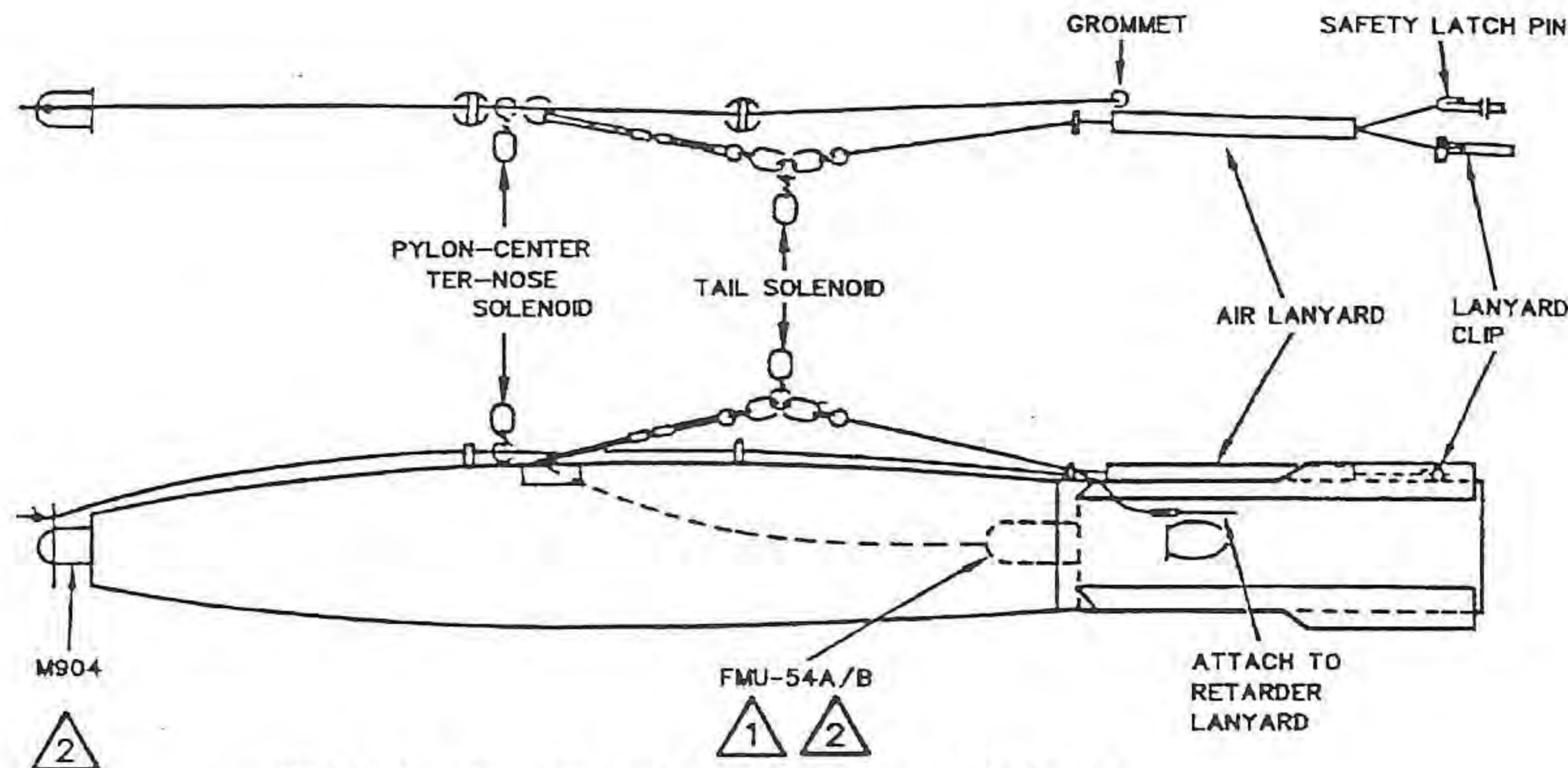
NOTE:



- Minimum allowable low-drag fuze (M905) arm delay is 6 sec. and minimum allowable high-drag fuze (M-904) arm delay is 2.5 sec. (T.O. 1-1M-34).

1A-10A-34-1-1-2-23

Figure 2-21. MK 82 AIR ARMING CONFIGURATIONS (Sheet 3 of 9)



HIGH/LOW DRAG – PILOT OPTION
M904 & FMU-54

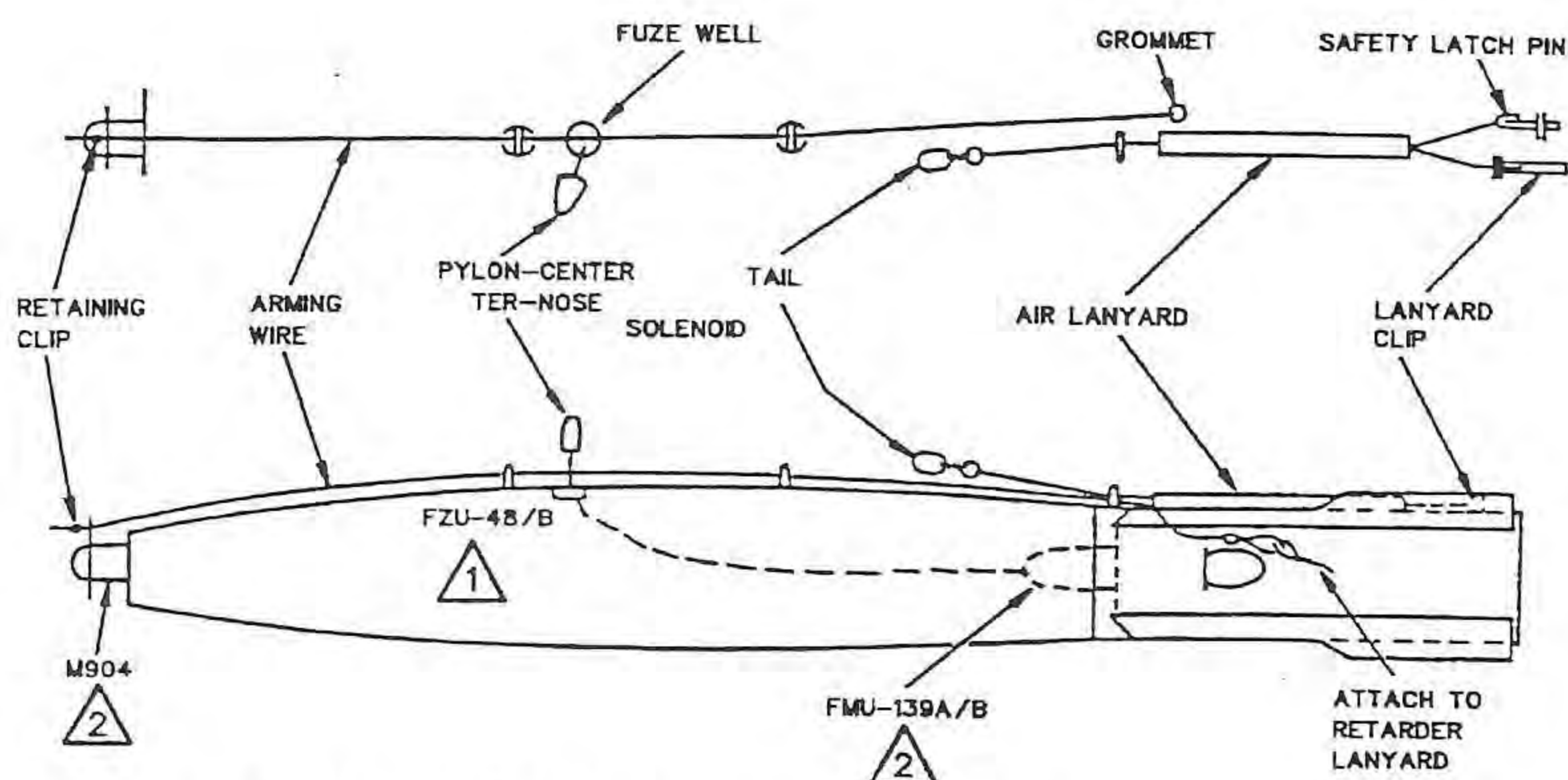
ARM SWITCH	FUZE ARM		DRAG
NOSE	904	ARM	LOW
	54	DUD	
N/T	904	ARM	HIGH
	54	ARM	
TAIL	904	ARM	HIGH
	54	ARM	

NOTE:

- 1 • FMU-54A/B minimum arm release speed: 330 KIAS.
- 2 • Minimum allowable low-drag fuze (M904) arm delay is 6 sec. and minimum allowable high-drag fuze (FMU-54A/B) arm delay is 2.5 sec. (T.O. 1-1M-34).

1A-10A-34-1-1-2-24

Figure 2-21. MK 82 AIR ARMING CONFIGURATIONS (Sheet 4 of 9)



HIGH/LOW DRAG – PILOT OPTION (1) M904 & FMU-139A/B

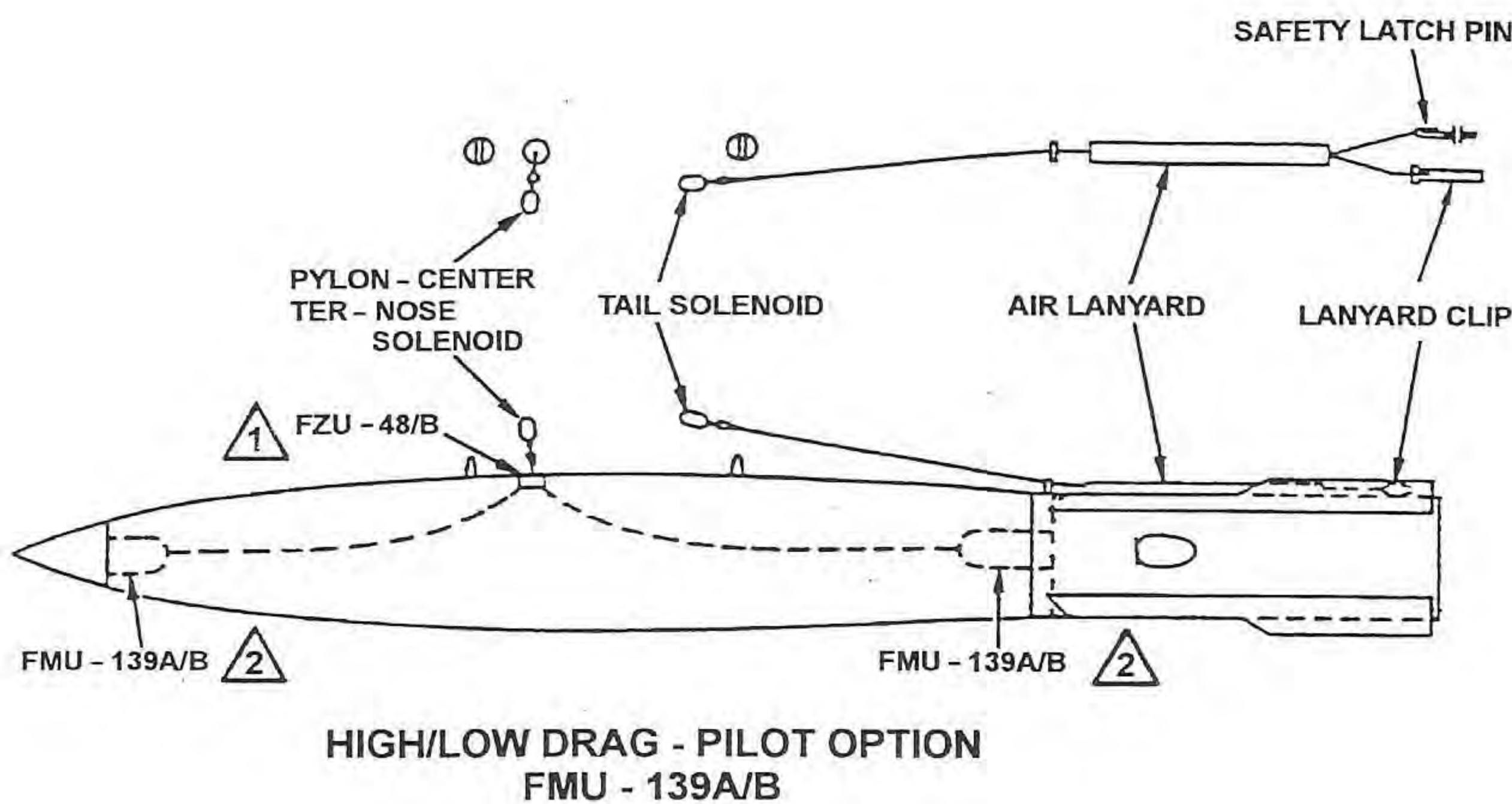
ARM SWITCH	FUZE ARM	DRAG
NOSE	904 DUD	LOW
	139 ARM	
N/T	904 ARM	HIGH
	139 ARM	
TAIL	904 ARM	HIGH
	139 DUD	

NOTE:

- ① • FZU-48/B will not function below 250 KCAS in low drag; 280 KCAS in high drag.
- ② • Minimum allowable high-drag fuze (M904) arm delay is 2.5 sec. and minimum allowable low-drag fuze (FMU-139A/B) arm delay is 6 sec. (T.O. 1-1M-34).

1A-10A-34-1-1-2-25

Figure 2-21. MK 82 AIR ARMING CONFIGURATIONS (Sheet 5 of 9)

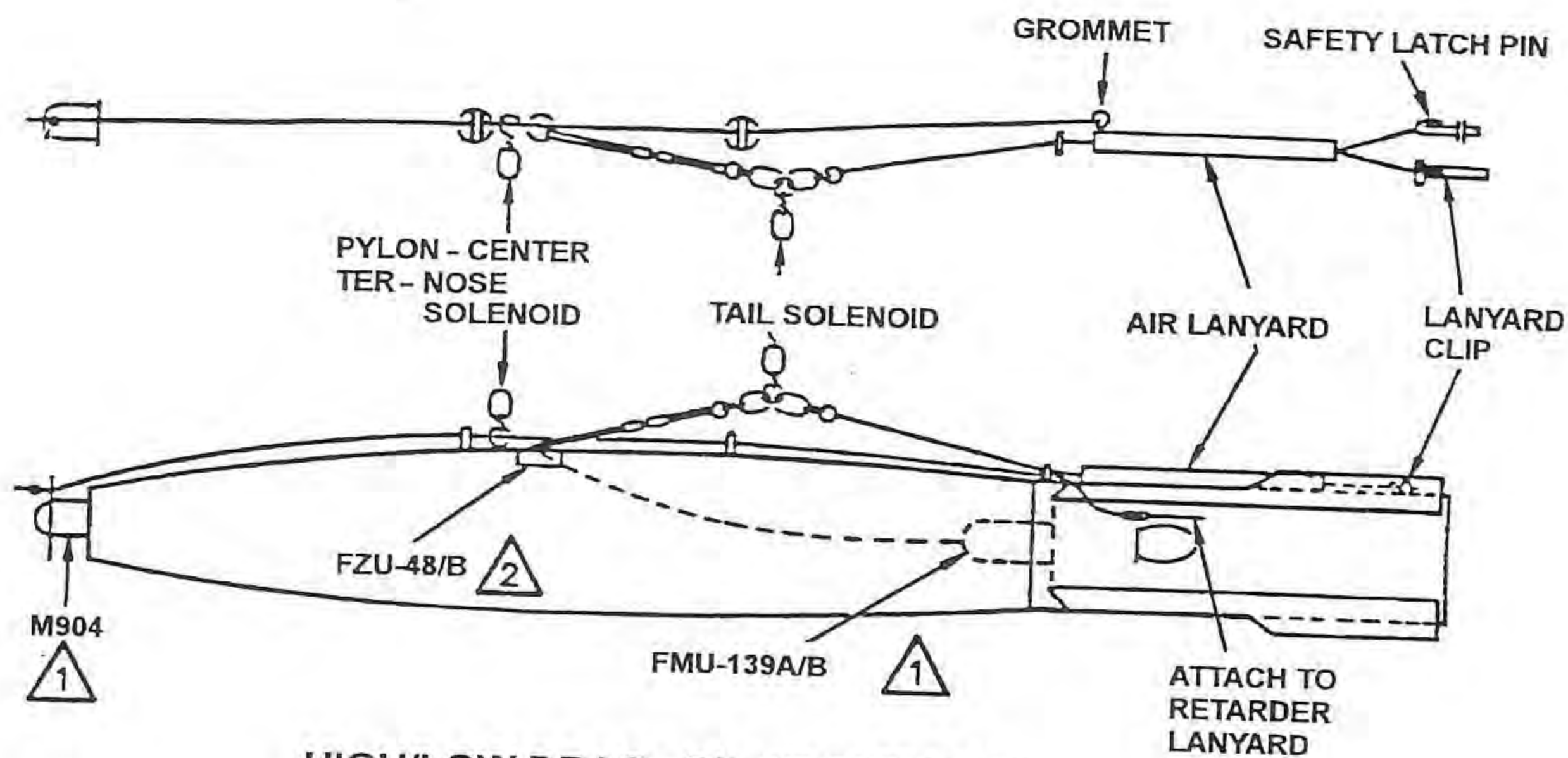


ARM SWITCH	FUZE ARM	DRAG
NOSE	139(N) ARM	LOW
	139(T) ARM	
N/T	139(N) ARM	HIGH
	139(T) ARM	
TAIL	139(N) DUD	HIGH
	139(T) DUD	

- NOTES:**
- 1** For low drag mode, FZU-48/B min function speed: 250 KCAS.
For high drag mode, FZU-48/B min function speed: 280 KCAS.
 - 2** FMU-139A/B will revert to low drag fuze arm time when used as nose fuze during high drag operation.
- Min allowable low drag fuze arm delay is 6 sec. and min allowable high-drag fuze arm delay is 2.6 seconds (T.O. 1-1M-34).
- MK 82 AIR may use only one FMU-139 fuze, nose or tail, however it must be installed in the tail for high drag setting to function.

1A-10A-34-1-1-2-26

Figure 2-21. MK 82 AIR ARMING CONFIGURATIONS (Sheet 6 of 9)



HIGH/LOW DRAG - PILOT OPTION (2)
M904 & FMU - 139A/B

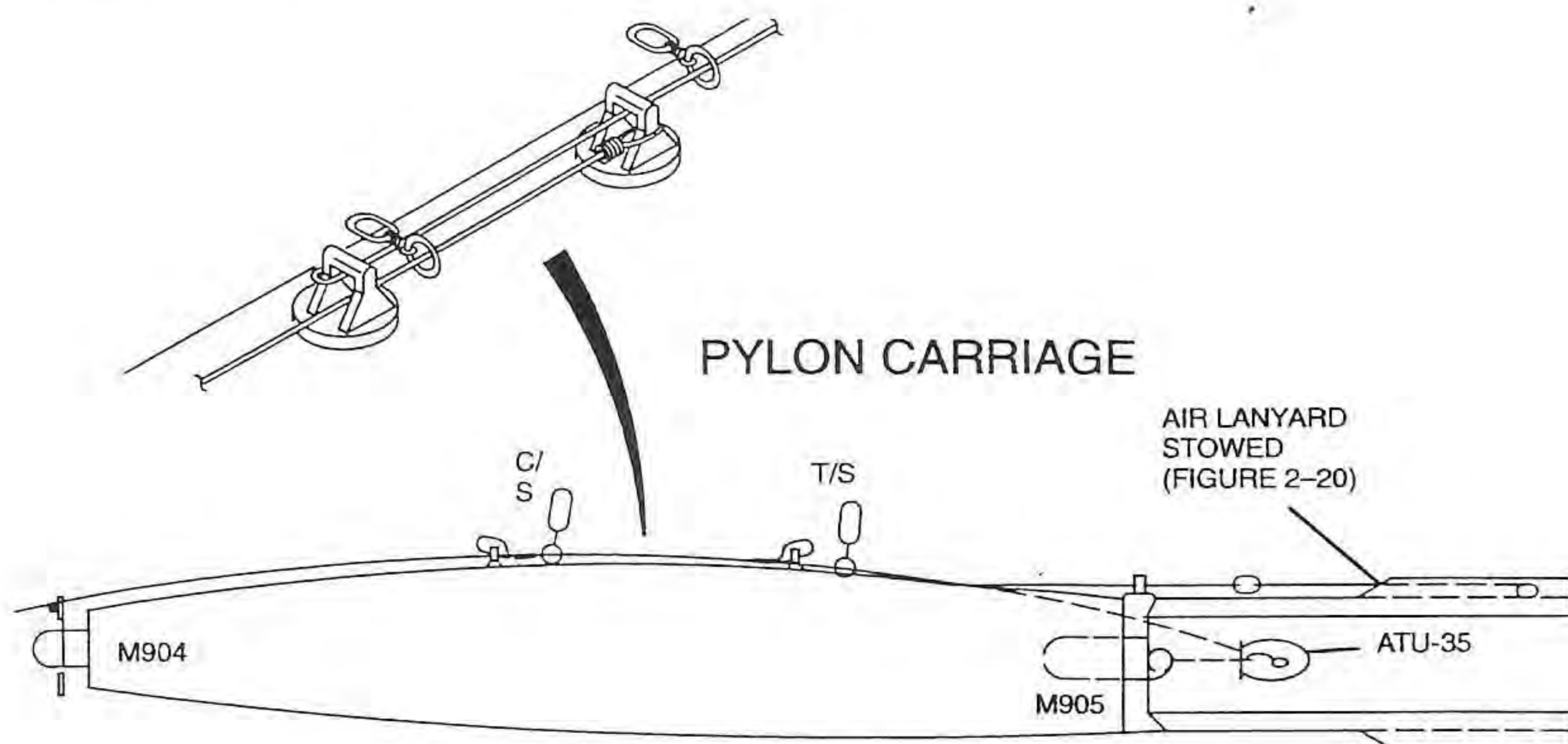
ARM SWITCH	FUZE ARM	DRAG
NOSE	904(N) ARM	LOW
	139(T) DUD	
N/T	904(N) ARM	HIGH
	139(T) ARM	
TAIL	904(N) ARM	HIGH
	139(T) ARM	

NOTES:

- 1 Min allowable low-drag fuze (M904) arm delay is 6 sec min allowable high-drag fuze (FMU-139A/B) arm delay is 2.6 sec (T.O. 1-1M-34).
- 2 For high drag mode, FZU-48/B min function speed: 280 KCAS.

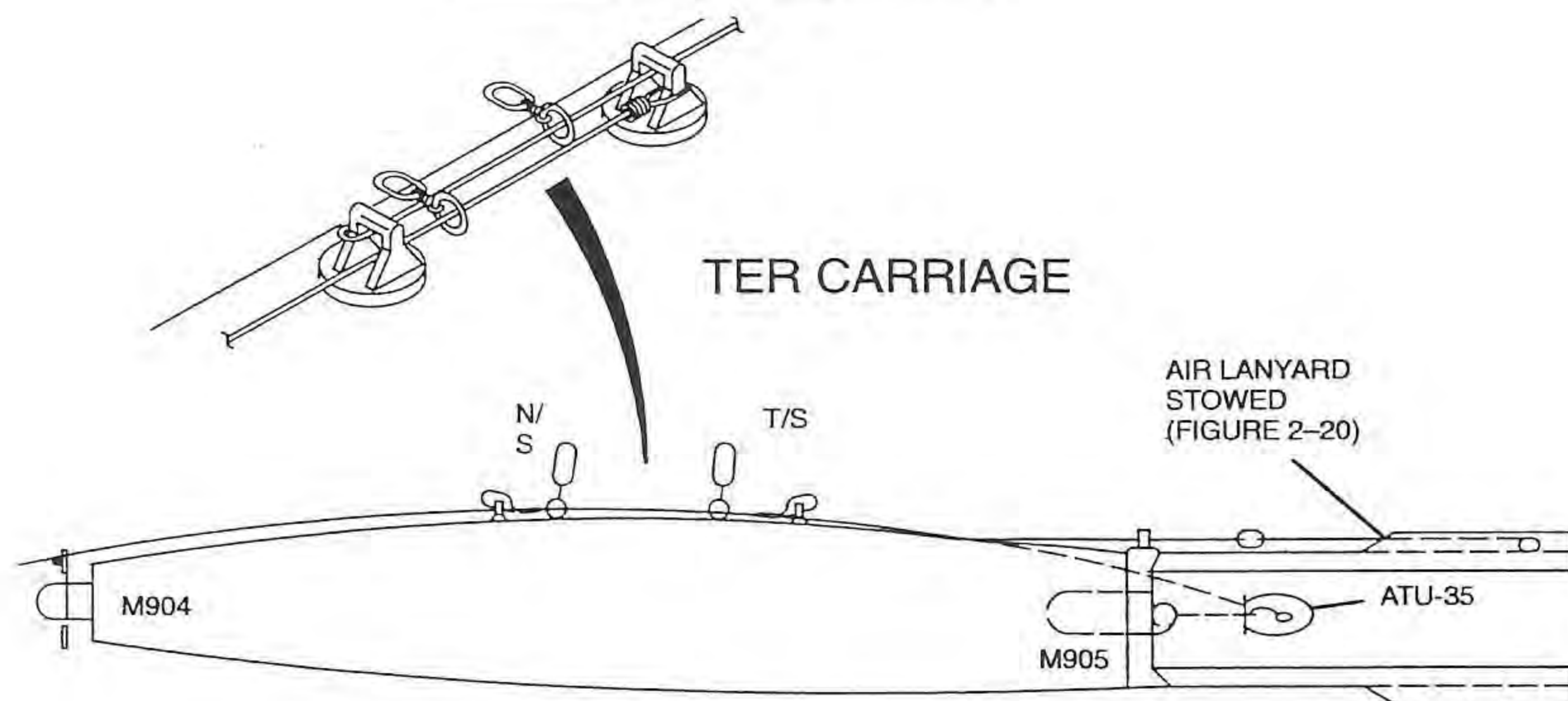
1A-10A-34-1-1-2-27

Figure 2-21. MK 82 AIR ARMING CONFIGURATIONS (Sheet 7 of 9)



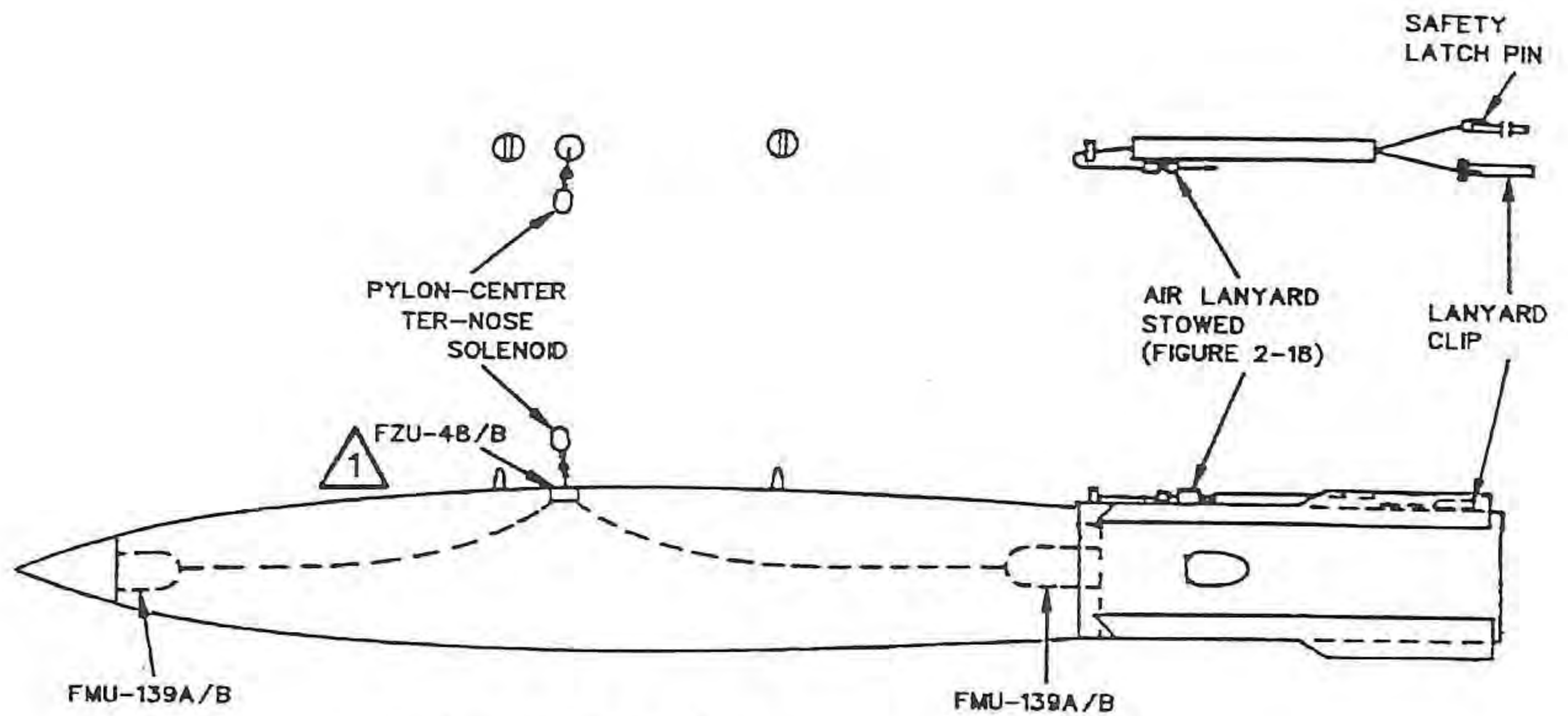
FIXED LOW DRAG
M904 & M905

ARM SWITC	FUUSE ARM		DRAG
H NOSE	904	ARM	LOW
	905	DUD	
N/T	904	ARM	LOW
	905	ARM	
TAIL	904	DUD	LOW
	905	ARM	



1A-10A-34-1-1-2-28

Figure 2-21. MK 82 AIR ARMING CONFIGURATIONS (Sheet 8 of 9)



**FIXED LOW DRAG
FMU-139A/B**

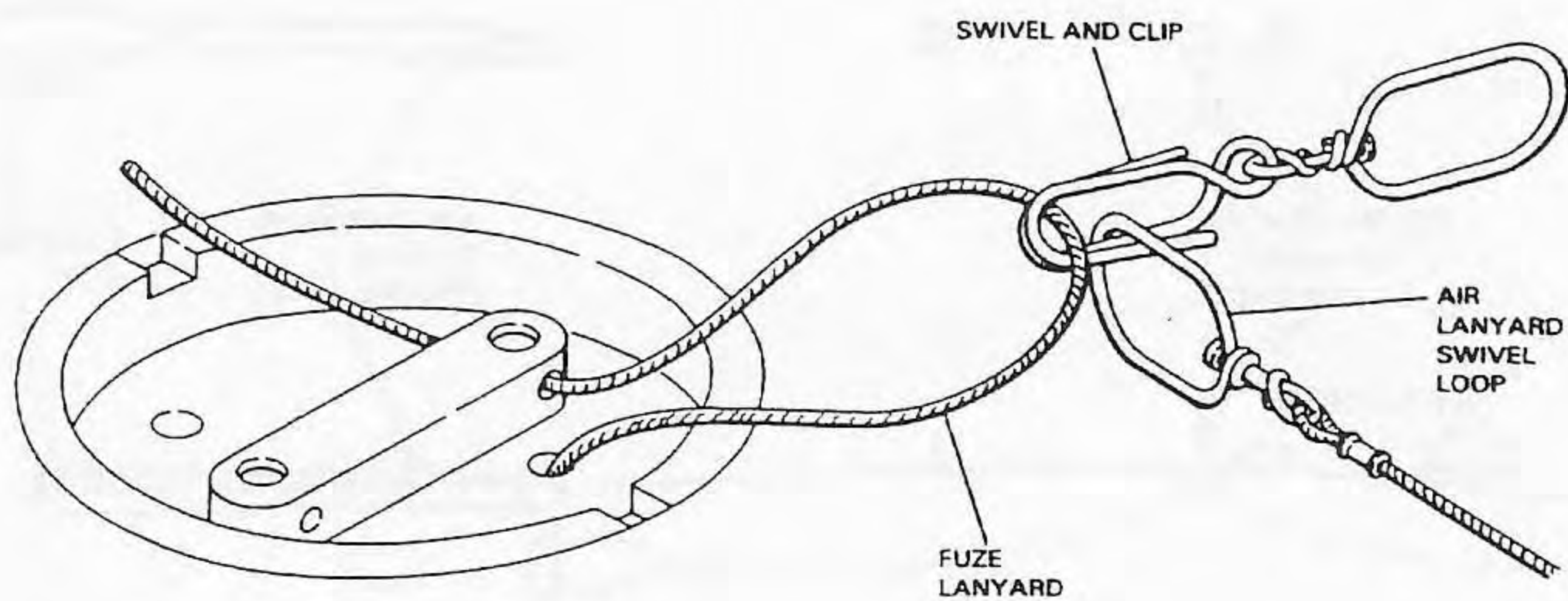
ARM SWITCH	FUZE ARM		DRAG
NOSE CENTER	139(N)	ARM	LOW
	139(T)	ARM	
N/T	139(N)	ARM	LOW
	139(T)	ARM	
TAIL	139(N)	DUD	LOW
	139(T)	DUD	

NOTE:

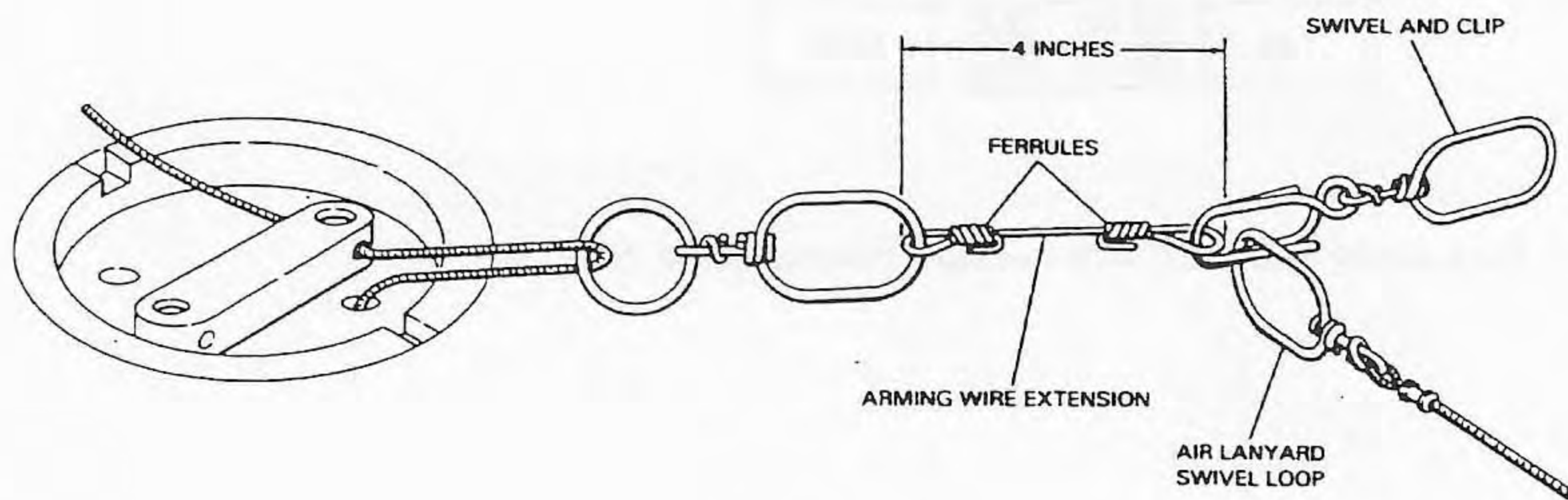
- 1** • For low-drag mode, FZU-48/B minimum function speeds: 250 KCAS.

1A-10A-34-1-1-2-29

Figure 2-21. MK 82 AIR ARMING CONFIGURATIONS (Sheet 9 of 9)



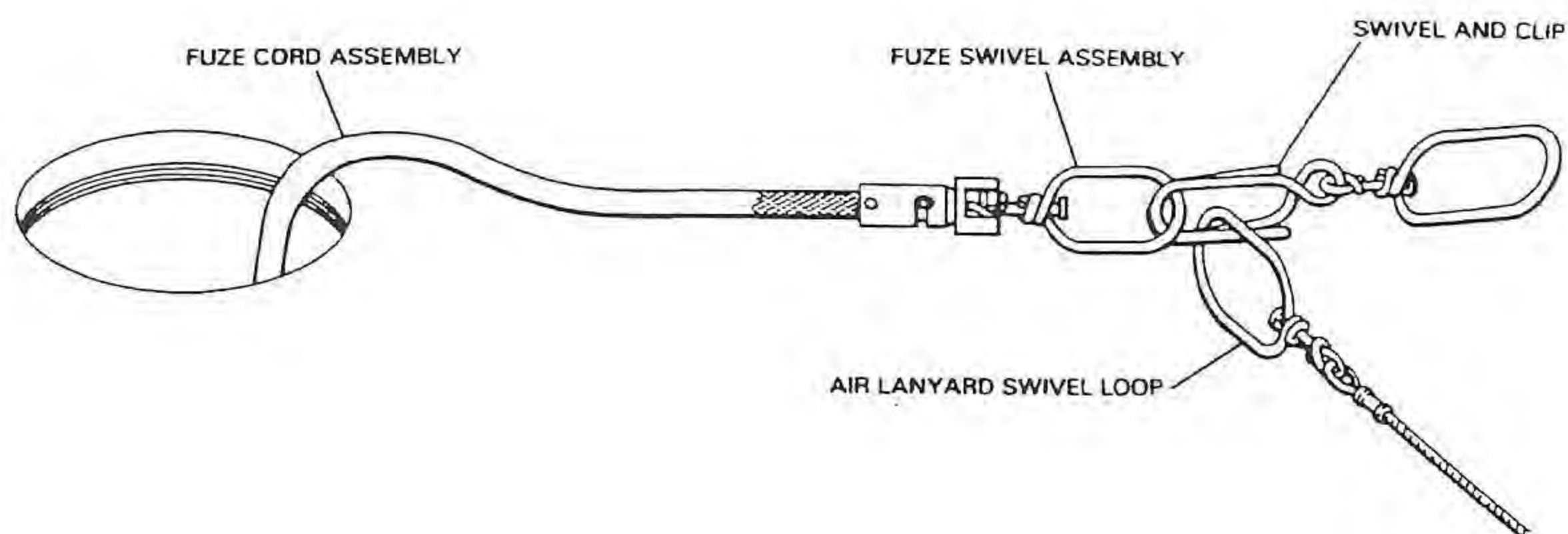
TER/MAU-50/FMU-54/B



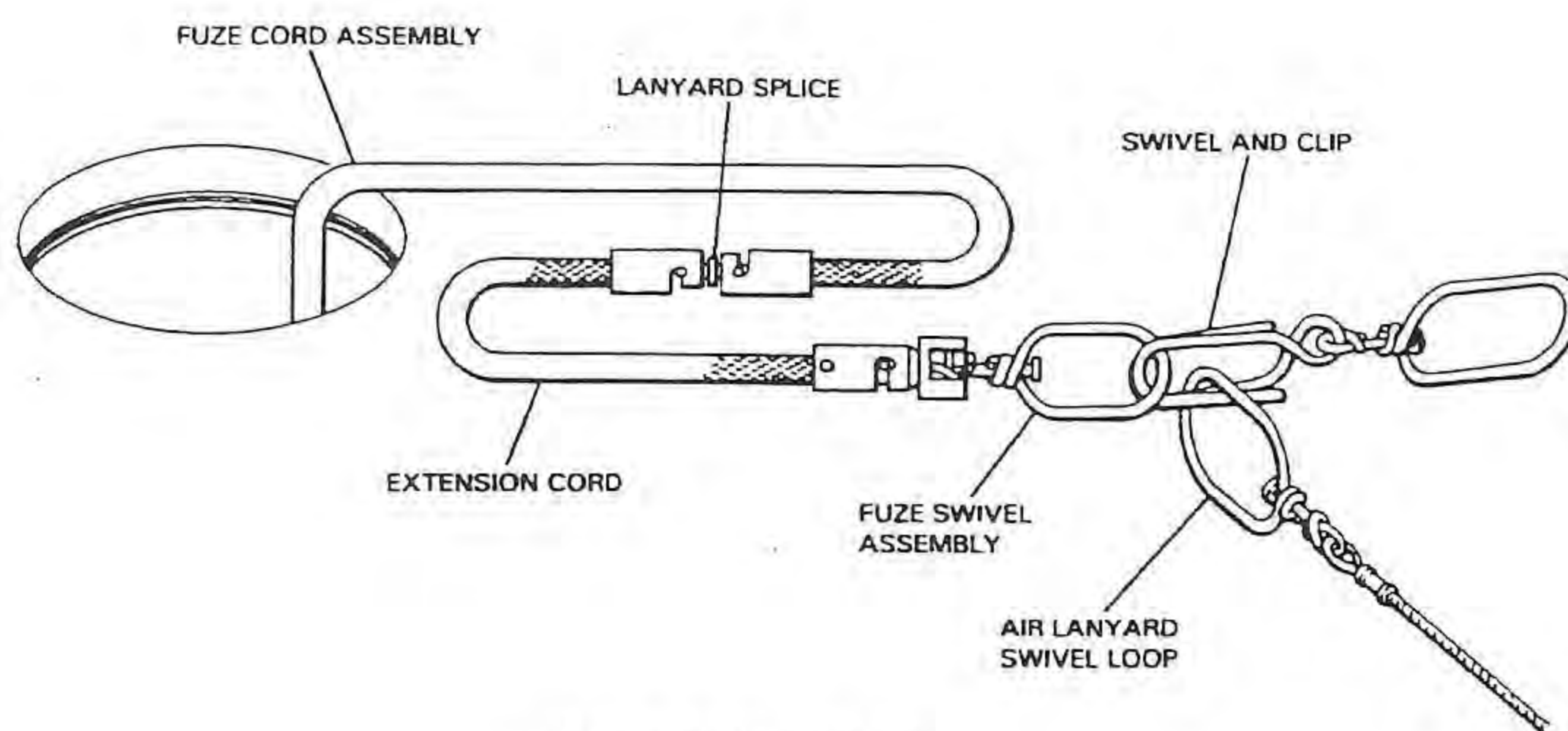
MAU-40/FMU-54/B

1A-10A-34-1-1-2-30

Figure 2-22. MK 82 AIR/FMU-54B AND AIR LANYARD ARMING HIGH/LOW DRAG-COCKPIT SELECTABLE



TER/FMU-54A/B



MAU-40/50/FMU-54A/B

1A-10A-34-1-1-2-31

Figure 2-23. MK 82 AIR/FMU-54A/B AND AIR LANYARD ARMING HIGH/LOW DRAG-COCKPIT SELECTABLE

LASER-GUIDED BOMBS

PAVEWAY I (GBU-10/B, A/B, B/B, GBU-12/B, A/B)-FIXED WING (Figure 2-24)

- *1. Control guidance section and seeker head - Checked:
 - a. Lens - Clean and undamaged.
 - b. Nose covers - Installed.
 - c. Seeker head - Free to swivel.
 - d. Serial number - Recorded.
2. Thermal battery - Checked:
 - a. Safety pin - Removed.
 - b. Thermal battery arming wire - Secured to sway-brace.

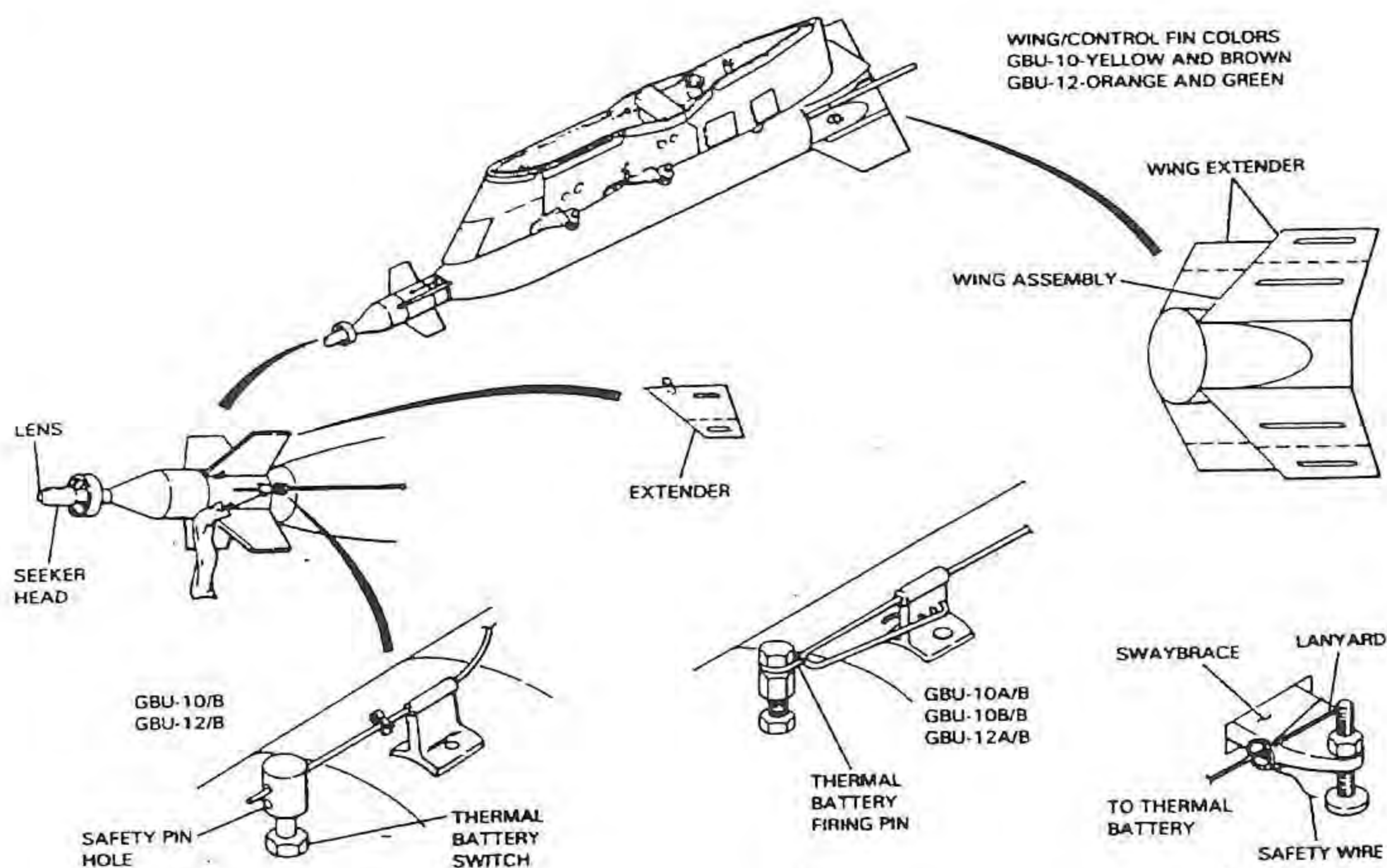
3. Wing assembly and guidance control fins Low speed configuration (X).
4. Fuze settings - Checked.

NOTE

Fuze settings/delay element settings will be marked on side of bomb.

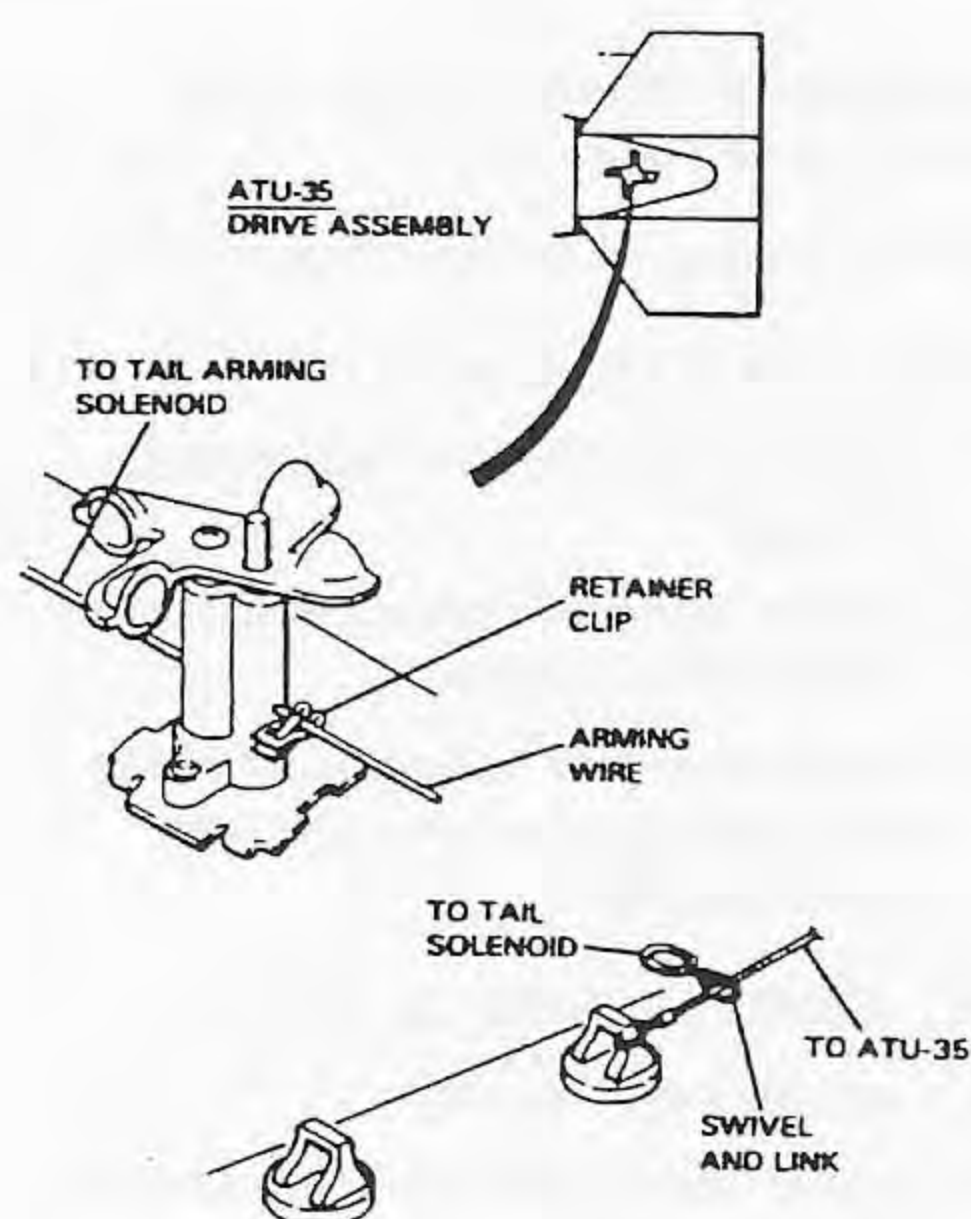
- *5. Arming wire routing - Checked (Figure 2-25):

- a. M905 with ATU-35 drive:
 - (1) Arming wire - Checked, free of kinks and burrs.
 - (2) Arming wire protrudes 1.5 to 2.0 inches beyond ATU-35 drive.

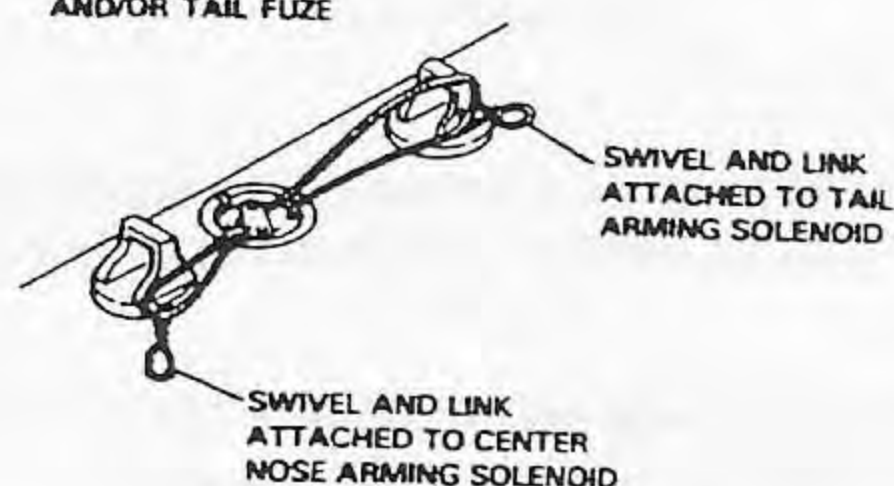


1A-10A-34-1-1-2-32

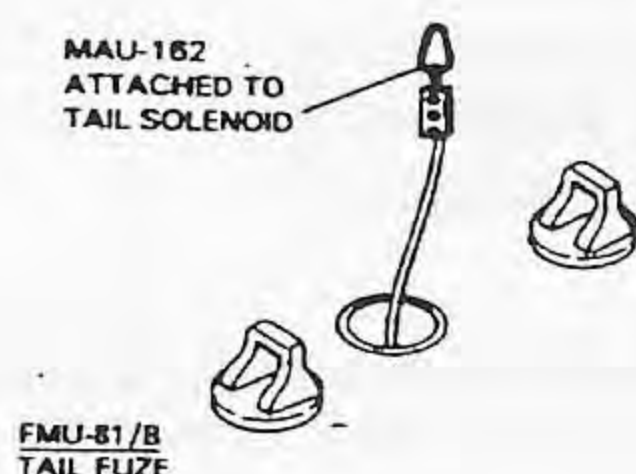
Figure 2-24. PAVEWAY I



FMU-26 B/B NOSE AND/OR TAIL FUZE



MAU-162 ATTACHED TO TAIL SOLENOID



1A-10A-34-1-1-2-33

Figure 2-25. PAVEWAY I ARMING WIRE ROUTING

(3) Arming wire tied to forward or aft lug and connected to tail solenoid with swivel and link.

b. FMU-26B/B nose and/or tail fuze:

- (1) Lanyard loops - Secured. End of lanyard loop must be secured to lanyard lock.
- (2) Lanyard swivel and link - Connected to correct solenoid.

WARNING

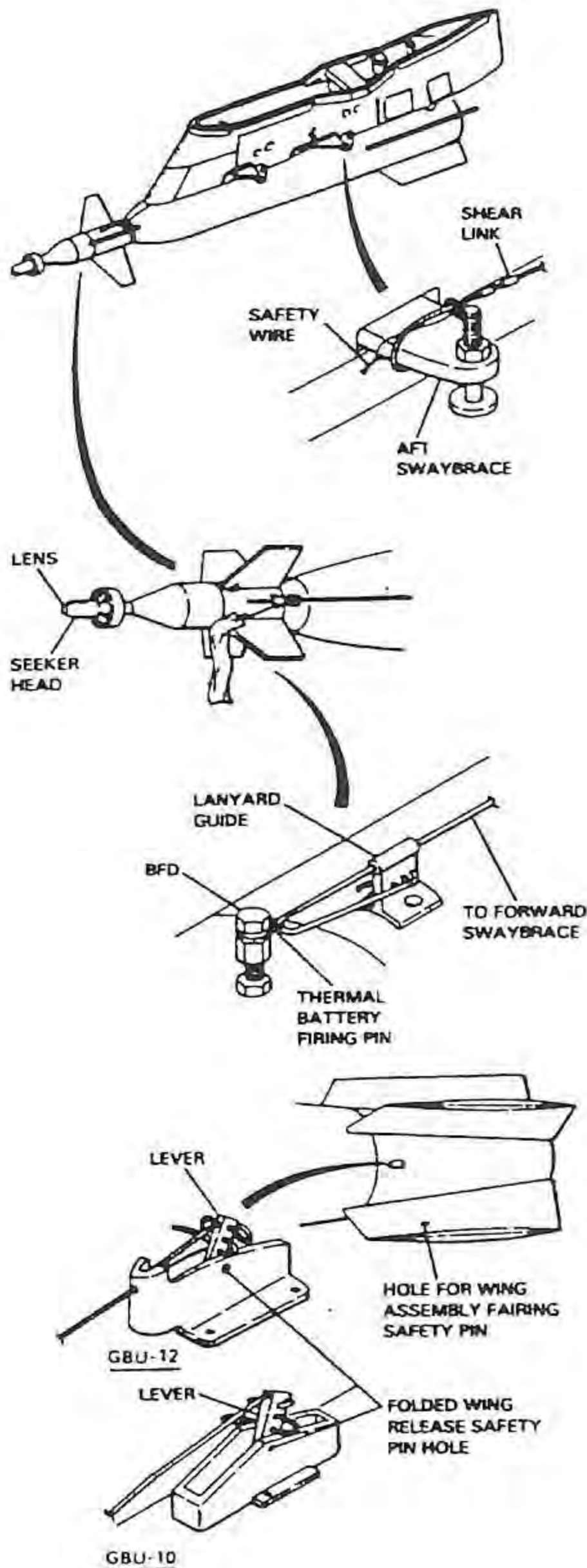
Extreme care must be exercised when inspecting lanyard. Pulling lanyard could arm FMU-series fuzes.

c. FMU-81/13 tail fuze:

- (1) MAU-162 lanyard adjuster - Attached to tail solenoid.

PAVEWAY II (GBU-10C/B, D/B, E/B, GBU-12B/B, C/B, D/B) - FOLDING WING (Figure 2-26)

1. Control guidance section and seeker head - Checked:
 - a. Lens - Clean and undamaged.
 - b. Nose covers - Installed.
 - c. Seeker head - Free to swivel.
 - d. Serial number - Recorded.
2. Thermal battery - Checked:
 - a. Safety pin - Removed.
 - b. Thermal battery arming wire - Secured to sway-brace.
- *3. Wing assembly and guidance control fins:
 - a. Control fin/wing assembly colors - Match.
 - b. Folded wing release latch safety pin - Removed.
 - c. Folded wing release lanyard - Secured to aft swaybrace.
 - d. Wing assembly fairing safety pin - Installed.



1A-10A-34-1-1-2-34

Figure 2-26. PAVEWAY II

4. Fuze settings - Checked.

NOTE

Fuze settings/delay element settings will be marked on side of bomb.

5. Arming wire routing - Checked (Figure 2-27):
 - a. M905 with ATU-35 drive:
 - (1) Arming wire - Checked free of kinks and burrs.
 - (2) Arming wire protrudes 1.5 to 2.0 inches beyond ATU-35 drive.
 - (3) Arming wire tied to forward or aft lug and connected to tail solenoid with swivel and link.
 - b. FMU-26B/B nose and/or tail fuze:
 - (1) Lanyard loops- Secured.
 - (2) Lanyard swivel and link - Connected to correct solenoid.

WARNING

Extreme care must be exercised when inspecting lanyard. Pulling lanyard could arm FMU-series fuzes.

- c. FMU-81/B nose and/or tail fuze MAU-162 lanyard adjuster attached to tail solenoid.

BLU-52 CHEMICAL BOMB

WARNING

During exterior inspection do not touch a leaking or contaminated BLU-52. Call EOD personnel immediately.

- *1. Fin configuration-(X) (Figure 2-1).
2. Bomb - Secured, no leaks.
3. Nose and tail caps - Secured (if applicable).

CLUSTER WEAPONS

BL-755 (Figure 2-28)

- *1. Fin configuration — (X) (Figure 2-1).
2. Fuze - Checked.
 - a. Fuze vane safety pin — Installed (remove before flight).
 - b. Fuze settings — Checked (not visible but placarded on side of munition).

NOTE

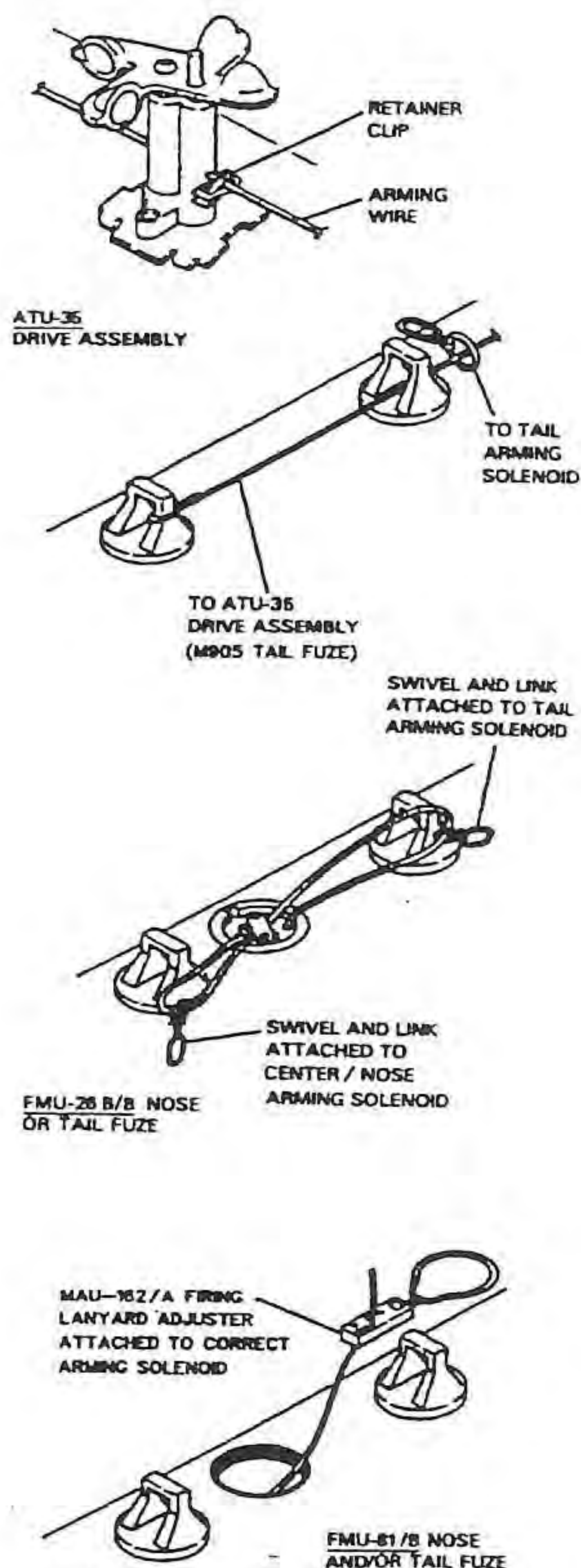
With fuze arming vane installed, neither the fuze time selector nor red arm/safe indicator can be viewed.

3. Spring motor safety pin — Removed.
4. Electrical lead — Removed and plug installed.
5. Access doors, panels, and skin — Secured.
6. Tail fin safety pin — Removed.
7. Tail fins — Secured and undamaged.

WARNING

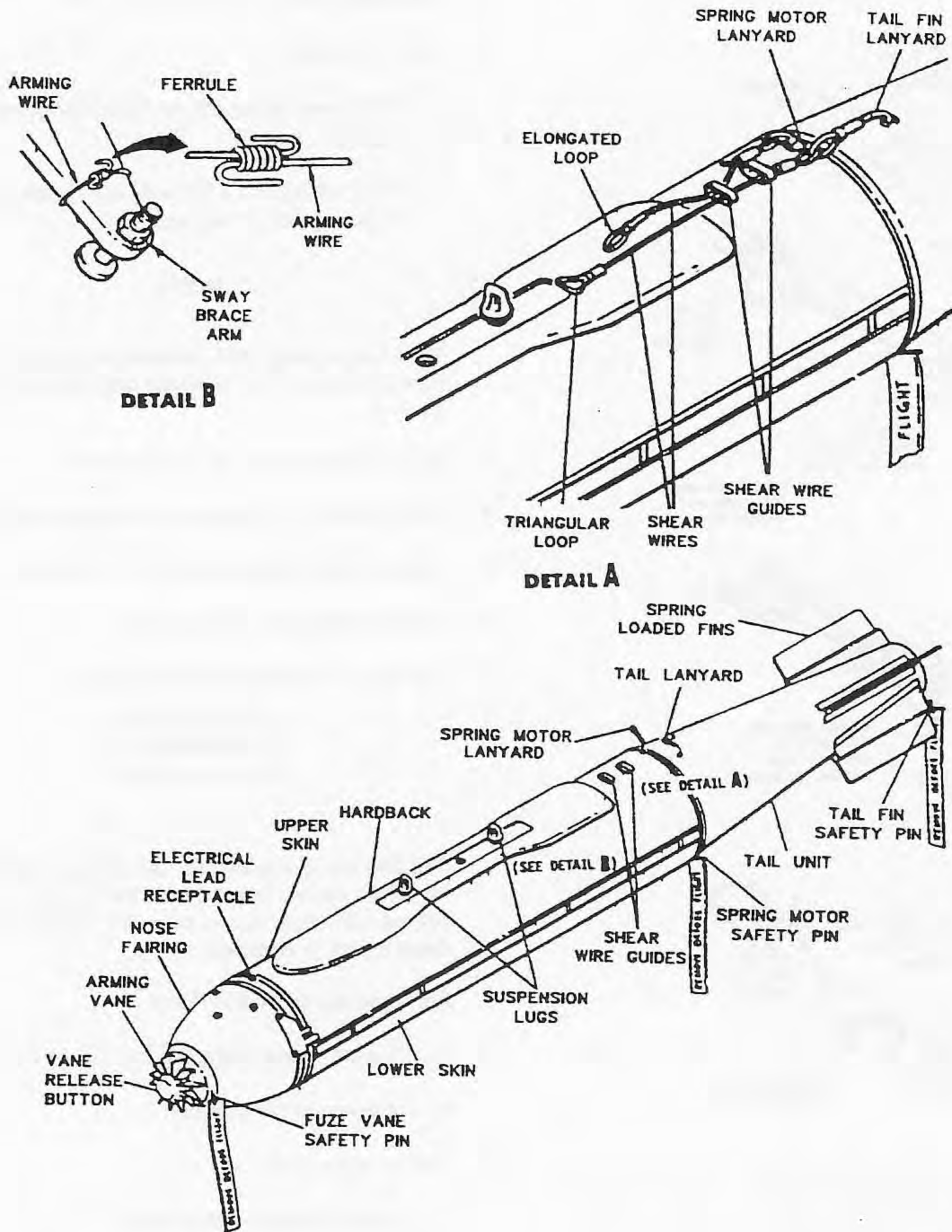
Tail fins are spring-loaded. Accidental functioning of fin release lanyard with safety pins removed will allow fins to snap out, which could cause injury to personnel.

8. Spring motor shear wire loop:
 - a. Routed through wire guides.
 - b. Installed in tail solenoid.
9. Tail fin shear wire:
 - a. Routed through wire guides.
 - b. Secured to aft swaybrace.
10. Bomb — Secured, no leaks.
11. Nose cap — Secured.
12. Tail cap — Secured.



1A-10A-34-1-1-2-35

Figure 2-27. PAVEWAY II ARMING WIRE ROUTING



1A-10A-34-1-1-2-36

Figure 2-28. BL-755

**CBU-87/B CEM/CBU-89/B GATOR, CBU-97/B,
A/B SFW****(Figures 2-29 and 2-30)**

1. Sealcup — Reject if missing or punctured.
2. Pitot tube — Not extended.

WARNING

If the pitot tube is extended, the fuse is armed.
Notify EOD immediately.

3. Spin set knob — Check:
 - a. (CBU-87) Set as briefed.
 - b. (CBU-89, CBU-97) Set on I and locked out.

SETTING	RPM
1	0
2	500
3	1000
4	1500
5	2000
6	2500

4. Arm time - Set as briefed.

SETTING	SECONDS
M	0.63
N	0.95
O	1.28
P	1.60
R	1.92
S	2.23
T	2.55
U	2.87
V	3.19
X	3.51
Y	3.83
Z	4.15

WARNING

(CBU-87/B) Time setting "M" (0.63 sec) prohibited.

CAUTION

With FZU-39/B installed, maximum arm time is setting "S" (2.23 sec).

NOTE

(CBU-89/B) Time settings start with "O" (1.28 sec).

5. Fuze and arm/option safety pins — Removed.
6. FZU-39/B sensor — Check recorded settings:
 - a. HOF knob — Set as briefed.
 - b. ECM knob — Set as briefed.

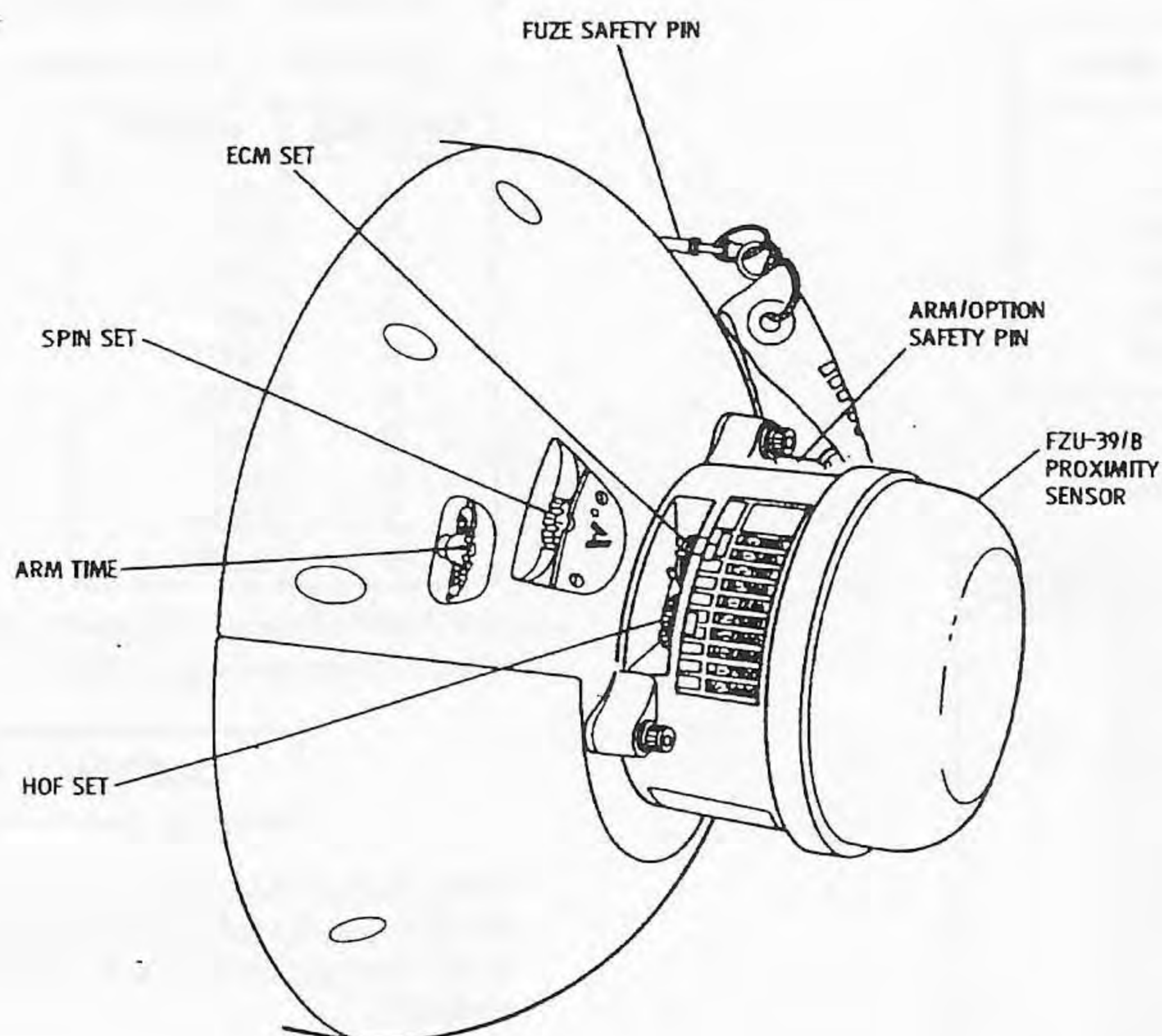
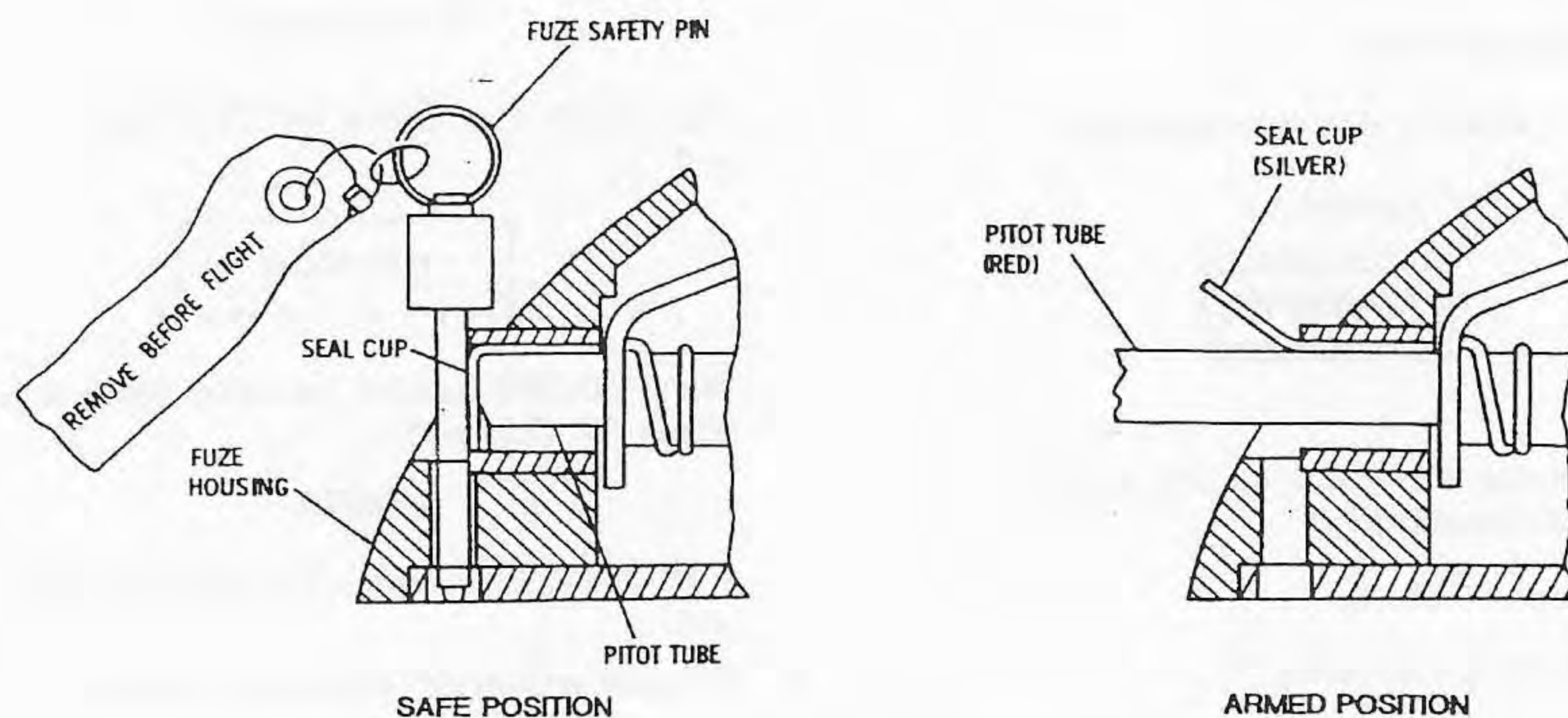
SETTING	HOF-FT
A	300
B	500
C	700
D	900
E	1200
F	1500
G	1800
H	2200
J	2600
K	3000

7. (CBU-89/B) Fuze arm lanyard — Installed and extends 1/8 inch past rear of BFD.

CAUTION

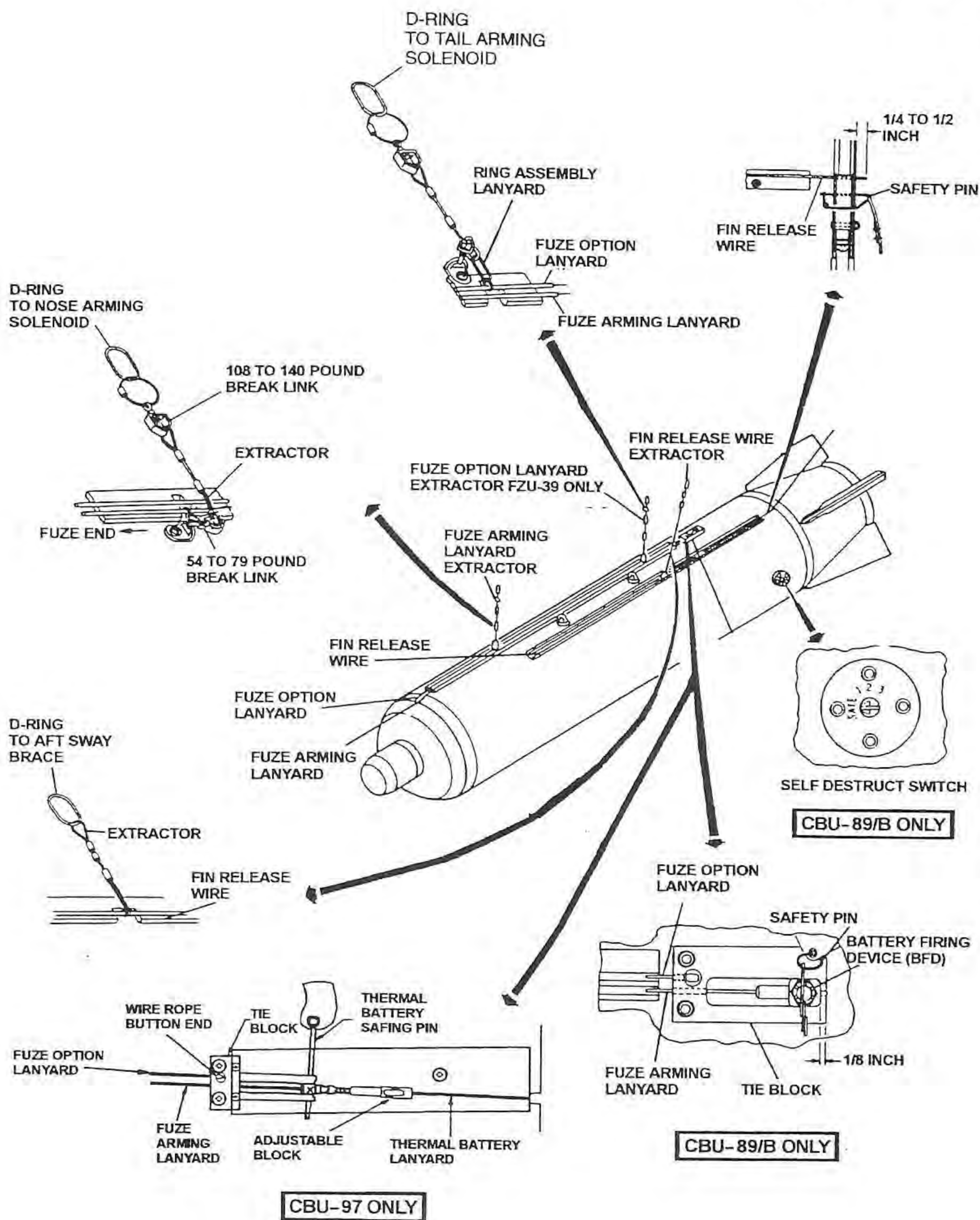
(CBU-89/B) If fuze arm lanyard does not engage the BFD and the safety pin is not installed, Adapter Kit Thermal Battery has fired. Notify EOD immediately.

8. Fuze arm lanyard extractor — Secured to nose arming solenoid.



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Figure 2-29. EXTERIOR INSPECTION FZU-39/B



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Figure 2-30. EXTERIOR INSPECTION CBU-87/B, -89/B, -97/B, -97A/B

If FZU-39/B Installed:

9. FUZE option lanyard extractor — Secured to tail arming solenoid.

If FZU-39/B not installed:

9. FUZE option lanyard extractor — Removed.

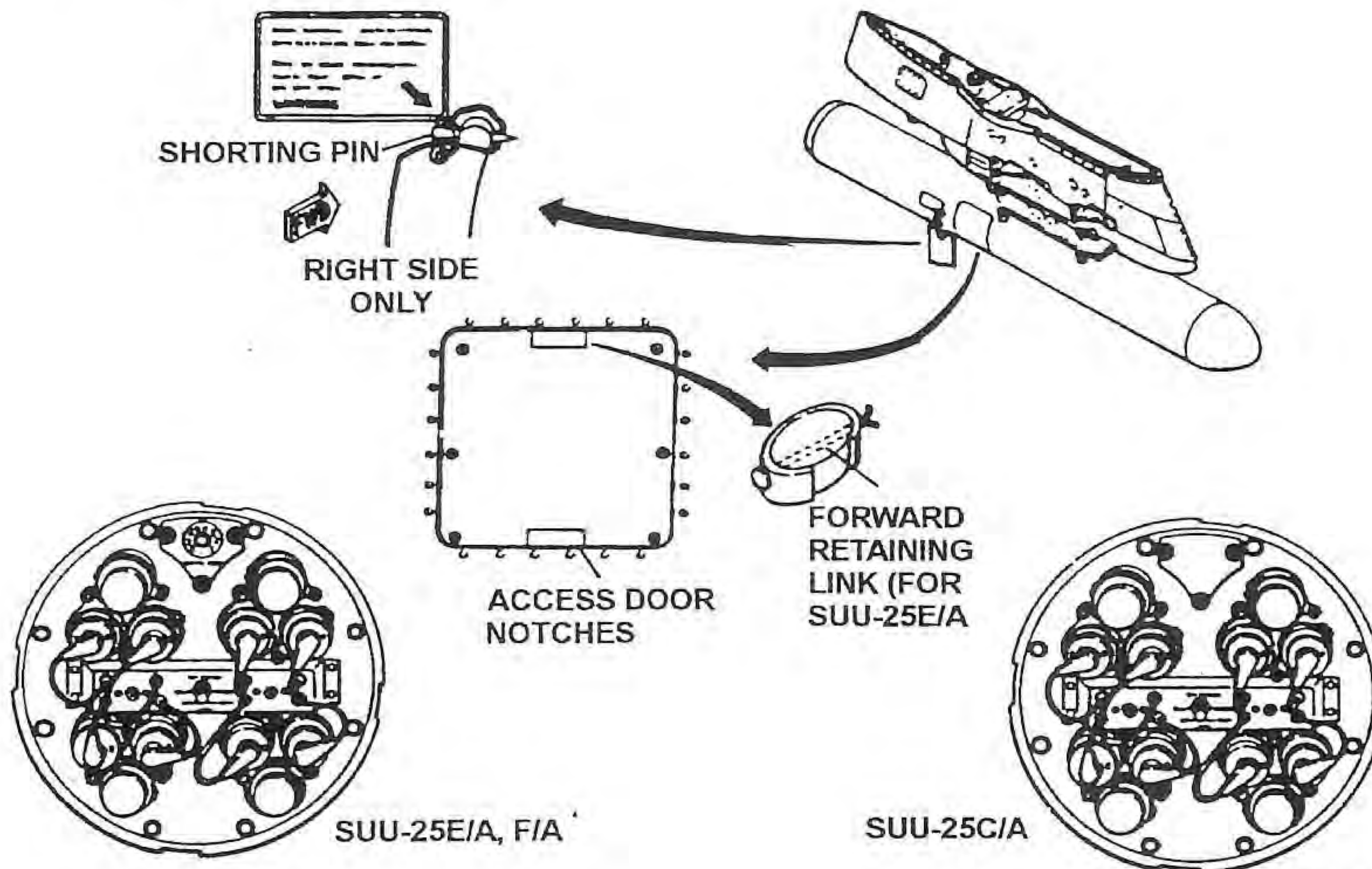
CAUTION

- If FZU-39/B not installed, option extractor lanyard connected, and tail solenoid armed, munition will dud.
 - Ensure lanyards and wires are routed so they will not hang on ejector feet sensing switches or swaybrace pads. Improper routing may result in armed CBU or undesirable arming combinations.
10. (CBU-89/B) Self destruct setter switch — Set as briefed.
 11. (CBU-89/B) BFD safety pin — Removed.

12. (CBU-97) Thermal battery lanyard safety pins — Removed.
13. Fin release lanyard extractor — Secured to aft sway brace.
14. Fin release lanyard — Installed and wire extends 1/4 to 1/2 inch past fin release band latch.
15. Fin release band safety pin — Removed.

SUU-25 FLARE DISPENSER (Figure 2-31)

1. TER-9/A CBU/ROCKET switch — ROCKET.
2. Rocket harness — Connected.
3. SUU-25 series dispenser — Checked:
 - a. Shorting pin — Installed.
 - b. Nose cone — Secured.
 - c. Flare retainer link and shearpins — Installed.
 - d. SUU-25E/A, F/A forward retaining link — Installed.



1A-10A-34-1-1-2-39

Figure 2-31. SUU-25

LAU 68/-131 ROCKET LAUNCHERS

1. TER-9/A CBU/ROCKET switch - ROCKET.
2. Rocket harness — Connected.
3. Rocket launcher — Checked:
 - a. Launcher — Secured.
 - b. Safety pin — Installed (removed prior to takeoff).

WARNING

If shorting device is not installed, rockets may be fired inadvertently.

- c. Intervalometer — Checked, (if not fully loaded, set intervalometer to tube number before the first tube loaded).
- d. Rocket motor igniter — Contact touching launcher ground firing contact.
- e. Nose and tail fairings — Locked (if applicable).

CAUTION

LAU-131 Certification Test determined the aft fairing mechanism is deficient and recommended prohibiting use of fairings until a more secure mechanism can be implemented.

- f. Single/Ripple mode switch — As required.

AGM/TGM-65 (Figure 2-33)**LAU-88 Launcher Checks**

1. Electrical connectors to LAU-88 — Connected.
- *2. Missile(s) — Secured.

NOTE

- The AGM-65G cannot be used on multiple rail Launchers due to weight constraints.
- Due to high initial power requirement for internal VTR equipped TGM-65D only two missiles can be loaded on a LAU-88.

- *3. Shear pins - Seated (red not visible), plunger bar 1/8 to 3/16 inch above top nut.
4. Umbilical connectors — Connected on loaded rails.

NOTE

No red should be showing on side of umbilical connector when connected and secured.

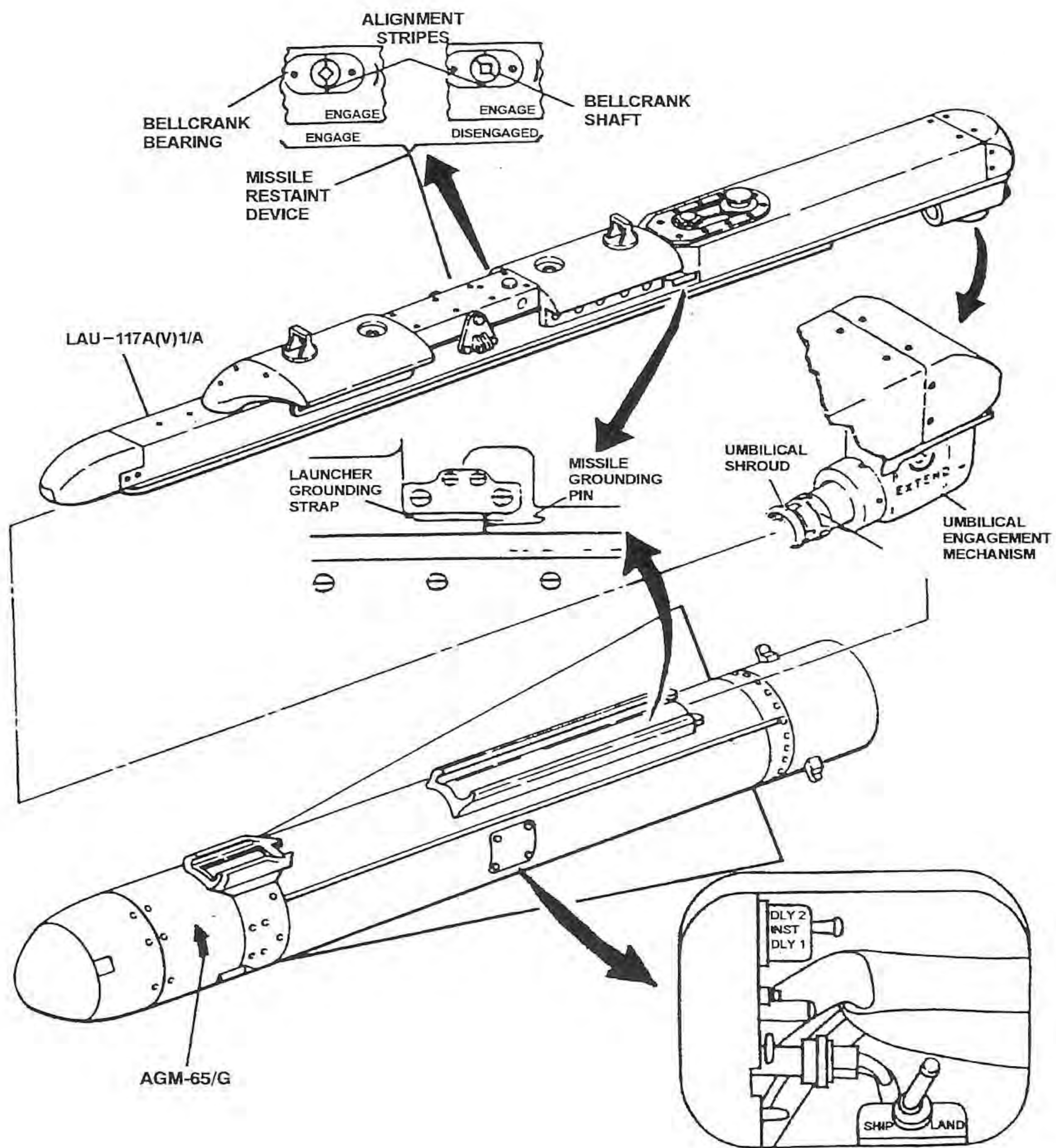
5. Dust caps - Installed on umbilical on unused launcher rails.

LAU-117A(V)1/A Launcher Checks (Figure 2-32)

1. Electrical connectors to LAU-117A(V)1/A — Connected.
2. Missile — Secured.
3. MRD holdback pin — Seated, shaft stripes aligned (within 5°)
- *4. Umbilical connector — Connected (red not visible).

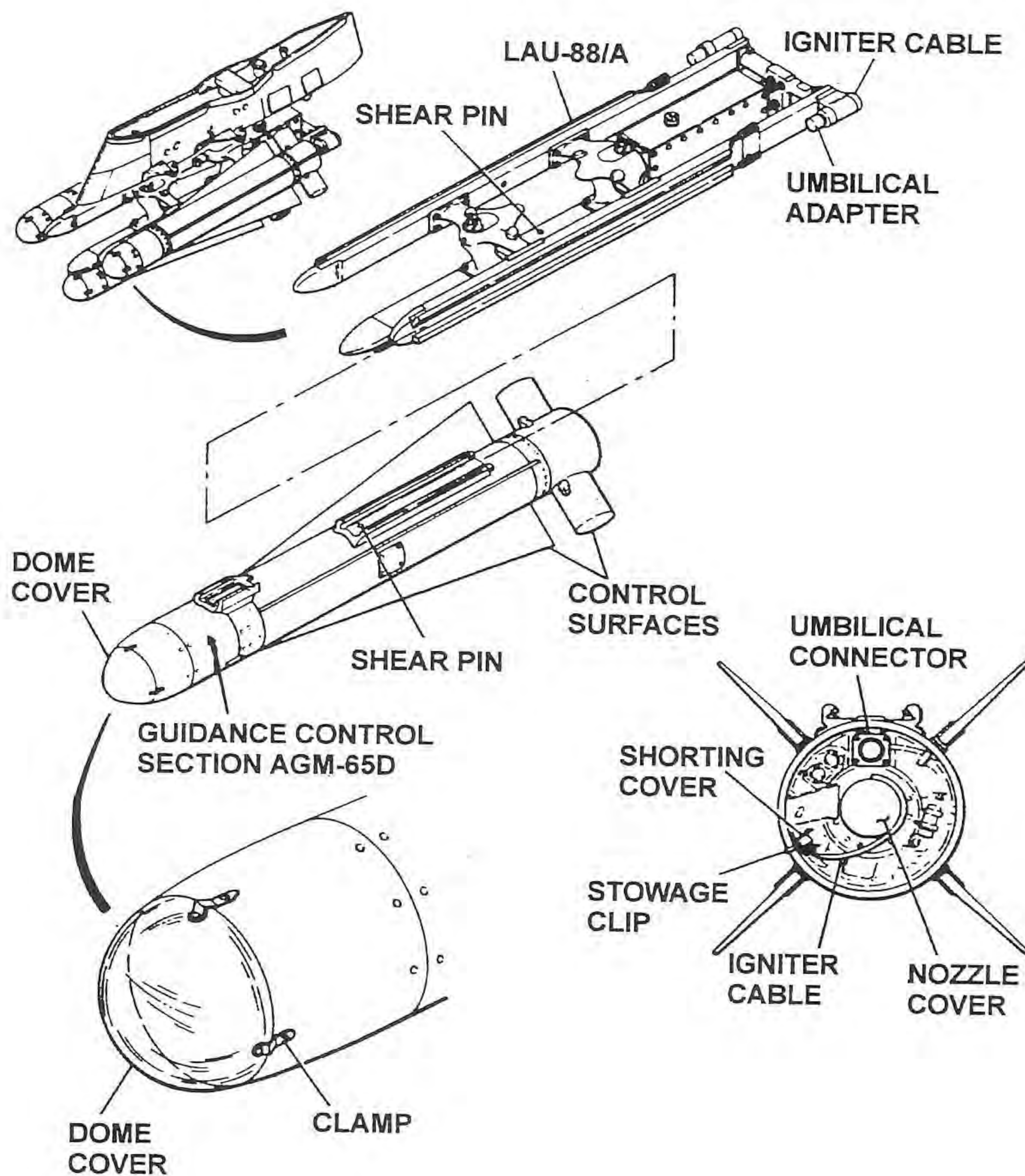
AGM-65 Preflight (Figure 2-32)

1. Missile igniter cable — Disconnected.
2. Missile grounding pin — Contacts launcher grounding strap.
- *3. Hydraulic actuation system — free of leakage.
4. Missile wings/control surfaces — Locked, no damage.
5. Umbilical adapter — Undamaged.
6. Rocket nozzle cover — Installed.
7. Humidity sensor — Checked (if installed).
8. Dome cover — Checked (if installed).
9. AGM-65D/G guidance and control section (GCS) — Properly, oriented (arrow on either side of GCS points up).
10. (AGM-65G) FUZE DELAY and SHIP/LAND switches — Set. (Switches accessed via push button latch on battery access panel).
11. Missile serial number(s) — Record.
12. (AGM-65A/B) TCTO 511 C/W stenciled on missile body (if not C/W — abort).



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Figure 2-32. AGM/TGM-65 AND LAUNCHERS (Sheet 1 of 2)



1A-10A-34-1-1-2-41

Figure 2-32. AGM/TGM-65 AND LAUNCHERS (Sheet 2 of 2)

TGM-65 Preflight

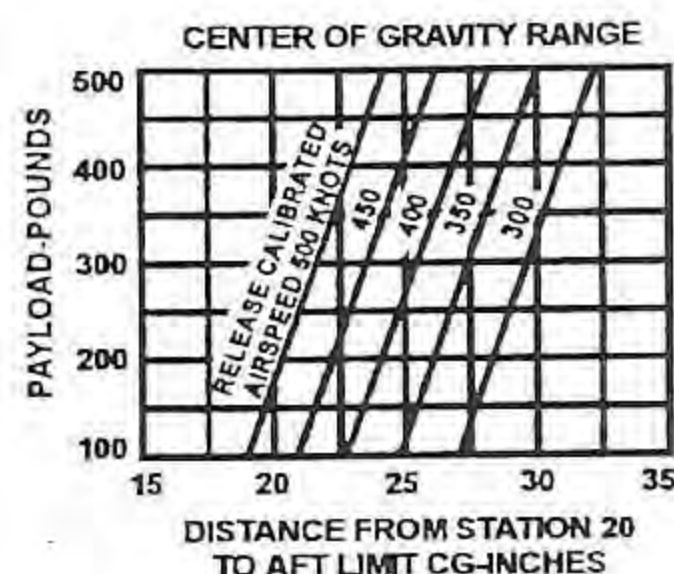
WARNING

TGMs and live missiles should not be mixed on LAU-88/A launchers.

CAUTION

Do not load more than one TGM with recorder installed and/or electrically connected on same LAU-88/A.

1. Missile grounding pin — Contacts launcher grounding strap.
2. Umbilical adapter — Undamaged.
3. Film recorder — Loaded and door secured (if applicable).
4. Humidity sensor — Checked (if installed).
5. TGM-65D/G (IIR) guidance and control section (GCS) — Properly oriented (arrow on either side of GCS points up).



ECM PODS ALQ-131/ALQ-184 PREFLIGHT

1. Pod — Secured, swaybraces tight, safety wired, and uncartered.
2. Umbilical connection — Secured.
3. Radomes — Check condition.
4. Check for leaks and/or loose panels.
5. Placard — Check pod settings.

CTU-2/A AERIAL RESUPPLY CONTAINER (Figure 2-33)

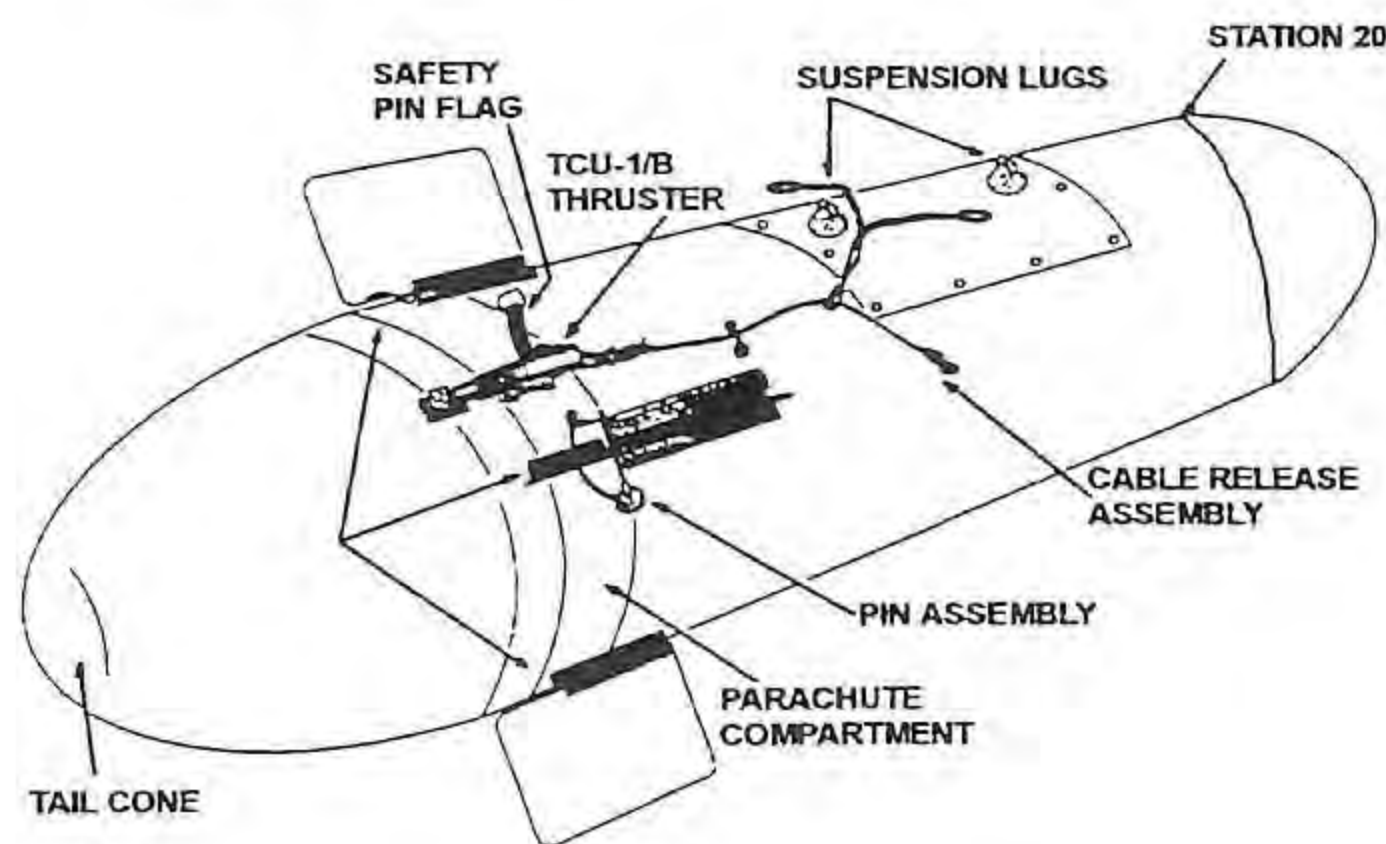
NOTE

If the bomb rack cable harness assembly length is insufficient for installation over both swaybrace arms, both cable loops may be installed over one swaybrace arm (Figure 2-32).

1. Check that bomb rack harness assembly is installed on swaybrace arm(s).
2. Check that TCU-1/B Thruster Assembly Safety Pin is installed.
3. Check that access doors and panels are secured.
4. Check that center of gravity mark is installed.

CHARACTERISTICS

WEIGHT, EMPTY	213 LB
MAX CONTAINER LOAD	500 LB
LENGTH	8 FT 10 IN
DIAMETER	21 IN
SUSPENSION LUG SPACING	14 IN

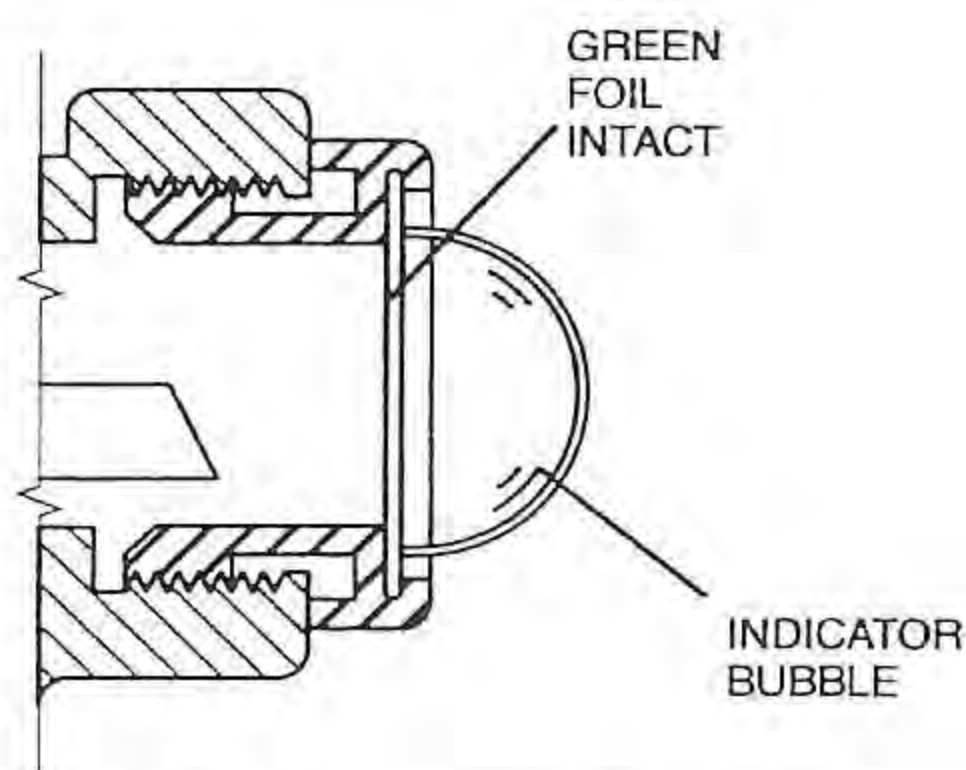


1A-10A-34-1-1-2-42

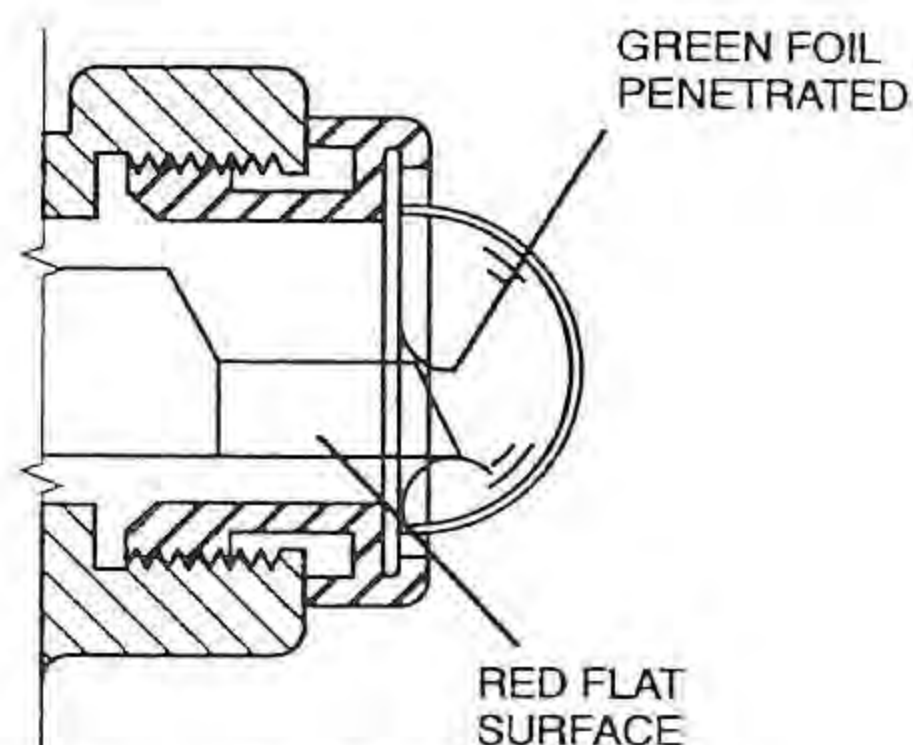
Figure 2-33. CTU-2/A Aerial Resupply Container

M-129 LEAFLET BOMB WITH MK 339 MOD 1 FUZE (Figures 2-34 and 2-35)

1. SAFE/ARM Indicator — Reject if green foil is punctured (Figure 2-34).
2. Primary fuze safety pin — Removed (Figure 2-35).
3. Arming wire protrudes 3/4 to 1 inch beyond impeller band stud (Figure 2-35).
4. Option safety pin flag — Removed, ensure cotter key remains in option pin bracket (Figure 2-35).
5. Fuze impeller — Secured and undamaged.
6. Tail fins — Secured and undamaged.



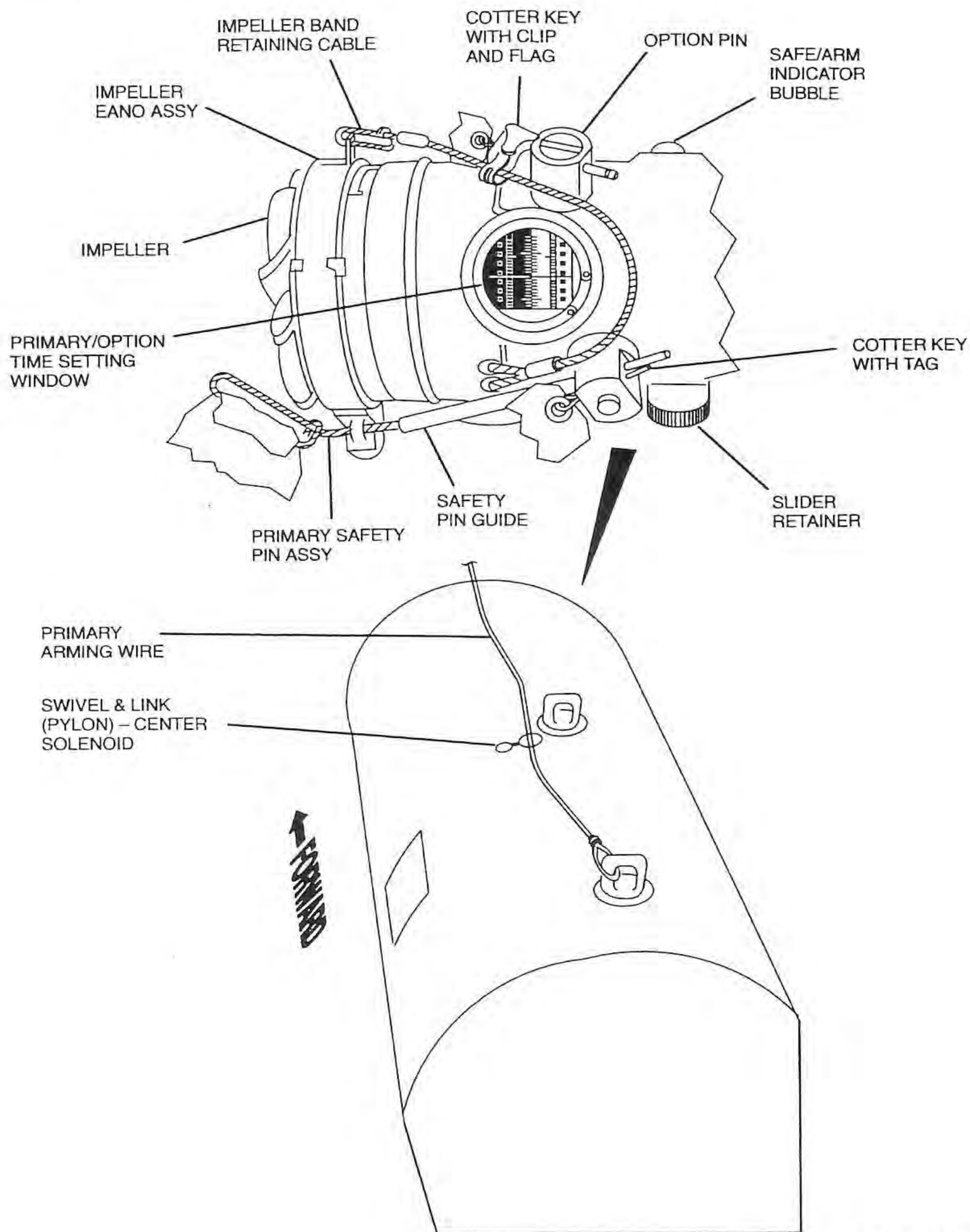
Fuze SAFE/ARM Indicator
in SAFE Position



Fuze SAFE/ARM Indicator
in ARM Position

1A-10A-34-1-1-2-38.2

Figure 2-34. (MK 339 Mod 1) Fuze SAFE/ARM Indicator



1A-10A-34-1-1-2-38.3

Figure 2-35. Fuze Arming Wire Configuration with MK 339 Mod 1 Fuze

BEFORE TAXI PROCEDURES**ARMAMENT CONTROL SYSTEM**

1. WPN STAT STATUS LTS — As required.
2. Armament control panel (ACP) light rheostat — As required.
3. ACP lights — BIT check.
4. EO PWR switch — ON (if AGM/TGM-65 loaded). Off after Maverick ground check.

ARMAMENT RECORDING SYSTEM 139

1. CTVS/AVTR — Check.
 - a. AVTR power switch — Standby (STBY light will come on).
 - b. CTVS BIT check button — Depressed (GO light should come on).
 - c. Video control knob — TVM or CTVS as required.

ARMAMENT RECORDING SYSTEM 140

1. CCTVS/CAVTR — Check.
 - a. CAVTR function switch to STDBY.
 - b. Remote Control Panel function switch to STDBY.
 - c. Remote Control Panel video select switch to AUTO.

HEAD-UP DISPLAY (AFTER -1 CHECKS)

1. Mil depression — Set to 41.
2. Standby pipper — Set to 41 mils and cross checked (within 3 mils).
3. LASTE System — Check
 - a. HUD mode selector — TEST.
 - b. HUD MAIN MENU — Select WEAPONS submenu.
 - c. WEAPONS submenu — Verify data has been stored for applicable weapons offset adjustments and variable target elevation. Perform recoil reset as required.
 - d. ELEV/TIME submenu — Selected steerpoints, target altitudes, time on target displayed, and current time displayed. Confirm present field elevation displayed in HUD (for Takeoff BARO Calibration).
 - e. AAS submenu — Appropriate data displayed.
4. HUD — Set, as required.

TISL (IF DETECTOR POD INSTALLED)

1. Mode select switch — Cage (30-second warmup).

CAUTION

Do not move aircraft with mode select switch set to OFF. Damage to the seeker head may result.

2. Laser code — Required code set.
3. TISL toggle switch — TISL.
4. BIT button — Depressed (TISL system BIT checks to 0 mil).
5. Mode select switch — As required.

AGM/TGM-65 GROUND CHECK

1. TVM power switch — PWR (2-minute warmup).
2. EO PWR switch — ON (3-minute warmup).

CAUTION

- Premature uncage (call up of video) of a AGM/TGM-65A/B prior to expiration of the 3-minute gyro spin-up time can result in guidance unit damage due to gyro tumbling. This is indicated by a rapidly moving TVM picture after missile uncage. AGM/TGM-65D/G have an inhibit circuit to prevent premature uncage.
- Do not maintain AGM/TGM-65 in ready mode (EO PWR switch ON) in excess of 60 minutes. This includes 3 minute gyro spin-up time.

3. Store loading display — Recheck E/O.
4. Weapon station(s) — Select (green lights on).
5. MASTER armament switch — SAFE.
6. Confirm no green ready lights.
7. AGM-65 — Check video (if applicable):
 - a. Reject/uncage switch — Forward.

CAUTION

- AGM-65A/B must not be maintained in the full power mode (video on) in excess of 3 minutes.
- AGM-65D/G must not be maintained in the full power mode (video on) in excess of 30 minutes.

NOTE

The dome cover should not blow.
(AGM-65A/B) Video may be blurred with dome cover installed. (AGM-65D/G) Video will not be present with dome cover installed.

- b. REJECT UNCAGE switch — Aft, then forward. Step through missiles and stations to confirm video present.

NOTE

ACS will not transfer between stations 3 and 9. If 9 is selected prior to 3, the pilot must deselect 9 before ACS can step to 3. If 3 is selected prior to 9, the pilot must deselect 3 before ACS can step to 9.

8. TGM-65 — Check video (if applicable):
 - a. Missile video polarity switch — FWD (dark on light/cool on warm).
 - b. Reject/uncage switch — Forward.

CAUTION

- TGM-65A/B must not be maintained in the full power mode (video on) in excess of 3 minutes.
- TGM-65D/G must not be maintained in the full power mode (video on) in excess of 30 minutes.
- c. Missile — Slew and lock-on to dark/cool target.
- d. TVM — Fine tune picture.
- e. TGM-65D/G — Reject/uncage switch forward for narrow field-of-view. (LAU-117A(V)1/A and LAU-88A/A only).

NOTE

It may be necessary to select/reject uncage switch forward twice to step to narrow field-of-view after initial callup of missile.

- f. Missile video polarity switch — Aft (light on dark/warm on cool).

NOTE

This switch affects the missile tracker only at instant of lock-on. To change the contrast

selection after lock-on, change switch to desired position, then reinitiate lock-on by depressing and releasing missile track enable button.

- g. REJECT/UNCAGE switch — Aft then forward. Step through missiles and stations to confirm video present. Repeat steps 8.a. through 8.f.

NOTE

ACS will not transfer between stations 3 and 9. If 9 is selected prior to 3, pilot must deselect 9 before ACS can step to 3. If 3 is selected prior to 9, pilot must deselect 3 before ACS can step to 9.

9. Weapons stations — Deselected.
10. EO PWR switch — OFF.
11. TVM — As required.

RADAR WARNING SYSTEM (ALR-69)

1. Power — ON, set audio and CRT brightness.
2. BIT check system, note system status.
3. File — Select.
4. Open/priority mode — Selected.
5. Unknown/search — As required.
6. Altitude — Selected.

ECM POD GROUND CHECKS

ALQ-184 (C-9492B Control)

1. Power switch — STBY ("S" light in special button comes on in 200 ± 20 seconds).
2. Pushbuttons — Not depressed.
3. Xmit switch — XMIT 1.
4. BIT button — Depress and hold (check all lights).

CMS/(EWMS) CHECKS 138

1. CMSP/(EWMU) mod selector — STBY.
 - a. CMSP/(EWMU) SYSTEM TEST menu — Perform EWMS/CMSP RWR, JMR, and DISP BIT.
 - b. CMSP/(EWMU) EC STORES SETUP menu — Select pod option.
 - c. Embedded training — As required.
 - d. JMR rotary — Set options as required.
 - e. RWR rotory — Set options.

ALQ-131/ALQ-184 (C-9492B Control)

1. Pushbuttons — Out.
2. Power switch — STBY.
3. Buttons 3, 4, and 5 F (FAULT) lights, and button 6 LO light come on.
4. If pod has no receiver processor installed, omit steps 4 and 5.
5. Button 8 RP (RECEIVER PROCESSOR) light comes on.
6. After 45-60 seconds, button 8 RP light goes out.
7. After 180-220 seconds, buttons 3, 4, and 5 F lights go out and buttons 3, 4, and 5 S (STBY) lights come on.
8. BIT button — Depress and hold for 3 seconds (pod performs CITS test for 30 seconds).

WARNING

Do not BIT check on ground with power switch set to OPR unless required by maintenance and personnel are at least 15 feet from pod.

9. The "C" light on button 7 can be on for up to 30 seconds. (On Block II pods the "C" will flash 5 times prior to going out.)
10. "S" lights will remain on until OPR is selected.
11. If fault(s) show after 200 second warm-up:
 - a. Reset button — Depressed for 5 seconds.
 - b. If fault(s) remain: Do an ICITS.
 - c. If ICITS does not clear fault(s): Avoid using affected band.
12. If fault remains after STBY ICITS:
 - a. Perform another ICITS.
 - b. If fault remains: Avoid using affected band.

ALQ-131 (C-6631)

1. Operate switch — STBY (CITS test performed after 200 second warm-up).

2. STBY 1 and 2 lights on after 200 seconds.
3. OVLD light indicates a fault in either bands 3, 4, or 5:
 - a. Perform another STBY ICITS. Turn pod off for more than 10 seconds and then ON, which starts 200 second warm-up followed by 30 seconds of ICITS.
 - b. If fault light still on — RESET button depressed.
 - c. If fault light remains ON — Pod OFF.

WARNING

Do not use XMIT mode on the ground. The XMIT mode activates an ICITS which transmits a test signal that could endanger personnel.

AIM-9 MODE CHECK

1. HUD — Set as desired.
2. MIL depression — 42 mils
3. DRA loaded station — Select
 - a. If live fire: Green "R" light — On.
 - b. If training: Amber "E" light — On.
 - c. If AIS pod: Amber "E" light — Flashing.

NOTE

AIM-9 mode sel switch OFF and no other station selected.

4. Missile track button — Press and hold.

If HUD diamond is centered on piper:

- a. Missile track button — Release; proceed to step 7.

If HUD diamond is not centered:

- b. Wait for diamond to flash and then return to steady state.
- c. Exert horizontal and vertical pressure on missile slew control to move diamond to desired position.

NOTE

System will reject any position greater than 17.5 mils from initial mil setting.

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- d. While holding slew position:
Missile track button — Release.

- e. Slew control — Release.

5. Missile track button — Press and hold.
6. HUD diamond — Check proper position

If proper position is not obtained:

- a. AIM-9 MODE check — Repeat.

If proper position is obtained:

- b. Missile track button — Release.

7. Weapon station — Deselect.

ARMING AREA CHECK

1. Arming switches — Rechecked OFF/SAFE.
2. Weapons stations — Deselected.
3. Flaps — UP, for Maverick continuity check (if AGM-65(s) loaded).
4. Pilot — Hands in view of crew chief.

INFLIGHT RELEASE PROCEDURES

AIM-9

Prior to Release

WARNING

Ensure that AIM-9 station ready light and AIM-9 mode indicator light remain off throughout other tactics.

1. HUD mode selector — As desired.
2. AIM-9 MODE switch — Cool.
3. AIM-9 light — ON.

NOTE

- Cool-down time is less than 1 minute.
- Coolant bottle time is 3 to 4 hours, depending on missile environment.

Release

1. AIM-9 MODE switch — SEL (verify green indicator light on).
2. Station select light — On (DRA loaded station only).
3. MASTER ARMAMENT switch — ARM.
4. Ready lights — On.

5. SLEW/TRACK switch — SLEW/TRACK as required.
6. Missile reject/uncage switch — UNCAGE/REJECT as required.

NOTE

- If first missile is rejected it can be recalled by momentarily moving AIM-9 MODE switch from SEL and back, or MASTER armament switch to SAFE and back to ARM.
- System will automatically select the best missile and step to next missile station after missile launch or when REJECT is activated.
- If last missile is fired or rejected system will automatically recall all previous rejected stations.
- All AIM-9 functions (self-track/circular scan) except "pickle" are available with MASTER arm OFF.

7. Missile tone — VERIFY.
8. Seeker head position — VERIFY.
9. Weapons release button — Depress.

Post Release

1. AIM-9 MODE switch — OFF/COOL as required.
2. MASTER armament switch — As required.

GAU-8/A

Prior to Firing

1. HUD mode selector — As desired.
2. Sight depressions — Set as required or aiming reference selected.
3. Rounds remaining — Checked.
4. GUN UNSAFE light — Off.
5. Gun rate switch — HI.
6. Air-to-air mode:
 - a. AIM-9 mode switch — SEL.
 - b. OSP select switch — Select FXD or RTY as applicable.
7. Air-to-ground mode:
 - a. Altitude source — As required.
 - b. EAC switch — As required.
 - c. PAC switch — As required.

8. MASTER armament switch — ARM.
9. GUN READY light — On.

CAUTION

With a Pave Penny detector pod installed, do not fire the GAU-8/A unless the TISL mode switch is out of OFF.

Firing

1. Trigger — Depressed.

CAUTION

- Attempts to shoot very short bursts (less than 14 rounds) may result in damage to the rear spur gear bolts on the aft of the gun housing.
- Do not set MASTER armament switch to SAFE during firing or before GAU-8/A has cleared.

Post-Firing Procedures

1. Gun rate switch — SAFE.
2. MASTER armament switch — SAFE.
3. GUN UNSAFE light — Off.
4. GUN READY light — Off.

LDGP, HDGP, SUU-64/-65/-66, BL-755, BLU-52, BDU-33

Prior to Release

1. Variable target elevation — As required.
2. HUD mode selector — As required.
3. Sight depression — Set, as required, or aiming reference selected.
4. Weapon station(s) — Select, (green lights on).
5. Release mode selector — As required.
6. Ripple quantity selector — As required.
7. Ripple interval selector — As required. (See WARNING HDGP Figure 2-34).
8. Mechanical fuzing selector — As required. (Figure 2-34).
9. OSP select switch — Toggle until HUD displays appropriate weapon.

10. Altitude Source — As required.
11. Target elevation — As required.
12. Target — Designate (MAV or MANUAL) as required. (In LASTE V4.0, can only be done in expanded mode)
13. For EXPANDED CCIP: compression factor — Select.
14. MASTER armament switch — ARM (steady green ready lights on).

Release

1. Weapons release button — Depress (hold until quantity of bombs selected has been released).

Post-Release Procedures

1. MASTER armament switch — SAFE.
2. Mechanical fuzing selector — SAFE.
3. Release mode selector — OFF.
4. Weapon station(s) — Deselected.

LASER-GUIDED BOMBS GBU-10/-12**Prior to Release**

1. HUD mode selector — As required.
2. Sight depression — Set, as required, or aiming reference selected.
3. Weapon station(s) — Select (green lights on).
4. Release mode selector — As required.
5. Ripple quantity selector — As required.
6. Ripple interval selector — As required.
7. Mechanical fuzing selector — As required. (Figure 2-34).
8. OSP select switch — Toggle until HUD displays appropriate weapon.
9. Altitude Source — As required.
10. Target elevation — As required.
11. Target — Designate (MAV or MANUAL) as required. (In LASTE V4.0, can only be done in expanded mode)
12. For EXPANDED CCIP: compression factor — Select.
13. MASTER armament switch — ARM (steady green ready lights on).

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If using TISL:

1. TISL mode selector — As required.
2. Slant range switch — As required.
3. Altitude above target selector — Set.
4. TISL code selector — Set.
5. TISL switch — As required.
6. TISL/AUX ENTER pushbutton — Depressed (check light off).
7. HUD/TISL display — On (indicates TISL tracking a laser designated target).
8. TISL lock-on light — On (indicates TISL tracking a laser designated target).

Release

1. Weapons release button — Depress (hold until quantity of bombs selected has been released).

Post-Release Procedures

1. MASTER armament switch — SAFE.
2. Mechanical fuzing selector — SAFE.
3. Release mode selector — OFF.
4. Weapon station(s) — Deselected.
5. TISL mode selector — As required.

ROCKETS

Prior to Firing

1. HUD mode selector — As required.
2. Sight depression — Set, as required, or aiming reference selected.
3. Weapon station(s) — Select (green lights on).
4. Release mode selector — As required.
5. Ripple quantity selector — As required.
6. Ripple interval selector — As required.
7. Mechanical fuzing selector — SAFE.
8. OSP select switch — Toggle until HUD displays appropriate weapon.
9. Altitude source — As required.
10. Target elevation — As required.
11. Target — Designate (MAV or MANUAL) as required. (In LASTE V4.0, can only be done in expanded mode)

12. For EXPANDED CCIP: compression factor — Select.
13. MASTER armament switch — ARM (steady green ready lights on).

Firing

1. Weapons release button — Depress and hold.

NOTE

- The LAU-68/-131 series rocket launchers are preset by the ground crew for either SINGLE or RIPPLE. With the mode selector set in SGL, each activation of the weapons release button will result in either firing of a single rocket or ripple firing of all rockets from selected aircraft station(s) in priority.
- The ACS will not automatically sequence from the highest priority launcher configured station or pair of stations, since these launchers do not provide a pod empty status to the ACS. Highest priority station or pair of stations must therefore be deselected before a lower priority station or pair of stations can be subsequently employed.
- When LAU series rocket launchers are carried on a TER, each actuation of the weapons release button will cause the TER to step to the next LAU on that TER.
- The interface of the LAU-68/-131 intervalometer and the ACS RIP SGL or RIP PRS mode causes system anomalies. When the launcher is mounted on a TER-9/A, these anomalies may cause hung rockets. In this case, if a ripple mode is desired, select RIPPLE on the LAU-68/-131 SINGLE/RIPPLE switch and use the SGL mode of the ACS. When the launcher is parent-mounted the RIP PRS mode of the ACS may be used; however, a minimum of 220 msec in the RIP INTVL selector is recommended to prevent possibility of hung rockets.
- RIP SGL release of rockets with paired stations selected may result in hung munitions, as the ACS may not automatically sequence between pods.

Post-Firing Procedures

1. MASTER armament switch — SAFE.
2. Release mode selector — OFF.
3. Weapon station(s) — Deselected.

SUU-20**Prior To Release**

1. HUD mode selector — As required.
2. Sight depression — Set.
3. Weapon stations(s) — Select (green lights on).
4. Release mode selector — As required.
5. Mechanical fuzing selector — Out of SAFE.
6. OSP select switch — Toggle until HUD displays appropriate weapon.
7. Ripple quantity selector — As required.
8. Ripple interval selector — As required.
9. MASTER armament switch — ARM (steady green ready light on).

Release

1. Weapons release button — Depress (hold if in ripple).

NOTE

The SUU-20 aircraft stations are in decreasing priority 8 and 4, 7, 5 with 8 having priority over its paired station 4. The aircraft automatic sequencer does not operate for the SUU-20 since this dispenser does not provide a dispenser empty or transfer status to the ACS. The highest priority pair of stations must therefore be deselected before a lower priority station or pair of stations can be subsequently employed.

Post-Release Procedures

1. MASTER armament switch — SAFE.
2. Mechanical fuzing selector — SAFE.
3. Release mode selector — OFF.
4. Weapon station(s) — Deselected.

SUU-25 FLARE POD**Prior to Release**

1. (LASTE V6.0 **136** only) HUD mode selector — CCRP.
2. Weapon station(s) — Select (green lights on).
3. Release mode selector — As required.
4. Mechanical fuzing selector — SAFE.
5. (LASTE V6.0 **136** only) OSP select switch — Toggle until HUD displays appropriate weapon.

6. (LASTE V6.0 **136** only) Altitude source — As required.
7. (LASTE V6.0 **136** only) Target elevation — As required.
8. MASTER armament switch — ARM (steady green ready lights on).
9. (LASTE V6.0 **136** only) Target — Designate (MAV or manual) as required.

Release

1. Weapons release button — Depressed.

NOTE

- When flare dispensers are carried on the TERs, each actuation of the weapons release button will cause the TER to step to the next flare dispenser on that TER.
- When the SUU-25 is completely empty, no amber empty light will appear on the applicable station selector switch.

Post-Release Procedures

1. MASTER armament switch — SAFE.
2. Mechanical fuzing selector — SAFE.
3. Release mode selector — OFF.
4. Weapon station(s) — Deselected.

AN/ALE 40 CHAFF/FLARE SYSTEM**Prior to Release**

1. Chaff mode selector knob — Set (green light).
2. Flare mode selector knob — Set (green light).

Release

1. Chaff and/or flare dispensing buttons — Depress momentarily.
2. Chaff and flare remaining indicators — Checked.

Post-Release Procedures

1. Flare mode selector knob — OFF.
2. Chaff mode selector knob — OFF.

CHAFF/FLARE DISPENSING SYSTEM **138****Prior to Release**

1. CMSP/(EWMU) main menu — Perform left and right switch setup.
2. CMSP/(EWMU) mode selector — As Required.
3. CMSP/(EWMU) DISP system switch — MENU (Payload Status page)

Release

1. Manual and semiautomatic modes depress left and/or right throttle switches momentarily.

Post-Release Procedures

1. CMSP/(EWMU) DISP rotory — Check payload status.
2. CMSP/(EWMU) mode selector — STBY.

AGM/TGM-65 Airborne Boresight

A/A Boresight Requirements: (LASTE V6.0 **136** only)

1. Wingman remains at co-altitude or higher.
2. Wingman at 9000ft (1/4th of depressible pipper).

NOTE

The boresight must be set correctly and a valid altitude source must be selected to achieve an accurate slant range to the target

3. Ensure that slant range (as determined by depressible pipper) is > 14.0 NM.

CAUTION

Inadvertant Air-to-Ground Boresight is possible if the wingman's altitude is lower than that of the boresighting A/C, and the resulting ground intercept slant range is <= 14.0 NM.

LASTE selects Air-to-Air (A/A) boresighting (fixed 1.5 NM range) when: Ground-intercept slant range (as determined through Depressible Pipper) > 14.0 NM.

LASTE selects Air-to-Ground boresighting (range to target computed) when: Ground-intercept slant range (as determined through Depressible Pipper) <= 14.0 NM.

NOTE

- It is recommended that every effort be made to check/set the boresight of the missile before entering target area to aid in target identification on the scope display.

- It is not possible to slave AGM-65A/B boresight. However, the following procedures will provide an estimate of HUD depressible reticle offset required to place the target in the tracking gate.

1. EO PWR switch — ON (requires 3 minute gyro spin-up).

CAUTION

- Premature uncage of the AGM/TGM-65A/B prior to expiration of the 3 minute gyro run-up time may result in guidance unit damage due to gyro tumbling, if missile is launched, guidance may be subnormal. (AGM/TGM-65D/G) have an inhibit circuit to prevent premature uncage. A momentary de-selection of the EO PWR switch 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. The 3 minute runup time starts at EO PWR ON.
- The AGM/TGM-65 missile must not be maintained in ready mode in excess of 60 minutes on any single mission. This includes 3 minutes of seeker gyro runup.
- The AGM/TGM-65A/B must not be maintained in the full power mode (video on) in excess of 3 minutes (30 minutes for AGM-65D/G) on any single pass if the missile is to be launched on that pass. The missile must not be maintained in full power mode in excess of 5 minutes on any single mission if the missile is not to be launched during that mission.
- For AGM-65A/B, allow 45 seconds between passes with the same missile, to allow autopilot roll null circuitry to reset.

2. HUD mode selector switch — WD-1/GUNS with depression as required.
3. TVM power switch — POWER (2-minute warmup).

NOTE

If the flap lever is set to other than UP, the weapon station READY lights will not come on, and the missile cannot be launched.

4. Weapon station 3 and or 9 — Select (green lights on).
5. Release mode — SAFE.

6. MASTER armament switch — As required.
 - a. SAFE (maintain dome cover).
 - b. ARM (Jettison dome cover).

NOTE

- (AGM-65A/B) The missile video may be blurred with dome cover retained and may degrade boresight, capability.
- (AGM-65D/G) impossible to boresight with dome cover retained.

7. Missile video polarity switch — As required:
 - a. Aft — AGM/TGM-65A or B: light target on dark background. AGM/TGM-65D/G: warm target on cool background.
 - b. Forward — AGM/TGM-65A or B: dark target on light background. AGM/TGM-65D/G: cool target on warm background.
8. Reject/Uncage switch forward (dome cover jettisons if ARM is selected).
9. MASTER armament switch — SAFE.
10. Place depressible pipper on target.
11. TVM — Fly aircraft to place target in tracking window for alignment of AGM/TGM-65A or B, proceed to step 13.
12. HUD — Adjust position of depressible reticle with respect to target. Pipper offset indicates aimpoint.
13. Reject/Uncage switch — Forward for changes to narrow field-of-view (LAU-117A(V) and LAU-88A/A only).

NOTE

It may be necessary to select reject/uncage switch forward twice to step to narrow held of-view after initial callup of missile.

14. Slew control/track button — As required to center target.
15. Slew control/track button — Release, confirm lock-on.
16. Missile video polarity switch — Center.

17. HUD — Fly aircraft to place depressible reticle on target.
18. Missile track button — Press and release.
19. REJECT/UNCAGE switch — Forward to recage missile.

NOTE

- If polarity switch remains in AUTO, subsequent actions of slew control/track button will set new boresight.
 - If AGM/TGM-65A or B missiles are carried on more than one LAU, repeat procedure for LAU not previously selected. Repeat steps 4 through 19.
 - If AGM/TGM-65D missiles are carried, only one missile on each LAU-88/A should be boresighted. Missile firing will damage an unprotected IR dome on the other missile.
20. HUD function selector switch — Rotate to 8 o'clock position labeled MAV.
 21. HUD function selector switch — Depress.

NOTE

Repeat steps 4 through 21 for LAU not previously selected. If AGM/TGM-65D missiles are carried, only one missile on each LAU-88/A should be bore-sighted. Missile firing will damage an unprotected IR dome on the other missile.

22. EO PWR switch — OFF.
23. TVM PWR switch — As required.

AGM/TGM-65 Launch Procedures**Prior to Release**

1. Store loading display — Recheck E/O.

WARNING

A store loading display other than E/O may result in an inadvertent release of the missile launcher when the weapons release button is depressed.

2. EO PWR switch — ON (requires 3 minute gyro spin-up).

CAUTION

- Premature uncage of the missile prior to expiration of the 3 minute gyro run-up time may result in guidance unit damage due to gyro tumbling; if missile is launched, guidance may be subnormal. A momentary deselection of the EO PWR switch after the gyro is up to speed will not result in appreciable slowdown of the seeker head gyro. A rapidly changing picture generally indicates gyro tumbling. The 3 minute runup time starts at EO PWR ON.
- If gyro tumbling is suspected, immediately recage missile.
- The AGM/TGM-65 missile must not be maintained in ready mode in excess of 60 minutes on any single mission. This includes 3 minutes of seeker gyro runup.
- The AGM/TGM-65A/B must not be maintained in full power mode (video on) in excess of 3 minutes (30 minutes for AGM-65D/G) on any single pass if the missile is to be launched on that pass. The missile must not be maintained full power mode in excess of 5 minutes on any single mission if the missile is not to be launched during that mission.
- For AGM-65A/B, allow 45 seconds between passes with the same missile to allow the autopilot roll null circuitry to reset.

3. HUD — Mode selector to W/D-1, WD-2, or EXPANDED, with depression as required.
4. TVM power switch — Power (2-minute warmup).
5. Wing flap lever — Up.

NOTE

If wing flap lever is in a position other than up, weapon station ready lights will not come on. This will preclude launch of AGM-65 or simulated launch of TGM-65.

6. Weapon station(s) — Select (green lights - on).
7. Release mode selector — SGL.
8. Mechanical fuzing selector — SAFE.
9. MASTER armament switch — ARM. Check weapon station ready lights steady green.

NOTE

- The weapon station ready lights will not come on steady unless the EO PWR switch has been ON for approximately 3 minutes for gyro spin-up.
 - The 3 minute spin-up time is a nominal time, based on operating temperatures. Once a gyro is up to speed, a momentary deselection of the EO PWR switch will not result in appreciable slowdown of the gyro. Subsequent gyro spin-up will not always require 3 minutes. The weapon stations green ready lights will come on again to indicate when the gyro is back up to speed.
 - The dome cover jettison circuit is now armed.
10. Missile video polarity switch — As required:
 - a. Aft — AGM/TGM-65A/B: light target on dark background.
AGM/TGM-65D/G: warm target on cool background.
 - b. Forward — AGM/TGM-65A/B: dark target on light background.
AGM/TGM-65D/G: cool target on warm background.
 - c. Center — AGM/TGM-65A/B/D: AUTO
AGM/TGM-65G/K: Force Correlate

NOTE

This switch affects missile only at the instant of lock-on. To change the contrast selection after lock-on, change the switch to desired selection and reinitiate lock-on.

11. Pipper — On or near target, as required by airborne boresight.
12. Reject/uncage switch — Forward (uncage), video present.

NOTE

- The missile frangible dome cover jettisons and the missile electrically boresights when the reject/uncage switch is moved forward to UNCAGE.
- If airborne alignment has been performed, AGM/TGM-65D/G seeker boresight will be set to line-of-sight of the HUD pipper and will be wide field-of-view (WFOV).

13. AGM/TGM-65D/G only — Reject/uncage switch - Forward again, calls up narrow field-of-view (NFOV).

NOTE

- It will be necessary to select reject/uncage switch forward twice to step to NFOV after initial callup of missile.
- To prevent missile recage when switch from WFOV to NFOV the missile track button must be depressed when moving the reject/uncage switch forward.

14. Reject/uncage switch - If video is unsatisfactory, aft (REJECT). The launcher automatically advances to next missile in priority. Repeat step 13.

NOTE

The reject function of the reject/uncage switch will sequence the launcher to next priority missile on that launcher. Missiles loaded on the outboard rail of the LAU-88A have first priority, followed by center rail, followed by inboard rail. Rejection of the lowest priority missile will not advance the launch sequence back to the highest priority missile on that launcher or transfer priority to another aircraft station. Reselection of a higher priority missile on a launcher requires that weapon station be momentarily deselected.

15. Missile seeker head slew control and/or missile track button — Depress and hold. Align tracking gate with center of target.
16. (AGM/TGM-65G/K) Force Correlate Mode: UNCAGE and SLEW actions are performed normally. Prior to commanding TRACK (Lock-on), selection of AUTO position on missile video polarity switch must be made. When TRACK is commanded, target tracking will be accomplished through correlation tracker circuitry. When Lock-on occurs, crosshairs will close in both horizontal and vertical axes on aimpoint in display center. The pointing cross will indicate when good Lock criteria has been met.

NOTE

(AGM/TGM-65G/K) Correlation track requires scene detail as would be found in large high value targets at employment slant range. Do not force

correlation mode on a good centroid target such as a tank.

17. Missile seeker head slew control and/or missile track button - Released, effecting a lock-on. If only missile seeker head slew/track control is depressed to slew enable, slew, and command track, then only missile seeker head slew control need be released. If the missile seeker head slew control is used only to slew and the missile track button is depressed to slew enable and command track, then only missile track button must be released to effect a lock-on.

CAUTION

Pointing AGM/TGM-65A/B seeker head with 20° of the sun while operating in the track mode may result in vidicon burn damage, which is seen as a dark spot on the TV monitor.

NOTE

- A solid lock-on for the AGM/TGM-65A is indicated when crosshairs become steady on the target, or a slight spreading of the crosshairs gap around the target occurs. Lock-on to a target that is too low in contrast or too small to survive missile launch transients (less than 1/2 the tracking window) is sometimes possible. When this occurs, AGM/TGM-65A will show unstable crosshairs.
- A solid lock-on for the AGM/TGM-65B is indicated when the four white dots depicting the background gates bound the target and the pointing cross and scene magnification identifier are steady. Lock-on to a target that is too low in contrast or too small to survive missile launch transients (less than 1/2 the tracking window) is sometimes possible. The pointing cross and scene mag identifiers will flash if the target is too small, or the angle of the missile seeker head from boresight exceeds specific limits.
- A solid lock-on for AGM/TGM-65D/G is indicated when the crosshairs tracking gate bounds the target, and when the pointing cross is steady after 1 second of target lock-on. The pointing cross will flash if the temperature difference between target and background is insufficient, the target size is too small, or the seeker head exceeds launch

angle criteria. Seeker depression angle markings assists the pilot in estimating displacement of pointing cross from boresight.

- (AGM-65G) Aimpoint biasing with AGM-65G shiptrack mode is a missile function after launch. Target acquisition procedures using shiptrack are identical to centroid land launches.

18. Weapons release button — Depress and hold until video disappears; green ready lights remain on.

CAUTION

If pickle button is not held until LAU completes its launch sequence (approximately 1 second),

TGM-65A/B will revert to track mode with full power on, but will not present video on the pilot's display. Under this condition, thermal damage to TGM-65A/B electronics and vidicon burns can occur. To prevent short pickle damage to TGM-65A/B, always hold pickle button until video disappears.

CAUTION

If simulated launch is not accomplished, immediately press forward on reject/uncage switch to electrically boresight AGM/TGM-65. Failure to complete launch sequence or recage the missile will leave the seeker in the track mode and may damage vidicon/seeker assembly.

Release

1. Weapons release button — Depress and hold until missile leaves launcher rail.

CAUTION

Failure to hold the weapon release button down (short pickle) until missile leaves the launcher rail by preclude missile launch. the missile uses a thermal battery, which is ignited when the weapons release button is depressed. This battery generates power for approximately 105 seconds, which is slightly longer than the maximum flight time of the missile. After the battery is ignited, a timer in the launcher delays 0.5 second and then ignites the rocket motor. If the weapons release button is released prior to missile leaving the launcher rail, the battery will activate but the rocket motor will not ignite. If the weapons release button is inadvertently released too soon, an immediate second attempt may result in a successful launch (if video is still present and outside minimum range) but the battery may not last long enough for a second pass. Replacement of the battery by maintenance personnel will restore the missile to operational condition.

NOTE

- If normal launch attempt is aborted (no quick pickle has occurred), missile should be placed in the ready mode by caging the missile, then momentarily deselecting the station. (AGM-65A/B) wait at least 45 seconds before pressing forward again on reject/uncage switch to reset missile autopilot roll null circuitry. During long video sequences (up to 3 minutes), the missiles roll gyro circuit can drift and cause the missile to go through an undesired roll maneuver after launch.
- Momentarily deselecting the station removes the video, takes the missile out of full power mode, and sequences that launcher back to the highest priority missile.
- The ACS will not automatically sequence between aircraft stations 9 and 3 after missile launch if both stations are selected. In this case, all missiles loaded on station 9 must be

expended or station 9 must be deselected prior to transfer to station 3. If one or more missiles are rejected on the station 9 launcher, the ACS will not sequence to station 3 after the last missile on that launcher is rejected or launched because the ACS will not sense an empty launcher. If station 3 is selected prior to station 9, the sequence will not automatically transfer from station 3 if station 9 is subsequently selected, until station 3 is expended/deselected. The cycling of either the MASTER armament switch from ARM and then back to ARM, or release mode selector from SGL and then back to SGL, will reset the automatic sequencer such that the sequence will again start at station 9.

2. For subsequent reattack, repeat steps 13 through 17 under Prior to Release and step 1 under Release.

NOTE

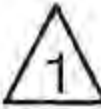
The priority weapon station ready lights will remain on until the last missile is launched from that station, after which the ready lights will go off and amber empty lights will come on.

Post-Release Procedures

1. Reject/uncage switch — Forward (TGM-65A/B only).
2. MASTER armament switch — SAFE.
3. Release mode selector — OFF.
4. Weapon station(s) — Deselected.
5. EO PWR switch — OFF.
6. TVM PWR switch — OFF.

POST MISSION PROCEDURES

1. Frag damage — Airborne check by other flight member(s).
2. Weapons systems — Check off.
3. Dearming:
 - a. All armament switches — OFF/ SAFE.
 - b. Weapons station(s) — Deselected.
 - c. Pilot — Hands in view of crew chief.
4. Walk around — Perform close inspection of aircraft to ensure no frag/battle damage.

STORE	FUZE	SWITCH POSITION	RESULT
MK 82, MK 84, LDGP	M904, M905 OR FMU-26 (N/T) FMU-72 (N/T) FMU-113 (NOSE) FMU-139 (N/T) DSU-33 (NOSE)	SAFE NOSE TAIL N/T	WILL NOT RELEASE NOSE FUZE ARMED, TAIL FUZE SAFE TAIL FUZE ARMED, NOSE FUZE SAFE NOSE AND TAIL FUZES ARMED
MK 82 AIR FIXED HIGH DRAG	M904 M905 FMU-139		NOTE: REFER TO FIGURE 2-21
MK 82 AIR FIXED LOW DRAG	M904 FMU-139		NOTE: REFER TO FIGURE 2-21
MK 82 AIR PILOT OPTION	M904 M905 FMU-64 FMU-139		NOTE: REFER TO FIGURE 2-21
MK-36 DESTRUCTOR (FIXED HIGH DRAG)	MK 32 ARMING DEVICE MK 42 FIRING MECHANISM	SAFE NOSE TAIL N/T	WILL NOT RELEASE DUD, LOW DRAG DUD, HIGH DRAG ARMED HIGH DRAG


WARNING

Fixed high drag or pilot option mode and N only arming operation requires pilots selection of proper minimum release interval (250 msec minimum in RIP PRS/RIP SGL mode from stations 5, 6, and 7 or any nonpaired stations; 130 msec minimum in RIP SGL from any paired stations) to prevent possible bomb collision after release.

*Figure 2-36. MECHANICAL FUZING SELECTOR POSITION AND RESULTS
(NORMAL RELEASE MODES) (Sheet 1 of 2)*

STORE	FUZE	SWITCH POSITION	RESULT
BLU-52	N/A	SAFE	WILL NOT RELEASE
		OUT OF SAFE	ANY POSITION OTHER THAN SAFE ENABLES RELEASE
GBU-10 GBU-12	FMU-26 B/B (N/T) FMU-81/B (N/T) M905 (TAIL) 	SAFE NOSE TAIL N/T	WILL NOT RELEASE NOSE FUZE ARMED, TAILED FUZE SAFE TAIL FUZE ARMED, NOSE FUZE SAFE NOSE AND TAIL FUZE ARMED
ROCKETS, AGM-65	N/A	N/A	MECHANICAL FUZING SELECTOR NOT REQUIRED FOR WEAPON RELEASE
BL-755	INSTALLED (SAFU)	SAFE NOSE TAIL N/T	WILL NOT RELEASE DUD ARMED ARMED
BDU-33	N/A	SAFE	WILL NOT RELEASE
		OUT OF SAFE	ANY POSITION OTHER THAN SAFE ENABLES RELEASE
SUU-64/B (CBU-89/B) SUU-65/B (CBU-87/B) SUU-66/B (CBU-97/B, A/B)	FZU-39/B (NOSE)	SAFE NOSE TAIL N/T	WILL NOT RELEASE TIME MODE DUD PROXIMITY MODE



- FMU-81/B cannot be used in nose on PAVEWAY I LGBs.

*Figure 2-36. MECHANICAL FUZING SELECTOR POSITION AND RESULTS
(NORMAL RELEASE MODES) (CONT) (Sheet 2 of 2)*

SECTION III EMERGENCY PROCEDURES

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WEAPONS MALFUNCTIONS, GENERAL

The procedures in this section are designed to correct actual or apparent weapons release problems resulting from system malfunctions or procedural errors. Since weapons release problems can result from a combination of aircraft, weapon, and/or procedural anomalies, all possible malfunctions and associated corrective actions cannot be covered. The pilot must consider specific circumstances in determining which procedure is appropriate and to what extent the procedure should proceed. Factors affecting this determination include:

- a. Compounding aircraft malfunctions.
- b. The urgency/need to expend or jettison ordnance based on aircraft performance/handling, combat situation, recovery facilities, and risk of detonation or inadvertent release.

During recovery, if hung ordnance, hang fire, misfire or other unsafe store condition exists, the following general rules should be observed:

- a. Avoid populated areas.

- b. Fly at minimum practical airspeed and avoid unnecessary or abrupt maneuvering.
- c. If aircraft damage is confirmed or suspected, isolate affected systems if able, and recover using only those systems necessary for safe recovery.

Specific recovery procedures and restrictions for inadvertent release, hung, or malfunctioning weapons should be in accordance with command and local directives.

WARNING

Following an attempted release or jettison, any store that does not separate from the aircraft should be considered susceptible to inadvertent release during landing. Under these circumstances, the pilot should be prepared to execute an immediate go-around (and to instruct following aircraft to do the same) in the event of inadvertent release of a hung store.

FAILURE TO GET STATION SELECT READY LIGHTS DISPENSERS

If neither R (ready) light for the selected station is on armament release logic has not been satisfied, lighting is not set properly, or a system malfunction.

1. WPN STA STATUS LTS - BRT.
2. Lamp test button - Depress. If either R (ready) light(s) tests good, do not attempt release until problem is resolved.
3. Store loading display - Check (display must agree with loaded store).
4. Landing gear handle - Up.
5. Flap level - Up.
6. Armament control switches - Re-check and recycle. If either R (ready) light(s) comes on, proceed with release.

FAILURE TO GET GUN READY LIGHT

1. SIGNAL LTS switch - BRT.
2. Signal lights lamp test button - Depress. If light does not check good, replace with bulb from less essential signal light.
3. Landing gear handle - Up.
4. MASTER armament and gun rate switches - Re-check and recycle. If GUN READY light comes on, proceed with gun firing.

FAILURE TO GET CHAFF/FLARE READY LIGHTS 137

1. SIGNAL LTS switch - BRT.
2. Signal lights lamp test button - Depress. If ready lights test good, do not attempt release until problem is resolved.
3. Landing gear handle - Up.
4. Chaff and flare mode selector knobs - Check out of OFF and recycle. If ready lights come on, proceed with release.

HUNG ORDNANCE

Hung ordnance is that ordnance that fails to release, launch, fire, or jettison when properly commanded by the pilot.

HUNG BOMBS

(INCLUDES AIRCRAFT RELEASES DISPENSERS)

WARNING

Following an attempted launch, fire, release, or jettison any store that does not separate from the aircraft should be considered armed and susceptible to inadvertent launch, fire, or release during recovery and landing.

CAUTION

Aircraft damage is likely if a hung store is unsecure on a parent station or expansion rack. If a hung store is insecure minimize G loading/air-speed and proceed with selective or emergency jettison as time and conditions permit.

1. Armament control switches and stores loading display - Check and reset as necessary.

NOTE

- If a hung bomb is on a parent station, ACS will inhibit release on lower priority stations until the hung bomb is released/jettisoned, or the station is deselected. If a hung bomb is on a TER, subsequent releases will not be inhibited and E (empty) light will appear once TER has completely cycled.
- If hung ordnance is loaded on TER, the TER may be rehomed and regular release attempted again. This procedure may release ordnance if the problem is due to an improperly homed TER or moisture in the cart or breech which grounded the fire signal. It will not correct problems associated with faulty wiring or bad sensing switches. To rehome the TER, with the master arm on, the station selected and fuzing selected, rotate the thumbwheel through 1(one) full rotation to bring it back to the correct position in the window. This should give ready lights on that station and the TER intervalometer will be set to the highest priority station loaded with a store.

If normal release is unsuccessful:

2. Perform SELECTIVE JETTISON-STORE procedure.

If store expenditure is required for safe recovery:

3. Perform SELECTIVE JETTISON-RACK and/or EMERGENCY JETTISON, as required.

HUNG ROCKETS, FLARES, OR DISPENSED MUNITIONS

WARNING

If flare or target marker partially releases or becomes entangled on the wing and ignites, immediate jettison (selective or emergency as time conditions dictate) should be accomplished.

1. Armament control switches and stores loading display - Check and reset as necessary.

NOTE

- A hung flare or target marker in SUU-25 release sequence 1, 3, 5, or 7 may be ejected by subsequent release of next flare or target marker,
 - If normal release is unsuccessful and store expenditure is required for safe recovery:
2. Perform SELECTIVE JETTISON-STORE procedure.

NOTE

SELECTIVE JETTISON-STORE will result in jettison of all selected dispensers LAU-68's. TER's on selected stations will be retained.

If SELECTIVE JETTISON-STORE is unsuccessful and store expenditure is required for safe recovery:

3. Perform SELECTIVE JETTISONS-RACK and/or EMERGENCY JETTISON, as required.

AGM-65 MISFIRE

A missile that fails to fire within 3 to 4 seconds after depressing the pickle button is a misfire.

There should be not observed smoldering or smoke near rocket motor.

1. Armament control switches - Check and reset as necessary.

If a misfire was due to switch error:

2. Reattempt normal release.

If cause of misfire is undetermined:

3. Step to next missile, is applicable, and attempt release.

WARNING

Do not reselect bad missile, due to possibility of inadvertent release.

If missile expenditure is required for safe recovery:

4. Perform SELECTED JETTISON-MISSILE procedure, if AGM is on LAU-88.

If SELECTIVE JETTISON-MISSILE is unsuccessful and expenditure is necessary for safe recovery:

5. Perform SELECTIVE JETTISONS-RACK and/or EMERGENCY JETTISON, as required.

AGM-65 HANGFIRE

A missile that fires but fails to depart the aircraft is a hangfire. A hangfire is usually accompanied by smoke or smoldering.

WARNING

If a hangfire has occurred, a potential missile launch is possible within the next 15 minutes.

1. Armament control switches - SAFE.
2. Remain in target area for 15 minutes if possible

If unable to remain in safe missile launch area (target area) for 15 minutes:

3. Perform SELECTIVE JETTISON - RACK and/or EMERGENCY JETTISON, as required.

AGM-65 QUICK PICKLE

Failure to hold the weapons release button until missile separation (approximately 1.0 second) constitutes a quick pickle. The missile battery will fire but launch will not occur, and missile video remains on.

If valid lock-on remains and if outside minimum range:

1. Repickle immediately and hold pickle button down.

If unable to repickle:

1. Step to next missile if applicable and attempt release.

NOTE

Do not reselect bad missile. The missile battery will melt if no launch occurs. There is no danger of missile or aircraft damage due to the melted battery. The missile can be brought home and the battery replaced. There is normally no need to jettison the missile.

AIM-9 MISFIRE/HANGFIRE

A missile whose rocket motor fails to fire is considered a misfire. A missile whose rocket motor fires but does not leave the rail is a HANGFIRE. In either case if a missile fails to launch, the Sidewinder Control System (SCS) considers the missile hung if it does not launch within 2 seconds after receipt of the launch command. The SCS removes the FIRE command, the MASTER ARM, and the launch enable signal after that 2 seconds. A yellow "E" indicates a hung missile.

WARNING

If a missile misfires, a malfunction may have occurred which could cause a launch delay of up to 5 minutes. During that 5 minute period, the aircraft should be pointed away from other aircraft and populated areas.

If a missile is hung and another missile is available:

1. REJECT/UNCAGE — AFT to call up other

If missile is hung and no other missiles are available:

1. AIM-9 Mode Switch — OFF
2. Master arm — SAFE
3. Point aircraft away from other aircraft and populated areas for 5 minute period.

JETTISON PROCEDURES

3-4

WARNING

- Always attempt to jettison above the maximum fragmentation clearance altitude when possible even if releasing ordnance in SAFE mode.
- Following an attempted launch, fire, release, or jettison, any store that does not separate from the aircraft should be considered armed and susceptible to inadvertent launch, fire, or release during recovery and landing.

SELECTIVE JETTISON STORE (FIGURE 3-1)

1. Weapon station select button(s) — Depress appropriate station(s) (white lights on).
2. RELEASE MODE SELECTIVE JETTISON selector — STORE.

NOTE

- Jettison will occur in a ripple pairs mode for selected stations with a single depression of the PUSH TO JETT button as long as the button is held depressed. TER's or SUU-20's will be retained because the release pulse is applied to the TER or SUU-20 carts rather than the parent station carts.
 - Rocket pods or dispensers should not be jettisoned unless the intent is to jettison all TER-mounted pods/dispensers on the selected station(s). The PUSH TO JETT button should be held in for 2 seconds for each set of pods/dispensers being jettisoned from one TER or pair of TER's.
3. Mechanical fuzing selector — As required.

NOTE

Stores may be released in an armed or unarmed condition at the pilot's option.

4. MASTER armament switch — ARM
 - a. Flashing green ready light(s) indicate store will be released unarmed.
 - b. Steady green ready light(s) indicate an armed store.
5. PUSH TO JETT button — Push and hold until stores release.

NOTE

A-10A external store airspeed limitations should be adhered to during all selective jettison operations. Refer to T.O. 1A-10A-1, Section V.

If stores still fails to release:

6. Deselect, the highest priority station(s) and reattempt selective jettison of subsequent stores.

NOTE

Hung parent mounted stores will inhibit release jettison of lower priority stations. Hung TER/SUU mounted stores will not inhibit release.

SELECTIVE JETTISON - RACK (FIGURE 3-1)

1. Weapon station select button(s) — Depress appropriate station(s) (white lights on).
2. RELEASE MODE SELECTIVE JETTISON selector — RACK.

NOTE

Jettison will occur from the highest selected priority station or the highest priority pair of stations with each depression of the PUSH TO JETT button. The release signal is applied to parent station carts, resulting in release of whatever is mounted on selected station. Weapons can only be released in an unarmed mode.

3. MASTER armament switch — ARM (green ready light(s) flash to indicate unarmed release).
4. PUSH TO JETT button — Push for each priority station or pair of priority stations from which release is intended.

NOTE

A-10A external store airspeed limitations should be adhered to during all selective jettison operations. Refer to T.O. 1A-10A-1, Section V.

SELECTIVE JETTISON - MISSILE (FIGURE 3-1)

AGM-65/LAU-88 only (Use SELECTIVE JETTISON-RACK for LAU-117A(V)1/A.

1. Weapon station select button(s) — Depress appropriate station(s) (white lights on).
2. RELEASE MODE SELECTIVE JETTISON selector — MSL.

NOTE

- Jettison will occur from the highest selected priority station or the highest priority pair of stations with each depression of the PUSH TO JETT button. An AGM-65 missile is launched on an unarmed, unguided mode with each depression of the button.
- AGM-65 missiles cannot be jettisoned from LAU-117 launchers. If jettison is necessary, the LAU-117 must be jettisoned using the SELECTIVE JETTISON - RACK.

3. EO PWR switch — ON.
4. Flap lever — Up.
5. MASTER armament switch — ARM (green ready light(s) flash to indicate unarmed release).
6. PUSH TO JETT button — Push for each missile or pair of missiles to released.

AIM-9

Jettison of DRA, launcher, and AIM-9 missiles has not been tested and is not authorized.

EMERGENCY JETTISON

If aircraft is involved in an emergency and time is a critical factor, the emergency jettison system should be used. The external stores jettison button, placarded EXT STORES JETT, is located in the glareshield. Emergency jettison is dual-powered from the DC essential bus with automatic backup from the battery bus. When EXT STORES JETT button is momentarily depressed, all external pylon stores are release in the following sequence:

T.O. 1A-10A-34-1-1

Simultaneous with button actuation — stations 1, 2, 10, and 11.

0.5 second after button actuation — stations 3, 4, 8, and 9.

1.0 seconds after button actuation — stations 5, 6, and 7.

1. EXT STORES JETT button — Depress.

WARNING

EXT STORES JETT button is for bonafide emergency use only. It results in jettison of stores contrary to normal release logic, and at intervals that may be below minimum release interval for that particular store. This may result in store-to-store collision. Use selective jettison if practical and always attempt to jettison above maximum fragmentation clearance altitude when possible. Recommended emergency jettison airspeed is 250 KIAS or less.

STORE	RACK	KIAS	ACCEL "G"
MK 82 LD/AIR MK36	PYLON OR TER	420	0.5 / 3.0 LD 0.8 / 3.0 HD
GBU-12			0.5 / 1.5
BDU-33	TER		
MK-84 SUU-64/-65/-66 BLU-52 GBU-10 (Note 1)	PYLON		0.5 / 3.0 0.5 / 1.5
AGM-65 TGM-65	LAU-88/-117		
BL-755	PYLON	250	
LAU-68/-131	PYLON OR TER	325	1.0 LEVEL
SUU-20	PYLON		
	PYLON		
SUU-25	TER	250	
600 GAL FUEL TANK	PYLON	250 (3 TANKS) 275 (1 OR 2 TANKS) 375	
CTU-2/A			
NO STORE	TER LAU-88-117	250	
M-129	PYLON	400	0.8/3.0
AIM-9	DRA LAU-105	JETTISON NOT TESTED AND NOT AUTHORIZED	

Note 1: ON STATIONS 4 AND 8, GBU-10C/B, D/B AND E/B JETTISON IS LIMITED TO 390- KIAS.

EXTERNAL STORES SELECTIVE JETTISON LIMITS

Figure 3-1.

ALE-40 FLARE JETTISON 137

Flare jettison may be required due to other associated emergencies. The flare jettison switch, placarded FLARE JETTISON, is located on the chaff/flare control panel on the right console. Flare jettison power is supplied by the auxiliary DC essential bus with automatic backup from the aircraft battery. When the FLARE JETTISON switch is pulled out and positioned forward, all remaining flares will be jettisoned regardless of flare mode selector knob position, provided the landing gear handle is up. Jettison occurs in the normal release sequence in ripple single at 0.1-second intervals. Chaff pay-loads cannot be jettisoned.

1. Landing gear handle — Up.
2. FLARE JETTISON switch — FLARE JETTISON.

PAYLOAD JETTISON 138

The EWMS/CMS provides the ability to jettison all ALE-40 chaff and flare payloads. The jettison switch placarded JTSN is located on the EWMU/CMSP on the right console. The switch is a lever-locked pull to move type switch. Jettison Power is supplied by the auxiliary DC essential bus with automatic backup from the aircraft battery. Setting the switch to JTSN (UP) will jettison the payloads regardless of EWMU/CMSP mode selection, (including OFF) provided there is no weight on wheels.

1. Landing gear handle — Up.
2. CMSP/(EWMU) jettison switch — JTSN

INADVERTENT RELEASE

An inadvertent release is the release of any store or ordnance that was not commanded by the pilot. The release of remaining ordnance following an inadvertent release will be governed by the situation and command/local policy.

1. Safe all armament switches while noting and recording switch positions at the time of the inadvertent release.

If remaining stores present a carriage or landing hazard:

2. Perform normal release or appropriate jettison procedures, as required.

GUN MALFUNCTIONS**GUN UNSAFE**

In the event gun unsafe light comes on and remains on, proceed as follows:

1. GUN RATE switch — SAFE.
2. MASTER armament switch — SAFE.
3. Do not reattempt to fire the gun.

WARNING

If the MASTER armament switch is set to SAFE during clearing cycle, the cycle will not be completed and GUN UNSAFE light will come on and remain on.

RUNAWAY GUN

In the event of a failure in the trigger circuitry, such as a stuck trigger, proceed as follows:

1. GUN RATE switch — SAFE.

This enables the gun clearing cycle. Note GUN UNSAFE and GUN READY lights are off.

2. MASTER armament switch — SAFE.

WARNING

If the MASTER armament switch is set to SAFE during clearing cycle, cycle will not be completed and GUN UNSAFE light will come on and remain on.

GUN REDUCED RATE OPERATION

If gun firing is required with one hydraulic system failed, on one hydraulic motor inoperable, a reduced rate gun operation can be obtained by selecting GUN RATE - HI. The gun will fire at a reduced rate only. Under normal conditions, the power supplied by the single-drive motor should be sufficient to complete the clearing cycle normally.

BATTLE/FRAG DAMAGE

1. Minimize g loading and attain a safe altitude.
2. Perform appropriate selective or emergency jettison procedures, as required.

If flight control jam or binding is evident:

3. Perform AILERON/ELEVATOR CONTROL JAM procedures. (T.O. 1A-10A-1CL-1)

If wing damage or hydraulic leakage is suspected:

4. Flap and/or speed brake emergency retract switches — EMER RETR as applicable.

Prior to landing:

5. Perform CONTROLLABILITY CHECK procedure. (T.O. 1A-10A-1CL-1)

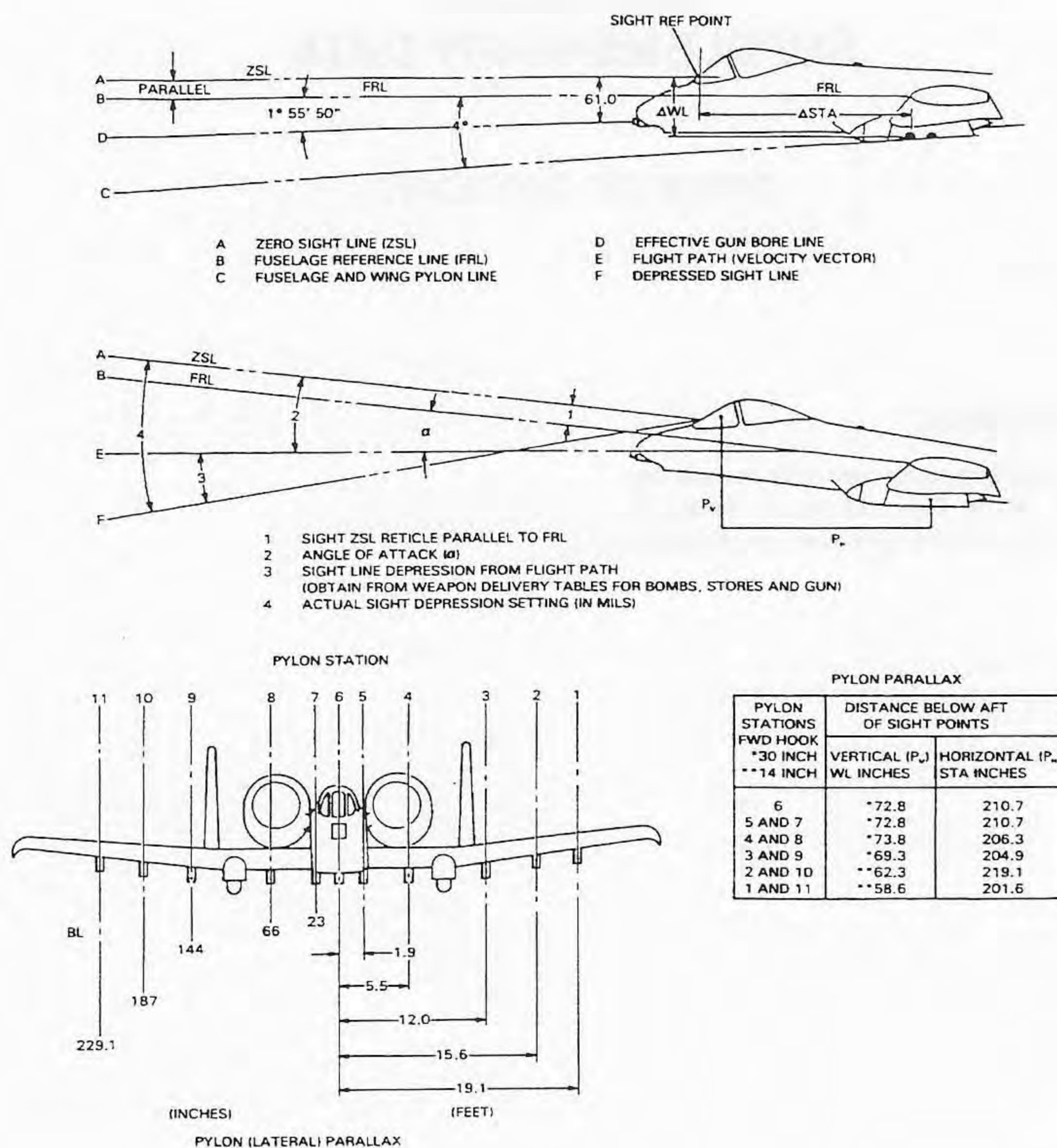
SECTION IV SUPPLEMENTARY DATA

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WEAPONS DELIVERY

Information on bombing geometry and error analysis can be found in T.O. 1-1M-34. However, specific armament reference lines for the A-10/OA-10 aircraft are included in Figure 4-1.



1A-10A-34-1-1-4-1

NOTE

- ZERO SIGHTLINE (ZSL) IS PARALLEL TO FUSELAGE REFERENCE LINE (FRL)
- EFFECTIVE GUN BORELINE IS BELOW FRL ($1^{\circ} 55' 50''$)
- BASED UPON GUN & INSTALLATION ANGLE f ($2^{\circ} 06' 39''$) BELOW FRL FUSELAGE AND WIRE PYLON LINE 4° BELOW FRL.
- GUN PARALLAX ERROR (6.0 INCHES)

Figure 4-1. ARMAMENT REFERENCE LINES

SECTION V

PLANNING PROCEDURES AND SAMPLE PROBLEMS

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BALLISTICS TABLES

Combat Weapon Delivery Software (CWDS V8.0) is the single source for ballistic table information and generation.

NOTE

CWDS is intended to replace existing T.O. 1A-10A-34-1-2 tables; therefore, T.O. 1A-10A-34-1-2 is no longer updated or distributed.

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. For planning purposes, indicated airspeed can be considered the same as calibrated airspeed.

Some ballistics tables provide the sight depression angle from flight path (SDFP). DFP plus the aircraft angle of attack (in mils) equals the sight setting for zero wind. Use the angle of attack table (T.O. 1-1M-34) to find the aircraft angle of attack in mils. The rocket launch and gun tables provide sight settings as a function of angle attack from ZSL.

Some ballistic tables provide the single weapon sight depression from flight path (SDFP) and a ripple release

correction factor. The number preceding the slash in the column labeled SDFP is the SDFP for a single or pairs release. The number following the slash is the ripple release mil correction factor for each additional weapon based on a 100 millisecond intervalometer setting. For example: 136/1 states that the SDFP for a single release is 136 mils. The 1 mil must be subtracted for each additional weapon rippled on a 100 millisecond intervalometer setting. Different intervalometer settings and various quantity ripple releases can be linearly compensated for using the following equation:

Ripple Release Correction = Correction Factor x (N - 1) x (intervalometer setting (msec) ÷ 100).

For instance, using the above example correction factor of 1, a ripple of six bombs using a 140 msec intervalometer setting would give a 7 mil ripple release correction:

$$7 = 1 \times (6 - 1) \times 140 \div 100$$

Thus, the corrected SDFP would be 129 mils.

For non-CCIP deliveries, 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 for headwind and subtracted for tailwind.

DETERMINATION OF MINIMUM ACCEPTABLE RELEASE ALTITUDES

Selection of the minimum acceptable release altitude is based upon three considerations:

1. The release altitude for dive delivery must be high enough to allow for the altitude lost during dive recovery plus the desired ground clearance.
2. The release altitude must be high enough to insure that the munitions time of flight is sufficient to allow completion of fuze arming prior to the munitions ground impact.
3. The minimum safe release altitude required for safe escape for fragmentation clearance must be observed.

The highest altitude, resulting from these three minimum release altitude considerations, determine the minimum acceptable release altitude.

WARNING

- The pilot must determine the ground clearance desired and add it to the altitude lost during dive recovery.
- For other than CWDS calculations, when computing minimum release altitude (MRA) for the first munition in ripple for parameters other than those provided in the safe escape charts, the following formula will be used: single bomb TOF + (intervalometer setting X the number of release pulses - 1) = new TOF. Refer to ballistic tables to determine a release altitude for which the TOF is equal to or greater than this new TOF. This altitude is the new MRA for the first munition.
- Refer to T.O. 1A-10A-1 for stores carriage and release limitations.
- Refer to the specific munitions and fuze descriptions in T.O. 1-1M-34 for additional information concerning safe and proper employment of nonnuclear munitions.

ALTITUDE LOST DURING PULLOUT FOR CLIMBING MANEUVER/TURNING (LEVEL TURN) MANEUVER

WARNING

The pilot must determine the desired ground clearance and add it to the altitude lost during dive recovery.

The altitude lost during dive recovery is the vertical distance above the ground where the pilot must initiate the pullout maneuver to insure zero ground clearance. The desired amount of ground clearance must be added to the altitude lost during dive recovery to obtain a minimum release altitude. A 4.0g wings level recovery ($\pm 30^\circ$ of bank) attained in 2 seconds is assumed in computing the altitude lost during dive recovery.

FUZE ARMING

Fuze arming is the vertical distance below the aircraft where the fuze remains unarmed. Vertical drop required for fuze arming is independent of release g. If bomb impact occurs within the fuze arming distance, a dud bomb is predicted. The fuze arming tables (Figure 6-5, sheets 1-4) provide the vertical drop required for arming of the fuzes compatible with general purpose bombs. The arming delay setting plus the positive tolerance and inherent delays is used in the determination of the vertical drop or minimum release altitude required for the fuze to arm. Current tolerances on arming delays and inherent delays for these fuzes are listed in T.O. 1-1M-34. Selection of an acceptable fuze arming delay setting for a particular mission is based upon the safe separation data, type of fuzing (contact or proximity), and operational considerations. Fuze arming figures are provided for 10,000 feet target density altitude (TDA) which provides TOF requirements for TDA's of 0 to 10,000 feet. Fuze arming figures for MK-82 and MK-84 bombs are as follows:

BOMB	PAGE
MK-82 LDGP/LD	6-11
MK-82 AIR/LD	6-12
MK-84 LDGP	6-13
MK-82 AIR/HD	6-14

SAFE ESCAPE

NOTE

- The safe escape information presented is based upon a probability of less than one in a thousand that the delivery aircraft will encounter fragments from its own munition when delivering at the minimum altitude for fragment clearance assuming instantaneous detonation at ground impact and executing the planned escape maneuver.

Based on studies to date, the safe escape/safe separation data presented in CWDS or in figure 6-6 (sheets 1-18) provides for safe escape from munitions fragments for 2.75 inch rockets. When using proximity fuzes with GP bombs, safety considerations require that the fuze be kept unarmed until the releasing aircraft has attained an adequate distance from the munition to assure safe separation. In the determination of proximity fuze safe arming time settings, the setting selected should be equal to or greater than the time-of-fall value for safe escape. Ordinarily, premature air burst detonations of impact fuzed munitions are not anticipated. To protect the pilot from earlier than intended burst, fuze arming settings which will assure safe separation should also be employed with impact fuzes whenever operational considerations will permit this course of action.

The data for safe escape figures includes two values which must be considered during mission planning to insure safe escape from the munition detonation. These factors are defined as follows:

- Minimum release altitude for fragment clearance (feet). The MRA value represents the minimum altitude for release of a single weapon or the minimum altitude to initiate a ripple release with munition impact spacing or intervalometer settings equal to or less than those provided by CWDS or in the safe escape figures.
- Time of fall (seconds). This value is munition time of fall to impact when released from the minimum altitude for fragment clearance. The single munition TOF in the safe escape figure is equal to or less than the TOF of any munition in a ripple release.

Safe escape figures are provided for sea level and 5000 feet TDA. To use the safe escape figures, enter with release conditions of dive angle and airspeed. Altitude loss during pullout is provided for the climbing and turning (level turn) maneuvers. Single munition MRA and TOF give values for single release of the munition. The single munition TOF is equal to or less than the TOF of any munition in a ripple release. Ripple safe escape MRAs are

provided for release of the designated number of bomb and impact spacing of 70 msec for low drag or 130 msec for high drag (FCC minimum), 75 feet or 100 feet. Under 70 or 130 msec, an MRA value is given which is valid for release of the designated number of bombs or less. Impact spacing reflects munition spacing at 70 or 130 msec and the given release conditions. Under 75 feet and 150 feet, MRAs are given which are valid for ripple release of the designated number of munitions or less and for any impact spacing of 75 feet or less or 150 feet or less. Intervalometer settings reflect the msec value required to give 75 feet or 150 feet impact spacing at the given release conditions. These settings should be rounded down for entry into the armament control panel (i.e., 148 msec rounded to 140 msec). This will cause a slight decrease in bomb spacing but rounding up may invalidate safe escape/safe separation data. Interpolation across release interval within a safe table is authorized.

The safe escape data provided in the tables or by CWDS is based upon the following escape maneuvers:

- Level straight through (LST).

Following release, safe escape is provided by a level, constant speed, no-turn profile.

CAUTION

After release of last bomb, the LST profile must be continued for at least 3 seconds plus TOF of the last bomb of the ripple.

NOTE

The LST maneuver is used only with level release.

- Climbing (CLM) (0-60 degrees of dive).

Following release, safe escape is provided by obtaining a 4.0g in 2-second pull. As the nose approaches the horizon, apply military power. G is maintained to a 20-degree climbing flight-path angle and then relaxed until a 30-degree flight-path angle is achieved.

NOTE

The escape maneuver terminates after reaching the 30-degree flight-path angle. The minimum release altitudes depicted for this escape maneuver allow for bank angles up to 30 degrees during recovery.

- Turning (TRN) (0-20 degrees of dive).

T.O. 1A-10A-34-1-1

Following release, safe escape is provided by simultaneously selecting military power, obtaining 4.0g's in 2 seconds while rolling as required (60-85 degrees of bank) to initiate a turn which decreases dive angle to approximately 5 degrees. Maintain 4.0g's for a minimum of 60 degrees of turn from release heading while varying bank angle to control flight-path vector and descent rate.

For most release conditions, this maneuver will result in a descending turn. To control descent rate, bank angle should be varied, within the 60-85 degree range, while maintaining 4.0g's to reduce dive angle to approximately 5 degrees. After 60 degrees of turn, safe escape is achieved; from this point, maneuver as the situation dictates.

WARNING

Increased bank angle and/or insufficient g may result in very nose low attitudes. Bank angle should be decreased and g increased to reduce pitch attitude and insure terrain clearance while continuing to maneuver for 60 degrees of turn. Failure to achieve 60 degrees of turn may result in self fragmentation.

d. Turning (Level Turn) [TRN(LT)]

Following release, safe escape is provided by simultaneously selecting military power and obtaining 4.0g's in 2 seconds in a wings level pull. As the flight path approaches the horizon, perform a 2.0 - 4.0 g's loaded roll to establish a level turn. As bank is established, insure 4.0 g's are maintained for a minimum of 60 degrees of turn from release heading.

e. Backup escape maneuver.

WARNING

Due to the numerous variables associated with safe escape analysis, all potential conditions cannot be predicted. This backup escape maneuver will, for most foreseen situations, provide a reasonable assurance of safe escape. This maneuver is not to be used as a primary escape maneuver.

If unexpected terrain, weather, or threats preclude execution of the planned escape maneuver, a backup maneuver can be performed. In this case, the planned release altitude

must be greater than or equal to the minimum release altitude provided in the turning maneuver safe escape figures. Safe escape in this case is provided by:

1. Obtaining 4.0 g's in 2 seconds.
2. As the nose approaches the horizon, select mil power.
3. Maintain 4.0 g's until a 20° climbing flight-path angle is achieved and then relax g until a 30° flight-path angle is achieved or maintain 4.0 g's until 60° of azimuth change has been achieved.
4. Bank angle may be varied to control flight-path vector/descent rate while continuing the 4.0 g pull.

SAFE ESCAPE TABLES

Safe escape tables for MK-82, MK-84, CBU-87, -89, -97 bombs are found in CWDS. Rocket safe escape tables for 2.75 FFAR and WAFAR can be found in figure 6-6, sheets 1-18.

CLUSTER BOMB RELEASE ENVELOPE TABLES

There are no cluster bomb release envelope tables for CBU-87/B, -89/B, -97/B, and -97A/B. The fuze and submunition will function correctly for all parameters listed in CWDS.

ALTIMETER LAG CHART

During a dive, the altimeter indication lags the actual aircraft altitude. The altimeter lag charts (Figure 6-2) provide the altitude that should be added to obtain an indicated release altitude above ground level. Enter the chart with release airspeed project to the dive angle, and down to read altimeter lag. This chart also provides altimeter lag during a climb.

The system implements altimeter lag corrections in the LASTE computer for use in all modes except HARS. The altitude displayed on the HUD includes lag corrections, and will differ from the altitude indicated on the cockpit instruments.

CAUTION

AAU-19/A altimeter indication in the STBY mode are not sufficiently accurate during high g maneuvers and must not be used during dive recoveries to determine terrain clearance.

ALTIMETER CORRECTION CHART

The altimeter correction chart (Figure 6-3) may be used to correct the altimeter indication for position or installation error. Enter the chart with indicated airspeed (KIAS), project up to release altitude (MSL), then across to the left to read altitude correction.

The system implements altimeter corrections in the LASTE computer for use in all modes except HARS. The altitude displayed on the HUD includes the corrections, and will differ from the altitude indicated on the cockpit instruments.

WARNING

The Safe Escape Data found in CWDS Safe Escape Tables or in Figure 6-6 (sheets 1-18) is not corrected for altimeter lag or altimeter position error. You must add the altimeter lag and position error to the minimum release altitude for a HARS release (references may change).

IMPACT LATERAL DISPLACEMENT CHARTS

When munitions are carried on the shoulder positions of 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 (Figure 6-4) are measured from the point of ejection and include the release conditions provided in the ballistic tables for a standard day. To obtain the total lateral displacement, the distance of the wing stations from the centerline of the fuselage must also be considered (Figure 4-1).

Two impact lateral displacement charts are provided. One chart is for low-drag general purpose (LDGP) bombs, and the other chart is for retarded munitions (MK82 or AIR).

FLARE DELIVERY TABLES

LUU-1/B, LUU-5/B and LUU-6/B

Target Marker Flare

The level release tables for the LUU-1/B, LUU-5/B, and LUU-6/B target marker flares (Figure 6-7, sheet1) 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 insure 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 per second. Figure 6-7, sheet 2, has a wind correction formula to determine range wind and crosswind corrections.

LUU-2 Series Flare

The LUU-2 flare delivery tables (Figure 6-7, sheets 3-8) provide horizontal travel and time of fall prior to flare ignition. To properly position the flare at ignition, range wind and crosswind corrections must be made. For example, assume release conditions of 4,000 feet release altitude, 300 KTAS for a LUU-2/B flare released from a SUU-25C/A dispenser. Desired fall prior to flare ignition is 1,500 feet. Therefore, the flare will ignite at 2,500 feet.

Using the LUU-2/B level release tables, from release to flare ignition, the horizontal travel is 2,394 feet, time of fall is 12.2 seconds, and the wind correction factor is 20.6 feet per knot of wind.

The winds at 4,000 feet (10 kt crosswind) are used to correct for drift from release to ignition and the winds at 2,500 feet (6 kt headwind, 4 kt crosswind) are used to correct for drift from ignition to burnout.

Thus prior to ignition, the flare will drift 206 feet uprange and 124 feet crossrange. After ignition the flare drift is approximately $1.69 \times$ burn time in seconds per knot of wind. For a nominal 5-minute burn time, the flare will drift 510 feet per knot or 3,000 feet uprange and 2,040 feet crossrange.

It is desirable to ignite the flare 1,530 feet downrange (one-half the distance the flare will drift while burning) and 1,020 feet to the side. To place the flare at this point, at ignition the flare must be released 658 feet uprange ($2,394 - 206 - 1,530$) and 1,144 feet ($1,020 + 124$) to the side of the target area.

T.O. 1A-10A-34-1-1

MISSION PLANNING

Combat Weapons Delivery Software (CWDS) has replaced T.O. 1A-10A-34-1-2 for ballistic data, and T.O.

1A-10A-34-1-1 for safe escape/safe separation data. If CWDS is not available, the mission planning form and squadron ballistic data from CWDS or T.O.

1A-10A-34-1-2 and T.O. 1A-10A-34-1-1 can be used to calculate weapons parameters and safe escape/safe separation. In all cases, the mission planning form may be used as a guide for weapons delivery calculations.

The mission planning form provides a sequence for planning a non-nuclear weapons delivery without the use of the small computer. The form is divided into eight sections.

The first three sections (Mission Conditions, Delivery Parameters, and Minimum Release Altitudes) are applicable to the release and planning conditions stated. These sections are labeled:

DIVE OR LEVEL, SINGLE OR RIPPLE RELEASE

(Parameters listed in T.O. 1A-10A-34-1-2 or CWDS)

DIVE OR LEVEL, RIPPLE RELEASE

(Parameters not listed in T.O. 1A-10A-34-1-2)

LOFT DELIVERIES ROCKET LAUNCH OR STRAFE

The remaining sections (Delivery Computations and/or Pop-Up Data) are applicable to all delivery modes.

MISSION PLANNING FORM

I. MISSION CONDITIONS

1. Delivery Mode: Single Ripple (Circle One)
2. Munition: _____
3. Fuze Data
(Fuze Compatibility Table, T.O. 1-1M-34, Fig 2-43)
 - a. Type _____
 - b. Arming Tolerance _____
 - c. Inherent Arming Delay _____
4. External Weight
(Store Weight Table, T.O. 1-1M-34, Fig. 8-23)
 - a. Stations 1-11 _____ pounds
 - b. ALE-40 Weight _____ pounds
 - c. Pylons Removed _____ pounds
 - d. Total Weight _____ pounds
5. Aircraft Weight Dry 28,000 pounds
(T.O. 1-1M-34, Fig 8-24)
6. Fuel Remaining Over Target _____ pounds
7. Aircraft Gross Weight _____ pounds
(Add Items 4d, 5, and 6)
8. Target Data
 - a. Altimeter Setting at Target _____ inches Hg
 - b. Target Altitude MSL _____ feet
 - c. Target Temperature _____ °C
 - d. Target Pressure Altitude _____ feet
 - e. Target Density Altitude _____ feet
(CWDS or Altitude Conversion Chart, T.O. 1-1M-34, Fig 8-25)

Figure 5-1. MISSION PLANNING FORM (Sheet 1 of 11)

T.O. 1A-10A-34-1-1

II. DELIVERY PARAMETERS

9. Release Conditions

- a. Ripple Quantity/Burst Length _____
- b. Dive Angle, Climb Angle for Loft _____°
- c. Track Time _____seconds
- d. Estimated Release Altitude (AGL) _____feet
- e. Temperature at Release Altitude _____°C
(Use lapse rate of 2°/1,000 feet from target temperature)
- f. Airspeeds:
 - (1) Release KIAS, Approach KIAS for Loft _____KIAS
 - (2) Release KTAS _____KTAS
(Airspeed Conversion Chart, T.O. 1-1M-34, Fig 8-28)
 - (3) Rollout KIAS _____KIAS
 - (4) Estimated Rollout Altitude (AGL) _____feet
<(Rule of Thumb: 10 x Dive Angle x Track Time = Altitude lost in track) + Item 9d>
 - (5) Rollout KTAS _____KTAS
(Airspeed Conversion Chart, T.O. 1-1M-34, Fig 8-28)
 - (6) Base KIAS _____KIAS
10. Escape Maneuver _____
(CLM, TRN, TRN(LT), LST)
11. CBU Pattern Overlap Desired _____feet
12. Impact Spacing feet _____
13. Number of Release Intervals (N-1) _____
(Subtract one from total of SINGLE OR PAIRED release pulses)
14. Stick Length _____
(Item 12 times Item 13)
15. One Half Stick Length _____feet
(Item 14 divided by 2)

NOTE 1: Skip to section VI for Loft.

Figure 5-1. MISSION PLANNING FORM (Sheet 2 of 11)

III. MINIMUM RELEASE ALTITUDE (MRA) FOR SINGLE ORDNANCE (MRA FOR LAST BOMB OF RIPPLE).

16. Required Ground Clearance after Pullout feet
(For Training: 11-AA/A-10 VOL II Requirements or as artificially set,
whichever is higher)
17. Altitude Lost During Pullout feet
(CWDS or Safe Escape Table, T.O. 1A-10A-34-1-1, Fig 6-6 or Dive
Recovery Chart, T.O. 1-1M-34, Fig 8-29)
18. MRA for Ground Clearance feet
(Add Items 16 and 17)
19. MRA for Frag Clearance feet
(CWDS or Safe Escape Table, T.O. 1A-10A-34-1-1, Fig 6-6)
20. Minimum TOF for Frag Clearance seconds
(Required when using a ripple release interval/spacing not listed in Safe
Escape Tables) (CWDS or Safe Escape Table, T.O. 1A-10A-34-1-1, Fig 6-6.)
21. Minimum Safe Arm Time (Safe Separation) seconds
- a. (Required for Proximity Fuzed General Purpose (GP) Weapons
and CBU-87 with level deliveries)
 - b. (Safe Escape Table, T.O. 1A-10A-34-1-1, Fig 6-6.
 - c. Recommended for ordnance fuzed with FMU-139A/B.
- NOTE: For ripple releases, minimum safe arm time for a single release
must be increased by the time expired during ripple. (Item 36 or 47). 25, 39, 50, or 74
22. Fuze Setting seconds
(Fuze setting + inherent delays - Fuze tolerance must be greater than 22.) Increased bank angle and/or insufficient
g may result in very nose low attitudes. Bank angle should be decreased and g increased to reduce pitch atti-
tude and insure terrain clearance while continuing to maneuver for 60 degrees of mm. Failure to achieve 60
degrees of turn may result in self fragmentation.
23. Minimum Release Altitude (MRA) for Fuze Arming feet
- a. CWDS .
 - b. MRA for Fuze arming Chart, LDGP, T.O. 1-1M-34, Figure 8-30.
 - c. MRA for Fuze Arming Chart, HDGP, T.O. 1-1M-34, Figure 8-30.
 - d. CBU-87/89 refer to CWDS or T.O. 1A-10A-34-1-2 to find altitude
corresponding to TOF equivalent to fuze setting + tolerance +
spin-up time (if applicable) + bomblet arm time.
24. MRA for SINGLE RELEASE feet
(Highest of Items 18, 19, or 23)
25. MRA TOF (CWDS or 1A-10A-34-1-2) seconds
(For GBU, check against guide time.)

Figure 5-1. MISSION PLANNING FORM (Sheet 3 of 11)

T.O. 1A-10A-34-1-1

IV. DIVE OR LEVEL, Single OR RIPPLE RELEASE
(CWDS or Parameters listed in T.O. 1A-10A-34-1-2)

- | | | |
|--|-------|---------|
| 26. Release Altitude AGL | _____ | feet |
| (Must be such that the last weapon will be released at or above MRA for single release, Item 24.) | | |
| (Ballistic Data: CWDS or T.O. 1A-10A-34-1-2) | | |
| 27. Release Altitude TOF | _____ | seconds |
| 28. TOF (Last weapon for Ripple) | _____ | seconds |
| Must be greater than the fuze setting _____ + tolerance _____ + inherent delay _____ ; Item 22 + Item 3b + Item 3c | | |
| 29. Release Altitude Last Weapon | _____ | feet |
| (Must be at or above MRA for single release; Item 24) | | |
| 30. Altitude Lost During Ripple | _____ | feet |
| (Item 26 - Item 29) | | |
| 31. Release Interval | _____ | msec |
| NOTE: Release interval must be greater than minimum in T.O. 1A-10A-1, Section 5. | | |
| 32. Sight Depression from Flight Path (SDFP) | _____ | mils |
| 33. Slant Range at Release | _____ | feet |
| 34. Bomb Range at Release | _____ | feet |
| 35. Ripple Only: MRA for Frag Clearance | | |
| a. If release interval/spacing required is listed in Safe Escape Tables, CWDS or T.O. 1A-10A-34-1-1, Fig 6-6. | | |
| MRA for Frag Clearance for desired ripple | _____ | feet |
| b. If release interval/spacing required is not listed in Safe Escape Tables, T.O. 1A-10A-34-1-1, Fig 6-6 then: | | |
| (1) Time expired during ripple | _____ | seconds |
| (Item 13 x Item 29 divided by 1000) | | |
| (2) Minimum Release TOF | _____ | seconds |
| (Item 35b(1) + Item 20) | | |
| (3) MRA for Frag Clearance for Ripple | _____ | feet |
| (Altitude in Ballistic Tables corresponding to Item 35b(2).) | | |
| (For CBU Deliveries, simulate an intact canister with MK82LD ballistics.) | | |

Figure 5-1. MISSION PLANNING FORM (Sheet 4 of 11)

36. Ripple only: (Safe Separation required) Minimum Safe Arm Time seconds
(Item 21 + Item 35b(1))
Note: Fuze setting - tolerance must be greater than Item 36
37. Abort Altitude AGL feet
(Single Release no lower than Item 24)
(Ripple Release no lower than the highest of Item 35 _____, Item 30 + Item 18 _____, or Item 30 + Item 23 _____)
38. Abort Altitude TOF (CWDS or 1A-10A-34-1-2)

NOTE

For LASTE 4.0 ripple deliveries, use single release MRA TOF, Item 25.

Wind Correction Factors

39. Headwind mils/knots
40. Tailwind mils/knots
41. Crosswind feet/knot
42. Crosswind mils/knots
(Item 41 x 1000 divided by Item 33)

V. DIVE OR LEVEL, RIPPLE RELEASE

(Ripple delivery parameters not listed in T.O. 1-1A-34-1-2)

43. Release Interval msec
(Impact Spacing Table, T.O. 1-1M-34, Fig 8-31)
(Use Items 9b, 9f(2)), and an altitude greater than Item 24)
Interval must be greater than minimum in T.O. 1A-10A-1, Section 5.
44. Time Expired During Ripple msec
(N-1 x release interval)
(Item 13 x Item 43)
45. Altitude Lost During Ripple Release feet
(T.O. 1-1M-34, Fig 8-32) or
(1.69 x Item 9f(2) x sin (Item 9b) x Item 43 (in seconds) x Item 13)

Figure 5-1. MISSION PLANNING FORM (Sheet 5 of 11)

T.O. 1A-10A-34-1-1

46. MRA for Frag Clearance:

- a. If release interval/spacing listed in Safe Escape Tables,
T.O. 1A-10A-34-1-1, Fig 6-5 MRA for frag clearance for
desired ripple feet
- b. If release interval/spacing not listed in Safe Escape Tables,
T.O. 1A-1-10A-34-1-1, Fig 6-6 then,
- (1) Minimum Release TOF seconds
(Item 44 + Item 20)
1000
- (2) MRA for Frag Clearance for Ripple feet
(Altitude in Ballistic Tables Corresponding to Item 46b(1)
or for CBU deliveries, simulate an intact canister with
MK 82LDGP ballistics, reference T.O. 1-1M-34 page 6-7
for guidance.)

47. Minimum Safe Arm Time (Safe Separation required) seconds
 $\frac{\text{Item 21} + \text{Item 44}}{1000}$

Note: Fuze setting - tolerance + inherent delay must be greater than Item 47.

48. Abort Altitude feet
(No lower than the highest of Item 46 _____ ,
Item 45 + Item 19 _____ , or Item 45 + Item 23 _____ .)
49. Abort Altitude TOF (CWDS or T.O. 1A-10A-34-1-2) seconds
50. Release Altitude AGL feet feet
(Must be at or above abort altitude, Item 49)
51. Bomb Range of First Weapon feet
(Use Ballistic Tables for single release at release altitude, Item 50)
52. Release Altitude of Last Weapon AGL feet
(Item 50 - Item 45)
53. Slant Range at Release to Center of Stick feet
(Slant Range = Square Root of $<(\text{Item } \underline{51} + \text{Item } \underline{15})^2 + (\text{Item } \underline{50})^2 >$)

Wind Correction Factors

54. Headwind mil/knot
(Use Ballistics Tables for single release.)
55. Tail wind mil/knot
(Use Ballistic Tables for single release.)
56. Crosswind feet/knot
(Use Ballistic Tables for single release.)

Figure 5-1. MISSION PLANNING FORM (Sheet 6 of 11)

57. Crosswind	_____ mil/knot
(Item 56 x 1,000 divided by Item 53)	
58. Range to Center of Stick	_____ feet
(Item 51 + Item 15)	
59. SDFP	_____ mils
(Sight Depression Angle Chart, T.O. 1-1M-34; Figure 8-33.)	
VI. LOFT DELIVERIES	
(Parameters from CWDS).	
60. Minimum Slant Range	_____ feet
(Bomb Fragmentation Chart, T.O. 1-1M-34, Figure 6-2.)	
61. Ground Distance Traveled Toward Target During Egress	_____ feet
$\frac{\{(Release\ TAS) \times 1.69\}^2}{G \times 32.2}$	
62. Minimum Release Slant Range to Target	_____ feet
a. Item 60 + Item 61	
b. Item 60 + Item 61 + Item 15 + {1.69 x TAS x (N-1)} (INT)	
(Ripple only)	
63. Delivery Information	
a. Run-In Altitude AGL	_____ feet
b. Release Altitude	_____ feet
c. Indicated Run-In Altitude	_____ feet
(Item 63a + Item 8b)	
d. Indicated Release Altitude AGL	_____ feet
(Item 63b + Item 8b)	
e. Release Angle	_____ °
f. Range Pull up to Impact	_____ feet
g. Range Pull up to Impact	_____ NM
(Item 63f divided by 6.076 feet)	
h. Range Release to Impact	_____ feet
(Must be greater than Item 62)	
i.	_____ seconds
NOTE: Required for proximity fuzed weapons,	
Recommended for ordnance fuzed with FMU-139A/B.	
Safe Escape Tables, T.O. 1A-10A-34-1-1, Section 6.	
(Use TOF from level straight through safe escape maneuver.)	
64. Fuze Setting	_____ seconds
NOTE: Fuze setting - tolerance + inherent delay must be greater than	
Minimum Safe Arm Time.	
NOTE: Fuze setting + tolerance + inherent delay must be less than the TOF.	

Figure 5-1. MISSION PLANNING FORM (Sheet 7 of 11)

T.O. 1A-10A-34-1-1

VII. ROCKET LAUNCH OR STRAFE

65. Release Interval (N/A strafe) msec
(Intervalometer Setting: Use 60 msec for pod ripple or use greater than 220 msec for cockpit ripple.)
66. Time Expired During Ripple seconds
(Item 65 (in seconds) x Item 13 for rockets)
(Burst length for strafe)
(60 msec for ripple parent mounted pod.)
67. Target Closure During Delivery feet
(1.69 x Item 9f(2) x Item 66)
68. Altitude Lost During Delivery feet
(T.O. 1-1M-34, Figure 8-32.)
(1.69 x Item 9f(2) x sin (Item 9b) x Item 65 x Item 13)
69. Minimum Release TOF (Rockets) seconds
(Item 66 + Item 20)
70. MRA for Frag Clearance (Rockets) feet
(Altitude in CWDS or Ballistic Table corresponding to Item 69)
71. Minimum release slant range feet
72. Abort Altitude AGL feet
(Single Release, no lower than Item 24)
(Ripple Release, no lower than the highest of
Item 70 _____ or Item 68 + Item 18 _____)
73. Pickle Altitude AGL feet
(Must be at or above Abort Altitude, Item 72.)

Ballistic Data: CWDS or T.O. 1A-10A-34-1-2.

74. Sight Setting mil
75. Slant Range at Release feet
76. Slant Range at End of Delivery feet
(Item 75 - Item 67)

Wind Correction Factors

77. Headwind/Tailwind mil/knots
78. Crosswind feet/knots
79. Crosswind mil/knots
(Item 80 x 1,000 divided by Item 75)

Figure 5-1. MISSION PLANNING FORM (Sheet 8 of 11)

VIII. DELIVERY COMPUTATIONS

80. Average TAS During Tracking (Item <u>9f(2)</u> + Item <u>9f(5)</u> divided by 2)	_____ KTAS
81. Altitude Lost During Track (1.69 x sin (Item <u>9b</u>) x Item <u>9c</u> x Item <u>80</u>)	_____ feet
82. Track Altitude AGL (Add Item <u>81</u> to Item <u>26</u> , <u>50</u> , or <u>73</u>)	_____ feet
83. Zero Sight Line Angle of Attack (ZSL AOA) (AOA Table, T.O. 1-1M-34, Figure 8-34.) (NOT REQUIRED FOR ROCKETS, STRAFE.)	
a. Release	_____ mils
b. Roll-Out	_____ mils
84. Aim Off Distance (AOD) (Chart T.O. 1-1M-34, Figure 8-36) or <(Release Altitude divided by tangent of dive angle) - Bomb Range to the center of the stick>	_____ feet
85. Rollout DFP (AOD Chart, T.O. 1-1M-34, Figure 8-36.)	_____ mils
a. Initial AIM off angle (IAA) = Item <u>85</u> divided by 17.45	_____ °
86. Sight Setting (Add Item <u>83a</u> to Item <u>32</u> or Item <u>59</u>) (For rockets or strafe use Item <u>74</u>)	_____ mils
87. Initial Pipper Placement (IPP) (Subtract Items <u>83b</u> and <u>85</u> from Item <u>86</u>)	_____ mils
88. Base Altitude AGL (Item <u>82</u> + altitude lost in roll-in)	_____ feet
89. Base Distance from Target (Dive Angle versus Distance Chart, T.O. 1-1M-34, Figure 8-37) or <(Item <u>88</u> divided by tangent Item <u>9b</u>) - Item <u>84</u> >	_____ feet
90. Indicated LASTE Pickle Altitude (Add Item <u>8b</u> to Item <u>26</u> , <u>50</u> , or <u>73</u>)	_____ feet
91. TOF for Pickle Altitude (DES TOF Option)	_____ seconds
92. Indicated LASTE Abort Altitude (Add Item <u>8b</u> to Item <u>24</u> , <u>37</u> , <u>48</u> , or <u>72</u>)	_____ feet
93. TOF for Abort Altitude	_____ seconds

Figure 5-1. MISSION PLANNING FORM (Sheet 9 of 11)

T.O. 1A-10A-34-1-1

94. Indicated LASTE Track Altitude feet
(Add Items 82 and 8b)
95. Indicated LASTE Base Altitude feet
(Add Items 88 and 8b)
96. Altimeter Lag (Required for MARS) feet
(Chart, T.O. 1A-10A-34-1-1, Figure 6-2.)
97. Altimeter Correction (Required for MARS) feet
(Chart, T.O. 1A-10A-34-1-1, Figure 6-3.)
98. Indicated Pickle Altitude (Required for MARS) feet
(Add Items 96, 97, and 8b to Items 26, 50, or 73)
99. Indicated Abort Altitude (Required for MARS) feet
(Add Items 96, 97, and 8b to Items 24, 37, 48 or 72)
100. Indicated Track Altitude (Required for MARS) feet
(Add Items 82, 96, 97, and 8b)
101. Indicated Base Altitude (Required for MARS) feet
(Add Items 88, 97, and 8b)

POP-UP DATA

- A. Track Altitude AGL feet
(Item 82)
- B. Minimum Attack Perimeter (MAP) feet
<(Item A divided by $\tan$ (Item 9b) - Item 84>
- C. Turn Radius During Roll-In (N/A for CWDS) feet
(Turn Radius Chart, T.O. 1-1M-34, Figure 8-27.)
- D. Climb Angle °
(Dive Angle + 5°; for 5° to 15° deliveries.)
(Dive Angle + 10°; for 20° deliveries and greater.)
- E. Optimum Angle Off °
(Item D x 2)
(ROT = 30° to 45°)
- F. Apex Altitude feet
<(Item 9b x 20) + Item A>
- G. Pull-Down Altitude AGL feet
(Item A for 5° to 15° deliveries)
<Item A - (10 x Item 9b) for 20° deliveries and greater>
- H. Indicated Pull-Down Altitude feet
(Item G + Item 8b)
- I. Pull-Up to Pull-Down Distance feet
<(Item G minus Run-in Altitude AGL) divided by $\tan$ Item D>

Figure 5-1. MISSION PLANNING FORM (Sheet 10 of 11)

SECTION VI

PLANNING CHARTS AND TABLES

TABLE OF CONTENTS

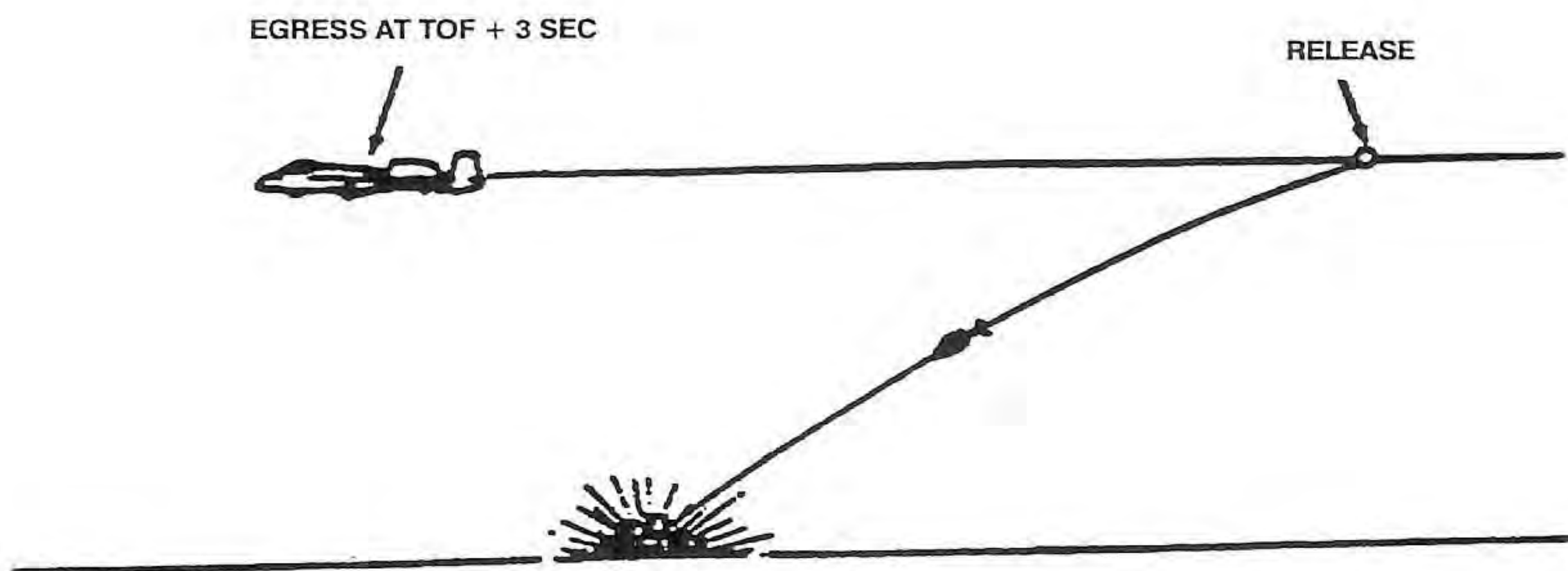
SAFE ESCAPE GRAPHICS	6-2	FUZE ARMING TABLES: MK 82	
ALTIMETER LAG CHARTS	6-6	LDGP, AIR LD; MK 84 LDGP,	
ALTIMETER CORRECTION CHART	6-8	MK 82 AIR HD	6-11
IMPACT LATERAL DISPLACEMENT		SAFE ESCAPE CHARTS - 2.75 INCH	6-15
CHART - TER SHOULDER POSITION		ROCKETS	
CARRIAGE	6-9	FLARE DELIVERY TABLES	6-32

CAUTION

After release of last bomb, the LST profile must be continued for at least three seconds plus TOF of the last bomb of the ripple.

NOTE

The LST maneuver is used only with level release.

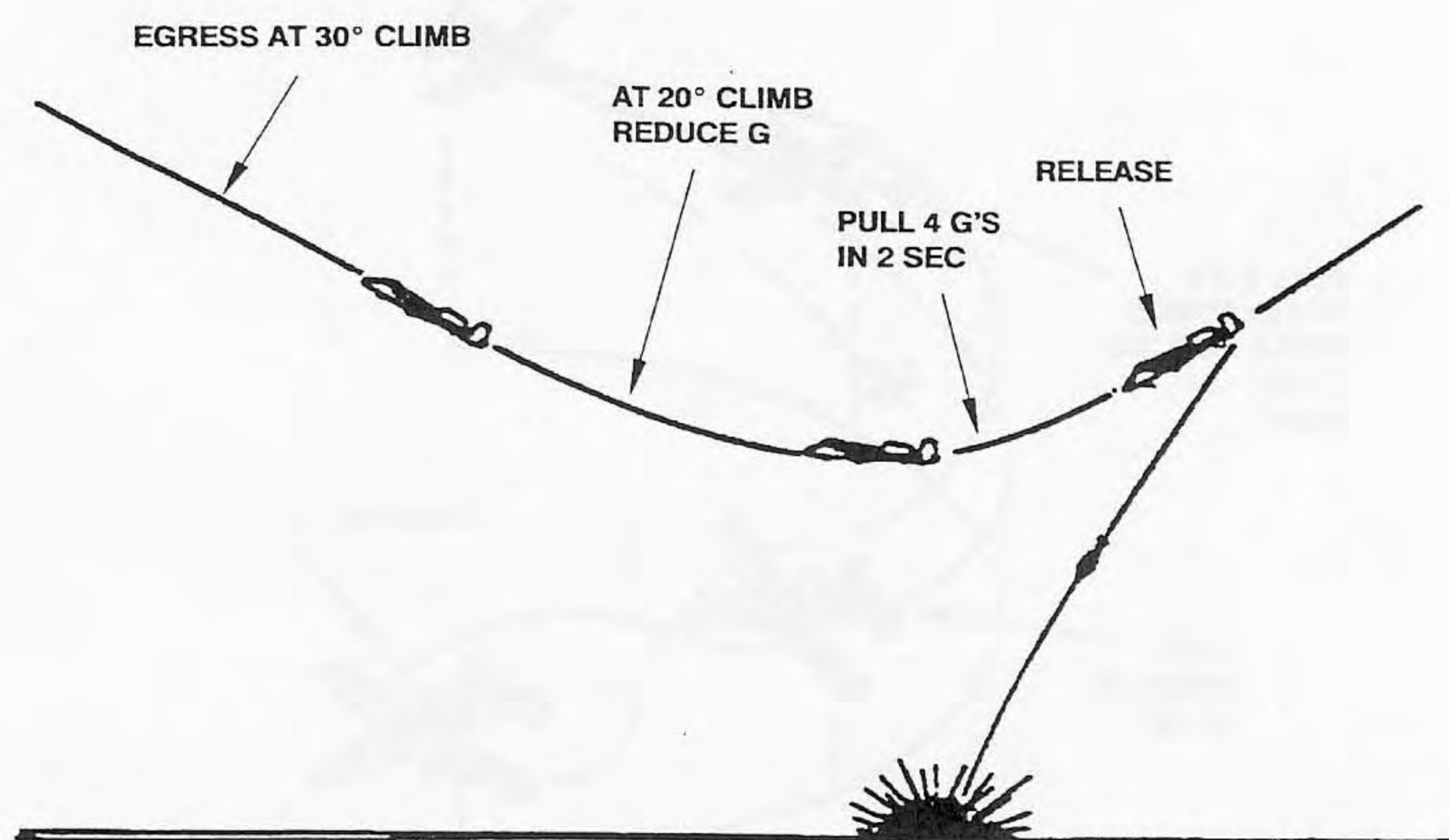


1A-10A-34-1-1-6-1

Figure 6-1. SAFE ESCAPE MANEUVERS LEVEL, CONSTANT SPEED, NO TURN (LST) (Sheet 1 of 4)

NOTE

The escape maneuver terminates after reaching the 30° flight path angle. The minimum release altitudes depicted for this escape maneuver allow for bank angles up to 30° during recovery.

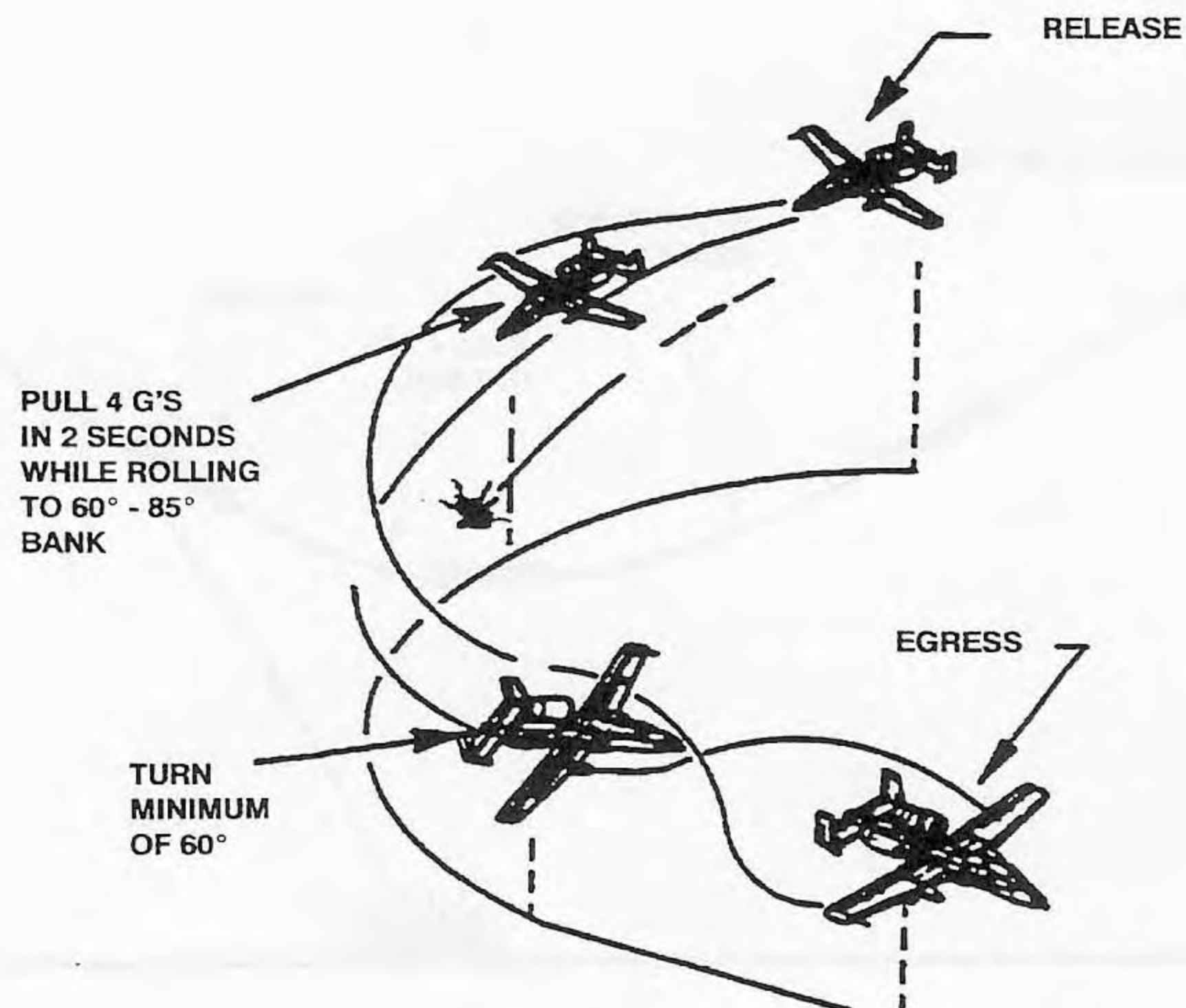


1A-10A-34-1-1-6-2

Figure 6-1. SAFE ESCAPE MANEUVERS — CLIMBING (CLM) (Sheet 2 of 4)

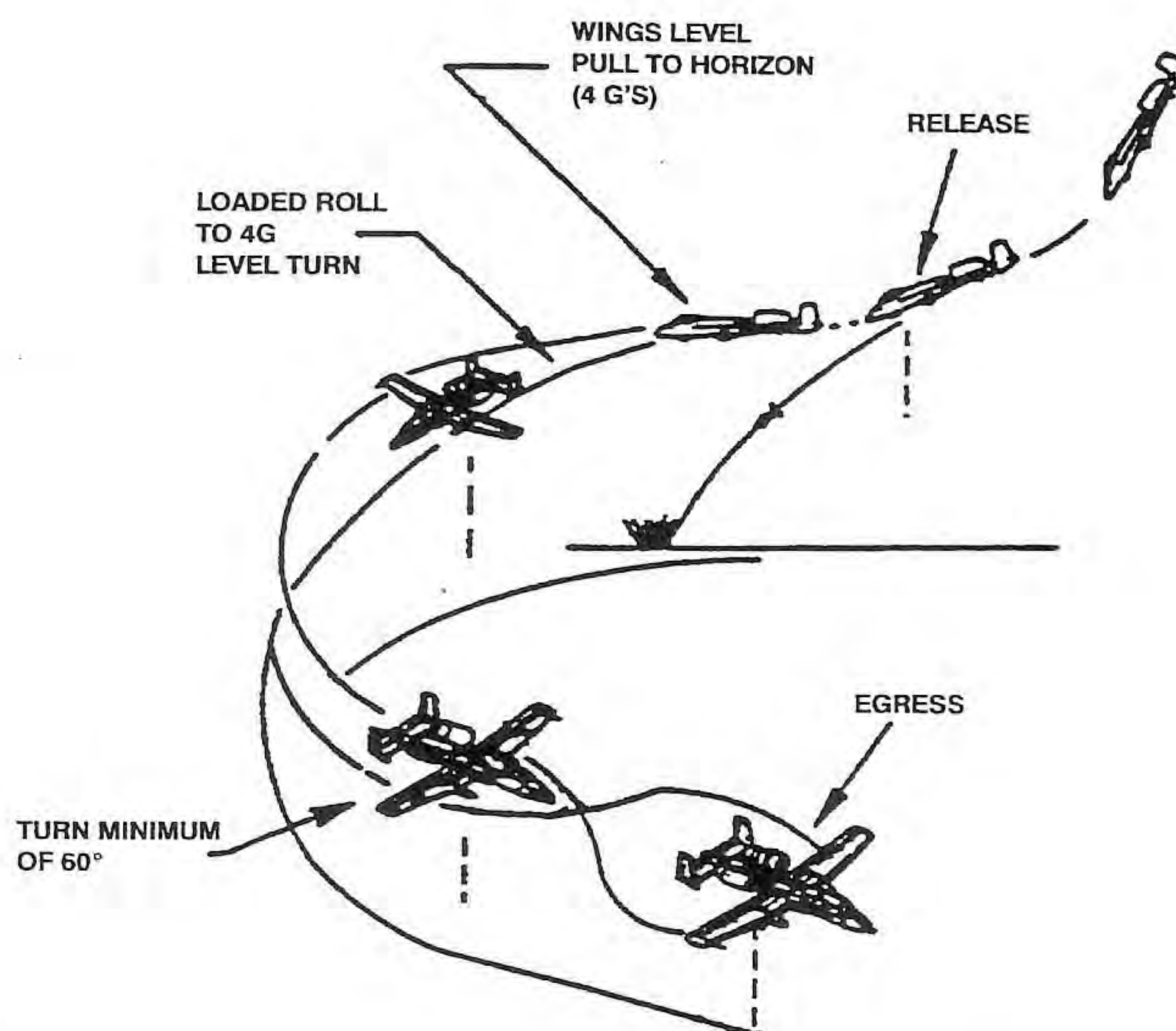
WARNING

Increased bank angle and/or insufficient G may result in very nose low pitch attitudes. Bank angle should be decreased and g increased to reduce pitch attitude and insure terrain clearance while continuing to maneuver for 60° of turn. Failure to achieve 60° of turn may result in self-fragmentation.



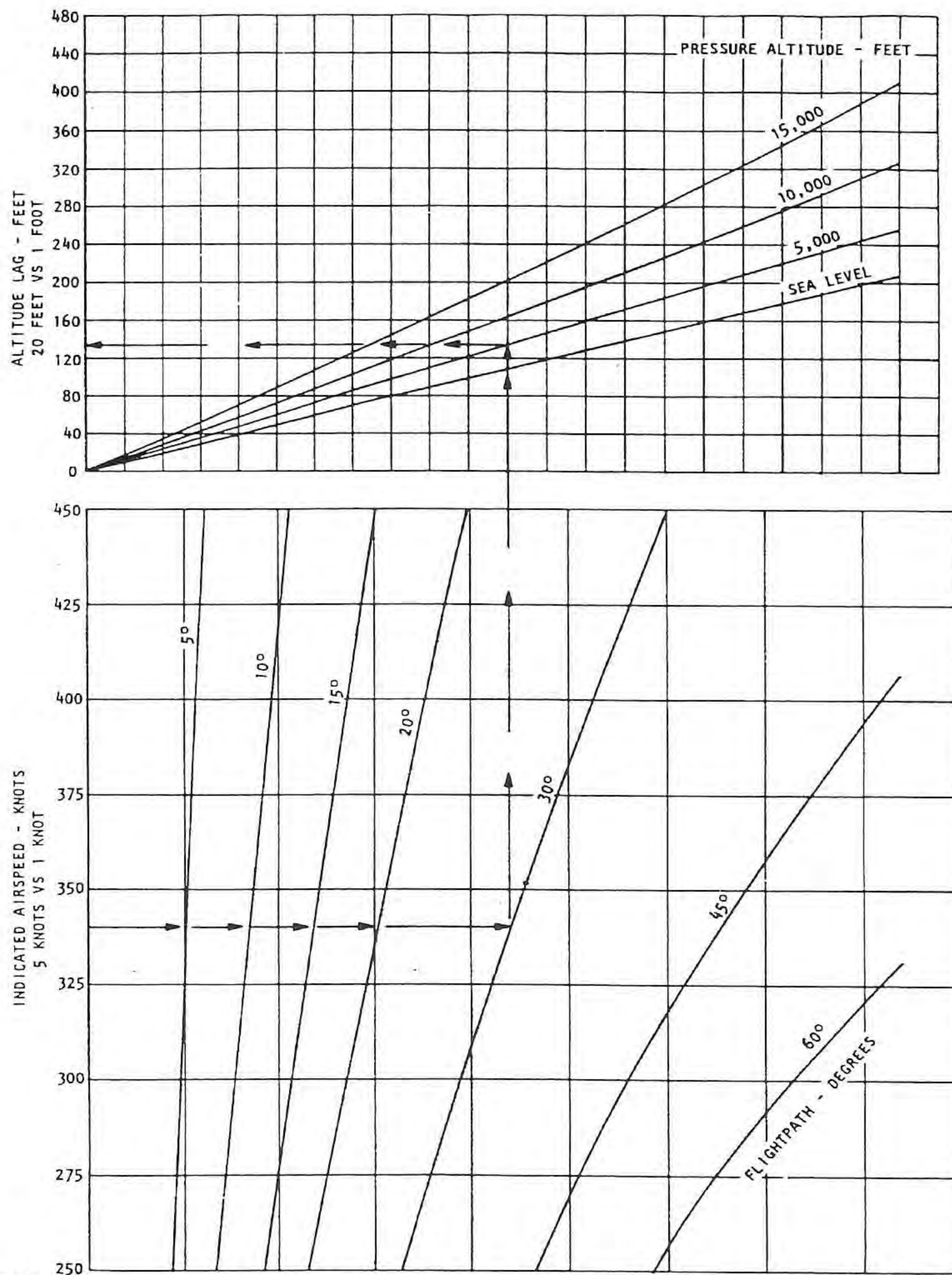
1A-10A-34-1-1-6-3

Figure 6-1. SAFE ESCAPE MANEUVERS — TURNING (TRN) (Sheet 3 of 4)



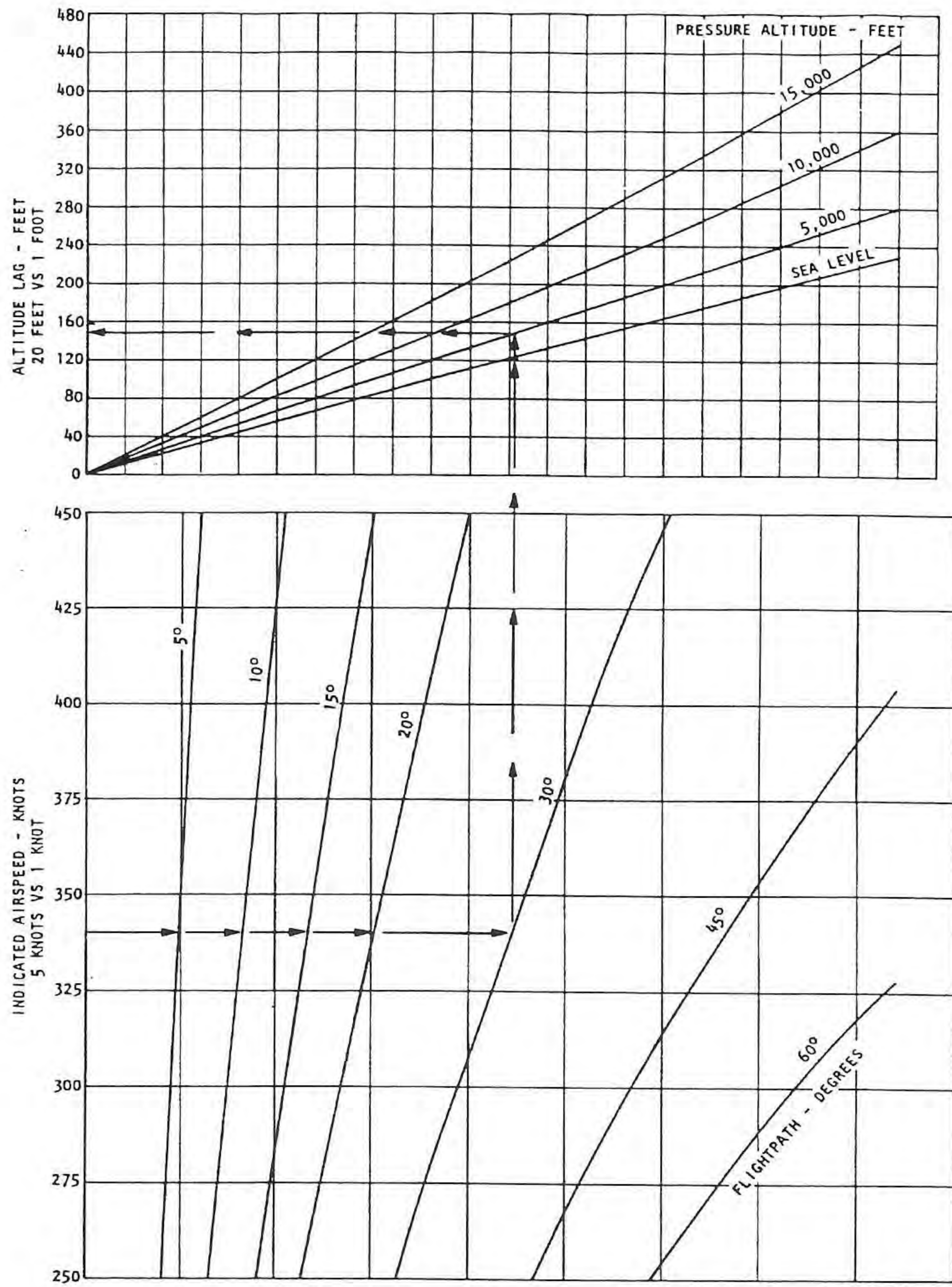
1A-10A-34-1-1-6-4

Figure 6-1. SAFE ESCAPE MANEUVERS — TURNING/LEVEL TURN (TRN LT) (Sheet 4 of 4)



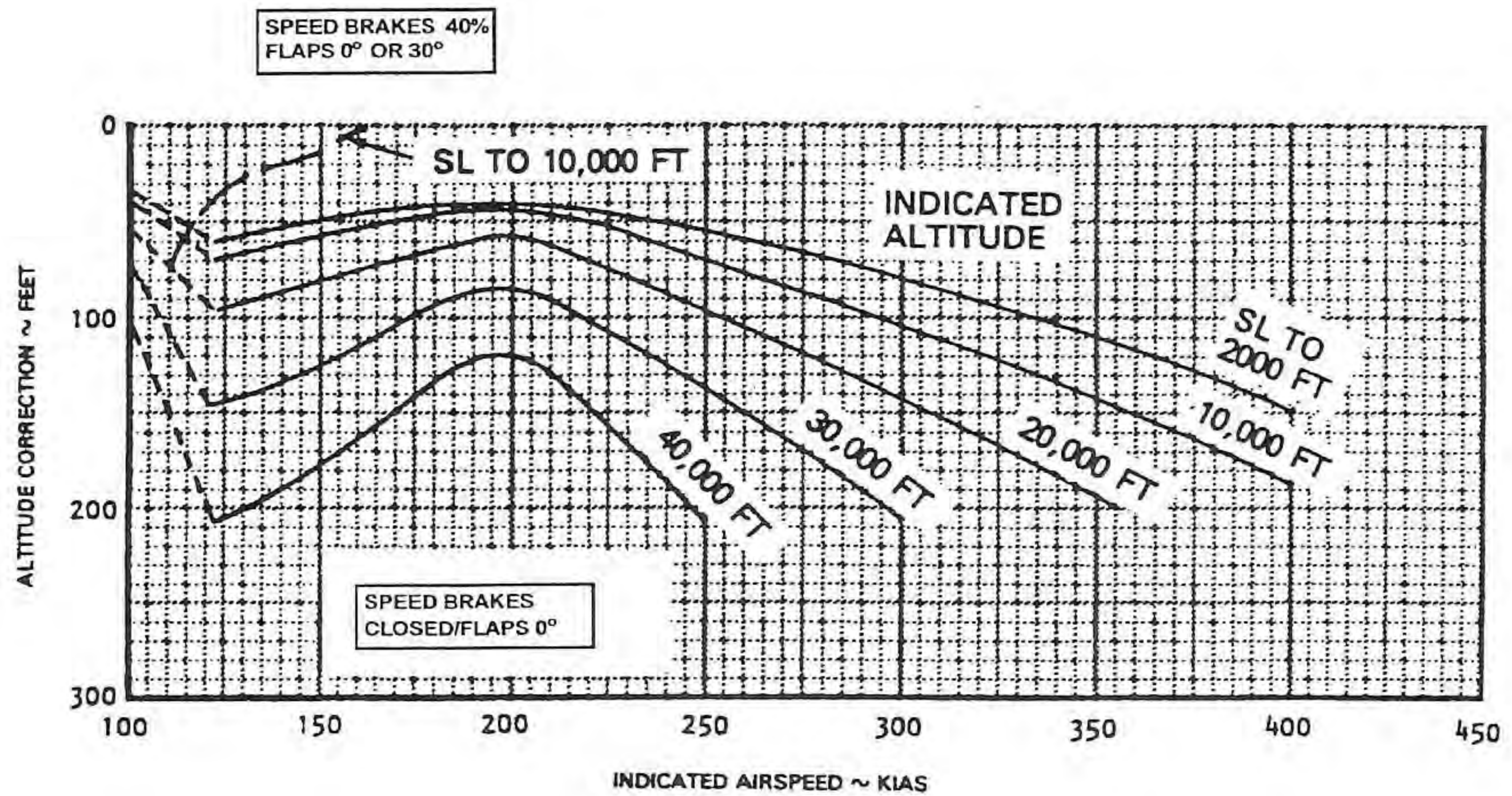
1A-10A-34-1-1-6-5

Figure 6-2. ALTIMETER LAG CHART - RESET MODE (ELECTRONIC) (Sheet 1 of 2)



1A-10A-34-1-1-6-6

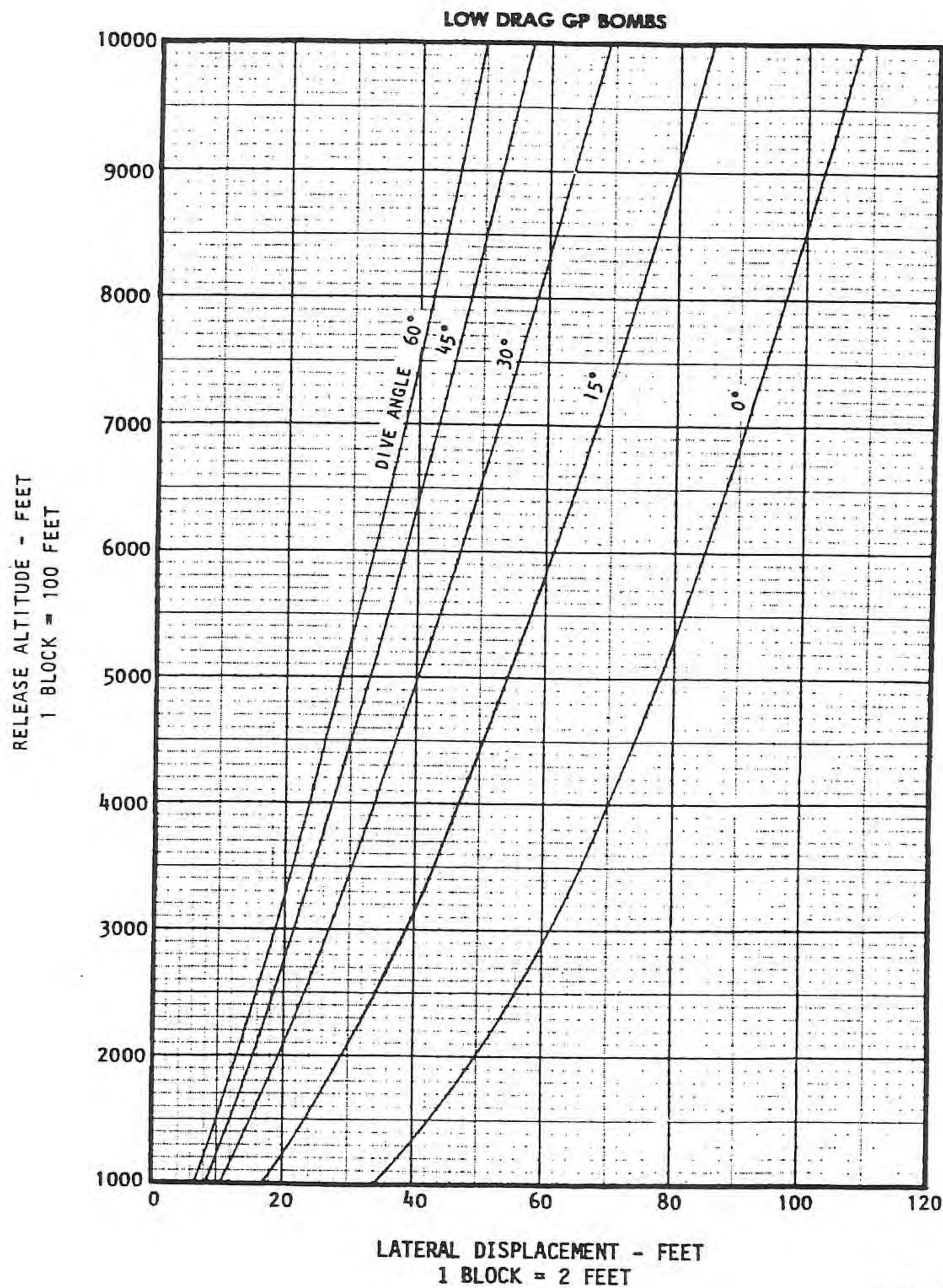
Figure 6-2. ALTIMETER LAG CHART - STANDBY MODE (PNEUMATIC) (Sheet 2 of 2)



NOTE:
 ACTUAL ALTITUDE IS
 INDICATED ALTITUDE
 LESS THE CORRECTIONS.

1A-10A-34-1-1-6-7

Figure 6-3. ALTIMETER CORRECTION CHART



1A-10A-34-1-1-6-8

Figure 6-4. IMPACT LATERAL DISPLACEMENT CHART - TER SHOULDER POSITION CARRIAGE (Sheet 1 of 2)

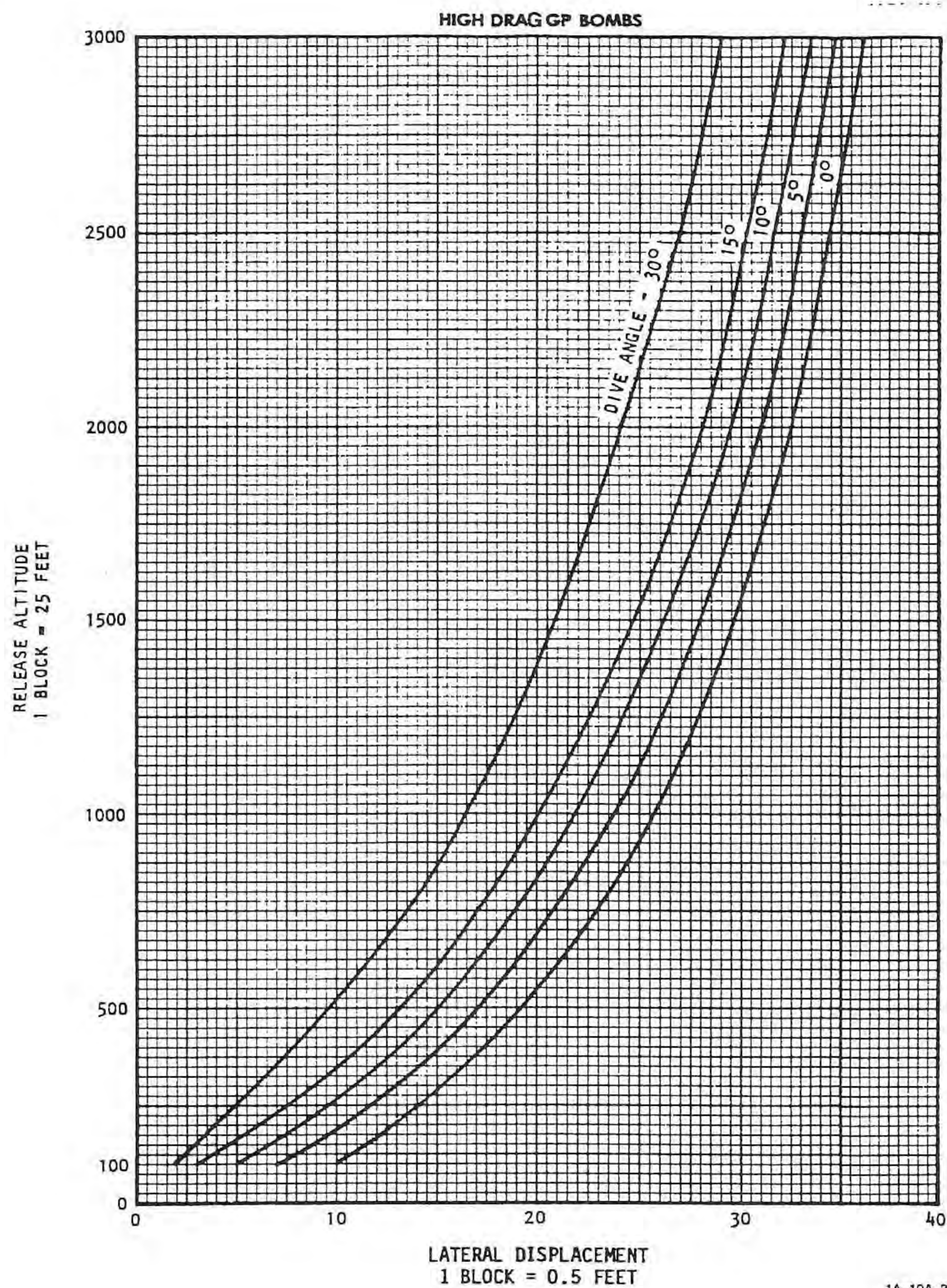


Figure 6-4. IMPACT LATERAL DISPLACEMENT CHART - TER SHOULDER POSITION CARRIAGE (Sheet 2 of 2)

MK 82 LDGP LOW DRAG BOMB TARGET DENSITY ALTITUDE - 10,000 FEET																	
RELEASE		VERTICAL DROP REQUIRED FOR FUZE ARMING (FEET)															
DIVE ANGLE	TAS	M904E2/E3 +10 PERCENT TOLERANCE			M905 +20 PERCENT TOLERANCE			FMU-113/B +10 PERCENT TOLERANCE			FMU-26B/B +0.3 SECOND TOLERANCE			FMU-81/B +5 PERCENT TOLERANCE			FMU-72/B +1.5 SECONDS TOLERANCE
DEG	KNOTS	4 SEC	6 SEC	8 SEC	4 SEC	6 SEC	8 SEC	6 SEC	8 SEC	10 SEC	4 SEC	6 SEC	8 SEC	4 SEC	6 SEC	8 SEC	6 SEC
0	300	350	750	1300	410	880	1540	860	1450	2190	330	680	1160	320	680	1190	950
	350	340	750	1300	410	880	1540	860	1450	2180	330	680	1160	320	680	1190	950
	400	340	750	1300	410	880	1540	860	1440	2180	330	680	1160	320	680	1190	950
5	300	540	1040	1680	620	1200	1960	1170	1850	2690	520	960	1520	500	960	1550	1280
	350	570	1080	1750	650	1250	2020	1220	1920	2760	550	1000	1580	530	1000	1610	1340
	400	600	1130	1810	690	1300	2090	1270	1980	2840	580	1050	1640	560	1050	1670	1390
10	300	730	1320	2060	830	1510	2370	1480	2250	3180	710	1230	1880	680	1230	1920	1610
	350	790	1420	2190	890	1610	2510	1580	2380	3340	770	1320	2000	740	1320	2040	1710
	400	860	1510	2310	960	1710	2640	1680	2510	3500	830	1410	2120	800	1410	2150	1820
15	300	920	1600	2440	1030	1820	2780	1780	2650	3670	890	1500	2230	860	1500	2270	1930
	350	1010	1740	2620	1130	1970	2980	1930	2840	3900	980	1630	2410	950	1630	2450	2090
	400	1110	1880	2810	1240	2120	3180	2080	3040	4140	1080	1770	2580	1040	1770	2630	2240
20	300	1100	1880	2800	1230	2110	3170	2070	3030	4140	1070	1760	2580	1040	1760	2620	2240
	350	1230	2060	3050	1370	2320	3440	2270	3290	4460	1190	1940	2810	1160	1940	2860	2450
	400	1350	2250	3290	1500	2520	3710	2470	3550	4770	1310	2120	3040	1280	2120	3090	2660
30	300	1450	2400	3500	1610	2680	3930	2640	3770	5050	1410	2260	3230	1370	2260	3290	2830
	350	1630	2670	3860	1810	2980	4330	2930	4150	5510	1590	2520	3580	1550	2520	3630	3140
	400	1820	2940	4220	2010	3280	4720	3220	4530	5980	1770	2780	3920	1720	2780	3980	3450
45	300	1900	3080	4400	2110	3420	4920	3370	4720	6220	1850	2910	4090	1810	2910	4150	3600
	350	2160	3460	4910	2390	3840	5470	3780	5260	6880	2110	3280	4570	2050	3280	4640	4040
	400	2420	3850	5420	2670	4260	6020	4190	5800	7530	2360	3650	5050	2300	3650	5120	4470
60	300	2250	3590	5080	2480	3990	5660	3920	5440	7110	2190	3400	4730	2140	3400	4800	4190
	350	2570	4070	5710	2830	4500	6340	4430	6100	7920	2500	3850	5320	2440	3850	5400	4720
	400	2880	4540	6330	3180	5020	7020	4940	6760	8720	2810	4310	5910	2740	4310	6000	5260

Figure 6-5. FUZE ARMING TABLE, MK 82 LDGP(Sheet 1 of 4)

MK 82 AIR LOW DRAG BOMB TARGET DENSITY ALTITUDE - 10,000 FEET																	
RELEASE		VERTICAL DROP REQUIRED FOR FUZE ARMING (FEET)															
DIVE ANGLE	TAS	M904E2/E3 +10 PERCENT TOLERANCE			M905 +20 PERCENT TOLERANCE			FMU-113/B +10 PERCENT TOLERANCE			FMU-26B/B +0.3 SECOND TOLERANCE			FMU-81/B +5 PERCENT TOLERANCE			FMU-72/B +1.5 SECONDS TOLERANCE
DEG	KNOTS	4 SEC	6 SEC	8 SEC	4 SEC	6 SEC	8 SEC	6 SEC	8 SEC	10 SEC	4 SEC	6 SEC	8 SEC	4 SEC	6 SEC	8 SEC	6 SEC
0	300	340	740	1280	400	870	1520	850	1430	2150	330	680	1150	310	680	1170	940
	350	340	740	1280	400	870	1510	850	1420	2140	330	680	1140	310	680	1170	940
	400	340	740	1280	400	870	1510	850	1420	2140	330	670	1140	310	670	1170	940
5	300	530	1020	1660	610	1180	1930	1160	1820	2630	520	950	1500	500	950	1530	1270
	350	570	1070	1720	650	1230	1990	1200	1880	2710	550	990	1560	530	990	1590	1320
	400	600	1110	1770	680	1280	2050	1250	1940	2780	580	1030	1610	560	1030	1640	1370
10	300	720	1310	2030	820	1490	2330	1460	2220	3120	700	1220	1850	680	1220	1890	1590
	350	790	1400	2150	890	1590	2460	1560	2340	3260	760	1300	1970	740	1300	2000	1690
	400	850	1490	2270	950	1690	2580	1650	2460	3410	820	1390	2080	800	1390	2110	1790
15	300	910	1580	2400	1020	1790	2730	1760	2600	3590	880	1480	2200	860	1480	2240	1900
	350	1000	1720	2580	1120	1940	2920	1900	2790	3810	970	1610	2370	940	1610	2410	2050
	400	1100	1850	2750	1220	2090	3110	2050	2970	4030	1060	1740	2540	1030	1740	2580	2200
20	300	1090	1850	2750	1220	2080	3120	2050	2980	4050	1060	1740	2540	1030	1740	2580	2200
	350	1210	2030	2990	1350	2280	3370	2240	3230	4340	1180	1910	2760	1150	1910	2810	2410
	400	1340	2210	3220	1490	2470	3620	2430	3470	4640	1300	2080	2980	1260	2080	3030	2610
30	300	1440	2370	3440	1600	2650	3870	2600	3710	4940	1400	2240	3190	1360	2240	3240	2790
	350	1620	2640	3790	1790	2940	4240	2890	4070	5390	1580	2490	3520	1530	2490	3570	3090
	400	1800	2900	4140	1990	3230	4620	3170	4440	5830	1750	2740	3850	1710	2740	3900	3390
45	300	1890	3040	4330	2090	3380	4830	3320	4640	6080	1840	2880	4020	1790	2880	4080	3550
	350	2140	3420	4820	2370	3790	5360	3730	5160	6710	2090	3240	4490	2040	3240	4560	3980
	400	2400	3790	5310	2640	4190	5890	4130	5670	7330	2340	3590	4950	2280	3590	5020	4400
60	300	2230	3550	5000	2460	3930	5560	3870	5350	6950	2170	3360	4660	2120	3360	4730	4130
	350	2540	4010	5600	2800	4430	6210	4360	5980	7710	2480	3800	5230	2420	3800	5300	4650
	400	2860	4470	6200	3140	4930	6860	4850	6610	8470	2790	4240	5800	2710	4240	5880	5160

Figure 6-5. FUZE ARMING, MK 82 AIR-LD (Sheet 2 of 4)

MK 84 LDGP, BOMB TARGET DENSITY ALTITUDE - 10,000 FEET																		
RELEASE		VERTICAL DROP REQUIRED FOR FUZE ARMING (FEET)																
DIVE ANGLE	TAS	M904E2/E3 +10 PERCENT TOLERANCE			M905 +20 PERCENT TOLERANCE			FMU-113/B +10 PERCENT TOLERANCE				FMU-26B/B +0.3 SECOND TOLERANCE			FMU-81/B +5 PERCENT TOLERANCE			FMU-72/B +1.5 SECONDS TOLERANCE
DEG	KNOTS	4 SEC	6 SEC	8 SEC	4 SEC	6 SEC	8 SEC	6 SEC	8 SEC	10 SEC	18 SEC	4 SEC	6 SEC	8 SEC	4 SEC	6 SEC	8 SEC	6 SEC
0	300	360	770	1340	430	910	1580	890	1490	2240	6790	350	710	1200	330	710	1230	990
	350	360	770	1340	430	910	1580	890	1490	2240	6780	350	710	1200	330	710	1230	990
	400	360	770	1340	430	910	1580	890	1490	2240	6780	350	710	1200	330	710	1230	990
5	300	560	1060	1730	640	1230	2000	1200	1900	2750	7670	540	990	1560	520	990	1590	1320
	350	590	1110	1790	670	1280	2070	1250	1960	2830	7810	570	1030	1620	550	1030	1660	1370
	400	620	1160	1850	710	1330	2140	1300	2030	2910	7950	600	1080	1680	580	1080	1720	1430
10	300	750	1350	2110	850	1540	2420	1510	2300	3250	8540	730	1260	1920	700	1260	1960	1640
	350	810	1450	2240	920	1650	2560	1610	2440	3410	8830	790	1350	2040	760	1350	2080	1750
	400	880	1540	2360	990	1750	2700	1720	2570	3570	9110	850	1440	2160	820	1440	220	1860
15	300	940	1630	2480	1050	1960	1850	2830	1810	2700	3740	9400	910	1530	2280	880	1530	2320
	350	1030	1780	2670	1160	2130	2010	3040	1970	2900	3980	9830	1000	1670	2460	970	1670	2500
	400	1130	1920	2860	1260	2290	2160	3240	2120	3100	4230	10250	1100	1800	2630	1060	1800	2680
20	300	1120	1910	2850	1250	2150	3230	2110	3090	4210	10240	1090	1790	2620	1060	1790	2670	2280
	350	1250	2100	3100	1390	2360	3500	2310	3350	4540	10800	1210	1970	2860	1180	1970	2910	2490
	400	1370	2290	3350	1530	2560	3770	2510	3610	4860	11360	1340	2150	3100	1300	2150	3150	2700
30	300	1470	2430	3550	1630	2720	3990	2670	3820	5120	11850	1430	2290	3280	1390	2290	3330	2870
	350	1650	2710	3910	1830	3020	4390	2970	4210	5600	12680	1610	2560	3630	1570	2560	3680	3180
	400	1840	2980	4280	2040	3320	4790	3270	4600	6080	13480	1790	2820	3970	1740	2820	4030	3500
45	300	1920	3110	4450	2130	3460	4970	3400	4780	6300	13910	1870	2940	4130	1820	2940	4200	3640
	350	2180	3500	4970	2410	3890	5540	3820	5320	6970	15060	2130	3310	4620	2070	3310	4690	4080
	400	2440	3890	5490	2700	4310	6100	4240	5870	7650	16180	2380	3690	5110	2320	3690	5190	4530
60	300	2270	3620	5130	2500	4020	5720	3950	5500	7190	15460	2210	3430	4780	2150	3430	4850	4220
	350	2560	4100	5770	2850	4540	6410	4470	6170	8020	16860	2520	3890	5380	2460	3890	4560	4770
	400	2910	4580	6400	3200	5060	7100	4980	6840	8840	18210	2830	4340	5980	2760	4340	6060	5310

Figure 6-5. FUZE ARMING, MK 84 LDGP (Sheet 3 of 4)

MK 82 AIR HIGH DRAG BOMBS TARGET DENSITY ALTITUDE - 10,000 FEET													
RELEASE		VERTICAL DROP REQUIRED FOR FUZE ARMING (FEET)											
DIVE ANGLE	TAS	M904E2/E3 +10 PERCENT TOLERANCE			M905 +20 PERCENT TOLERANCE		M905 +10 PERCENT TOLERANCE			FMU-54/B, A/B +0.3 SECOND TOLERANCE			
		2 SEC	4 SEC	6 SEC	4 SEC	6 SEC	2.5 SEC	3.5 SEC	5 SEC	2 SEC	2.6 SEC	4 SEC	5 SEC
0	300	140	360	670	330	660	180	290	510	100	150	290	420
	350	130	340	640	320	640	170	280	480	100	140	280	410
	400	120	320	320	310	630	160	260	460	100	140	280	400
5	300	240	520	880	480	860	300	440	690	190	260	440	590
	350	240	510	860	490	860	300	440	680	200	270	450	590
	400	240	510	850	490	860	300	440	670	210	270	450	600
10	300	350	680	1070	630	1060	420	590	870	280	370	580	760
	350	360	390	1070	650	1070	430	600	870	300	390	610	780
	400	370	390	1080	670	1090	440	610	880	320	410	620	800
15	300	450	830	1260	780	1250	540	730	1040	370	470	720	920
	350	470	850	1280	820	1280	560	750	1060	400	510	760	960
	400	490	870	1300	850	1310	580	770	1080	430	540	790	990
20	300	550	980	1450	920	1430	650	870	1210	460	580	860	1080
	350	580	1010	1480	970	1480	680	900	1240	500	620	960	1130
	400	600	1050	1510	1020	1530	710	940	1280	540	660	960	1170

Figure 6-5. FUZE ARMING, MK 82 AIR-HD (Sheet 4 of 4)

2.75 IN. WAFAR W/MK-1 WARHEAD AND MK-40 MOTOR DIVE RELEASE 4.0G Climbing Maneuver							
RELEASE		SAFE ESCAPE					
DIVE ANGLE DEG	TAS KNOTS	TDA - SEA LEVEL			TDA - 5000 FEET		
		ALT LOSS DURING PULLOUT FEET	TIME OF FALL SECONDS	MINIMUM RELEASE ALTITUDE FEET	ALT LOSS DURING PULLOUT FEET	TIME OF FALL SECONDS	MINIMUM RELEASE ALTITUDE FEET
0	300	—	1.58	80	—	1.62	80
	350	—	1.67	90	—	1.70	90
	400	—	1.70	90	—	1.72	90
5	300	70	1.63	320	70	1.66	330
	350	80	1.72	360	80	1.77	380
	400	90	1.64	340	90	1.66	350
10	300	160	1.61	540	160	1.61	540
	350	190	1.63	570	190	1.67	600
	400	230	1.73	650	230	1.77	680
15	300	270	1.60	750	270	1.61	770
	350	340	1.67	840	340	1.67	850
	400	410	1.65	850	410	1.65	860
20	300	410	1.60	970	410	1.61	990
	350	510	1.67	1080	510	1.67	1090
	400	630	1.64	1090	630	1.65	1110
30	300	760	1.61	1400	760	1.62	1420
	350	960	1.66	1530	960	1.68	1570
	400	1170	1.64	1550	1180	1.66	1600
45	300	1450	1.60	1910	1460	1.60	1930
	350	1850	1.58	1960	1960	1.60	2020
	400	2270	1.70	2270	2270	1.70	2290

■ Refer to Figure 6-1 (Sheet 2).

Figure 6-6. SAFE ESCAPE, 2.75 FFAR (MK-1, MK-40), CLM (Sheet 1 of 18)

2.75 IN. WAFAR W/MK-1 WARHEAD AND MK-66 MOTOR DIVE RELEASE 4.0G Climbing Maneuver							
RELEASE		SAFE ESCAPE					
DIVE ANGLE DEG	TAS KNOTS	TDA - SEA LEVEL			TDA - 5000 FEET		
		ALT LOSS DURING PULLOUT FEET	TIME OF FALL SECONDS	MINIMUM RELEASE ALTITUDE FEET	ALT LOSS DURING PULLOUT FEET	TIME OF FALL	MINIMUM RELEASE ALTITUDE
0	300	—	1.22	50	—	1.38	60
	350	—	1.25	50	—	1.28	50
	400	—	1.28	50	—	1.30	50
5	300	70	1.12	220	70	1.13	220
	350	80	1.22	260	80	1.22	260
	400	90	1.28	290	90	1.31	300
10	300	160	1.11	390	160	1.13	400
	350	190	1.20	460	190	1.21	470
	400	230	1.28	530	230	1.29	540
15	300	270	1.17	620	270	1.18	630
	350	340	1.28	750	340	1.31	780
	400	410	1.27	760	410	1.29	780
20	300	410	1.21	850	410	1.22	870
	350	510	1.28	970	510	1.31	1010
	400	630	1.25	970	630	1.28	1010
30	300	760	1.20	1220	760	1.20	1220
	350	960	1.17	1210	960	1.19	1250
	400	1170	1.24	1380	1180	1.27	1440
45	300	1450	1.21	1710	1460	1.21	1720
	350	1850	1.20	1750	1860	1.20	1770
	400	2270	1.30	2060	2290	1.30	2080

■ Refer to Figure 6-1 (Sheet 2).

■ *Figure 6-6. SAFE ESCAPE, 2.75 WAFAR (MK-1, MK-66), CLM (Sheet 2 of 18)*

2.75 IN. FFAR W/MK-1 WARHEAD AND MK-40 MOTOR DIVE RELEASE 4.0G Turning Maneuver					
RELEASE		SAFE ESCAPE			
DIVE ANGLE DEG	TAS KNOTS	TDA - SEA LEVEL		TDA - 5000 FEET	
		TIME OF FALL SECONDS	MINIMUM RELEASE ALTITUDE FEET	TIME OF FALL SECONDS	MINIMUM RELEASE ALTITUDE FEET
0	300	1.67	90	1.71	90
	350	1.76	100	1.79	100
	400	1.88	110	1.90	110
5	300	1.55	290	1.58	300
	350	1.63	330	1.66	340
	400	1.70	360	1.72	370
10	300	1.59	530	1.63	550
	350	1.61	560	1.62	570
	400	1.70	630	1.70	640
15	300	1.57	730	1.63	780
	350	1.61	790	1.63	820
	400	1.69	890	1.72	920
20	300	1.55	920	1.55	920
	350	1.61	1020	1.63	1050
	400	1.71	1160	1.72	1190

Figure 6-6. SAFE ESCAPE, 2.75 FFAR (MK-1, MK-40 Motors), TRN (Sheet 3 of 18)

2.75 IN. WAFAR W/MK-1 WARHEAD and MK-66 MOTOR DIVE RELEASE 4.0G Turning Maneuver					
RELEASE		SAFE ESCAPE			
DIVE ANGLE DEG	TAS KNOTS	TDA - SEA LEVEL		TDA - 5000 FEET	
		TIME OF FALL SECONDS	MINIMUM RELEASE ALTITUDE FEET	TIME OF FALL SECONDS	MINIMUM RELEASE ALTITUDE FEET
0	300	1.34	60	1.38	60
	350	1.25	50	1.28	50
	400	1.53	70	1.55	70
5	300	1.26	270	1.29	280
	350	1.35	310	1.38	320
	400	1.45	350	1.47	360
10	300	1.23	470	1.25	480
	350	1.30	530	1.35	560
	400	1.39	600	1.43	630
15	300	1.24	690	1.24	690
	350	1.30	760	1.32	790
	400	1.39	870	1.41	900
20	300	1.21	860	1.24	890
	350	1.30	990	1.32	1030
	400	1.39	1140	1.42	1180

■ Refer to Figure 6-1 (Sheet 3).

Figure 6-6. SAFE ESCAPE, 2.75 WAFAR (MK-1, MK-66), TRN (Sheet 4 of 18)

2.75 IN. FFAR W/MK-1 WARHEAD AND MK-40 MOTOR DIVE RELEASE 4.0G Turning Maneuver (Level Turn)							
RELEASE		SAFE ESCAPE					
DIVE ANGLE	TAS	TDA – SEA LEVEL			TDA – 5000 FEET		
		ALT LOSS DURING PULLOUT FEET	TIME OF FALL SECONDS	MINIMUM RELEASE ALTITUDE FEET	ALT LOSS DURING PULLOUT FEET	TIME OF FALL SECONDS	MINIMUM RELEASE ALTITUDE FEET
DEG	KNOTS	FEET	SECONDS	FEET	FEET	SECONDS	FEET
0	300	—	1.67	90	—	1.71	90
	350	—	1.76	100	—	1.79	100
	400	—	1.88	110	—	1.90	110
5	300	70	1.80	380	70	1.81	380
	350	80	1.83	400	80	1.83	400
	400	100	1.87	420	100	1.89	430
10	300	160	1.71	600	160	1.73	610
	350	200	1.75	640	200	1.79	670
	400	240	1.82	700	240	1.85	730
15	300	280	1.60	750	280	1.69	830
	350	340	1.67	840	340	1.69	870
	400	410	1.72	910	410	1.75	950
20	300	410	1.57	940	410	1.62	1000
	350	510	1.64	1050	510	1.66	1080
	400	620	1.69	1140	620	1.70	1170

■ Refer to Figure 6-1 (Sheet 4).

■ *Figure 6-6. SAFE ESCAPE, 2.75 FFAR (MK-1, MK-40), TRN (LT) (Sheet 5 of 18)*

2.75 IN. WAFAR W/MK-1 WARHEAD AND MK-66 MOTOR DIVE RELEASE 4.0G Turning Maneuver (Level Turn)							
RELEASE		SAFE ESCAPE					
DIVE ANGLE	TAS	TDA - SEA LEVEL			TDA - 5000 FEET		
		ALT LOSS DURING PULLOUT	TIME OF FALL	MINIMUM RELEASE ALTITUDE	ALTLOSS DURING PULLOUT	TIME OF FALL	MINIMUM RELEASE ALTITUDE
DEG	KNOTS	FEET	SECONDS	FEET	FEET	SECONDS	FEET
0	300	—	1.34	60	—	1.38	60
	350	—	1.25	50	—	1.28	50
	400	—	1.53	70	—	1.55	70
5	300	70	1.42	330	70	1.43	330
	350	80	1.52	370	80	1.57	390
	400	100	1.50	370	100	1.55	390
10	300	160	1.44	600	160	1.48	630
	350	200	1.52	670	200	1.59	720
	400	240	1.59	730	240	1.69	800
15	300	280	1.41	840	280	1.45	880
	350	340	1.39	850	340	1.44	900
	400	410	1.39	870	410	1.45	930
20	300	410	1.20	840	410	1.23	880
	350	510	1.25	940	510	1.29	990
	400	620	1.34	1070	620	1.36	1110

■ Refer to Figure 6-1 (Sheet 4).

Figure 6-6. SAFE ESCAPE, 2.75 WAFAR (MK-1, MK-66), TRN (LT) (Sheet 6 of 18)

2.75 IN. FFAR W/MK-5 WARHEAD AND MK-40 MOTOR DIVE RELEASE 4.0G Climbing Maneuver							
RELEASE		SAFE ESCAPE					
DIVE ANGLE	TAS	TDA - SEA LEVEL			TDA - 5000 FEET		
		ALT LOSS DURING PULLOUT	TIME OF FALL	MINIMUM RELEASE ALTITUDE	ALT LOSS DURING PULLOUT	TIME OF FALL	MINIMUM RELEASE ALTITUDE
DEG	KNOTS	FEET	SECONDS	FEET	FEET	SECONDS	FEET
0	300	—	1.67	90	—	1.71	90
	350	—	1.76	100	—	1.79	100
	400	—	1.79	100	—	1.81	100
5	300	70	1.63	320	70	1.69	340
	350	80	1.72	360	80	1.71	360
	400	90	1.78	390	90	1.80	400
10	300	160	1.65	560	160	1.68	580
	350	190	1.70	610	190	1.72	630
	400	230	1.73	650	230	1.80	700
15	300	270	1.63	780	270	1.66	810
	350	340	1.70	870	340	1.72	890
	400	410	1.74	930	410	1.81	1000
20	300	410	1.64	1010	410	1.66	1040
	350	510	1.69	1110	510	1.72	1150
	400	630	1.73	1190	630	1.80	1280
30	300	760	1.64	1440	760	1.67	1500
	350	960	1.70	1590	960	1.73	1650
	400	1170	1.74	1700	1180	1.81	1830
45	300	1450	1.65	2010	1460	1.68	2100
	350	1850	1.69	2180	1860	1.74	2320
	400	2270	1.74	2370	2290	1.81	2550

■ Refer to Figure 6-1 (Sheet 2).

■ *Figure 6-6. SAFE ESCAPE, 2.75 FFAR (MK-5, MK-40), CLM (Sheet 7 of 18)*

2.75 IN. WAFAR W/MK-5 WARHEAD AND MK-66 MOTOR DIVE RELEASE 4.0G Climbing Maneuver							
RELEASE		SAFE ESCAPE					
DIVE ANGLE	TAS	TDA - SEA LEVEL			TDA - 5000 FEET		
		ALT LOSS DURING PULLOUT	TIME OF FALL	MINIMUM RELEASE ALTITUDE	ALT LOSS DURING PULLOUT	TIME OF FALL	MINIMUM RELEASE ALTITUDE
DEG	KNOTS	FEET	SECONDS	FEET	FEET	SECONDS	FEET
0	300	—	1.44	70	—	1.49	70
	350	—	1.48	70	—	1.51	70
	400	—	1.53	70	—	1.55	70
5	300	70	1.37	310	70	1.40	320
	350	80	1.46	350	80	1.49	360
	400	90	1.53	380	90	1.55	390
10	300	160	1.37	560	160	1.40	580
	350	190	1.44	620	190	1.48	650
	400	230	1.51	680	230	1.55	710
15	300	270	1.37	800	270	1.41	840
	350	340	1.44	890	340	1.47	930
	400	410	1.51	980	410	1.54	1020
20	300	410	1.37	1040	410	1.41	1100
	350	510	1.43	1150	510	1.47	1210
	400	630	1.50	1270	630	1.54	1330
30	300	760	1.36	1490	760	1.41	1580
	350	960	1.43	1660	960	1.47	1740
	400	1170	1.49	1810	1180	1.52	1870
45	300	1450	1.37	2080	1460	1.41	2200
	350	1850	1.43	2310	1860	1.48	2430
	400	2270	1.49	2520	2290	1.51	2600

■ Refer to Figure 6-1 (Sheet 2).

Figure 6-6. SAFE ESCAPE, 2.75 WAFAR (MK-5, MK-66), CLM (Sheet 8 of 18)

2.75 IN. FFAR W/MK-5 WARHEAD AND MK-40 MOTOR					
DIVE RELEASE					
4.0G Turning Maneuver					
RELEASE		SAFE ESCAPE			
DIVE ANGLE	TAS	TDA - SEA LEVEL		TDA - 5000 FEET	
		TIME OF FALL	MINIMUM RELEASE ALTITUDE	TIME OF FALL	MINIMUM RELEASE ALTITUDE
DEG	KNOTS	SECONDS	FEET	SECONDS	FEET
0	300	1.67	90	1.71	90
	350	1.76	100	1.79	100
	400	1.79	100	1.90	110
5	300	1.66	330	1.69	340
	350	1.75	370	1.80	390
	400	1.84	410	1.89	430
10	300	1.66	570	1.69	590
	350	1.73	630	1.77	660
	400	1.83	710	1.87	740
15	300	1.66	800	1.70	840
	350	1.73	890	1.76	930
	400	1.84	1010	1.86	1040
20	300	1.66	1030	1.70	1080
	350	1.73	1150	1.76	1190
	400	1.84	1300	1.86	1340

■ Refer to Figure 6-1 (Sheet 3).

■ *Figure 6-6. SAFE ESCAPE, 2.75 FFAR (MK-5, MK-40), TRN (Sheet 9 of 18)*

2.75 IN. WAFAR W/MK-5 WARHEAD AND MK-66 MOTOR DIVE RELEASE 4.0G Turning Maneuver					
RELEASE		SAFE ESCAPE			
DIVE ANGLE	TAS	TDA - SEA LEVEL		TDA - 5000 FEET	
		TIME OF FALL	MINIMUM RELEASE ALTITUDE	TIME OF FALL	MINIMUM RELEASE ALTITUDE
DEG	KNOTS	SECONDS	FEET	SECONDS	FEET
0	300	1.44	70	1.49	70
	350	1.48	70	1.51	70
	400	1.53	70	1.55	70
5	300	1.40	320	1.40	320
	350	1.46	350	1.52	370
	400	1.56	390	1.58	400
10	300	1.37	560	1.40	580
	350	1.44	620	1.50	660
	400	1.51	680	1.55	710
15	300	1.38	810	1.41	840
	350	1.45	900	1.48	940
	400	1.52	990	1.55	1030
20	300	1.37	1050	1.40	1090
	350	1.45	1170	1.49	1230
	400	1.52	1290	1.56	1350

■ Refer to Figure 6-1 (Sheet 3).

Figure 6-6. SAFE ESCAPE, 2.75 WAFAR (MK-5, MK-66), TRN (Sheet 10 of 18)

2.75 IN. FFAR W/MK-5 WARHEAD AND MK-40 MOTOR DIVE RELEASE 4.0G Turning Maneuver (Level Turn)							
RELEASE		SAFE ESCAPE					
DIVE ANGLE	TAS	TDA - SEA LEVEL			TDA - 5000 FEET		
		ALT LOSS DURING PULLOUT	TIME OF FALL	MINIMUM RELEASE ALTITUDE	ALT LOSS DURING PULLOUT	TIME OF FALL	MINIMUM RELEASE ALTITUDE
DEG	KNOTS	FEET	SECONDS	FEET	FEET	SECONDS	FEET
0	300	—	1.67	90	—	1.71	90
	350	—	1.76	100	—	1.79	100
	400	—	1.79	100	—	1.90	110
5	300	70	1.86	400	70	1.89	410
	350	80	1.95	440	80	2.00	460
	400	100	2.05	480	100	2.08	500
10	300	160	1.87	690	160	1.92	720
	350	200	1.92	740	200	1.99	790
	400	240	2.04	810	240	2.07	860
15	300	280	1.79	910	280	1.86	970
	350	340	1.84	980	340	1.91	1050
	400	410	1.90	1060	410	1.99	1150
20	300	410	1.69	1060	410	1.77	1160
	350	510	1.75	1170	510	1.82	1260
	400	620	1.83	1290	620	1.88	1360

■ Refer to Figure 6-1 (Sheet 4).

■ *Figure 6-6. SAFE ESCAPE, 2.75 FFAR (MK-5, MK-40), TRN (LT) (Sheet 11 of 18)*

2.75 IN. WAFAR W/MK-5 WARHEAD AND MK-66 MOTOR DIVE RELEASE 4.0G Turning Maneuver (Level Turn)							
RELEASE		SAFE ESCAPE					
DIVE ANGLE	TAS	TDA - SEA LEVEL			TDA - 5000 FEET		
		ALT LOSS DURING PULLOUT	TIME OF FALL	MINIMUM RELEASE ALTITUDE	ALT LOSS DURING PULLOUT	TIME OF FALL	MINIMUM RELEASE ALTITUDE
DEG	KNOTS	FEET	SECONDS	FEET	FEET	SECONDS	FEET
0	300	—	1.44	70	—	1.49	70
	350	—	1.48	70	—	1.51	70
	400	—	1.53	70	—	1.55	70
5	300	70	1.56	380	70	1.60	390
	350	80	1.66	420	80	1.68	430
	400	100	1.76	460	100	1.80	480
10	300	160	1.56	680	160	1.63	720
	350	200	1.63	740	200	1.69	780
	400	240	1.70	800	240	1.76	840
15	300	280	1.51	930	280	1.57	990
	350	340	1.56	1000	340	1.62	1060
	400	410	1.61	1070	410	1.66	1130
20	300	410	1.45	1140	410	1.51	1210
	350	510	1.50	1230	510	1.56	1310
	400	620	1.56	1340	620	1.56	1350

■ Refer to Figure 6-1 (Sheet 4).

Figure 6-6. SAFE ESCAPE, 2.75 WAFAR (MK-5, MK-66), TRN (LT) (Sheet 12 of 18)

2.75 IN. FFAR W/MK-151 WARHEAD AND MK-40 MOTOR DIVE RELEASE 4.0G Climbing Maneuver							
RELEASE		SAFE ESCAPE					
DIVE ANGLE	TAS	TDA - SEA LEVEL			TDA - 5000 FEET		
		ALT LOSS DURING PULLOUT	TIME OF FALL	MINIMUM RELEASE ALTITUDE	ALT LOSS DURING PULLOUT	TIME OF FALL	MINIMUM RELEASE ALTITUDE
DEG	KNOTS	FEET	SECONDS	FEET	FEET	SECONDS	FEET
0	300	—	1.65	80	—	1.70	80
	350	—	1.73	90	—	1.76	90
	400	—	1.75	90	—	1.77	90
5	300	70	1.59	270	70	1.63	280
	350	80	1.64	300	80	1.71	320
	400	90	1.71	330	90	1.77	350
10	300	160	1.60	470	160	1.62	480
	350	190	1.65	520	190	1.68	540
	400	230	1.73	580	230	1.76	600
15	300	270	1.59	660	270	1.62	680
	350	340	1.64	730	340	1.69	770
	400	410	1.71	810	410	1.76	850
20	300	410	1.58	840	410	1.62	880
	350	510	1.65	940	510	1.68	980
	400	630	1.71	1040	630	1.74	1080
30	300	760	1.59	1200	760	1.63	1260
	350	960	1.64	1330	960	1.69	1400
	400	1170	1.71	1470	1180	1.75	1540
45	300	1450	1.59	1670	1460	1.63	1760
	350	1850	1.65	1860	1860	1.69	1960
	400	2270	1.8	2200	2290	1.80	2230

■ Refer to Figure 6-1 (Sheet 2).

■ *Figure 6-6. SAFE ESCAPE, 2.75 FFAR (MK-151, MK-40), CLM (Sheet 13 of 18)*

2.75 IN. WAFAR W/MK-151 WARHEAD AND MK-66 MOTOR DIVE RELEASE 4.0G Climbing Maneuver							
RELEASE		SAFE ESCAPE					
DIVE ANGLE	TAS	TDA - SEA LEVEL			TDA - 5000 FEET		
		ALT LOSS DURING PULLOUT	TIME OF FALL	MINIMUM RELEASE ALTITUDE	ALT LOSS DURING PULLOUT	TIME OF FALL	MINIMUM RELEASE ALTITUDE
DEG	KNOTS	FEET	SECONDS	FEET	FEET	SECONDS	FEET
0	300	—	1.36	60	—	1.41	60
	350	—	1.47	70	—	1.50	70
	400	—	1.50	70	—	1.53	70
5	300	70	1.32	260	70	1.36	270
	350	80	1.38	290	80	1.41	300
	400	90	1.46	320	90	1.48	330
10	300	160	1.31	460	160	1.35	480
	350	190	1.37	510	190	1.42	540
	400	230	1.45	570	230	1.49	600
15	300	270	1.31	660	270	1.33	680
	350	340	1.36	730	340	1.41	770
	400	410	1.43	810	410	1.49	860
20	300	410	1.30	850	410	1.34	890
	350	510	1.36	940	510	1.41	1000
	400	630	1.43	1050	630	1.48	1110
30	300	760	1.30	1210	760	1.34	1280
	350	960	1.36	1340	960	1.40	1430
	400	1170	1.42	1500	1180	1.47	1580
45	300	1450	1.30	1680	1460	1.34	1780
	350	1850	1.35	1870	1860	1.40	1990
	400	2270	1.50	2250	2290	1.50	2270

■ Refer to Figure 6-1 (Sheet 2).

Figure 6-6, SAFE ESCAPE, 2.75 WAFAR (MK-151, MK-66), CLM (Sheet 14 of 18)

2.75 IN. FFAR W/MK-151 WARHEAD AND MK-40 MOTOR DIVE RELEASE 4.0G Turning Maneuver					
RELEASE		SAFE ESCAPE			
DIVE ANGLE	TAS	TDA – SEA LEVEL		TDA – 5000 FEET	
		TIME OF FALL	MINIMUM RELEASE ALTITUDE	TIME OF FALL	MINIMUM RELEASE ALTITUDE
DEG	KNOTS	SECONDS	FEET	SECONDS	FEET
0	300	1.65	80	1.70	80
	350	1.73	90	1.76	90
	400	1.84	100	1.87	100
5	300	1.68	300	1.72	310
	350	1.77	340	1.80	350
	400	1.88	380	1.90	390
10	300	1.66	500	1.67	510
	350	1.75	570	1.78	590
	400	1.87	650	1.89	670
15	300	1.65	700	1.66	710
	350	1.76	810	1.79	840
	400	1.87	920	1.90	950
20	300	1.65	900	1.66	920
	350	1.76	1040	1.78	1070
	400	1.88	1190	1.91	1230

■ Refer to Figure 6-1 (Sheet 3).

■ *Figure 6-6. SAFE ESCAPE, 2.75 FFAR (MK-151, MK-40), TRN (Sheet 15 of 18)*

2.75 IN. WAFAR W/MK-151 WARHEAD AND MK-66 MOTOR DIVE RELEASE 4.0G Turning Maneuver					
RELEASE		SAFE ESCAPE			
DIVE ANGLE	TAS	TDA - SEA LEVEL		TDA - 5000 FEET	
		TIME OF FALL	MINIMUM RELEASE ALTITUDE	TIME OF FALL	MINIMUM RELEASE ALTITUDE
DEG	KNOTS	SECONDS	FEET	SECONDS	FEET
0	300	1.36	60	1.41	60
	350	1.47	70	1.50	70
	400	1.51	70	1.54	70
5	300	1.41	290	1.45	300
	350	1.51	330	1.54	340
	400	1.58	360	1.64	380
10	300	1.36	490	1.38	500
	350	1.47	470	1.51	590
	400	1.55	630	1.60	660
15	300	1.36	700	1.38	720
	350	1.46	810	1.50	840
	400	1.56	910	1.60	950
20	300	1.36	910	1.39	940
	350	1.45	1040	1.49	1090
	400	1.57	1190	1.59	1230

■ Refer to Figure 6-1 (Sheet 3).

Figure 6-6. SAFE ESCAPE, 2.75 WAFAR (MK-151, MK-66), TRN (Sheet 16 of 18)

2.75 IN. FFAR W/MK-151 WARHEAD AND MK-40 MOTOR DIVE RELEASE 4.0G Turning Maneuver (Level Turn)							
RELEASE		SAFE ESCAPE					
DIVE ANGLE	TAS	TDA - SEA LEVEL			TDA - 5000 FEET		
		ALT LOSS DURING PULLOUT	TIME OF FALL	MINIMUM RELEASE ALTITUDE	ALT LOSS DURING PULLOUT	TIME OF FALL	MINIMUM RELEASE ALTITUDE
DEG	KNOTS	FEET	SECONDS	FEET	FEET	SECONDS	FEET
0	300	—	1.65	80	—	1.70	80
	350	—	1.73	90	—	1.76	90
	400	—	1.84	100	—	1.87	100
5	300	70	1.78	330	70	1.82	340
	350	80	1.94	390	90	1.97	400
	400	100	2.08	440	100	2.13	460
10	300	160	1.82	580	160	1.83	590
	350	200	1.95	670	200	1.98	690
	400	240	2.05	740	240	2.09	770
15	300	280	1.76	780	280	1.80	810
	350	340	1.83	860	340	1.89	910
	400	410	1.88	930	410	1.95	990
20	300	410	1.67	920	410	1.72	970
	350	510	1.73	1020	510	1.78	1070
	400	620	1.81	1130	620	1.86	1190

■ Refer to Figure 6-1 (Sheet 4).

■ *Figure 6-6. SAFE ESCAPE, 2.75 FFAR (MK-151, MK-40), TRN (LT) (Sheet 17 of 18)*

2.75 IN. WAFAR W/MK-151 WARHEAD AND MK-66 MOTOR DIVE RELEASE 4.0G Turning Maneuver (Level Turn)							
RELEASE		SAFE ESCAPE					
DIVE ANGLE	TAS	TDA - SEA LEVEL			TDA - 5000 FEET		
		ALT LOSS DURING PULLOUT	TIME OF FALL	MINIMUM RELEASE ALTITUDE	ALT LOSS DURING PULLOUT	TIME OF FALL	MINIMUM RELEASE ALTITUDE
DEG	KNOTS	FEET	SECONDS	FEET	FEET	SECONDS	FEET
0	300	—	1.36	60	—	1.41	60
	350	—	1.47	70	—	1.50	70
	400	—	1.51	70	—	1.54	70
5	300	70	1.51	320	70	1.55	330
	350	80	1.60	360	80	1.66	380
	400	100	1.71	400	100	1.77	420
10	300	160	1.49	560	160	1.55	590
	350	200	1.58	630	200	1.63	660
	400	240	1.70	710	240	1.76	750
15	300	280	1.41	740	280	1.47	7890
	350	340	1.50	840	340	1.57	900
	400	410	1.58	930	410	1.65	990
20	300	410	1.36	910	410	1.41	960
	350	510	1.42	1010	510	1.47	1070
	400	620	1.51	1130	620	1.55	1190

■ Refer to Figure 6-1 (Sheet 4).

Figure 6-6. SAFE ESCAPE, 2.75 WAFAR (MK-151, MK-66), TRN (LT) (Sheet 18 of 18)

A-10 LEVEL RELEASE TABLES FOR LUU-1/B, 5/B, 6/B SUU-25C/A, E/A DISPENSERS						
RELEASE TRUE AIRSPEED (KTS)	EJECTION FUZE SETTING - SEC					
	5	10	15	20	25	30
	HORIZONTAL TRAVEL - FT					
200	1084	1742	2153	2418	2598	2735
250	1320	2077	2550	2858	3069	3233
300	1532	2367	2888	3231	3468	3655
350	1724	3623	3182	3553	3813	4020
400	1900	2851	3442	3837	4116	4340
EJECTION FUZE SETTING (SEC)	RELEASE TRUE AIRSPEED (KTS)	IGNITION FUZE SETTING - SEC				
		10	15	20	25	30
		VERTICAL DROP FROM RELEASE - FT				
5	200	712	890	1067	1245	1421
5	250	696	875	1052	1229	1406
5	300	684	862	1040	1217	1394
5	350	673	851	1029	1206	1383
5	400	664	842	1020	1197	1374
10	200	1575	1753	1931	2108	2284
10	250	1537	1715	1893	2070	2247
10	300	1505	1683	1861	2038	2215
10	350	1478	1656	1834	2011	2188
10	400	1455	1633	1811	1989	2165
15	200	2704	2882	3059	3236	3413
15	250	2647	2826	3003	3180	3357
15	300	2600	2778	2956	3133	3310
15	350	2560	2738	2916	3093	3270
15	400	2526	2704	2882	3060	3237
20	200	3969	4147	4324	4501	4678
20	250	3902	4080	4258	4435	4612
20	300	3846	4024	4202	4379	4556
20	350	3798	3977	4155	4332	4509
20	400	3758	3936	4114	4292	4469
25	200	5300	5478	5655	5832	6009
25	250	5229	5407	5584	5761	5938
25	300	5168	5346	5524	5701	5878
25	350	5116	5295	5473	5650	5827
25	400	5073	5251	5429	5607	5784
30	200	6679	6857	7034	7211	7388
30	250	6605	6783	6960	7138	7314
30	300	6541	6720	6898	7075	7252
30	350	6488	6666	6844	7022	7199
30	400	6442	6620	6798	6976	7153

NOTE: See sheet 2 for wind correction factor.

Figure 6-7. FLARE DELIVERY TABLES (Sheet 1 of 8)

WIND CORRECTION FACTORS FOR LUU-1/B, 5/B AND 6/B TARGET MAKER FLARE	
RANGE WIND ADJUSTMENT	
HORIZONTAL TRAVEL (ft)	(+)
$1.69 \times (Fe + Fi) \times Wr1 (\pm) \quad \underline{\hspace{2cm}}$ $1.69 \times \left(\frac{Ar - Vd}{15} \right) \times Wr2 (\pm) \quad \underline{\hspace{2cm}}$	
RANGE TRAVEL	
CROSS WIND ADJUSTMENT	
$1.69 \times (Fe + Fi) \times Wc1 (\pm) \quad \underline{\hspace{2cm}}$ $1.69 \times \left(\frac{Ar - Vd}{15} \right) \times Wc2 (\pm) \quad \underline{\hspace{2cm}}$	
CROSS RANGE ADJUSTMENT	
Where: Wr1-range wind from release to flare ignition (+tail/-head) (knots). Wr2-range wind in knots from flare ignition to impact (+tail/-head) (knots). Wc1-cross wind in knots from release to ignition (knots). Wc2-cross wind from ignition to impact. Fe-ejection fuze setting (sec). Fi-ignition fuze setting (sec). Ar-release altitude (ft). Vd-vertical drop (ft).	

Figure 6-7. FLARE DELIVERY TABLES (Sheet 2 of 8)

LEVEL RELEASE FOR LUU-2/B SUU-25 C/A, SUU-25 E/A DISPENSERS				
VERTICAL DROP PRIOR TO IGNITION ALTITUDE	RELEASE TRUE AIRSPEED	HORIZONTAL TRAVEL	TIME OF FALL	WIND CORRECTION FACTOR
FT	KTS	FT	SECS	FT/KT
500	200	1203	6.2	10.5
	250	1470	6.4	10.8
	300	1706	6.5	11.0
	350	1917	6.6	11.2
	400	2107	6.7	11.3
1500	200	1763	11.7	19.7
	250	2103	12.0	20.3
	300	2394	12.2	20.6
	350	2648	12.3	20.8
	400	2872	12.5	21.1
3000	200	2127	18.3	30.9
	250	2512	18.6	31.4
	300	2837	18.7	31.9
	350	3117	19.0	32.1
	400	3363	19.2	32.4
4000	200	2264	22.4	37.8
	250	2669	22.7	38.3
	300	3009	23.0	38.8
	350	3302	23.2	39.2
	400	3558	23.3	39.3

Figure 6-7. FLARE DELIVERY TABLES (Sheet 3 of 8)

LEVEL RELEASE FOR LUU-2/B SUU-25 C/A, SUU-25 E/A DISPENSERS				
VERTICAL DROP PRIOR TO IGNITION ALTITUDE	RELEASE TRUE AIRSPEED	HORIZONTAL TRAVEL	TIME OF FALL	WIND CORRECTION FACTOR
FT	KTS	FT	SECS	FT/KT
5000	200	2365	26.4	44.6
	250	2786	26.7	45.1
	300	3139	27.0	45.6
	350	3443	27.2	45.9
	400	3708	27.3	46.1
6500	200	2482	32.2	54.3
	250	2924	32.5	54.9
	300	3294	32.8	55.4
	350	3613	33.0	55.7
	400	3891	33.2	56.0
7500	200	2547	36.0	60.8
	250	3003	36.3	61.3
	300	3385	36.6	61.8
	350	3713	36.8	62.1
	400	3999	37.0	62.4
8500	200	2609	39.7	67.0
	250	3077	40.1	67.7
	300	3470	40.3	68.0
	350	3808	40.6	68.5
	400	4103	40.7	68.7

Figure 6-7. FLARE DELIVERY TABLES (Sheet 4 of 8)

LEVEL RELEASE FOR LUU-2A/B SUU-25 C/A, SUU-25 E/A DISPENSERS				
VERTICAL DROP PRIOR TO IGNITION ALTITUDE	RELEASE TRUE AIRSPEED	HORIZONTAL TRAVEL	TIME OF FALL	WIND CORRECTION FACTOR
FT	KTS	FT	SECS	FT/KT
500	200	1203	6.2	10.5
	250	1470	6.4	10.8
	300	1706	6.5	11.0
	350	1917	6.6	11.2
	400	2107	6.7	11.3
1000	200	1547	9.19	15.5
	250	1860	9.42	15.9
	300	2131	9.59	16.2
	350	2369	9.73	16.4
	400	2581	9.85	16.6
2000	200	1917	14.0	23.6
	250	2276	14.3	24.1
	300	2581	14.5	24.5
	350	2845	14.7	24.8
	400	3078	14.8	25.0
3000	200	2127	18.3	30.9
	250	2512	18.6	31.4
	300	2837	18.9	31.9
	350	3117	19.0	32.1
	400	3363	19.2	32.4
4000	200	2264	22.4	37.8
	250	2669	22.7	38.3
	300	3009	23.0	38.8
	350	3302	23.2	39.2
	400	3558	23.3	39.3
5000	200	2365	26.4	44.6
	250	2786	26.7	45.1
	300	3139	27.0	45.6
	350	3443	27.2	45.9
	400	3708	27.3	46.1

Figure 6-7. FLARE DELIVERY TABLES (Sheet 5 of 8)

LEVEL RELEASE FOR LUU-2A/B SUU-25 C/A, SUU-25 E/A DISPENSERS				
VERTICAL DROP PRIOR TO IGNITION ALTITUDE	RELEASE TRUE AIRSPEED	HORIZONTAL TRAVEL	TIME OF FALL	WIND CORRECTION FACTOR
FT	KTS	FT	SECS	FT/KT
6000	200	2446	30.3	51.1
	250	2881	30.6	51.6
	300	3246	30.9	52.2
	350	3559	31.1	52.5
	400	3833	31.2	52.7
7000	200	2515	34.1	57.6
	250	2964	34.4	58.1
	300	3340	34.7	58.6
	350	3663	34.9	58.9
	400	3946	35.1	59.2
8000	200	2578	37.9	64.0
	250	3040	38.2	64.5
	300	3428	38.5	65.0
	350	3761	38.7	65.3
	400	4052	38.9	65.7
9000	200	2638	41.6	70.2
	250	3113	41.9	70.7
	300	3512	42.2	71.2
	350	3855	42.4	71.6
	400	4154	42.6	71.9
10000	200	2697	45.2	76.3
	250	3184	45.6	77.0
	300	3595	45.9	77.5
	350	3948	46.1	77.8
	400	4256	46.3	78.1
11000	200	2754	48.8	82.4
	250	3256	49.2	83.0
	300	3678	49.5	83.5
	350	4041	49.7	83.9
	400	4359	49.9	84.2

Figure 6-7. FLARE DELIVERY TABLES (Sheet 6 of 8)

LEVEL RELEASE FOR LUU-2B/B SUU-25 C/A DISPENSERS				
VERTICAL DROP PRIOR TO IGNITION ALTITUDE	RELEASE TRUE AIRSPEED	HORIZONTAL TRAVEL	TIME OF FALL	WIND CORRECTION FACTOR
FT	KTS	FT	SECS	FT/KT
250	200	909	4.18	7.1
	250	1131	4.31	7.3
	300	1331	4.41	7.4
	350	1512	4.48	7.6
	400	1678	4.54	7.7
500	200	1203	6.20	10.5
	250	1470	6.40	10.8
	300	1706	6.50	11.0
	350	1917	6.60	11.2
	400	2107	6.70	11.3
1000	200	1547	9.19	15.5
	250	1860	9.42	15.9
	300	2131	9.59	16.2
	350	2369	9.73	16.4
	400	2581	9.85	16.6
1500	200	1763	11.70	19.7
	250	2103	12.00	20.3
	300	2394	12.20	20.6
	350	2648	12.30	20.8
	400	2872	12.50	21.1
2000	200	1917	14.00	23.6
	250	2276	14.30	24.1
	300	2581	14.50	24.5
	350	2845	14.70	24.8
	400	3078	14.80	25.0
3000	200	2127	18.30	30.9
	250	2512	18.60	31.4
	300	2837	18.90	31.9
	350	3117	19.00	32.1
	400	3363	19.20	32.4
4000	200	2264	22.40	37.8
	250	2669	22.70	38.3
	300	3009	23.00	38.8
	350	3302	23.20	39.2
	400	3558	23.30	39.3

Figure 6-7. FLARE DELIVERY TABLES (Sheet 7 of 8)

LEVEL RELEASE FOR LUU-2B/B SUU-25 C/A DISPENSERS				
VERTICAL DROP PRIOR TO IGNITION ALTITUDE	RELEASE TRUE AIRSPEED	HORIZONTAL TRAVEL	TIME OF FALL	WIND CORRECTION FACTOR
FT	KTS	FT	SECS	FT/KT
5000	200	2365	26.40	44.6
	250	2786	26.70	45.1
	300	3139	27.00	45.6
	350	3443	27.20	45.9
	400	3708	27.30	46.1
6000	200	2446	30.30	51.1
	250	2881	30.60	51.6
	300	3246	30.90	52.2
	350	3559	31.10	52.5
	400	3833	31.20	52.7
7000	200	2515	34.10	57.6
	250	2964	34.40	58.1
	300	3340	34.70	58.6
	350	3663	34.90	58.9
	400	3946	35.10	59.2
8000	200	2578	37.90	64.0
	250	3040	38.20	64.5
	300	3428	38.50	65.0
	350	3761	38.70	65.3
	400	4052	38.90	65.7
9000	200	2638	41.60	70.2
	250	3113	41.90	70.7
	300	3512	42.20	71.2
	350	3855	42.40	71.6
	400	4154	42.60	71.9
10000	200	2697	45.20	76.3
	250	3184	45.60	77.0
	300	3595	45.90	77.5
	350	3984	46.10	77.8
	400	4256	46.30	78.1
11000	200	2754	48.80	82.4
	250	3256	49.20	83.0
	300	3678	49.50	83.5
	350	4041	49.70	83.9
	400	4359	49.90	84.2

Figure 6-7. FLARE DELIVERY TABLES (Sheet 8 of 8)

SECTION VII

NON-NUCLEAR WEAPONS DELIVERY INFORMATION

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WEAPON DESCRIPTION

GBU-10 SERIES GENERAL PURPOSE GUIDED LASER BOMB PLANNING DATA

The GBU-10 Series is a MK-84 GP bomb fitted with a laser bomb guidance kit. Weapon release capabilities are shown in figures 7-1 thru 7-6. The release envelopes show optimum release conditions and indicate the degree of flexibility in release requirements. The envelopes define release requirements. The envelopes define release parameters that enable weapon guidance to within 30 feet of the target.

The GBU-10 Series GPGLB is available with KMU-351B/B, and KMU-35C/B. The kits are similar and are delivered in a low speed configuration; then adapted to a high speed configuration by breaking off the outer fin panels. The ballistic tables and release envelopes are for the low speed configuration.

BALLISTIC TABLES

Level and dive ballistic tables for 1CMU-35B/B, C/B are presented in Figure 7-12 and described in Figure 7-7. Dive-toss tables are also presented including the required CB values. The title block on each page of the ballistic tables identifies the data basis. Each table consists of paired sheets: (Sheet 1, 2 of 6), (Sheet 3, 4 of 6) and (Sheet 5, 6 of 6). Planned release conditions are listed for each page.

The Fin Damper Constant stated in the title specifies the average proportionality constant of the oil damper used to damp the canard flutter in captive flight. The value use for these ballistic tables is 10 foot-pounds per radian per second. This value can vary among bombs and with the oil temperature at release from 6.0 to 11.0.

The ballistic tables are based on 12,000 feet maximum possible slant range where the reflected laser energy is of sufficient intensity to be usable as a guidance signal. The intensity of the reflected laser energy at 12,000 feet slant range is an average value based upon 8 nautical mile visibility, target reflectivity of 0.4, a 100-millijoule laser illuminator, and an illuminator-to-target slant range of 16,000 feet. Refer to Effect of Acquisition Slant Range and Figure 1-4. The ballistic tables assume no overcast. The weapon

and the illuminator must be below the overcast for weapon guidance and target illumination.

In Figure 7-12 (Sheets 1, 3, 5 of 6), the first three columns of the ballistic tables state speed, altitude, and dive angle for which the remaining data on that line are valid. Of course, these are the planned release conditions, and the effect on the release envelope parameters of releasing the weapon with unintentional delivery errors can be determined from the release envelopes which are described later.

The next four columns, collectively labeled Horizontal Range, give the down-range distance of four important envelope points (Figure 1-1). The MAX point corresponds to the maximum horizontal range from target at which the weapon can be released and still successfully guide to the target. Similarly, the MIN point is the minimum horizontal range at which the weapon can be released and still guide to the target. It will be shown that both these extremes result only when there is zero cross range (for azimuth) release error. These distances are not to be confused with the maximum down range and minimum downrange capabilities of the bomb itself. These could possibly be greater but are of little practical importance. For example, a bomb could travel farther than the maximum envelope point if it were released at a horizontal range greater than the maximum envelope point. However, the bomb would fall short of the target by virtue of the very definition of what is meant by the target envelope. In other words, there are some release points outside the envelope from which the bomb will attempt to guide but impact at unacceptable distances from the target due to limitations in weapon maneuverability.

The centroid range represents the horizontal distance from the center area of the envelope to the target. If no significant release biases exist, the centroid range would be the most advantageous position within the envelope to release. The ballistic range represents the horizontal travel of the bomb release to target if guidance were never initiated.

In the last two columns, sight depressions from flight path are given; one positions the aircraft at the envelope centroid, the other positions the aircraft at the ballistic horizontal range. (When using the Direct release mode, fuselage angle of attack must be added to the sight depression value.)

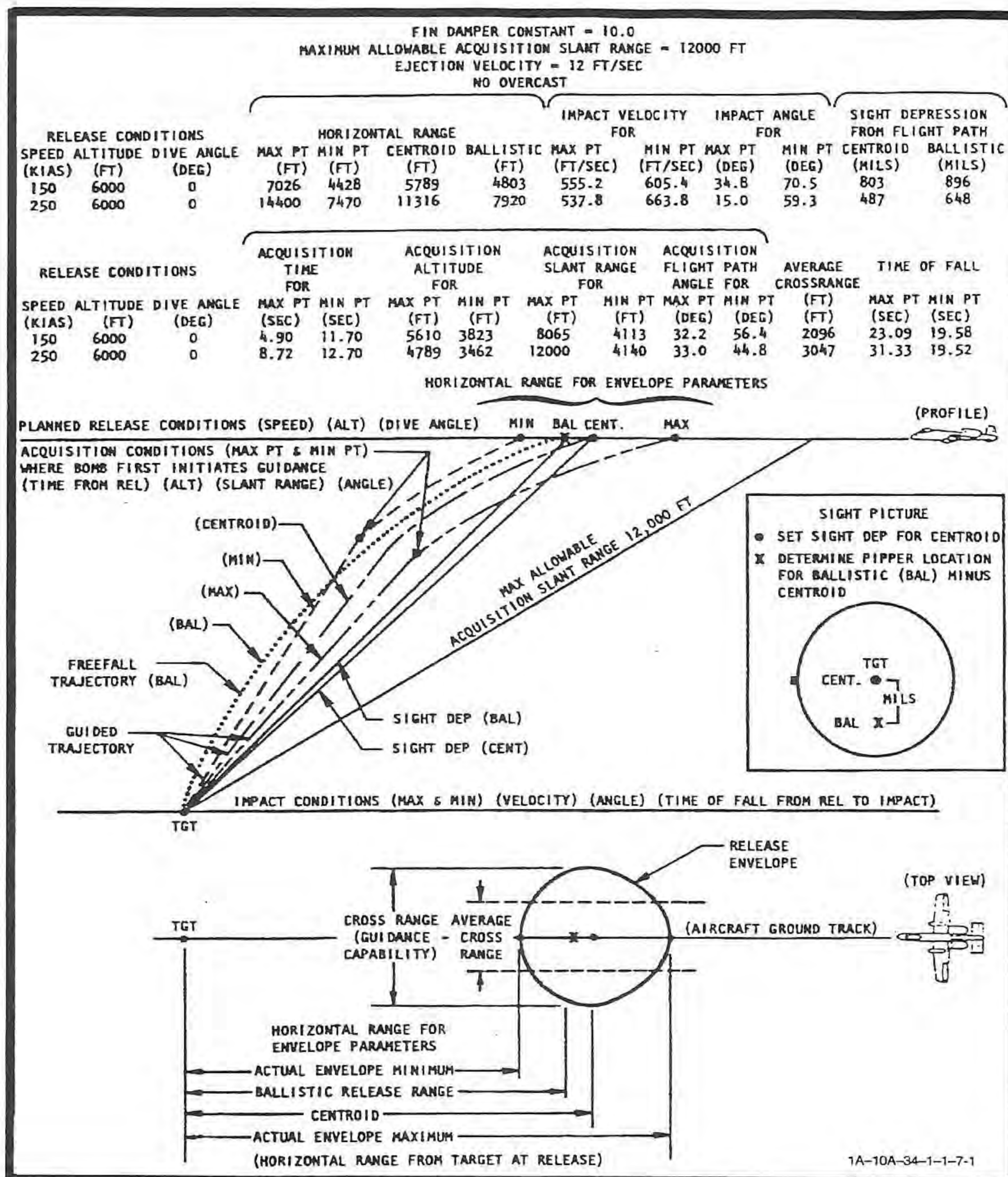
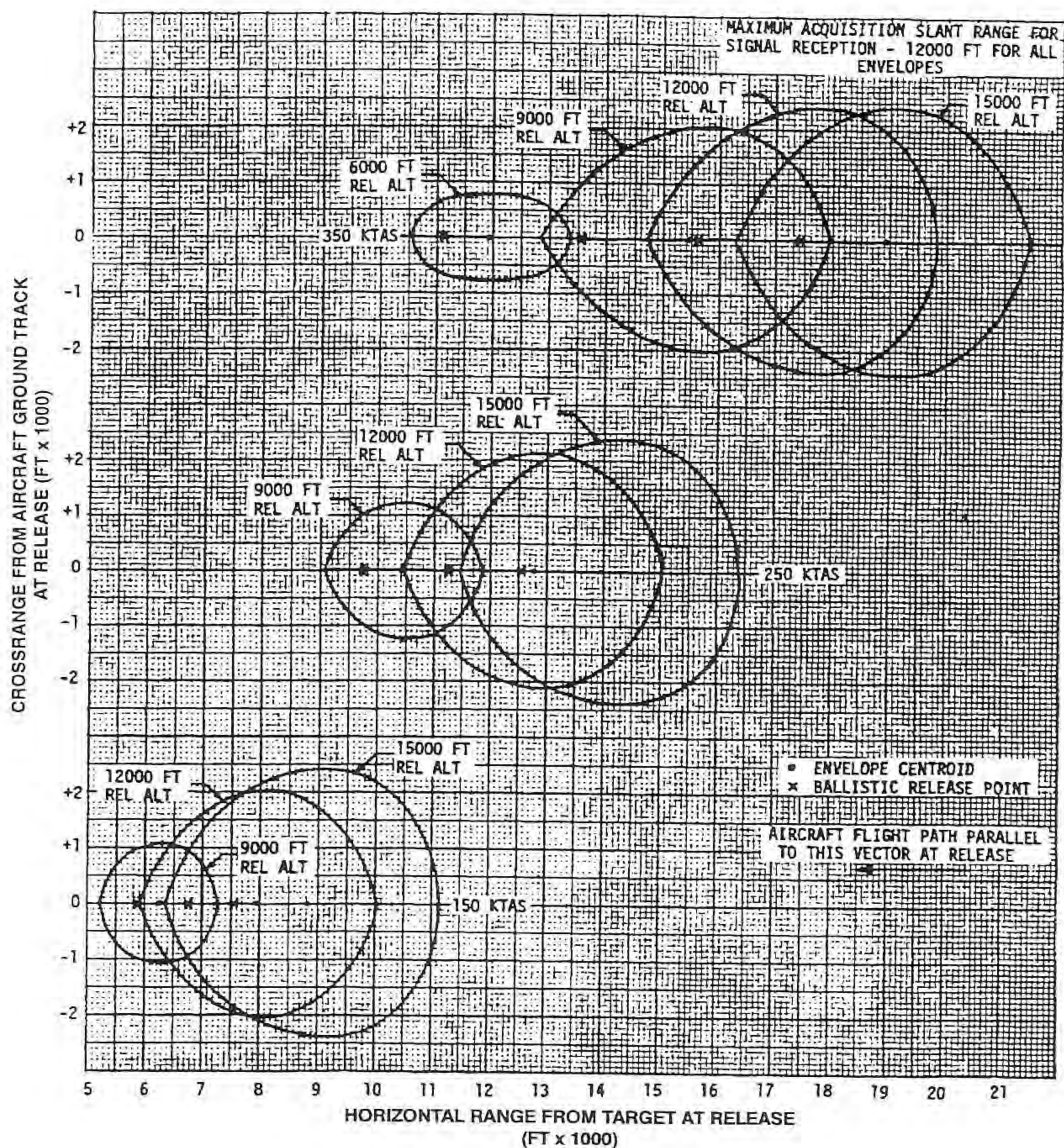


Figure 7-1. LASER GUIDED BOMB PLANNING

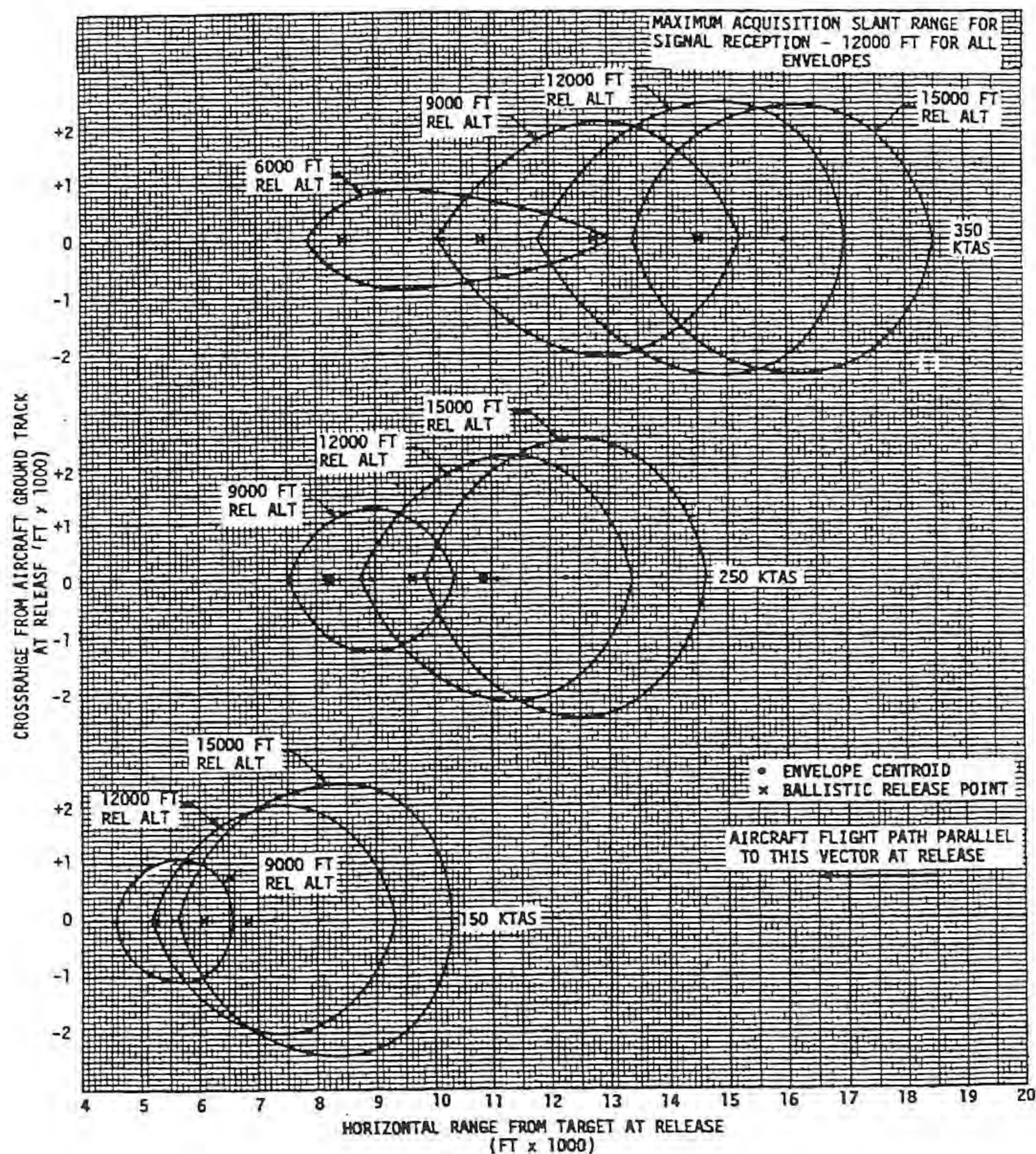
MK-84 (54 INCH TAIL FIN) LASER GUIDED BOMB
LEVEL RELEASE



1A-10A-34-1-1-7-2

Figure 7-2. GBU-10A/B, B/B RELEASE ENVELOPES - TOP VIEW (Sheet 1 of 9)

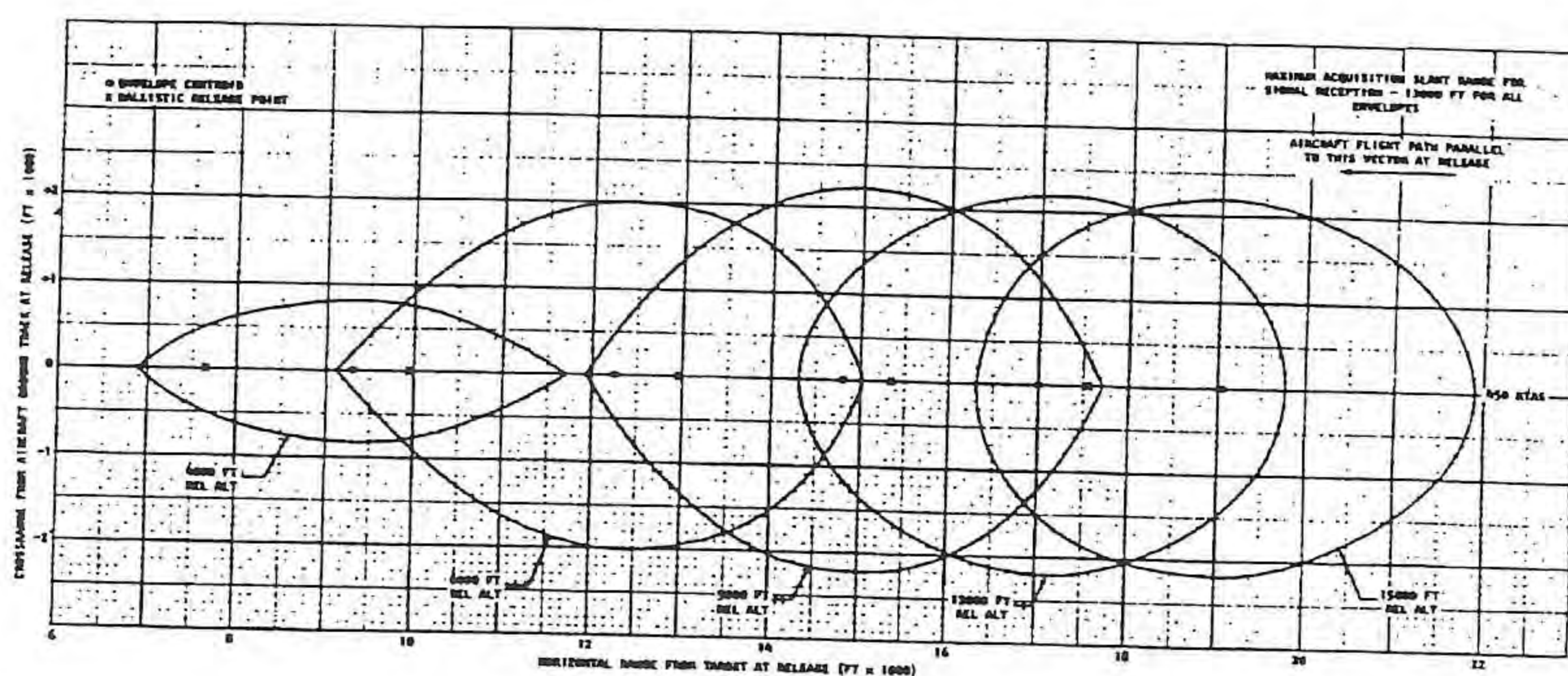
MK-84 (54 INCH TAIL FIN) LASER GUIDED BOMB
15° DIVE RELEASE



1A-10A-34-1-1-7-4

Figure 7-2. GBU-10A/B, B/B RELEASE ENVELOPES - TOP VIEW (Sheet 2 of 9)

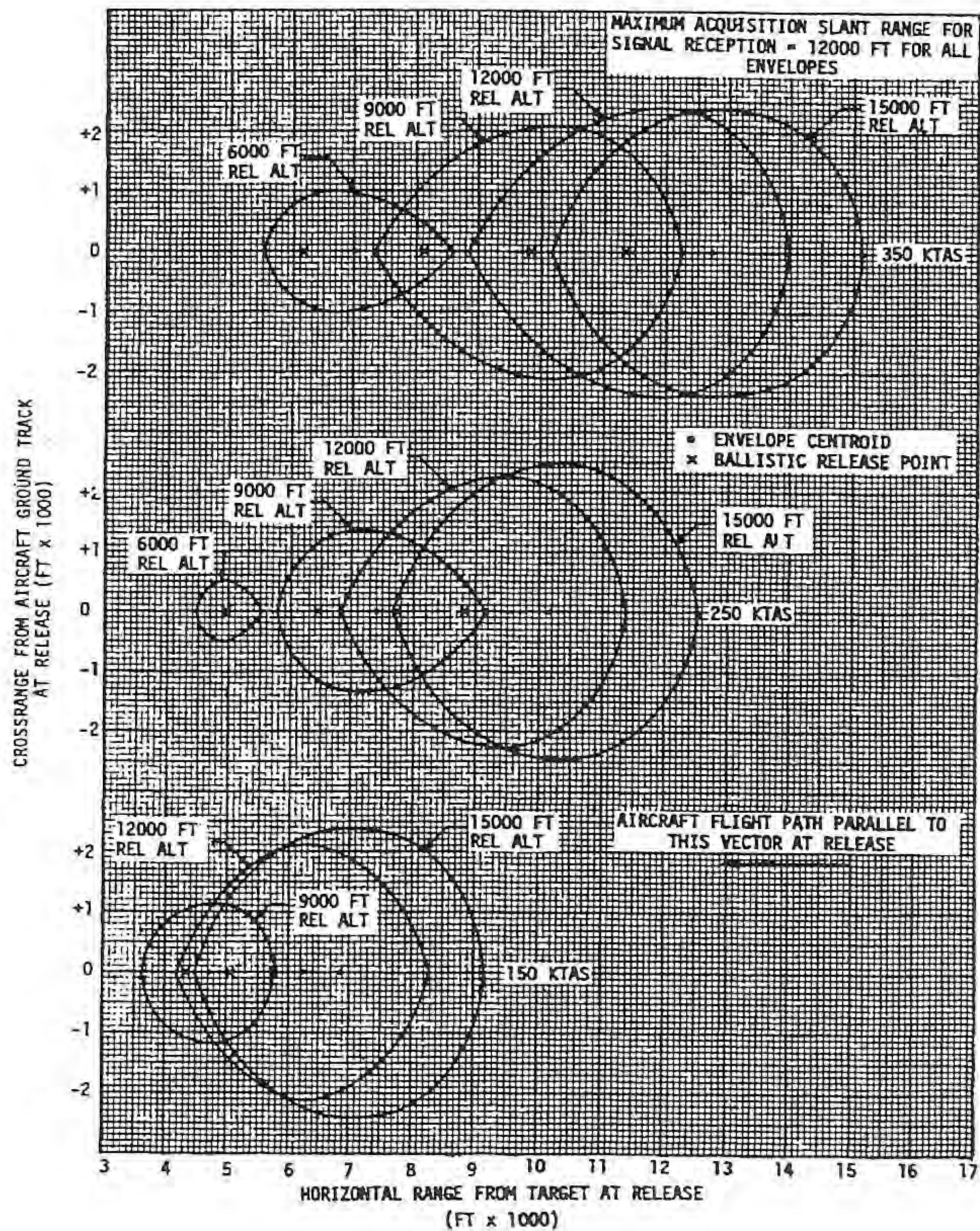
MK-84 (54 INCH TAIL FIN) LASER GUIDED BOMB
15° DIVE RELEASE



1A-10A-34-1-1-7-5

Figure 7-2. GBU-10A/B, B/B RELEASE ENVELOPES - TOP VIEW (Sheet 3 of 9)

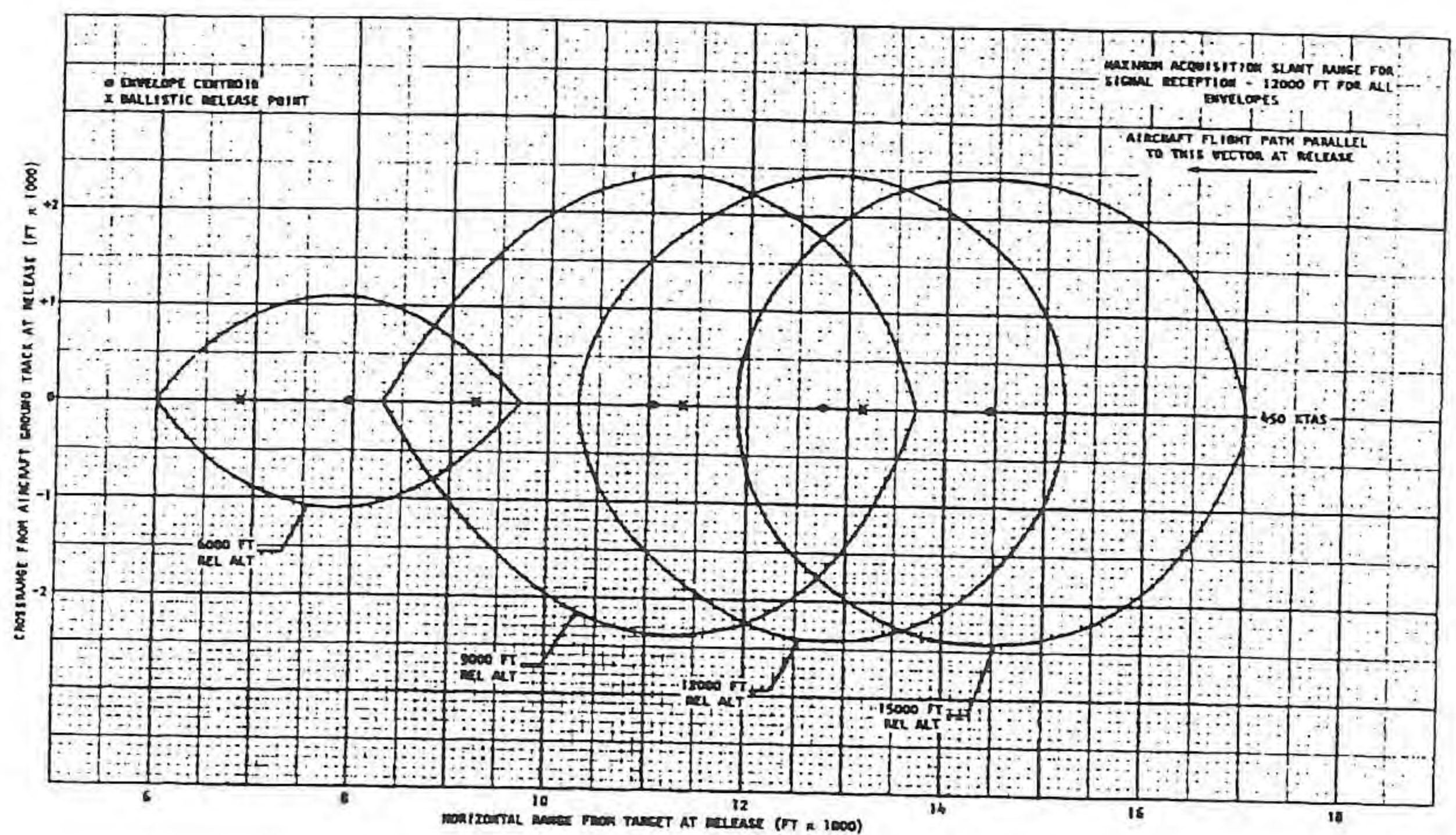
MK-84 (54 INCH TAIL FIN) LASER GUIDED BOMB
30° DIVE RELEASE



1A-10A-34-1-1-7-6

Figure 7-2. GBU-10A/B, B/B RELEASE ENVELOPES - TOP VIEW (Sheet 4 of 9)

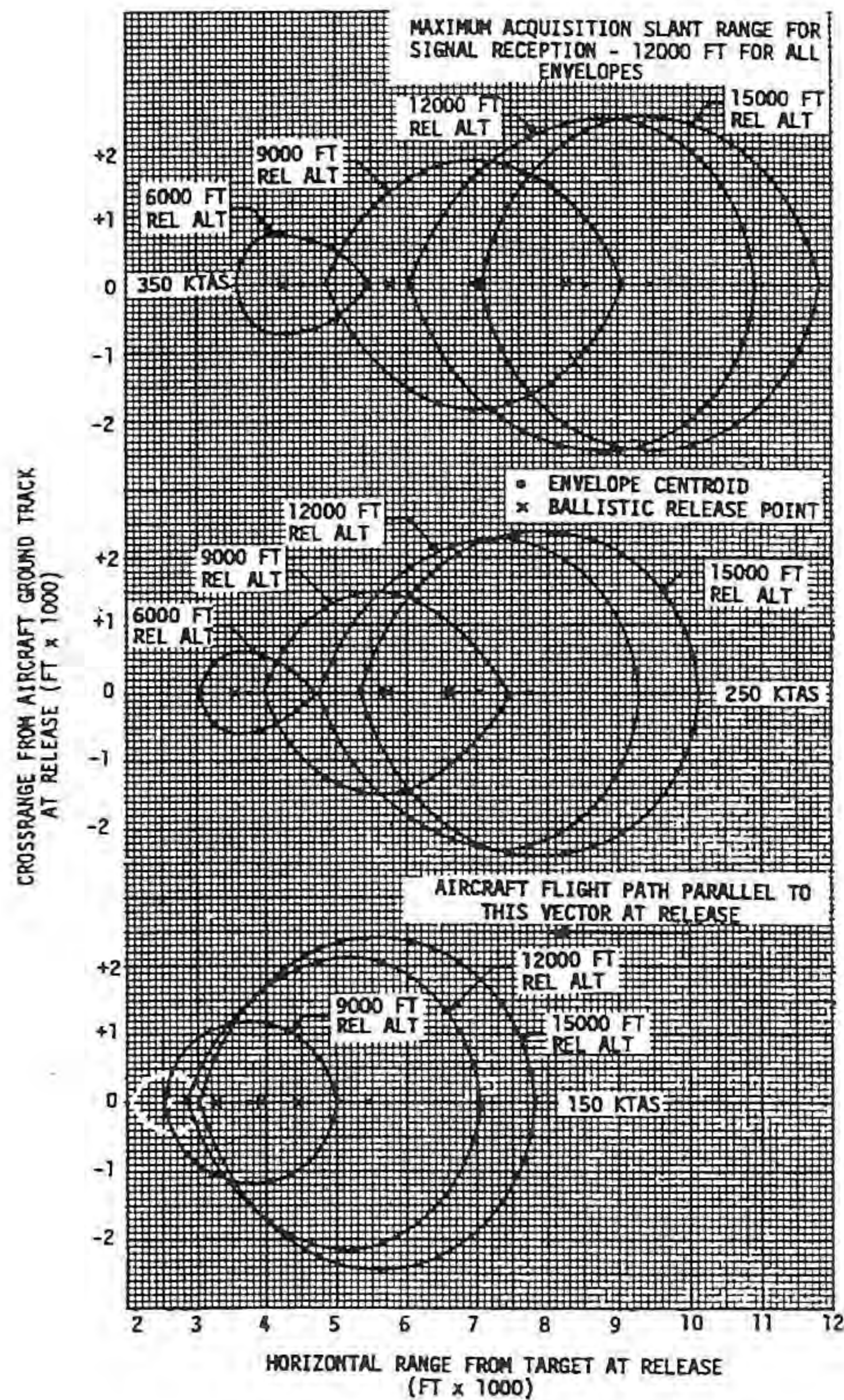
**MK-84 (54 INCH TAIL FIN) LASER GUIDED BOMB
30° DIVE RELEASE**



1A-10A-34-1-1-7-7

Figure 7-2. GBU-10A/B, B/B RELEASE ENVELOPES - TOP VIEW (Sheet 5 of 9)

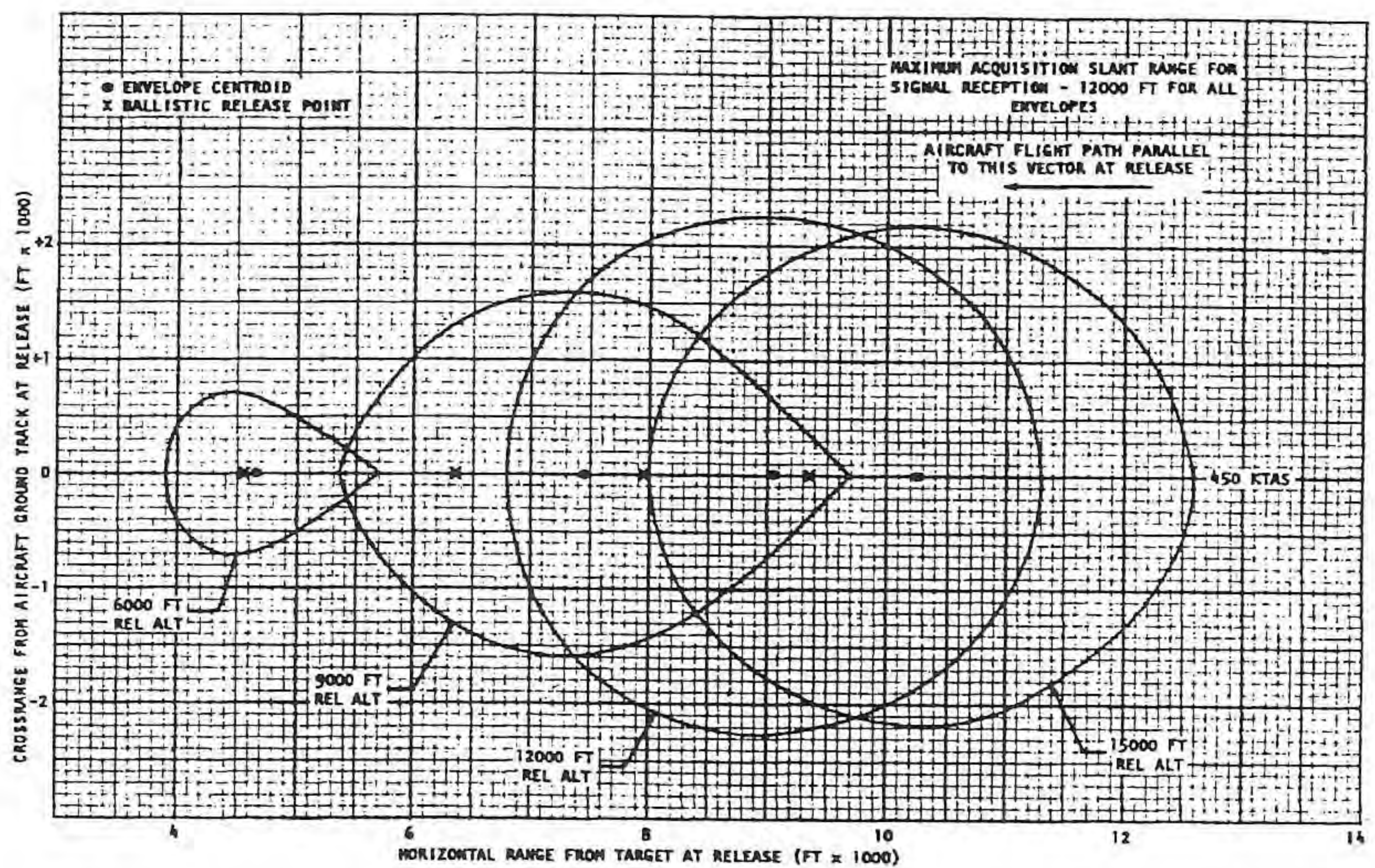
MK-84 (54 INCH TAIL FIN) LASER GUIDED BOMB
45° DIVE RELEASE



1A-10A-34-1-1-7-B

Figure 7-2. GBU-10A/B, B/B RELEASE ENVELOPES - TOP VIEW (Sheet 6 of 9)

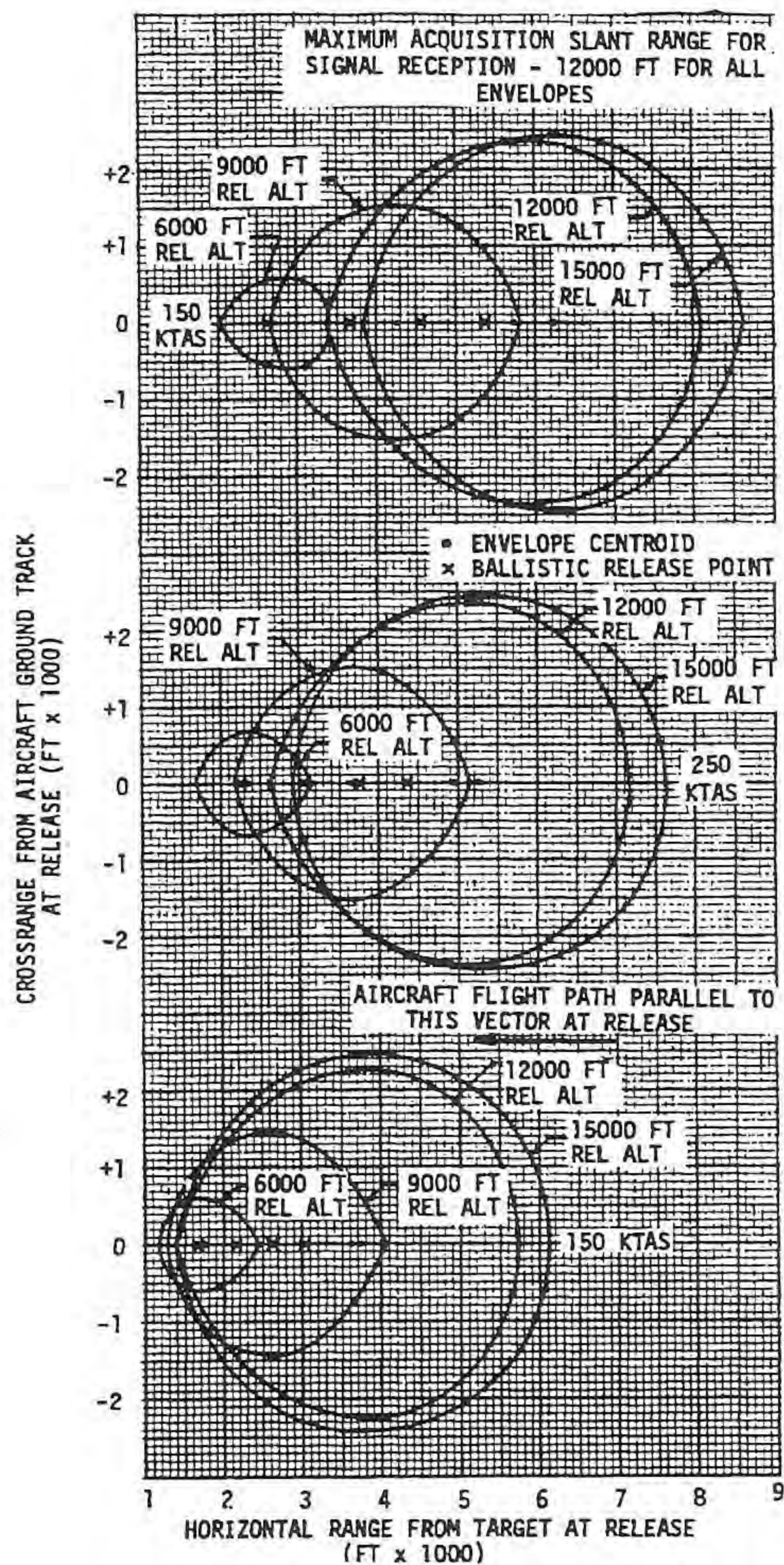
**MK-84 (54 INCH TAIL FIN) LASER GUIDED BOMB
45° DIVE RELEASE**



1A-10A-34-1-1-7-9

Figure 7-2. GBU-10A/B, B/B RELEASE ENVELOPES - TOP VIEW (Sheet 7 of 9)

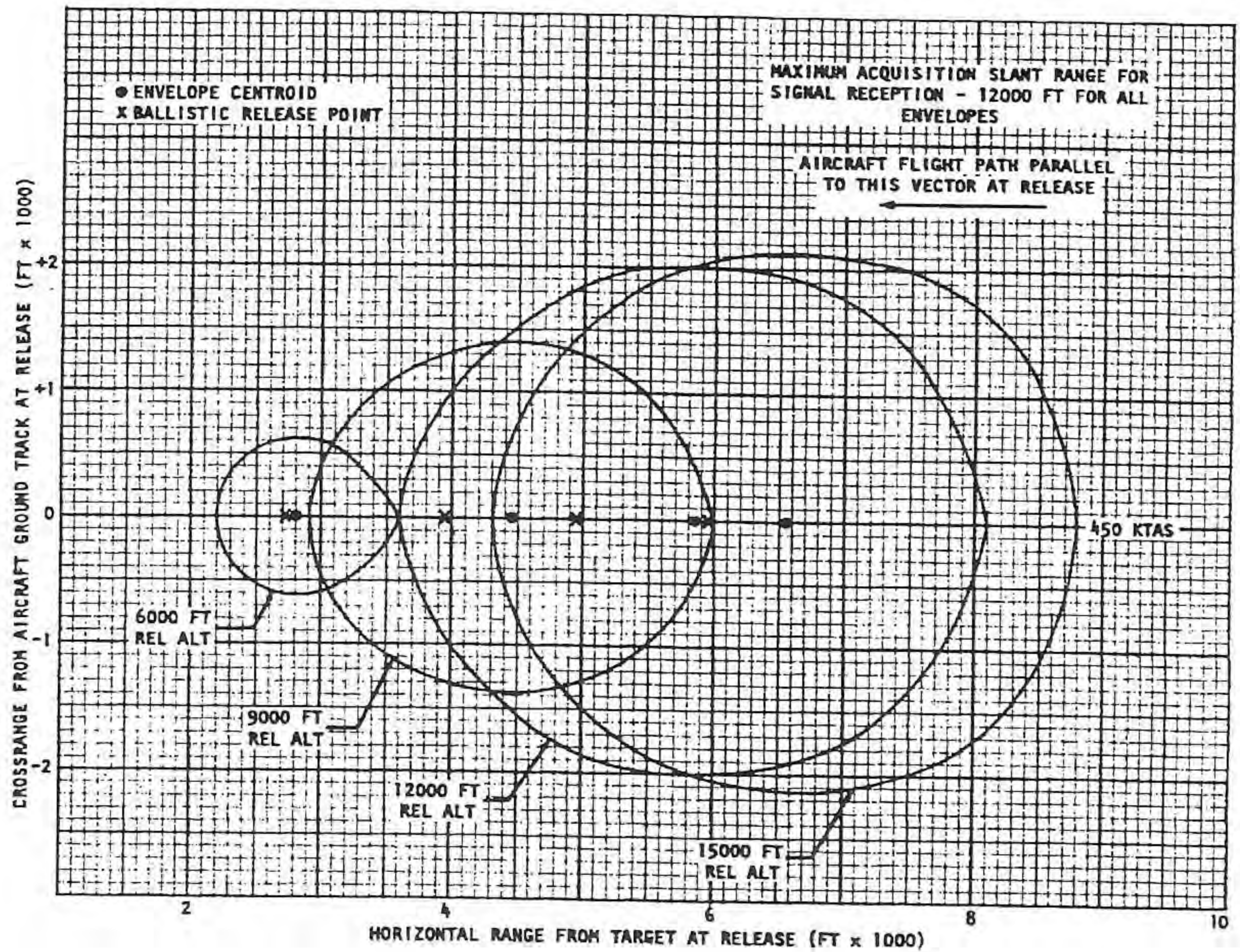
MK-84 (54 INCH TAIL FIN) LASER GUIDED BOMB
60° DIVE RELEASE



1A-10A-34-1-1-7-10

Figure 7-2. GBU-10A/B, B/B RELEASE ENVELOPES - TOP VIEW (Sheet 8 of 9)

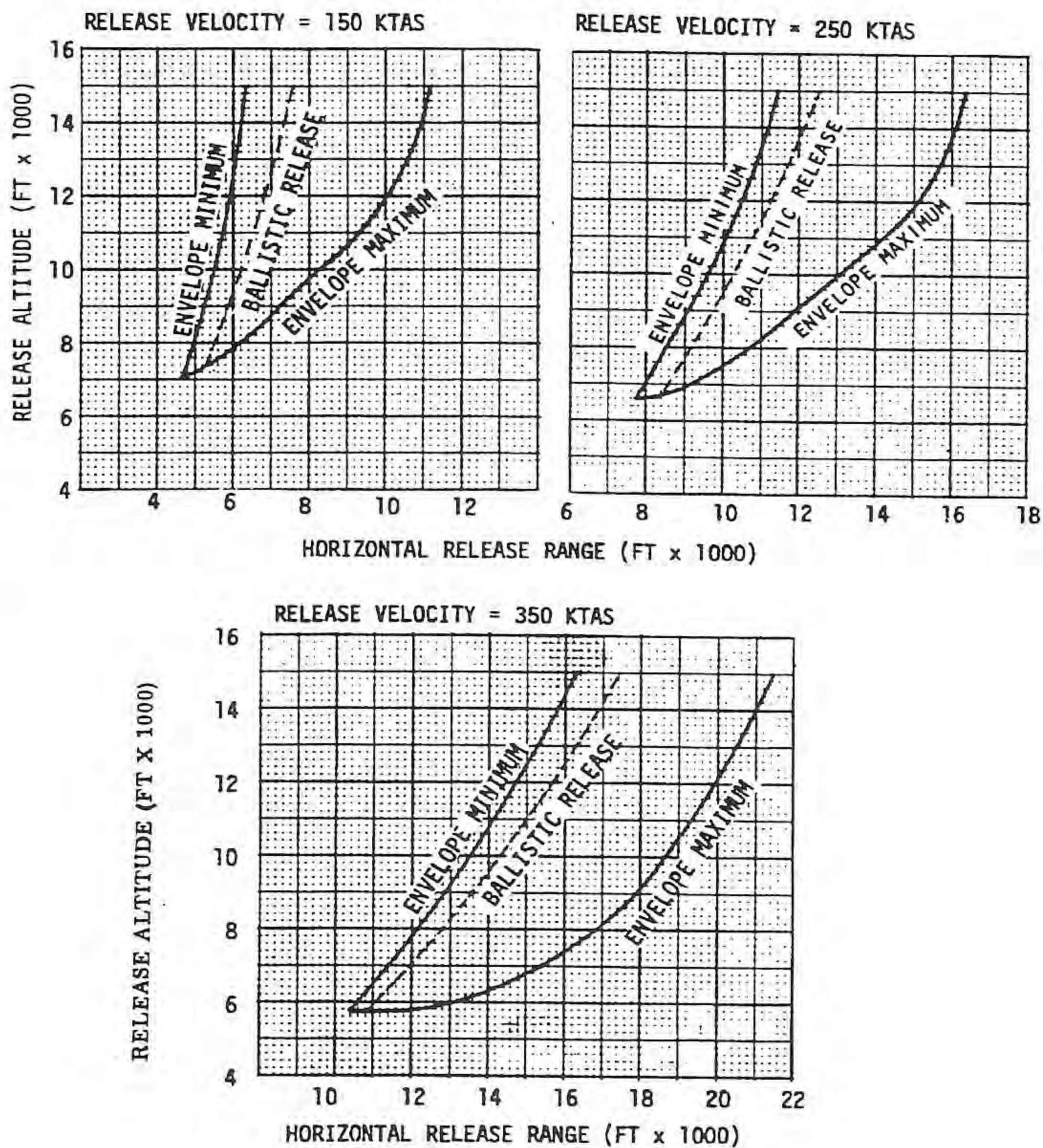
**MK-84 (54 INCH TAIL FIN) LASER GUIDED BOMB
60° DIVE RELEASE**



1A-10A-34-1-1-7-11

Figure 7-2. GBU-10A/B, B/B RELEASE ENVELOPES - TOP VIEW (Sheet 9 of 9)

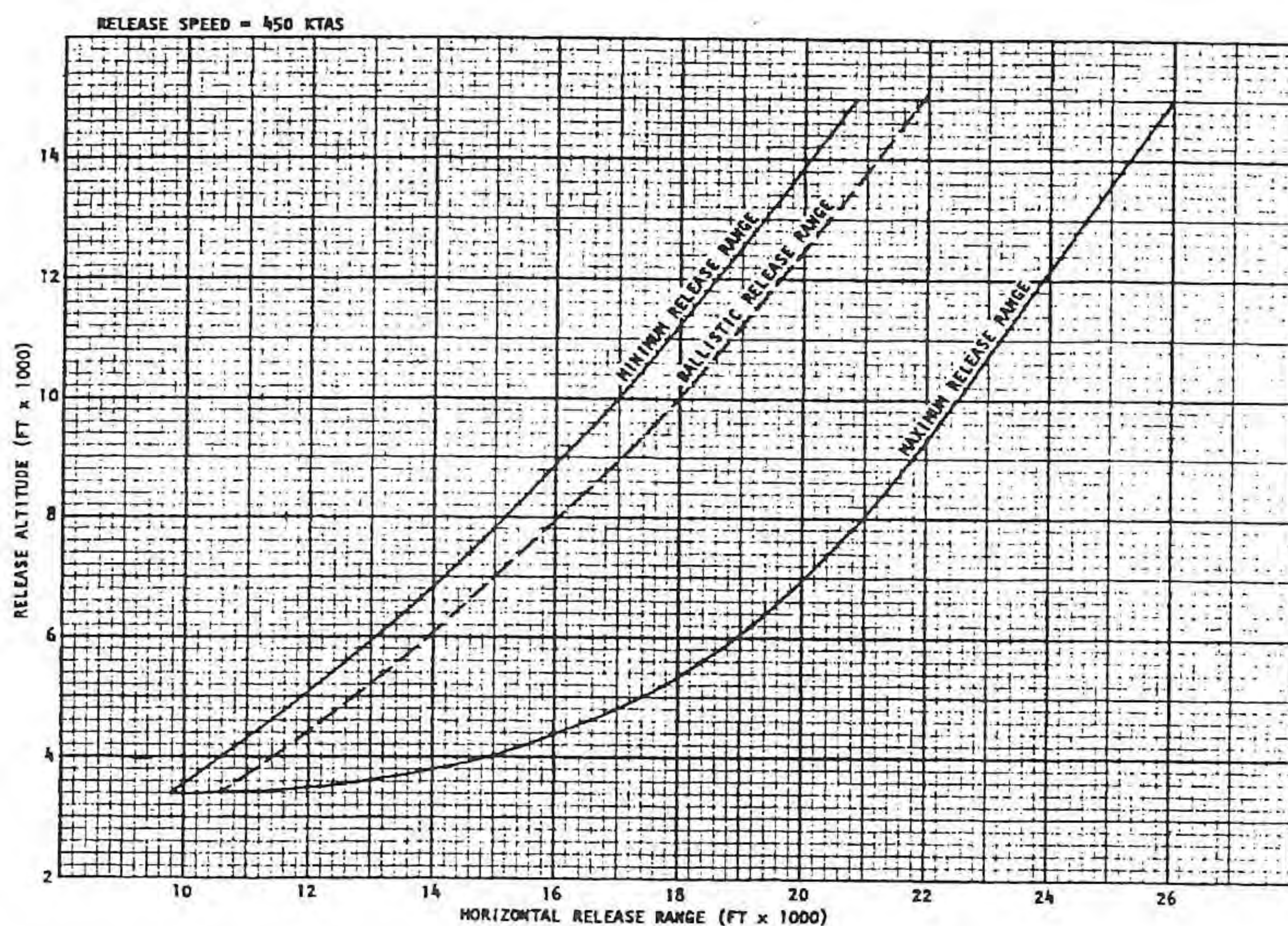
MK-84 (54 INCH TAIL FIN) LASER GUIDED BOMB
DIVE ANGLE = 0°



1A-10A-34-1-1-7-12

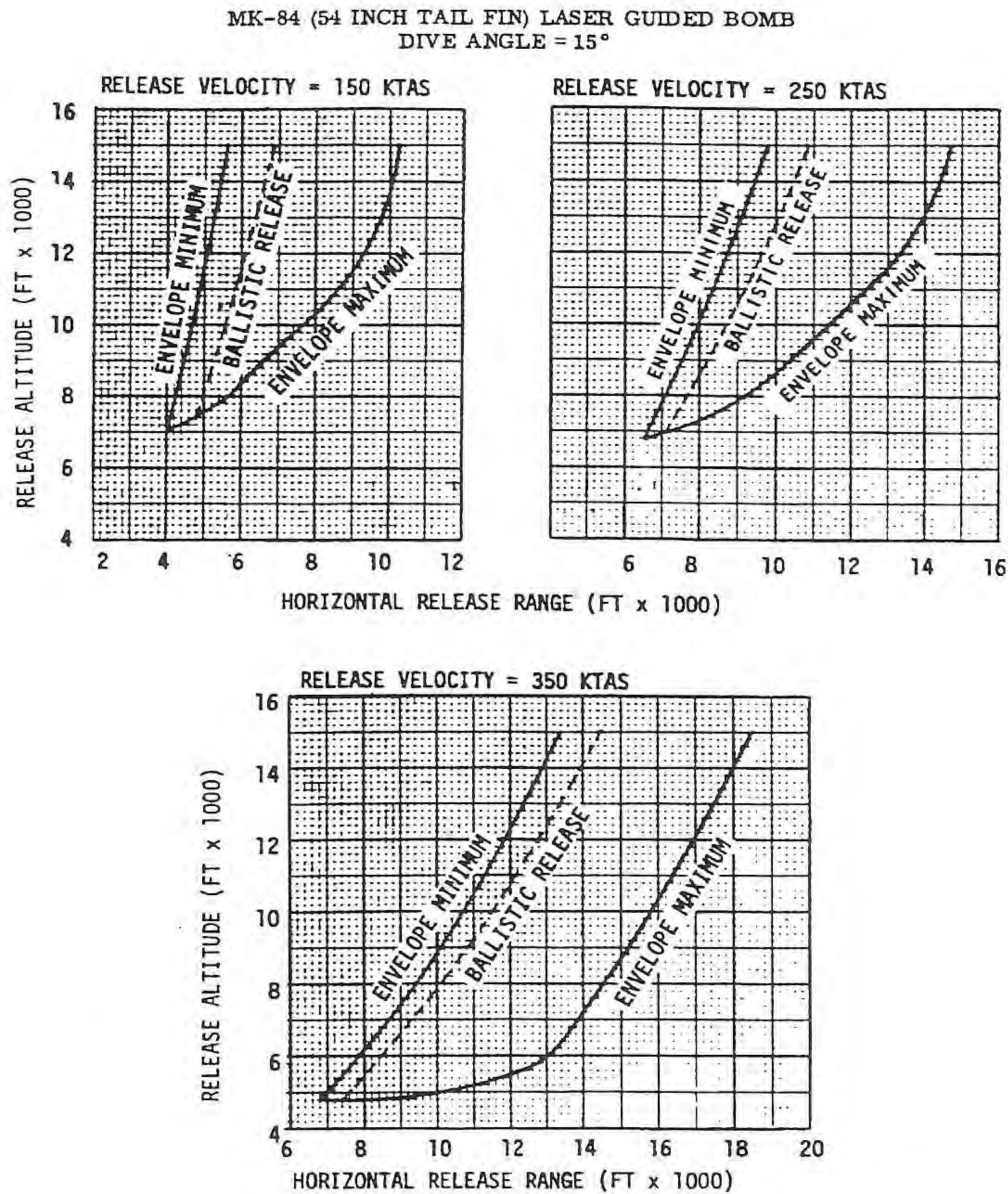
Figure 7-3. GBU-10A/B, B/B RELEASE ENVELOPES - PROFILE (Sheet 1 of 11)

MK-84 (54 INCH TAIL FIN) LASER GUIDED BOMB
DIVE ANGLE = 0°



1A-10A-34-1-1-7-13

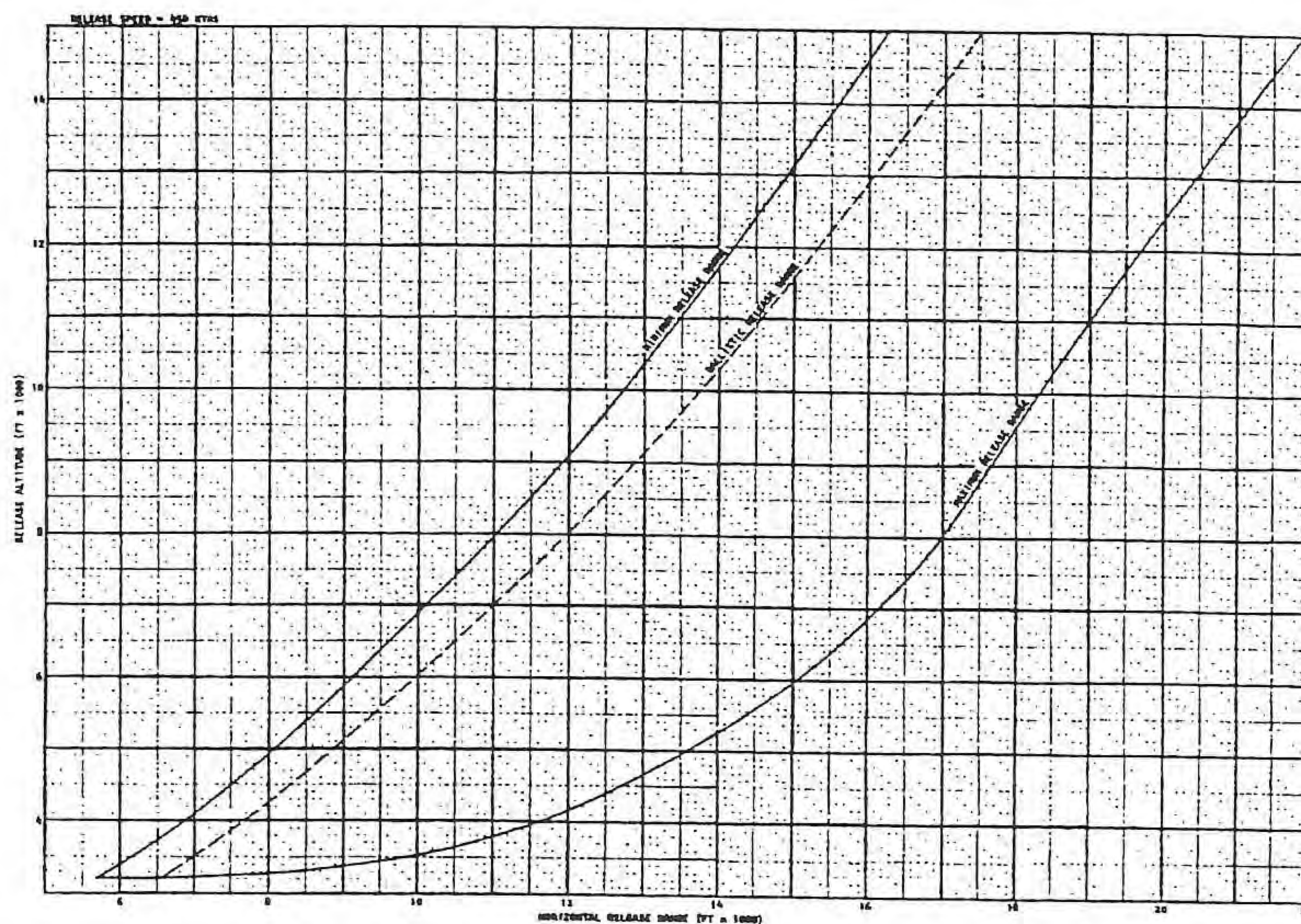
Figure 7-3. GBU-10A/B, B/B RELEASE ENVELOPES - PROFILE (Sheet 2 of 11)



1A-10A-34-1-1-7-14

Figure 7-3. GBU-10A/B, B/B RELEASE ENVELOPES - PROFILE (Sheet 3 of 11)

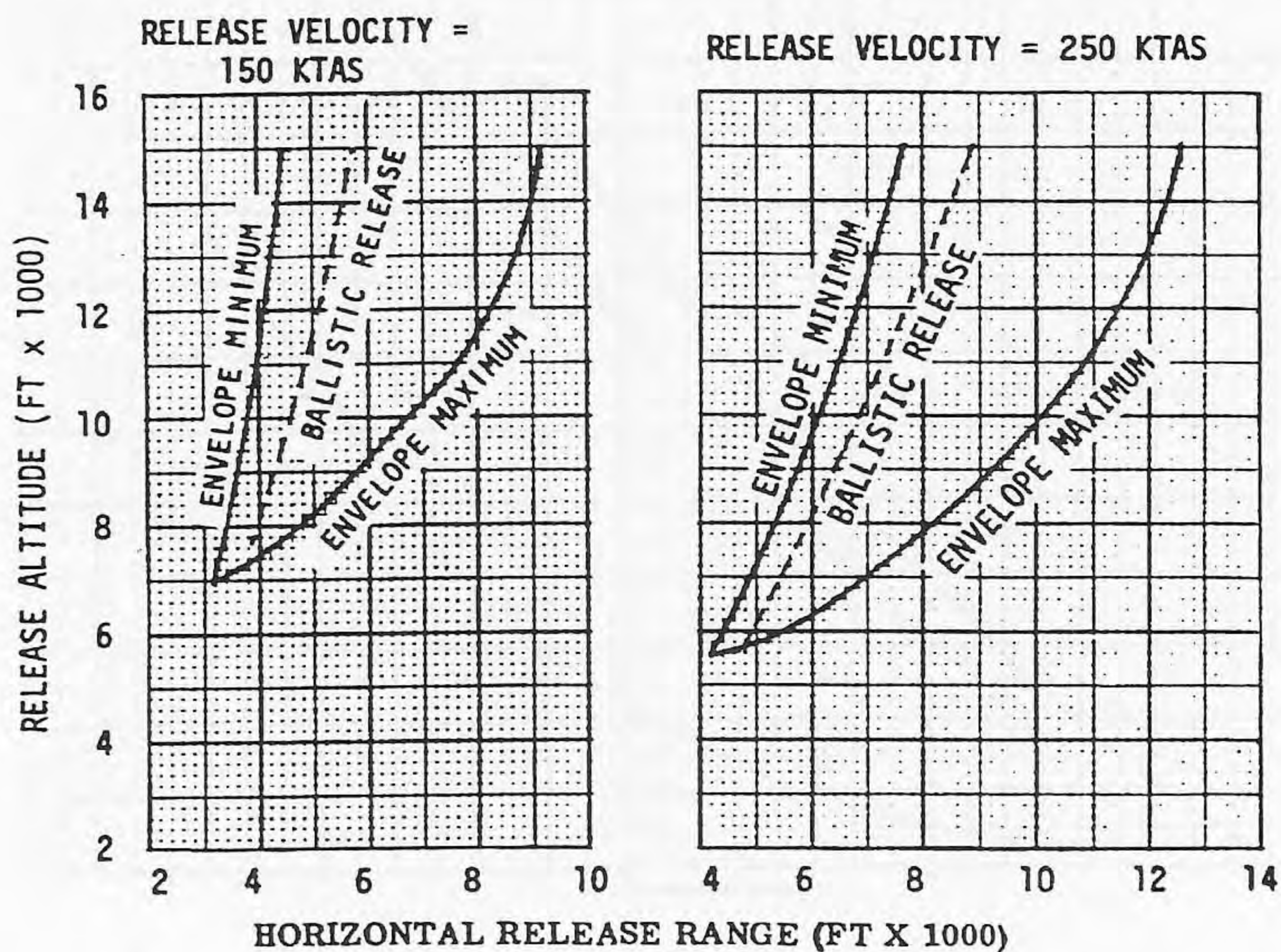
MK-84 (54 INCH TAIL FIN) LASER GUIDED BOMB
DIVE ANGLE = 15°



1A-10A-34-1-1-7-15

Figure 7-3. GBU-10A/B, B/B RELEASE ENVELOPES - PROFILE (Sheet 4 of 11)

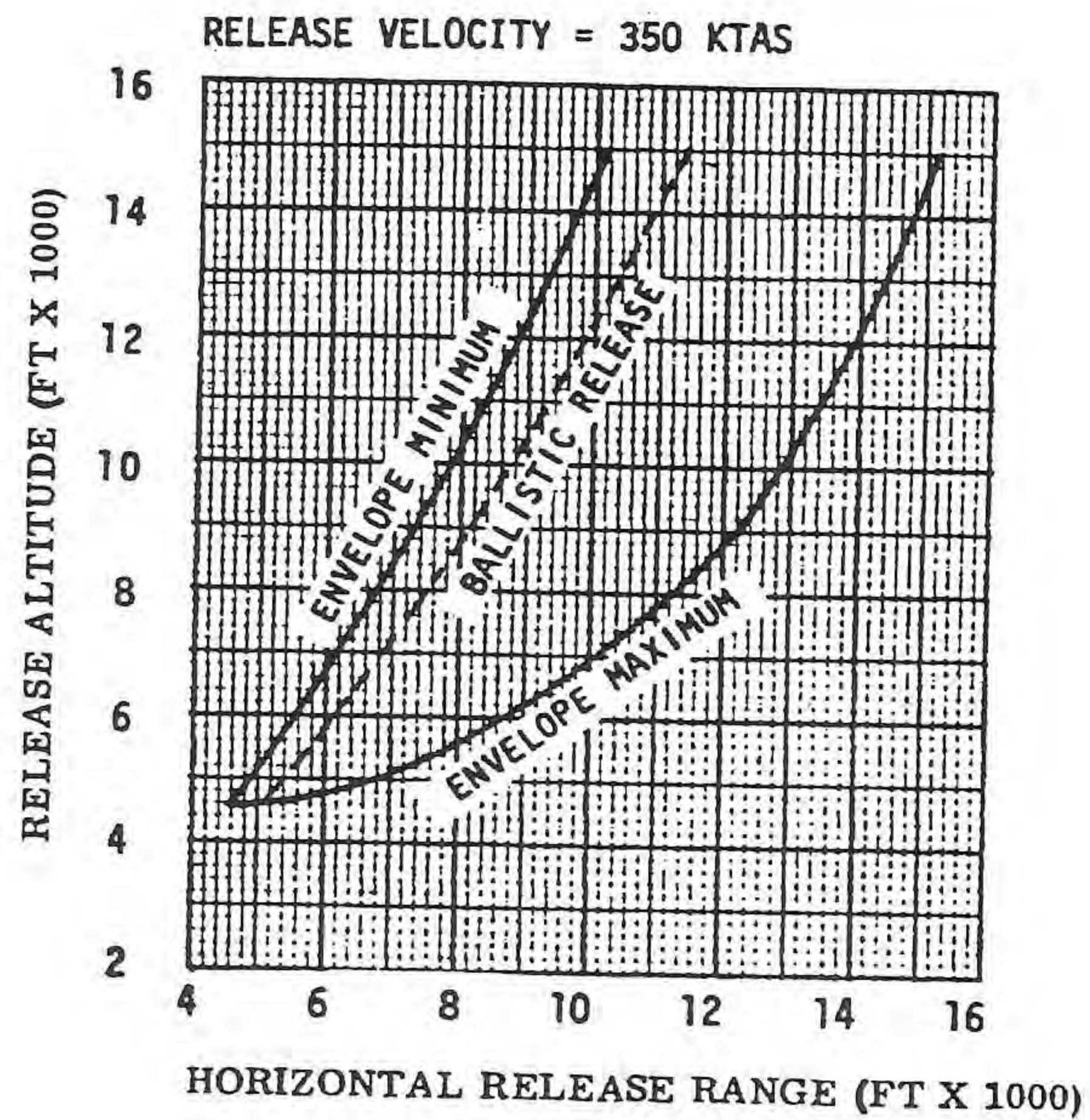
MK-84 (54 INCH TAIL FIN) LASER GUIDED BOMB
DIVE ANGLE = 30°



1A-10A-34-1-1-7-16

Figure 7-3. GBU-10A/B, B/B RELEASE ENVELOPES - PROFILE (Sheet 5 of 11)

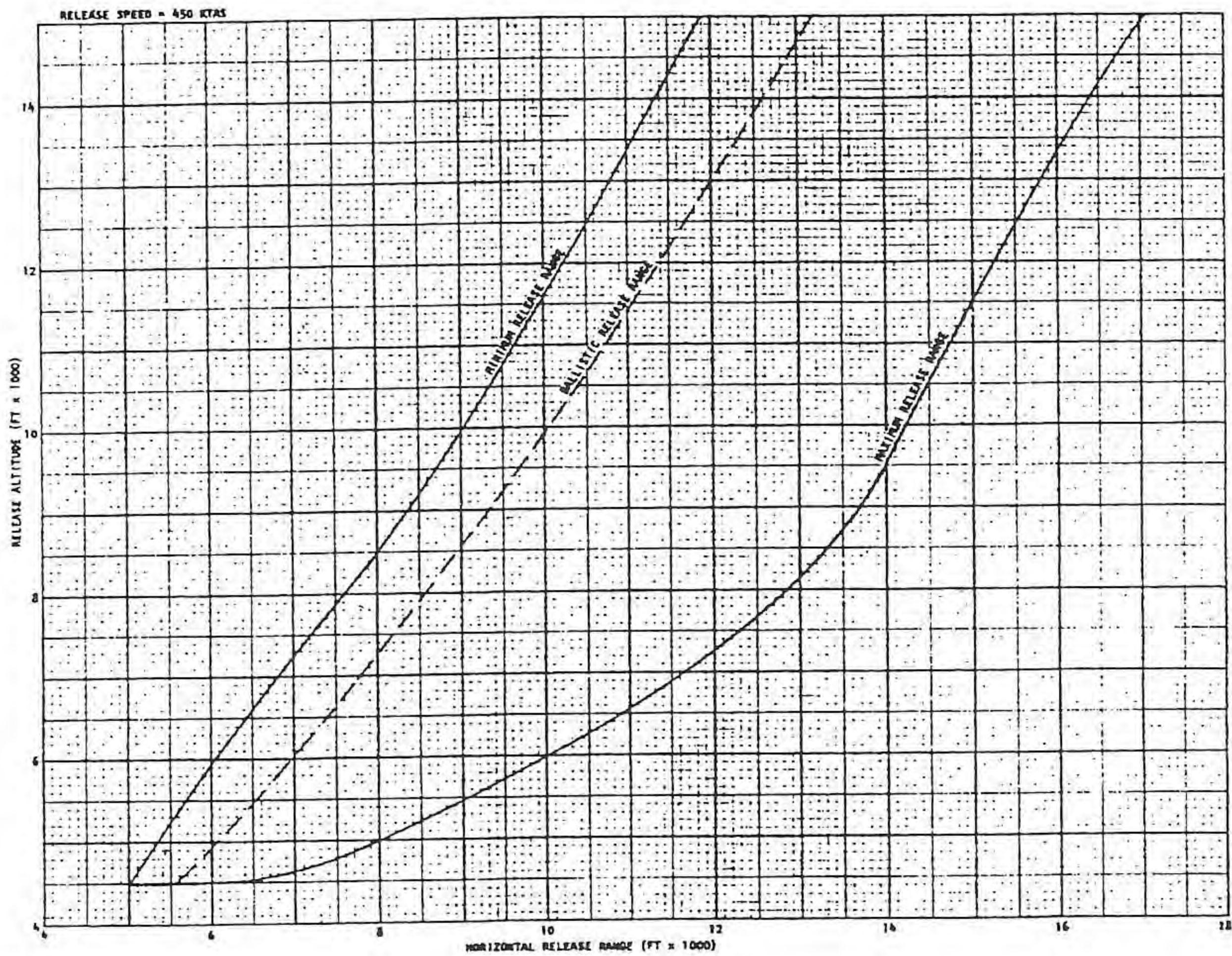
MK-84 (54 INCH TAIL FIN) LASER GUIDED BOMB
DIVE ANGLE = 30°



1A-10A-34-1-1-7-17

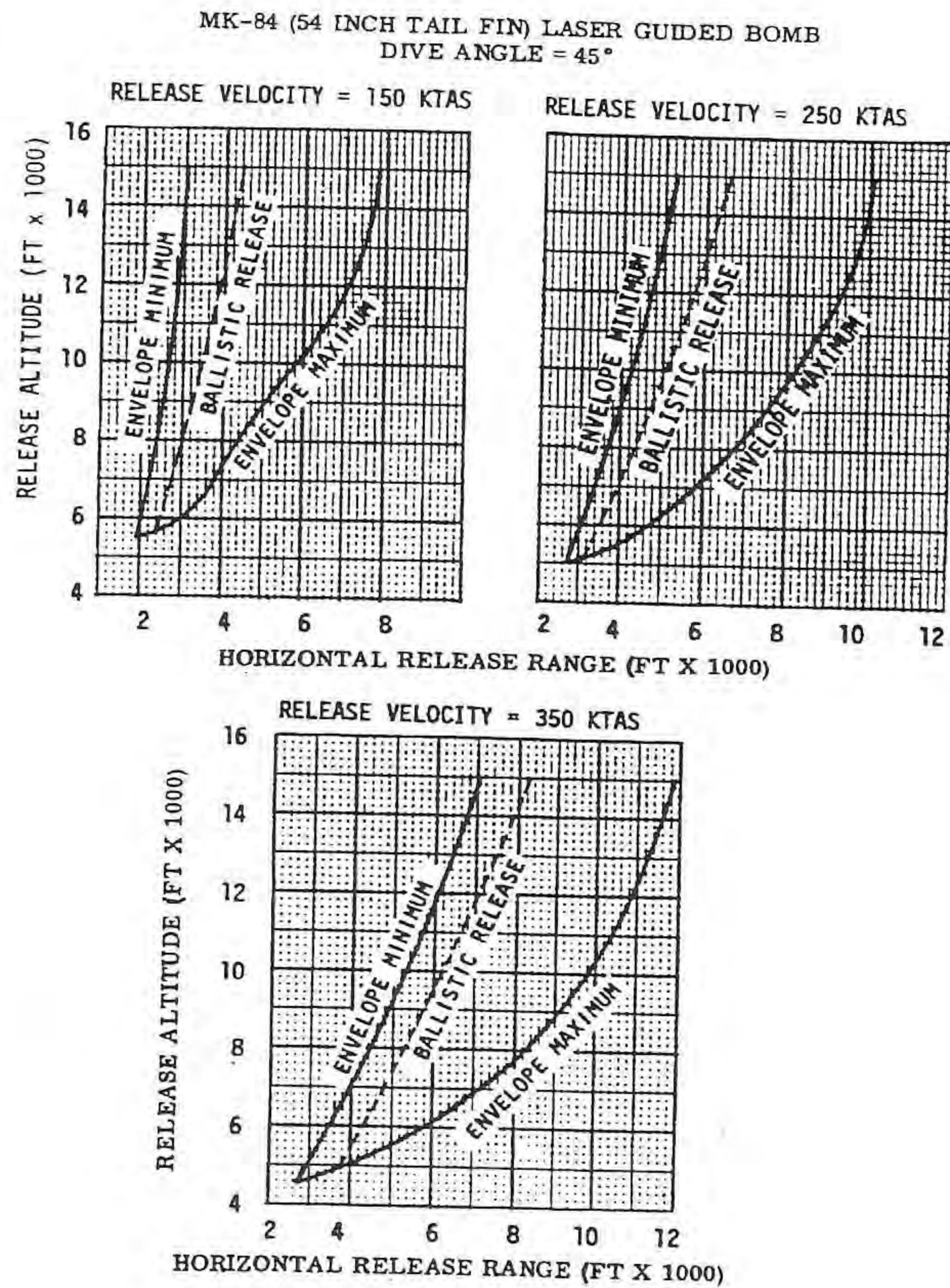
Figure 7-3. GBU-10A/B, B/B RELEASE ENVELOPES - PROFILE (Sheet 6 of 11)

MK-84 (54 INCH TAIL FIN) LASER GUIDED BOMB
DIVE ANGLE = 30°



1A-10A-34-1-1-7-18

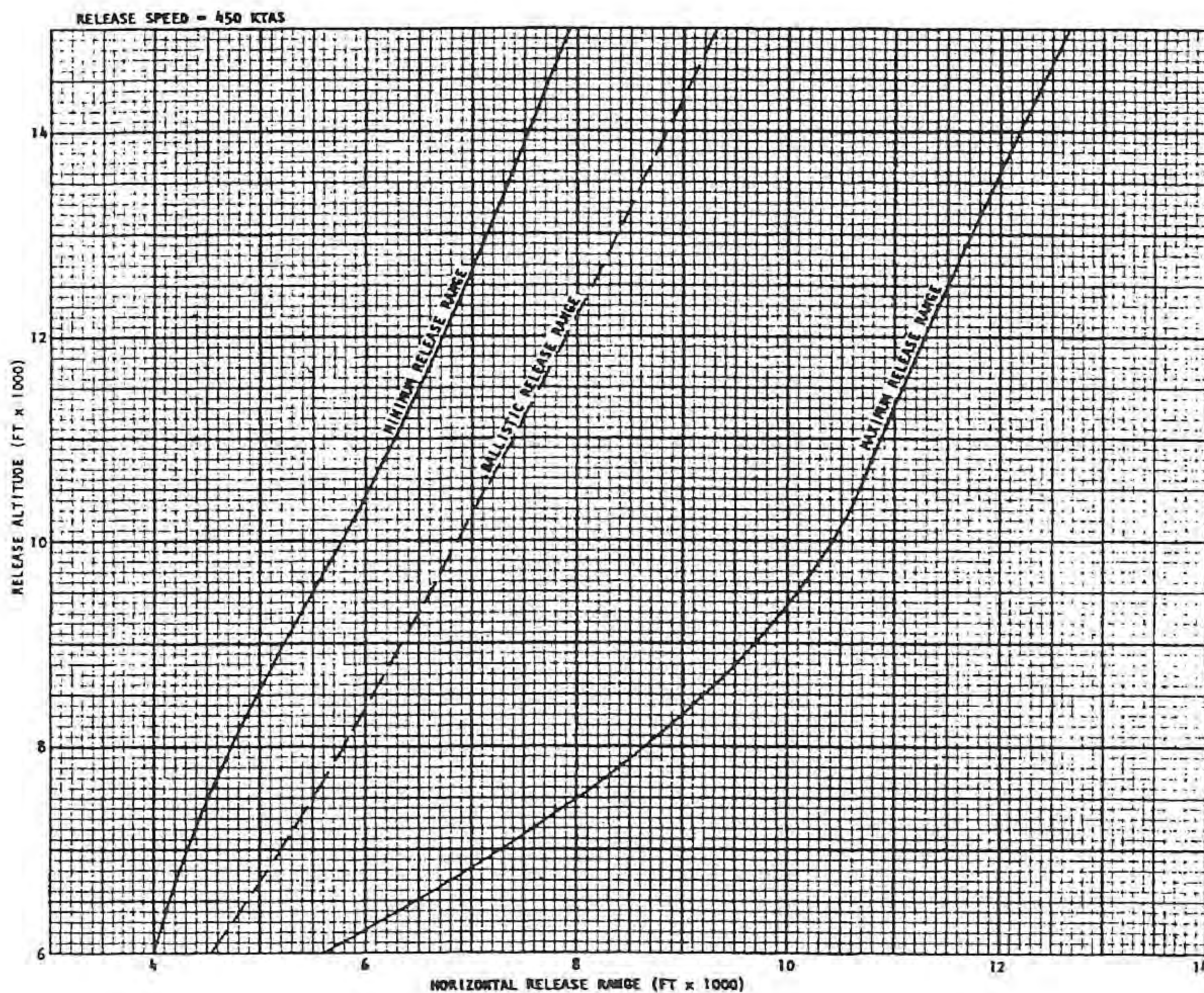
Figure 7-3. GBU-10A/B, B/B RELEASE ENVELOPES - PROFILE (Sheet 7 of 11)



1A-10A-34-1-1-7-19

Figure 7-3. GBU-10A/B, B/B RELEASE ENVELOPES - PROFILE (Sheet 8 of 11)

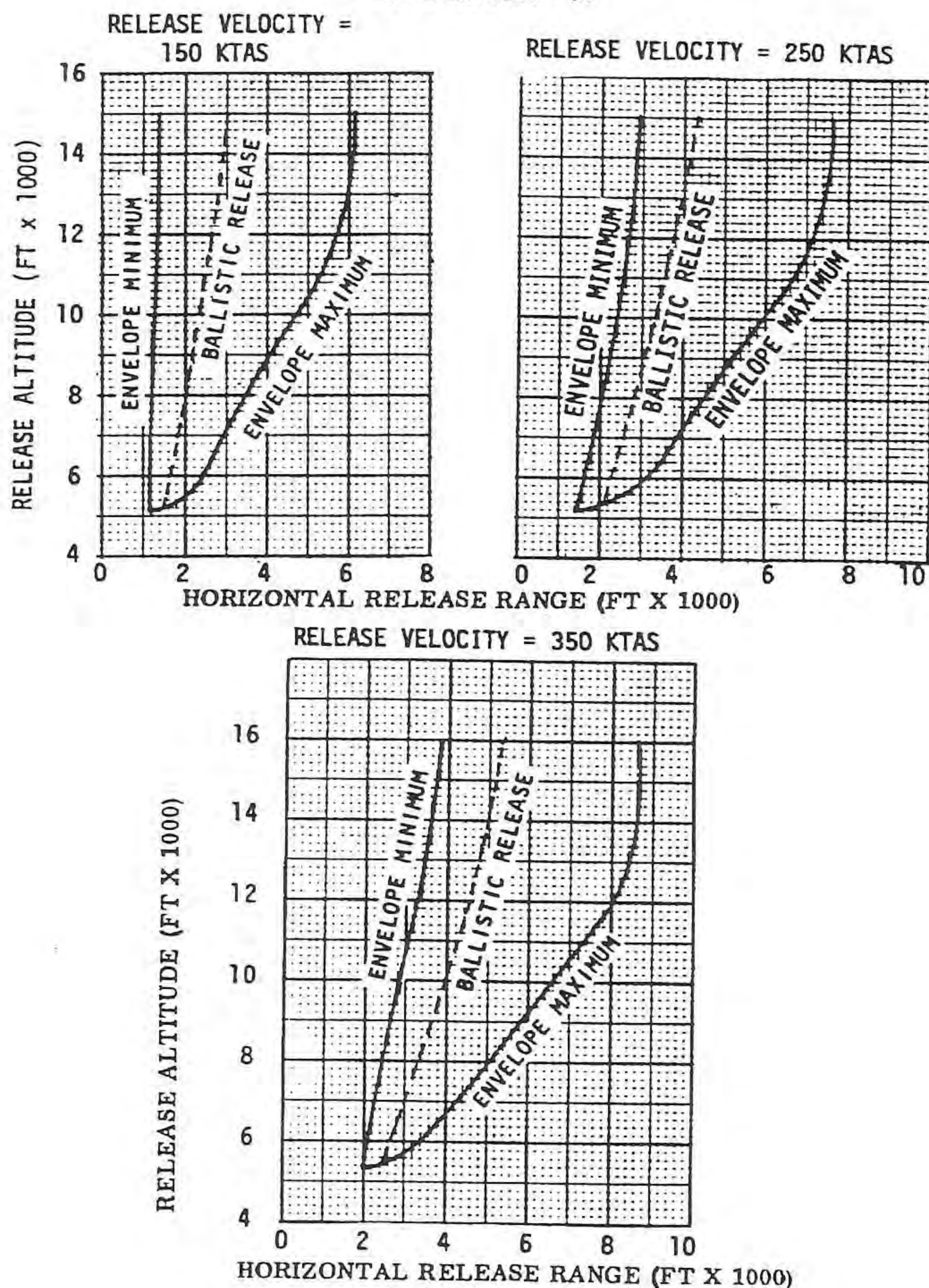
MK-84 (54 INCH TAIL FIN) LASER GUIDED BOMB
DIVE ANGLE = 45°



1A-10A-34-1-1-7-20

Figure 7-3. GBU-10A/B, B/B RELEASE ENVELOPES - PROFILE (Sheet 9 of 11)

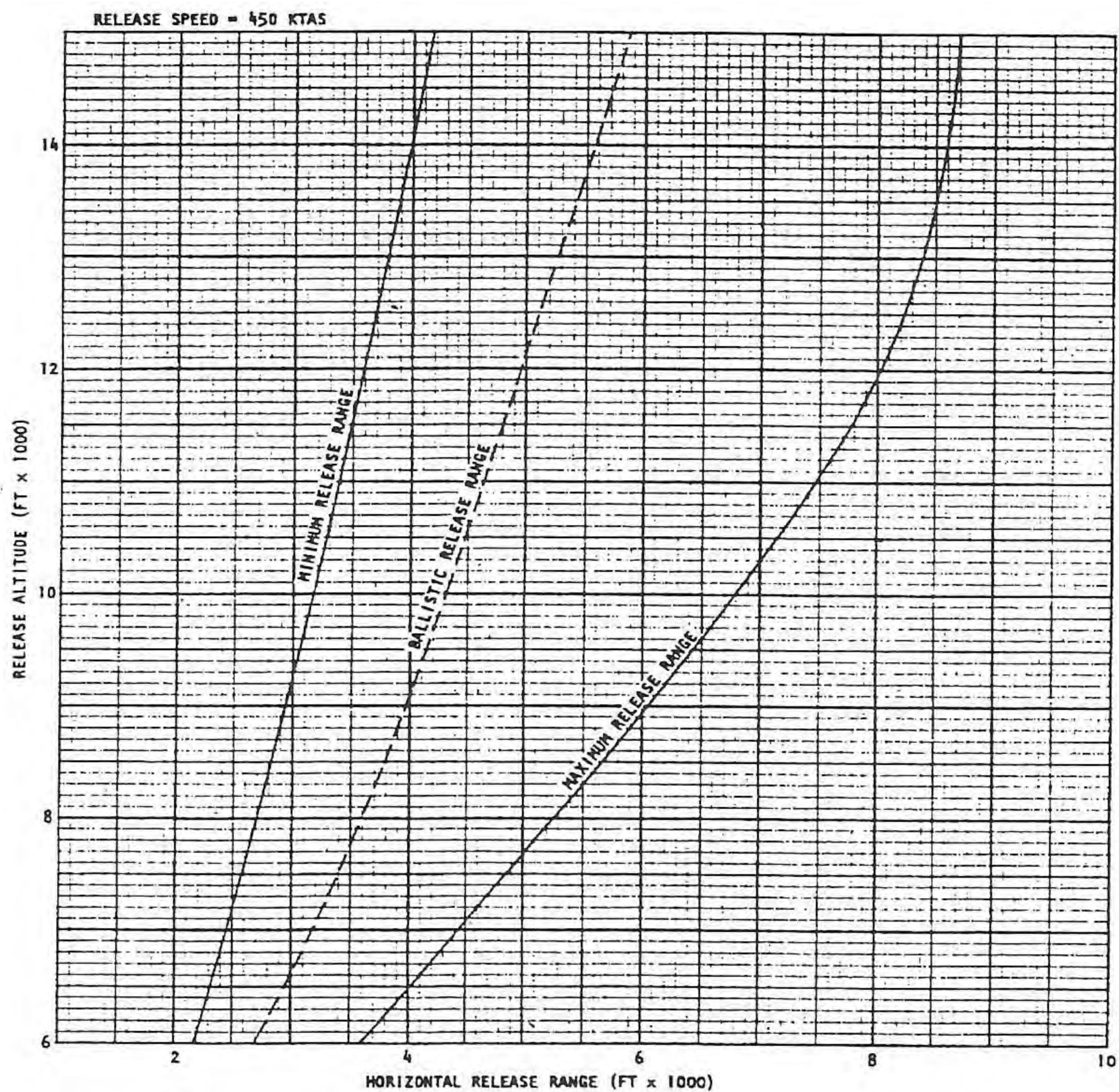
MK-84 (54 INCH TAIL FIN) LASER GUIDED BOMB
DIVE ANGLE = 60°



1A-10A-34-1-1-7-21

Figure 7-3. GBU-10A/B, B/B RELEASE ENVELOPES - PROFILE (Sheet 10 of 11)

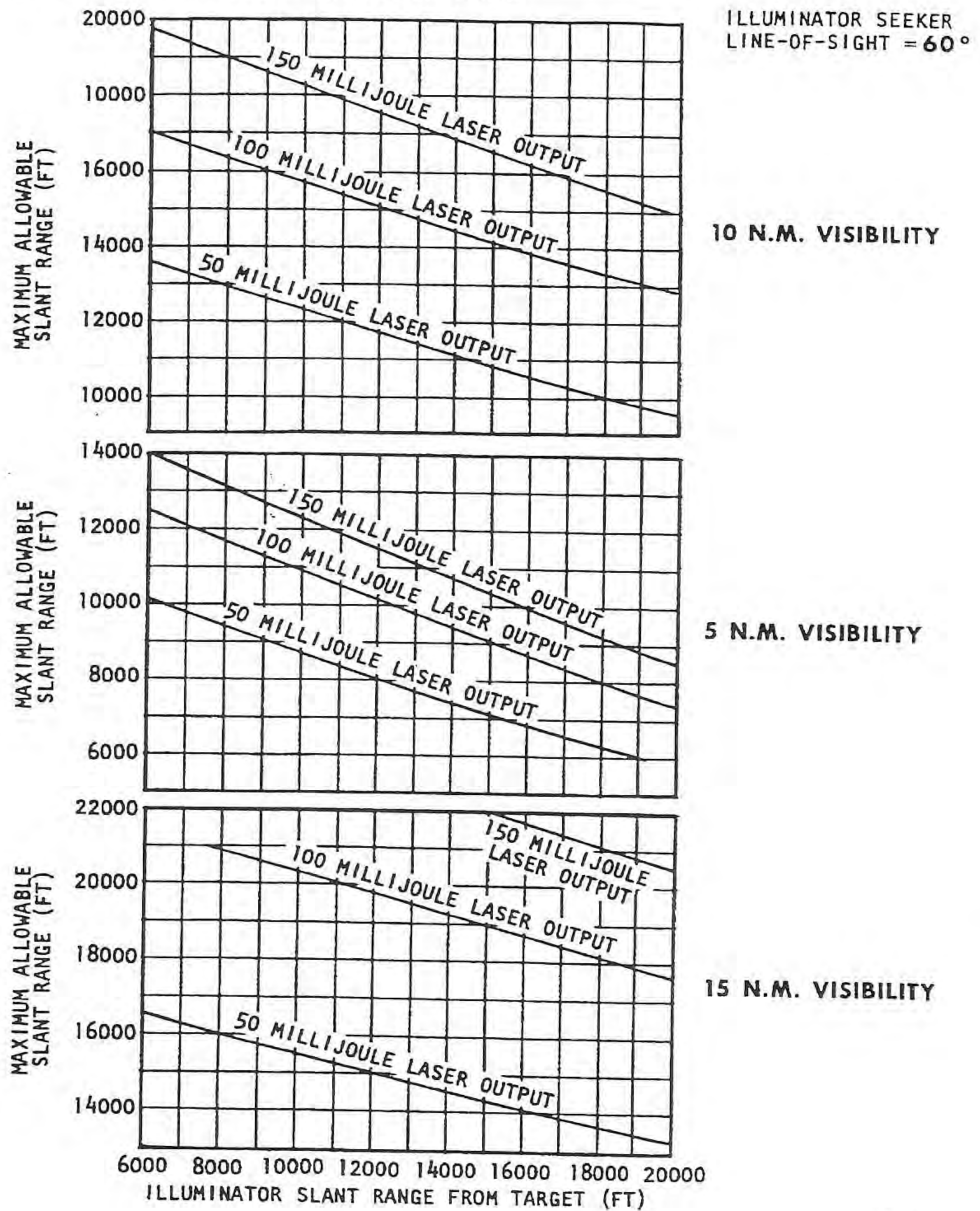
MK-84 (54 INCH TAIL FIN) LASER GUIDED BOMB
DIVE ANGLE = 60°



1A-10A-34-1-1-7-22

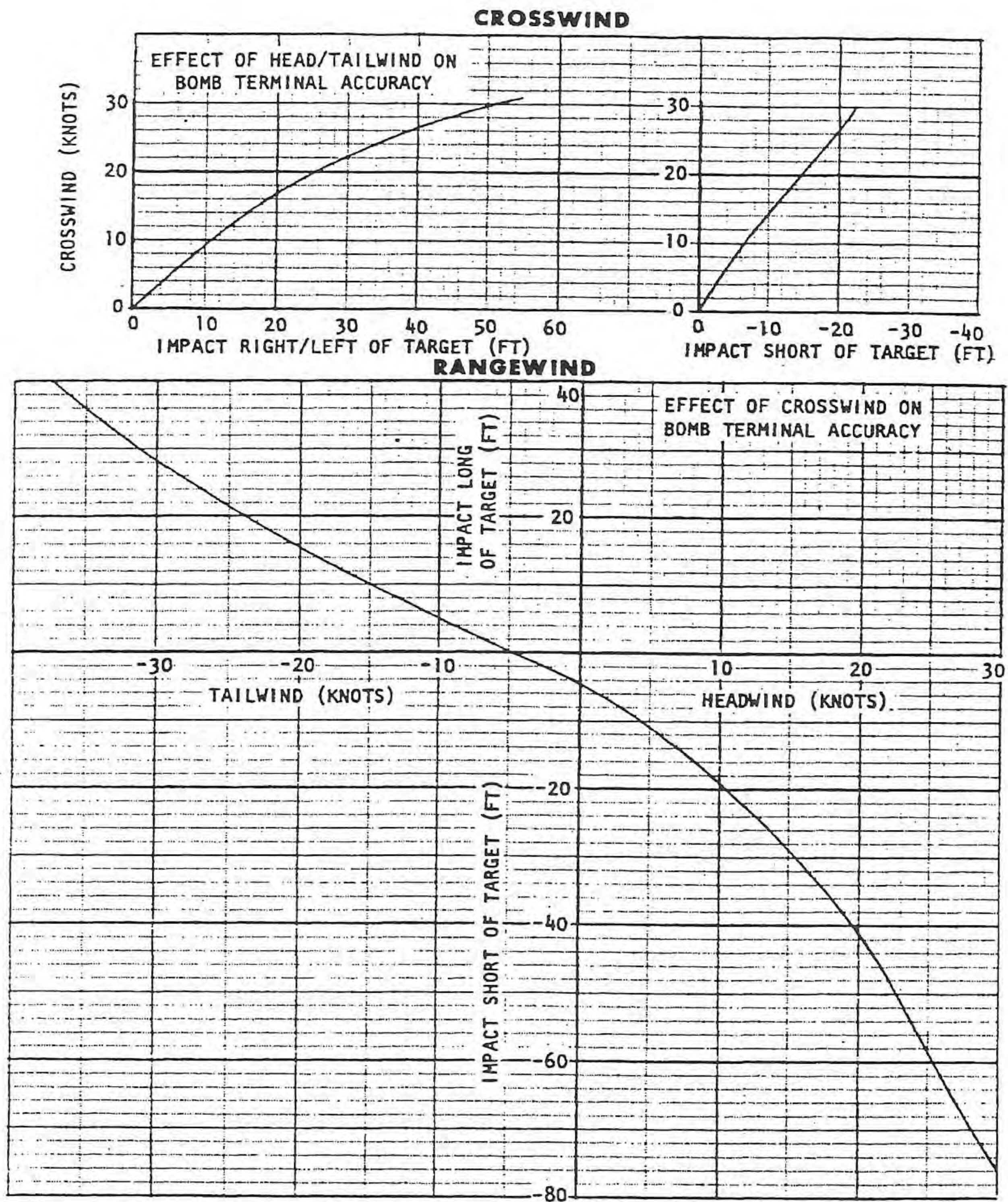
Figure 7-3. GBU-10A/B, B/B RELEASE ENVELOPES - PROFILE (Sheet 11 of 11)

MAXIMUM ALLOWABLE SLANT RANGE AS A FUNCTION OF LASER INTENSITY,
VISIBILITY, AND ILLUMINATOR SLANT RANGE



1A-10A-34-1-1-7-23

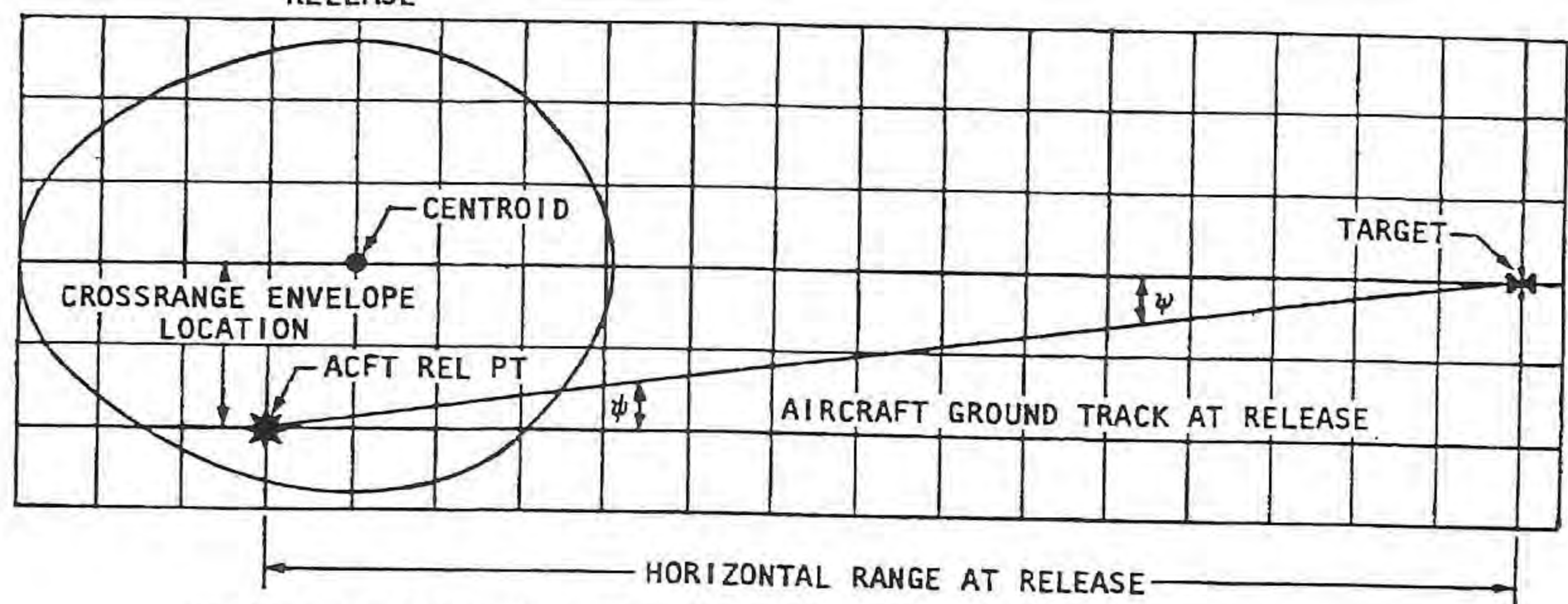
Figure 7-4. EFFECT OF ACQUISITION SLANT RANGE



1A-10A-34-1-1-7-24

Figure 7-5. WIND EFFECT ON GBU-10 SERIES LGB

METHOD FOR DETERMINING (a) CROSSRANGE ENVELOPE LOCATION
FOR A GIVEN AZIMUTH ANGLE ERROR OR (b) ALLOWABLE
AZIMUTH ANGLE ERROR FOR A GIVEN HORIZONTAL RANGE AT
RELEASE

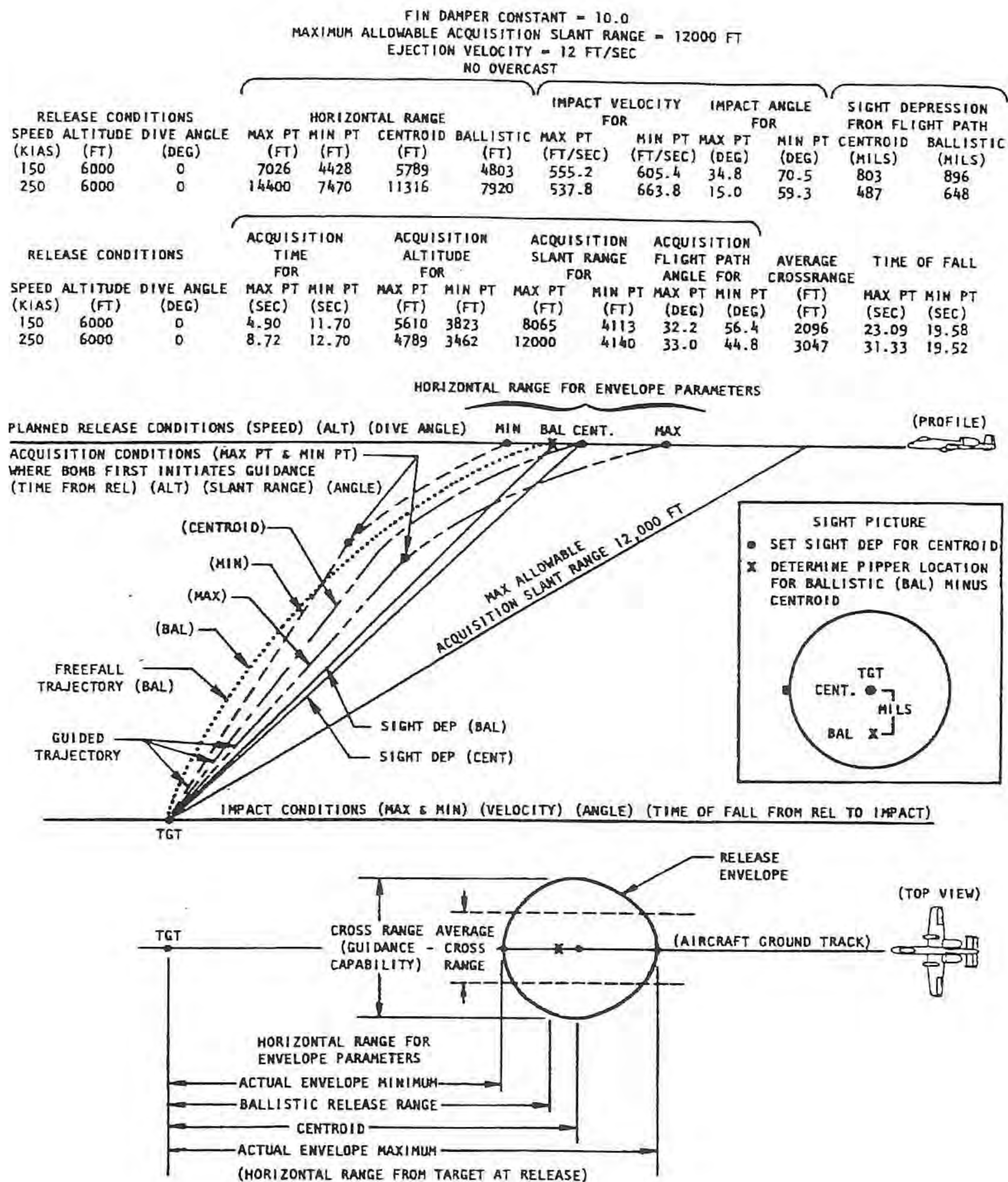


$$\text{CROSSRANGE ENVELOPE LOCATION} = (\text{HORIZONTAL RANGE AT RELEASE}) \times \tan \psi$$

$$\text{ALLOWABLE AZIMUTH ANGLE ERROR} = \text{ARCTAN} \left(\frac{\text{ENVELOPE HALF-WIDTH AT RELEASE}}{\text{HORIZONTAL RANGE AT RELEASE}} \right)$$

1A-10A-34-1-1-7-25

Figure 7-6. AZIMUTH ANGLE & CROSS RANGE ERROR LGB



1A-10A-34-1-1-7-26

Figure 7-7. LASER GUIDED BOMB PLANNING

In Figure 7-12 (Sheets 2, 4, 6 of 6), the first three columns repeat the planned release conditions. The next eight columns identify the weapon position where the weapon first initiates guidance; this is the acquisition point. The acquisition point is identified for a weapon released within the envelope at the maximum and minimum acceptable release points. Four conditions must be satisfied before guidance can be initiated:

- Weapon time of fall must be 3.5 seconds or greater.
- The target must be within the 12° half-cone angle field of view.
- Slant range from weapon to target must be equal to or smaller than the maximum allowable acquisition slant range.
- The weapon must be below any overcast.

Thus, the parameters given are for the first point in the weapon trajectory where all of these conditions are initially satisfied.

The next column labeled Average Cross Range gives a represented cross range guidance capability for a weapon released roughly in the center one-half of the envelope. The columns labeled Time of Fall give the time of fall for a release at the maximum and minimum release points respectively.

RELEASE ENVELOPES

Two views of the release envelope are presented. Figure 7-2 presents the top view and Figure 7-3 presents the side view of profile. The top view indicates the effect that the horizontal release range has on the actual cross range guidance capability at the selected release altitude, dive angle, and airspeed. The horizontal ranges are also presented; minimum, ballistic (with an X), centroid (with a dot), and the maximum range.

The profile plot is shown through the center of the envelope along the aircraft flight path. The profile indicates the effect that altitude has upon the horizontal range at the selected release dive angle and airspeed. Two release envelopes are shown; the maximum and the practical. The maximum envelope assumes 0° ground track error (zero feet cross range error) at release. The practical envelope assumes no more than 2° azimuth ground track error at release. The optimum release range is the center of the practical envelope. The dashed line indicates the ballistic release range and altitude.

EFFECT OF ACQUISITION SLANT RANGE

The strength of the reflected laser energy at the bomb seeker head is primarily a function of the following:

- Illuminator output energy.
- Atmospheric scattering and absorption.
- Target reflectivity.
- Illuminator slant range to target.
- Bomb slant range to target.
- Illumination and reflection angles.

Figure 7-4 illustrates the maximum acquisition slant range using the following parameters:

- Illuminator output energy of 50, 100, 500 millijoules.
- Atmospheric scattering and absorption (measured in terms of visibility) for 5, 10, and 15 nautical mile visibility.
- Illuminator slant range (independent variable).
- A constant target reflectivity of 0.4 is assumed, along with an average 60° angle between the line of incidence and the line of reflection.

The envelope size (and therefore the centroid location) is a strong function of the maximum allowable acquisition slant range. Although it is too involved to generate envelopes with several values of maximum acquisition slant range for each release condition, some general guidelines can be established:

- For smaller acquisition slant range values (less than 12,000 feet), the envelopes become smaller in area and the centroid approaches the ballistic release point.
- If the acquisition slant range distance for the maximum envelope point listed in the ballistic table data is less than the actual slant range capacity available, there is no need to adjust the release centroid listed in the table.
- If the acquisition slant range distance for the maximum envelope point listed in the ballistic table data is greater than the actual slant range capacity available, then the listed centroid should be moved closer to the ballistic release point. (The ballistic release point is actually the centroid location for 0.0 feet acquisition slant range.) A good rule is to move the centroid a distance determined by computing the ratio of the actual acquisition slant divided by 12,000 feet. For example, if the actual acquisition slant range (obtained from Figure 7-4) is only 6,000 feet, then the adjusted cen-

troid should be placed midbay

$$\frac{6000}{1200} = 1/2$$

between the old centroid and the ballistic release point. (Remember that the basket also becomes much smaller.) Similarly, if the actual acquisition slant range is 8000 feet, then the adjusted centroid should be moved closer to the ballistic point by a distance equal to one third

$$1 - \frac{8000}{12000} = 1 - 2/3 = 1/3$$

of the total distance between the old centroid and the ballistic release point. The total envelope length should decrease by roughly twice the distance through which the centroid is moved.

- d. For acquisition slant ranges greater than 12,000 feet, the envelopes become larger and the centroid moves further downrange from the target in most cases. There are two notable exceptions to this rule:
 - (1) The envelope is not affected by making the maximum allowable acquisition slant range greater than the bomb slant range at 3.5 seconds after release, since the bomb cannot begin guidance before release or during the first 3.5 seconds following release.
 - (2) It is also possible to actually decrease the envelope size and shorten the downrange centroid distance by having too large an acquisition slant range. This occurs in the level and shallow dive angle releases. What actually happens is that, by acquiring early, the bomb is forced to fly a glide angle less than its capability. By holding off acquisition until a later time, the bomb is closer to the target and at a steeper dive angle.

EFFECT OF FIN DAMPER VALUES ON ENVELOPE SIZE AND POSITION

The canard damper induces sustained weapon oscillations during the ballistic portion of flight. The net effect of such oscillations is to decrease the weapon speed which in turn decreases the downrange travel and maneuvering capability of the weapon. For release conditions which produce very little ballistic flight (e.g., 45° dive at 12,000 feet) the damper effect is minor. However, for high altitude level releases which result in long ballistic trajectories before guidance is initiated in the damper constant between a 6

ft-lb/rad/sec and 15 ft-lb/rad/sec. Thus, the ballistic tables represent the guidance capabilities of the average bomb. If the damper constant values were restricted between 5 ft-lb/rad/sec and 8 ft-lb/rad/sec, the ballistic tables would be representative of the worst case for weapon maneuverability. The revised envelopes would, in general, be somewhat larger and shifted a little downrange from the target.

EFFECT OF WINDS ON LASER GUIDED BOMB TRAJECTORIES

The effect of winds on the trajectory of the laser guided bomb is significantly different and more complicated than that for purely ballistic bombs. Corrections for wind effects are to be made by both the delivery aircraft and the illuminator aircraft.

The delivery aircraft should correct according to the effect of the wind velocity of ground speed. Two methods of correction are described. An aircraft flying at 400 KTAS level into a 20 knot headwind has a ground speed of 380 knots, and should release at the centroid position of the appropriate 380 knot envelope, rather than that of the 400 knot envelope. A simple linear interpolation, using the values given in the table, provides a sufficiently accurate release range and mil setting. This method is applicable to dives by adding the wind speed (or wind components) to the aircraft horizontal velocity component. For a delivery dive angle of 45° or greater, the envelope does not shift a sufficient amount to necessitate a correction. Another method of correction consists of increasing or decreasing the aircraft speed in order to obtain the correct ground velocity of 400 knots. The advantage of this method is that no interpolations are necessary.

The total velocity of the aircraft relative to the earth determines which release envelope should be used. The methods given above are therefore rigorously valid only for level releases; in a dive, the horizontal velocity component should be corrected, but not the vertical component. In a dive, however, the wind effect is smaller, so that correcting the total velocity (and not just the horizontal component) should be sufficiently accurate.

The second part of the wind correction procedure must be accomplished by the illuminator aircraft and is intended to compensate for the effect of winds on the guided portion of the guided bomb trajectory.

The method of correction for laser guided bombs during the guided portion of the trajectory differs from that for ballistic bombs because of the nature of the error source. In very general terms, guided bomb errors result from the fact that the seeker is measuring line of sight errors in the direction of the bomb's velocity vector relative to the air-

stream whereas in reality the bomb is moving in a somewhat different direction (relative to the ground) due to the velocity of the air mass. Thus, when the seeker measures no errors (supposedly an indication that the bomb is moving directly toward the target), the bomb is actually traveling in a different direction, the degree of difference depends upon the magnitude and direction of the wind.

Since the wind magnitude and direction vary with altitude, it must be determined what altitude level is most sensitive in determining weapon miss distance. Computations show that the winds in the 2,000 to 4,000-foot altitude range affect the weapon trajectory far more than winds at higher altitudes. Therefore, the wind magnitude and direction to be used in any type of wind correction should be the average expected wind occurring in this altitude layer.

Since the delivery aircraft cannot compensate for this occurrence, the illuminator aircraft must correct by offsetting the spot from the target. The magnitude of the offset should be opposite that of the weapon miss distance. Figure 7-5 may be used to determine the average direction and magnitude that the illuminator must offset the spot from the target to compensate for a given wind. Although such offsets are in general a function of the release altitude, angle, and speed, it was determined that, for the range of conditions listed in the ballistic tables, the correction is relatively independent of the release conditions. However, different graphs must be used for each type bomb. Figure 7-5 indicates that a crosswind affects both the cross range and downrange offset distance, while a head or tailwind affect only the downrange-distance. To compensate for a given wind speed and direction, the headwind or tailwind and crosswind magnitude must be determined. Figure 7-5 is entered with the crosswind magnitude and the cross range and downrange offset distance is determined. Then enter with the head or tailwind to determine the downrange effect. This is algebraically added to the downrange effect due to crosswind to determine total downrange effect. The laser spot should be offset into the wind an amount equal to the distance determined to be caused by the crossrange and downrange wind components.

Example: Suppose the aircraft is headed due north and there is a 20 knot wind (in the 2,000 ft- 4,000 ft altitude layer) coming from the northeast. This wind can be divided into the following components:

$$\begin{aligned} 1. \text{ Headwind} &= (20 \text{ knots}) \\ \text{component} &(\cos 45^\circ) \\ &= (20 \text{ knots}) \\ &(.707) = 14 \text{ knots} \end{aligned}$$

$$\begin{aligned} 2. \text{ Crosswind} &= (20 \text{ knots}) \\ \text{component} &(\cos 45^\circ) \\ &= (20 \text{ knots}) \\ &(.707) = 14 \text{ knots} \end{aligned}$$

Referring to the wind charts one finds the following miss distances:

	Down-range*	Cross-range**
Average miss distance due to crosswinds	-9.5 ft	-15.5 ft
Average miss distance due to headwind	-26.0 ft	0.0 ft
Total miss distance	-35.5 ft	-15.5 ft

* Downrange is negative for impact short of the target.

** Cross range is positive for impact to right of target.

This implies that, if the laser spot is placed on target, the bomb will impact (on the average) 35.5 ft short and 15.5 ft to the left. Therefore, the laser spot should be aimed 35.5 ft long of the target and 15.5 ft to the right.

NOTE

Extreme care should be used when offsetting the illuminator from the target to correct for winds. In particular, the area being illuminated must possess a sufficient degree of reflectivity in the direction of the bomb trajectory. For example, offsetting a laser spot onto a water surface when bombing a bridge would probably result in a completely ballistic trajectory since very little laser energy is reflected along the direction of the bomb line of sight.

COMPUTATION OF MAXIMUM ALLOWABLE AZIMUTH ANGLE/CROSS RANGE ERROR AT RELEASE

Figure 1-6 graphically depicts two methods of obtaining useful information from the cross range envelope data. The aircraft ground track at release should pass through the target. Any deviation from this condition will be called azimuth angle error. The Figure shows that an azimuth angle error can be converted into a cross range error vice versa. The following description can be accomplished.

- To convert expected envelope cross range error into azimuth angle error, a determination should be made of the expected downrange error (how far the A/C will miss the centroid in down range): this number is added or subtracted from the centroid value, and the maximum available cross

range at this downrange is then read from the appropriate envelope plot. The maximum allowable azimuth angle error is then computed using the second expression at the bottom of Figure 7-6.

- b. Conversely, a good estimate of the azimuth error at release permits a determination of the resulting cross range error in the release envelope. The acceptable release points can be determined by computing a cross range error, using the first expression at the bottom of Figure 7-6.

GBU-12 SERIES, GENERAL PURPOSE GUIDED LASER BOMB PLANNING DATA

The GBU-12 Series is a MK 82 GP bomb fitted with a laser bomb guidance kit. The guidance capability of the GBU-12 series is presented in Figures 7-7 thru 7-11. The capability of the weapon is described by a release envelope which shows the optimum release conditions for the weapon and indicates the degree of flexibility in the release requirements. The release envelope defines an area within which the bomb can be released and guided to within 30 feet of the target.

The GBU-12 series bomb is available with KMU-388/B and EMU-388A/B. The -388/B has two sets of canard fins with the larger fin span used for low speed release and the smaller set used for high speed release. These are assembled on the bomb as required. The EMU388A/B has one size canard which is initially a low speed assembly, and then adapted for high speed delivery by breaking off the outer fin panel. The ballistic tables and release envelopes are only for the low speed configuration.

BALLISTIC TABLES

Level and dive ballistic tables for the KMU-388A/B are presented in Figure 7-13 and described in Figure 7-7. The title block on each page of the ballistic tables identifies the data basis. Each table consists of paired sheets: (Sheet 1, 3 of 6), (Sheet 3, 4 of 6), (Sheet 5, 6 of 6), and planned release conditions are listed on each page.

The Fin Damper Constant stated in the title specifies the average proportionality constant of the oil damper used to damp the canard flutter in captive flight. The value use of these ballistics tables is 8.0 ft-lbs per radian per second. This

value can vary among bombs and with the oil temperature at release from 6.0 to 14.0.

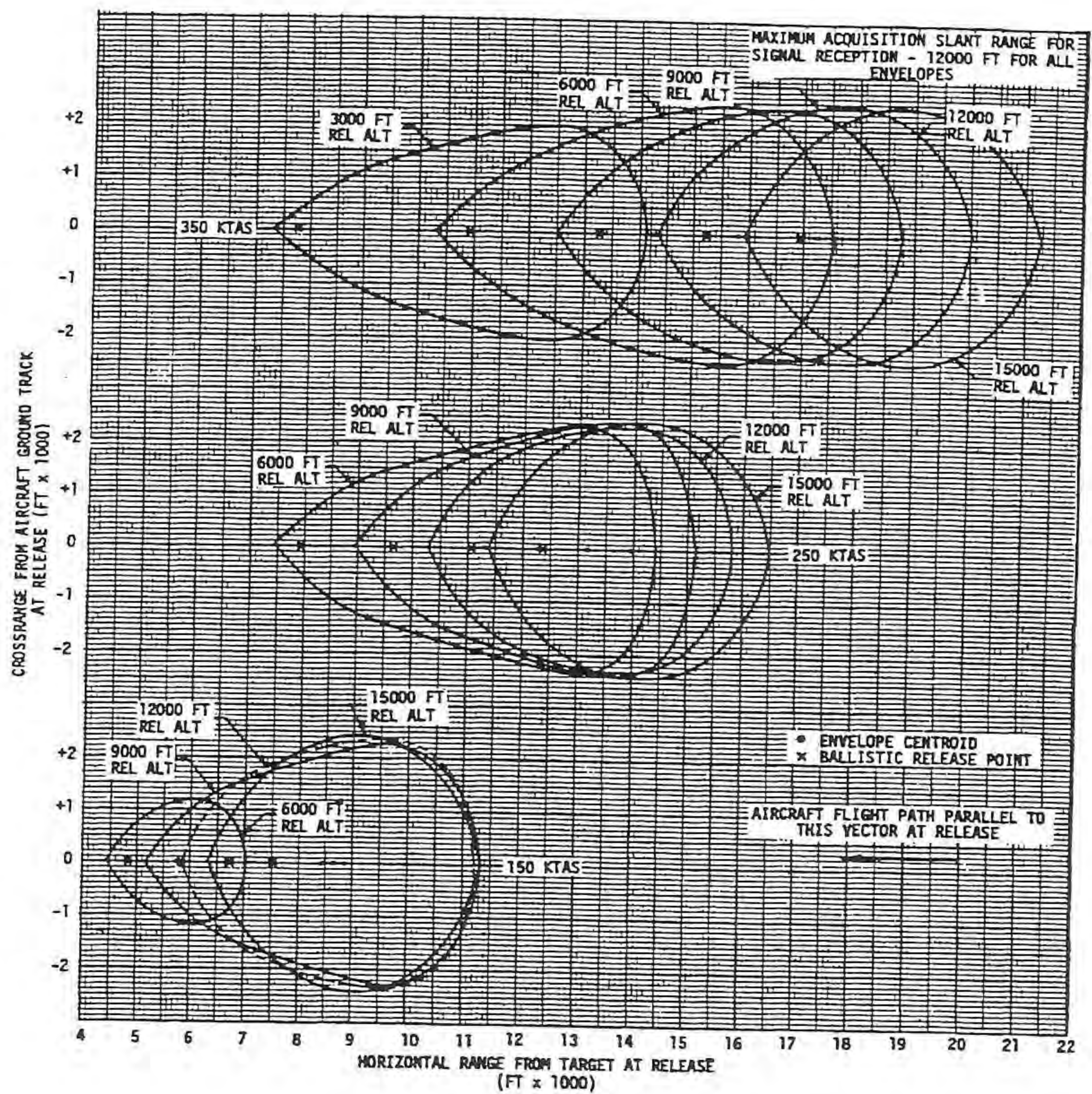
The ballistic tables are based on 12,000 feet maximum possible slant range where the reflected laser energy is of sufficient intensity to be usable as a guidance signal. The intensity of the reflected laser energy at 12,000 feet slant range is an average value based upon 8 nautical mile visibility, target reflectivity of 0.4, a 100-millijoule laser illuminator, and an illuminator-to-target slant range of 16,000 feet. Refer to Effect of Acquisition Slant Range and Figure 7-10. The ballistic tables assume no overcast. The weapon and the illuminator must be below the overcast for weapon guidance and target illumination.

In Figure 7-13 (Sheets 1, 3, 5 of 6), the first three columns of ballistic tables state speed, altitude, and dive angle for which the remaining data on that line are valid. Of course, these are the planned release conditions, and the effect on the release envelope parameters of releasing the weapon with unintentional delivery errors can be determined from the release envelopes which are described later.

The next four columns, collectively labeled Horizontal Range, give the downrange distance of four important envelope points, (Figure 7-7). The MAX point corresponds to the maximum horizontal range from target at which the weapon can be released and still successfully guide to the target. Similarly, the MIN point is the minimum horizontal range at which the weapon can be released and still guide to the target. (It will be shown that both these extremes result only when there is zero cross range (or azimuth) release error.) These distances are not to be confused with the maximum downrange and minimum downrange capabilities of the bomb itself. These could possibly be greater but are of little practical importance. For example, a bomb could travel farther than the maximum envelope point if it were released at a horizontal point. However, the bomb would fall short of the target by virtue of the very definition of what is meant by the target envelope. In other words, there are some release points outside the envelope from which the bomb will attempt to guide but impact at unacceptable distances from the target due to limitations in weapon maneuverability.

The centroid range represents the horizontal distance from the center area of the envelope to the target. If no significant release biases exist, the centroid range would be the most advantageous position within the envelope to release. The ballistic range represents the horizontal travel of the bomb from release to target if guidance were never initiated.

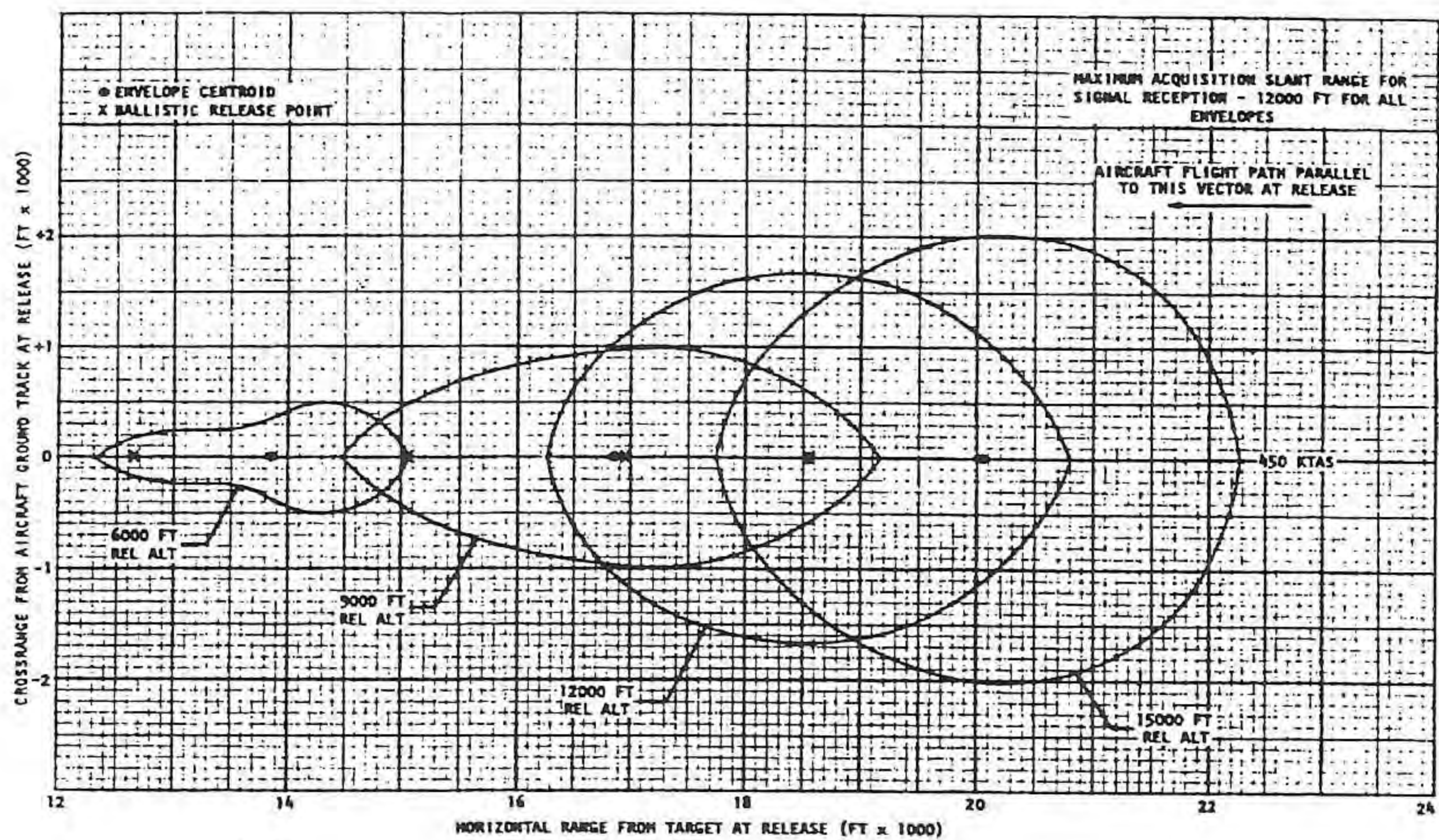
MK-82 (39 INCH TAIL FIN) LASER GUIDED BOMB LEVEL RELEASE



1A-10A-34-1-1-7-27

Figure 7-8. GBU-12A/B RELEASE ENVELOPES - TOP VIEW (Sheet 1 of 10)

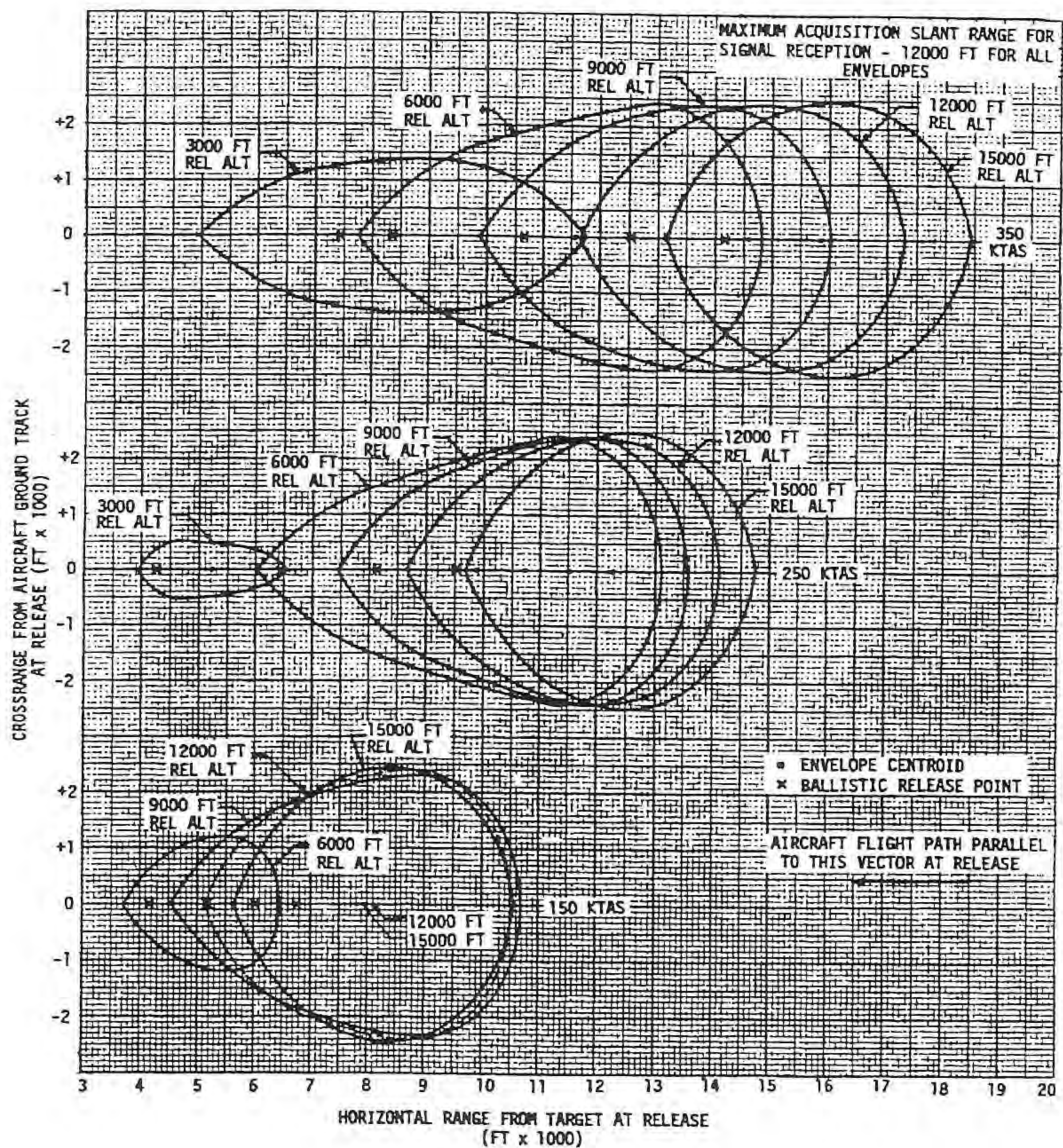
MK-82 (39 INCH TAIL FIN) LASER GUIDED BOMB
LEVEL RELEASE



1A-10A-34-1-1-7-28

Figure 7-8. GBU-12A/B RELEASE ENVELOPES - TOP VIEW (Sheet 2 of 10)

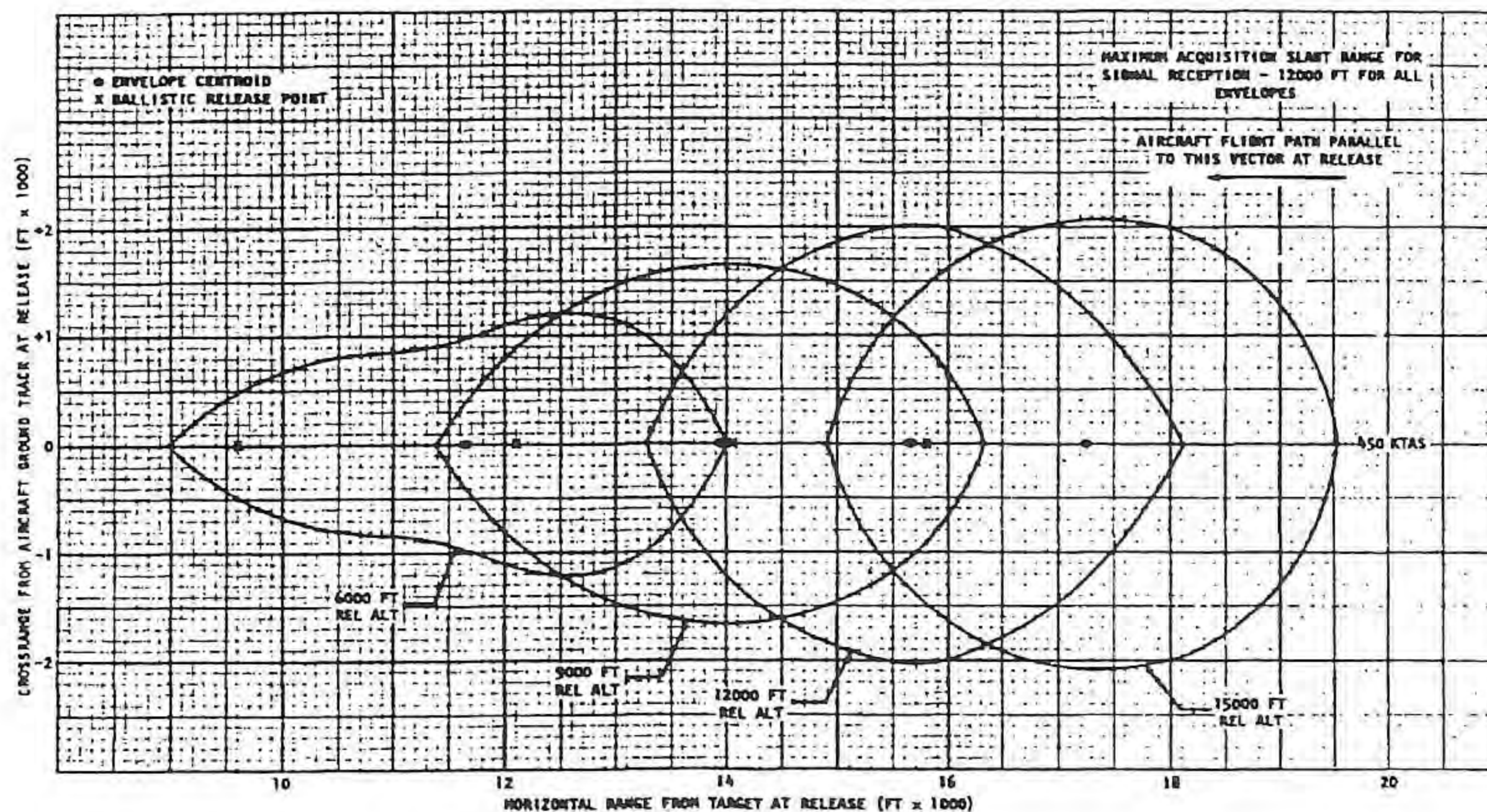
MK-82 (39 INCH TAIL FIN) LASER GUIDED BOMB
15° DIVE RELEASE



1A-10A-34-1-1-7-29

Figure 7-8. GBU-12A/B RELEASE ENVELOPES - TOP VIEW (Sheet 3 of 10)

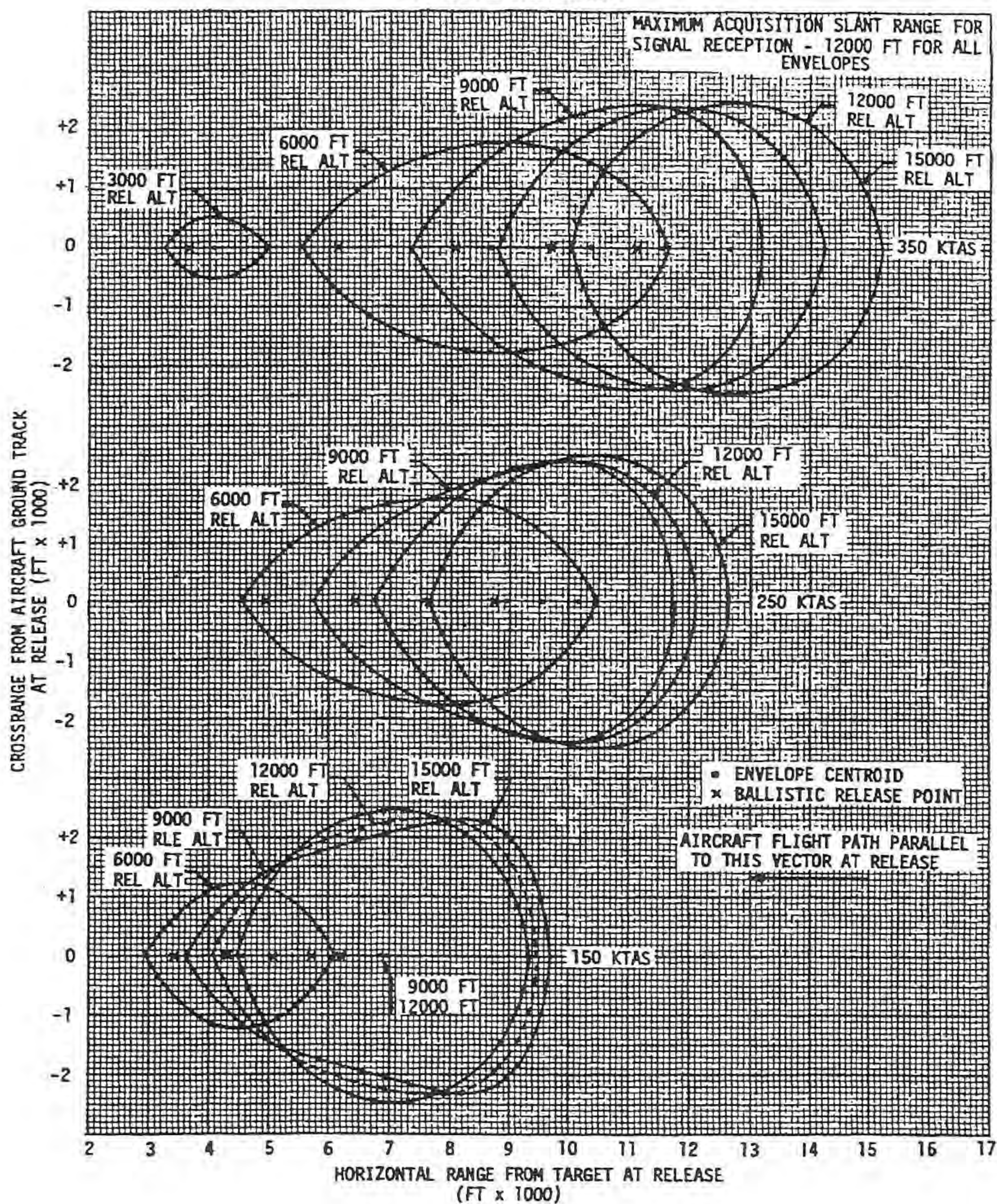
MK-82 (39 INCH TAIL FIN) LASER GUIDED BOMB
15° DIVE RELEASE



1A-10A-34-1-1-7-30

Figure 7-8. GBU-12A/B RELEASE ENVELOPES - TOP VIEW (Sheet 4 of 10)

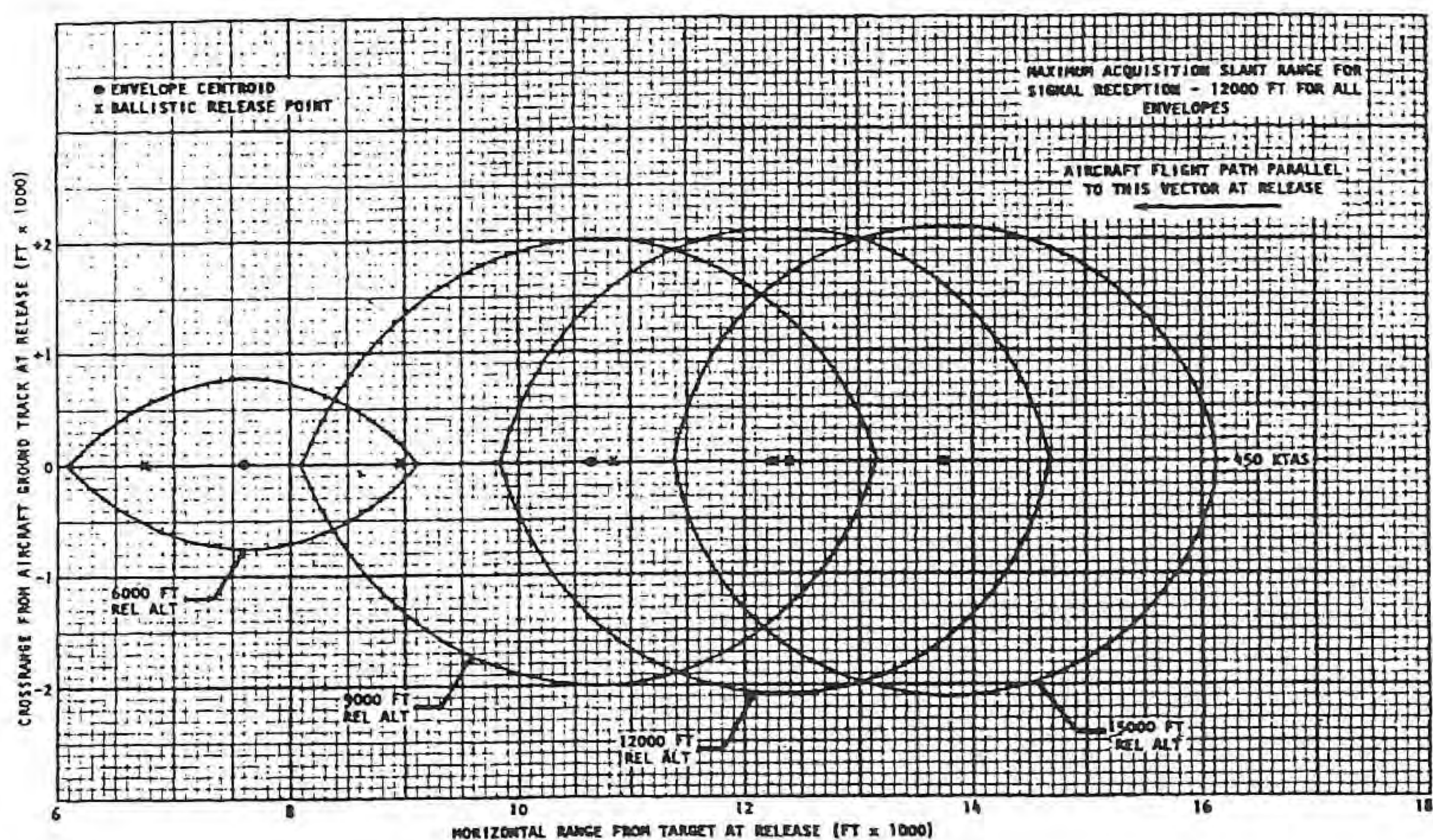
MK-82 (39 INCH TAIL FIN) LASER GUIDED BOMB
30° DIVE RELEASE



1A-10A-34-1-1-7-31

Figure 7-8. GBU-12A/B RELEASE ENVELOPES - TOP VIEW (Sheet 5 of 10)

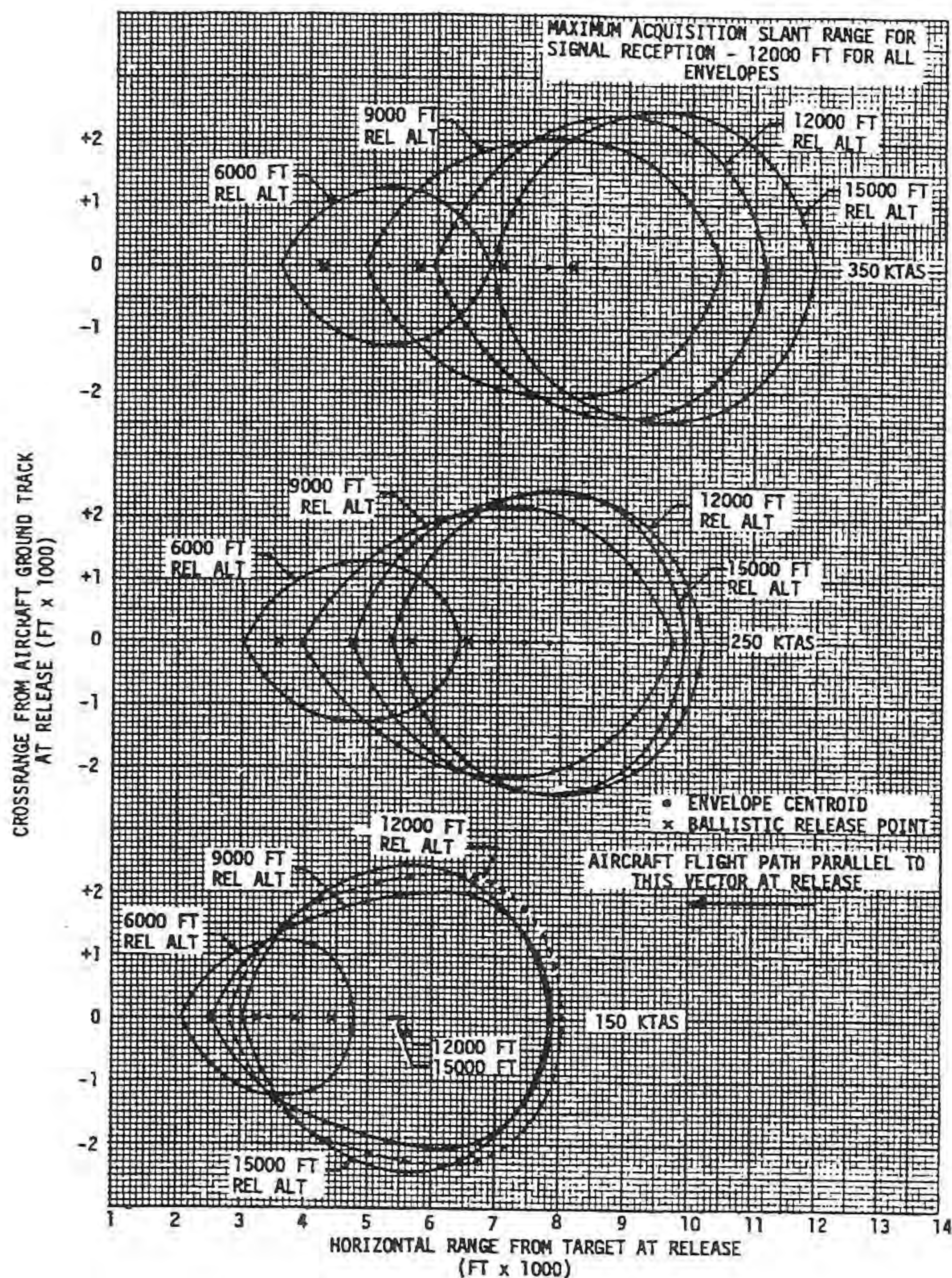
MK-82 (39 INCH TAIL FIN) LASER GUIDED BOMB
30° DIVE RELEASE



1A-10A-34-1-1-7-32

Figure 7-8. GBU-12A/B RELEASE ENVELOPES - TOP VIEW (Sheet 6 of 10)

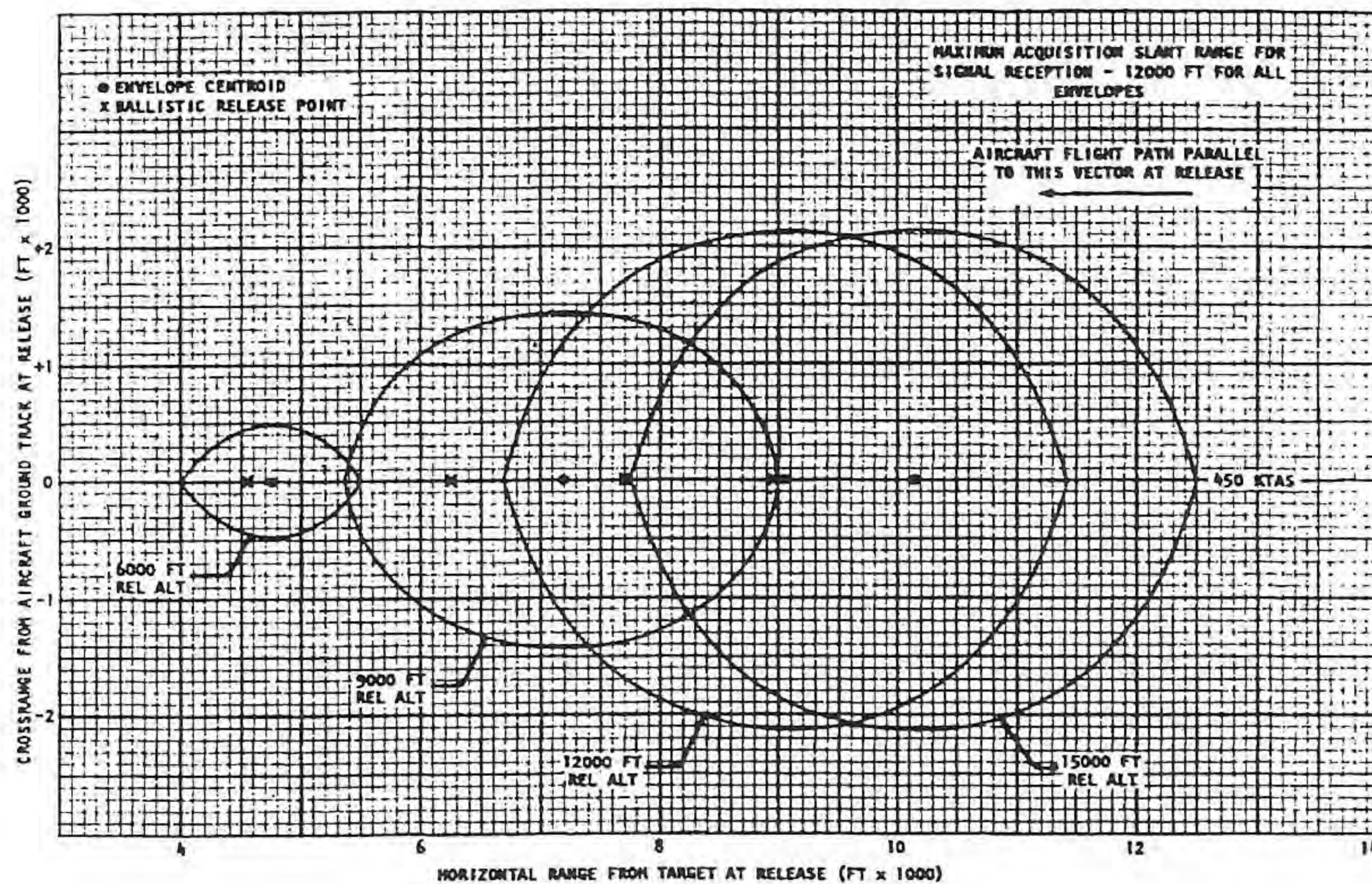
MK-82 (39 INCH TAIL FIN) LASER GUIDED BOMB
45° DIVE RELEASE



1A-10A-34-1-1-7-33

Figure 7-8. GBU-12A/B RELEASE ENVELOPES - TOP VIEW (Sheet 7 of 10)

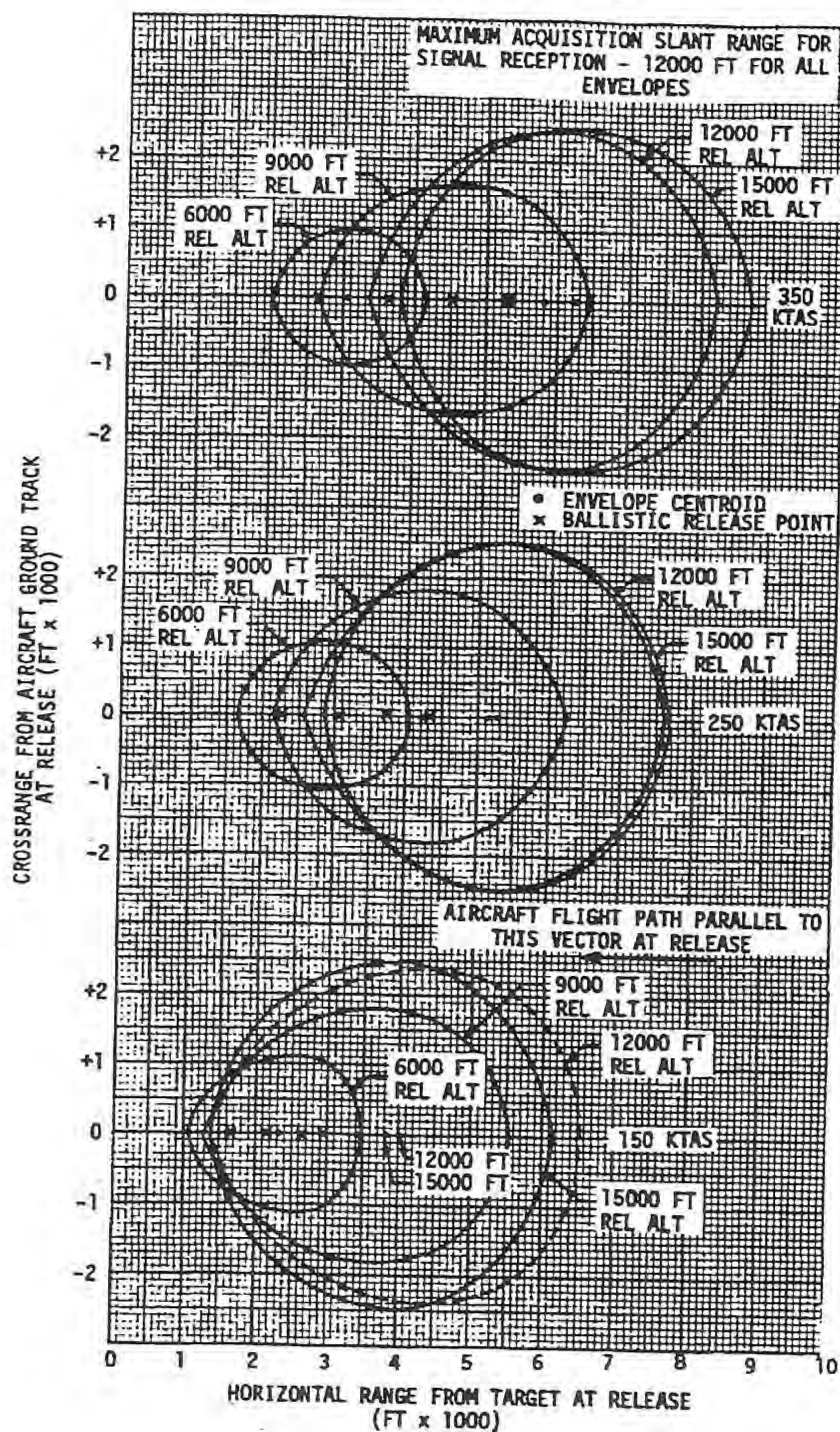
MK-82 (39 INCH TAIL FIN) LASER GUIDED BOMB
45° DIVE RELEASE



1A-10A-34-1-1-7-34

Figure 7-8. GBU-12A/B RELEASE ENVELOPES - TOP VIEW (Sheet 8 of 10)

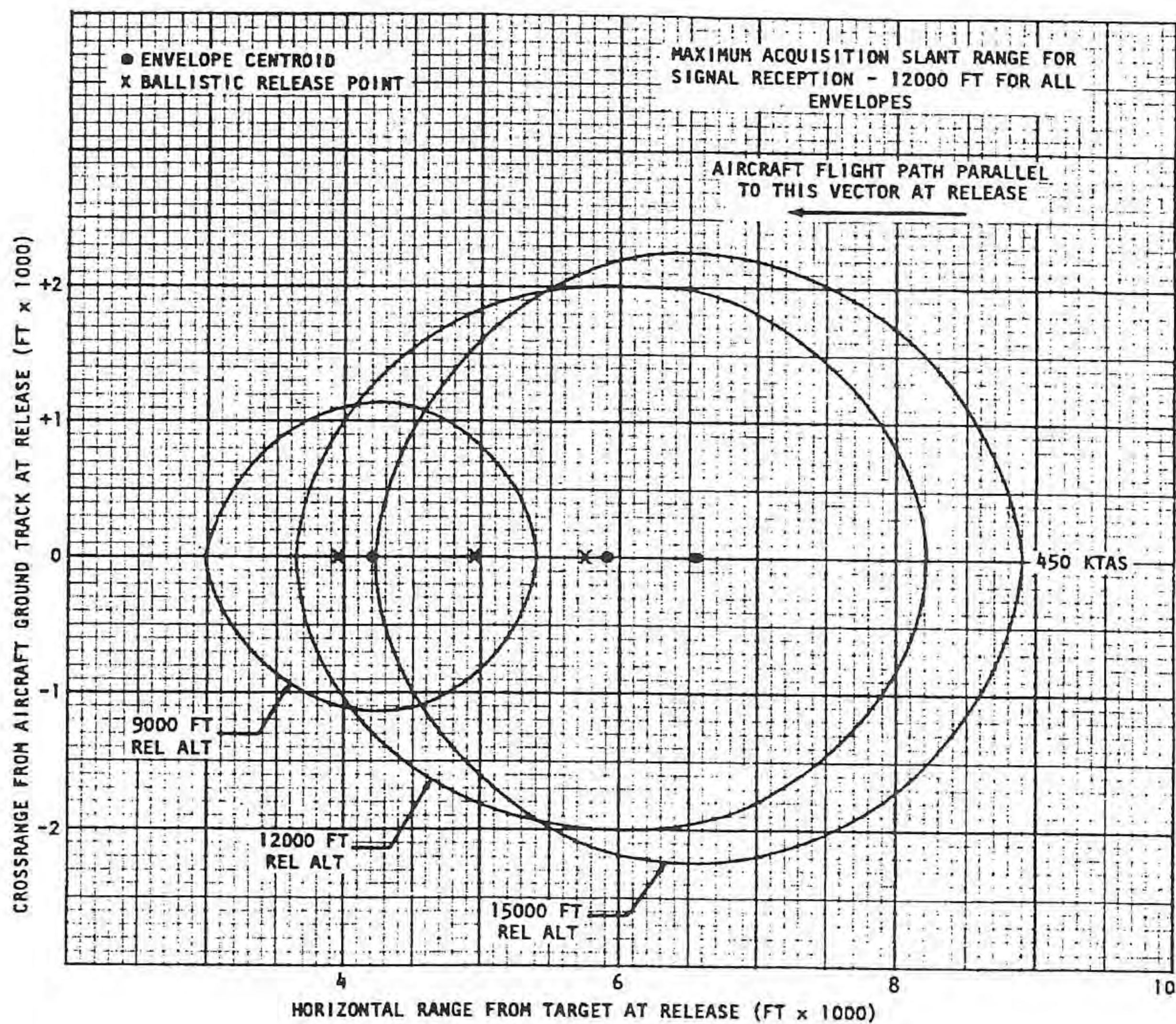
MK-82 (39 INCH TAIL FIN) LASER GUIDED BOMB
60° DIVE RELEASE



1A-10A-34-1-1-7-35

Figure 7-8. GBU-12A/B RELEASE ENVELOPES - TOP VIEW (Sheet 9 of 10)

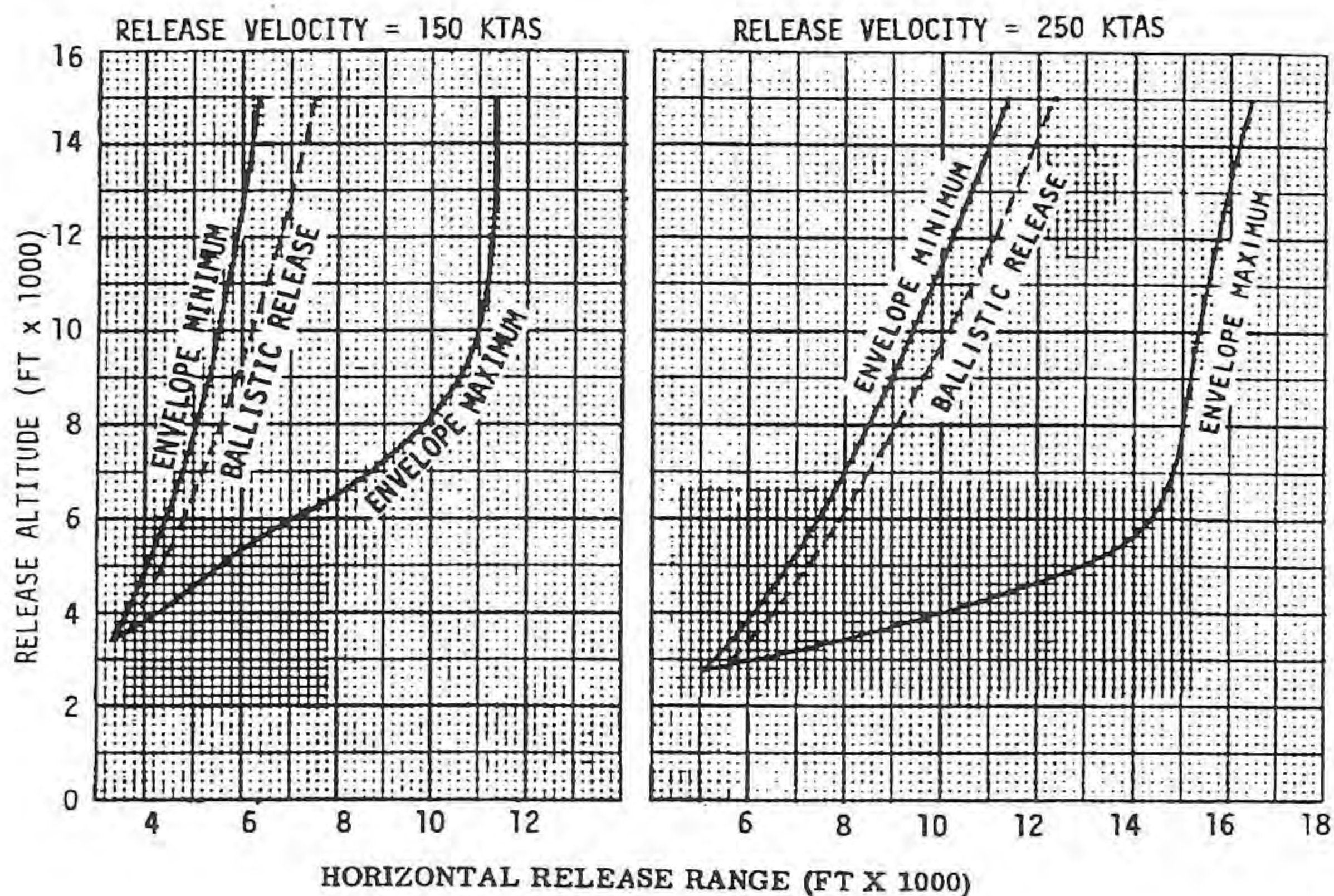
MK-82 (39 INCH TAIL FIN) LASER GUIDED BOMB
60° DIVE RELEASE



1A-10A-34-1-1-7-36

Figure 7-8. GBU-12A/B RELEASE ENVELOPES - TOP VIEW (Sheet 10 of 10)

MK-82 (39 INCH TAIL FIN) LASER GUIDED BOMB
DIVE ANGLE = 0°

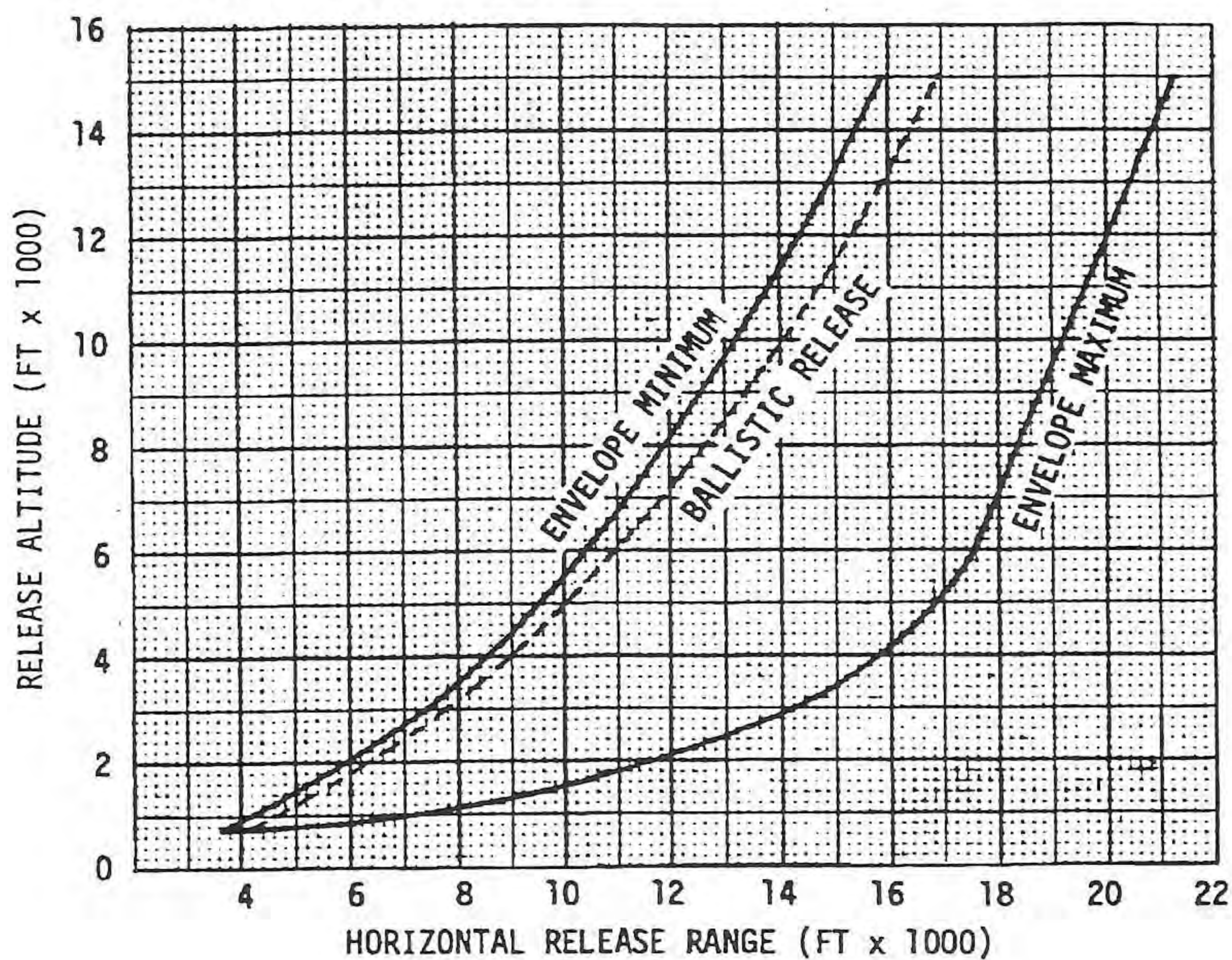


1A-10A-34-1-7-37

Figure 7-9. GBU-12A/B RELEASE ENVELOPES - PROFILE (Sheet 1 of 13)

MK-82 (39 INCH TAIL FIN) LASER GUIDED BOMB
DIVE ANGLE = 0°

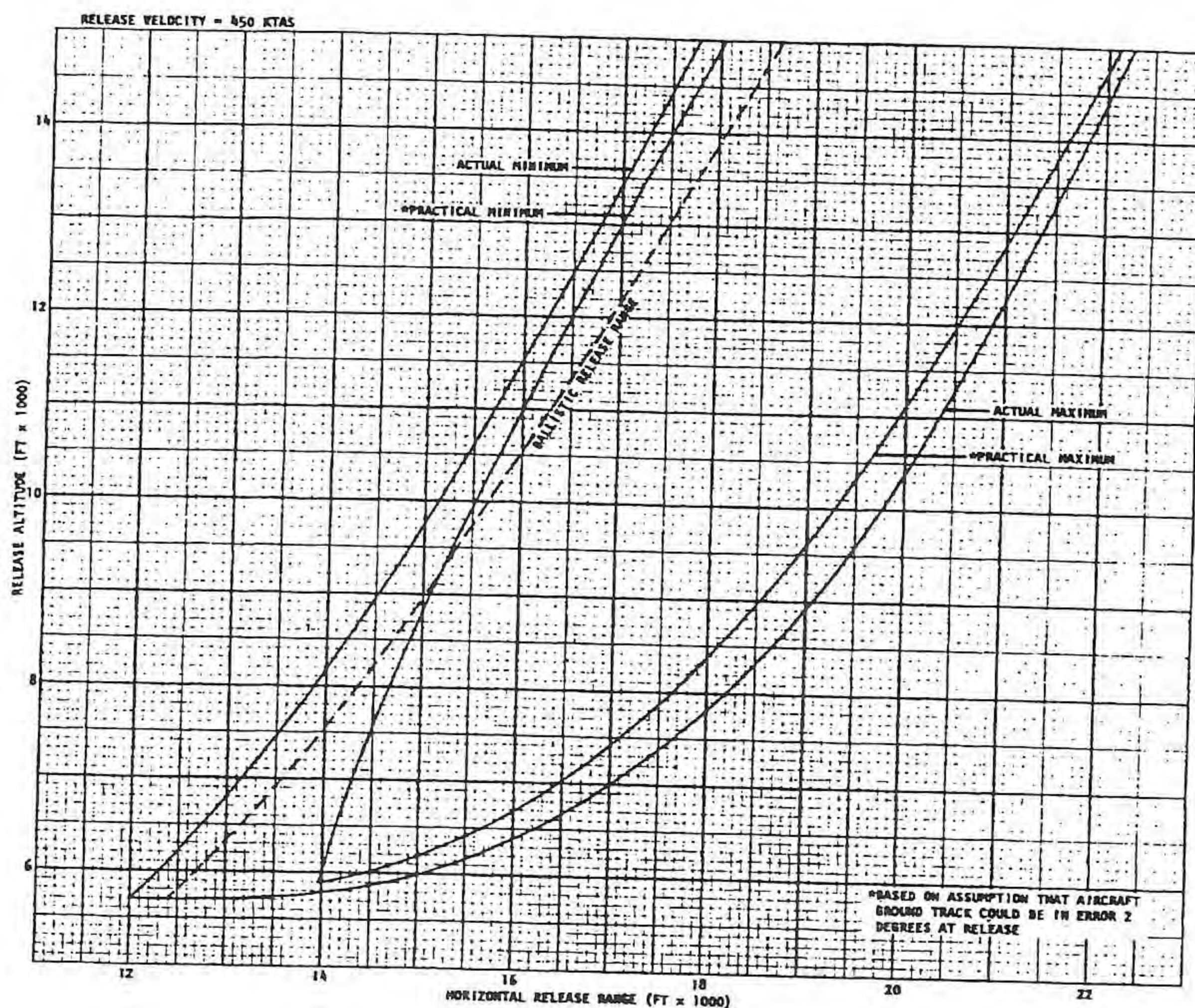
RELEASE VELOCITY = 350 KTAS



1A-10A-34-1-1-7-38

Figure 7-9. GBU-12A/B RELEASE ENVELOPES - PROFILE (Sheet 2 of 13)

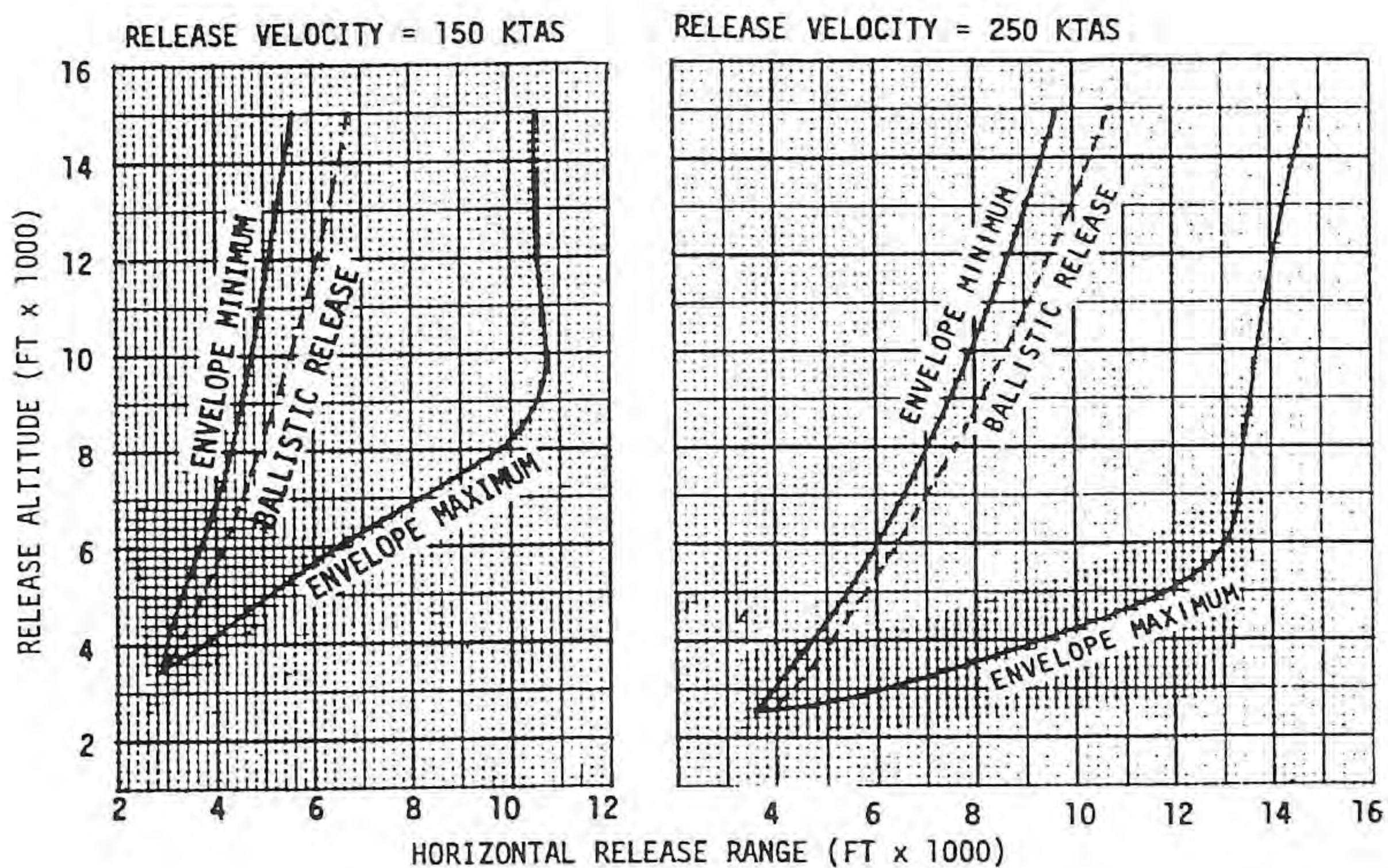
MK-82 (39 INCH TAIL FIN) LASER GUIDED BOMB
DIVE ANGLE = 0°



1A-10A-34-1-1-7-39

Figure 7-9. GBU-12A/B RELEASE ENVELOPES - PROFILE (Sheet 3 of 13)

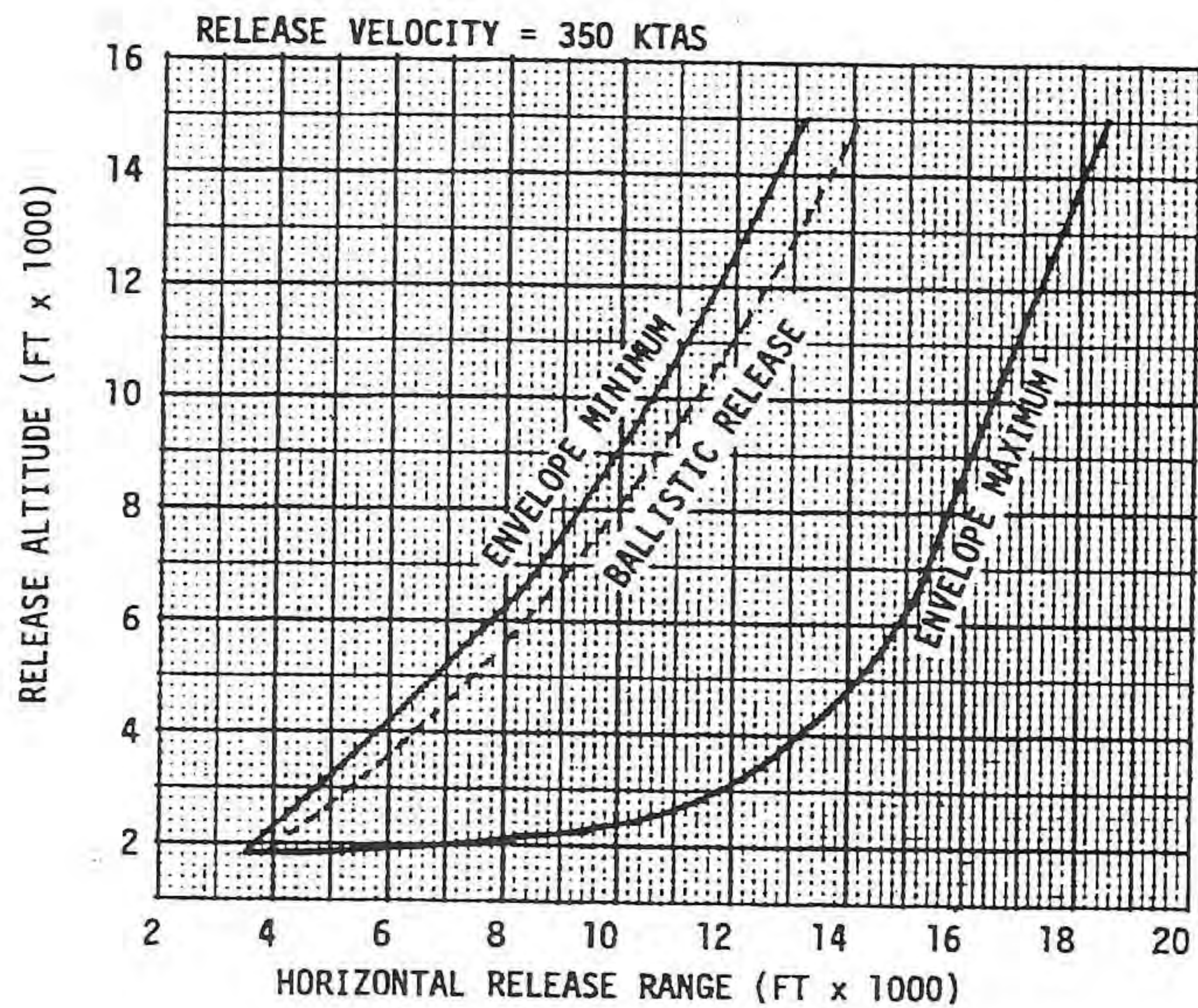
MK-82 (39 INCH TAIL FIN) LASER GUIDED BOMB
DIVE ANGLE = 15°



1A-10A-34-1-1-7-40

Figure 7-9. GBU-12A/B RELEASE ENVELOPES - PROFILE (Sheet 4 of 13)

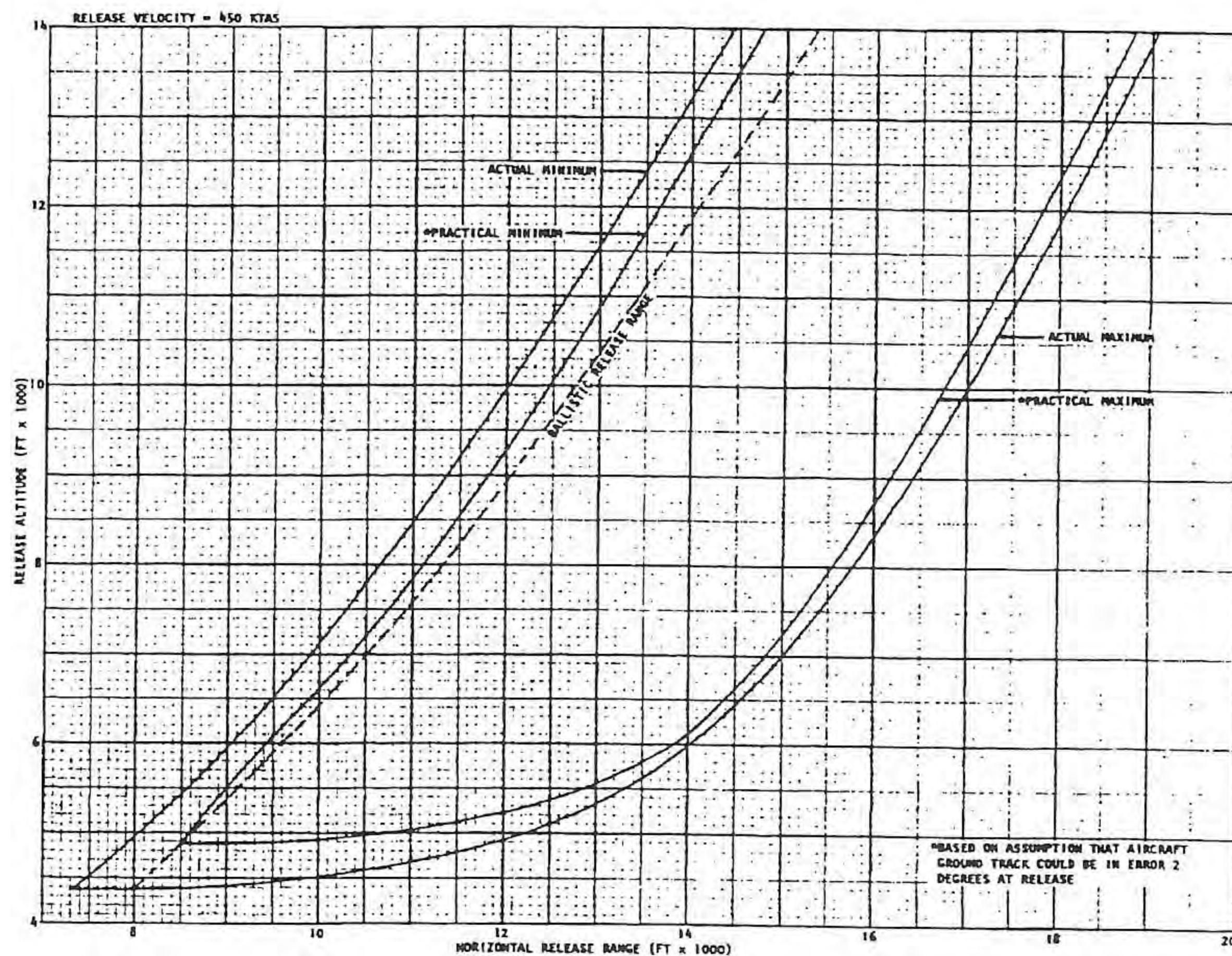
MK-82 (39 INCH TAIL FIN) LASER GUIDED BOMB
DIVE ANGLE = 15°



1A-10A-34-1-1-7-41

Figure 7-9. GBU-12A/B RELEASE ENVELOPES - PROFILE (Sheet 5 of 13)

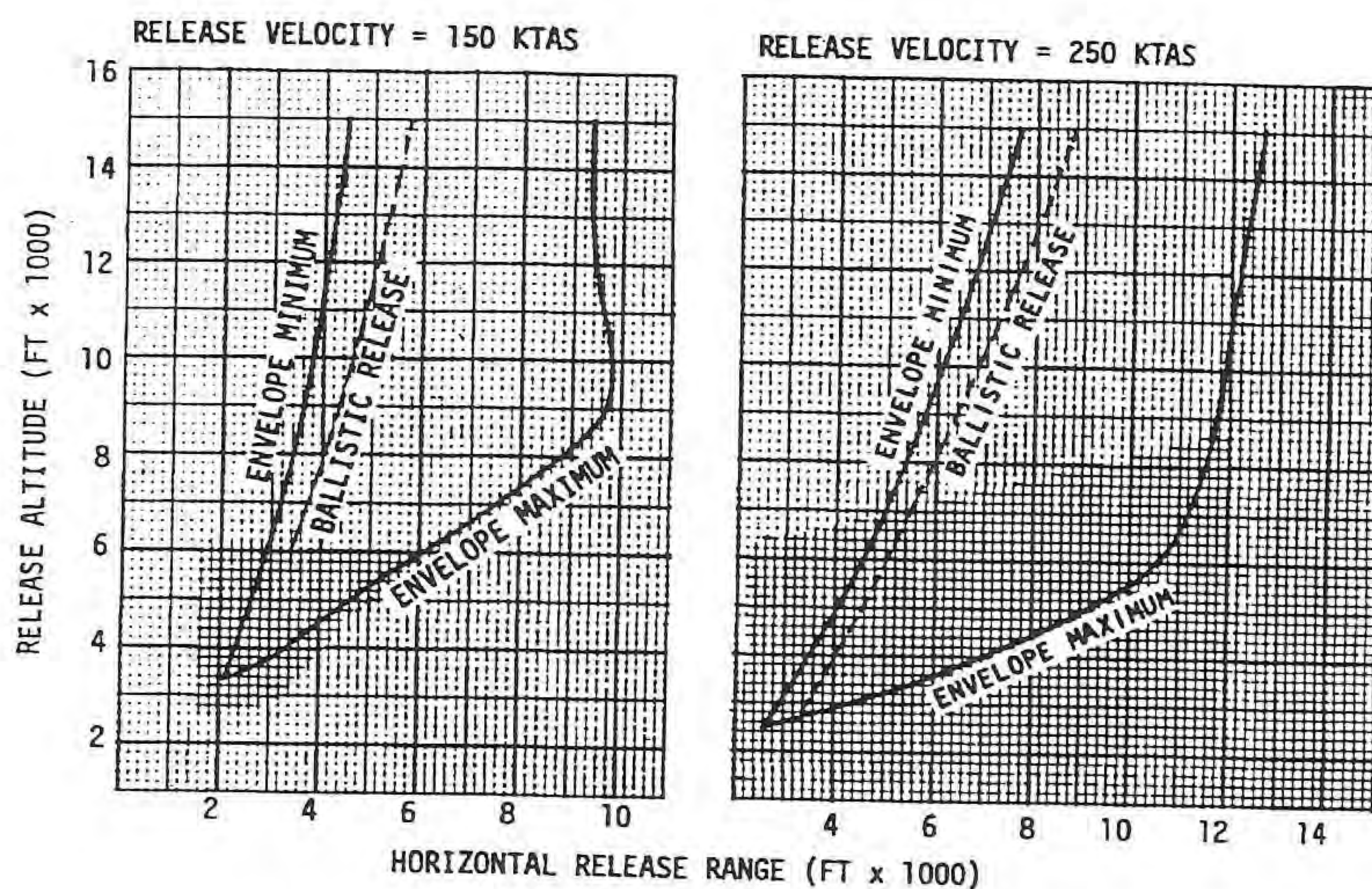
MK-82 (39 INCH TAIL FIN) LASER GUIDED BOMB
DIVE ANGLE = 15°



1A-10A-34-1-1-7-42

Figure 7-9. GBU-12A/B RELEASE ENVELOPES - PROFILE (Sheet 6 of 13)

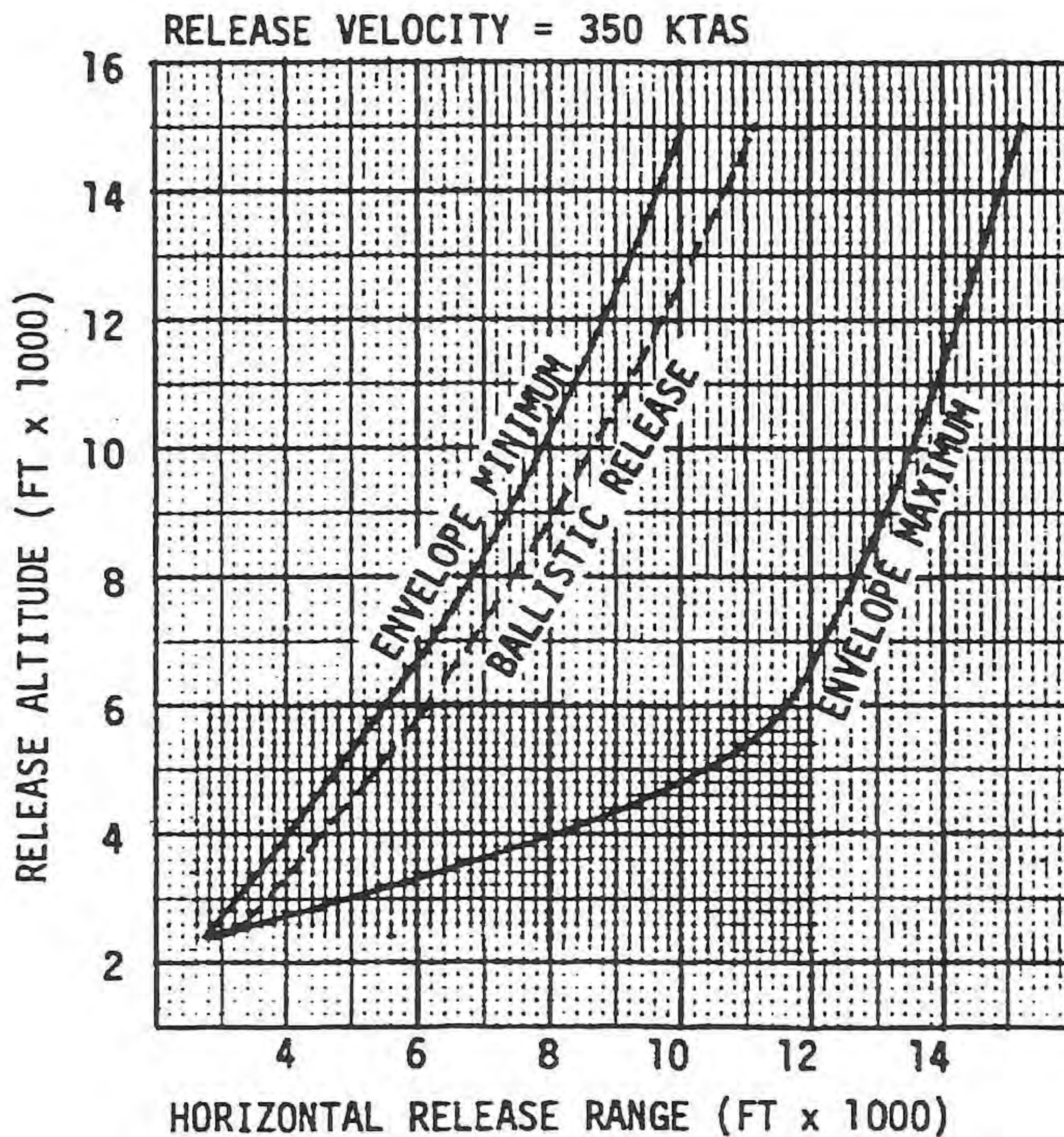
MK-82 (39 INCH TAIL FIN) LASER GUIDED BOMB
DIVE ANGLE = 30°



1A-10A-34-1-1-7-43

Figure 7-9. GBU-12A/B RELEASE ENVELOPES - PROFILE (Sheet 7 of 13)

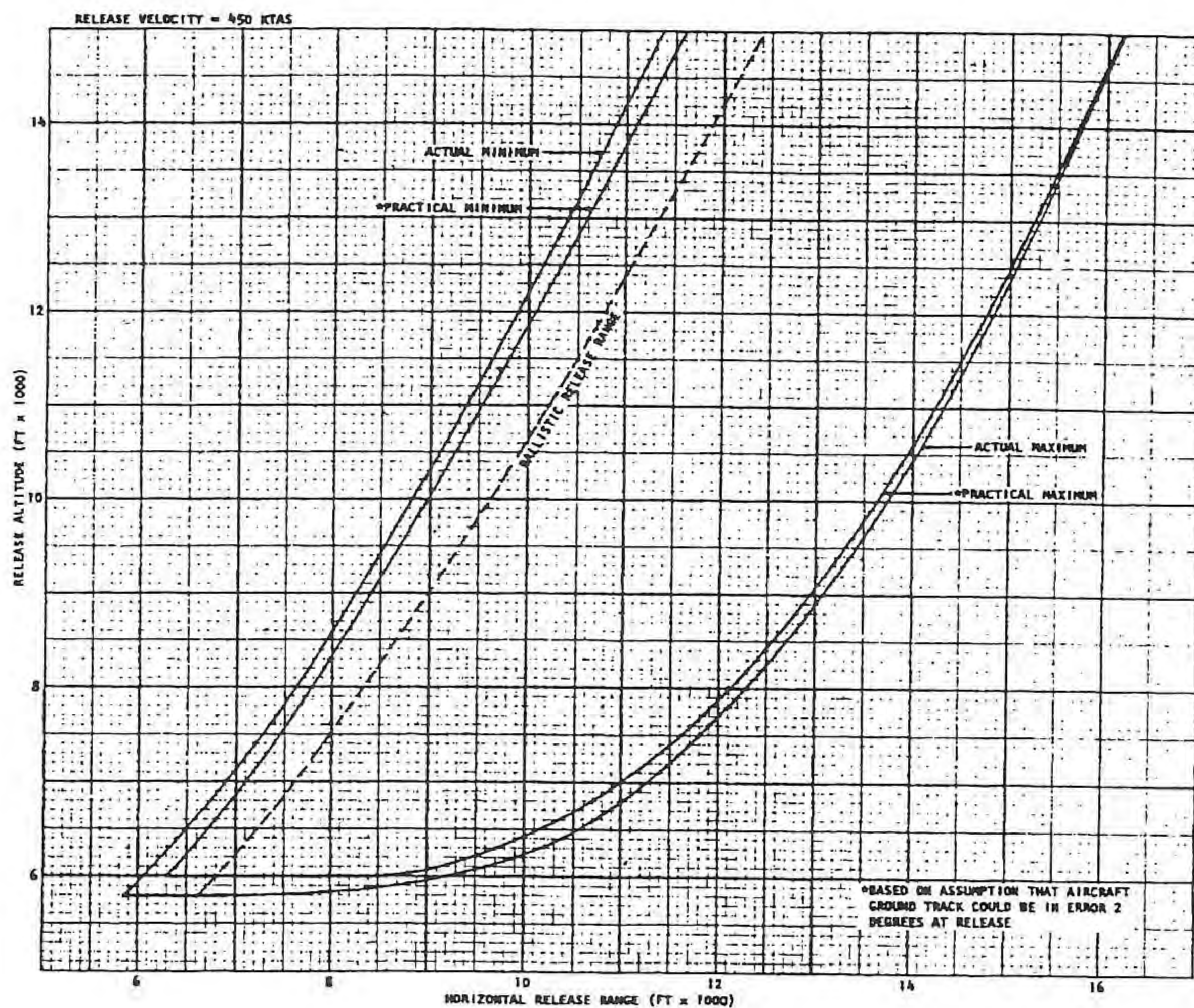
MK-82 (39 INCH TAIL FIN) LASER GUIDED BOMB
DIVE ANGLE = 30°



1A-10A-34-1-1-7-44

Figure 7-9. GBU-12A/B RELEASE ENVELOPES - PROFILE (Sheet 8 of 13)

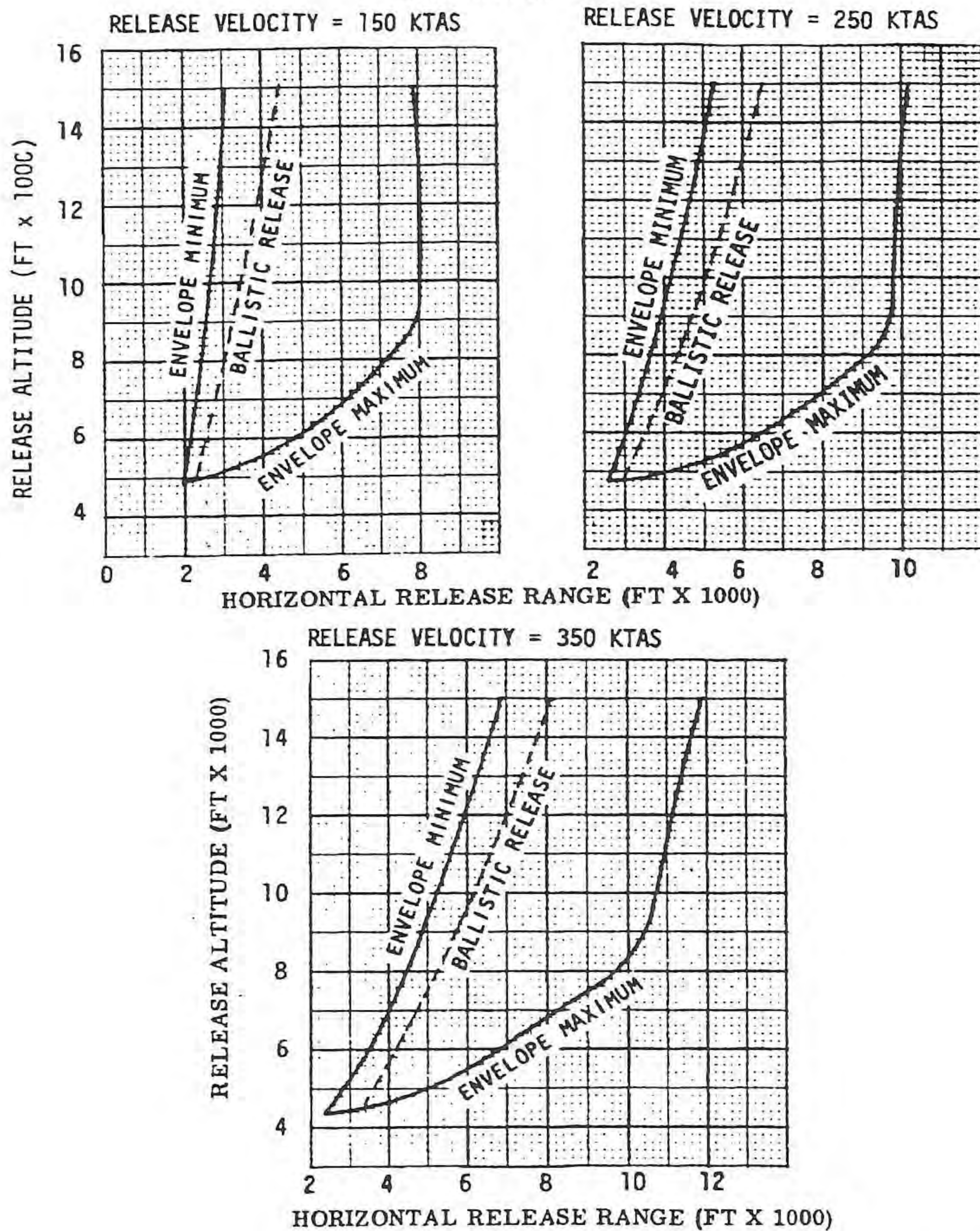
MK-82 (39 INCH TAIL FIN) LASER GUIDED BOMB
DIVE ANGLE = 30°



1A-10A-34-1-1-7-45

Figure 7-9. GBU-12A/B RELEASE ENVELOPES - PROFILE (Sheet 9 of 13)

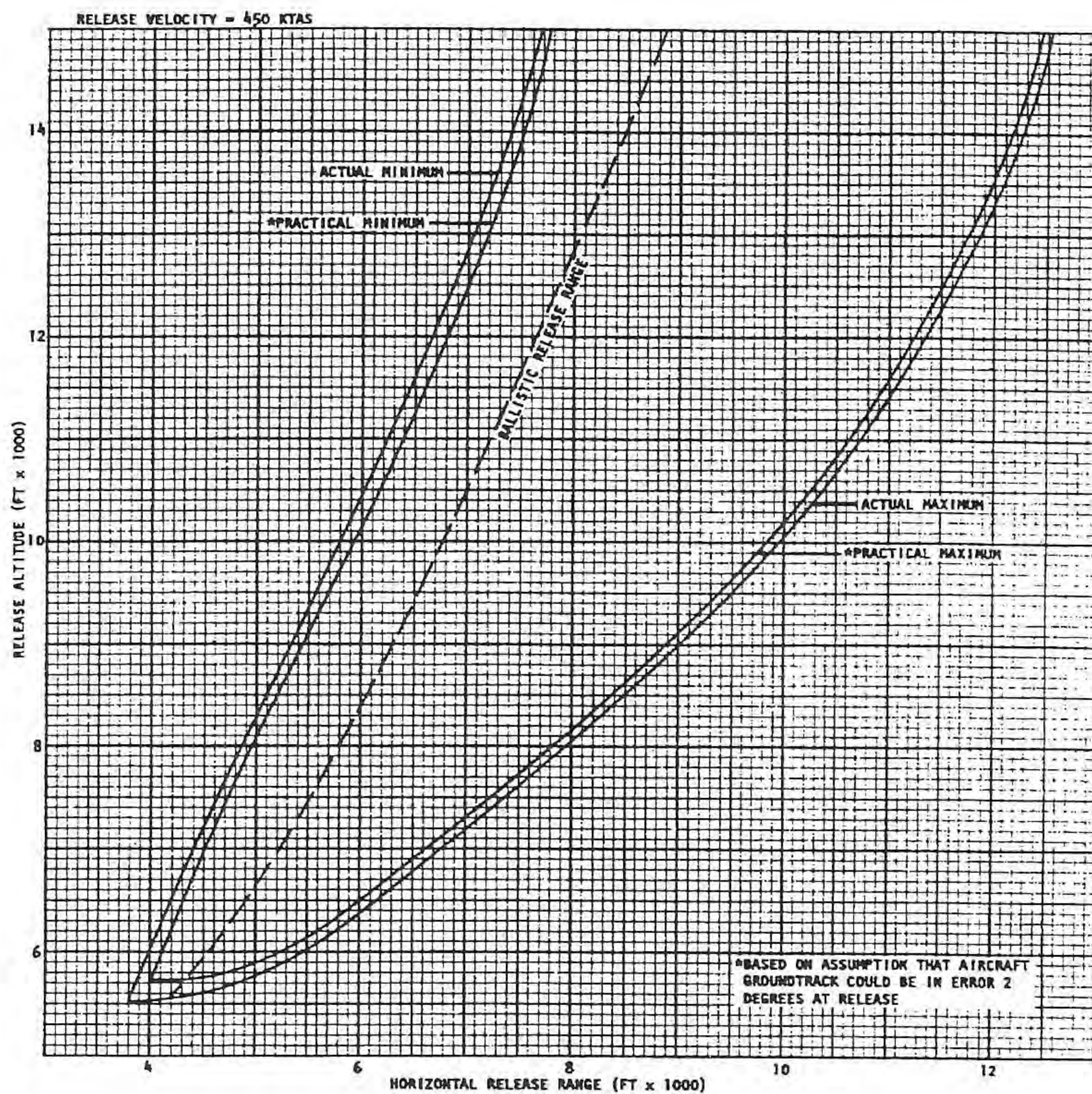
MK-82 (39 INCH TAIL FIN) LASER GUIDED BOMB
DIVE ANGLE = 45°



1A-10A-34-1-1-7-46

Figure 7-9. GBU-12A/B RELEASE ENVELOPES - PROFILE (Sheet 10 of 13)

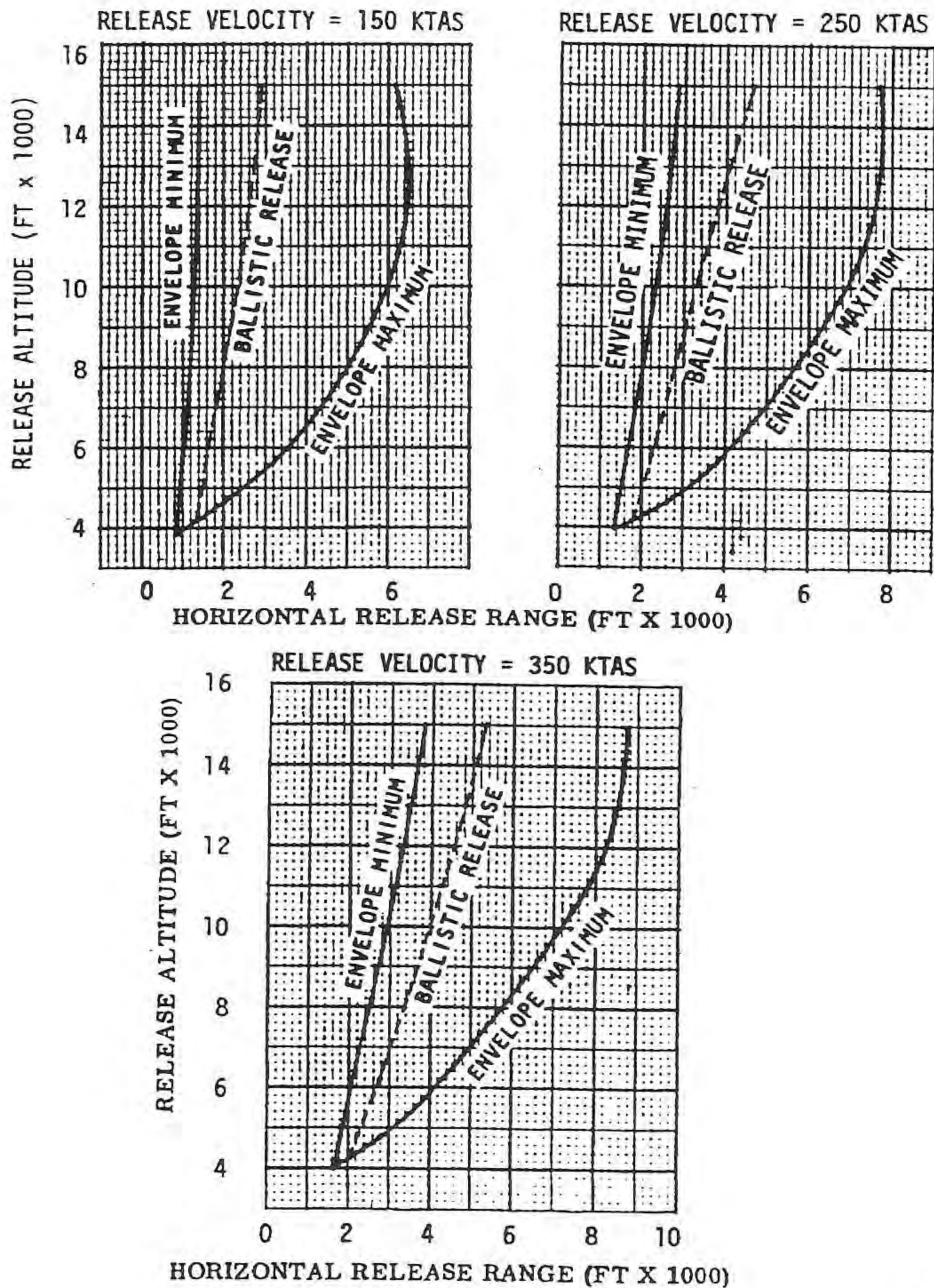
MK-82 (39 INCH TAIL FIN) LASER GUIDED BOMB
DIVE ANGLE = 45°



1A-10A-34-1-1-7-47

Figure 7-9. GBU-12A/B RELEASE ENVELOPES - PROFILE (Sheet 11 of 13)

MK-82 (39 INCH TAIL FIN) LASER GUIDED BOMB
DIVE ANGLE = 60°

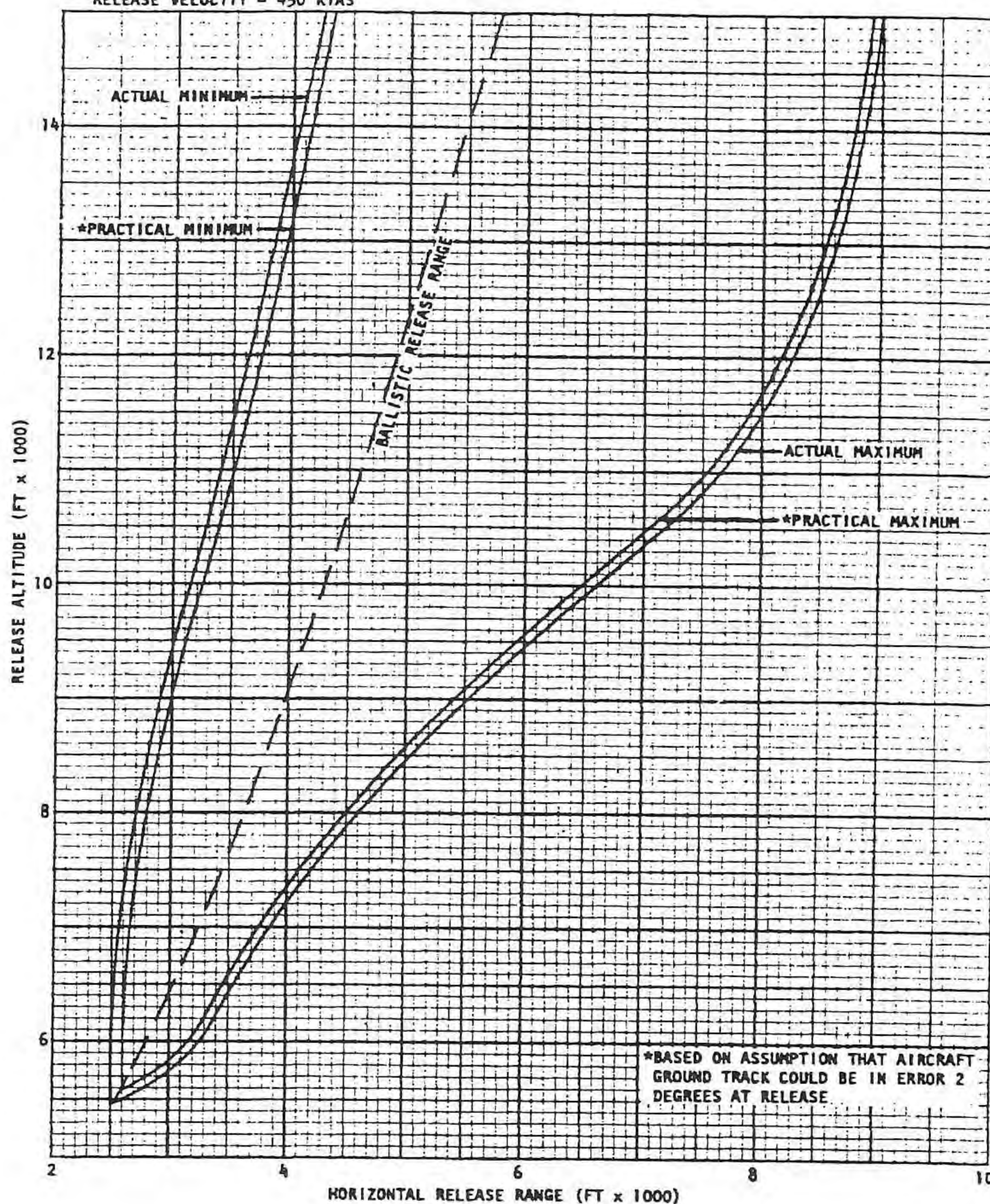


1A-10A-34-1-1-7-48

Figure 7-9. GBU-12A/B RELEASE ENVELOPES - PROFILE (Sheet 12 of 13)

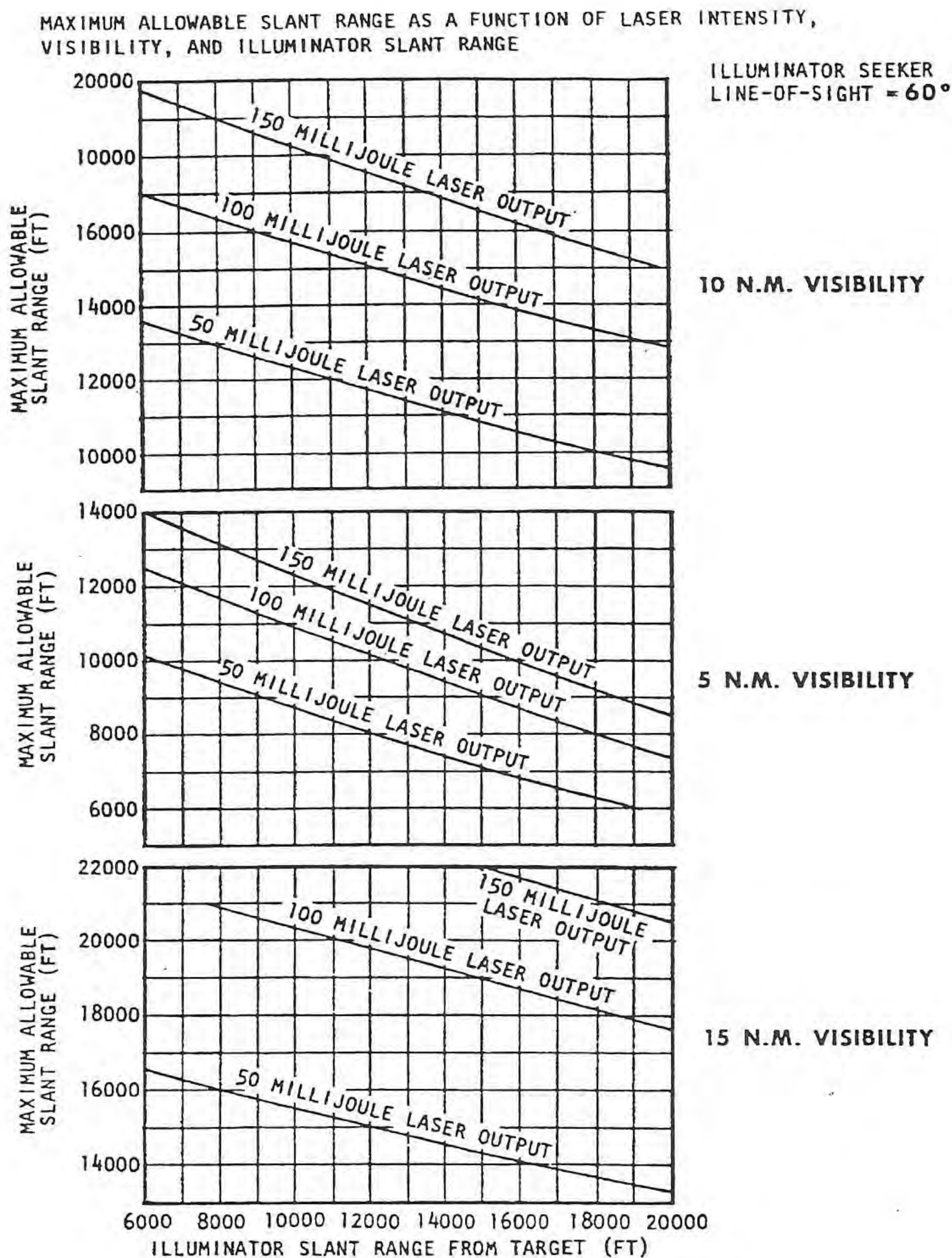
MK-82 (39 INCH TAIL FIN) LASER GUIDED BOMB
DIVE ANGLE = 60°

RELEASE VELOCITY = 450 KTAS



1A-10A-34-1-1-7-49

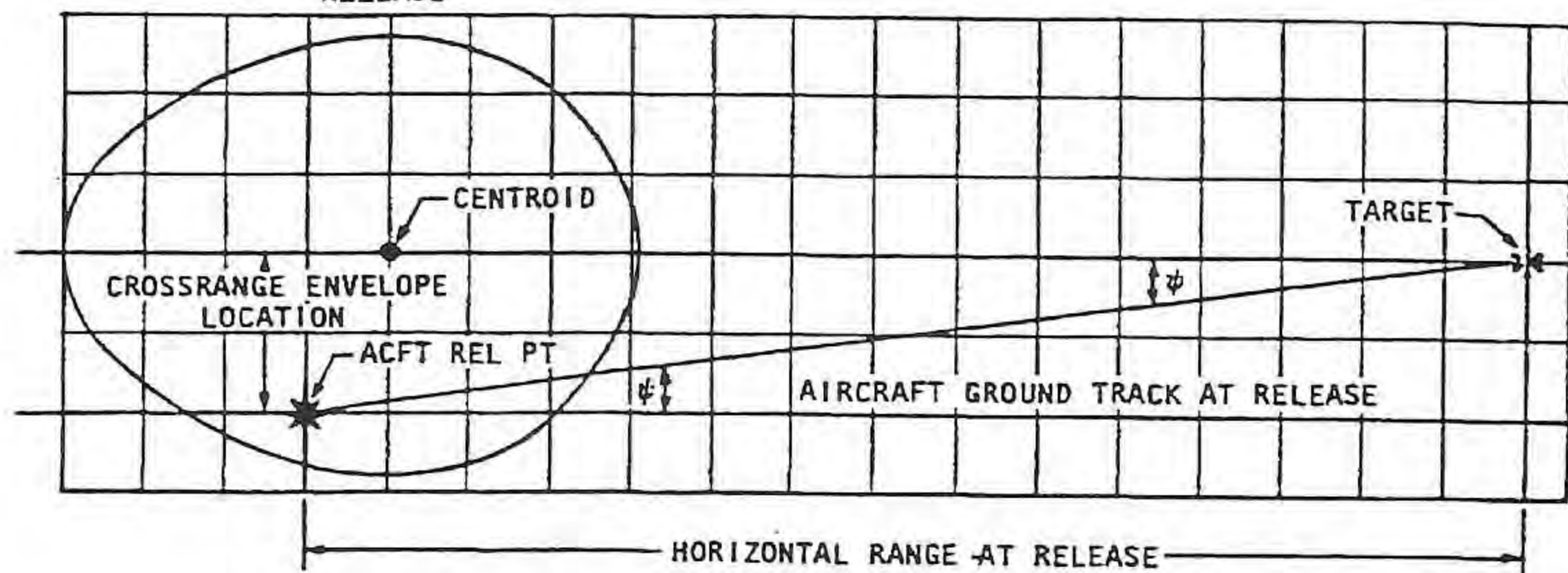
Figure 7-9. GBU-12A/B RELEASE ENVELOPES - PROFILE (Sheet 13 of 13)



1A-10A-34-1-1-7-50

Figure 7-10. EFFECT OF ACQUISITION SLANT RANGE

METHOD FOR DETERMINING (a) CROSSRANGE ENVELOPE LOCATION
FOR A GIVEN AZIMUTH ANGLE ERROR OR (b) ALLOWABLE
AZIMUTH ANGLE ERROR FOR A GIVEN HORIZONTAL RANGE AT
RELEASE



$$\text{CROSSRANGE ENVELOPE LOCATION} = (\text{HORIZONTAL RANGE AT RELEASE}) \times \tan \psi$$

$$\text{ALLOWABLE AZIMUTH ANGLE ERROR} = \text{ARCTAN} \left(\frac{\text{ENVELOPE HALF-WIDTH AT RELEASE}}{\text{HORIZONTAL RANGE AT RELEASE}} \right)$$

1A-10A-34-1-1-7-51

Figure 7-11. AZIMUTH ANGLE & CROSS RANGE ERROR LGB

In the last two columns, sight depressions from flight path are given; one positions the aircraft at the envelope centroid, the other positions the aircraft at the ballistic horizontal range. (When using the Direct Release mode, fuselage angle of attack must be added to the sight depression value.)

In Figure 7-13 (Sheets 2, 4, 6 of 6), the first three columns repeat the planned release conditions. The next eight columns identify the weapon position where the weapon first initiates guidance; this is the acquisition point. The acquisition point is identified for a weapon released within the envelope at the maximum and minimum acceptable release points. Four conditions must be satisfied before guidance can be initiated:

- a. Weapon time of fall must be 3.5 seconds or greater.
- b. The target must be within the 12° half-cone angle field of view.
- c. Slant range from weapon to target must be equal to or smaller than the maximum allowable acquisition slant range.
- d. The weapon must be below any overcast.

Thus, the parameters given are for the first point in the weapon trajectory where all of these conditions are initially satisfied.

The next column labeled Average Cross Range gives a representative cross range guidance capability for a weapon released roughly in the center one-half of the envelope. The columns labeled Time of Fall give the time of fall for release at the maximum and minimum release points respectively.

RELEASE ENVELOPES

Two views of the release envelope are presented. The top view (Figure 7-8) indicates the effect that the horizontal release range has on the actual cross range guidance capability at the selected release altitude, dive angle, and airspeed.

The horizontal ranges (Figure 7-9) are also presented: minimum, ballistic (with an X), centroid (with a dot), and the maximum range.

The profile plot is shown through the center of the envelope along the aircraft flight path. The profile indicates the effect that altitude has upon the horizontal range at the selected release dive angle and airspeed. Two release envelopes are shown: the maximum and the practical. The maximum envelope assumes 0° ground track error (zero

feet cross range error) at release. The practical envelope assumes no more than 2° azimuth ground track error at release. The optimum release range is the center of the practical envelope.

The dashed line indicates the ballistic release range and altitude.

EFFECT OF ACQUISITION SLANT RANGE

The strength of the reflected laser energy at the bomb seeker head is primarily a function of the following

- a. Illuminator output energy.
- b. Atmospheric scattering and absorption.
- c. Target reflectivity.
- d. Illuminator slant range to target.
- e. Bomb slant range to target.
- f. Illumination and reflection angles.

Figure 7-13

Figure 7-10 illustrates the maximum acquisition slant range using the following parameters:

- a. Illuminator output energy of 50, 100, 150 millijoules.
- b. Atmospheric scattering and absorption (measured in terms of visibility) for 5, 10, and 15 nautical mile visibility.
- c. Illuminator slant range (independent variable).
- d. A constant target reflectivity of 0.4 is assumed, along with an average 60° angle between the line of incidence and the line of reflection.

The envelope size (and therefore the centroid location) is a strong function of the maximum allowable acquisition slant range. Although it is too involved to generate envelopes with several values of maximum acquisition slant range for each release condition, some general guidelines can be established:

- a. For smaller acquisition slant range values (less than 12,000 feet), the envelopes become smaller in area and the centroid approaches the ballistic release point.
- b. If the acquisition slant range distance for the maximum envelope point listed in the ballistic table data is less than the actual slant range capability available, there is no need to adjust the release centroid listed in the table.
- c. If the acquisition slant range distance for the maximum envelope point listed in the ballistic table

data is greater than the actual slant range capability available, then the listed centroid should be moved closer to the ballistic release point. (The ballistic release point is actually the centroid location for 0.0 feet acquisition slant range.) A good rule is to move the centroid a distance determined by computing the ratio of the actual acquisition slant divided by 12,000 feet. For example, if the actual acquisition slant range (obtained from Figure 7-10) is only 6,000 feet, then the adjusted centroid should be placed midway

$$\frac{6000}{12000} = 1/2$$

between the old centroid and the ballistic release point. (Remember that the basket also becomes much smaller.) Similarly, if the actual acquisition slant range is 8,000 feet, then the adjusted centroid should be moved closer to the ballistic point by a distance equal to one-third

$$1 - \frac{8000}{12000} = 1 - 2/3 = 1/3$$

of the total distance between the old centroid and the ballistic release point. The total envelope length should decrease by roughly twice the distance through which the centroid is moved.

- d. For acquisition slant ranges greater than 12,000 feet, the envelopes become larger and the centroid moves further downrange from the target in most cases. There are two notable exceptions to this rule:
 - (1) The envelope is not affected by making the maximum allowable acquisition slant range greater than the bomb slant range at 3.5 seconds after release, since the bomb cannot begin guidance before release or during the first 3.5 seconds following release.
 - (2) It is also possible to actually decrease the envelope size and shorten the downrange centroid distance by having too large an acquisition slant range. This occurs in the level and shallow dive angle releases. What actually happens is that, by acquiring early, the bomb is forced to fly a glide angle less than its capability. By holding off acquisition until a later time, the bomb is closer to the target and at a steeper dive angle.

EFFECT OF FIN DAMPER VALUES ON ENVELOPE SIZE AND POSITION

The canard damper induces sustained weapon oscillations during the ballistic portion of flight. The net effect of such oscillations is to decrease the weapon speed, which in turn decreases the downrange travel and maneuvering capability of the weapon. For release conditions which produce very little ballistic flight (e. g., 45° dive at 12000 feet) the damper effect is minor. However, for high altitude level releases which result in long ballistic trajectories before guidance is initiated, variations in the damper constant can significantly alter both the envelope size and downrange position. Presently, most dampers have a torque constant between 6 ft-lb/rad/sec and 14 ft-lb/rad/sec, with a median of about 10 ft-lb/rad/sec. Thus, ballistic tables represent the guidance capabilities of the average bomb. If the damper constant values were restricted between 5 ft-lb/rad/sec and 8 ft-lb/rad/sec, the ballistic tables would be representative of the worst case for weapon maneuverability. The revised envelopes would, in general, be somewhat larger and shifted a little downrange from the target.

EFFECT OF WINDS ON LASER GUIDED BOMB TRAJECTORIES

The effect of winds on the trajectory of the laser guided bomb is significantly different and more complicated than that for purely ballistic bomb. Corrections for wind effects are to be made by both the delivery aircraft and the illuminator aircraft.

The delivery aircraft should correct according to the effect of the wind velocity on ground speed. Two methods of correction are described. An aircraft flying at 400 KTAS level into a 20 knot headwind has a ground speed of 380 knots, and should release at the centroid position of the appropriate 380 knot envelope, rather than that of the 400 knot envelope. A simple linear interpolation, using the values given in the table, provides a sufficiently accurate release range and mil setting. This method is applicable to dives by adding the wind speed (or wind components) to the aircraft horizontal velocity component. For a delivery dive angle of 45° or greater, the envelope does not shift a sufficient amount to necessitate a correction. Another method of correction consists of increasing or decreasing the aircraft speed in order to obtain the correct ground velocity. In the example, the aircraft speed should be increased to 420 KTAS, giving a ground velocity of 400 knots. The advantage of this method is that no interpolations are necessary.

The total velocity of the aircraft relative to the earth determines which release envelope should be used. The methods given above are therefore rigorously valid only for level releases; in a dive, the horizontal velocity component should be corrected, but not the vertical component. In a dive, however, the wind effect is smaller, so that correcting the total velocity (and not just the horizontal component) should be sufficiently accurate.

The second part of the wind correction procedure must be accomplished by the illuminator aircraft and is intended to compensate for the effect of winds on the guided portion of the guided bomb trajectory.

The method of correction for laser guided bombs during the guided portion of the trajectory differs from that for ballistic bombs because of the nature of the error source. In very general terms, guided bomb errors result from the fact that the seeker is measuring line of sight errors in the direction of the bomb's velocity vector relative to the airstream whereas in reality, the bomb is moving in a somewhat different direction (relative to the ground) due to the velocity of the air mass. Thus, when the seeker measures no errors (supposedly in indication that the bomb is moving directly toward the target), the bomb is actually traveling in a different direction, the degree of difference depends upon the magnitude and direction of the wind.

Since the wind magnitude and direction vary with altitude, it must be determined what altitude level is most sensitive in determining weapon miss distance. Computations show that the winds in the 2,000 to 4,000-foot altitude range affect the weapon trajectory far more than winds at higher altitudes. Therefore, the wind magnitude and direction to be used in any type of wind correction should be the average expected wind occurring in this altitude layer.

Since the delivery, aircraft cannot compensate for this occurrence, the illuminator aircraft must correct by offsetting the spot from the target. The magnitude of the offset should equal the net magnitude of the weapon miss dis-

tance, and the direction of the offset should be opposite that of the weapon miss distance.

NOTE

Extreme care should be used when offsetting the illuminator from the target to correct for winds. In particular, the area being illuminated must possess a sufficient degree of reflectivity in the direction of the bomb trajectory. For example, offsetting a laser spot onto a water surface when bombing a bridge would probably result in a completely ballistic trajectory since very little laser energy is reflected along the direction of the bomb line of sight.

COMPUTATION OF MAXIMUM ALLOWABLE AZIMUTH ANGLE/CROSS RANGE ERROR AT RELEASE

Figure 7-11 graphically depicts two methods of obtaining useful information from the cross range envelope data. The aircraft ground track at release should pass through the target. Any deviation from this condition will be called azimuth angle error. The Figure, shows that an azimuth angle error can be converted into a cross range error or vice versa. The following description indicates methods by which these conversions can be accomplished.

1. To convert expected envelope cross range error into azimuth angle error, a determination should be made of the expected downrange error (how far the A/C will miss the centroid in downrange): this number is added or subtracted from the centroid value, and the maximum available cross range at this downrange is then read from the appropriate envelope plot. The maximum allowable azimuth angle error is then computed using the second expression at the bottom of Figure 7-11.
2. Conversely, a good estimate of the azimuth error at release permits a determination of the resulting cross range error in the release envelope. The acceptable release points can be determined by computing a cross range error, using the first expression at the bottom of Figure 7-11.

LEVEL AND DIVE BALLISTIC TABLES

GBU-10A/B, B/B

MK-84 (54 INCH TAIL FIN) LASER GUIDED BOMB
OIL AND SPRING DAMPERS
MAXIMUM ALLOWABLE ACQUISITION SLANT RANGE OF 12000 FT
NO EJECTION VELOCITY, NO OVERCAST

RELEASE CONDITIONS			HORIZONTAL RANGE				IMPACT VELOCITY		IMPACT ANGLE		SIGHT DEPRESSION	
SPEED (KTAS)	ALT (FT)	D ANG (DEG)	MAX (FT)	MIN (FT)	CENT. (FT)	BALLIST. (FT)	MAX (FT/SEC)	MIN (FT/SEC)	MAX (DEG)	MIN (DEG)	CENT. (MILS)	BALL. (MILS)
350	6000	0	13356	10520	11938	11120	715.1	775.6	25.6	50.3	466	495
150	9000	0	7295	5219	6257	5894	713.5	746.9	50.8	80.5	963	991
250	9000	0	11870	9089	10480	9764	746.5	790.7	38.0	67.5	709	745
350	9000	0	17994	12813	15474	13563	789.3	859.2	25.3	56.8	527	586
150	12000	0	10043	5890	7966	6790	793.5	840.2	47.0	79.7	985	1056
250	12000	0	15041	10420	12761	11245	812.1	881.9	34.0	68.0	755	818
350	12000	0	19821	14718	17384	15618	856.4	938.4	27.8	61.0	604	655
150	15000	0	11115	6358	8812	7576	860.0	915.6	44.2	84.1	1039	1103
250	15000	0	16394	11465	13981	12545	882.9	953.8	35.4	72.3	820	874
350	15000	0	21476	16308	18947	17428	940.6	1911.7	31.9	65.0	670	711
350	6000	15	13019	7888	10195	8488	712.8	781.1	22.5	51.3	270	353
150	9000	15	6580	4555	5592	5230	724.6	747.9	54.2	80.0	755	782
250	9000	15	10355	7525	8940	8200	748.0	796.4	38.5	67.5	527	570
350	9000	15	15227	10067	12718	10817	786.8	862.6	23.6	57.7	354	432
150	12000	15	9317	5193	7283	6093	793.3	838.9	47.3	80.8	763	839
250	12000	15	13360	8723	11100	9623	824.8	876.1	37.9	73.2	562	633
350	12000	15	16987	11806	14512	12781	856.9	941.2	26.4	65.8	429	492
150	15000	15	10292	5644	8019	6849	866.1	912.6	47.7	82.2	818	881
250	15000	15	14681	9814	12298	10874	891.9	953.7	38.6	72.6	622	682
350	15000	15	18496	13413	15981	14512	944.0	1011.7	31.5	64.0	492	540

Figure 7-12. (Sheet 1 of 6)

LEVEL AND DIVE BALLISTIC TABLES

7-62

GBU-10A/B, B/B

MK-84 (54 INCH TAIL FIN) LASER GUIDED BOMB

OIL AND SPRING DAMPERS

MAXIMUM ALLOWABLE ACQUISITION SLANT RANGE OF 12000 FT

NO EJECTION VELOCITY, NO OVERCAST

RELEASE CONDITIONS		ACQUISITION TIME			ACQ. ALT		ACQ. SLANT RANGE FOR		ACQ. FLIGHT PATH ANGLE FOR		AVRG. CROSS	TIME OF FALL	
SPEED (KTAS)	ALT (FT)	D ANG (DEG)	MAX PT. (FT)	MIN PT. (FT)	MAX (FT)	MIN (FT)	MAX (FT)	MIN (FT)	MAX (FT)	MIN (FT)	RANGE (FT)	MAX (SEC)	MIN (SEC)
350	6000	0	5.30	12.4	5544	3563	12000	4908	16.3	34.6	1483	22.88	19.21
150	9000	0	7.50	15.60	8090	5122	9732	5292	43.8	63.5	1985	25.44	23.84
250	9000	0	7.80	16.40	8019	4742	12000	5282	31.1	51.9	2269	26.60	23.79
350	9000	0	13.37	15.80	6167	5062	12000	6301	36.7	41.5	3681	29.28	23.75
150	12000	0	11.95	16.70	9709	7556	12000	7751	56.9	65.0	3476	30.67	27.67
250	12000	0	15.33	17.80	8263	6984	12000	7635	50.0	54.2	3817	31.60	27.62
350	12000	0	17.69	18.40	7071	6673	12000	7882	44.7	45.9	4281	32.20	27.59
150	15000	0	17.78	19.50	9962	8956	12000	9083	66.4	68.3	4403	33.75	31.06
250	15000	0	19.88	20.50	8749	8362	12000	8896	57.2	58.0	4354	34.46	31.00
350	15000	0	21.56	21.60	7715	7687	12000	8664	50.5	50.6	4346	34.84	30.95
350	6000	15	3.87	7.90	5167	3811	12000	5145	26.1	35.8	1532	21.56	15.01
150	9000	15	5.70	13.10	8100	5411	9624	5589	45.7	63.6	2056	23.38	21.91
250	9000	15	4.30	13.00	8230	4917	12000	5443	31.6	52.7	2397	23.44	20.62
350	9000	15	9.00	11.20	6350	5329	12000	6555	38.1	42.4	3760	24.86	19.46
150	12000	15	9.86	14.70	9794	7602	12000	7781	57.6	65.8	3655	28.66	25.73
250	12000	15	11.99	16.10	8413	6173	12000	6593	50.9	57.5	3928	28.28	24.41
350	12000	15	13.29	15.10	7213	6152	12000	7046	46.0	48.8	4337	27.74	23.22
150	15000	15	15.67	16.80	10072	9421	12000	9557	67.0	68.3	4391	31.67	29.16
250	15000	15	16.57	16.60	8871	8854	12000	9415	58.1	58.1	4400	31.16	27.81
350	15000	15	17.06	16.20	7877	8445	12000	9537	51.5	50.4	4392	30.30	26.59

Figure 7-12. (Sheet 2 of 6)

LEVEL AND DIVE BALLISTIC TABLES

GBU-10A/B, B/B

MK-84 (54 INCH TAIL FIN) LASER GUIDED BOMB
OIL AND SPRING DAMPERS
MAXIMUM ALLOWABLE ACQUISITION SLANT RANGE OF 12000 FT
NO EJECTION VELOCITY, NO OVERCAST

RELEASE CONDITIONS			HORIZONTAL RANGE				IMPACT VELOCITY		IMPACT ANGLE		SIGHT DEPRESSION	
SPEED (KTAS)	ALT (FT)	D ANG (DEG)	MAX (FT)	MIN (FT)	CENT. (FT)	BALLIST. (FT)	MAX (FT/SEC)	MIN (FT/SEC)	MAX (DEG)	MIN (DEG)	CENT. (MILS)	BALL. (MILS)
250	6000	30	5512	4465	4989	4990	681.2	695.0	47.2	74.3	354	353
350	6000	30	8609	5533	7027	6167	747.7	785.2	31.2	57.4	183	248
150	9000	30	5781	3649	4715	4324	714.8	748.1	53.1	79.3	565	599
250	9000	30	9186	5790	7417	6465	751.0	797.4	39.4	71.1	358	424
350	9000	30	12276	7323	9899	8148	797.6	869.9	27.7	65.5	214	311
150	12000	30	8295	4118	6234	5093	796.0	836.2	49.0	83.2	568	646
250	12000	30	11381	6815	9184	7715	820.1	886.3	37.0	72.3	394	476
350	12000	30	13993	8877	11492	9848	867.2	944.1	29.3	65.1	283	360
150	15000	30	9179	4500	6891	5768	867.8	906.3	49.2	85.2	616	680
250	15000	30	12553	7690	10171	8821	889.8	953.9	38.6	75.4	451	516
350	15000	30	15140	10189	12715	11355	951.4	1022.1	34.5	68.1	344	399
250	6000	45	4704	3043	3795	3579	683.9	700.9	48.6	74.2	221	247
350	6000	45	5500	3587	4508	4254	778.1	791.1	44.2	67.4	141	169
150	9000	45	5029	2540	3758	3290	716.6	749.8	54.4	84.8	390	434
250	9000	45	7457	3990	5690	4737	757.7	805.3	43.0	74.9	222	301
350	9000	45	9074	4884	6979	5769	824.1	869.3	37.4	71.5	126	215
150	12000	45	7092	2858	5002	3908	795.9	847.0	50.9	86.5	390	470
250	12000	45	9302	4754	7082	5729	828.4	877.5	42.2	77.2	252	340
350	12000	45	10903	6019	8516	7088	887.3	953.7	37.7	71.8	168	252
150	15000	45	7831	3037	5459	4455	871.1	911.1	51.2	-89.1	436	497
250	15000	45	10119	5345	7757	6613	909.4	966.9	45.5	80.4	308	370
350	15000	45	11839	7009	9449	8274	967.5	1021.3	41.5	73.9	223	281

Figure 7-12. (Sheet 3 of 6)

LEVEL AND DIVE BALLISTIC TABLES

GBU-10A/B, B/B

MK-84 (54 INCH TAIL FIN) LASER GUIDED BOMB
OIL AND SPRING DAMPERS
MAXIMUM ALLOWABLE ACQUISITION SLANT RANGE OF 12000 FT
NO EJECTION VELOCITY, NO OVERCAST

RELEASE CONDITIONS		D ANG (DEG)	ACQUISITION TIME		ACQ. ALT		ACQ. SLANT RANGE FOR		ACQ. FLIGHT PATH ANGLE FOR		AVRG. CROSS	TIME OF FALL	
SPEED (KTAS)	ALT (FT)		MAX PT. (FT)	MIN PT. (FT)	MAX (FT)	MIN (FT)	MAX (FT)	MIN (FT)	MAX (FT)	MIN (FT)		MAX (SEC)	MIN (SEC)
250	6000	30	3.00	7.80	5220	3396	6841	3779	40.2	51.9	931	14.74	13.81
350	6000	30	3.00	5.00	4969	4133	8643	5110	37.6	41.9	1770	15.40	12.07
150	9000	30	3.50	10.40	8357	5963	9748	6125	47.9	64.7	2215	21.77	20.26
250	9000	30	3.00	9.30	8220	5678	12000	6183	40.2	54.7	2405	21.38	18.12
350	9000	30	5.12	8.70	7078	5263	12000	6063	42.1	48.7	3757	21.08	16.24
150	12000	30	7.84	12.80	10023	7781	12000	7899	60.2	68.1	3793	26.82	24.06
250	12000	30	9.01	11.70	8817	7387	12000	7838	54.2	58.4	3976	25.42	21.83
350	12000	30	9.55	10.20	7772	7384	12000	8288	50.0	50.9	4334	24.02	19.89
150	15000	30	13.75	14.60	10263	9777	12000	9871	69.1	70.1	4419	29.83	27.50
250	15000	30	13.63	14.00	9219	8982	12000	9375	61.0	61.5	4397	28.27	25.17
350	15000	30	13.21	12.60	8418	8837	12000	9658	55.0	54.3	4373	26.47	23.10
250	6000	45	3.00	4.90	4960	4159	6258	4456	53.1	57.1	1055	13.51	12.16
350	6000	45	3.00	3.00	4605	4606	6271	5167	51.0	5.10	1347	11.73	10.21
150	9000	45	3.00	8.80	8316	6195	9454	6274	57.3	69.1	2310	20.56	19.00
250	9000	45	3.00	6.70	7959	6297	10320	6613	53.1	60.1	2645	19.12	16.29
350	9000	45	3.00	5.80	7604	6062	10915	6555	51.1	55.5	3239	17.55	14.11
150	12000	45	5.95	10.70	10367	8272	12000	8239	64.6	71.4	3835	25.25	22.75
250	12000	45	6.42	8.90	9434	8108	12000	8386	59.7	63.3	4163	23.08	19.95
350	12000	45	6.40	7.60	8696	7943	12000	8455	56.4	58.0	4409	21.02	17.53
150	15000	45	12.04	13.90	10550	9465	12000	9485	72.7	74.3	4423	28.27	26.17
250	15000	45	11.02	11.50	9819	9511	12000	9716	65.7	66.2	4405	25.77	23.15
350	15000	45	10.13	8.90	9205	10072	12000	10618	60.9	59.6	4455	23.46	20.68

Figure 7-12. (Sheet 4 of 6)

LEVEL AND DIVE BALLISTIC TABLES

GBU-10A/B, B/B

MK-84 (54 INCH TAIL FIN) LASER GUIDED BOMB
OIL AND SPRING DAMPERS
MAXIMUM ALLOWABLE ACQUISITION SLANT RANGE OF 12000 FT
NO EJECTION VELOCITY, NO OVERCAST

RELEASE CONDITIONS		HORIZONTAL RANGE				IMPACT VELOCITY		IMPACT ANGLE		SIGHT DEPRESSION		
SPEED (KTAS)	ALT (FT)	D ANG (DEG)	MAX (FT)	MIN (FT)	CENT. (FT)	BALLIST. (FT)	MAX (FT/SEC)	MIN (FT/SEC)	MAX (DEG)	MIN (DEG)	CENT. (MILS)	BALL. (MILS)
150	6000	60	1162	2454	1779	1692	630.6	636.9	65.8	86.3	235	249
250	6000	60	3148	1670	2383	2297	689.4	702.5	56.9	85.7	146	158
350	6000	60	3407	2014	2741	2664	790.7	789.3	56.2	85.2	95	106
150	9000	60	4074	1296	2658	2197	718.6	746.1	57.6	89.7	236	284
250	9000	60	5149	2183	3666	3084	776.6	805.8	53.9	85.2	137	193
350	9000	60	5805	2673	4239	3672	848.4	885.2	48.7	79.3	83	136
150	12000	60	5782	1363	3626	2627	795.4	848.6	51.9	-88.2	230	308
250	12000	60	7166	2617	4944	3766	842.9	886.6	48.7	84.3	133	219
350	12000	60	8109	3324	5743	4563	902.9	948.0	45.7	80.4	77	160
150	15000	60	6117	1363	3740	3005	890.4	916.6	58.1	-85.1	279	326
250	15000	60	7635	2914	5275	4374	929.0	970.3	53.6	84.5	185	240
350	15000	60	8642	3828	6235	5368	990.2	1031.6	51.0	83.1	130	180

Figure 7-12. (Sheet 5 of 6)

LEVEL AND DIVE
BALLISTIC TABLES

T.O. 1A-10A-34-1-1

GBU-10A/B, B/B

MK-84 (54 INCH TAIL FIN) LASER GUIDED BOMB
OIL AND SPRING DAMPERS
MAXIMUM ALLOWABLE ACQUISITION SLANT RANGE OF 12000 FT
NO EJECTION VELOCITY, NO OVERCAST

RELEASE CONDITIONS		ACQUISITION TIME		ACQ. ALT		ACQ. SLANT RANGE FOR		ACQ. FLIGHT PATH ANGLE FOR		AVRG. CROSS RANGE		TIME OF FALL	
SPEED (KTAS)	ALT (FT)	D ANG (DEG)	MAX PT. (FT)	MIN PT. (FT)	MAX (FT)	MIN (FT)	MAX (FT)	MIN (FT)	MAX (FT)	RANGE (FT)	RANGE (FT)	MAX (SEC)	MIN (SEC)
150	6000	60	3.00	3.40	4760	4576	5392	4676	65.6	66.4	1192	11.95	11.15
250	6000	60	3.00	3.00	4326	4326	5011	4473	64.2	64.2	1157	9.87	9.18
350	6000	60	3.00	3.70	5196	4969	5598	5019	68.6	69.9	1121	14.46	13.85
150	9000	60	3.00	7.20	8196	6601	8993	6613	68.5	74.7	2568	19.53	18.18
250	9000	60	3.00	5.10	7760	6730	8982	6823	65.6	68.5	2771	16.84	15.15
350	9000	60	3.00	3.00	7325	7325	8828	7542	64.2	64.2	2861	14.55	12.79
150	12000	60	4.23	9.10	10787	8697	12000	8700	70.7	76.4	4070	23.97	21.88
250	12000	60	4.15	6.40	10211	9023	12000	9115	67.3	70.0	4364	21.19	18.67
350	12000	60	3.91	3.90	9767	9771	12000	10013	65.3	65.3	4436	18.76	16.08
150	15000	60	10.45	11.00	10985	10681	12000	10681	77.5	77.8	4479	26.82	25.29
250	15000	60	8.92	7.90	10508	11142	12000	11215	72.4	7.15	4449	23.82	21.81
350	15000	60	7.72	7.00	10148	10676	12000	10826	69.0	68.3	4535	21.15	19.06

Figure 7-12. (Sheet 6 of 6)

LEVEL AND DIVE BALLISTIC TABLES

GBU-12A/B

MK-82 (39 INCH TAIL FIN) LASER GUIDED BOMB
OIL AND SPRING DAMPERS
MAXIMUM ALLOWABLE ACQUISITION SLANT RANGE OF 12000 FT
NO EJECTION VELOCITY, NO OVERCAST

RELEASE CONDITIONS			HORIZONTAL RANGE				IMPACT VELOCITY		IMPACT ANGLE		SIGHT DEPRESSION	
SPEED (KTAS)	ALT (FT)	D ANG (DEG)	MAX (FT)	MIN (FT)	CENT. (FT)	BALLIST. (FT)	MAX (FT/SEC)	MIN (FT/SEC)	MAX (DEG)	MIN (DEG)	CENT. (MILS)	BALL. (MILS)
350	3000	0	14135	7349	11000	7799	540.6	639.5	11.3	35.6	266	367
150	6000	0	7026	4428	5789	4803	555.2	605.4	34.8	70.5	803	896
250	6000	0	14400	7470	11316	7920	537.8	663.8	15.0	59.3	487	648
350	6000	0	17519	10316	14227	10916	616.8	722.5	16.7	52.7	399	502
150	9000	0	11366	5182	8482	5857	633.0	706.0	32.8	78.4	815	994
250	9000	0	15158	8977	12291	9652	677.0	744.0	29.4	69.1	632	750
350	9000	0	18792	12522	15807	13272	700.6	785.1	26.1	58.9	517	596
150	12000	0	11235	5839	8659	6739	737.5	777.2	45.4	78.7	946	1059
250	12000	0	15790	10274	13153	11099	747.4	805.2	38.2	68.9	739	824
350	12000	0	20001	14338	17292	15238	756.1	830.4	34.3	64.7	607	667
150	15000	0	11301	6320	8863	7509	784.3	808.7	53.2	80.6	1037	1106
250	15000	0	16489	11360	13979	12362	792.0	835.0	42.6	69.4	820	881
350	15000	0	21291	15931	18641	16958	810.1	863.8	37.8	65.8	677	724
250	3000	15	6579	3985	5218	4285	511.5	558.3	23.2	50.6	260	349
350	3000	15	11794	4950	8440	5438	541.3	653.3	9.2	39.4	80	242
150	6000	15	6490	3731	5175	4181	557.5	609.1	35.4	76.5	597	700
250	6000	15	13107	6001	9870	6451	542.4	662.3	15.2	58.7	284	487
350	6000	15	14826	7791	11566	8391	628.5	735.7	18.2	52.1	217	359
150	9000	15	10692	4524	7830	5199	631.1	705.0	32.4	78.3	593	785
250	9000	15	13566	7441	10721	8116	672.0	744.5	30.2	68.1	436	575
350	9000	15	16033	9901	13146	10651	709.6	787.1	26.4	56.4	338	440

Figure 7-13. (Sheet 1 of 6)

LEVEL AND DIVE BALLISTIC TABLES

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GBU-12A/B

MK-84 (39 INCH TAIL FIN) LASER GUIDED BOMB
OIL AND SPRING DAMPERS
MAXIMUM ALLOWABLE ACQUISITION SLANT RANGE OF 12000 FT
NO EJECTION VELOCITY, NO OVERCAST

RELEASE CONDITIONS		D ANG (DEG)	ACQUISITION TIME		ACQ. ALT		ACQ. SLANT RANGE FOR		ACQ. FLIGHT PATH ANGLE FOR		AVRG. CROSS RANGE (FT)	TIME OF FALL	
SPEED (KTAS)	ALT (FT)		MAX PT. (FT)	MIN PT. (FT)	MAX (FT)	MIN (FT)	MAX (FT)	MIN (FT)	MAX (FT)	MIN (FT)		MAX (SEC)	MIN (SEC)
350	3000	0	4.20	7.40	2714	2128	12000	3752	13.2	22.5	3286	25.33	13.48
150	6000	0	4.90	11.70	5610	3823	8065	4113	32.2	56.4	2096	23.09	19.58
250	6000	0	8.72	12.70	4789	3462	12000	4140	33.9	44.8	3849	31.33	19.52
350	6000	0	10.96	13.10	4105	3313	12000	4407	31.8	36.6	4074	29.95	19.46
150	9000	0	8.76	15.70	7769	5106	12000	5269	48.3	63.8	4029	31.52	24.15
250	9000	0	12.44	17.30	6556	4336	12000	4756	44.1	53.7	4044	31.75	24.13
350	9000	0	14.56	17.30	5684	4359	12000	5204	39.7	44.8	4176	31.72	24.15
150	12000	0	13.58	17.10	9068	7384	12000	7557	60.2	65.7	4292	32.66	28.10
250	12000	0	16.36	18.30	7803	6775	12000	7345	52.0	55.3	4200	33.47	28.18
350	12000	0	18.16	20.20	6884	5711	12000	6499	46.2	49.4	4303	33.98	28.23
150	15000	0	18.04	20.00	9858	8709	12000	8820	66.8	68.9	4400	34.83	31.87
250	15000	0	20.17	20.40	8569	8519	12000	9062	57.8	58.1	4313	35.83	31.92
350	15000	0	21.77	21.40	7711	7946	12000	8906	51.6	51.0	4355	36.41	31.97
250	3000	15	3.00	5.30	2526	1975	5930	2711	27.0	34.8	1023	15.22	10.57
350	3000	15	3.00	3.50	2398	2272	10380	3746	23.8	25.1	2497	21.08	9.47
150	6000	15	3.00	11.00	5655	3367	8072	3540	34.0	60.1	2155	21.19	17.59
250	6000	15	5.41	9.30	4944	3630	12000	4298	35.2	45.6	3939	28.02	16.41
350	6000	15	6.53	8.50	4342	3591	12000	4733	32.0	37.3	4113	25.36	15.27
150	9000	15	6.67	13.30	7848	5343	12000	5508	49.1	63.9	4037	29.52	22.22
250	9000	15	9.08	13.50	6711	4702	12000	5157	45.0	53.7	4114	28.42	20.95
350	9000	15	10.11	12.10	5889	4923	12000	5909	40.6	44.4	4301	27.11	19.91

Figure 7-13. (Sheet 2 of 6)

LEVEL AND DIVE BALLISTIC TABLES

GBU-12A/B

MK-82 (39 INCH TAIL FIN) LASER GUIDED BOMB
OIL AND SPRING DAMPERS

MAXIMUM ALLOWABLE ACQUISITION SLANT RANGE OF 12000 FT
NO EJECTION VELOCITY, NO OVERCAST

RELEASE CONDITIONS			HORIZONTAL RANGE				IMPACT VELOCITY		IMPACT ANGLE		SIGHT DEPRESSION	
SPEED (KTAS)	ALT (FT)	D ANG (DEG)	MAX (FT)	MIN (FT)	CENT. (FT)	BALLIST. (FT)	MAX (FT/SEC)	MIN (FT/SEC)	MAX (DEG)	MIN (DEG)	CENT. (MILS)	BALL. (MILS)
150	12000	15	10506	5146	7946	6046	736.7	759.3	47.2	81.2	724	842
250	12000	15	14142	8684	11531	9509	757.4	789.2	39.7	68.3	543	639
350	12000	15	17263	11638	14542	12538	756.4	837.6	33.3	61.1	428	502
150	15000	15	10546	5619	8133	6789	796.7	805.6	54.4	82.0	812	884
250	15000	15	14798	9663	12286	10729	783.6	834.8	44.9	73.0	623	688
350	15000	15	18453	13165	15865	14180	823.3	864.2	40.1	65.4	495	552
350	3000	30	4955	3271	4069	3681	633.4	668.5	24.6	51.7	112	160
150	6000	30	6103	2958	4566	3408	560.6	612.5	37.8	77.3	397	531
250	6000	30	10440	4517	7526	4067	563.5	666.0	19.5	61.4	149	356
350	6000	30	11695	5534	8663	6122	653.2	734.9	22.4	55.0	82	252
150	9000	30	9701	3631	6888	4306	635.1	701.5	34.7	78.0	394	601
250	9000	30	11764	5748	8938	6423	679.6	750.7	33.1	68.3	265	427
350	9000	30	13189	7310	10387	8060	730.1	794.9	31.3	60.5	190	317
150	12000	30	9464	4085	6897	5060	738.6	767.7	50.2	83.1	525	648
250	12000	30	12111	6749	9549	7649	758.3	790.3	42.4	73.4	375	480
350	12000	30	14236	8772	11595	9703	776.3	827.2	37.2	63.9	279	367
150	15000	30	9380	4467	6974	5721	797.3	813.6	56.6	84.3	612	683
250	15000	30	12640	7646	10195	8723	805.3	835.9	47.4	75.7	450	520
350	15000	30	15220	10046	12660	11147	822.1	879.3	42.5	68.8	346	408
150	6000	45	4796	2078	3468	2558	566.8	609.0	39.7	78.8	261	382
250	6000	45	6417	3036	4726	3564	624.9	671.2	34.4	71.9	118	249
350	6000	45	6847	3583	5215	4234	702.4	740.0	34.0	64.0	70	171

Figure 7-13. (Sheet 3 of 6)

LEVEL AND DIVE BALLISTIC TABLES

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GBU-12A/B

MK-84 (39 INCH TAIL FIN) LASER GUIDED BOMB
OIL AND SPRING DAMPERS
MAXIMUM ALLOWABLE ACQUISITION SLANT RANGE OF 12000 FT
NO EJECTION VELOCITY, NO OVERCAST

RELEASE CONDITIONS		D ANG (DEG)	ACQUISITION TIME		ACQ. ALT		ACQ. SLANT RANGE FOR		ACQ. FLIGHT PATH ANGLE FOR		AVRG. CROSS RANGE (FT)	TIME OF FALL	
SPEED (KTAS)	ALT (FT)		MAX PT. (FT)	MIN PT. (FT)	MAX (FT)	MIN (FT)	MAX (FT)	MIN (FT)	MAX (FT)	MIN (FT)		MAX (SEC)	MIN (SEC)
150	12000	15	11.47	14.90	9161	7531	12000	7696	61.0	66.1	4366	30.57	26.27
250	12000	15	13.01	14.80	7941	6990	12000	7550	52.9	55.8	4258	30.03	25.06
350	12000	15	13.77	14.90	7013	6365	12000	7277	47.2	49.0	4458	29.53	23.93
150	15000	15	15.98	16.70	9933	9525	12000	9664	67.5	68.3	4454	32.75	29.93
250	15000	15	16.84	17.80	8778	8173	12000	8603	58.6	59.8	4318	32.53	28.63
350	15000	15	17.31	16.50	7842	8365	12000	9363	52.4	51.3	4447	31.87	27.60
350	3000	30	3.00	3.00	1975	1975	3964	2640	37.7	37.7	957	9.27	7.10
150	6000	30	3.00	8.70	5473	3705	7724	3849	46.0	6.18	2196	19.99	16.01
250	6000	30	3.00	6.30	5222	4053	10712	4639	40.4	48.9	3108	22.98	14.05
350	6000	30	3.00	4.80	4974	4233	11326	5259	37.6	41.6	3195	20.57	12.37
150	9000	30	4.23	10.50	8176	5937	12000	6093	50.4	65.0	3984	27.49	20.61
250	9000	30	5.98	9.80	7180	5455	12000	5904	48.1	55.5	4137	25.47	18.46
350	9000	30	6.27	7.80	6556	5786	12000	6734	44.6	47.2	4262	23.17	16.73
150	12000	30	9.39	13.20	9415	7600	12000	7703	63.1	68.6	4280	28.65	24.54
250	12000	30	9.91	12.40	8380	7029	12000	7413	55.7	59.5	4368	27.02	22.43
350	12000	30	9.96	10.50	7578	7260	12000	8096	50.8	51.6	4341	25.58	20.64
150	15000	30	13.99	15.80	10158	9104	12000	9170	69.4	71.2	4441	30.85	28.17
250	15000	30	13.82	13.60	9160	9295	12000	9716	61.3	61.1	4513	29.45	26.04
350	15000	30	13.47	12.70	8346	8862	12000	9645	55.7	54.6	4444	28.02	24.07
150	6000	45	3.00	6.30	5317	4245	6816	4354	57.4	65.1	2240	17.68	14.82
250	6000	45	3.00	4.90	4963	4168	7431	4464	53.1	57.1	2382	16.21	12.34
350	6000	45	3.00	3.20	4611	4510	7260	5047	51.1	51.5	2339	13.71	10.45

Figure 7-13. (Sheet 4 of 6)

LEVEL AND DIVE BALLISTIC TABLES

GBU-12A/B

MK-82 (39 INCH TAIL FIN) LASER GUIDED BOMB
OIL AND SPRING DAMPERS
MAXIMUM ALLOWABLE ACQUISITION SLANT RANGE OF 12000 FT
NO EJECTION VELOCITY, NO OVERCAST

RELEASE CONDITIONS			HORIZONTAL RANGE				IMPACT VELOCITY		IMPACT ANGLE		SIGHT DEPRESSION	
SPEED (KTAS)	ALT (FT)	D ANG (DEG)	MAX (FT)	MIN (FT)	CENT. (FT)	BALLIST. (FT)	MAX (FT/SEC)	MIN (FT/SEC)	MAX (DEG)	MIN (DEG)	CENT. (MILS)	BALL. (MILS)
150	9000	45	7923	2531	5373	3281	653.0	708.7	39.7	84.7	247	436
250	9000	45	9763	3961	6900	4711	693.5	748.0	37.6	75.3	131	303
350	9000	45	10498	4893	7733	5723	755.0	792.9	37.0	69.6	76	219
150	12000	45	8046	2843	5535	3893	743.6	772.9	50.8	87.0	353	472
250	12000	45	9944	4717	7419	5692	757.9	799.2	47.4	78.6	232	342
350	12000	45	11175	5956	8626	7008	787.3	835.3	42.9	69.8	162	257
150	15000	45	7889	3048	5494	4425	799.2	804.1	59.7	86.3	434	498
250	15000	45	10222	5336	7804	6534	818.0	834.3	54.0	77.8	306	374
350	15000	45	11931	6891	9438	8149	848.1	872.8	48.5	74.6	224	288
150	6000	60	3508	1089	2327	1689	585.2	602.3	49.5	87.8	154	249
250	6000	60	4060	1670	2865	2290	645.6	672.2	48.0	78.7	78	159
350	6000	60	4151	2008	3080	2656	728.7	747.0	49.1	77.7	49	107
150	9000	60	5554	1281	3450	2191	676.5	710.9	51.9	88.2	158	285
250	9000	60	6253	2167	4210	3067	725.9	762.1	50.4	82.8	86	195
350	9000	60	6492	2679	4585	3650	789.0	799.9	50.6	75.7	52	138
150	12000	60	6539	1394	4054	2613	753.7	779.0	58.4	87.7	198	309
250	12000	60	7611	2581	5152	3735	776.4	810.2	53.3	84.4	118	222
350	12000	60	8235	3339	5814	4521	806.6	835.9	50.1	76.5	72	163
150	15000	60	6195	1408	3802	2987	809.0	826.2	65.7	-89.3	275	327
250	15000	60	7688	2852	5270	4327	828.3	831.0	60.6	85.6	186	243
350	15000	60	8707	3818	6262	5301	846.7	869.6	54.2	81.4	128	184

Figure 7-13. (Sheet 5 of 6)

LEVEL AND DIVE BALLISTIC TABLES

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GBU-12A/B

MK-84 (39 INCH TAIL FIN) LASER GUIDED BOMB
OIL AND SPRING DAMPERS
MAXIMUM ALLOWABLE ACQUISITION SLANT RANGE OF 12000 FT
NO EJECTION VELOCITY, NO OVERCAST

RELEASE CONDITIONS		D ANG (DEG)	ACQUISITION TIME		ACQ. ALT		ACQ. SLANT RANGE FOR		ACQ. FLIGHT PATH ANGLE FOR		AVRG. CROSS RANGE (FT)	TIME OF FALL	
SPEED (KTAS)	ALT (FT)		MAX PT. (FT)	MIN PT. (FT)	MAX (FT)	MIN (FT)	MAX (FT)	MIN (FT)	MAX (FT)	MIN (FT)		MAX (SEC)	MIN (SEC)
150	9000	45	3.00	8.80	8316	8316	11126	6287	57.5	69.0	3696	24.58	19.31
250	9000	45	3.00	7.20	7962	6059	12000	6338	53.2	61.0	3820	22.68	16.65
350	9000	45	3.00	4.90	7610	6598	11984	7201	51.0	54.2	3713	19.95	14.58
150	12000	45	7.18	10.60	9898	8343	12000	8401	66.6	71.3	4341	26.80	23.25
250	12000	45	7.16	9.20	9074	7965	12000	8222	60.9	63.6	4458	24.53	20.48
350	12000	45	6.71	7.70	8533	7917	12000	8406	56.9	58.2	4353	22.33	18.25
150	15000	45	12.14	12.60	10520	10264	12000	10299	72.9	73.3	4465	29.08	26.97
250	15000	45	11.19	10.80	9795	10000	12000	10240	66.0	65.6	4505	26.80	24.08
350	15000	45	10.32	10.30	9144	9159	12000	9559	61.3	61.3	4542	24.70	21.62
150	6000	60	3.00	5.90	5198	4160	6070	4175	68.5	73.1	2131	15.88	14.04
250	6000	60	3.00	3.00	4764	4764	5873	4877	65.6	65.6	2020	13.17	11.34
350	6000	60	3.00	3.00	4333	4333	5433	4479	64.3	64.3	1831	10.82	9.37
150	9000	60	3.00	7.30	8197	6565	9697	6576	68.6	74.7	3285	21.46	18.46
250	9000	60	3.00	5.10	7763	6740	9589	6831	65.7	68.5	3382	18.38	15.45
350	9000	60	3.00	3.00	7331	7331	9236	7550	64.2	64.2	3133	15.70	13.28
150	12000	60	5.16	8.20	10448	9149	12000	9157	72.1	75.6	4398	25.19	22.36
250	12000	60	4.62	6.30	9985	9094	12000	9184	67.8	69.9	4515	22.25	19.21
350	12000	60	4.03	3.60	9699	9967	12000	10227	64.5	65.0	4517	19.77	16.88
150	15000	60	10.55	9.80	10951	11349	12000	11351	77.5	77.0	4510	27.59	25.98
250	15000	60	9.01	9.20	10481	10359	12000	10403	72.5	72.6	4554	24.76	22.80
350	15000	60	7.83	5.90	10113	11475	12000	1168	69.0	67.4	4603	22.38	20.21

Figure 7-13. (Sheet 6 of 6)

GLOSSARY

A

- AAA – Antiaircraft Artillery.
- AAS – Air-to-Air Sight.
- ACD – Adapter Control Detector.
- ACMI – Air Combat Maneuvering Instrumentation.
- ACP – Armament Control Panel.
- ACS – Armament Control System.
- AD – Armament Datum line.
- ADI – Altitude Director Indicator.
- ADVERSE YAW – A yaw opposite to the direction of turn, induced by rolling motion and aileron deflection.
- AERP – Aircrew Eye Respiratory Protection.
- AFSEO – Air Force SEEK EAGLE Office.
- A/G – Air-to-Ground.
- AGF – Angle of Gunfire.
- AGL – Above Ground Level - aircraft absolute altitude.
- AGM – Air-to-Ground Missile - an air launched, surface attack, guided missile.
- AIM – Air Intercept Missile.
- AIMING POINT – The point on the ground used as a reference to determine bomb release.
- AIR – Air Inflatable Retarder.
- Aircraft Axes – There are three axes, which are mutually perpendicular and have a common point of intersection:
 - a. Longitudinal axis: This axis is parallel to the fuselage reference line. Rotating the longitudinal axis will change the aircraft angle of attack and/or pitch.
 - b. Vertical axis: This axis is perpendicular to the longitudinal axis. The aircraft rotates about this axis when yawing.
 - c. Lateral axis: This axis rotates about the longitudinal axis when the aircraft is rolled or banked.
- AIS – Air Instrumentation Subsystem.

- AIU – Aircraft Integration Unit.
- AMIL – Air Mass Impact Line.
- AN – A prefix to denote use in common by Army, Air Force, and Navy.
- ANGLE OF ATTACK (AOA) – The angle between the fuselage reference line and the relative wind.
- ANGLE-OFF – The angular measurement between the longitudinal axis of two or more aircraft.
- ANGLE OF GUNFIRE (AGF) – The angle between the gun bore line and the flight path.
- ANGLE OF INCIDENCE – A fixed angle between the wing chord line and the fuselage reference line.
- ANGLE OF PITCH – The angle of the aircraft flight path relative to a level plane.
- AOA – Angle of Attack.
- AOD – Aim Off Distance.
- AOP – Aim Off Point.
- AP – Armor Piercing.
- API – Armor Piercing Incendiary.
- ASL – Azimuth Steering Line.
- ASU – Antenna Switching Unit.
- ATU – Anemometer-vane-type Unit.
- AVTR – Airborne Video Tape Recorder.
- AZ – Azimuth.

B

- BATA – Bullets at Target Altitude.
- BDU – Bomb Dummy Unit (practice munition).
- BFD – Battery Firing Device.
- BITE – Built-in Test Equipment.
- BLU – Bomb Live Unit.
- BOMB STICK – The number of bombs released during a ripple delivery.
- BOMB TRAIL – The distance the bomb trails behind the aircraft after release.
- BOMB TRAJECTORY – The path of a bomb from release to impact.

GLOSSARY – Continued

BULLET DENSITY – The number of rounds passing through an area of one square foot per unit of time.

BULLET DISPERSION – Deviation of a bullet trajectory from the aiming point.

C

CADC – Central Air Data Computer.

CAP – Caution Annunciator Panel.

CAPt – CCRP Aim Point.

CAS – Close Air Support.

CAVTR – Color Airborne Videotape Recorder.

CBU – Cluster Bomb Unit.

CCIP – Continuously Computed Impact Point.

CCRP – Continuously Computed Release Point.

CCTVS – Color Cockpit Television Sensor.

CG – Center of Gravity.

CLM – Climbing - a climbing maneuver.

CMDS – Countermeasures Dispenser System.

CMS – Countermeasures Set.

CMSC – Countermeasures Set Control.

COCKPIT G – Acceleration forces on the aircraft as read from the G meter.

CORRECTED SIGHT DEPRESSION – True sight depression corrected for a head or tailwind component.

CRS – Course.

CRT – Cathode Ray Tube.

CTVS – Cockpit Television Sensor.

CWDS – Combat Weapons Delivery Software.

D

DDPU – Digital Data Processing Unit.

DFP – Depression angle from Flight Path.

DRA – Dual Rail Adapter.

DRC – Desired Release Cue.

DUD – A round or bomb that fails to explode.

E

EAC – Enhanced Attitude Control.

ECM – Electronic Countermeasures.

EFFECTIVE SIGHT DEPRESSION – The depression from desired flight path. Varies with release conditions. When preplanned parameters are met, effective depression equals required depression.

EGI – Embedded Global Positioning System/Inertial Navigation System.

EMI – Electromagnetic Interference.

E/O – Electro-optical.

EOD – Explosive Ordnance Disposal.

ET – Embedded Training.

ETP – Electrical Test Panel.

EVE – Estimated Vertical Error.

EW – Electronic Warfare.

F

FBL – Fixed Bore Line.

FEDS – Firing Evaluation Display System.

FFAR – Folding Fin Aircraft Rocket.

FFOD – Firefighting Operational Distance.

FGL – Fixed Gun Line.

FIRE PULSE – An electrical impulse transmitted to fire/release stores.

FLIGHT PATH – The line or plane that describes the longitudinal motion of the aircraft.

FMU – Fuze Munition Unit.

FOV – Field of View.

FRL – Fuselage Reference Line - A basic reference line through the fuselage parallel to the longitudinal axis of the aircraft.

FSRS – Frequency Selective Reference System.

GLOSSARY – Continued

G

G – Gravity.

■ GBL – Gun Bore Line.

GBU – Guided Bomb Unit.

GCAS – Ground Collision Avoidance System.

■ GCI – Ground Control Interception.

■ GMIU – Guided Missile Interface Unit.

GP – General Purpose Bomb.

■ GPS – Global Positioning System.

GROUND RANGE – The horizontal distance from the point directly below the aircraft to the target.

GROUND TRACK – The actual line of movement of an aircraft over the ground.

GUN BORE LINE (GBL) – Extension of the initial bullet muzzle velocity.

H

HARMONIZATION RANGE – Range where the bullet pattern crosses the gun sight line (gun cross or 41 mil pipper). Designed to be 4,000 feet in the A-10A.

HARS – Heading Attitude Reference System.

HAS – Hydraulic Actuation System.

■ HCP – HUD Control Panel.

■ HD – High-Drag.

HDGP – High-drag General Purpose bomb.

HE – High Explosive.

HEAP – High Energy Armor Piercing.

HEAT – High Explosive Anti-tank.

HEI – High Explosive Incendiary.

■ HOB – Height of Burst.

■ HOF – Height of Function.

HUD – Head-up Display - an optical and electronic device that projects flight information into the pilot's forward field of view, and provides primary and standby weapon delivery capability.

I

ICT – Integrated Combat Turn.

INS – Inertial Navigation System.

IP – Initial Point - a point over which an aircraft begins an attack.

IPP – Initial Pipper Placement.

IR – Infrared.

ITP – Initial Target Placement.

K

KCAS – Knots Calibrated Air Speed is the indicated airspeed corrected for installation error.

KIAS – Knots Indicated Air Speed is read directly from the airspeed indicator.

KTAS – Knots True Air Speed is the equivalent airspeed corrected for atmospheric density.

L

LAAP – Low Altitude Autopilot.

LASTE – Low Altitude Safety and Targeting Enhancements.

LAU – Launcher Aircraft Unit.

LAUNCHER LINE (LL) – A line through a rocket launcher tube extended to infinity.

LD – Low-Drag.

LDGP – Low-Drag General Purpose bomb.

LEU – Launcher Electronics Unit.

LFIP – Locus of Future Impact Points.

LGB – Laser Guided Bomb.

LOD – Line of Departure - the path that a rocket takes after leaving the aircraft.

LOS – Line of Sight.

LRU – Line Replaceable Unit.

LSFFAR – Low Spin Folding Fin Aircraft Rocket.

LSS – Laser Spot Seeker.

LST – Level Straight Through - a maneuver that is level, at constant speed, and with no turn.

LUU – Illumination Unit.

GLOSSARY – Continued

M

MAU – Miscellaneous Armament Unit.

MIL – A milliradian, which is 1/1000 of a radian (17.45 mil = 1 degree). 1 mil subtends approximately 1 foot at 1,000-foot range.

MISSILE HANGFIRE – When a missile fails to launch after all normal procedures have been accomplished and smoke or smoldering is observed. A potential launch is considered possible within the next 15 minutes.

MISSILE MISFIRE – When a missile fails to launch after all normal procedures have been accomplished and no smoke or smoldering is observed within 3 minutes.

MOD – Modification.

MRA – Minimum Release Altitude.

MRC – Minimum Range Caret.

MRGS – Multiple Reference Gunsight.

MRS – Minimum Range Staple.

MSEC – Millisecond, one msec = 0.001 second.

MSL – Mean Sea Level.

MTI – Moving Target Index.

N

NAV – Navigation.

NVIS – Night Vision Imaging System.

NWS Button – Nosewheel Steering Button.

O

OAP – Offset Aiming Point.

OSP – Option Select Panel.

P

PAC – Precision Attitude Control.

PARALLAX – The linear separation of the sight weapons installed in the aircraft.

PBIL – Projected Bomb Impact Line.

PBRL – Projected Bomb Release Line.

PCO – Power Changeover.

PFL – Pilot Fault List.

PICKLE – The act of depressing the weapons release button.

PREDICTION ANGLE – Total lead angle required after calculations.

PYLON – A component attached to the aircraft to carry, arm release, or jettison external stores.

R

RADIAL G – Cockpit plus or minus the component of gravity.

REQUIRED SIGHT DEPRESSION – The amount of depression below the ZSL necessary to accurately define bomb range.

RIP - RIPPLE – A release mode in which the quantity and interval of bombs released may be selected.

RKT – Rocket.

RTSEC – Real-Time Safe Escape.

RWR – Radar Warning Receiver.

S

SAFU – Safety, Arming, and Fuzing Unit.

SAM – Surface to Air Missile.

SAS – Stability Augmentation System.

SCS – Sidewinder Control System.

SD – Sight Depression.

SDFP – Sight Depression from Flight Path.

SIGHT LINE (SL) – The base or zero line for all sight computations that has been corrected for parallax.

SIGHT SETTING – The value in mils the aiming reticle is depressed.

SLANT RANGE – Line of sight distance from the aircraft to the target.

STANDBY AIMING RETICLE – A backup display on the HUD depressible over the same range as the primary.

STS – Search Track Set.

SUU – Suspension and Release Unit.

GLOSSARY – Continued

T

TAS – True Airspeed.

■ TAWC – Tactical Air Warfare Center.

■ TD Box – Target Designation box.

TDD – Target Detecting Device.

TER – Triple Ejector Rack.

■ TGM – Training Guided Missile.

TISL – Target Identification Set Laser.

TOF – Time Of Flight (or Fall).

■ TOT – Time on Target.

TP – Target Practice round.

TPT – Target Practice Tracer.

TRAJECTORY – Flight path from release to impact.

TRAJECTORY SHIFT – The angular shift of the bullet or rocket trajectory from bore line toward the flight path of the aircraft.

■ TRN – Turning - a turning maneuver.

■ TRN (LT) – Turning (Level Turn).

TRUE SIGHT DEPRESSION – A no-wind sight, setting computed for preplanned flight conditions.

■ TVM – TV Monitor.

TVV – Total Velocity Vector.

U

UPWIND AIM POINT – Point upwind of the target used to determine bomb release.

V

VELOCITY VECTOR – A vector quantity denoting both magnitude and direction.

VIP – Visual Identification Point.

VMU – Voice Message Unit.

VSI – Valid Solution Indicator.

W

WAFAR – Wrap Around Fin Aircraft Rocket.

WD – Weapon Delivery.

WD-1 – Weapon Delivery-1.

WD-2 – Weapon Delivery-2.

WD – Warhead.

Z

ZSL – Zero Sight Line - the pippet line of sight when the optical sight is set on zero mil depression: parallel to the FRL.

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