airspeeds greater than 250 KCAS are usually non-oscillatory with little warning and can produce, at the pilot's seat, severe vertical, horizontal, and lateral accelerations that may abruptly reverse direction. Helmet/canopy impact is possible as the pilot's upper torso responds to these sudden accelerations. One or more uncommanded snap rolls in the direction of and away from the departure may occur during the PSG as the aircraft loses airspeed and assumes a steep, nose down attitude. Recovery from the PSG is prompt with neutral controls. If the departure occurred during vectoring in forward flight (VIFF), rapidly moving the nozzles aft may aggravate the departure and/or result in more violent PSG. Nozzle angle should be slowly reduced to zero; however, engine shutdown after locked-in surge may prevent the nozzles from retracting fully aft. Departure recovery will not be effected with the nozzles deflected. Airstarts have been successfully completed with nozzle angles up to 40°. Nozzle down airstarts resulted in slightly higher JPT levels than nozzle aft airstarts and no significant difference in recovery altitude. Post relight dive recovery and engine spool-up should be performed nozzles aft to prevent large nose up pitch/AOA excursions and possible departure. Moving the nozzles aft may prolong the PSG by momentarily inducing a negative AOA autoroll.

Due to the abrupt and extreme changes in aircraft attitude that can occur during a departure and subsequent PSG, the aircraft INS may cause erroneous maximum normal load factors (NZ) to be displayed on the HUD and the DDI Fatigue Life Counter display. Following a departure, the pilot should use the Maximum Possible Normal Load Factor Chart (see Figure 4-12) to estimate the maximum NZ attained by the aircraft. An over-g inspection of the aircraft per the A1-AV8BB-GAI-400 Maintenance Manual is required if this estimated NZ exceeds the allowable structural load factor limit.

11.7.2 Positive AOA Auto Roll

The positive AOA autoroll is characterized by positive AOA (20° to 45°), low to moderate yaw rate (35 to 70°/sec) and moderate roll rate (70 to 120°/sec). Positive AOA autorolls may follow rudder rolls above the maneuvering boundary with the IFR probe installed or may follow departures at extreme AOAs induced by VIFFing. This spin like motion can be disorienting regarding the nature of the motion or the number of rolls. Recovery with neutral controls normally occurs after 4 seconds or within 2 rolls. Recovery is aided with opposite rudder. Opposite aileron in not effective and may induce additional sideslip and aggravate the post stall gyration.

11.7.3 Negative AOA Auto Roll

The negative AOA autoroll is characterized by negative AOA (-5° to -10°), approximately 90° nose down pitch attitude and divergent roll rate (roll rates as high as 320 degrees/second have been recorded). This spin like motion is disorienting, uncomfortable and easily misinterpreted as an inverted spin. With neutral controls the motion is transient. With pro-spin control a spin will occasionally self-recover and deteriorate into a negative AOA autoroll. Neutral controls are effective in all cases in producing recoveries in one to two turns, however, altitude loss from the ensuing recovery is large (2,000 to 6,000 feet) because of the extreme nose down attitude and rapidly increasing airspeed.

11.7.4 Upright Spins

The aircraft is very reluctant to enter and maintain upright spins, requiring precisely timed inputs of aft stick along with crossed ailerons and rudder. The typical upright spin is steep and oscillatory in nature with yaw rates near 70°/second and AOA between 45° and 65°. For the symmetric aircraft, approximately 50 percent of all spin attempts with full aft stick and crossed controls result in post stall motions classified as spins. Of these spins approximately 50 percent are self recovering even with full pro-spin controls and in all cases neutral controls are effective in producing rapid spin recoveries within 7 seconds or 1 1/2 turns.

The effect of asymmetric store loadings on upright spins is to increase spin susceptibility and to decrease the ease of recovery, requiring full anti-spin controls for recovery in one case with an asymmetric 300 gallon tank on the intermediate station. The effects of weight asymmetries on upright spin characteristics are similar with a tendency towards somewhat flatter and faster spins than the symmetric case. Neutral control recoveries provided a 100 percent success rate only up to 12,000 inch-pounds asymmetry (example: AIM-9 on an outboard station = 29,700 inch-pounds). Neutral control recovery probability decreases rapidly with increasing asymmetry and becomes totally ineffective at 90,000 inch-pounds asymmetry (example: Mk-82 outboard = 88,000 inch-pounds). Only full anti-spin controls are 100 percent effective in upright spin recoveries for asymmetries between 12,000 inch-pounds and 90,000 inch-pounds, however, even at 90,000 inch-pounds asymmetry, recoveries using full anti-spin controls were rapid with recoveries occurring within 5 seconds or 1 turn.

11.7.5 Inverted Spins

Inverted spins are easily produced by sustained rudder and forward stick inputs. The typical inverted spin is steeper and less oscillatory than the upright spin. Yaw rates were near 55°/second with AOAs between −30° and −45°. Recoveries from inverted spins are almost immediate upon control neutralization, requiring 6 seconds or 1 1/2 turns.

For inverted spins the effect of lateral weight asymmetries is to flatten spins into the heavy wing, and to steepen those away from the heavy wing, with little to no significant change in associated roll and yaw rates. For all asymmetries tested, neutral controls resulted in rapid spin recoveries within 6 1/2 seconds or 1 1/2 turns.

11.7.6 Falling Leaf (TAV-8B and Radar Aircraft Only)

Departures and tailslides can result in prolonged, highly oscillatory PSGs that have been given the term Falling Leaf due to the violent reversing characteristics of the motion. The motion is similar in nature to spins only to the extent that equilibrium in the pitch axis is achieved through inertial coupling, thereby preventing a reduction in AOA. The motion can be quite severe and disorienting to the pilot since the aircraft repeatedly reverses direction and does not exhibit a predominant direction as does a left or right spin. Violent reversals in bank and heading angles can occur along with extreme oscillations in AOA and pitch attitude. Altitude loss rate can be as high as 24,000 fpm. Engine compressor stall, resulting in a locked surge requiring engine shutdown, is likely to occur. Recovery from the falling leaf PSG is best achieved with full forward stick and neutral ailerons and rudder. Recovery from the PSG motion to a nose down attitude can take several seconds. Additional time and altitude are required to regain flying speed, restart the engine, and recover to level flight.

11.7.7 Effects of Departure On Engine

Engine compressor stall/locked surge is likely to occur during high Mach/high altitude departures (less than 250 KCAS/greater than 0.7 Mach) or high airspeed/medium altitude departures (greater than 250 KCAS) and is indicated by increasing JPT with decreasing rpm. Compressor stall/locked surge can be accompanied by a pop or series of pops which can be felt in the airframe or be audible to the pilot. If engine rpm is low during the departure, locked compressor stall/surge may only be apparent to the pilot through cross check of rpm and JPT. Departures at high power setting will result in engine fan rub, possibly requiring engine removal. Fan rub can be greatly reduced by promptly retarding the throttle to idle at the first indication of departure.

During a high speed departure (greater than 250 knots), LP fan rub is likely. LP fan rub reduces the ablative materials that protect the engine casing from the fan blades. Minimize maneuvering and land the aircraft as soon as practical. Full authority of the engine is still available and should be used if necessary for a successful landing.

11.7.8 Recovery

Neutral controls are effective in producing recoveries from all departure post stall gyrations, inverted spins, positive or negative AOA auto-rolls, and upright spins with lateral weight asymmetries up to 12,000 inch-pounds. Neutral controls are defined as zero degree rudder, aileron and stabilator. The pilot can confirm neutral controls by centering the rudder pedals, centering the stick laterally and fore-aft in the cockpit, and by checking the stabilator position indicator on the EDP at zero degrees. Stabilator trim position can affect the pilot’s workload in maintaining a consistent neutral control position due to stick pressure. Recovery from positive AOA auto-rolls may be hastened with opposite rudder. For upright spins with large store and/or lateral weight asymmetries full anti-spin controls (opposite rudder and aileron in the direction of the spin) may be necessary to effect spin recovery.

Unexpected forces during OCF can make it difficult for the pilot to operate flight controls and view cockpit instruments. A locked shoulder harness may help keep the pilot in a position to manipulate the flight controls and view the instruments. Consideration should be given to locking the shoulder harness prior to maneuvers where OCF may be encountered.

11.8 SEMI-JETBORNE/JETBORNE FLIGHT CHARACTERISTICS

The Harrier, in wingborne flight, is similar to any other jet aircraft, but, in the semi-jetborne and jetborne regime, it exhibits peculiar characteristics not readily apparent to those familiar only with conventional aircraft. The term semi-jetborne indicates that some of the lift required for flight is provided by engine thrust with the remainder supplied by wing lift. The semi-jetborne flight regime includes all altitudes and different aircraft configurations, including gear up or down and is not limited to flight near the ground. The term jetborne indicates that all lift is being generated by engine thrust (30 knots or less).

11.8.1 Pitch Stability

The aircraft exhibits neutral to unstable pitch stability characteristics in semi-jetborne flight. This is seen by the pilot as a progressive forward movement of the control stick with increasing pitch sensitivity as AOA increases. Factors which affect the stability are:

1. CG location. The greater the instability, the greater the tendency to over control. This characteristic is particularly evident during high-performance STO. When operating at an aft cg, coarse back stick movement should be avoided.

2. Carriage of forward extending inboard stores.

3. Engine thrust. Nose up pitching moments increase with increasing thrust. Use caution during turns or high AOA flight. AOA excursions due to power increases, especially idle to full throttle slams, can lead to departure. The effect increases with lower altitude, slower speed and increasing nozzle and wing flap deflection. AOA excursions greater than 10° have occurred during throttle slams at 30° nozzles.

CAUTION

The carriage of outboard stores and water produces an aft cg condition which increases pitch sensitivity.

11.8.2 Yaw Stability

Intake momentum drag which acts parallel to the relative wind and ahead of the cg is a destabilizing force in yaw. See Figure 11-6. This destabilizing force is much smaller than the stabilizing effect of the vertical stabilizer at normal wingborne flight speeds. It is obvious that the vertical stabilizer has no effect at zero airspeed; therefore, the intake momentum drag makes the aircraft unstable in yaw in the hover. The exact crossover point is dependent upon several factors, but the stability decreases progressively with decrease in airspeed. The aircraft is near neutral stability in yaw between 50 and 60 knots and is unstable below 50 knots. Appreciable yaw between 30 and 90 knots can lead to loss of control in roll.

11.8.3 Roll Stability

As in most aircraft, rolling moments are produced as a result of and proportional to sideslip. If the sideslip angle (angle between the aircraft centerline and the relative wind) becomes so large that the rolling moment exceeds that produced by the ailerons or other roll control devices, control is lost. At wingborne speeds the vertical stabilizer provides sufficient directional stability to prevent loss of roll control. The rolling moment produced by sideslip is proportional to the product of indicated air speed (q), AOA (α) and sideslip angle (β). If any two of the terms have a large value, it is obvious that even a small value for the third term will produce a large rolling moment. Thus if airspeed and AOA are high (120 knots and 15°), a small sideslip angle will produce a large rolling moment. Likewise, a large sideslip angle (30°) and a large AOA (15°) will produce a large rolling moment at a low airspeed.

While airspeed and sideslip angle can change fairly rapidly, it is obvious to the pilot from visual cues that this is occurring; however, AOA can increase rapidly without obvious visual or feel cues. AOA can be increased rapidly by stick application but, more dangerously because of poor visual cues, it can increase rapidly with sink rate. Most dangerous of all, the AOA will increase instantly with roll if there is a sideslip angle present. This can result in an almost instantaneous loss of control with very little or no warning. A typical loss of control sequence at low airspeed involves allowing a sideslip to develop which introduces a rolling moment which, if not counteracted, instantly increases AOA which increases the rolling moment so that the situation becomes progressive. This is why we keep the nose into the relative wind on all V/STOL evolutions and NEVER fly a crosswind approach using the wing-down top-rudder method.

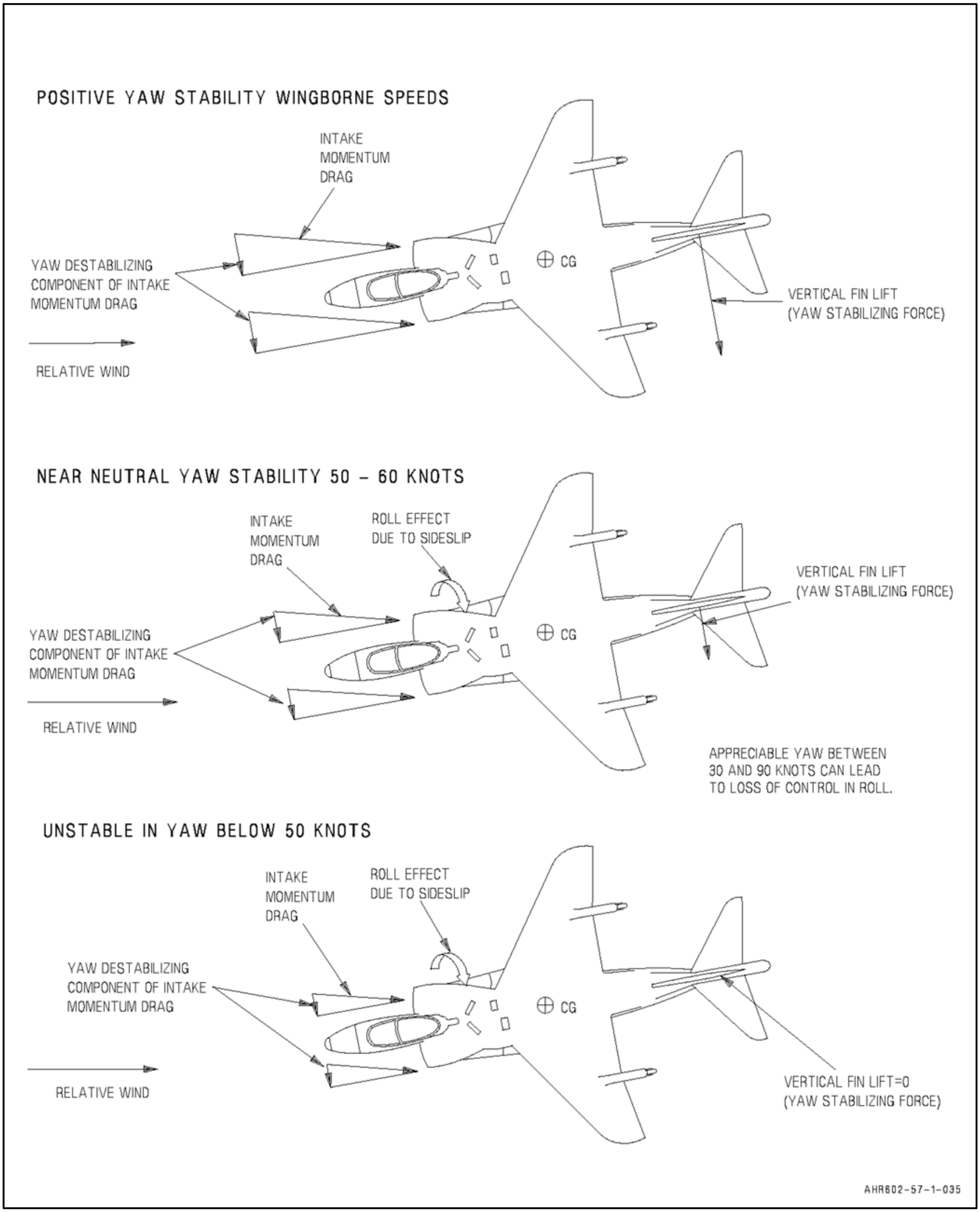

Figure 11-6. Intake Momentum Drag

11.8.4 Out-of-Control Roll Avoidance

From the preceding discussion it can be seen that, if the sideslip angle is zero, no rolling moment can exist. Control of sideslip is therefore the primary method of avoiding (but not recovering from) loss of control. The most reliable sideslip indicator is the yaw vane. The yaw vane points into the relative wind, in the direction of nose movement to zero sideslip, and in the direction of the rudder pedal to zero sideslip. The HUD sideforce symbol is in the direction of the relative wind and toward the rudder required to zero sideslip. The rudder pedal shaker shakes the rudder required to zero sideslip (push the shaking pedal). The rudder pedal shaker is set at a relatively low sideforce so that initiation of rudder pedal shaking does not indicate a requirement for large or coarse corrective action.

11.8.5 Reaction Control Power

Control in the semi-jetborne regime is provided by a combination of conventional aerodynamic controls and the reaction control system (RCS). The effectiveness of the aerodynamic controls decreases with decreasing airspeed. With SAS off, controls are sensitive in roll, fairly sensitive in pitch and sluggish in yaw. The pitch, roll and yaw stability augmentation noticeably steadies the aircraft and reduces pilot workload. Simultaneous application of control in more than one axis may result in a reduction of maximum available reaction control in all axes. This is because a maximum control deflection in one axis uses over half the total RCS bleed air available. As an example, full forward stick used to correct a pitch-up will degrade the pilot's capability to correct a disturbance in yaw or roll, and control inputs to correct this disturbance will reduce thrust of the rear pitch nozzle.

WARNING

Large nose-up pitch rates must be avoided in V/STOL flight because available tailplane and reaction control pitch authority maybe insufficient to prevent the angle of attack from rapidly increasing above the point where pitch control is lost. Uncontrollable pitch-up is most likely to occur at extreme aft cg loadings and/or with the wing flaps deflected more than 25°. Flap deflection more than 25° dramatically increases the downwash on the tailplane. In extreme cases, this increased downwash on the tailplane results in loss of pitch control. In these situations, the nose can be lowered by moving the nozzle lever forward (reducing the nozzle angle 20° is sufficient) followed by an immediate movement of the nozzle lever aft to the previous nozzle angle (to the STO stop on a STO). If pitch control cannot be regained with nozzle movement and altitude permits, initiate the out-of-control/spin recovery procedure.

11.8.5.1 Nose Tuck with Flap Programming

Loss of horizontal stabilator effectiveness when the flaps program down greater than 25° can cause a nose down pitching moment that must be arrested with RCS pressure from the forward RCS duct. This effect is most pronounced in the TAV-8 and to a lesser extent the RADAR variant due to their heavier nose. The problem develops when the flaps are allowed to program with the throttle at idle, providing very little pressure to the RCS. A typical scenario that induces this is a weak pull in the break that does not decelerate the aircraft quickly so on the downwind the pilot is fast abeam with the throttle still at idle while selecting gear down, nozzles to 60° and flaps to STOL. At the 180 position the pilot starts the approach turn descent and as the aircraft finally decelerates through the 165 KCAS the flaps program from 25° to 62° near instantly causing a strong nose down pitching moment. Because the aircraft is fast, the pilot still has the throttle at idle trying to get on-speed with little RCS pressure to stop the nose. This coupled with already being in a descending approach turn can put the aircraft in an extreme nose low attitude with a high rate of descent and very little altitude to recover. The fix for this problem is to add power prior to the flaps programming to energize the RCS system to provide control power to stop the nose down pitch.

11.8.6 Nozzle Blast Impingement

Nozzle blast impingement occurs when exhaust gases from the rear (hot) nozzles are directed onto the flap surfaces resulting in a moderate to severe nose down pitch rate. Impingement will occur anytime the flap angle exceeds the proper value dictated by the nominal STOL flap/nozzle interconnect schedule as shown in Figure 11-7. For example, with a nozzle angle of 40°, a flap angle greater than 47° will result in impingement. Conversely, if flaps were failed locked at 47°, a nozzle angle less than 40° would result in impingement. Since the flaps are located aft of the center of gravity, any force acting on the flap surface will cause a rotation of the aircraft about the C.G. In the case of nozzle blast impingement, the force of the engine exhaust from the rear nozzles acting on the underside of the flaps will result in a nose down pitching moment. The severity of the pitch moment and pitch rate will vary with the magnitude of flap impingement, engine rpm, and aircraft loading. Time and altitude to stop the pitch rate and recover the aircraft will vary with pilot reaction time to apply aft stick and lower the nozzles, attitude at initiation of recovery, engine rpm (thrust), airspeed (aerodynamic control), and initial aircraft pitch, roll, and yaw rates. Severe pitch rates of 40 to 50 degrees per second, cockpit load factors of -2.5 g, and a rapidly descending flight path can be generated by an aircraft operating at light gross weight, nozzles aft, at full power, and flaps failed full down. Generally, full aft stick with nozzles moved to 40° or greater is required to stop the pitch rate and recover the aircraft from this failure scenario.

The extreme aircraft response to full flap deployment generally exists for nozzle angles of 20° or less. However, beyond 20° nozzle, aircraft pitch rate response to full flap deployment quickly diminishes. Full flap deployment with nozzle angle at 25° requires only aft stick to stop the pitch rate and establish the desired nose attitude for rapid recovery. Full flap impingement with nozzles positioned at 30° requires little to no aft stick input to maintain the desired climb attitude. In both cases, the aircraft maintains a zero to positive rate of climb flight path throughout the initial impingement and subsequent recovery.

CAUTION

- Rotation of the nozzles aft with failed flaps can cause a severe nose down pitch due to nozzle blast impingement on flap surfaces. The nose down pitch rate will be arrested by a combination of aft stick and selection of a nozzle angle greater than 40°. The aircraft must then be recovered from the nose down attitude.
- Uncommanded programming of the flaps greater than 25° with nozzles less than 20° will cause a severe nose down pitch rate. The extreme attitudes coupled with negative g of up to -2.5, as experienced by the pilot, will be extremely disorienting and make cockpit functions difficult to perform. A combination of full aft stick and rotation of the nozzles to an angle greater than 40° are required to arrest this condition.

11.8.7 Crosswind Accelerations

When conducting VTO-Accelerating Transitions, the preferred technique is to perform the maneuver directly into the wind and then turn into the landing pattern once wingborne flight is achieved. However, there may be occasions when local traffic procedures or the proximity of obstacles preclude this technique. When required, the accelerating transition can be conducted along a track line that does not coincide with the wind line. After a normal into the wind VTO, the pilot conducts a pedal turn until the nose of the aircraft is pointed down the desired acceleration path. When the pedal turn has been completely stopped, a normal accelerating transition begins. Once forward velocity has been established along the desired track, the pilot then centers the wind vane. This action must occur prior to reaching 30 KCAS. This normally requires the pilot to apply a moderate amount of rudder back toward the wind line shortly after the accelerating transition begins. As aircraft velocity increases during the transition, less and less crab will be required. This technique is referred to as a Continuous Crosswind Accel due to the fact that there is no pause between the VTO and the transition, and the power remains at full throttle throughout the maneuver. When the desired track substantially differs from the wind line, there is a risk that the pilot will lose adequate hover references before he can establish a proper transition. This problem becomes more severe when excess performance is very high, the pedal turn is conducted slowly or visual cues are degraded due to darkness. If the pilot lacks proper visual cues to conduct the maneuver or if the pilot begins the transition before stopping the pedal turn rotation, then a rapid loss of control can occur. In order to minimize this risk, the pilot may elect to perform a Non–continuous Crosswind Accel. Due to the use of a hover phase, this maneuver must be performed at or below hover weight. (MC computed VL weight can be used as an in–flight substitute.) This maneuver starts with a normal into the wind PRESS–UP to a HOVER. The pilot conducts a pedal turn until the nose of the aircraft is pointed down the desired acceleration path. When the pedal turn has been completely stopped, the throttle is advanced to FULL and a normal accelerating transition begins. Once forward velocity has been established along the desired track, the pilot then centers the wind vane. This action must occur prior to reaching 30 KCAS. This normally requires the pilot to apply a moderate amount of rudder back toward the wind line shortly after the accelerating transition begins. As aircraft velocity increases during the transition, less and less crab will be required. Use of the hover helps to ensure that visual cues are maintained and increases the likelihood that pedal turn will be fully stopped before the transition begins.

11.8.8 Short Takeoff

Takeoff distance charts in the Performance Data, Part XI, are based on use of the high performance Short Takeoff (STO) technique. The essential difference between the normal and high performance STO is that, in the high performance STO, the aircraft is rotated to a 14° pitch attitude which is maintained until all obstacles are cleared.

On a STO, the angle of attack shall not be greater than 15° Over rotation or high rotational rates may result in the AOA rising uncontrollably even with stick full forward. When this occurs a nose down pitch may be induced by moving the nozzle lever forward (reducing the nozzle angle 20° is sufficient) followed by an immediate movement of the nozzle lever aft to the STO stop. Uncontrollable pitch–ups are most likely to occur at extreme aft cg loadings and/or with the wing flaps deflected more than 25°.

During STOs with high lateral asymmetries:

1. Pilots should attempt to position the relative wind under the heavy wing (if feasible) or, if known in advance, load the aircraft according to the prevailing relative wind.

CAUTION

Flight test results have indicated that with asymmetries greater than 80,000 inch pounds pilot workload is dramatically reduced by positioning the relative wind under the heavy wing.

2. During initial ground roll, NWS will be required to correct tendency to drift toward the heavy wing.
3. With lateral asymmetries above 32,000 inch–pounds, increase STO NRAS by 10 KCAS.
4. With lateral asymmetries above 80,000 inch–pounds pilot workload is reduced and comfort level increases by adding 15 KCAS to the NRAS.
5. Rotating nozzles aft too quickly will reduce total roll control power requiring large lateral stick inputs away from the heavy wing. The rate of nozzle rotation is dependent on excess performance and should be performed at a rate which will allow the wings level attitude to be controlled without excessive lateral stick deflections.

Note

Takeoffs at aft cg positions in high crosswinds will require more forward stick position and increased reaction control system demands. For short takeoffs, AUTO flaps will require more forward stick displacements than STOL flaps. AUTO flap STOs at cg positions approaching the aft limit in crosswinds in excess of 10 knots are approaching the limits of control authority. For crosswinds of more than 10 knots, a CTO is recommended if runway length permits, otherwise a STOL flap STO is recommended.

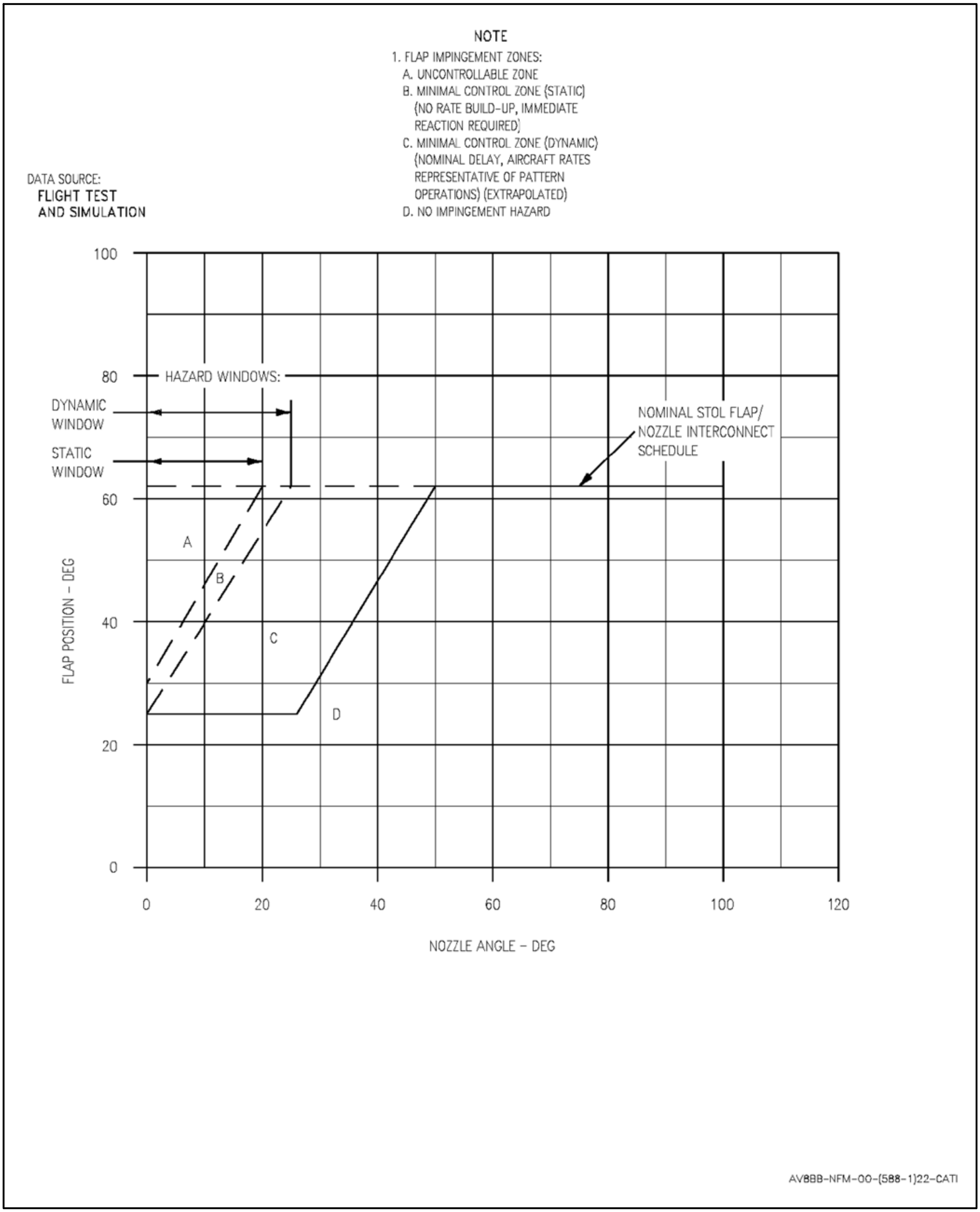

Figure 11-7. Flap Impingement Envelope

11.8.9 Vertical Takeoff

With SAS and LIDS operable and strakes or gun packs installed, VTOs are very smooth throughout and minimal pilot control is required. For a maximum performance VTO, a small amount of back stick just after lift off may be required to initially capture more of the LIDS lifting pressure. If the SAS and/or LIDS are not operable, upsets in ground effect will be more noticeable and will require more aggressive pilot control to compensate.

During a VTO, some instability due to ground effect may occur resulting in uncommanded roll at lift-off. A crosswind VTO may also result in uncommanded rolls at lift-off. It can be aggravated by: low performance margin, improper longitudinal and lateral trim, lateral stick interference, allowing the heading to diverge downwind, and nozzle misrigged/inaccuracy. To minimize those effects, VTO performance must be accurately computed, trim properly set, stick interference avoided and heading maintained during lift-off.

Unstable rolling moments due to bank can reach a maximum at only 5° to 6° bank angle. This occurs very close to the ground (1 foot above the deck). Crosswind during a VTO has little effect at low heights but produces a rolling moment at zero bank angle as height increases. It is critical that any bank angle at lift-off be immediately recognized. Scan at lift-off on a VTO should be primarily straight ahead in order to more easily notice a roll attitude change. Should a wing start to drop during a VTO, an immediate application of corrective control is needed to overcome the instability. Both coarse rudder and aileron (frequently full opposite stick for a short period of time) may be required to arrest a roll and maintain the desired heading into the wind. When too little corrective control has been applied, or it has been applied too late, recovery to wings level may be impossible due to insufficient authority of the roll reaction controls.

Should a roll be experienced and the bank angle cannot be reduced by full opposite control, the throttle should be reduced and the aircraft landed if lateral velocity has not developed. Whenever possible VTOs should be executed with nose into wind.

A VTO from a surface with lateral slope should be avoided, if possible, as the aircraft may tend to skip and skid during engine acceleration due to the side component of lift relative to the true vertical. The wings cannot be leveled to prevent the slide until wing gear freedom is attained and this occurs at a thrust level which exceeds that at which skip and skid occurs. With the aircraft positioned heading up or down the slope, the nozzles may be adjusted away from the hover stop by an angle equal to the slope so that a clean unstick may be achieved. Preferably, the aircraft heading should be up the slope to minimize the recirculation effect.

11.8.10 Hovering

The aircraft is unstable in yaw and has neutral stability in pitch and roll in hovering flight. The reaction controls are acceleration demand controls as opposed to the normal rate demand control of aerodynamic surfaces. This difference requires no conscious change of pilot technique but can lead to over control until experience is gained. Turns with very small angles of bank can be made at speeds up to 30 knots. Large sideslip angles can inadvertently develop due to directional instability at low speed which results in yaw out of the relative wind. The sideslip which can be developed causes large rolling moments which, in extreme cases, can lead to loss of control. If significant sideslip develops, use rudder to reduce the sideslip and aileron to level the wings. If roll is used to reduce sideslip, a sudden increase in incidence will occur with a resultant increase in rolling moment and possible loss of control.

11.8.11 Accelerating Transition

The aircraft is unstable in pitch during an accelerating transition. A constant attitude transition simplifies the pilot task. If pitch attitude must be increased during transition, aim for 12° AOA and do not exceed 15° AOA. The pitch reaction control bleed air required for trim during transition will cause a JPT increase; therefore, the JPT must be monitored during transition. After sufficient wing lift has been attained, the throttle may be reduced to control JPT. Transitions near performance limits require smooth and cautious nozzle control and stick movement to avoid excessive pitch trim changes and resultant coarse corrective control. Coarse control may result in a reduction in engine thrust due to excessive control bleed or JPT cutback. Smooth and cautious control is particularly important when operating in confined sites where obstacle clearance is a factor.

Below 120 knots, pilot action is required to minimize sideslip to prevent large mid-transition rolling moments. A large aileron application to maintain roll attitude is an indication that excessive sideslip has developed. Rudder in the same direction as aileron corrects sideslip. Above 120 knots, there is sufficient directional stability to control sideslip with little pilot input required.

11.8.12 Crosswind Landing

During operations in crosswind conditions, the aircraft, in concert with the SAAHS system, reliably seeks and maintains a zero sideslip, crabbed condition throughout the landing approach with little to no pilot input required. The magnitude of the crab angle will vary as a function of approach speed and crosswind component. As the aircraft enters ground effect at approximately 20 to 30 feet AGL, some natural alignment of the aircraft heading to the established ground track will occur. The amount to which the aircraft aligns itself varies with approach speed and rate of decent. During conventional landings, stabilized crab angles may be up to 6°, however, very little natural alignment will occur prior to touchdown. During slow landings, the aircraft will tend to reduce approximately 50 to 75 percent of the stabilized crab angle prior to touchdown. During RVL landings, the aircraft will tend to nearly align itself completely with the established ground track. Assuming that the aircraft does not stagnate in ground effect during this natural alignment, very little deviation from the established ground track will be noted. Similarly, there will be little to no rolling tendency associated with the natural alignment requiring pilot input to maintain a wings level attitude for touchdown. Stagnation in ground effect or other delay in touchdown even in the presence of natural alignment will permit sufficient lateral drift to develop resulting in sharply degraded handling qualities. Post touchdown handling qualities will vary with gross weight, groundspeed, touchdown crab angle, and lateral drift.

While all these factors will ultimately determine how the aircraft behaves at touchdown, it is most sensitive to lateral drift. With little to no lateral drift prior to touchdown, the aircraft completes its alignment and continues along the established ground track with little to no initial pilot input required. If the aircraft is landed in a crab, side forces applied to the landing gear at touchdown will result in the aircraft rolling away from the upwind wing as it aligns itself. The apparent severity and magnitude will vary with crab angle and touchdown speed, however the aircraft will seek and maintain the ground track established prior to touchdown. The recommended technique for landing in the presence of crosswinds is a crabbed approach with pilot augmentation of whatever natural alignment occurs prior to touchdown. The aircraft may be safely landed in a crabbed condition up to 10° within the crosswind envelope, however, minimizing the crab angle prior to touchdown will minimize the touchdown aircraft motion described above. The magnitude to which the pilot elects to further reduce the crab angle during alignment will be based on his comfort level and proficiency. It is critical that the pilot not attempt to reduce the crab angle too early in the approach nor stagnate in ground effect in order to minimize the opportunity for significant lateral drift to develop.

If the pilot is uncomfortable with the established crab angle during the approach and landing, he may reduce the crab angle by either one or combination of two methods. The pilot may elect to increase his approach airspeed via use of lower nozzle angle or flap angle with due consideration for runway length and stopping distance. If the pilot elects to fly a faster airspeed, he should ensure that an on speed condition is maintained. Electing to fly the aircraft at a faster airspeed by reducing the angle of attack to less than 10° units will effectively reduce the crab angle during the approach, however, this will degrade touchdown and post touchdown handling qualities. His second option may be to reduce crab angle just prior to touchdown via aircraft natural alignment or rudder input. If the pilot favors this method, rudder input should be made after the landing attitude has been set, and prior to touchdown, generally 20 to 30 feet AGL. This will preclude development of lateral drift at touchdown optimizing aircraft handling and rollout characteristics.

During landing rollout, aircraft control and steering may be enhanced by selecting flaps to CRUISE. Selecting 4° nose down trim when below 100 KIAS will also reduce the porpoising effect common to conventional landings. Lateral stick into the wind will also assist with maintaining a wings level attitude during landing rollout. Forward stick during landing rollout and PNB will result in more weight shifting to the nose gear sharply reducing controllability and steering effectiveness. Runway centerline tracking immediately after touchdown should be accomplished using rudder aerodynamic forces. As the rudder loses its effectiveness to maintain desired track, NWS should be used for steering the aircraft. Care must be taken to ensure that the rudder pedals are centered prior to engaging the nosewheel steering to preclude undesirable swerve and potential loss of control.

11.8.13 Decelerating Transition

Power must be applied to maintain the desired flight path during deceleration. Use the stick to maintain 8° to 10° AOA and the rudder to minimize sideslip. Should application of aft stick to the aft stick stop be required to maintain approach angle of attack when not associated with flap transition in a V/STOL configuration, the aft RCS nozzle may have failed in the open position. If this situation is encountered, emergency procedures for Reaction Control failure should be initiated. With AUTO flaps, an appreciable power increase is required between 80 knots and 40 knots to prevent sink as wing lift decreases rapidly. With STOL flaps, this power increase is delayed to below 40 knots. Maintain 8° to 10° AOA until below 50 knots. Lower AOA will reduce nozzle angle and increase deceleration distance. A combination of lower AOA and braking nozzle can be used to improve forward visibility when approaching a restricted site but this is an inefficient balance between wing lift and jet lift. The optimum compromise between performance and handling is 10° AOA which is the target value for all decelerating transitions.

Minimize sideslip, particularly with a crosswind. Aircraft directional stability will minimize sideslip above 120 knots, but, below 120 knots, and increasingly until 30 knots is reached, sideslip must be minimized by rudder to yaw into the relative wind with the wings maintained as level as possible. If the surface wind is over 30 knots, judgement of the deceleration path is particularly important since drift may induce the pilot to bank to achieve the desired hover position. The desire to turn the aircraft toward a landing site after a late deceleration or misaligned approach must be resisted until below 30 knots. At altitudes near 100 feet, significant speed relative to the ground may exist while the aircraft appears stationary. For fine range correction to a landing site, vary the thrust axis by changing attitude. Coarse range correction may require excessive throttle adjustment to compensate for wing lift change. A wave-off from any point in a decelerating transition may be made by progressively moving the nozzle lever forward. A wave-off should be made immediately if any control difficulties are encountered, or if JPT or rpm do not remain within planned limits.

11.8.14 Vertical Landing

Without LIDS during a vertical landing, at about 15 feet above the ground, cobblestoning (random attitude disturbances) may occur. Control stick activity will increase in order to hold attitude. Frequent coarse control movements may be required just prior to touchdown. If the rate of descent is correct, only small power changes are required close to the ground; however, a too fast descent will require a large power increase to arrest the descent. A too slow descent may result in reingestion and a large throttle movement to compensate for the reduction in engine thrust.

With LIDS, ground effect disturbances are reduced and control activity is small. The LIDS will cushion the descent, normally requiring a power reduction below 10 feet. If the rate of descent is correct, only small power changes are required close to the ground; however, a too fast descent will require a large power increase to arrest the descent. A too slow descent may result in reingestion and additional power may be required to compensate for thrust loss due to reingestion. Also, winds greater than 10 knots can reduce the effectiveness of the LIDS.

If the fast deceleration solenoid is disabled, the rate of descent for a vertical landing should be maintained at no more than 200-300 feet per minute. Knowing that wind in excess of 10 knots can cause a “suck down” effect at approximately 10 feet off the deck, using this modest rate of descent initially may keep the aircraft from developing an excessive rate of descent just prior to landing that would require a large power addition and engine acceleration with no countering “fast decel” effect after landing. Conversely, if the winds are light, as previously discussed, the aircraft’s rate of descent will decrease just prior to landing due to encountering the LIDS cushion (“hung up in cobblestones”). As the pilot senses the rate of descent decreasing the power may be reduced (decelerating the engine) to maintain a constant rate of descent to touchdown, which will partially fulfill the function that the fast decel solenoid would have performed. While descending through 10 to 20 feet AGL on a VL, pitch attitudes above 10 degrees can result in a rapid increase in rate of descent due to loss of LIDS effectiveness and potentially hot gas reingestion.

11.8.15 Slow Approach and Landing

Fixed 60° nozzle STOL flap approaches optimize the entrained flow effects of the wing, flap, and nozzle geometry. This reduces the average engine power and fuel flow required for approach, as well as affording the easiest and most precise control of glideslope. Selection of the hover stop just prior to touchdown is an option to reduce landing rollout distance.

If considerations for maximum available engine power or minimum stopping distance dictate, a fixed throttle approach can be flown with the following considerations:

With over 80 percent rpm in a slow approach, nozzle angles are typically 60° and above. A small change in nozzle angle produces a large change in horizontal thrust but only a small change in vertical thrust. Higher rpm requires a larger nozzle angle and the effect of change in nozzle angle is more marked. A wave-off, initiated on approach without applying power, will result in a slight tendency to sink unless AOA is increased. Increased rpm will reduce the AOA almost instantly, increase the airspeed, and reduce the rate of descent. Do not exceed 15° AOA during wave-off.

If the speed brake does not extend when the gear is lowered, a directional oscillation may occur during the approach which can be controlled with rudder. Automatic speed brake extension does not occur when the landing gear emergency lowering system is used.

During SL with high lateral asymmetries the following recommendations apply:

1. Relative wind should be placed under the heavy wing if feasible.

CAUTION

Flight tests have shown a drop off in handling qualities with asymmetries greater than 80,000 inch-pounds without the relative wind under the heavy wing.

2. Maximum lateral asymmetries will require considerable pilot compensation due to degraded flying qualities.
3. Full lateral trim authority may be required.
4. Pilot workload can be reduced by decreasing nozzle angle from 60° to 50°, or by using the variable nozzle SL technique with auto flaps selected.
5. A firm touchdown should be utilized to minimize time in ground effect.

11.8.16 Center of Gravity Effects (Trim Bleed Rise)

The aircraft with a forward cg requires bleed from the forward RCS duct to balance the aircraft in a hover. This requirement is due to a large difference between the cg of the aircraft and the thrust center of the engine. All AV-8B aircraft experience this cg shift as fuel is burned from the fuselage tank. This is especially evident in the TAV-8B and radar aircraft due to increased weight in the forward fuselage.

The problem of a forward cg manifests itself only during hot weather when the aircraft is performance limited by the engine JPT. During these periods, the aircraft can perform V/STOL maneuvers only at light gross weights. As the gross weight is adjusted to enable vertical operations, greater bleed demands from the forward RCS valve is required to adjust for the forward shift in cg.

11.8.17 V/STOL with Asymmetric Loading

All sideslip aids utilizing lateral accelerometer inputs (yaw stab aug, shakers, HUD sideslip symbol) will operate erroneously. The external sideslip vane should be used to minimize sideslip. If landing is required with significant asymmetric loads, refer to Asymmetric Landing, Part V. A long straight-in approach will reduce pilot workload. Small lateral/directional oscillations may occur during an approach in turbulence or gusts. If a steady approach has been achieved, these oscillations will damp out. If a vertical landing is required, the decelerating transition shall be made directly into the wind. The transition should be flown in as near level attitude as possible to avoid a need to reduce power for altitude control as this significantly reduces available roll reaction control power. If control difficulties or severe lateral/directional oscillations occur, immediately initiate a waveoff.

11.8.18 SAAHS-Off V/STOL

11.8.18.1 Flight Characteristics

Any discussion on the skills and procedures for safe recovery of an aircraft that has degraded or failed SAAHS must begin with an understanding of the aircraft's inherent stability in the various regimes of flight.

11.8.18.1.1 Pitch

The airplane is neutral to unstable in pitch in the V/STOL regime. As the airspeed decreases below approximately 120 KCAS, during a decel with the nozzles down, the pilot must begin to program the stick forward and trim nose down to counter the increasing nose–up pitch tendency. There is a “neutral point” around 100 to 110 KCAS where the airplane will tend to maintain its attitude. Forward extending stores, water, and engine thrust (adding power) can further increase the instability. In ground effect on roll–on landings and during the decel, approaching the hover, and while executing the vertical landing, the AV–8B II+ and TAV–8B’s nose often tends to drop unless this is anticipated by the pilot.

11.8.18.1.2 Yaw and Roll

The jet is increasingly stable in yaw and roll at speeds above 60 to 70 KCAS as the airflow over the vertical stabilizer contributes a strong counter–force to yaw and aerodynamic flight controls regain effectiveness. The jet, however, is near neutral stability in yaw and roll between 50 to 60 KCAS and unstable below 50 KCAS. In addition to honoring the one–half lateral stick limitation, the pilot must control yaw at all times using the wind vane, rudder pedal shakers, and VSTOL ball (HUD sideslip indicator) because appreciable yaw between 30 to 90 KCAS can lead to loss of control due to sideslip–induced roll.

11.8.18.2 SAAHS–Off Landing (RVL and Decel/VL)

In many cases a degraded SAAHS or SAAHS–off landing will be performed as the result of another system malfunction that provides inputs to the SAAHS. In these cases the pilot must make the appropriate decisions in light of the malfunction, but must also deal with the SAAHS–off flight and landing of the airplane. By itself SAAHS–off flight is manageable, but can be complicated by other malfunctions or external conditions so it is important for the pilot to understand the considerations of operating without the SAAHS. Most of the system malfunctions that cause the SAAHS to become degraded or fail will also require you to do an RVL or VL to land the aircraft therefore the pilot must understand the capabilities of the primary flight control in the semi–jetborne and jetborne environment, the Reaction Control System.

11.8.18.2.1 RCS

The reaction controls are relatively weak compared to aerodynamic controls in conventional flight. Reaction controls are an “acceleration demand” control which means that their thrust displaces the aircraft in the desired direction at a slowly increasing rate. Aerodynamic controls, on the other hand, are more powerful “rate demand” controls which cause a more dramatic and immediate displacement of the aircraft (assumes that there is sufficient wind across the control surfaces – starts at approximately 60 KCAS and increases with airspeed.) This is why holding the nose of the aircraft at the desired attitude is so important. If the nose movement is not controlled, it can accelerate at a rate at which the reaction control system cannot overcome. The TAV–8B in a hover at lower fuel weights (approximately 2,000 lbs and below) uses approximately two–thirds of the available RCS power to hold the nose up because the CG is slightly forward of the center of thrust. Care must be taken so momentum, gravity, and pitch rate do not overtake the reaction control effectiveness. There is only a finite amount of control effectiveness available from the reaction control system. A simultaneous demand from all axes results in a reduced amount of power from each RCS and, therefore, a relatively diminished reaction control capability. Flying the aircraft in balanced flight (wings–level and into the relative wind) will help reduce the overall bleed demand and provide more available pitch and roll control power/effectiveness.

11.8.18.2.2 Approach and Landing

The key to a successful SAAHS–off V/STOL landing is anticipation, smooth airwork, and proper trimming of the aircraft. The pilot essentially has to do the job of the SAS by immediately correcting any excursions from balanced flight that may build up a rolling moment and prevent a safe landing. SAAHS–off V/STOL should be done into the wind to keep sideslip at zero and maintain balanced flight. In addition to reducing the opportunity for a rolling moment to build, this reduces the number of variables the pilot must account for and thereby reduces pilot work load. When performing a SAAHS–off landing, the pilot should lower the landing gear early and trim it for level flight (either for a straight–in or in the landing pattern). The pilot should then fly a slightly longer pattern to allow more straight away to trim and ensure the approach is into the relative wind. The pilot should fly a slightly flatter approach (avoiding unnoticed AOA buildup with increased rates of descent) and look for normal cues for the proper position to select hover stop. Hover stop should be selected so braking stop and excessive nose up profiles are not required to stop the aircraft over the landing spot. This would dramatically increase pilot workload. If this condition occurs, a wave off should be initiated and the approach tried again. During the decel and in the hover until landing, the vane must be kept into the wind at all times. This may be a challenge because the nose will want to wander due to intake momentum drag with no balancing effect from the vertical stabilizer and the pilot will need to actively control the aircraft to keep it centered. Any deviations in roll or yaw must immediately be countered so rates that exceed control power/effectiveness are not exceeded (remember the finite capability of the accelerating reaction controls). As with all V/STOL, on SAAHS-off V/STOL the pilot must fly the aircraft all the way to the deck. Deviations cannot be allowed to go unchecked and the rate of descent must be kept under control. If there are winds approaching or exceeding 15 knots, a power addition in close must be anticipated so a controlled descent can be made and a power bounce can be avoided. This is especially important if the fast deceleration solenoid is disabled. The selection of an RVL or VL is a factor of several considerations. The first of these considerations starts with the type of landing NATOPS recommends for the aircraft malfunction. Other considerations include winds, runway length, condition, and surface, type of malfunction(s), available performance, and others. For example, on a calm day, a SAAHS-off RVL (there will rarely be a time when a 5 to 6 degree RVL is required, -3 degrees should be sufficient in most cases) should be easily controllable. However, with a significant crosswind, a vertical landing may be a better choice as long as the additional power requirement is anticipated and performance margin is available.

11.9 ENGINE HANDLING CHARACTERISTICS

11.9.1 Engine Handling on Takeoff

When accelerating from low power, the limiting rpm may be reached before reaching the limiting JPT due to thermal lag. This condition is not a steady state. The JPT will continue to rise. The JPT will approach the limiting datum where the JPTL will reduce fuel flow, hence rpm, to maintain the JPT limit. Three important factors which act to determine the final JPT/RPM relationship are bleed usage, reingestion, and ambient temperature.

11.9.1.1 Bleed Usage

Refer to paragraph 2.3.8.1 for description of bleed effects on engine performance and thrust available. Large bleed demands are associated with accelerating and decelerating transitions, particularly if accomplished at an AOA other than optimum. Downward thrust from the wing RCS valves causes a nose down pitching moment that may be countered by increasing downward thrust from the forward RCS valve. Increased forward RCS bleed demands required to balance the aircraft in a hover are associated with lighter aircraft weights and the resulting forward cg.

11.9.1.2 Hot Gas Ingestion

Reingestion effects are small during a normal into-wind VTO. A no-go or excessively slow VTO, a downwind VTO, a VTO where the aircraft drifts backwards, or a VTO where the nose is high can result in reingestion, large JPT increases, and compressor stalls.

11.9.1.3 Ambient Temperature Effects

The JPT varies as a function of ambient temperature. As the ambient temperature decreases the JPT will decrease.

11.9.2 JPT Limiter

The engine fuel system reduces rpm as the short lift (wet or dry) limit is reached if the nozzles are deflected more than 16° or the landing gear is selected down. The throttle must be reduced to enter normal lift from short lift. Allowing the engine to continue to operate at the short lift limit, when not required, rapidly increases the life count.

When the landing gear are up and the nozzles are rotated up through 12 to 7 toward fully aft the JPTL will signal DECS to reduce RPM to maintain JPT limits within the maximum thrust datum.

The JPTL reduces engine rpm to the maximum thrust datum when both the landing gear is selected up and the nozzles are rotated up through 12° to 7° toward fully aft.

11.9.3 Water Injection

Water injection lowers the JPT about 35 °C for the -406 engine and about 20 °C for the -408 engine for a given thrust. Water injection does not change engine handling technique. With the water injection switch in TO or LDG, the engine fuel system is reset to allow a 3.3 to 4.3 percent increase in maximum rpm for the −406 engine and 6.0 to 7.0 percent increase for the −408 engine, even if water does not flow and the FLOW light does not come on.

When water is exhausted with the engine above the short lift dry limit, JPT will not be automatically reduced to the short lift dry limit. When water is exhausted with the engine below the short lift wet limit, JPT will rise. If the JPT reaches the short lift wet limit, a small thrust loss may occur. Whether or not water is flowing, the rpm (thrust) can be maintained by overriding the limiters if required. The JPT will exceed the short lift dry limit.

Water flow is stopped by reducing the throttle below 94 to 96 percent rpm for the −406 engine, 103 to 105 percent rpm for the −408 engine, or by selecting the water arm switch off. If water conservation is desired, the water switch may be selected off before rpm is reduced. If the water switch is turned off above about 87 percent rpm, whether or not water is flowing, there will be a 3 to 4 percent rpm reduction with the −406 engine and a 7 to 8 percent rpm reduction with the −408 engine, due to governor limit reset.

After takeoff, if it is desired to use the water rather than jettison it, the throttle should be maintained at the lowest rpm which will keep the water flowing. This will reduce engine wear caused by a slightly inferior flame pattern with water.

11.9.4 Engine Life Versus JPT

Engine life is determined by flight hours and Engine Life Counts (ELC) and can be expended in either. Engine operating time is one measure of engine life. If engine JPT is not considered, the engine would be pulled at the end of the flight hour limit. Engine life counts is another measure of engine life and is a function of the thermal stress placed on the engine. The greater the thermal stress, the more engine life that is expended. Over−temperature conditions, besides using the entire engine life count, can literally melt the turbine section of an engine. Thermal stress is measured in Engine Life Counts.

The engine life of the −406/−408 engines are as follows:

ENGINE	TIME (HOURS)	COUNTS
406A	500	5,500
406B	750	7,500
408A Pre−PPC 192	1,000	35,000
408A PPC 192/408B	1,000	50,000

The engine count rate (engine life counts per minute) is a logarithmic function of engine JPT, Figure 4-3. To help explain this relationship, a comparison of −408A/B engine lift ratings versus engine life rate is as follows (a different but similar relationship exits for the −406):

LIFT RATING	JPT	COUNT RATE (PER MINUTE)
SLW	800	Approximately 1,500
SLD	780	Approximately 600
Combat	750	Approximately 60
Max Thrust	710	Approximately 5

It is apparent that time spent at or near the engine lift ratings (SLW, SLD) greatly reduces engine life. Even a 15° reduction in JPT (from 800° to 785 °C) can save hundreds of counts. Every attempt should be made by the pilot to reduce aircraft gross weight when conducting vertical landings to avoid premature engine removal as a result of excessive engine life counts.

11.9.5 Accelerating Transition

After a VTO, RVTO, or STO, JPT will increase during the transition due to RCS bleed demands needed to trim for the transition. A progressive reduction in throttle cannot be made simultaneously with reduction of nozzle angle so one or more step reductions in rpm may be necessary during the transition.

11.9.6 P3 Limiter Fan Speed Fluctuations

When operating at high airspeeds (greater than 450 KCAS), low altitudes (below 3,000 feet) with low ambient temperatures (ISO standard day temperature and below for -408), the engine operates on the P3 limit and fluctuations in fan rpm of approximately 1 to 3 percent may occur. These fluctuations will occur at a rate of 2 to 3 times per second, reducing the throttle slightly will cause the fluctuations to stop.

11.9.7 Decelerating Transition

Before commencing a decelerating transition pay due regard to landing site pressure altitude, temperature, wind, and aircraft weight. As nozzles are lowered and deceleration begins, increase power to replace wing lift loss. With STOL flaps, an appreciable power increase is required below 40 knots to prevent sink. A long slow deceleration with gentle nozzle rotation and power application requires less bleed than one which uses the braking stop throughout the deceleration. A braking stop deceleration will require about 2 percent more rpm than an equivalent hover stop deceleration. Very coarse nozzle application and control usage can cause high bleed demands and JPT rise which will dangerously reduce the performance margin. If either an rpm or JPT limit is approached, perform a wave-off and reduce aircraft weight before commencing another approach.

11.9.8 Landing

Landing, like takeoff, can be an RPM or JPT limited maneuver. Use of the LDG position of the water injection switch will increase power and save water by delaying flow until about 684 ±5 °C JPT with the -406 engine or 765 ±5 °C JPT with the -408 engine. This flow point will occur late in the deceleration therefore extra attention to power margin available is required. If wave-off is not feasible and JPT is limiting power, consider overriding the JPT limiter.

11.10 JET EXHAUST INTERACTION

11.10.1 Energy Levels in V/STOL Flight

The front nozzles exhaust emerges at about 700 knots, 105 °C (220 °F) and 16 psi. The rear nozzles exhaust emerges at about 1,050 knots, 645 °C (1,195 °F) and 11 psi. The reaction control valves exhaust emerges at about 1,500 knots, 400 °C (750 °F) and 150 psi. Although velocity, pressure, and temperature drop off with distance, the exhaust velocity at ground level in a low hover can be 300 to 400 knots at 4 psi. If this pressure is permitted to build up under a surface such as a landing mat or manhole cover by penetrating through holes or around unsealed edges, the lifting force becomes tremendous. A pressure of 4 psi will lift 4-foot-thick concrete or 8-inch-thick steel. The aircraft has proven to be an efficient manhole cover remover although it displays no discretion in depositing them after removal. The aircraft has raised an 11 ton mat 4 feet above the ground. Pneumatically supported mats do not soften the landing; therefore, all landing mats should be thoroughly sealed including the perimeter. The aircraft should never cross the edge of a mat in V/STOL flight at less than 50 feet.

11.10.2 Single Exhaust Pattern

A jet exhaust will interact with a surface upon which it impinges to form a flow pattern as shown in Figure 11-8. In the V/STOL mode the predominate surface is the ground which may be considered as a plane approximately normal to the exhaust; however, the presence of other large surfaces in the immediate area, such as buildings or vehicles, may alter the flow pattern to some extent. The jet exhaust will mix with the surrounding air by jet edge shear resulting in a rapid drop in temperature and velocity but with a relatively small reduction in mass flow.

11.10.3 Complex Exhaust Patterns

Figure 11-9 is a pictorial representation of the interaction of the four exhaust nozzles and the ground for the aircraft in a low level hover. Interactions of the control reaction jets are not shown in order to simplify the representation and discussion. Their interaction has a considerably smaller though similar effect on the complete pattern.

Note that there are two intersecting surfaces of symmetry labeled A-A and B-B. Their point of intersection on the ground is the initiation point for a relatively focused jet fountain which angles toward the tail of the aircraft. This angle is due to the higher energy of the forward nozzles in comparison with the aft nozzles due to their exhausting cooler air with a consequent higher mass flow.

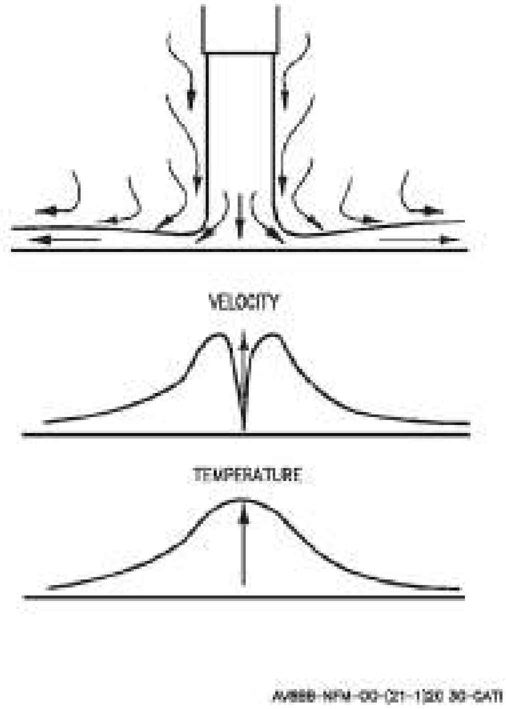

Figure 11-8. Single Exhaust Pattern

11.10.4 Instability Due to Ground Effect

Figure 11-10 illustrates two instability mechanisms associated with the jet fountain. As the aircraft reaches a critical altitude the jet fountain moves forward from aft of the aircraft and commences to impinge on the tail surfaces causing a nose down trim change. As the aircraft descends, the center of pressure moves forward on the aircraft and at the same time, becomes more powerful. These two actions tend to cancel each other, however, as the jet fountain moves forward, its force is expended on varying surface areas resulting in random pitch trim changes. As the aircraft is rolled, the jet fountain moves toward the high wing. If it then impinges upon the aircraft it will tend to increase the roll angle and may cause a pitch trim change. If it leaves the aircraft surface it will cause a nose up pitch trim change. Surface irregularities will also cause deflection of the jet fountain causing rapid trim changes or turbulence sometimes known as cobblestoning. Wind gusts will also cause random trim changes. If LIDS is used, these effects are greatly reduced.

11.10.5 FOD

V/STOL aircraft are particularly adept at creating their own FOD and then ingesting it. FOD can cover a wide range of effects ranging from covering aircraft with dirt and dust to severe damage to the airframe and engine possibly resulting in failure and catastrophic destruction to the aircraft as well as possible death or injury to the pilot. The most FOD-sensitive component of the aircraft is the engine. The Pegasus engine is inherently capable of dealing with ingested debris better than smaller engines in conventional fighters and has been qualified to withstand impact of a 1 pound bird at 600 knots when running at 97 percent N_f. If engine damage due to FOD is suspected airborne a pilot should perform the Engine Mechanical Failure/Engine Vibration emergency procedures. In most cases FOD is not noticed until post flight inspection by the pilot or maintenance personnel. Despite the ability of the Pegasus to withstand FOD, it is highly susceptible to FOD due to the fact that the Harrier in V/STOL operations tends to disturb more surface debris than conventional aircraft. The chance of FOD ingestion is dependent to a great degree on the observance of correct operating procedures.

11.10.5.1 Engine

The low pressure fan blades of the Pegasus engine are made of high-strength titanium alloy. These blades rotate at over 6,000 rpm and can ingest objects at a relative speed in excess of 1,000 mph. Soft objects generally do not cause damage, however harder objects such as stones or metallic objects that impact the blades at these high relative speeds can seriously damage the engine. FOD is normally discovered on the LP fan blades or stator vanes, but not always on the first stage. The first evidence of damage may occur on the second or third stage. The HP compressor blades are also liable to be damaged. The 408 engine is more susceptible to later stage damage than the 406 engine due to a reduced number of blades on the first stage (23 vice 26) and thus greater gaps through which objects can pass. Some objects may shatter on impact and generally do not cause further damage to the engine. Harder objects have a tendency to make multiple impacts as they bounce around the engine. Blade leading edges can be damaged causing poor aerodynamics, reduced engine performance, possible surge and stress concentrations that can lead to blade failure within a short time. Blade failures will cause further damage down the engine and may cause catastrophic engine failure.

11.10.5.2 Jet/Ground Interaction

If a jet of air is directed at a solid surface like the ground it does not bounce off. The jet flows away smoothly in a radial pattern as a sheet of air from the center of the impact area. This is called a wall jet, and at the center point of impact a high pressure exists (stagnation point). When two or more of these sheets meet the effect is a rising jet sheet flow. Close to the ground the Harrier's four exhaust jets, in a normal hover attitude, interact to create a rising fountain at a point centered laterally about the aircraft and slightly aft of the center point between the nozzles. This interaction results in a fountain that rises and flows rearward. As the aircraft descends the upflow increases in strength and the fountain moves forward relative to the aircraft. At touchdown the fountain impinges at maximum strength directly on the main gear and belly just forward of the main gear doors. This fountain is the cause of the "cobblestone" effect identified by a high frequency buffet of the aircraft when in close proximity to the ground in a hover. The fountain describes the concentration of the upflows, but in reality there exists a sheet of rising flow all along the center line of the aircraft fore and aft. While FOD has the possibility to ride this upflow and damage the airframe aft of the intakes, its most dangerous region is the part of the upflow that goes to the intakes. When the nozzles are deflected aft the upflow biases in a rearward direction, however some forward-moving upflow persists down to jet impact angles as small as 20° to the ground. When the aircraft is moving forward the upflow tends to move rearward. This effect is dependent on throttle position and nozzle angle. As the ground speed decreases the upflow will move progressively forward towards the intakes until 50 knots, at which point the upflow will move forward of the intakes. It is this reason that RVLs should target 60 knots ground speed, and should never be flown at less than 50 knots. It is also the reason than PNB should cease at 60 knots. If lower airspeeds are used it must be understood that the risk of FOD increases. After PNB, selecting idle below 50 knots will also help reduce FOD.

The energy output of the Pegasus engine exhaust flows in V/STOL flight is approximately 30,000 horsepower. In V/STOL flight the forward cold nozzles have a jet velocity of around 800 mph, a stagnation pressure of 16 psi, and a temperature of 105 °C. The rear hot nozzles have a jet velocity of about 1,200 mph, a stagnation pressure of 11 psi and temperatures of about 700 °C. In V/STOL flight the reaction control system output is up to 1,700 mph jet velocity, 150 psi stagnation pressure, and 400 °C temperature. An object lying on the surface exposed to these high velocity jet sheets can acquire speeds of up to a hundred or more mph in a relatively short distance. If the surface is rough or uneven it almost inevitably bounces and may be deflected sharply up into the air. This path could be toward the intake, particularly if the motion is caused by the front jet sheets.

The Pegasus engine also has the ability to damage surfaces that are not suitable. If the ground is granular a crater will form immediately starting at the stagnation point. If unprepared surfaces are used, such as grass, the jets have a tendency to dry the covering causing it to lose its cohesion and break up. This can occur in as little as a few seconds over the same spot and thus requires the pilot to keep the aircraft and exhaust from residing over the same spot. For this reason VTOs or VLs should never be attempted over unprepared natural ground, no matter how firm and stable the surface appears. True vertical take-offs and landings always require a prepared surface (mat or concrete pavement).

AM-2 aluminum mats can be used for V/STOL operations if prepared properly. The edges of the mats should be sealed and anchored at the edges. If the aircraft's exhaust sheet crosses the edge of a mat at a low hover height and the mat is not anchored or sealed properly the mat and entire pad can become airborne. The same applies for the connections between mat sections. AM-2 mats should always have their edges properly sealed and should be securely staked to the ground. Never rely on weight alone to hold down a pad. The aircraft should never cross the pad at less than 50 feet to preclude the jet sheets from lifting the surface at the edges. Debris may be raised at these heights and blown onto the pad or into the intakes and as such the Harrier should not perform a decelerating transition over a surface where debris may get lifted or disturbed below 150 feet. Harriers should also avoid performing V/STOL operations over manhole covers or other objects that may be picked up by the jet sheets. Concrete pads are normally segmented slabs to allow for expansion. The joints of these slabs can contain loose debris and if unsealed may allow for the pressure from the engine exhaust to lift the slabs. Any debris contained in these joints may also be blown out violently and may cause FOD. These joints must be sealed continuously otherwise the jet can penetrate even a small slot. If a gap is present the sealant may also be blown out and into the air by the aircraft. It is for this reason that Harrier pilots should ensure that vertical takeoff and landing areas are free from FOD, slots in pavements are free from loose debris and are properly and continuously sealed. The seal should extend the full slot depth and should not be cracked or gapped.

Poor workmanship or inadequately repaired surfaces can produce unexpected hazards for FOD during V/STOL operations. Care must be taken to inspect the surface for damage and cracking in areas that V/STOL operations may be conducted that could result in high velocity exhaust exposing potential weaknesses in the surface. Asphalt or other softer substance heat up quickly and can be damaged easily by the Harrier’s exhaust. If using a surface other than properly sealed concrete or if in doubt about the integrity of the surface the aircraft should be operated to minimize jet exhaust residence time on any one spot by using STO or RVTO and RVL or SL procedures to reduce the chances of damage. Prolonged and repeated operations over the same surface will accelerate the wear and possible damage to that surface. Consideration should be given to varying V/STOL spots on asphalt or soft surfaces to maximize their serviceability.

Vertical takeoffs and landings should only be performed on clean surfaces. Stabilizing above 50 feet for several seconds over a landing spot may clear debris prior to landing and possibly reduce the chances of FOD. Vertical takeoffs can benefit from reduced FOD risks by being performed after an aircraft has performed a vertical landing at a spot in order to ensure any debris has been blown off the pad.

11.10.5.3 Taxi Operation

At low power settings the engine will not normally pick up objects that are not already airborne. The ground attitude of the aircraft is greater than that of conventional aircraft. Even with the nozzles fully aft the jets meet the ground close behind the aircraft, presenting a FOD hazard to following aircraft from surface debris which may be disturbed and swept to the rear. The Harrier also has a much wider area of rearward jet flow than conventional aircraft since the jets are separated by the fuselage and splayed outwards by 50 each side. The best formation for multiple aircraft taxiing for FOD avoidance is line abreast with each aircraft’s intakes forward of the other cold nozzle exhaust. If it is required to taxi in trail the distance behind another Harrier should be no less than 600 feet with 1,000 feet normally sufficient. Taxiing in a staggered formation may also help reduce the chances of following aircraft picking up debris from preceding aircraft. When operating in close proximity to other aircraft the nozzles should be placed aft since the exhaust tend to splash out to the sides more when the nozzles are deflected, causing a wider area of surface disturbance. When taxiing nozzles should never be more than 60°, and if the surface is questionable 30° is the maximum nozzle angle that should be used. Aircraft should not be taxied backwards as FOD risk is increased.

11.10.5.4 Reaction Control System

The reaction control system is energized when the nozzles are down. The front reaction control valve (RCV) is open at stabilator positions of less than 2° nose down. The front RCV is forward of the intakes and has the greatest chance of sending objects into the intake causing FOD. When taxiing, pilots shall ensure the front RCV is closed by maintaining the stabilator position at least 2° nose down. If the nozzles are aft the RCV position is not critical since the reaction control system is not energized. When landing, this RCV can kick up objects which can then be ingested by the engine. If excessive nose attitude is used during the landing, the nozzle angle and jet sheet are biased forward causing a greater risk of FOD to the engine. Additionally, when landing with the nozzles deflected, any nose attitude greater than the normal landing attitude will increase the front RCV output, increasing the FOD risk. It is also good airmanship to avoid prolonged time in ground effect, which can increase the risk of FOD.

11.10.5.5 Formation V/STOL

Aircraft performing a formation takeoff or landing must ensure that intakes are forward of cold nozzle exhaust or is far enough aft that the following aircraft are airborne before the preceding aircraft's takeoff point. When performing line abreast takeoffs or landings the potential for FOD is greatly increased if following aircraft become sucked on bearing. When performing trailing takeoffs or landings FOD risks can be reduced by alternating sides of the runway. Generally a 300 foot buffer added to the takeoff distance is enough to ensure following aircraft get airborne prior to picking up any "energized" FOD from preceding aircraft.

11.10.5.6 Ground Operations

There are numerous apertures, holes and cavities in the airframe through which dirt, stones, and other objects may enter the aircraft and cause damage. Of special concern to a pilot are the following areas.

11.10.5.6.1 Intake Suction Doors

These should never be used as steps and nothing should ever be placed on these. Objects can rest on the inside of these doors, especially the lower doors, and get ingested by the engine on start. The only way to be sure they are free from FOD is to enter the intake to look at them from the inside. If this is done extreme care must be taken to ensure the inspector is free from all objects which may FOD the intake.

11.10.5.6.2 Boundary Layer Doors

Small objects can get stuck inside the bottom landing behind these doors and make their way into the engine. With the canopy closed objects can fall into this area from the ducts on top of the aircraft in the rear skirt of the canopy. During preflight careful attention to looking inside the doors at the bottom of the landing is necessary.

11.10.5.6.3 Cockpit Conditioning System Cooling Ducts

Care must be taken anytime someone is on top of the aircraft. Objects falling into openings may enter the engine or the GTS and cause FOD. Inlets on top of the intake cowl allow air to enter the heat exchanger and then pass through the bullet fairing in the intake to the motor. Objects that enter these inlets may FOD the motor.

11.10.5.6.4 Footsteps

The footstep receptacles are potential debris traps. Boots should be free of mud and any objects before stepping on the aircraft or the footsteps so that debris does not enter the cockpit, get stuck in the footsteps or fall into another aircraft cavity and cause damage.

11.10.5.6.5 Intake

The intake should never be used as a shelf on which to hold anything. It should not be used as a step either since debris on the soles of foot gear can be deposited in the intakes. Care must be taken to limit the items taken in the cockpit. Everything must be secure and accounted for when entering and leaving the cockpit. Items should never be placed on the glare shield or canopy edge as they may get sucked out and down the engine.

11.10.6 Hot Gas Ingestion

In a normal hover at 50 to 60 feet, the jets from the nozzles merge prior to reaching the surface and there is, therefore, no interaction as at lower levels. Instead, the merged exhaust acts as a single jet and upon striking the surface, expands radially through 360°. The ground jet sheet velocity decays rapidly and, as the velocity approaches zero, the warm exhaust gases commence to rise by convection. The gases break from the surface and commence to raise at a radius of 50 to 100 feet dependent upon hover height, wind, surface roughness and ambient temperature. As the gases rise they are blown by the wind. The gases which are upwind will be blown toward the aircraft and will envelope it. Ingestion of this warm gas will reduce engine thrust if JPT-limiting is reached. Figure 11-11 illustrates the best and worst case. With the aircraft pointed into the wind, the ingested gases will be predominantly from the front nozzles, thus cooler than in the case where the aircraft is pointed downwind and thus ingesting gas predominantly from the rear nozzles. At lower hovers, convection is still present but the major part of the gas is blown directly back by the exhaust reaction with the surface and reaches the aircraft much hotter than the convection gas, therefore, low hovers cannot usually be sustained and are not recommended. Reingestion can become critical at low forward speeds on or near the ground (Figure 11-12).

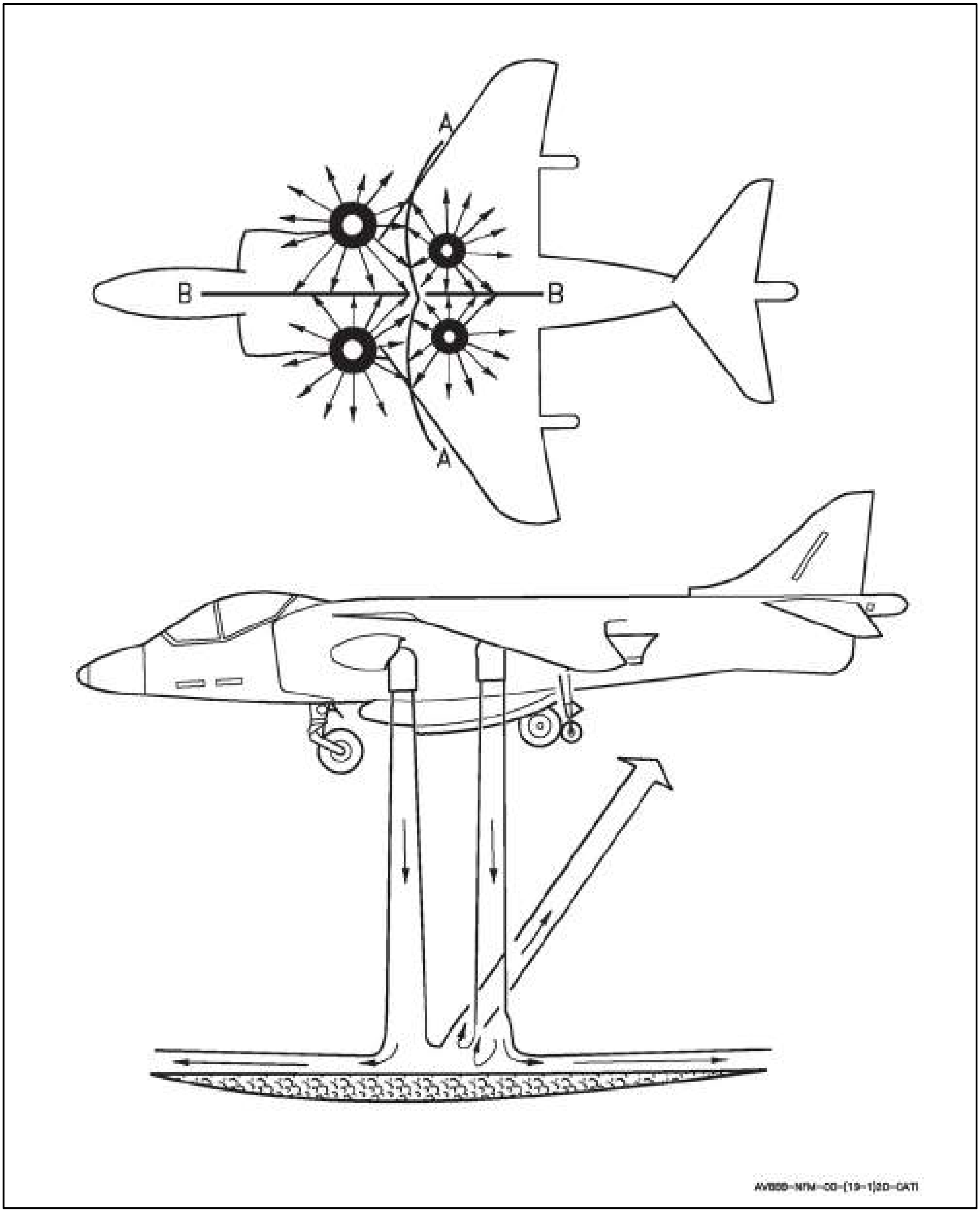

Figure 11-9. Nozzles Exhaust Pattern

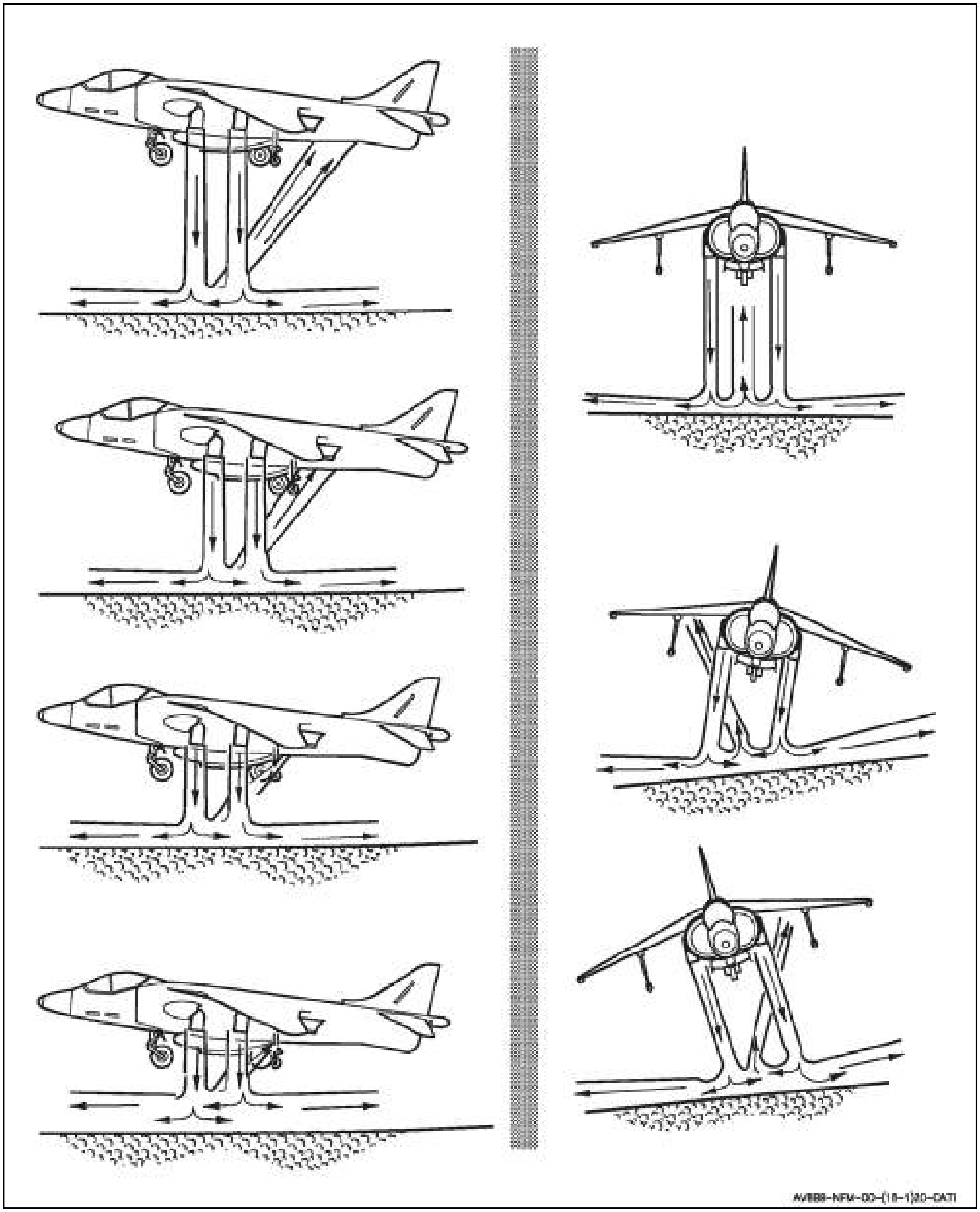

Figure 11-10. Instability Due to Ground Effect

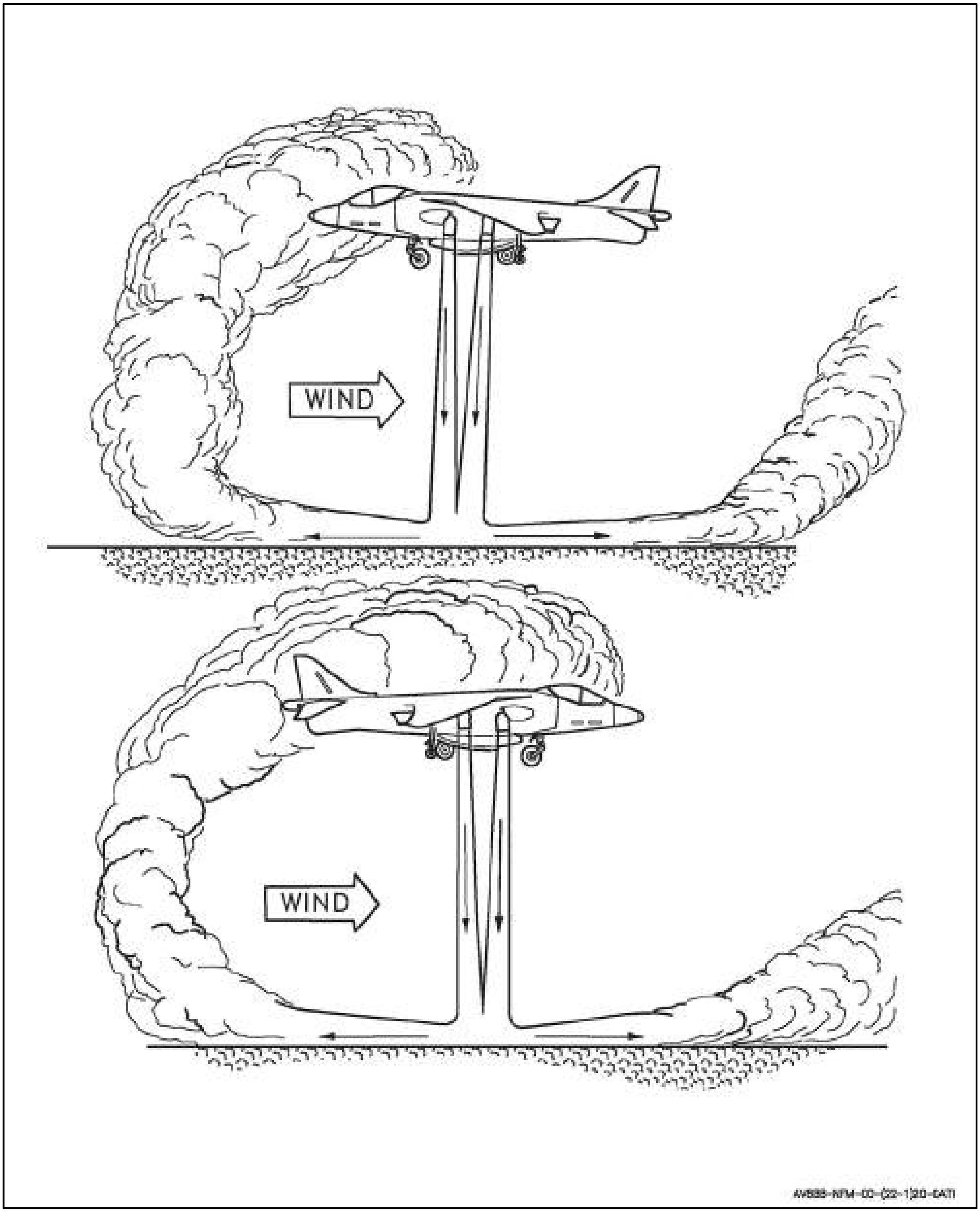

Figure 11-11. Hot Gas Reingestion

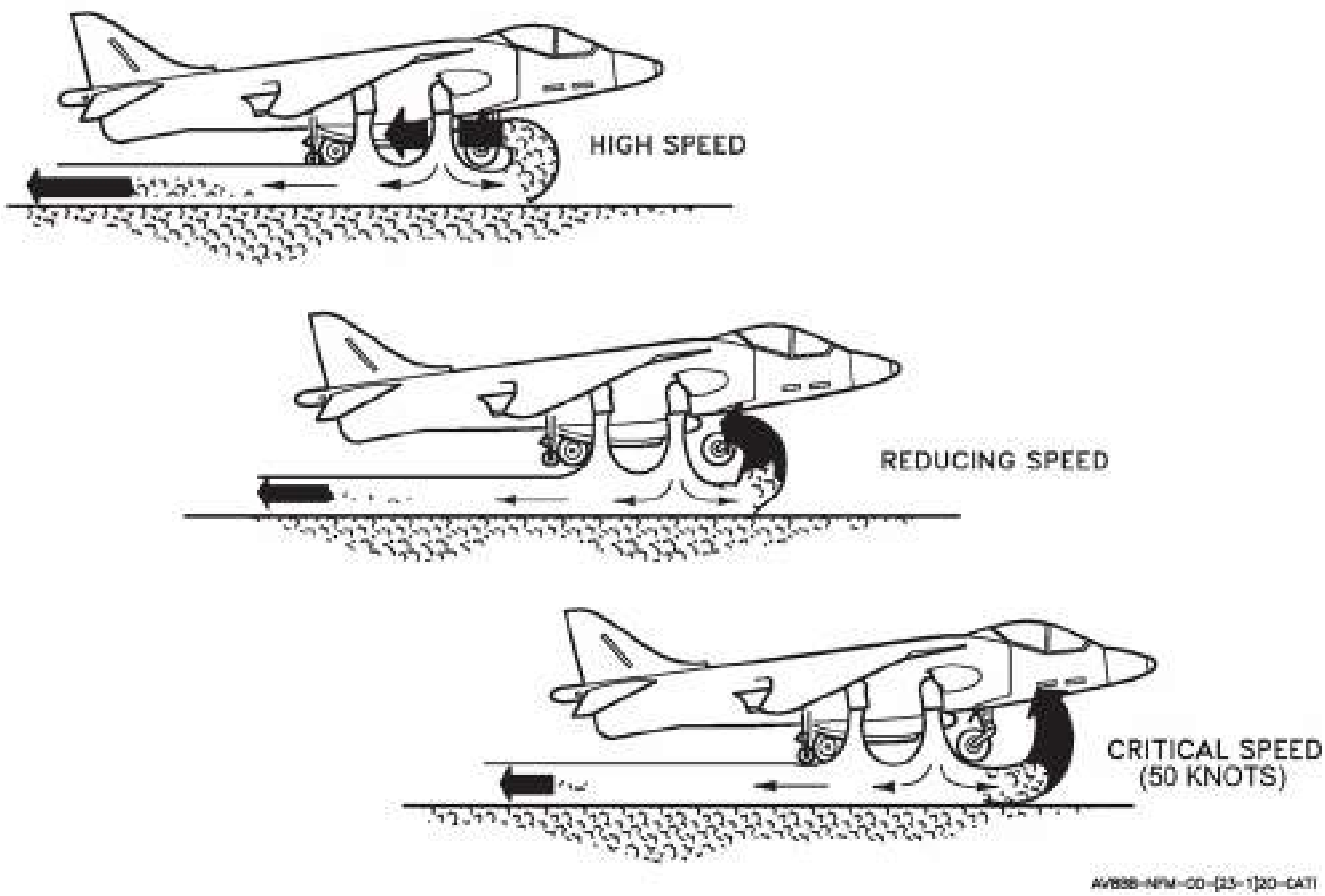

Figure 11-12. Reingestion Critical Speed

PART V

Emergency Procedures

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CHAPTER 15 — IN-FLIGHT EMERGENCIES

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CHAPTER 12

General Emergencies

12.1 GENERAL EMERGENCY PROCEDURES

This part contains procedures to be followed to properly respond to and manage a system malfunction or emergency condition. These procedures will ensure maximum safety for the pilot and/or aircraft until a safe landing or other appropriate action is accomplished. Multiple emergencies, adverse weather and other peculiar conditions may require modification of these procedures. It is essential, therefore, that pilots determine the correct course of action by use of common sense and sound judgement. The pilot must assess many factors that will dictate the options available to him. These factors include, but are not limited to, aircraft speed, drift rate, engine status, airworthiness, configuration, and the environmental conditions of the pad/runway and the surface adjacent to the pad/runway, such as winds, ambient lighting, and weather. These factors must be evaluated and remain part of the operating mind set during flight operations. As soon as possible, the pilot should notify the flight/flight leader and appropriate controlling agency of any existing emergency and of the intended action. When practical notify the Operations Duty Officer (ODO). When an emergency occurs, three basic rules are established which apply to airborne emergencies. They should be thoroughly understood by all pilots:

1. Maintain aircraft control.
2. Analyze the situation and take proper action.
3. Land as soon as practical.

When an airborne emergency occurs and flight conditions permit, the pilot should record and/or broadcast all available information such as airspeed, altitude, power settings, instrument readings and fluctuations, warning lights illuminated, loss of thrust and unusual noises. Flight leaders, wingmen, other pilots, or any ground station receiving such information should copy it and record their observations of vapor, smoke, flames or other phenomena. Whenever possible, an effort should be made to escort an aircraft with a declared emergency until it has safely landed. This escort should observe the distressed aircraft for any external indications or symptoms of the problem, provide assistance or advice that may be required, and assist in a search and rescue (SAR) effort if required. ODOs, when assisting distressed aircraft, may call the 24 hour Boeing Hotline number, (314) 232–9999 or (888) 222–0058, for technical assistance. ODOs should identify themselves and request Conference X–Ray assistance. They will then be connected with the appropriate department for assistance and guidance for the airborne emergency.

WARNING

> In troubleshooting a system discrepancy or in accomplishment of an emergency procedure, the operation of a system control (such as flap, throttle, flight control, electrical switch, etc.) is usually required. Due to the nature of some failures and/or the occurrence of successive malfunctions, some control operations may occasionally result in undesirable aircraft responses, such as unexpected roll or pitch, smoke, unstable engine operation, etc. Often the most prudent action to take to eliminate such an undesirable response is to immediately return the operated control to its former setting. The pilot must be mentally conditioned to take that action promptly when appropriate.

12.1.1 Immediate Action Items

Procedural steps preceded by an asterisk (*) are considered immediate action items. Pilots should be able to accomplish these steps without reference to the checklist.

12.1.2 Warning/Caution/Advisory Lights

The warning, caution, and advisory lights are listed in Figure 12-1 together with the cause and corrective action. They are listed under three major headings:

1. Warning Lights.

2. Caution Lights.

3. Advisory Lights.

Each light is listed alphabetically under its major heading; however, if preceded by L or R that letter is not used to place the light alphabetically. Emergency procedures associated with a warning or caution display are shown in this figure and are not repeated elsewhere in this manual.

WARNING LIGHTS

INDICATOR	CAUSE/REMARKS	CORRECTIVE ACTION
AAA AI CW (AV-8B only)	Refer to A1-AV8BB-TAC-100/(S).	
EFC 1 (Voice - FUEL CONTROL, FUEL CONTROL)	Number 1 and 2 DECU failed. ★ Refer to paragraph 15.16.3 Dual DECS Failure.	**IN V/STOL FLIGHT (Takeoff/Approach/Landing)** **Time Critical** *1. MFS — SELECT. *2. Water switch — OFF. **If rpm does not recover:** 3. EJECT. **IN CONVENTIONAL FLIGHT** *1. Throttle — IDLE. *2. MFS — SELECT. *3. Throttle — ADVANCE SLOWLY. **If unable to select MFS and sufficient power not available:** *4. EFC switch — CHANGE LANE. **If available power insufficient for recovery:** 5. EJECT. **If MFS fails to restore control but sufficient power:** 6. Cautiously use nozzles to control airspeed. 7. Flaps — AUTO. 8. Land as soon as practical. **After landing:** 9. Use nozzle braking as required. 10. Throttle — OFF. 11. Fuel shutoff handle — OFF.

Figure 12-1. Warning/Caution/Advisories (Sheet 1 of 13)

WARNING LIGHTS

INDICATOR	CAUSE/REMARKS	CORRECTIVE ACTION
FIRE 1 (Voice - ENGINE FIRE, ENGINE FIRE)	Fire in the engine compartment. -- GROUND FIRE (ENGINE) ★ Refer to paragraph 13.2 Ground Fire. -- TAKEOFF/LANDING/VERTICAL/INFLIGHT ★ Refer to paragraph 15.27 Fire.	**GROUND** *1. Execute emergency shutdown. **TAKEOFF/LANDING/VERTICAL/OPERATION** *1. Abort or land immediately. *2. Execute emergency shutdown. **INFLIGHT** *1. Nozzles — AFT AS SOON AS POSSIBLE. *2. APU GEN — OFF. *3. Master arm/gun — OFF. *4. Throttle — MINIMUM REQUIRED. **If fire persists:** *5. EJECT. **If light goes out:** 6. Land as soon as possible.
FLAP 1 (Voice - FLAP FAILURE, FLAP FAILURE)	Flap failure. ★ Refer to paragraph 15.36 Flap Failure.	**TAKEOFF/LANDING/VERTICAL/OPERATION** *1. Nozzles — 40° OR GREATER. 2. Stores — JETTISON (if required). 3. Land as soon as practical. **If flap retraction required:** 4. Emergency flaps retract button — SLOWLY BEEP FLAPS UP. **INFLIGHT** 1. Climb to safe altitude (5,000 feet AGL minimum, 250 KCAS maximum). 2. Flap mode switch — CRUISE. 3. Land as soon as practical. **If flap retraction required:** 4. Emergency flap retract — SLOWLY BEEP FLAPS UP. **If asymmetry occurs:** 5. Do not attempt further retraction. 6. Flap power switch — OFF. 7. Nozzles as required (no less than 20° less than flap position).
GEAR Gear Handle 1 (Voice - LANDING GEAR, LANDING GEAR)	Steady light - In transit or unsafe. ★ Refer to paragraph 14.6 Landing Gear Fails to Retract or paragraph 16.1 Landing Gear Unsafe/Fails to Extend. -- Flashing light - Gear up and below 6,000 feet slower than 160 knots and rate of descent over 250 feet/minute.	**STEADY:** 1. Check gear down indicators. -- **FLASHING:** 1. Gear — DOWN. 2. Increase airspeed or altitude.

Figure 12-1. Warning/Caution/Advisories (Sheet 2)

WARNING LIGHTS

INDICATOR	CAUSE/REMARKS	CORRECTIVE ACTION
GEN 1 (Voice - GENERATOR, GENERATOR)	AC generator off the line. ★ Refer to paragraph 15.9 Main Generator Failure.	1. Generator switch — CYCLE. **If GEN resets:** 2. Continue flight. **If GEN warning, DC, and STBY TR cautions still on or after reset, generator drops off line:** 3. Generator switch — OFF. **-406/-408A engine:** 4. MFS — SELECT. **All aircraft:** 5. APU GEN — ON (when in APU starting envelope). **If APU comes on line:** 6. MFS — AS REQUIRED. **If APU GEN caution comes on:** 7. APU GEN — RESET/ON (attempt as required). **If APU GEN caution still on:** 8. APU GEN — OFF. **-406/-408A engine:** 9. MFS — SELECT. **All aircraft:** 10. Nonessential DC equipment — OFF. 11. Landing Gear — DOWN AS SOON AS POSSIBLE (below 200 knots and 16 volts minimum). 12. Do not select STOL flaps above 165 knots and less than 25° nozzles. 13. Fuel boost pump switches — DC (before landing). 14. Land as soon as practical. Perform a VL if possible (HOT NWS).
HYD 1 (Voice - HYDRAULICS, HYDRAULICS)	HYD 1 and HYD 2 failed. ★ Refer to paragraph 15.47 Hydraulic System Failure.	**INFLIGHT** 1. Slow to 250-300 knots. 2. Hydraulic systems pressures — CHECK. **If both hydraulic systems failing:** 3. EJECT. **ON GROUND** 1. Throttle — OFF. 2. Parking brake — SET WHEN STOPPED.
JPTL 1 (Voice - LIMITER OFF, LIMITER OFF)	JPTL control inoperative: • JPTL switch set to OFF. • Failure detected in controlling DECU JPT limiting function. • Electrical power lost to either or both DECUs (EFC warning or caution also illuminated). • State input fault external to DECU (fast deceleration solenoid may be inoperative).	1. JPTL switch — CHECK ON. **If no EFC warning or caution light:** 2. EFC switch — SET TO OTHER DECU. **If light remains on:** 3. JPTL switch — OFF. 4. Maintain JPT/RPM limits manually.

Figure 12-1. Warning/Caution/Advisories (Sheet 3)

WARNING LIGHTS

INDICATOR	CAUSE/REMARKS	CORRECTIVE ACTION
LAW 1 (Voice - ALTITUDE, ALTITUDE)	Below set altitude.	Information.
1 (Voice - OBSTACLE, OBSTACLE)	Aircraft is at or below the set obstacle clearance elevation angle of the AWLS ground station.	Information.
MASTER WARNING (Radar/Night attack aircraft)	A warning has been activated.	Check warnings.
OT 1 (Voice - OVERTEMP, OVERTEMP)	JPT limits exceeded: • Before AFC-394, an open thermocouple circuit will result in JPT indications rising to 999 °C.	**If JPT exceeds 765 °C with -406 engine or 820 °C with -408 engine. (OT light):** 1. Land as soon as practical (conventionally if possible). 2. Use minimum power. **If conventional landing not possible:** 3. Jettison fuel and stores if feasible.
R FEED (TAV-8B only) 1 (Voice - RIGHT FEED, RIGHT FEED)	Crossfeed system failure or valve in wrong position.	1. Fuel quantity indicator switch — FEED. **If left and right fuel quantities above 300 pounds:** 2. Fuel proportioner switch — DL. 3. R FEED warning and advisory lights — OUT. **If left fuel quantity less than 300 pounds and right fuel quantity above 300 pounds:** 4. Fuel proportioner switch — RT. 5. R FEED advisory light — ON. 6. R FEED warning light — OUT. **If both left and right fuel quantities below 300 pounds:** 7. Fuel proportioner switch — OFF. 8. R FEED warning and advisory lights — OUT.
SAM (AV-8B only)	Refer to A1-AV8BB-TAC-100/(S).	
L TANK R TANK 1 (Voice - LEFT TANK, LEFT TANK or RIGHT TANK, RIGHT TANK)	Fuel tank overpressure or overtemperature.	**DURING AIR REFUELING.** *1. Break away. **IN NORMAL FLIGHT.** 1. Throttle — MINIMUM REQUIRED. 2. A/R switch — CHECK (out of PRESS position). 3. Fuel dump switches — NORM. **DURING HOT REFUELING.** *1. Throttle — OFF.

Figure 12-1. Warning/Caution/Advisories (Sheet 4)

CAUTION LIGHTS

INDICATOR	CAUSE/REMARKS	CORRECTIVE ACTION
AFC	AFC malfunction or AFC deselected.	1. Assume control.
AFT BAY	Aft bay ECS failed. Selection of reset will remove the AFT BAY Caution from the Caution/Advisory Panel for 45 seconds. If the overheat condition still exists, the AFT BAY Caution can be expected to return. Repeated AFT BAY lights should be considered a system fault. Repeated selection of RESET can result in aircraft damage.	**NON-RADAR AIRCRAFT.** 1. EQUIP RESET switch — RESET (No more than three RESETs allowed in a flight). **If AFT BAY caution reilluminates three consecutive times or does not reset:** 2. EQUIP RESET switch — OFF. 3. Limit airspeed as follows: Below 5,000 feet - 0.7 Mach. 5,000 to 10,000 feet - 0.8 Mach. 10,000 to 15,000 feet - 0.9 Mach. 4. Land as soon as practical. **RADAR AIRCRAFT.** 1. AFT EQUIP switch — RESET (No more than three RESETs allowed in a flight). **If AFT BAY caution reilluminates three consecutive times or does not reset:** 2. Limit airspeed as follows: Below 5,000 feet - 0.4 Mach. 5,000 to 10,000 feet - 0.6 Mach. 10,000 to 15,000 feet - 0.7 Mach. 3. For operational necessity up to 0.2 Mach increase over the above speeds is acceptable for 30 minutes. 4. Land as soon as practical.
APU GEN	APU selected and emergency generator failed. ★ Refer to paragraph 15.12 APU Generator Failure.	1. APU switch — RESET/ON (attempt several times). **If APU GEN caution still on:** 2. APU switch — OFF. 3. Land as soon as practical.
AUT FLP	Auto flap mode or ADC failed. ★ Refer to paragraph 15.37 AUTO Flap Failure.	1. Flap control switch — RESET. **If flaps do not reset or AUT FLP caution reilluminates during flight:** 2. Flap mode switch — CRUISE OR STOL (below 165 knots and nozzles greater than 25°). 3. BIT display — CHECK FOR ADC FAILURE (ADC 1). 4. If ADC failure confirmed — do not extend landing gear at airspeeds >200 KCAS.
BINGO 1 (Voice - BINGO, BINGO)	Fuel below bingo setting.	Information.
CANOPY	Canopy not locked closed. ★ Refer to paragraph 15.5 Canopy Unsafe Inflight.	1. Descend below 25,000 feet. 2. Cabin pressure switch — DUMP. 3. Slow below 250 knots. **If unsafe latch can be determined:** 4. Land as soon as practical.
CASTER	On AV-8B 163677 and up; light is not used, illuminates on lights test only.	Information.

Figure 12-1. Warning/Caution/Advisories (Sheet 5)

CAUTION LIGHTS

INDICATOR	CAUSE/REMARKS	CORRECTIVE ACTION
CIP AUT	SMS unable to operate in computed delivery mode (AUTO and CCIP).	Information.
CMBT	Combat thrust activated. Flashes after 2 1/2 minutes.	Information.
CS COOL	Cockpit avionics cooling fan failed. Affected equipment: HUD, ODU, DC, DDI, and ACP.	1. Cockpit temperature — AS COLD AS PRACTICAL. 2. Affected avionics — OFF (if not required). 3. Land as soon as practical.
CW NOGO (AV-8B only)	Refer to A1-AV8BB-TAC-100/(S).	
DC	Main transformer-rectifier failed ★ Refer to paragraph 15.10 Main TRU Failure. NOTES • Hot NWS, perform RVL or VL if possible. • Below 16 volts, normal manual fuel selection cannot be guaranteed. • DC equipment to consider for step 8: DC boost pumps. Radios (transmit drains more power). Seat adjust. Trim.	1. Confirm DC failure by checking hydraulic gauges. 2. Fuel boost pump switches — NORM OR OFF. 3. Voltmeter and STBY TR caution — MONITOR. 4. Do not select STOL flaps above 165 knots and less than 25° nozzles and do not lower landing gear greater than 200 kts. 5. Land as soon as practical. **If STBY TR caution on and/or voltmeter below 26 volts:** 6. MFS — SELECT (16 volts minimum). 7. Landing gear — DOWN AS SOON AS POSSIBLE (below 200 knots and 16 volts minimum). 8. Nonessential DC equipment — OFF.
DEP RES	Departure resistance reduced.	Observe Prohibited Maneuvers and AOA Limitations without departure resistance.
EFC	DECU number 1 or 2 has failed. ★ Refer to paragraph 15.6.2 Single DECS Failure (EFC caution).	1. Do not change lanes. 2. Land as soon as practical.
ENG EXC	Engine overspeed, overtemperature, or over g was detected.	Information.
FLAPS 1 - - - - - - - - - - FLAPS 2	Flaps channel 1 failed. - - - - - - - - - - Flaps channel 2 failed. ★ Refer to paragraph 15.36 Flaps Channel Failure.	**FLAPS 1 and FLAPS 2.** 1. Flaps — AUTO. 2. Flap power switch — RESET (single channel failure only). **If FLAPS 1 or FLAPS 2 does not reset or reilluminates during flight:** 3. Flap mode switch — CRUISE OR STOL (below 165 knots and nozzles greater than 25°). **For FLAPS 2.** 4. If flap circuit breaker popped — RESET.
L FUEL R FUEL 1 (Voice - when fuel is less than 250 pounds: FUEL LOW LEFT, FUEL LOW LEFT or FUEL LOW RIGHT, FUEL LOW RIGHT)	Steady light - left or right fuel 750 pounds. Flashing light - left or right fuel 250 pounds. ★ Refer to paragraph 15.32 Fuel Low Level.	**Flashing Light.** 1. Fuel quantity indicator switch — FEED. 2. Apply negative and then positive g's. **If single feed tank decreasing:** 3. Fuel proportioner switch — OFF. 4. Boost pump switch (flashing side) — OFF. 5. Boost pump switch (nonflashing side) — ON. 6. Fuel asymmetry — MONITOR. 7. Land as soon as practical. **If both feed tanks decreasing:** 8. Drop tanks — JETTISON. 9. Both boost pumps — NORM. 10. Fuel proportioner switch — OFF. 11. Land immediately.

Figure 12-1. Warning/Caution/Advisories (Sheet 6)

CAUTION LIGHTS

INDICATOR	CAUSE/REMARKS	CORRECTIVE ACTION
FWD BAY (Radar aircraft)	Forward ECS failure.	1. FWD EQUIP switch — RESET. **If FWD BAY caution reilluminates or does not reset:** 2. Descend to below 25,000 feet. 3. Limit airspeed as follows: Below 5,000 feet - 0.4 Mach. 5,000 to 10,000 feet - 0.6 Mach. 10,000 to 15,000 feet - 0.7 Mach. 4. If radar mode is in OPR or STBY, limit airspeed above 15,000 feet to 0.7 Mach. **If no ECS airflow from cockpit louvers:** 5. PRESS switch — RAM.
3 GPS	GPS not valid, aggressive maneuvering or vertical and horizontal position error not within tolerance for mode selected. **CAUTION** Continued INS operation in IFA following a GPS caution can lead to INS failure.	**If not in maneuvering flight:** 1. Check GPS BIT and EHPE/EVPE status. **If BIT and EHPE/EVPE indicate GPS failure:** 2. INS knob to NAV.
H_2O 1 (Voice - WATER, WATER)	Less than 15 seconds water remaining.	Information.
H_2O SEL	Over 250 knots and water switch not OFF.	1. Water switch — OFF.
HYD 1	HYD 1 pressure ≤1,400 psi. Speedbrake and LIDS not available. Expect about 500 pounds decrease in VTOL/VL lift. ★ Refer to paragraph 15.46 HYD 1 Failure. HYD 1 Caution is accompanied by the prop caution due to the dependence of the fuel flow propotioner hydraulic motor on HYD 1 system pressure.	1. Fuel proportioner — OFF. **If failure indications persist:** 2. Land as soon as practical (VL/RVL if practical). 3. Fuel asymmetry — MONITOR. 4. Below 210 knots, landing gear handle — DOWN, TURN AND PULL. **After touchdown.** 5. Throttle — OFF. 6. Parking brake — SET WHEN STOPPED. **If VL/RVL not practical:** 7. Make slow landing. 8. Use power nozzle braking (60 knots minimum) then steady brake pressure without antiskid cycling. Braking will be lost if brake accumulator pressure drops below 1,000 psi. 9. Shut down engine and set parking brake when stopped.
HYD 2	HYD 2 pressure ≤1,400 psi.	1. Land as soon as practical. 2. Throttle — OFF WHEN CLEAR OF RUNWAY.
IFF	Mode 4 off, zeroized, or not responding.	Information.

Figure 12-1. Warning/Caution/Advisories (Sheet 7)

CAUTION LIGHTS

INDICATOR	CAUSE/REMARKS	CORRECTIVE ACTION
INS	INS aligning or failed.	1. Use the standby attitude indicator for attitude reference. 2. INS switch — OFF (5 seconds - ASN-139/ 3 minutes - ASN-130). 3. Maintain straight and level flight. **If attempting an in-flight alignment (IFA):** 4. Master mode — NAV. 5. INS switch — IFA. 6. Make any required turns using greater than 30° AOB. 7. EHSD — Monitor alignment time and quality. 8. Alignment complete when HUD attitude information returns. (GPS IFA with good satellite data may take up to 10 minutes). **If attempting a radar IFA:** 9. Master mode — NAV. 10. Radar mode — Land or Sea based on terrain. 11. INS switch — IFA. 12. Make any required turns using greater than 30° AOB. 13. A/C data page — RIFA (GPS data page — RIFA with C1+). 14. EHSD — Monitor alignment time and quality after 2 minutes. 15. INS caution — Verify extinguished (may take up to 20 minutes). 16. INS switch — NAV. **If IFA is unsuccessful, attempt a GYRO recovery:** 17. INS switch — OFF (5 seconds - ASN-139/ 3 minutes - ASN-130). 18. INS switch — GYRO.
JMR HOT (Night Attack)	ASPJ Overtemp.	Information.
L	Left wing gear in transit.	Information.
LIDS	LIDS not in correct position.	**With gear up:** 1. Do not exceed 200 knots. **With gear down:** 1. LIDS switch — CHECK NORM. 2. Expect about 500 pound decrease in VTO/VL lift.
LOAD	Fuel asymmetry over VL limit.	Refer to Asymmetric Landing.
M	Main landing gear in transmit.	Information.
MASTER CAUTION 1 (Voice - CAUTION, CAUTION)	A caution has been activated.	Check cautions.
MFS 1 (Voice - MANUAL FUEL, MANUAL FUEL)	Manual fuel system on. **CAUTION** Verify the MFS switch has returned to neutral position prior to activating the emergency MFS battery. The MFS switch in OFF will direct battery power away from the MFS solenoid and prevent MF activation.	1. MAN FUEL switch — POSITIVELY SELECT ON AND RELEASE. 2 2. MFS EMER BATT switch — CHECK.

Figure 12-1. Warning/Caution/Advisories (Sheet 8)

CAUTION LIGHTS

INDICATOR	CAUSE/REMARKS	CORRECTIVE ACTION
N	Nose landing gear in transit.	Information.
5 NWS	Nosewheel Steering Malfunction. ★ Refer to paragraph 16.3 NWS Failure.	**INFLIGHT** 1. Perform VL. **If unable to perform VL:** 2. Determine available steering mode. 3. Perform RVL as slow as practical with minimum crab angle. **TAKEOFF/LANDING ROLL OUT** *1. Attempt to get airborne. **If unable to get airborne:** *2. Engage NWS button at minimum practical ground speed.
OIL	Oil pressure low. ★ Refer to paragraph 15.24 Oil System Failure.	*1. Throttle — MAINTAIN CONSTANT RPM (75 to 85%, -406) (80 to 85%, -408). 2. Minimize g-loading. 3. Land as soon as possible using VNSL. 4. Use nozzles, speedbrake, flaps, and landing gear to control airspeed. 5. Fuel/Stores — JETTISON AS REQUIRED. 6. If vertical landing is the only option, use throttle slowly and progressively and be prepared for engine failure. 7. Throttle — OFF AS SOON AS PRACTICAL.
OXY	OBOGS malfunction. ★ Refer to paragraph 15.4 OBOGS Failure.	*1. Emergency oxygen actuator — PULL. *2. Oxygen switch — OFF. 3. Descend below 10,000 feet cockpit altitude. 4. Oxygen mask — RELEASE.
PITCH	Pitch stab aug off or failed.	1. AFC — RESET. **If erroneous input occurs:** 2. Paddle switch — PRESS AND HOLD. 3. Pitch stab aug switch — OFF. 4. Paddle switch — RELEASE.
P NOGO (AV-8B only)	Refer to A1-AV8BB-TAC-100/(S).	
PROP	Fuel proportioner off or failed.	1. Fuel proportioner switch — OFF. 2. Monitor fuel quantity indicators. 3. Balance fuel by switching lowest feed group boost pump switch OFF until balanced.
L PUMP R PUMP	Left or right boost pump pressure low.	1. Boost pump switch (failed pump) — DC OPR. **If pump still failed:** 2. Boost pump switch (failed pump) — OFF. 3. Fuel asymmetry — MONITOR. 4. Land as soon as practical.

Figure 12-1. Warning/Caution/Advisories (Sheet 9)

CAUTION LIGHTS

INDICATOR	CAUSE/REMARKS	CORRECTIVE ACTION
R	Right wing gear in transit.	Information.
ROLL	Roll stab aug off or failed.	1. AFC — RESET. **If erroneous input occurs:** 2. Paddle switch — PRESS AND HOLD. 3. Roll stab aug switch — OFF. 4. Paddle switch — RELEASE.
[4] SKID	If light stays on (antiskid failure). If light goes out (caster failure). → NOTE A skid failure will mask a caster failure.	**ON GROUND** *1. ANTISKID switch — NWS. 2. Brakes — MINIMUM REQUIRED. **INFLIGHT** 1. Check ANTISKID switch — ON. 2. Select NWS on stick grip. 3. ANTISKID switch — NWS. 4. Perform VL. **If unable to land vertically:** 5. Minimize crab angle. 6. Perform RVL as slow as practical. 7. Brakes — MINIMUM REQUIRED.
[5] SKID	Antiskid System Malfunction.	1. Brakes — MINIMUM REQUIRED.
STBY TR	Standby TRU inoperative or off line. ★ Refer to paragraph 15.11 Standby TRU Failure.	1. Voltmeter and DC caution — MONITOR.
L TRANS R TRANS	Low air pressure to left or right feed tanks. ★ Refer to paragraph 15.31 Fuel Transfer Failure.	1. Descend below 30,000 feet. 2. Air refuel switch — IN. 3. Dump switches — NORM. 4. Fuel quantity indicator switch — AS REQUIRED. **SINGLE FEED TANK DECREASING:** **If L FUEL or R FUEL caution flashes:** 1. Fuel proportioner switch — OFF. 2. Boost pump switch (flashing side) — OFF. 3. Boost pump switch (non-flashing side) — ON. 4. Fuel asymmetry — MONITOR. 5. Land as soon as practical. **BOTH FEED TANKS DECREASING:** **If both L FUEL and R FUEL cautions flash:** 1. Drop tanks — JETTISON. 2. Both boost pump switches — NORM. 3. Fuel proportioner switch — OFF. 4. Land immediately.
WSHLD	Windshield hot.	Information.
YAW	Yaw stab aug off or failed.	1. AFC — RESET. **If erroneous input occurs:** 2. Paddle switch — PRESS AND HOLD. 3. Yaw stab aug switch — OFF. 4. Paddle switch — RELEASE.
15 SEC [1] (Voice - FIFTEEN SECONDS, FIFTEEN SECONDS)	JPT above normal lift rating (flashing after 15 seconds).	1. Monitor JPT.

Figure 12-1. Warning/Caution/Advisories (Sheet 10)

ADVISORY LIGHTS

INDICATOR	CAUSE/REMARKS	CORRECTIVE ACTION
1 (Voice - ACNIP GO, ACNIP GO)	ACNIP BIT passed.	Information.
1 (Voice - ACNIP FAIL, ACNIP FAIL)	ACNIP BIT failed.	Information.
#AFC	AFC selected in front cockpit.	Information.
A/G	Air-to-ground HUD mode Information.	Information.
#ALTHD	Altitude hold selected in front cockpit.	Information.
APU	APU operating.	Information.
#AUTO (Flap)	Flaps AUTO mode selected.	Information.
AUTO (VRS)	VRS AUTO mode selected.	Information.
AV BIT	Light de-activated.	
CW JAM (AV-8B only)	Refer to A1-AV8BB-TAC-100/(S).	
#CRS	Flaps CRUISE mode selected.	Information.
DROOP	Ailerons dropped.	Information.
#$H_2$0	$H_2$0 switch in TO or LDG.	Information.
L	Left wing gear locked down.	Information.
LEFT	Flashing - Left feed group full with air refuel probe extended. --------------------------------------- Steady - 4 external tanks aboard and left inboard external tank full with air refuel probe extended.	Information.
M	Main landing gear locked down.	Information.
N	Nose landing gear locked down.	Information.
NAV	Navigation HUD mode.	Information.
P JAM (AV-8B only)	Refer to A1-AV8BB-TAC-100/(S).	
R	Right wing gear locked down.	Information.
R FEED (TAV-8B only)	TAV-8B crossfeed valve in right feed position.	Information.
READY	Air refuel probe extended and locked without fuel pressure/flow or tank pressurization.	Information.
REPLY	IFF responding to Mode 4 interrogation.	Information.
RIGHT	Flashing - Right feed group full with air refuel probe extended. --------------------------------------- Steady - 4 external tanks aboard and right inboard external tank full with air refuel probe extended.	Information.
RUN	VRS RUN mode selected.	Information.
SEL	Combat thrust limiter selected.	Information.
SPD BRK	Gear up and speed brake extended Gear down and speed brake not 25°.	Information.

Figure 12-1. Warning/Caution/Advisories (Sheet 11)

ADVISORY LIGHTS

INDICATOR	CAUSE/REMARKS	CORRECTIVE ACTION
STO	Flap switch in STOL.	Information.
#STOL	Flaps STOL mode selected.	Information.
VSTOL	VSTOL HUD mode.	Information.
W	Water is flowing.	Information.

* Immediate action item
★ Discussion in Part V
#Rear cockpit indicator

1 AV-8B 163519 and up, TAV-8B 163856 and up.

2 AV-8B 164151 and up; also TAV-8B, AV-8B 161573 through 164150 after AFC-328.

3 AV-8B 165384 and up; also 161573 through 165383, TAV-8B 162963 through 164542 after AFC-354 RevA/Part 2/Part 3.

4 AV-8B 161573 through 165312, TAV-8B.

5 AV-8B 165354 and up; also 161573 and up after AFC-391 Part 2, TAV-8B 162963 and up after AFC-391 Part 4.

Figure 12-1. Warning/Caution/Advisories (Sheet 12)

GPWS VOICE WARNINGS

INDICATOR	CAUSE/REMARKS	CORRECTIVE ACTION
PULL-UP	Activated when the altitude is $\leq$90 feet and the airspeed is $\geq$250 KCAS, or $\geq$200 KCAS, at least 60 seconds after takeoff or waveoff, or aircraft calculates a dive recovery is required.	1. Immediate pull up using the direction-of-pull arrow on the HUD.
ROLL OUT	If <150 feet, between 100 and 200 KCAS, at least 60 seconds after takeoff or waveoff, and at bank angle >45° for 1 second, ROLL OUT is annunciated.	1. Immediate roll to wings level and pull up using the direction-of-pull arrow on the HUD.
POWER	**Landing Phase.** If altitude <150 feet, <200 KCAS, more than 60 seconds after take-off or waveoff, and sink rate = a threshold for 0.3 seconds, POWER is annunciated. **Takeoff Phase.** If altitude <150 feet, <250 KCAS, <60 seconds after take-off or waveoff, and a sink rate $\geq$300 fpm, POWER is annunciated.	1. Immediate power addition to control sink rate and pull up using the direction-of-pull arrow on the HUD.
CHECK GEAR	• GPWS detects the gear is not down and locked. • If <150 feet, between 100 and 200 KCAS, more than 60 seconds after take-off or waveoff, and descending, warning is activated if gear not down and locked for 0.3 seconds.	1. Lower landing gear.

TAV-8B with H4.0 and Night Attack/Radar Aircraft Only.

Figure 12-1. Warning/Caution/Advisories (Sheet 13)

CHAPTER 13

Ground Emergencies

13.1 EMERGENCY SHUTDOWN

*1. Throttle — OFF.

*2. Fuel shutoff handle — OFF.

*3. Engine start switch — OFF.

*4. APU GEN — OFF.

*5. Battery switch — OFF.

6. Egress.

13.2 GROUND FIRE

The first indication of a fire is normally illumination of the FIRE warning light. There are multiple sources of fire while operating on the ground such as Engine Fire, GTS/APU Fire, and Brake Fire.

If a fire is suspected or is indicated by ground crews:

*1. Execute Emergency Shutdown.

13.3 ABNORMAL START

If the JPT rises rapidly between 350° and 400° (hot start), or if rpm stabilizes below idle (hung start), or if engine does not light off within 10 seconds after selecting idle (wet start):

*1. Throttle — OFF.

If wet start:

*2. Engine start switch — OFF.

Perform dry cycle, if required:

3. Ignition isolate switch — ON.
4. Engine start switch — ENG ST (motoring automatically stops after 40 seconds).
5. Repeat cycle as necessary.

13.4 LOSS OF ENGINE CONTROL ON GROUND

If engine RPM-JPT indications on EDP freeze at approximately 22 percent or display an abnormal indication during start, the voltmeter drops to zero when the DC test switch is set to STBY during standby TRU check, or during any undemanded engine acceleration.

*1. Throttle — OFF.

*2. Fuel shutoff handle — OFF.

13.5 BRAKE FAILURE

13.5.1 Ground

*1. ANTISKID switch — NWS.

2. Steer toward safe area.

3. Nozzles — HOVER/BRAKING STOP AS REQUIRED.

4. Throttle — OFF WHEN PRACTICAL.

13.5.2 Air

1. ANTISKID switch — NWS.

2. Perform VL.

3. Throttle — OFF WHEN CHOCKED.

13.6 HOT BRAKE

Brake energy zones for the two scenarios are provided in Figure 13-1. Chart A assumes that the nozzles are stuck in the aft position and PNB is not available. Chart B assumes the nozzles are at the hover stop, engine speed maintained at idle, and PNB is not available. In either scenario, brake overheat occurs when the energy absorbed by an individual brake exceeds normal zone limits. Tire deflation due to wheel thermal fuse plug activation generally occurs within 50 seconds after exceeding the normal zone. In the fuse plug release zone, fuse plug release is expected, wheel/brake damage may occur, and brake fires are possible.

In the brake fire zone, fires are usually fueled by wheel or brake contaminates, and are easily extinguished. In the brake fire zone, brake energies exceed all tested conditions and wheel/brake damage is certain. Hydraulic fluid fires are possible in the brake fire zone due to the deterioration of seals within the brake assembly. Setting the parking brake or applying pressure on the brake pedals will pressurize the brake assembly and drastically increase the probability of fire due to hydraulic seal failure. The brake energy limit charts should be used whenever a takeoff is aborted, and for emergency landings. As stated before, the effects of brake usage/heat buildup are cumulative. If brake overheat occurs, the aircraft must not be operated for 90 minutes to allow the brakes to cool and have sufficient energy capacity should the ensuing takeoff be aborted.

Brake overheat should be considered when:

1. Brakes are applied at speeds in excess of 80 knots.

2. Brakes are dragging during taxi.

3. Successive stops resulting in cumulative energies within the fuse plug release zone.

If brake overheating is suspected:

1. Taxi aircraft to closest safe location. Use brakes only as needed to stop or turn.

2. Turn aircraft into the wind.

3. Wheels — CHOCKED.

4. Brakes — RELEASE.

5. Place nozzles to 30° at idle rpm.

6. Shutdown engines after firefighting equipment arrives.

WARNING

- When brake overheat occurs, stay clear of an area extending at least 300 feet in a 45° cone around the axle on both sides of the wheel until brakes have cooled or until thermal release plugs have deflated the tires.
- Due to the possibility of hydraulic seal failure with hot brakes and blown main tires, a hydraulic fire may develop. Parking brake application will increase the probability of fire.

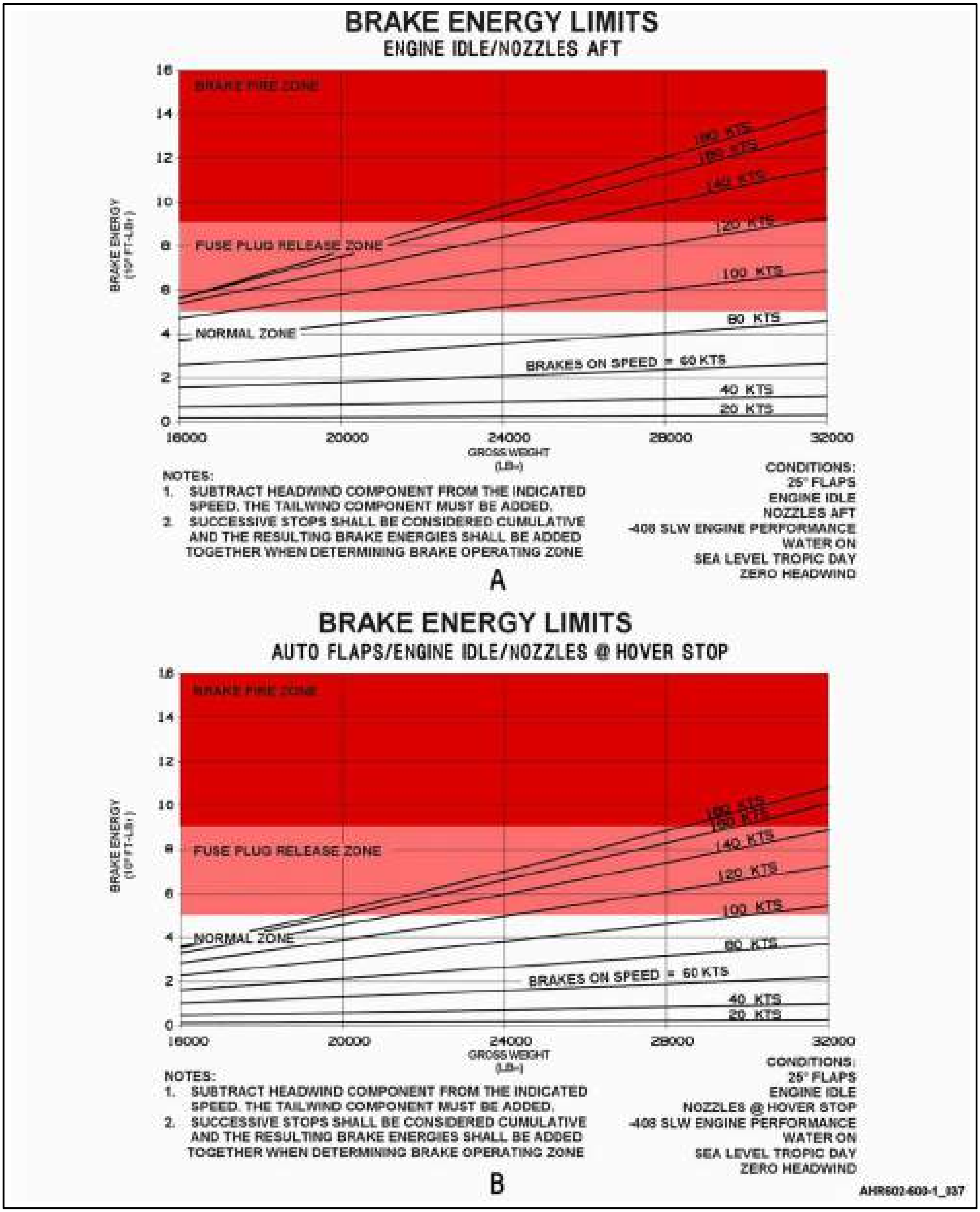


Figure 13-1. Brake Energy Limits

CHAPTER 14

Takeoff Emergencies

14.1 ABORT

14.1.1 Ashore (CTO or STO)

At all speeds, PNB is more effective at stopping the aircraft then the brakes alone. If PNB is not available due to questionable engine control, combine idle PNB and braking. If the brake energy required to stop the aircraft is anticipated to be above the normal energy zone (see Figure 13-1), bring the aircraft to a stop using maximum braking. Light braking will cause heat build up and the main tire fuse plug release prior to stopping, greatly reducing braking effect and causing damage to the wheel assembly. Expect the main tire fuse plugs to release shortly after stopping.

*1. Throttle — IDLE.

WARNING

Manual fuel may be required in the event of EFC warning or loss of engine control.

*2. Nozzles — BRAKING STOP.

*3. Throttle — AS REQUIRED.

*4. Brakes — AS REQUIRED.

If hot brakes are suspected:

5. Refer to Hot Brake procedure.

Note

Consideration should be given to ejecting prior to leaving a prepared surface.

14.1.2 Afloat (STO)

WARNING

Any delay in the decision to abort beyond about 2 seconds after throttle slam may preclude a successful abort.

*1. Throttle — OFF.

*2. Brakes — FULL.

If unable to stop:

3. EJECT.

14.2 NO LIFTOFF ON STO

*1. Nozzles — AFT.

*2. Increase speed 20 knots.

*3. Nozzles — STO STOP.

14.3 RPM STAGNATION/LOSS OF THRUST AFLOAT

*1. MFS — SELECT.

*2. STO at nozzle rotation line.

*3. Stores — JETTISON (if required).

*4. Water switch — OFF.

5. Land as soon as practical.

If unable to sustain level flight:

6. EJECT.

14.4 OVER ROTATION ON STO

*1. Stick — FULL FORWARD.

*2. Nozzles — REDUCE 20 DEGREES.

*3. Nozzles — STO STOP.

If control not Regained:

4. EJECT.

14.5 BLOWN TIRE ON TAKEOFF

If takeoff is continued:

1. Leave gear down.
2. Perform a VL if possible.

14.6 LANDING GEAR FAILS TO RETRACT

1. Gear handle — DOWN.
2. Landing gear circuit breaker — CHECK IN.
3. Obtain visual check.

If unable to obtain visual check:

4. Land as soon as practical.

If visual check indicates no damage:

5. Gear handle — UP.

If unsafe indication still present:

6. Gear handle — DOWN AS SOON AS PRACTICAL.
7. Land as soon as practical.

CHAPTER 15

In-Flight Emergencies

15.1 MISSION COMPUTER FAILURE

If the mission computer fails, the following items are inoperative:

1. AFC.
2. AWLS.
3. Radar beacon.

TAV-8B, Day Attack and Night Attack Aircraft:

4. Dual mode tracker.

All Aircraft:

If the mission computer fails, the following items are affected:

5. HUD — Reverts to back-up display. See Figure 15-1.
6. DDI — See Figure 15-1.
   a. TAV-8B, AV-8B Day Attack, reverts to HUD backup displays.
   b. AV-8B Night Attack and Radar Aircraft, right DDI reverts to HUD backup display and left DDI reverts to map backup display.
7. SAS — Degraded.
8. VHF/UHF — Operates in manual mode using radio set control.
9. TACAN — Only X channels available. If Y channel selected, reverts to same number X channel. Range and bearing displayed on HUD. Can be turned ON/OFF.
10. INS — No steering. Pitch, roll, true heading and present position displayed.
11. IFF — Goes OFF but can be turned ON. Modes 1 and 2 inoperative. Mode 3 code initialized to zero but can be reset.
12. Radar altimeter — Goes OFF but can be turned ON. Low altitude warning light fixed at 200 feet.
13. HOTAS — Target designator control (TDC) and sensor select inoperative. The display alternate toggle function is now performed with the WINC switch.
14. SMS — No computed delivery modes, CIP/AUT light on.
    a. Weapon delivery possible in DSL, DSL-1, or DIR modes using the roll stabilized site reticle.
    b. The standby reticle can also be used on day attack and TAV-8B aircraft.
15. RWR — No head-down ECM threat lethality display. Head-up ECM display provided on HUD and DDI.
16. EMCON — Goes OFF but can be turned on.

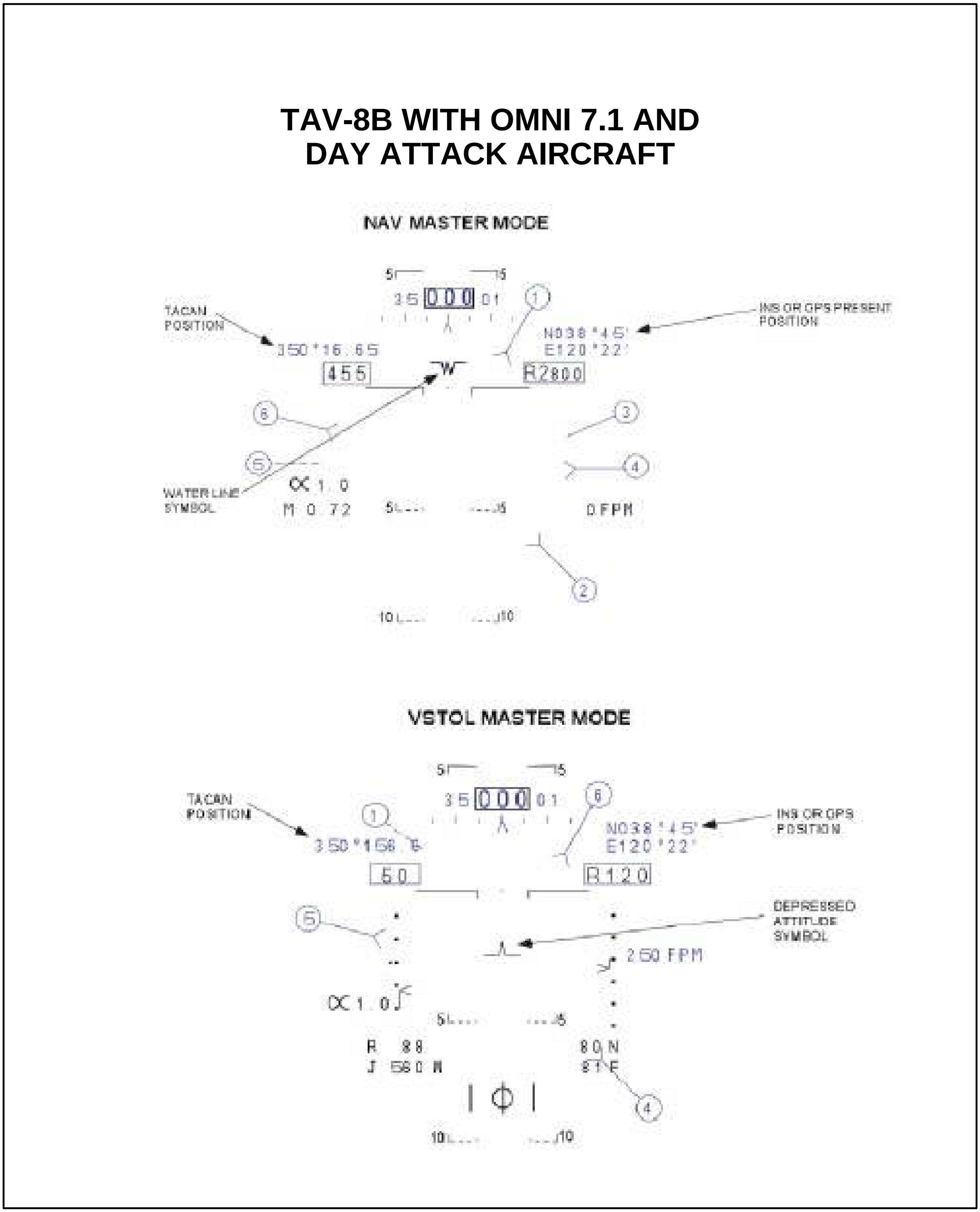
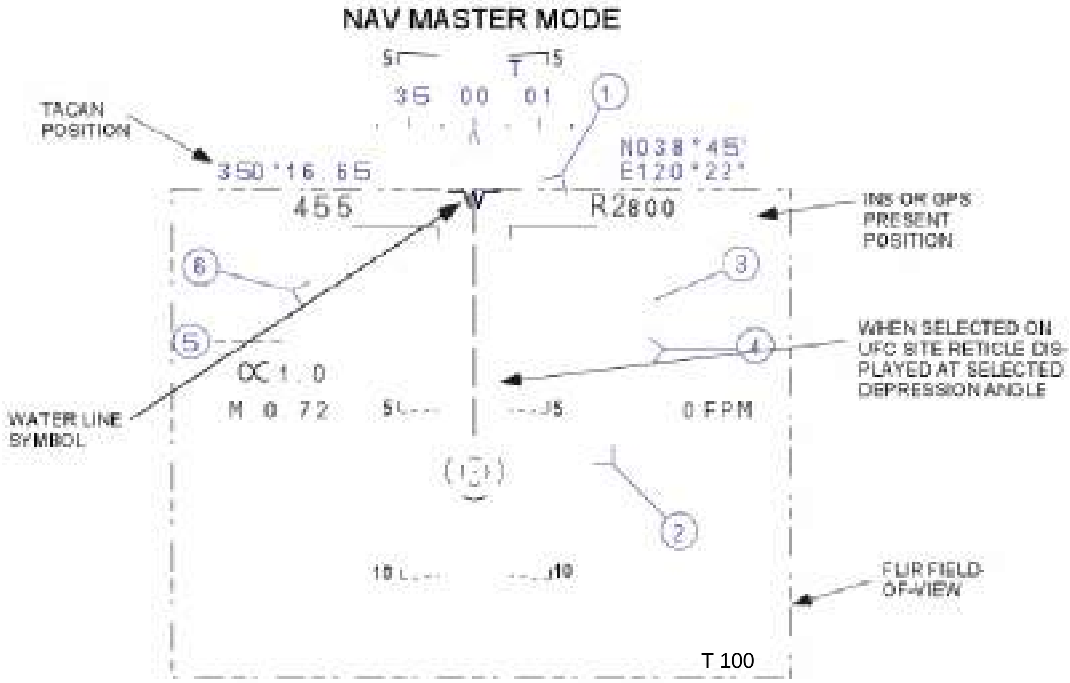


Figure 15-1. Mission Computer Failure Displays (Sheet 1 of 5)

TAV-8B WITH H4.0, RADAR, AND NIGHT ATTACK AIRCRAFT



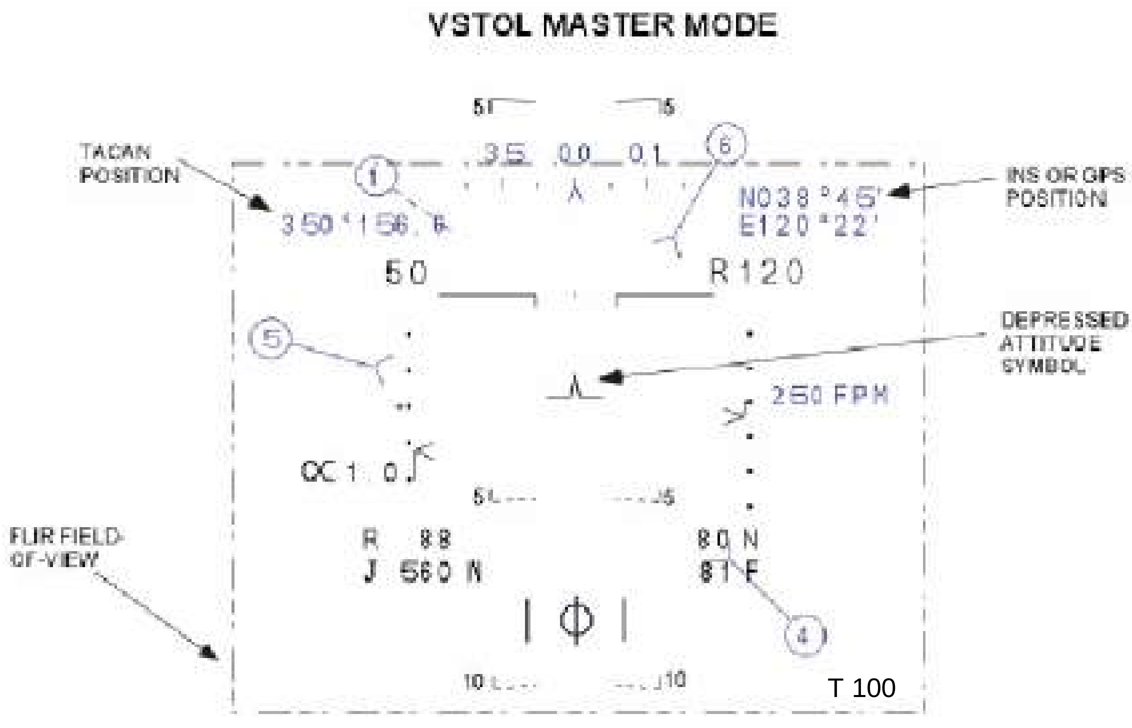


Figure 15-1. Mission Computer Failure Displays (Sheet 2)

TAV-8B WITH H4.0, RADAR, AND NIGHT ATTACK AIRCRAFT

EHSD MAP DISPLAY

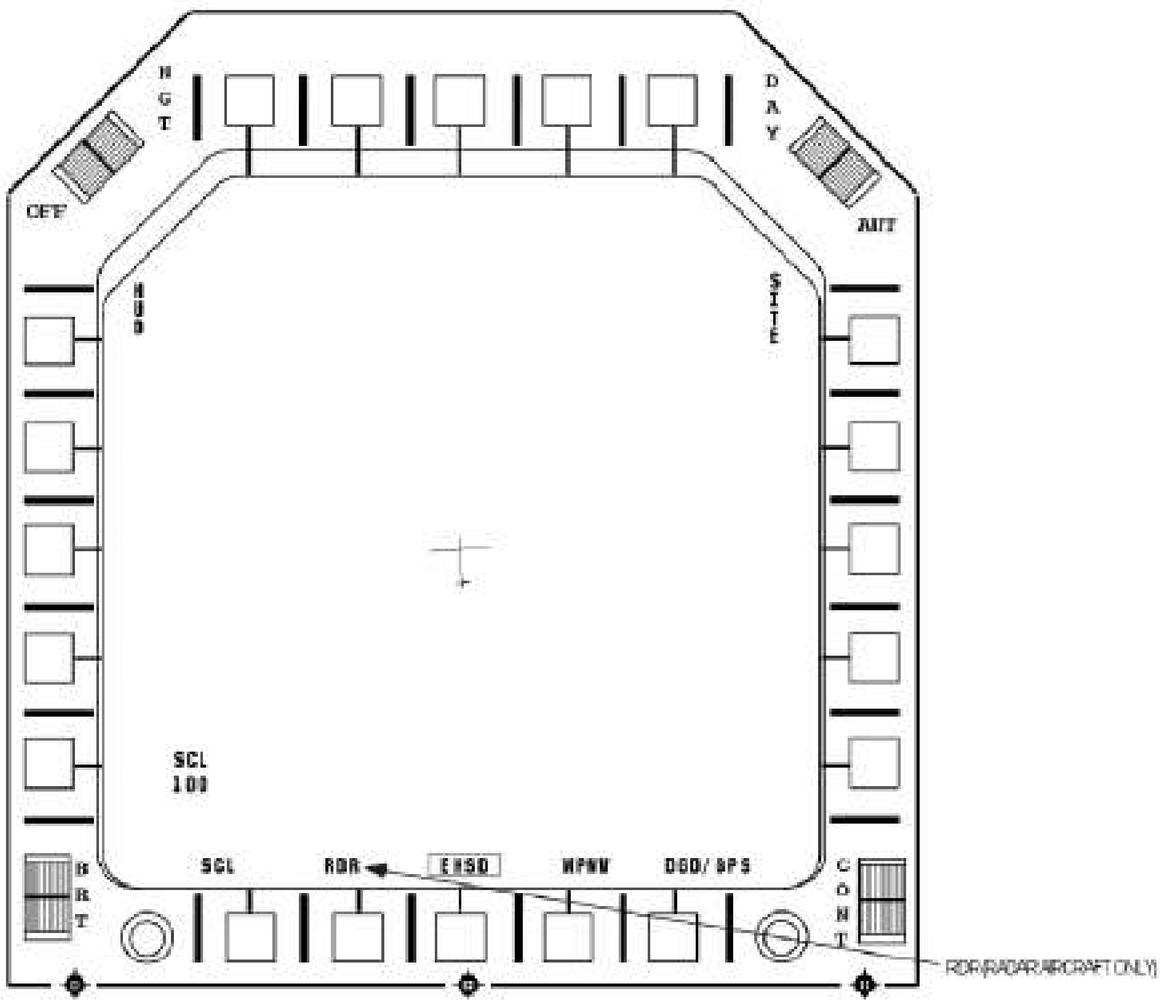


Figure 15-1. Mission Computer Failure Displays (Sheet 3)

RADAR AIRCRAFT

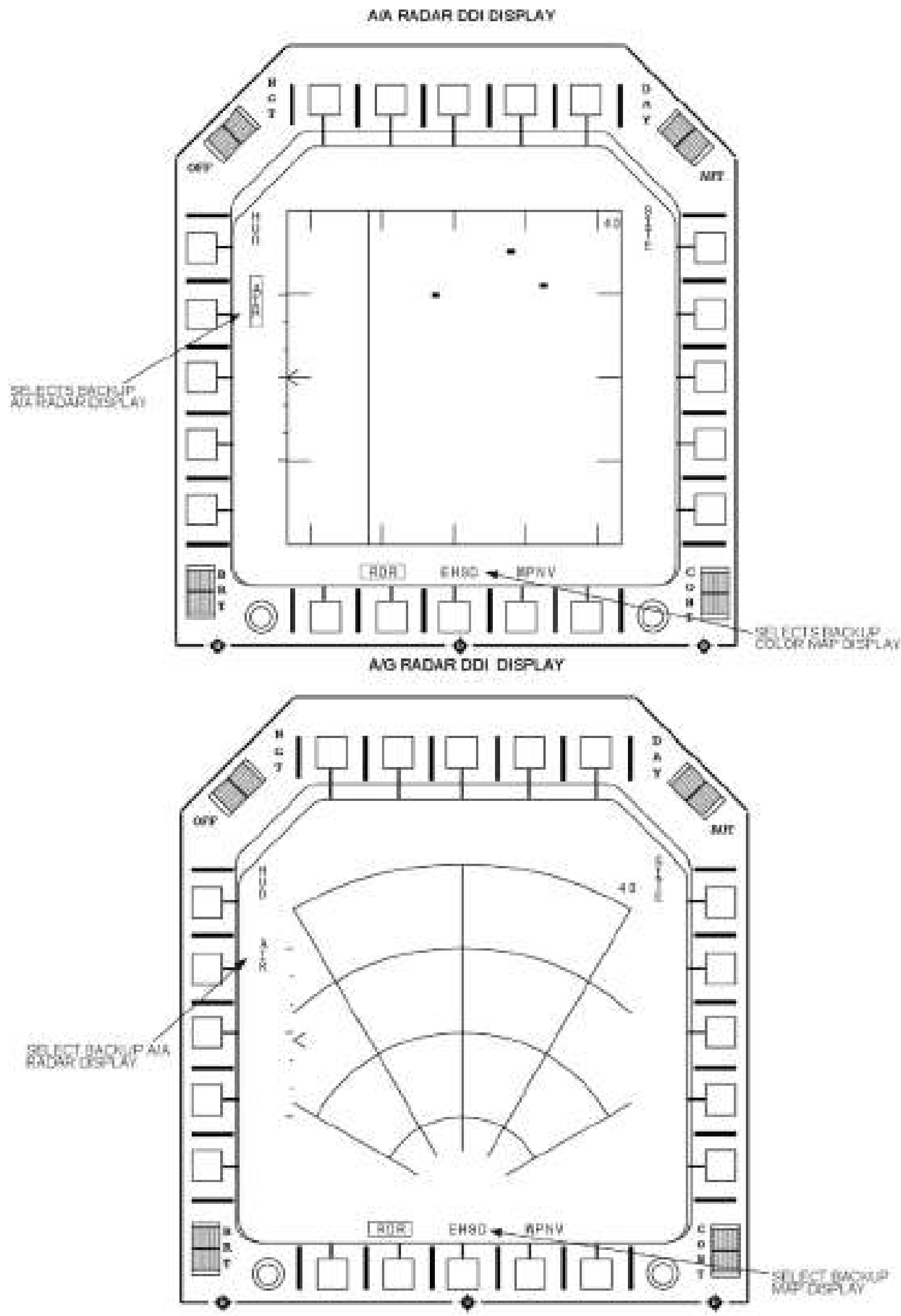


Figure 15-1. Mission Computer Failure Displays (Sheet 4)

TAV-8B WITH H4.0, RADAR, AND NIGHT ATTACK AIRCRAFT

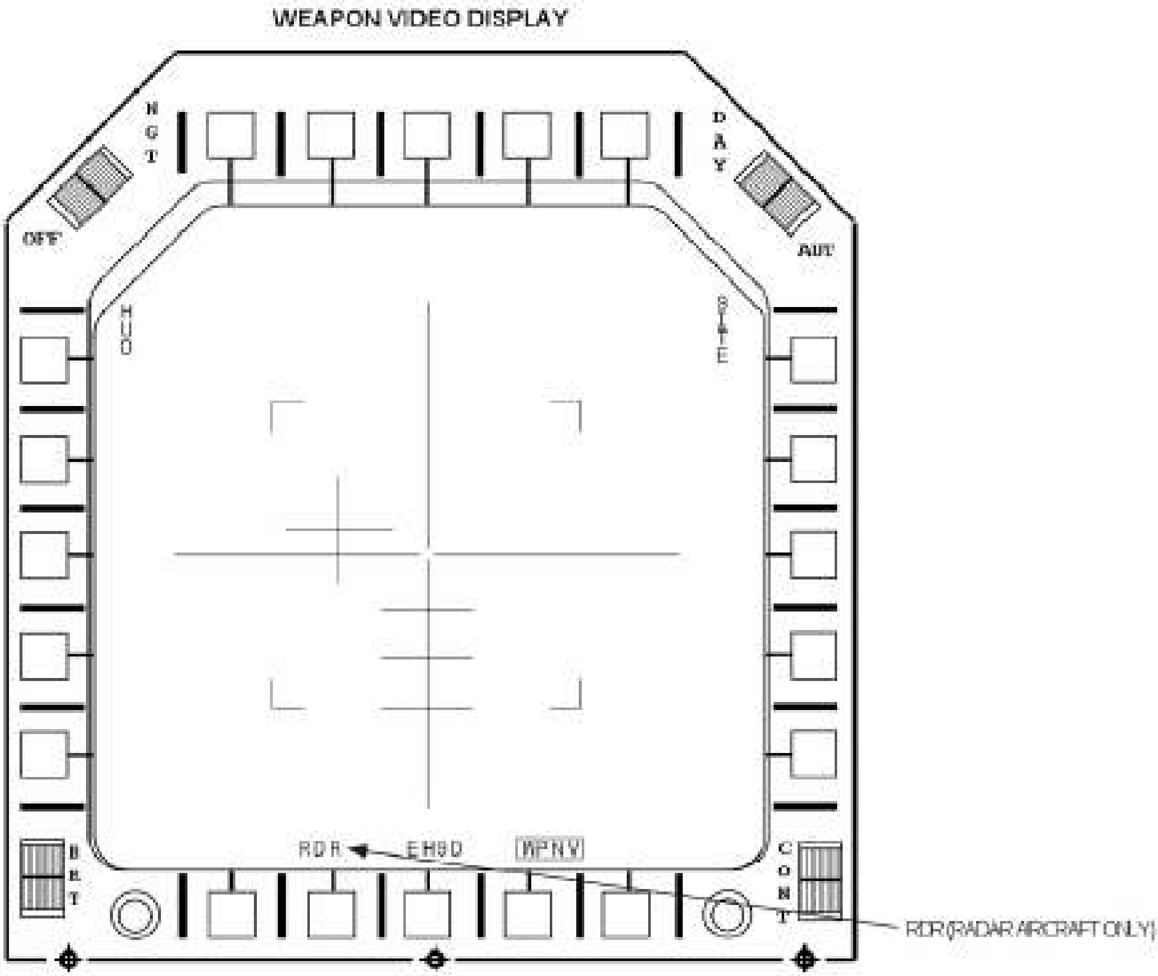


Figure 15-1. Mission Computer Failure Displays (Sheet 5)

17. FLIR — On radar and night attack aircraft only the FLIR video is provided for display on the HUD and right DDI backup displays. No DDI options, pushbutton legends, are available.
18. Map — On radar and night attack aircraft, backup map display provided on left DDI.
19. Radar — Backup radar display provided on right DDI. A/G program is limited to RBGM with a fixed 40 nm range scale, 120° scan, and AUTO scan A/A program limited to RWS/with a fixed 40 nm range scale, INTL PRF, 2 bar/140° scan, and 2 second target aging.

If backup display appears on the HUD and DDI:

20. MC switch — OVRD.

If normal operation not restored (STANDBY appears on displays or displays remain blank):

21. MC switch — OFF.

15.2 AIR DATA COMPUTER FAILURE

Air data computer failure may cause some or all air data (airspeed, Mach, altitude, AOA, rate of climb) to disappear from the HUD. The Q–feel fails on. SAAHS reverts to fixed low gains. Aileron high speed stops fail disengaged. The LIDS will extend with the landing gear regardless of airspeed. Landing gear warning, stall warning, departure resistance, auto flaps, and IFF altitude reporting fail. The CIP/AUT and DEP RES lights will come on. The mission computer and INS operate from degraded data.

If ADC failure is suspected:

1. BIT display — CHECK FOR ADC FAILURE (ADC 1).

CAUTION

- With an ADC failure, exercise caution in applying lateral stick above 250 knots. With the aileron high speed stops not engaged, excessive lateral stick may cause structural damage.
- With an ADC failure, do not lower the landing gear above 200 knots to prevent LIDS structural failure.
- With an ADC failure ensure airspeed is below 165 knots and nozzles are 25° or greater prior to selecting STOL flaps. Flap scheduling may occur and, at high speed, this will cause a severe nose down pitch.

2. Flaps — OFF.
3. Determine appropriate landing type with consideration to flap position.
4. Land as soon as practical.

WARNING

Faulty or fluctuating ADC airspeed signals sent to the Digital Flap Controller (DFC) can cause sudden, unexpected flap movement. With Auto Flaps selected, the Digital Flap Controller will reposition the flaps between 5 and 25 degrees any time an airspeed signal greater than 275 KIAS is received, regardless of the gear position.

CAUTION

After landing with flaps secured, any flap position greater than 25 degrees will require flaps to be emergency retracted prior to going nozzles aft to preclude flap damage due to exhaust temperatures.

15.3 INS FAILURE

If there is an INS failure while in NAV master mode (see Figure 15-2), the HUD symbology is affected as follows:

The velocity vector, aircraft g, max g, and flight path/pitch ladder symbols are not displayed. If the INS reverts to AHRS or if GYRO mode is selected, the flight path/pitch ladder symbol is displayed but the velocity vector, aircraft g, and max g symbols are not displayed. If there is an INS failure while in VSTOL master mode, the flight path/pitch ladder, sideslip acceleration, and pitch caret symbols are not displayed. If the INS reverts to AHRS or if the GYRO mode is selected, the flight path/pitch ladder and pitch caret symbols are displayed but the sideslip acceleration symbols are not displayed.

CAUTION

To prevent damage to the gyros on the AN/ASN-130A inertial navigation system, after an INS failure, the OFF position of the INS mode switch must be momentarily selected prior to selecting GYRO.

1. Use the standby attitude indicator for attitude reference.
2. INS switch — OFF (5 seconds - ASN-139/3 minutes - ASN-130).
3. Maintain straight and level flight.

If attempting an in-flight alignment (IFA):

4. INS switch — IFA.
5. Make any required turns using greater than 30° AOB (see note).
6. EHSD — MONITOR ALIGNMENT TIME AND QUALITY.
7. Alignment complete when HUD attitude information returns. (GPS IFA with good satellite data may take up to 10 minutes).

If attempting a radar IFA:

8. Master mode — NAV.
9. Radar mode — LAND OR SEA BASED ON TERRAIN.
10. INS switch — IFA.
11. Make any required turns using greater than 30° AOB (see note).
12. A/C data page — RIFA (GPS data page — RIFA with C1+).
13. EHSD — MONITOR ALIGNMENT TIME AND QUALITY (after 2 minutes).
14. INS caution — VERIFY EXTINGUISHED (may take up to 20 minutes).

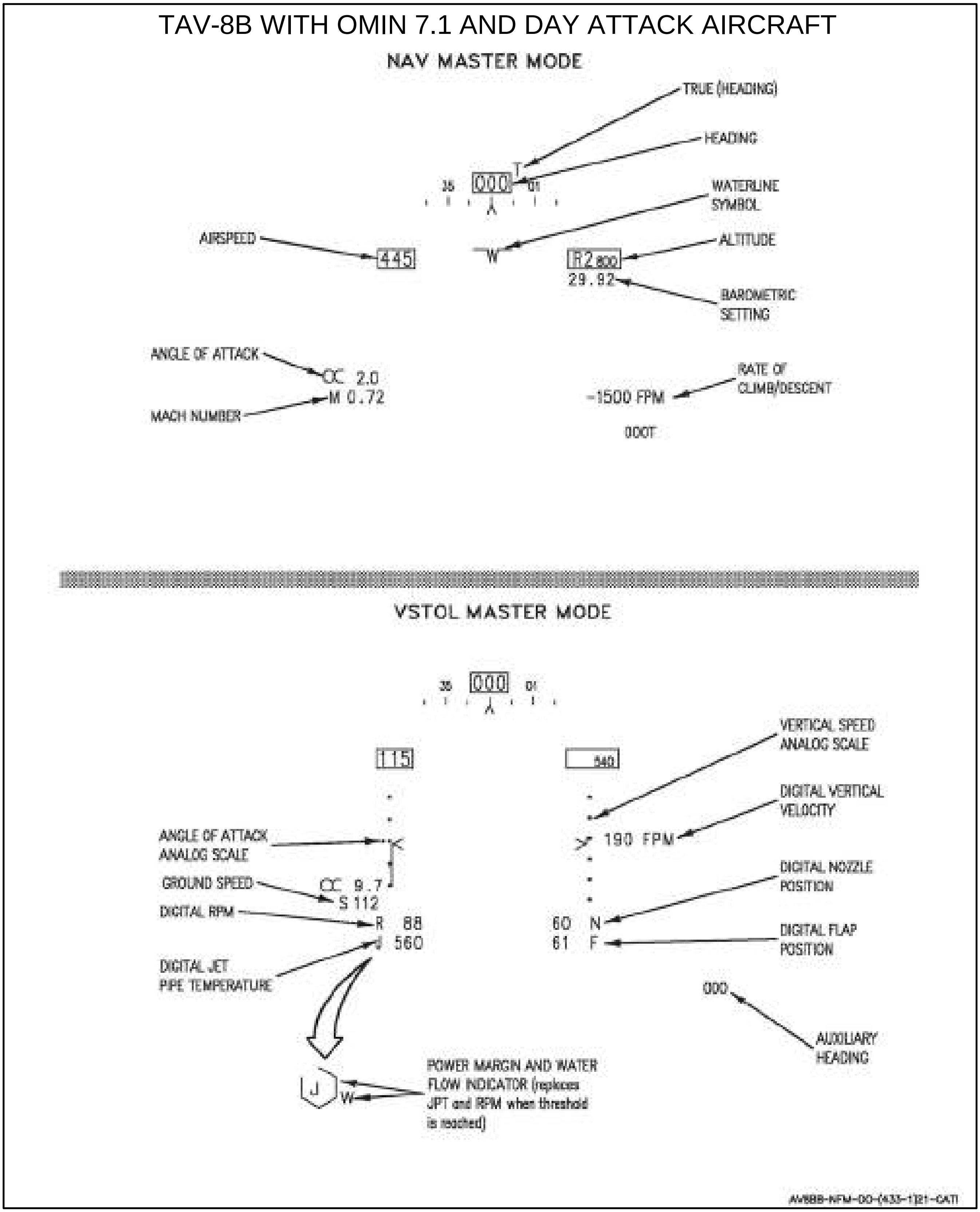
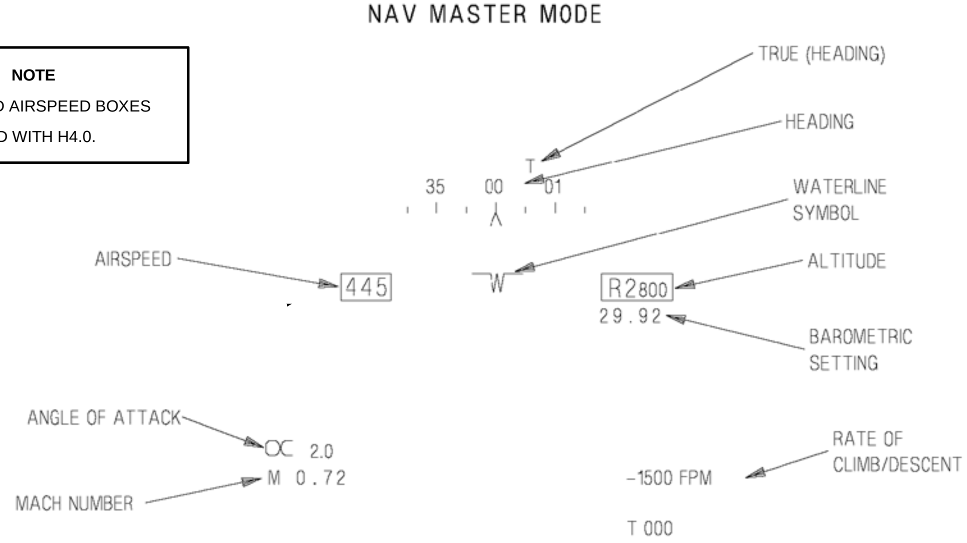


Figure 15-2. Total INS Failure Displays (Sheet 1 of 2)

TAV-8B WITH H4.0, RADAR, AND NIGHT ATTACK AIRCRAFT

NOTE

ALTITUDE AND AIRSPEED BOXES ARE REMOVED WITH H4.0.



NOTE

ALTITUDE AND AIRSPEED BOXES ARE REMOVED WITH H4.0.

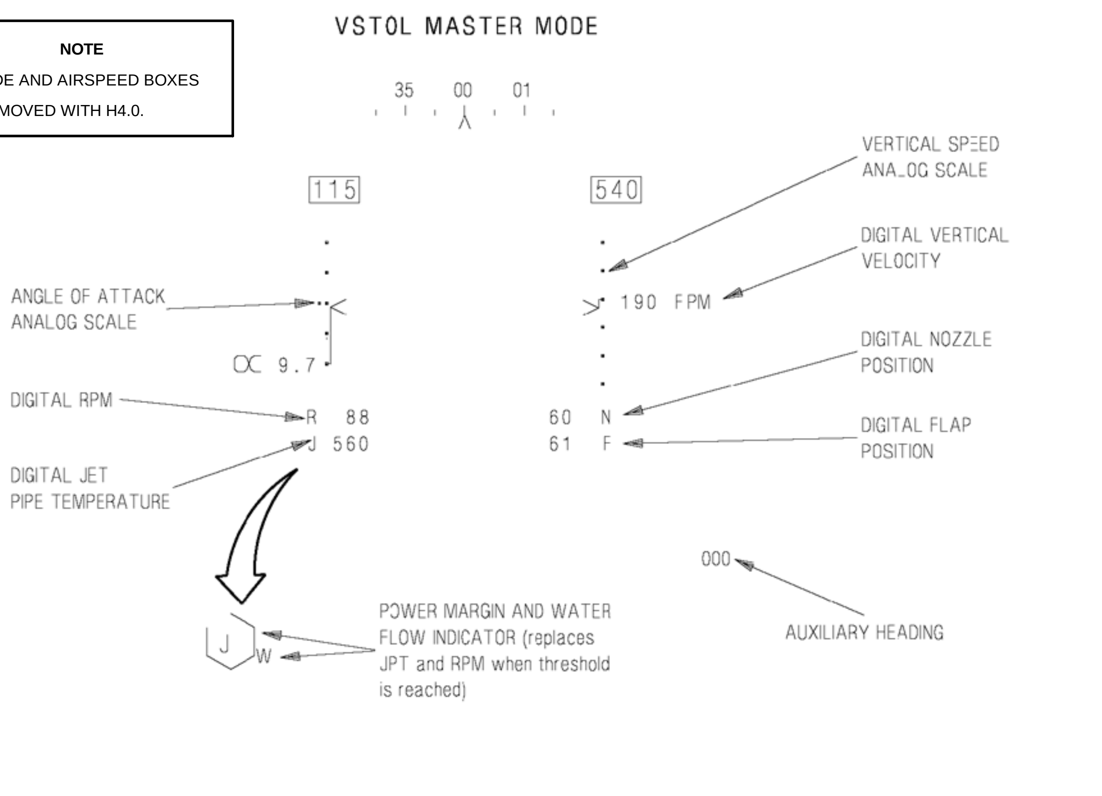


Figure 15-2. Total INS Failure Displays (Sheet 2)

15. INS switch — NAV.

If IFA is unsuccessful, attempt a GYRO recovery:

16. INS switch — OFF (5 seconds - ASN-139/3 minutes - ASN-130).

17. INS switch — GYRO.

Note

The NAV system will enter align hold during an in-flight alignment when aircraft roll exceeds 30° in order to reduce alignment time in non-wings level flight.

15.4 OBOGS FAILURE

On-board oxygen generating system (OBOGS) failure may be indicated by the OXY caution light, reduced pressure and/or quantity of breathing gas, or hypoxia symptoms. The failure may be a high temperature bleed air leak, a heat exchanger, shut off valve or concentrator failure resulting in insufficient oxygen concentration. Any failure should be treated as though the OXY caution light is on. Refer to the OXY light in the Warning/Caution/Indicator Lights chart.

WARNING

Failure to turn the OBOGS off and breathe from an alternate source when a failure is indicated may result in system damage, fire, and hypoxia.

15.5 CANOPY UNSAFE INFLIGHT

An unsafe canopy may be indicated by a CANOPY caution light, a yellow latch or white off center indication in the canopy latch viewport, or canopy movement. A partially engaged latch may disengage as cabin pressure differential increases.

15.5.1 Canopy Explosion Inflight

*1. EMERGENCY DESCENT — IF REQUIRED.

*2. LOWER SEAT — AS REQUIRED.

*3. Throttle — AVIOD ABRUPT THROTTLE MOVEMENTS.

4. Minimize g-loading.

5. Land as soon as practical.

15.6 COCKPIT TEMPERATURE HOT/COLD

1. Cabin pressure switch — NORM.

2. Cabin air temperature knob — MANUAL - REGULATE TEMPERATURE.

If temperature stays too hot/cold:

3. Descend to below 25,000 feet MSL.

4. Cabin pressure switch — RAM.

5. Limit airspeed as follows:

   Below 5,000 feet – 0.4 Mach.
   5,000 to 10,000 feet – 0.6 Mach.
   10,000 to 15,000 feet – 0.7 Mach.

15.7 COCKPIT UNDER PRESSURE

1. Descend below 25,000 feet MSL.

15.8 COCKPIT OVER PRESSURE

1. Descend below 25,000 feet MSL.

2. Cabin pressure switch — DUMP.

If cockpit still over pressure:

3. Cabin pressure switch — RAM.

4. Limit airspeed as follows:

   Below 5,000 feet – 0.4 Mach.
   5,000 to 10,000 feet – 0.6 Mach.
   10,000 to 15,000 feet – 0.7 Mach.

15.9 MAIN GENERATOR FAILURE (GEN, DC AND STBY TR CAUTION LTS)

If the main generator fails with APU not selected on in the standby mode, the GEN, DC and STBY TR caution lights will come on. The APU will have to be selected on if the main generator is not restored on the line.

Note

Loss of ac power will cause cockpit lights to come on full bright.

If the main generator fails with the APU selected on in the standby mode, the APU advisory light and the GEN warning light will be on (but not the DC and STBY TR caution lights). For equipment lost/available, refer to Emergency Power Distribution, see Figure 15-3.

On the ground, a main generator failure will cause the loss of all warning, caution, and advisory lights except the FIRE light. In this case, the main generator failure can be recognized by the loss of all ac powered equipment and absence of the green gear down lights. Pressing the COMP/LTS TEST switch momentarily will restore operation of the emergency warning, caution, and advisory lights. Should generator failure occur on takeoff, the emergency warning, caution, and advisory lights will be restored when the aircraft becomes airborne.

DECS operation requires DC power which is supplied by the generator, battery, or APU. In some cases, attempts to start the APU may drain the battery power to a level which would preclude MFS selection. On –408B engines, LANE 2 DECU is also powered continuously by the EVICS HMU permanent magnetic alternator. For aircraft equipped with –408B engines and Emergency MFS batteries, DECS control as well as the potential to select MFS (if required) will be maintained. For –408B engines, operation in EFC POS 2 will minimize battery drainage. For aircraft without –408B engines or Emergency MFS batteries, MFS should be selected prior to placing additional drainage on the battery and before battery voltage drops below 16 volts.

On AV–8B 164151 and up; also AV–8B 161573 through 164150, TAV–8B after AFC–328, manual fuel selection and emergency landing gear extension can be accomplished with less than 16 volts indicated using the MFS emergency battery and the LDG emergency battery. The MFS emergency battery provides an alternate source of electrical power for manual fuel selection in time critical selection scenarios. Below 16 volts, normal manual fuel selection cannot be guaranteed.

WARNING

On aircraft not equipped with -408B engines or MFS Emergency batteries, failure to expeditiously switch to MFS could result in loss of engine control. If generator failure is the result of electrical fire, switching to MFS may not be possible.

CAUTION

- A main generator failure will cause the AUT FLP caution light to come on. Ensure airspeed is below 165 knots and nozzles are 25° or greater prior to selecting STOL flaps.
- Nosewheel steering hot/No antiskid.

15.10 MAIN TRU FAILURE (DC CAUTION LIGHT)

Illumination of the DC caution light indicates the main transformer rectifier (TRU) has failed. Normally, the standby TRU output automatically switches to power the emergency dc bus. Subsequent failure of the standby TRU is indicated by the STBY TR caution light coming on and/or the dc voltmeter dropping below 26 volts. Below 16 volts, normal manual fuel selection cannot be guaranteed. The pilot can consider securing the following systems if the main and standby TRU fail in order to preserve battery life:

1. DC boost pumps.
2. Radios (transmit drains more power).
3. Seat adjust.
4. Trim.

For equipment lost/available refer to Emergency Power Distribution, see Figure 15-3.

CAUTION

- Do not lower landing gear above 200 knots.
- Nosewheel steering hot/No antiskid.
- Landing gear should be lowered before battery discharges below 16 volts.
- On aircraft not equipped with -408B engines or MFS Emergency battery, MFS should be selected before battery discharges below 16 volts.

Note

Emergency MFS and LDG emergency battery activation may be required if DC voltage depletes below 16 volts indicated.

MAIN GENERATOR FAILED APU GENERATOR OPERATING

GEN APU

USABLE EQUIPMENT

MAIN GEN FAILED
APU GEN OPERATING
MAIN TRU OK
STBY TRU OK

GEN APU

ENGINE/FUEL–
- APU/Engine Start
- Bingo Light
- DECU No. 1 & 2
- Engine Ignition (L and R)
- Engine Life Recorder
- Engine RPM Indicator
- Fire/Overheat Detection
- Fuel Boost Pumps (DC)
- Fuel Dump
- Fuel Flow Indicator
- Fuel Flow Proportioner
- Fuel Quantity Indicator
- In-flight Refueling
- JPT Indicator
- Manual Fuel Control
- Nozzle Position Indicator
- Water Select/Dump/Quantity/Anti-freezing Valve

FLIGHT CONTROLS–
- Aileron Droop
- Aileron Stop Solenoid
- Emer Flap Retract Solenoid
- Flaps (All Modes)
- Flaps Controller No. 1
- (5) Flaps Controller No. 2
- Position Indicator (Flaps & Stab)
- RCS Duct Pressure Indicator
- Rudder Pedal Shaker

- Q-Feel
- SAAHS
- Speed Brake
- Trim Indicators (Aileron & Rudder)
- Trim (Manual)
- Trim (SAAHS)

FLIGHT INSTRUMENTS–
- Altimeter Vibrator
- HUD
- (15) Radar Altimeter
- Standby AOA Indicator
- Standby Attitude Indicator
- Turn and Slip Indicator

LIGHTING EQUIPMENT–
- Anti-collision Lights
- Aux Landing/Taxi Light
- Emer Flood and Chart Lights
- Emer Warning/Caution Lights
- Flood Lights
- Instrument Lights
- Kneeboard Light
- Master Caution Light
- (9) Master Warning Light
- Sideslip Vane Lights
- Utility Light

NAVIGATION EQUIPMENT–
- (16) ATHS
- AWLS
- (9) DMS
- (13) GPS
- IFF (except mode 4)
- INS
- KY-58
- (8) HSI
- Tacan
- UHF/VHF R/T No. 1 and No. 2

OTHER–
- Air Data Computer
- Air Data Computer Airspeed and Altitude Relays
- Anti-skid/Nosewheel Steering
- Brake Pressure Indicator
- Cockpit Pressure Dump
- Cockpit Temperature Control
- DDI
- DC
- DC Voltmeter
- (7) DSS
- ECS Alt Equipment Shutoff Valve
- ECS Cabin Shutoff Valve
- ECS Cooling Fans
- Emergency Jettison
- Emergency Landing Gear
- (9) FLIR
- Hydraulic Pressure Indicator
- Landing Gear Control
- LIDS Control
- L, R Pitot and AOA Probe Htrs
- Mission Computer
- OBOGS
- Seat Adjust
- Upfront Control
- Video Recording System
- Windshield Overtemperature Control

EQUIPMENT LOST

ENGINE/FUEL–
- Fuel Boost Pumps (AC)
- In-flight Refueling Light (Ext)

FLIGHT INSTRUMENTS–
- (14) Radar Altimeter

LIGHTING EQUIPMENT–
- Approach/Hover Lights
- Console Lights
- Formation Lights
- Position Lights

NAVIGATION EQUIPMENT–
- IFF Mode 4
- Radar Beacon
- (10) Radar

OTHER–
- Battery Heater
- Chaff Dispenser
- (11) DMT
- ECM
- IR Coolant Control
- OBOGS Heaters
- RWR
- Selective Jettison
- Total Temperature Probe Htr
- Weapons Fire/Release/Launch

MAIN GEN FAILED
APU GEN OPERATING
MAIN TRU OK
STBY TRU FAILED

GEN APU STBY TR

USABLE EQUIPMENT
(Same as above)

EQUIPMENT LOST
(Same as above)

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Figure 15-3. Emergency Power Distribution (Sheet 1 of 4)

MAIN GENERATOR FAILED
APU GENERATOR OPERATING (CONT)
MAIN TRU FAILED

GEN APU

USABLE EQUIPMENT

MAIN GEN FAILED
APU GEN OPERATING
MAIN TRU FAILED
STBY TRU OK

GEN APU DC

ENGINE/FUEL-
- APU/Engine Start
- Bingo Light
- DECU No. 1 & 2
- Engine Ignition (L and R)
- Engine RPM Indicator
- Fire/Overheat Detection
- Fuel Boost Pumps (DC)
- Fuel Dump
- Fuel Flow Indicator
- Fuel Flow Proportioner
- Fuel Quantity Indicator
- Inflight Refueling
- JPT Indicator
- Manual Fuel Control
- Nozzle Position Indicator
- Water Select/Dump/Quantity

FLIGHT CONTROLS-
- Aileron Droop
- Emer Flap Retract Solenoid
- Flaps (All Modes)
- Flaps Controller No. 1
- 5 Flaps Controller No. 2
- Flaps Indicator
- Position Indicator (Flaps & Stab)
- Trim (Manual, Aileron & Stab)

FLIGHT INSTRUMENTS-
- Altimeter Vibrator
- HUD
- Standby AOA Indicator
- Standby Attitude Indicator
- Turn and Slip Indicator

LIGHTING EQUIPMENT-
- Emer Flood and Chart Lights
- Emer Warning/Caution Lights
- Flood Lights
- Instrument Lights
- Kneeboard Light
- Master Caution Light
- 9 Master Warning Light
- Sideslip Vane Lights
- Utility Light

NAVIGATION EQUIPMENT-
- 13 GPS
- IFF (Emer)
- INS
- KY-58
- UHF/VHF R/T No. 1 and No. 2 (Manual Mode Only)
- 9 DMS

OTHER-
- Air Data Computer
- Brake Pressure Indicator
- Cockpit Pressure Dump
- Cockpit Temperature Control
- DDI
- DC
- DC Voltmeter
- ECS Cabin Shutoff Valve
- ECS Cooling Fans
- Emergency Jettison
- Emergency Landing Gear
- Landing Gear Control
- LIDS Control
- L, R Pitot and AOA Probe Htrs
- Mission Computer
- Nosewheel Steering (Hot Only)
- OBOGS
- Seat Adjust
- Windshield Overtemperature Control

EQUIPMENT LOST

ENGINE/FUEL-
- Engine Life Recorder
- Fuel Boost Pumps (AC)
- In-flight Refueling Light (Ext)
- Water Anti-freezing Valve

FLIGHT CONTROLS-
- Aileron Stop Solenoid
- Q-Feel
- RCS Duct Pressure Indicator
- Rudder Pedal Shaker
- 3 SAAHS
- Speed Brake
- Trim Indicators (Aileron & Rudder)
- 3 Trim (Manual Rudder)
- 3 Trim (SAAHS)

FLIGHT INSTRUMENTS-
- 1 HUD
- Radar Altimeter

LIGHTING EQUIPMENT-
- Anti-Collision Lights
- Approach/Hover Lights
- Aux Landing Taxi Lights
- Console Lights
- Formation Lights
- Position Lights

NAVIGATION EQUIPMENT-
- 16 ATHS
- AWLS
- IFF (Normal)
- Radar Beacon
- 8 HSI
- Tacan
- 10 Radar

OTHER-
- Air Data Computer Airspeed and Altitude Relays
- Anti-Skid
- Battery Heater
- Chaff Dispenser
- 11 DMT
- 7 DSS
- ECM
- ECS Aft Equipment Shutoff Valve (Deenergized Open)
- 9 FLIR
- Hydraulic Pressure Indicator
- IR Coolant Control
- OBOGS Heaters
- Probe Heater Control (Htrs operate on ground)
- RWR
- Selective Jettison
- Total Temp Probe Htr
- Upfront Control
- Video Recording System
- Weapons Fire/Release/Launch

MAIN GEN FAILED
APU GEN OPERATING
MAIN & STBY TRU'S FAILED

GEN APU DC STBY TR

USABLE EQUIPMENT
(Same as above until battery discharged)

EQUIPMENT LOST
(Same as above until battery discharged)

USABLE EQUIPMENT WHEN BATTERY DISCHARGED

ENGINE/FUEL-
- Fuel Flow Indicator

LIGHTING EQUIPMENT-
- Emer Warning/Caution Lights
- Flood Lights
- Instrument Lights

NAVIGATION EQUIPMENT-
- INS

OTHER-
- Air Data Computer
- DDI
- DC
- ECS Cooling Fans
- L & R Pitot and AOA Heater Probes
- Mission Computer

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Figure 15-3. Emergency Power Distribution (Sheet 2)

TRU(S) FAILED MAIN GENERATOR OPERATING — DC — STBY TR

USABLE EQUIPMENT

MAIN GEN OPERATING / MAIN TRU FAILED / STBY TRU OK — DC

ENGINE/FUEL–
- APU/Engine Start
- Bingo Light
- DECU No. 1 & 2
- Engine Ignition (L and R)
- Engine RPM Indicator
- Fire/Overheat Detection
- Fuel Boost Pumps (AC and DC)
- Fuel Dump
- Fuel Flow Indicator
- Fuel Flow Proportioner
- Fuel Quantity Indicator
- In-flight Refueling
- JPT Indicator
- Manual Fuel Control
- Nozzle Position Indicator
- Water Select/Dump/Quantity

FLIGHT CONTROLS–
- Aileron Droop
- Emer Flap Retract Solenoid
- Flaps (All Modes)
- Flaps Controller No. 1
- 5 Flaps Controller No. 2
- Position Indicators (Flaps & Stab)
- Trim (Manual, Aileron & Stab)

FLIGHT INSTRUMENTS–
- Altimeter Vibrator
- HUD
- Standby AOA Indicator
- Standby Attitude Indicator
- Turn and Slip Indicator

LIGHTING EQUIPMENT–
- Console Lights
- Emer Flood and Chart Lights
- Emer Warning/Caution Lights
- Flood Lights
- Instrument Lights
- Kneeboard Light
- Master Caution Light
- Master Warning Light
- Sideslip Vane Lights
- Utility Light

NAVIGATION EQUIPMENT–
- 13 GPS
- IFF (Emer)
- INS

- 2 9 DMS
- KY-58
- UHF/VHF R/T No. 1 and No. 2 (Manual Mode Only)

OTHER–
- Air Data Computer
- Battery Heater
- Brake Pressure Indicator
- Cockpit Pressure Dump
- Cockpit Temperature Control
- DDI
- DC
- DC Voltmeter
- ECM
- ECS Cabin Shutoff Valve
- ECS Cooling Fans
- Emergency Jettison
- Emergency Landing Gear
- Landing Gear Control
- LIDS Control
- L, R Pitot and AOA, and Total Temperature Probe Htrs
- Mission Computer
- Nosewheel Steering (Hot Only)
- OBOGS
- Seat Adjust
- Windshield Overtemperature Control

EQUIPMENT LOST

ENGINE/FUEL–
- Engine Life Recorder
- In-flight Refueling Light (Ext)
- Water Anti-freezing Valve

FLIGHT CONTROLS–
- Aileron Stop Solenoid
- Q-Feel
- RCS Duct Pressure Indicator
- Rudder Pedal Shaker
- 3 SAAHS
- Speed Brake
- Trim Indicator (Aileron & Rudder)
- 3 Trim (Manual Rudder)
- 3 Trim (SAAHS)

FLIGHT INSTRUMENTS–
- 1 HUD
- Radar Altimeter

LIGHTING EQUIPMENT–
- Anti-Collision Lights
- Approach/Hover Lights
- Aux Landing Taxi Lights
- Formation Lights
- Position Lights

NAVIGATION EQUIPMENT–
- 16 ATHS
- AWLS
- IFF (Normal)
- Radar Beacon
- 8 HSI
- Tacan
- 10 Radar

OTHER–
- Air Data Computer Airspeed and Altitude Relays
- Anti-Skid
- Chaff Dispenser
- 11 DMT
- 7 DSS
- ECS Aft Equipment Shutoff Valve (Deenergized open)
- 9 FLIR
- Hydraulic Pressure Indicator
- IR Coolant Control
- OBOGS Heaters
- Probe Heater Control (Htrs operate on ground)
- RWR
- Selective Jettison
- Upfront Control
- Video Recording System
- Weapon Fire/Release/Launch

MAIN GEN OPERATING / MAIN & STBY TRU'S FAILED — DC — STBY TR

USABLE EQUIPMENT
(Same as above until battery discharged)

EQUIPMENT LOST
(Same as above until battery discharged)

USABLE EQUIPMENT WHEN BATTERY DISCHARGED

LIGHTING EQUIPMENT–
- Console Lights
- Emer Warning/Caution Lights
- Flood Lights
- Instrument Lights

NAV EQUIPMENT–
- INS

OTHER–
- Air Data Computer
- DDI

DC
- ECM (w/o Chaff Dispenser)
- ECS Cooling Fans
- L, R Pitot, AOA, & Total Temp Probe Htrs
- Mission Computer

MAIN GEN OPERATING / MAIN TRU OK / STBY TRU FAILED — STBY TR

ALL EQUIPMENT USABLE

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Figure 15-3. Emergency Power Distribution (Sheet 3)

MAIN AND APU GENERATORS FAILED BATTERY AT HIGH STATE OF CHARGE

GEN
STBY TR DC APU GEN

USABLE EQUIPMENT

ENGINE/FUEL–
- APU/Engine Start
- Bingo Light
- DECU No. 1 & 2
- Engine Ignition (L and R)
- Engine RPM Indicator
- Fire/Overheat Detection
- Fuel Boost Pumps (DC)
- Fuel Dump
- Fuel Flow Proportioner
- Fuel Quantity Indicator
- In-flight Refueling
- JPT Indicator
- Manual Fuel Control
- Nozzle Position Indicator
- Water Select/Dump/Quantity

FLIGHT CONTROLS–
- Aileron Droop
- Emer Flap Retract Solenoid
- Flaps (STOL & Cruise Modes)
- Flaps Controller No. 1
- [5] Flaps Controller No. 2
- Position Indicator (Flaps & Stab)
- Trim (Manual, Aileron & Stab)

FLIGHT INSTRUMENTS–
- Altimeter Vibrator
- Standby AOA Indicator
- Standby Attitude Indicator
- Turn and Slip Indicator

LIGHTING EQUIPMENT–
- Emer Flood and Chart Lights
- [4] Emer Warning/Caution Lights
- Kneeboard Light
- Sideslip Vane Lights
- Utility Light

NAVIGATION EQUIPMENT–
- IFF (Emer)
- KY-58
- UHF/VHF R/T No. 1 and No. 2 (Manual Mode Only)

OTHER–
- Brake Pressure Indicator
- Cockpit Pressure Dump
- Cockpit Temperature Control
- DC Voltmeter
- ECS Cabin Shutoff Valve
- Emergency Jettison
- Emergency Landing Gear
- Landing Gear Control
- LIDS Control
- Nosewheel Steering (Hot Only)
- OBOGS
- Seat Adjust
- Windshield Overtemperature Control

EQUIPMENT LOST

ENGINE/FUEL–
- Engine Life Recorder
- Fuel Boost Pumps (AC)
- Fuel Flow Indicator
- In-flight Refueling Light (Ext)
- Water Anti-freezing Valve
- [6] MFS

FLIGHT CONTROLS–
- Aileron Stop Solenoid
- Flaps (Auto Mode)
- Q-Feel
- RCS Duct Press Indicator
- Rudder Pedal Shaker
- [3] SAAHS
- Speed Brake
- Trim Indicators (Aileron & Rudder)
- [3] Trim (Manual Rud)
- [3] Trim (SAAHS)

FLIGHT INSTRUMENTS–
- HUD
- Radar Altimeter

LIGHTING EQUIPMENT–
- Anti-Collision Lights
- Approach/Hover Lights
- Aux Landing Taxi Lights
- Console Lights
- Flood Lights
- Formation Lights
- Instrument Lights
- Master Caution Light
- [9] Master Warning Light
- Position Lights

NAVIGATION EQUIPMENT–
- [16] ATHS
- AWLS
- [9] DMS
- EHSD
- [13] GPS
- IFF (Normal)
- [2] INS
- Radar Beacon
- [8] HSI
- Tacan
- [10] Radar

OTHER–
- Air Data Computer
- Air Data Computer Airspeed and Altitude Relays
- Anti-Skid
- Battery Heater
- Chaff Dispenser
- DDI
- DC
- [11] DMT
- [7] DSS
- ECM
- ECS Aft Equipment Shutoff Valve (Deenergized open)
- ECS Cooling Fans
- [9] FLIR
- Hydraulic Pressure Indicator
- IR Coolant Control
- L, R Pitot, AOA, and Total Temperature Probe Heaters
- Mission Computer
- OBOGS Heaters
- Probe Heater Control (Htrs operate on ground)
- RWR
- Selective Jettison
- Upfront Control
- Video Recording System
- Weapons Fire/Release/Launch

ALL EQUIPMENT LOST WHEN BATTERY DISCHARGED

NOTES

1. HUD information available on DDI.
2. If interrupted ac power is restored within 90 seconds, INS may not be lost.
3. If failure occurs above 0.4 Mach and 6 AOA, equipment remains usable until aircraft goes below 0.4 Mach or 6 AOA for more than 30 seconds.
4. If airborne, all lights good. With weight-on-wheels, except for FIRE light, lights not operational until COMP/LT TEST switch is activated to TEST.
5. After RESET of flaps power switch.
6. Inability to select manual fuel on with battery under 16vdc.
7. AV-8B 163176 and up; TAV-8B 163180 and up.
8. TAV-8B, AV-8B 161573 thru 163852.
9. AV-8B 163853 and up.
10. AV-8B 164549 and up.
11. AV-8B 161573 thru 164547.
12. Presently displayed map coverage and overlays only.
13. AV-8B 165384 and up; also AV-8B 161573 thru 165383, TAV-8B 162963 thru 164542 after AFC-354 Rev A/ Part 2/ Part3.
14. AV-8B 163853 thru 164547, TAV-8B 164113 thru 164542 before AFC-368.
15. AV-8B 164549 and up; also AV-8B 163853 thru 164547, TAV-8B 164113 thru 164542 after AFC-368.
16. AV-8B 165305 and up; also AV-8B 163853 thru 165006 after AFC-325/Part 3.

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Figure 15-3. Emergency Power Distribution (Sheet 4)

15.11 STANDBY TRU FAILURE (STBY TR CAUTION LIGHT)

Illumination of the STBY TR caution light indicates the standby TRU has failed or, during GTS start, is off line. When the standby TRU fails, the main TRU powers the entire dc system, including charging of the battery. Subsequent failure of the main TRU is indicated by the DC caution light coming on and/or the dc voltmeter dropping below 26 volts.

15.12 APU GENERATOR FAILURE (APU GEN CAUTION LIGHT)

Illumination of the APU GEN light indicates the APU generator is malfunctioning with the APU selected on. This could occur in the standby mode before main generator failure, or it could occur after main generator failure in which case the aircraft has lost all ac power and is operating on the battery unless one of the ac generators is restored. With nominal load, the battery will provide power for about 30 minutes. With one DC boost pump operating, this time is reduced to 15 minutes and with both DC boost pumps operating, this time is reduced to 8 minutes. Below 20 volts, operation of battery powered equipment may be erratic. For equipment lost/available, refer to Emergency Power Distribution, see Figure 15-3.

15.13 TOTAL ELECTRICAL FAILURE (GEN, APU GEN, DC, STBY TRU)

Aircraft not equipped with –408B engines:

1. MFS — SELECT.

All Aircraft:

2. Landing gear — DOWN (below 200 knots before dc power lost, if not fuel critical).
3. Non-essential dc power equipment — OFF.

If VMC:

4. Battery switch — ALERT (if necessary to reattempt communications).

Note

- Emergency MFS and LDG emergency battery activation may be required if DC voltage depletes below 16 volts indicated. Below 16 volts, normal manual fuel selection cannot be guaranteed.
- To minimize the drain on the battery, the igniters may be secured by momentarily selecting the BATT switch to OFF or ALERT. However, operating in MFS without continuous ignition gives a slightly increased chance of engine flame out on slam deceleration.
- Hot NWS perform VL or RVL if possible.
- Selecting ALERT will secure standby AOA indicator, attitude gyro, and turn and slip indicator.
- With hot NWS, perform VL. Engine fast deceleration solenoid function lost.

15.14 EMERGENCY DC BUS FAILURE

The emergency DC bus is defined as the “emergency” DC bus because it is supposed to be one of the last busses to lose power during any type of electrical failure. The emergency DC bus powers multiple components critical to normal and emergency flight regimes. If the power to the emergency DC bus is lost it constitutes a serious compound emergency situation. The aircraft’s electrical priority is designed to provide power to the emergency DC bus even when two of the three electrical supply components are lost. Since the alert bus is normally powered from the emergency DC bus, both busses will be lost during an emergency DC bus failure. It is important to first understand which components you lose and the effects of each component if you have an emergency DC and alert bus failure. It is also important to understand how the emergency DC and alert busses are powered, how they can lose power and the ways power can be regained as well as the anomalies associated with certain power loses.

Systems affected and how they affect the operation of the aircraft.

15.14.1 DC Emergency Bus, Circuits

15.14.1.1 Landing Gear

Purpose: Powers solenoids in landing gear control valve which open/close doors and lower/raise the landing gear.

Indication/consequence to pilot if lost: Landing gear cannot be raised or lowered via normal means using the landing gear handle.

15.14.1.2 Emergency Landing Gear

Purpose: To fire impulse cartridge (CAD) which discharges the landing gear emergency extension bottle (blow down bottle) when the landing gear handle is turned 90 degrees and pulled.

Indication/consequence to pilot if lost: Emergency gear blow down does not occur when the landing gear handle is turned 90 degrees and pulled. Note: CAD can still be fired and landing gear blown down using the landing gear emergency battery.

15.14.1.3 Brake Pressure

Purpose: Powers the main landing gear brake pressure transmitter in the NLG wheel well and the hydraulic pressure indicator in the cockpit.

Indication/consequence to pilot if lost: PSI X10 BRAKE indicator wheels will be driven to the striped position (barber pole) indicating brake pressure indication is invalid. HYD-1 and HYD-2 pressure indications are also driven to striped position (barber poles) and will indicate zero pressure. Actual hydraulic brake pressure is not affected.

15.14.1.4 Landing Gear Relay

Purpose: Energizes the landing gear handle down, MLG down and locked or MLG not down and locked relays if condition exists.

Indication/consequence to pilot if lost: Neither the approach or the hover light can/will be turned on when the main landing gear is down and locked. The total temperature probe heater will not be automatically turned off when the landing gear handle is set to the down position. The side slip vane light will not illuminate when the landing gear handle is set to the down position. The speed brake will not automatically deploy to between 23 and 27 degrees when main landing gear is down and locked. With the landing gear down and locked, the speed brake can be fully extended (to 66 degrees) and retracted. When the gear is not down and locked, erroneous JPTL datum will be provided to DECU. IFF Mode-4 codes will be zeroized (due to de-energized MLG not down and locked relay). When gear is not down and locked, an erroneous landing gear down signal will be provided to the DFC (due to de-energized MLG not down and locked relay).

15.14.1.5 Nose Wheel Steering

Purpose: To energize the nosewheel steering switchover solenoid in NWS switchover valve when NWS is selected, weight is on wheels and HYD-1 pressure is below 1,600 PSI.

Indication/consequence to pilot if lost: No indication. The switchover solenoid will be unable to automatically switch NWS operation to HYD-2 if needed.

15.14.1.6 Anti Skid/Nose Landing Gear Steering

Purpose: Used to energize the nose wheel steering (NWS) control valve solenoid when ANTISKID is selected. It is also used to energize the NWS selector solenoid when high gain NWS is selected.

Indication/consequence to pilot if lost: When power to the NWS control valve solenoid is lost with ANTISKID selected, the system will be stuck in low gain NWS instead of castor mode. When high gain is selected, the system will stay in low gain NWS because power is not available to the NWS selector solenoid.

15.14.1.7 Aileron Droop

Purpose: Allows pilot to select aileron droop with flaps to produce greater lift.

Indication/consequence to pilot if lost: Unable to droop ailerons.

15.14.1.8 Flap Indicator

Purpose: Powers flaps position indicator on landing gear/flaps panel.

Indication/consequence to pilot if lost: No change in flaps position indicator with change in flaps. HUD flap indication will still be valid.

15.14.1.9 Yaw SAAHS

Purpose: Powers YAW portion of SAAHS. Indication/consequence to pilot if lost: If DC emergency bus loses power the yaw system would disengage and power to the rudder servo cylinder would discontinue. No auto control.

15.14.1.10 Flap Controller

Purpose: Powers the emergency flap retract switch on the engine throttle lever and retract solenoid P/O flap hydraulic controller.

Indication/consequence to pilot if lost: Unable to retract flaps using the emergency flap retract switch.

15.14.1.11 Mission Computer (OMNI 7.1 and C1+)

Purpose: Powers the MC Relay which will remove AC power from the mission computer when the display computer is in back-up mode and is therefore acting as the mux bus controller. This ensures that there is only one mux bus controller at a time. The display computer enters back-up mode if it has not been able to communicate with the mission computer for 2 seconds. After the display computer has entered back-up mode it energizes the Mux auto switching relay, which in turn energizes the mission computer control relay.

Indication/consequence to pilot if lost: None, under most circumstances. If in back-up mode and the mission computer comes back on-line, indications are erratic and/or incorrect data on the displays. In this case, the pilot can switch the mission computer switch to either OVRD (mission computer control only) or Off (display computer control only) to force only one of the computers to be the Mux controller.

15.14.1.12 Mission Computer (H4.0 Only)

Purpose: None. With H4.0, the mission computer control relay is no longer utilized. The mission computer software ensures that there is only one MUX bus controller. Before becoming the MUX bus controller, the mission computer will determine if the display computer is acting as the controller. If the display computer is acting as the MUX bus controller, then the mission computer will initiate a handshaking process to resume control of the mux bus.

Indication/consequence to pilot if lost: None.

15.14.1.13 ACNIP Emergency Power

Purpose: Powers the ACNIP (28Vdc emergency input). If the 28Vdc emergency is not supplied, the ACNIP can be powered from the alert bus by placing the battery switch in the ALERT position. The ACNIP is then turned on in a power conservation mode to reduce the power drain on the aircraft storage battery.

Indication/consequence to pilot if lost: No audio in headset. No audible warnings. Loss of Radio Communication.

15.14.1.14 IFF

Purpose: Powers APX–100 IFF transponder.

Indication/consequence to pilot if lost: Transponder indicator lights out (edge–lit panels will remain lighted). Unable to transmit in all IFF modes.

15.14.1.15 Jettison Busses A/B

Purpose: Energizes Jettison Bus A and B contactors if landing gear handle is up or weight is off wheels.

Indication/consequence to pilot if lost: The pilot will be unable to selectively jettison stores and Emergency Jettison is inoperable.

15.14.1.16 AOA Indicator

Purpose: Powers angle of attack indicator ID–2276/A.

Indication/consequence to pilot if lost: No head–down AOA indication (indicator back light remains on). AOA will still be displayed on HUD.

15.14.1.17 Annunciator Light Circuits

Purpose: Together, these four circuits provide all of the electrical power for the Annunciator Light Controller.

Indication/consequence to pilot if lost: All warning, caution and advisory lights will be off. Amber and green landing gear position lights will not be seen in cockpit as landing gear is lowered down and locked. Landing gear control handle lights will not light. No audible warnings even when switched to ALERT mode. For TAV–8B only, landing gear position lights will be seen during Emergency DC Bus failure.

15.14.1.18 Seat Adjust

Purpose: Powers seat height adjust motors through seat adjust switch.

Indication/consequence to pilot if lost: Pilot is unable to adjust seat height.

15.14.1.19 OBOGS Bleed Air Shut Off

Purpose: Powers OBOGS bleed air shutoff valve and oxygen concentrator.

Indication/consequence to pilot if lost: Loss of on board oxygen generation system without any indication to the pilot. Setting the oxygen switch to the OFF position will not close the OBOGS bleed air shutoff valve. Shutoff valve will remain open; engine bleed air will be supplied to pilot.

15.14.1.20 Oxygen Monitoring Unit

Purpose: Powers Oxygen Monitoring Unit.

Indication/consequence to pilot if lost: No indication of failure. Oxygen is no longer being monitored, no caution light or ACNIP message will be provided if oxygen concentration falls below safe level.

15.14.1.21 Cockpit Temperature Relay

Purpose: Powers the cabin temperature control/selector and opens/closes the temperature regulating valve. Also, energizes windshield over–temperature relay when windshield over–temperature switch senses windshield temperature to be 250 ±8 °F.

Indication/consequence to pilot if lost: Loss of control of cabin temperature and windscreen overtemp protection. Temperature regulating valve stays at same setting.

15.14.1.22 Cabin Pressure Control Circuit Breaker

Purpose: Powers pressure reducing and shutoff valve, emergency ram air vent control valve and cabin dump control valve when pressurization switch is in the RAM position.

Indication/consequence to pilot if lost: Unable to dump pressure but the pressure regulator and safety relief valve will continue to regulate pressure.

15.14.1.23 Cabin ECS Circuit Breaker #2

Purpose: Powers pressure reducing and shutoff valve, emergency ram air vent control valve and canopy seal control valve when pressurization switch is in the NORM position.

Indication/consequence to pilot if lost: Canopy seal will not deflate, the canopy will be harder to open. Ram air vent cannot be opened, if needed.

15.14.1.24 Water Select

Purpose: Powers water selector switch, water injection pump solenoid and water dump switch.

Indication/consequence to pilot if lost: Unable to either inject water into engine or dump water overboard.

15.14.1.25 Flow Proportioner Indicator MFS Ignition Relay

Purpose: Powers fuel flow proportioner indicator and energizes manual fuel ignition relay when the MFS switch is set to the ON position.

Indication/consequence to pilot if lost: No fuel flow proportioner caution light. No fuel priming or igniters when the MFS switch is set to the ON position.

15.14.1.26 Right and Left Ignitor Engine Start

Purpose: Powers engine right and left igniter plugs and DC Boost Pump Contactors.

Indication/consequence to pilot if lost: No indication to pilot. Right and left igniters will not be functioning. Boost Pumps cannot be operated in DC OPR mode.

15.14.1.27 Fuel Priming

Purpose: Powers the torch igniter (fuel priming) solenoid valve.

Indication/consequence to pilot if lost:No indication to pilot. The torch igniter will not be functioning.

15.14.1.28 Emergency Cockpit Power

All of the below.

RUDDER SERVO

Purpose: Powers the rudder servo valve for hydraulic control of rudder position.

Indication/consequence to pilot if lost: Loss of automatic control of rudder position.

STABILATOR TRIM

Purpose: Electrical trim control of stabilator (pitch trim).

Indication/consequence to pilot if lost: Pilot cannot manually trim stabilator.

AILERON TRIM

Purpose: Electrical trim control of ailerons (roll trim).

Indication/consequence to pilot if lost: Pilot cannot manually trim ailerons.

15.14.1.29 Emergency Flood Chart Light

Purpose: Powers cockpit emergency floodlights No.1 and No.2 and emergency NVG floodlights No. 1 and No. 2 through the instrument panel control and floodlight control. Powers the cockpit chart light through the chart light switch and brightness control.

Indication/consequence to pilot if lost: Emergency floodlights and chart light are off and cannot be turned on.

15.14.1.30 Right and Left IFR

Purpose: Powers the right and left fluid pressure regulator valve solenoid. When powered during ground or in-flight refueling, this valve removes engine bleed air pressure and vents right-side fuel tanks to atmosphere.

Indication/consequence to pilot if lost: Cannot perform in-flight refueling.

15.14.1.31 Fuel Dump Control

Purpose: Powers the left and right fuel jettison (dump) valve motors through the fuel control panel left and right dump switches.

Indication/consequence to pilot if lost: Unable to dump fuel.

15.14.1.32 Right and Left Boost Pumps

Purpose: Energizes the right and left AC boost pump relays when fuel control panel right and left pump switches are set to NORM. This applies 3-phase AC power to the right and left boost pumps.

Indication/consequence to pilot if lost: Right and left boost pumps do not run when the fuel control panel right and left pump switches are set to NORM but will run (powered from 28 Vdc Ground Service Bus) when the fuel control panel right and left pump switches are set to DC.

15.14.1.33 Fuel Gauge Monitor

Purpose: Powers the fuel quantity processor and fuel digital display indicator.

Indication/consequence to pilot if lost: No fuel quantity information is displayed in cockpit. Fuel readings on the fuel display panel will freeze at last state.

15.14.1.34 Fuel Prop Shut Off

Purpose: Powers the fuel flow proportioner solenoid selector valve when the fuel prop control switch is set to OFF.

Indication/consequence to pilot if lost: Unable to turn off fuel flow proportioner.

15.14.1.35 Fire Overheat Detector

Purpose: Powers the fire detector controller and engine fire warning circuit.

Indication/consequence to pilot if lost: Loss of engine fire warnings (visual and aural).

15.14.1.36 EMS

Purpose: Powers the engine monitoring unit, P3 pressure transducer and EMU incident recorder.

Indication/consequence to pilot if lost: Loss of the HUD power margin indicator.

15.14.1.37 EFC BIT

Purpose: Powers DECU BIT.

Indication/consequence to pilot if lost: No indication or consequence to pilot. Maintenance personnel would be unable to perform DECU BIT check.

15.14.1.38 EFC 2

Purpose: Powers DECU 2 and, through a diode arrangement, also powers DECU 1 if switched battery bus power is lost.

Indication/consequence to pilot if lost: No indication to pilot. The selected DECU will continue to perform EFC functions via the switched battery bus and backup DC power source to lane 2 DECU provided by permanent magnet alternator on 4080-B EVICS engines.

15.14.1.39 JPT Limiter

Purpose: Powers JPTL switch and JPTL system.

Indication/consequence to pilot if lost: Loss of the DECS automatic jet pipe temperature limiting feature (same as tripping JPTL switch on throttle quadrant) will limit the engine to short lift wet speed datum with no JPT limiting (the lower of 120 percent indicated or 116.8 percent corrected regardless of JPT).

15.14.1.40 GTS Power

Purpose: Powers the GTS/APU digital control unit.

Indication/consequence to pilot if lost: Unable to start GTS/APU.

15.14.1.41 Engine Display Panel

Purpose: Powers the engine performance indicator (EPI).

Indication/consequence to pilot if lost: All EPI displays (fuel flow, duct PSI, stabilator position, RPM percent, JPT degrees C, H_2O remaining) will freeze. HUD display of engine performance data will disappear.

15.14.1.42 Altimeter Vibrator

Purpose: Powers vibrator in standby pressure altimeter.

Indication/consequence to pilot if lost: No indication to pilot but head down (standby) pressure altitude instrument will become inaccurate.

15.14.1.43 Attitude Gyro

Purpose: Powers vertical reference gyroscope indicator.

Indication/consequence to pilot if lost: Off flag will be displayed. Gyro inertia maintains attitude reference within ±6° for a minimum of 9 minutes after electrical power is lost.

15.14.1.44 Turn/Slip Indicator

Purpose: Powers the turn and slip indicator.

Indication/consequence to pilot if lost: Off flag will be displayed in the turn and slip indicator.

15.14.2 Alert Bus, 7 Circuits

15.14.2.1 Communication Control

Purpose: Provides 28 Vdc alert power to the V/UHF radios.

Indication/consequence to pilot if lost: Cannot control V/UHF Radios via backup control panel. Power may be regained if the battery switch is set to the ALERT position.

15.14.2.2 ACNIP Alert Power/IFF Eject Seat

Purpose: To partially power the ACNIP when the battery switch is set to ALERT position and power the ejection seat IFF Switch which zeroizes KY and KIT and sets the IFF to the eject mode.

Indication/consequence to pilot if lost: No audio in headset. No audible warnings. Loss of radio communications. On ejection, IFF will not transmit distress code 7700 on mode 3A; mode 4A and 4B secure codes will not be zeroized. Power may be regained if the battery switch is set to the ALERT position.

15.14.2.3 Voltage Indicator

Purpose: Provides a path for the alert and emergency DC bus voltage to be displayed on the DC voltmeter.

Indication/consequence to pilot if lost: The voltmeter will read zero volts (full left deflection) when the DC test switch is in normal (center) position and the battery switch is set to BATT but will read battery voltage when the battery switch is set to ALERT.

15.14.2.4 Utility Kneeboard Light

Purpose: Powers the left utility floodlight, utility floodlight and kneeboard light.

Indication/consequence to pilot if lost: The left utility floodlight, utility floodlight and kneeboard light are off and cannot be turned on.

15.14.2.5 UHF/VHF Receive/Transmitter No. 1 and 2

Purpose: Powers both UHF/VHF receiver/transmitters.

Indication/consequence to pilot if lost: Unable to communicate via COMM 1 or COMM 2.

15.14.2.6 Communication Control

Purpose: Energizes COMM 1 and COMM 2 ON/OFF relays. Powers KY-58 NO.1, KY-58 NO.2 and the antenna selector switch.

Indication/consequence to pilot if lost: Loss of secure radio communications. Unable to select UHF antenna.

A short or wire fire could lead to initial indications of an emergency DC bus failure only to turn into a much larger emergency as failures develop. There are emergency procedures for other types of electrical emergencies to include total electrical failure and dual DECS failure. The emergency DC bus failure procedure is focused on some type of disconnect or breakage between the power source and the emergency DC bus. There are multiple terminal lugs, contactors, and wires where a break can occur; it would be impossible to define every possible failure and indication in this manual. If a breakage occurs between an operating power source and the emergency DC bus, the pilot has options to change the power source supplying power to the emergency DC bus. A thorough understanding of the system as described in paragraph 2.10 (Electrical Power Supply System) and this emergency procedure discussion is necessary for a pilot to cope with this type of failure.

15.14.3 Failure Analysis

If an emergency DC bus failure occurs the pilot should immediately set the DC test switch to STBY.

If power is regained with DC test switch set to STBY, there is a failed connection between the main TRU output and the emergency DC bus contactor. In this case the main TRU is operating correctly therefore the relays are operating to supply power to the emergency DC bus from the main TRU. However, emergency DC bus is not working because of the failed connection. By selecting STBY on the DC test switch the system is removing main TRU output power from the DC emergency bus and connecting standby TRU output power. Once the standby TRU takes over as the aircraft’s emergency DC bus power supply, certain relays open and others close providing power to the DC emergency bus. As long as the DC test switch remains in the STBY position, all components that were previously lost will work correctly to include vital systems like fuel quantity, fuel dump, communications and normal gear operation.

If power is not regained with DC test switch set to STBY, the DC test switch should be set to MAIN. In this case the emergency DC bus contractor has failed. The main TRU and the standby TRU are operating correctly but the failed contactor is preventing DC power from reaching the emergency DC bus. To recover, aircraft battery power must be connected to the emergency DC bus by de-energizing the standby TRU contactor. Setting the DC test switch to MAIN will deenergize the standby TRU contactor but, depending on battery state-of-charge, it will take two to three minutes. The standby TRU contactor will remain energized until battery voltage discharges to about 24.5 volts. When the DC test switch is set to MAIN, a valid battery voltage indication will appear on the BATT VOLTS indicator and this voltage must be monitored.

If power is regained, with DC test switch set to MAIN and battery discharge to about 24.5 volts, the emergency DC bus is being powered by the battery and its rate of discharge will increase. Only 15 or 20 minutes will be available for lowering landing gear, communicating, jettisoning stores, dumping fuel etc. before the battery discharges to 16 volts and must be recharged. The battery can be recharged by setting the DC test switch to the center position for a few minutes then returning it to MAIN. Power to the emergency DC bus is lost while the DC test switch is in the center position (BATT VOLTS will read zero) but restored in MAIN after battery discharges to about 24.5 volts.

If power is not regained with DC test switch set to MAIN and battery discharged to less than 24 volts, multiple DC power system failures have occurred and power cannot be regained. Set the DC test switch to the center position. The pilot will have to estimate fuel state and perform the LANDING GEAR UNSAFE/FAILS TO EXTEND procedures in proper sequence to include using the landing gear emergency battery.

15.14.4 Discussion

If using the previously mentioned methods to regain power to the emergency DC bus fail, and communications are required, a pilot may select the ALERT position of the battery. When selecting ALERT, the emergency DC bus is bypassed and the battery is connected directly to the alert bus.

If an emergency DC bus failure is experienced and the battery switch is in BATT, the battery voltage will always read ZERO. The voltage readout on the gauge is supplied through the emergency DC bus while in the BATT position. Moving the battery switch to ALERT will give a true reading of battery voltage. If the ALERT position is used it is important to monitor the voltmeter and periodically return the battery switch to the BATT position to recharge the battery.

Inability to communicate will be the first indication that something is wrong. If the radios have failed, look at the HYD and Brake Pressure indications. They will read ZERO with barber poles. The HUD will be missing RPM, JPT and PMI indications. Battery voltage will read ZERO. If a lights test is performed and the warning, caution and advisory lights are inoperative, the emergency DC bus failure is confirmed.

15.14.5 Emergency DC Bus Failure Procedures

Initial evidence of an EMERGENCY DC BUS failure is indicated by the following:

1. Loss of communications.
2. Loss of hydraulic pressure indications (barber pole) — READS ZERO.
3. Loss of brake pressure indications (barber pole) — READS ZERO.
4. Loss of warning, caution and advisory lights (confirm with lights test).
5. Loss of fuel flow indications.
6. Loss of fuel quantity indications — Fuel quantity displayed will not be valid/current. Fuel quantity indication will be frozen at amount when failure occurred.
7. Loss of RPM, JPT and PMI indications in HUD.
8. Stabilator Trim INOP.
9. Yaw SAS INOP.

If emergency DC bus failure suspected:

If above 10,000 feet cabin pressure.

*1. Emergency oxygen actuator — PULL.

*2. Descend below 10,000 feet cabin pressure.

WARNING

Activating emergency oxygen with an emergency dc bus failure does not guarantee flow of 100 percent emergency oxygen to the mask. Failure to achieve 10,000 feet cabin pressure altitude immediately increases the possibility of hypoxia.

With emergency oxygen activated or below 10,000 feet cabin pressure:

*3. DC test switch — SET TO STBY.

If power is regained:

4. DC test switch — LEAVE IN STBY

5. Land as soon as practical.

If power is not regained:

*6. DC test switch — SET TO MAIN.

7. BATT VOLTS indicator — VOLTS slowly decreases to 24. (two to three minutes)

If power is regained:

8. DC test switch — LEAVE IN MAIN.

9. Land as soon as practical. If required, battery can be recharged by temporarily setting DC TEST switch to the center position.

If power is not regained:

10. DC test switch — SET TO CENTER POSITION.

11. FUEL state — begin to calculate elapsed time for fuel quantity. Fuel quantity displayed will not be valid/current. Fuel quantity indication will be frozen at amount when failure occurred.

If radio communication required:

12. Battery switch — ALERT to restore communications.

Note

When battery switch is in BATT voltage will read zero.

Prior to voltmeter reaching 16V:

13. Battery switch — BATT to charge batteries. Return to ALERT for communication as required.

Prior to landing:

14. LANDING GEAR UNSAFE/FAILS TO EXTEND procedures — PERFORM.

Note

Landing gear indication lights and the approach light are inoperative. TAV-8B only will have landing gear indication lights but no approach light.

When prepared to land:

15. Land as soon as practical using a gentle VL if possible.

CAUTION

No antiskid. No JPT or RPM indications.

If unable to perform VL:

16. Land as slow as possible using a minimum rate of descent.

CAUTION

The canopy seal will not deflate quickly. If rapid egress is required the emergency canopy shattering handle may be required.

15.15 OUT-OF-CONTROL

15.15.1 Jetborne/Semi-Jetborne

Out-of-Control Recovery. Always reduce angle of attack by placing the stick forward. Further, reducing the nozzle angle will reduce AOA due to a decrease in down wash on the tail plane thus reducing nose up pitching moment. The initial rudder requirement to bring the aircraft nose into the relative wind will be in the same direction as the required aileron (i.e., right aileron right rudder, left aileron left rudder). Do not overcontrol as this can cause sideslip and bank angle to diverge in the opposite direction. The primary piloting cue during recovery is lateral response to aileron. If lateral response to recovery control is normal, vary control inputs as required to maintain wings level and minimize sideslip. If lateral response is not immediate when recovery control is applied, ejection may be the only alternative.

Note

This procedure is designed to counter high AOA, uncontrolled nose up pitch and roll due to sideslip at high angles of attack and will provide the pilot with the best possible reaction to loss of control while in semi-jetborne flight near the ground (landing pattern), where the reaction should be immediate and positive to regain roll control.

*1. Stick — FORWARD.

*2. Throttle — FULL.

An increase in rpm will increase the reaction control duct pressure and thus the control available. In addition, the increased thrust will reduce AOA even without attitude change due to the flight path change.

*3. Stick — AGAINST ROLL.

*4. Rudder — AGAINST SIDESLIP.

Note

Steps 1 through 4 should be applied simultaneously but the priority is in the order shown.

If AOA not recovered and time and altitude permit:

*5. Nozzles — REDUCE 20 DEGREES.

When AOA recovered:

*6. Nozzles — AS REQUIRED.

15.15.2 Out of Control/Spin/Falling Leaf Recovery

Neutral controls are defined as zero degree rudder, zero degree aileron, and zero degree stabilator. The pilot can confirm neutral controls by centering the rudder pedals, centering the stick laterally and fore-aft in the cockpit, and by checking the stab position indicator on the engine display panel at zero degrees.

Unexpected g-forces during OCF can make it difficult for the pilot to operate flight controls and view cockpit instruments. A locked shoulder harness assists the lap restraints with keeping the pilot in a proper position in the ejections seat under these g-forces. Consideration should be given to locking the shoulder harness prior to non-tactical maneuvering (i.e. intentional departures, practice TVC drills, approach to stalls, FCF DEP RES checks) where OCF may be encountered. For the same reason, the shoulder harness should be selected to the locked position (if not already locked) if an aircraft departure is encountered. However, completion of the first three boldface procedures takes precedence over locking the harness.

*1. Controls — NEUTRAL.

*2. Throttle — IDLE/OFF IF COMPRESSOR LOCKED IN STALL.

CAUTION

If throttle is not promptly retarded to idle at first indication of departure, engine fan rub requiring engine removal is possible.

*3. Nozzles — AFT.

WARNING

Rapid nozzle movement during the early phase of a departure may aggravate the departure and/or result in more violent post-stall gyrations. Nozzles should be moved aft smoothly (at a rate equivalent to from hover stop to fully aft in three to five seconds).

If spin positively confirmed after 2 turns with neutral controls:

*4. Rudder — FULL OPPOSITE SPIN DIRECTION.

*5. Aileron — FULL WITH SPIN IF UPRIGHT, NEUTRAL IF INVERTED.

If Falling Leaf positively confirmed after 5 seconds with neutral controls (TAV-8B and Radar aircraft only):

*6. Stick — FULL FORWARD.

When recovered:

*7. Initiate airstart (if required).

*8. Nozzles — AFT.

If still out-of-control below 10,000 feet AGL:

*9. EJECT.

15.16 FUEL CONTROL

15.16.1 EFC CAUTION AND JPTL WARNING LIGHTS ON

1. DECS enable switch — CHECK ON.

If lights extinguish:

2. The mission may be continued at the discretion of the pilot in command.

If lights do not extinguish:

3. Execute SINGLE DECU FAILURE procedures or select MFS and perform MFS RECOVERY procedures.

Note

The Caution light takes precedence over the JPTL Warning and the SINGLE DECU FAILURE procedures are to be executed.

15.16.2 SINGLE DECS FAILURE (EFC CAUTION LIGHT)

1. Do not change lanes.

2. Land as soon as practical.

CAUTION

The EFC switch should not be repositioned during an in-flight DECU failure. This could erroneously reset a failed DECU.

15.16.3 DUAL DECS FAILURE (EFC WARNING LIGHT)

Loss of engine control can be caused by a malfunction within the engine fuel control systems or a throttle linkage failure. Probable failure modes within the current -408B configuration that may result in dual DECS Failure include noise detected on fan or compressor speed signals and internal FMU actuator faults. Probable faults that may result in apparent loss of throttle response without a corresponding DECS failure include: loss of P3 air signal to the FMU (power restricted), internal FMU scheduled flow reset (power restricted), IGVs failed at high angle (power restricted), IGVs failed at low angle (restricted deceleration) and throttle linkage failure. MFS selection will restore full engine control for any of the probable mechanisms responsible with the exception of IGV faults and throttle linkage failure. If the engine does not respond to throttle movement, time permitting, the engine page should be checked to verify IGV functionality before selection of MFS. In conventional flight the throttle should be set to idle to reduce the risk of compressor stall before MFS is selected.

Note

- Care should be taken not to move the throttle faster than the engine will normally accelerate when controlled by the primary fuel control system. Moving the throttle from the idle stop to the mid-throttle position in less than approximately six seconds or moving the throttle without appropriate engine rpm response greatly increases the risk of engine surge. Since the possibility of surge is greater at low rpm, throttle movement must be slowest in the lower portion of the rpm band. (Approximately 4 seconds from idle to 55 percent and 2.5 seconds from 55 percent to 100 percent).

- MFS is fuel flow limited to a maximum scheduled flow of approximately 260 pounds per minute. Selection of MFS near sea level static conditions may result in significantly less thrust than that available under DECS control depending upon engine operating conditions (bleed, water, and prevailing ambient conditions).

If loss of engine control occurs in V/STOL flight, the decision to select MFS should be made with an understanding of the expected thrust available. On aircraft with MFS battery, the MFS emergency battery provides an alternate means for manual fuel selection. The required engine power should be adjusted after MFS selection has been achieved. If the throttle has been retarded from the setting at which the failure occurred, the rpm will decrease rapidly when MFS is selected. If after selecting MFS engine control is not restored, it is an indication of a throttle linkage failure.

CAUTION

Selection of MFS with low engine rpm and high throttle lever angle position will significantly increase the likelihood of engine surge.

The EFC warning light indicates complete DECS failure has occurred. The FMU stepper motor is magnetically latched in its last commanded position. However, total scheduled fuel flow is dependent upon stepper motor position and P3 air pressure signal. Subsequently, engine power may change depending upon the last demanded stepper motor movement prior to failure. If failure occurred during a demanded acceleration or deceleration, the engine will likely continue to accelerate or decelerate as scheduled fuel flow from the FMU continues to change with changes in P3 pressure. In the extreme case, the engine may either overspeed or run down to sub-idle. If failure occurred at a steady speed setting below 35 percent fan speed, the engine may eventually either run down to sub-idle or accelerate to approximately 75 percent over a period of approximately 30 seconds with the initial change occurring slowly and increasing rapidly in the last 5 seconds. If failure occurred at a steady speed setting between 35 and 90 percent fan speed, the engine may either decelerate or accelerate depending upon the response of the FMU to small changes in spool speed and P3 pressure. The initial response will be slow, progressing rapidly through the range of 35 to 75 percent fan speed before eventually stabilizing. If failure occurred at a steady speed setting above approximately 90 percent fan speed, the engine speed will most likely remain at the level set prior to failure. In all cases, selection of MFS will be required to restore full engine control.

DECS consists of two fully independent lanes of control with minimal potential single point failures by design. Simultaneous failure of both lanes (complete DECS failure) indicates that both DECUs have either detected a fault within one of the common input signals or components, or have both lost electrical power if accompanied by a JPTL warning light. For the current -408B configuration, shared signals and components common to both lanes of DECS within which a detected fault could result in failure of both lanes include the fan and compressor speed signals and the FMU stepper motor. Selection of MFS will restore engine control.

Failure of the Variable Inlet Guide Vane System (VIGVS) will change the matching relationship between the fan and compressor, and subsequently alter the response of the DECS. For all current -408 configurations, DECS failure will not occur as a result of VIGV failure. Failure of the IGVs to the fully closed (high angle, 31 to 39 degrees) position during demanded engine acceleration will be apparent to the pilot as slow engine response with eventual engine stagnation at approximately 75 percent fan speed. Failure of the IGVs to the fully closed position at high engine speed may result in a brief fan stall, with rapid uncommanded deceleration to approximately 75 percent fan speed. In each case, initial control by the DECU in response to the IGV error will be on the HP corrected speed limiter (105 percent NH). Engine JPT will be abnormally higher in each case, and active control may shift to the JPT limiter with further reduction in available engine power occurring depending upon ambient conditions. Selection of MFS and attempted acceleration above approximately 75 percent NF will result in engine compressor stall. Failure of the IGVs to the fully open (low angle, 0 to -4 degrees) position at high power settings will be apparent to the pilot as an inability to decelerate the engine below approximately 70 percent fan speed. Selection of MFS and attempted deceleration below approximately 70 percent will result in engine stall and flameout with little chance for recovery.

Throttle linkage failure may occur at any point within the throttle system. Most probable points of failure include the throttle cable, the interface connection between the throttle cable and engine control system and the linkage attachment point at the FMU. The engine response to throttle linkage failure depends upon the point of failure. Failure at any point between the throttle quadrant and input connection to the engine control system Pilots Lever Angle Unit (PLAU) will result in complete loss of input to the engine control system including MFS. In this case, failure will be apparent to the pilot as a complete lack of response to throttle input, with potential for uncommanded changes in engine speed which occur with changing altitude and airspeed. Failure of the interface connection between the PLAU and FMU shut-off valve will result in loss of physical control of the shut-off valve and create the potential for linkage jamming. The unrestrained shut-off valve may assume any position from off to fully open under the action of internal hydraulic forces. Under DECS control, provided that the shut-off valve remains at any position greater than approximately IDLE, full engine control will be available. Under MFS engine power available will change with movement of the unrestrained shut-off valve.

WARNING

If throttle linkage fails, the fuel control can assume any position from OFF to FULL and may not remain stable at any power setting.

In V/STOL flight (Takeoff/Approach/and Landing):

Time Critical.

*1. MFS — SELECT.

Note

On aircraft after AFC-328, the MFS emergency battery provides an alternate means of manual fuel selection.

*2. Water switch — OFF.

If rpm does not recover:

3. EJECT.

WARNING

The ejection decision must be timely. The development of a high sink rate can prevent a successful ejection.

In Conventional Flight:

*1. Throttle — IDLE.

WARNING

DECUs will prevent rpm reduction below 70 percent with IGVs failed at low angles. Selection of manual fuel with throttle at idle will result in engine surge with little chance of recovery. Time permitting, verify IGV position commensurate with engine speed prior to selection of MFS.

*2. MFS — SELECT.

*3. Throttle — ADVANCE SLOWLY.

If unable to select MFS and sufficient power not available:

*4. EFC switch — CHANGE LANE.

If available power insufficient for recovery:

5. EJECT.

If MFS fails to restore control but sufficient power available:

Note

If MFS achieved, throttle linkage failed, or MFS fuel valve position constant, rpm will increase approximately 1 percent per 1,000 feet altitude gain and decrease by approximately 1 percent per 1,000 feet altitude lost.

Note

If MFS not achieved and DECS frozen, the rpm will increase in a descent at constant Mach number and decrease during deceleration at constant altitude. A descent from high altitude cruise to pattern altitude and speed can result in a loss of rpm of up to 5 percent. As nozzles are selected and as bleed is demanded, rpm will decrease. If the initial rpm prior to nozzle selection is at 80 percent or below, the effect of bleed may run the engine to a sub-idle condition. At higher initial rpm and with maximum bleed the reduction in rpm may be up to 20 percent.

6. Cautiously use nozzles to control airspeed.

7. Flaps — AUTO.

8. Land as soon as practical.

After landing:

9. Use power nozzle braking as required.

10. Throttle — OFF.

11. Fuel shutoff handle — OFF.

15.17 MINOR RPM FLUCTUATION

For the current configuration of engine control system, the most probable causes for minor fluctuations in engine speed are associated with excessive wear in the interface connection between the Pilots Lever Angle Unit (PLAU) input lever and aircraft throttle linkage system, excessive wear in the aircraft throttle linkage system inboard transverse shaft assembly, and instability or fluctuation in VIGV position driving changes in high pressure spool speed. In each case, fluctuations of up to 3 percent NF may be apparent near sea level conditions, and may become larger with increasing altitude with no corresponding engine control system cautions or warnings. Typically, fluctuations resulting from excessive wear in the throttle system are on the order of 1 percent NF, and are throttle position dependent. Therefore, reducing throttle position may eliminate the fluctuation. If necessary, selection of MFS may also reduce or eliminate the fluctuation due to the differences in throttle system interface and stiffness between primary and backup control. Fluctuations driven by instability or fluctuation in VIGV position will be most likely in the upper speed range operating near zero degrees VIGV position where aerodynamic loads on the VIGVs are low. In this case, engine stall may become more likely in MFS. In all cases, if the engine fluctuations are not detrimental to aircraft control, retaining DECS control of the engine is preferable to MFS operation.

In conventional flight:

1. Throttle — REDUCE.

If fluctuation continues:

2. Throttle — IDLE.
3. Verify IGV angle (time permitting).

If IGVs commensurate with throttle setting:

4. MFS — SELECT.
5. Throttle — ADVANCE SLOWLY.
6. Land as soon as practical.

15.18 MFS RECOVERY

WARNING

Maximum throttle position in MFS will provide approximately 111.0 percent corrected fan speed versus the 116.8 percent corrected fan speed limitation provided under DECS control. Actual mechanical speed and thrust achieved in MFS will vary with ambient conditions. RCS bleed, and water injection usage. Anticipate maximum achievable MFS performance with nozzles at 10 degrees and neutral flight controls equal to or slightly less than short lift dry performance under DECS control when operating near sea level static conditions. Increase in RCS bleed or use of water injection will reduce maximum speed and thrust available.

CAUTION

If the engine RPM goes sub-idle, the generator falls off line and consequently NWS is hot, antiskid is off, and external lights are out.

1. Throttle — SMOOTHLY ADJUST (NO SLAMS) TO REMAIN WITHIN NORMAL LIMITS.
2. Climbs — LIMIT TO 90 percent (-406 engine) OR 100 percent (-408 engine) FOR SAFETY MARGIN.

3. Recommend straight in approach. Any type landing may be performed:

   a. If runway available — VNSL (rpm 80 to 95 percent).

   b. If VL essential — VL.

   Reduce aircraft weight to minimum practical and perform a smooth throttle deceleration.

4. PNB — ONLY IF REQUIRED USING SLOW SMOOTH THROTTLE MOVEMENT.

5. Throttle — IDLE, MAINTAIN IDLE RPM LIMITS.

Note

- For MFS recovery, consideration should be given to dumping fuel and water to reduce landing airspeed.
- Inflight, once manual fuel has been selected, it should not normally be deselected.

15.19 COMPRESSOR STALL

If the pilot experiences a loud bang with falling rpm and steady/rising JPT, compressor stall is likely. This is usually a result of a combination of high AOA, low airspeed, and high power settings. At first indications of compressor stall, the throttle should immediately be brought to idle to prevent a locked in stall. Monitor JPT closely. If the stall does not clear, the JPT will rise rapidly and the engine will overtemp unless the throttle is immediately placed OFF. Due to the possibility of structural damage, a VNSL is recommended.

*1. Throttle — IDLE.

*2. AOA — REDUCE TO LEVEL FLIGHT AOA.

If JPT continues to rise; before 590 °C:

*3. Throttle — OFF.

4. Emergency oxygen actuator — PULL.

5. Initiate airstart.

If time and altitude permit following a successful airstart:

6. Slowly advance power and monitor engine page for proper IGV operation.

7. If IGV angle does not decrease as rpm increases, execute IGV failure procedure.

15.20 ENGINE MECHANICAL FAILURE/ENGINE VIBRATION

If the pilot experiences a bang or bangs without a high AOA, low airspeed, and high power setting condition, or if other indications accompany the bang or bangs, mechanical failure is likely. These other indications could include any or all of the following: loss of rpm or seizure, vibration possibly accompanied by ENG EXC caution, increased JPT, loss of thrust, and sparks from the hot nozzles. Vibrations that are specifically felt in the rudder pedals may be the result of the radar slamming against the stops and may be eliminated by turning the radar to STBY or OFF.

Inflight.

If engine flames out or surges:

1. Follow compressor stall procedures.

If engine continues to run:

2. Follow oil system failure (OIL caution light) procedures.

CAUTION

If the engine is still running, establish a constant rpm setting (75 to 85 percent -406 engine, 80 to 85 percent -408 engine is recommended). Unnecessary movement of the throttle may increase the likelihood of engine failure.

On ground.

1. Throttle — OFF.

2. Fuel shutoff handle — OFF.

15.21 IGV FAILURE

The IGVs may be visualized as a valve controlling corrected air mass flow into the high pressure compressor. Complete failure of the variable inlet guide vane system will change the matching relationship between the fan and compressor, and subsequently alter the response of the DECS. Potential failure modes for the current configuration of engine and engine control system include failure of the IGV control system and binding/jamming of the IGV linkage or operating mechanism. In the event of a complete EVICS failure the IGV will proceed to the fully closed position (high angle, 31 to 39 degrees), resulting in limited available thrust. In this case, follow procedure for IGV Failure - Stuck at High Angle. In the event of an inlet guide vane failure in non -408B equipped aircraft, the IGVCU may freeze the vanes or command them to either the fully open or fully closed position. In the event of binding/jamming of the IGV linkage or operating mechanism, the IGVs may remain either fixed or restricted in range of travel.

IGVs failed at a high angle during attempted engine acceleration from low speeds will result in a slow engine response with eventual engine stagnation at approximately 75 percent fan speed. Failure of the VIGV system to the fully closed position (high angle) at high engine speed may result in a brief fan stall, with rapid uncommanded deceleration to approximately 75 percent fan speed. In each case, initial active control by the DECU in response to the VIGV error will be on the high pressure compressor corrected speed limiter (105 percent NH). Thrust available will be degraded. Engine JPT, fuel flow rate and high pressure compressor speed will all be abnormally high. In high ambient temperatures, active DECU control may eventually shift from RPM limiting to JPT limiting with further reduction in available engine power occurring to maintain selected short lift datum. In this case, selecting the JPTL switch to OFF may restore available thrust back to that initially available on the corrected high pressure compressor speed limiter without compromising stall margin. Selection of water will increase the JPT limiting datum to short lift wet; however, water flow may compromise engine stall margin making engine stall more likely and is therefore not recommended. Selection of MFS and attempted acceleration above approximately 75 percent fan speed will result in engine compressor stall.

IGVs failed at a low angle position (0 to -4 degrees) at high power settings will be apparent to the pilot as abnormal throttle response and inability to decelerate the engine below approximately 70 percent fan speed. Active control by the DECU in response to the VIGV error will minimize potential for flameout. Sustained operation below approximately 80 percent fan speed with IGVs failed open may result in catastrophic failure of the engine. Selection of MFS and attempted deceleration below approximately 70 percent will result in engine stall and flameout with little chance for recovery.

For the current configuration of engine and engine control systems, the engine will be better protected during IGV failure in DECS control with the JPTL switch ON and water injection selected OFF, rather than in MFS. If the JPTL switch is selected OFF, sustained operation at JPT values in excess of 800 degrees increases the probability of engine hot end component failure.

15.21.1 Stuck at High Angle

1. Throttle — IDLE, CHECK FOR SURGE.

2. Boost pumps — ON.

3. PROP — ON.

If locked in surge:

4. Follow compressor stall procedure.

If IGVs respond to throttle movement:

5. Land conventionally as soon as practical with cautious use of engine.

If IGVs fail to respond to throttle movement:

6. Land conventionally as soon as possible using minimum power and slow, smooth throttle movements. Do not use nozzles. Consider reducing aircraft weight by jettisoning fuel, water and stores.

WARNING

Continued operation of the engine at high JPT may result in engine failure. Use of nozzles will result in engine surge with mechanical failure likely. The risk of surge is increased during throttle movement and as rpm is increased. Use of water may result in engine surge.

Note

- If the JPTL is set OFF then ON, up to 15 seconds delay may occur before the limiter actively controls the JPT under DECS control.
- Fuel flow may be increased by 50 percent, the JPT at 70 percent may be as high as 850 °C (JPTL OFF).
- PNB is available but engine surge is highly likely.
- Do not select MFS.
- Limiters may be selected OFF to increase the available thrust if engine is JPT limited, but engine failure becomes more likely with sustained operation at high JPTs.

15.21.2 Stuck at Low Angle

1. Maintain maximum feasible power, avoid continuous operation below 80 percent rpm.

2. Perform fixed throttle variable nozzle slow landing as soon as practical.

3. Throttle — OFF (after touchdown).

Note

Do not select MFS.

15.22 LOSS OF ENGINE CONTROL INFLIGHT

In conventional flight:

*1. Menu - Engine - IGVs — MONITOR.

*2. Throttle — SLOWLY REDUCE TO IDLE.

If IGV failure indicated (stuck IGVs or wandering with constant throttle position):

*3. Execute IGV failure procedures.

If IGV failure not indicated:

*4. MFS — SELECT.

Note

RPM fluctuations due to mechanical linkage wear are easier to manage in MFS.

5. Throttle — ADVANCE SLOWLY.

6. Land as soon as practical.

15.23 AIRSTART

The manual fuel control should be used if there is time for only one airstart attempt. At low altitude, below 5,000 feet AGL, all airstart attempts should be initiated in manual fuel. If time permits, JPT should be allowed to cool below 300 °C to minimize the possibility of a hot start. If time does not permit JPT to cool below 300 °C, attempts should be initiated while windmill rpm is above 20 percent with corresponding JPT below 400 °C to reduce the probability of exceeding the starting JPT limit. Attempts made at greater than 250 KCAS within 10 seconds of shutdown from high power setting will increase the chances of a satisfactory start. Positive indications of a relight should be visible in 15 seconds; however, full power may not be available for 30 seconds or more. Time permitting, rpm and JPT should be allowed to stabilize at idle before advancing the throttle. If required, airstarts performed with deflected nozzles should be attempted above 250 KCAS to reduce the probability of hot start. Stagnant or falling rpm with JPT increasing toward 475 °C during a relight is a clear indication of a hot start and the attempt should be terminated.

If practical, when in manual fuel control, throttle advance from OFF to IDLE should be done slowly to minimize possibility of a hot start. If an airstart is made using manual fuel control, do not deselect manual fuel control. Climbs in manual fuel control at a constant throttle setting will result in approximately 1 percent rpm increase per 1,000 feet of altitude and will require continuous throttle reduction to prevent exceeding engine limits. The optimum airstart envelope is below 25,000 feet (20,000 feet manual fuel) at an airspeed between 250 and 325 knots.

If time and altitude permits multiple airstart attempts and no fuel control malfunction is suspected, airstarts with primary fuel may be made.

Considerations should be given to jettisoning external stores (see Figure 15-4) prior to executing immediate action procedures. Stores should be jettisoned in accordance with NWP 3-22.5-AV8B VOL II to provide better aerodynamic performance.

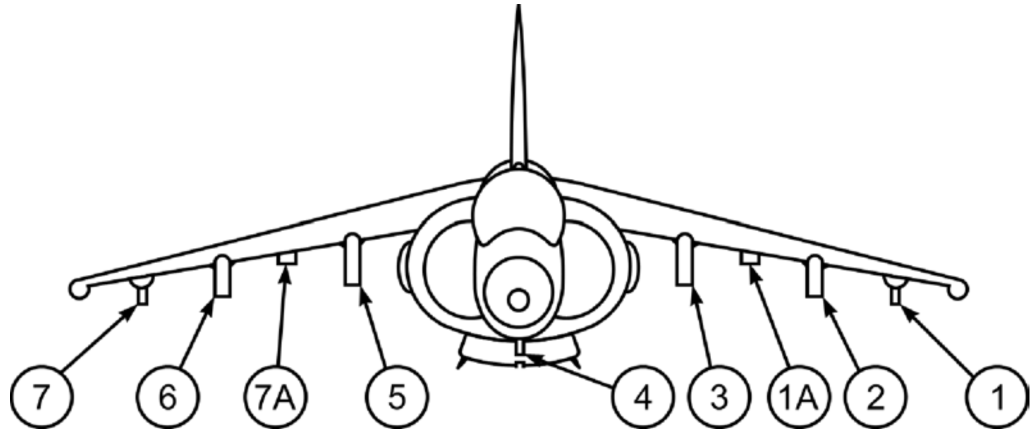
*1. Nozzles — AFT.

*2. Stores — JETTISON (if required).

*3. Throttle — OFF.

*4. Emergency oxygen actuator — PULL.

*5. MFS — AS REQUIRED.



EXTERNAL STATION(S) (STORES JETTISONED)	INTERLOCKS	JETTISON CONTROLS	JETTISON PROCEDURE
All Stations (Emergency Mode) (All stores and suspension equipment on BRU-36 bomb racks. AIM-9/AGM-122s suspended from LAU-7 launchers on stations 1, 1A, 7 and 7A are retained).	Gear handle UP or aircraft weight off wheels. 1	Emergency Jettison Button.	Emergency Jettison Button — PUSH.
All Stations (Combat Mode) (All stores and suspension equipment on BRU-36 bomb racks, except all AIM-9/AGM-122s are retained).	Gear handle UP and aircraft weight off wheels.	Selective Jettison Knob, Selective Jettison Pushbutton.	Selective Jettison Knob — CMBT. Selective Jettison Pushbutton — PUSH.
2, 3, 5, 6 (Fuel Tank Mode) (Fuel tanks dropped in pairs from 2 and 6, then 3 and 5).	Same as above.	Selective Jettison Knob, Selective Jettison Pushbutton.	Selective jettison Knob — FUEL. Station Select Buttons — PRESS. APPROPRIATE BUTTON(S). Selective Jettison Pushbutton — PUSH.
(Station Mode) All Selected Stations 1, 2, 3, 4, 5, 6, and/or 7 (All stores, including suspension equipment on BRU-36 bomb racks. AIM-9/AGM-122s suspended from LAU-7 launchers on stations 1, 1A, 7 and 7A are retained).	Same as above.	Selective Jettison Knob, Station Select Buttons, Selective Jettison Pushbutton.	Selective Jettison Knob — STA. Station Select Buttons — PRESS. APPROPRIATE BUTTON(S). Selective Jettison Pushbutton — PUSH.
(Stores Mode) All Selected Stations 1, 2, 3, 4, 5, 6, and/or 7 (All stores and suspension equipment on BRU-36 bomb racks except: stores mounted on ITERs are jettisoned while retaining ITERs. AIM-9/AGM-122s suspended from LAU-7 launchers on stations 1, 1A, 7 and 7A, are retained).	Same as above.	Selective Jettison knob, Station Select Buttons, Selective Jettison Pushbutton.	Select Jettison — STOR. Station Select Buttons — PRESS. APPROPRIATE BUTTON(S). Selective Jettison Pushbutton — PUSH.

1 A weight-on-wheels failure will inhibit jettison and prevent raising the gear handle. Emergency jettison can be enabled by using the DN LOCK OVRD to raise the gear.

2. On Day Attack/TAV-8B aircraft, if emergency jettison is selected in A/G master mode with a weapon selected SMS lock up will result. The weapons will be jettisoned, but weapon inhibit symbology will appear in the HUD and WPN FAIL will be displayed on DDI. The STRS page will not show cleared and VRST calculations will be affected. Selection of other master modes will not be possible until DSL-1 on the ACP is selected by rotating MAN knob from NORM to N/T and selecting NAV or VSTOL master mode.

Figure 15-4. External Stores Jettison Chart

*6. Airstart button — PRESS AND HOLD.

*7. Throttle — ADVANCE SLOWLY TO IDLE.

*8. JPT — MONITOR (475 °C MAX).

WARNING

Do not continue airstart attempts below safe ejection altitude.

15.24 OIL SYSTEM FAILURE (OIL CAUTION LIGHT)

Operation of the engine with an oil system failure requires that the pilot ensure minimum loads are maintained on the engine bearings. Set the minimum practical rpm within the band 75 to 85 percent (-406 engine) or 80 to 85 percent (-408 engine) and maintain it constant with slow smooth throttle movement. Minimize the g loading and land as soon as possible using a VNSL. Use nozzle braking if required, ensuring smooth throttle movements and be prepared for engine failure. Set throttle off as soon as practical after landing. Nozzles, speedbrake, flaps and landing gear may be used to control airspeed. If a vertical landing is the only option, use throttle slowly and progressively and be prepared for engine failure.

*1. Throttle — MAINTAIN CONSTANT RPM.

   a. 75 percent - 85 percent RPM (-406 engine).

   b. 80 percent - 85 percent RPM (-408 engine).

15.25 NOZZLE DRIVE FAILURE

A nozzle drive failure will affect a single nozzle or either the front or rear nozzles, and will cause either a roll or pitch as the nozzles are rotated. In either case, attempt to match the operating nozzles with the failed nozzle(s) and make a fixed nozzle slow landing. The nozzle position indicator in the cockpit reads forward nozzle position only.

15.26 NOZZLE CONTROL FAILURE

Exact technique to be used in event of nozzle control failure depends on the position at which the nozzles are failed and the phase of flight in which they fail. The following procedures provide a general guide which may require modification due to the circumstances of a specific failure.

15.26.1 During STO

If not enough runway remains for either abort or CTO:

1. EJECT.

15.26.2 During Transition

1. Set nozzle lever to angle shown on indicator.
2. Lighten aircraft to HOVER weight (if feasible).
3. Make landing consistent with nozzle angle.
4. Be prepared for possible uncommanded nozzle rotation on approach.
5. Throttle — OFF WHEN STOPPED.

With nozzle in braking position:

6. Accelerate to 50 knots.

7. Flare to hover attitude.

8. Touchdown before airspeed falls to zero.

9. Throttle — OFF WHEN STOPPED.

15.26.3 During Conventional Flight

1. Maintain 300 knots minimum until hover weight is reached.

15.27 ENGINE FIRE (FIRE WARNING LIGHT)

The first indication of fire is normally illumination of the FIRE warning light. If the FIRE warning light comes on during ground operations or flight operations where an immediate landing can be accomplished, i.e., short final, or vertical operations, the aircraft should be stopped and secured using the Engine Fire emergency procedures. If the aircraft is airborne or in a position where an abort or immediate landing is not possible, the in-flight fire procedure should be followed.

There are three possible sources of ignition in an engine bay fire: the RCS system, the GTS/APU, and the engine. If the nozzles are down, they should be placed aft as soon as conditions allow. This means rapid acceleration to wingborne flight if in the jetborne/semi-jetborne flight region and an immediate landing is not possible. The GTS/APU should be secured, if it is operating, to eliminate it as the fire source. The throttle should be pulled to the minimum power required for safe flight. This could be IDLE or MAX power depending on whether you are at 20,000 feet or on the deck in an accelerating transition. If the engine air valve is open (only applicable to an aircraft with a fuselage gun on board) it should be closed by deselecting gun and placing the master arm switch to SAFE. The gun will be deselected by switching to NAV or V/STOL master mode. Even with the gun deselected, it is still necessary to secure Master Arm switch in order to close the engine air valve.

The engine air valve is open if a gun is present AND any of the following are true:

1. Master Arm — ON.

2. A/G Master Mode and gun selected (Master Arm OFF or ON).

3. A/A Gun selected (Master Arm OFF or ON).

For these reasons the Master Arm must be selected OFF and the gun (either A/G or A/A) must be deselected to secure the valve.

After following the first four steps of the in-flight fire procedure, check for confirmatory signs of the fire. Engine fires are normally accompanied by one or more of the following: abnormally high JPT, abnormally high or erratic fuel flow, erratic or rough engine operation, or visible flames or smoke trail. If a FIRE warning light persists with no other signs of fire, use minimum power and land as soon as possible.

If required runway length is available, keep nozzles aft during landing rollout. However, due consideration must be given to the stopping distances required when PNB is not used after a conventional landing. Recommend landing as light and as slow as possible. To achieve minimum braking distance, the antiskid system operates most efficiently when the brakes are applied 2 seconds after touchdown using a quick, full pedal input held steady until taxi speed is reached. Do not cycle, pump or lightly ride the brakes.

A momentary illumination of the FIRE warning light may indicate the circuitry has burned through so the circuit should be tested by placing the COMP/LTS TEST switch to LTS TEST. If the circuit fails the test, further investigation is required.

CAUTION

Use nosewheel steering judiciously after engine shutdown. About three cycles (neutral to 3° L to 3° R and back to neutral) are available after rpm below 10 percent.

15.27.1 Ground

*1. Execute Emergency Shutdown.

15.27.2 Takeoff/Landing/Vertical Operation

*1. Abort or Land Immediately.

*2. Execute Emergency Shutdown.

15.27.3 Inflight

*1. Nozzles — AFT AS SOON AS POSSIBLE.

*2. APU GEN — OFF.

*3. MASTER ARM/GUN — OFF.

*4. Throttle — MINIMUM REQUIRED.

If fire persists:

*5. EJECT.

If light goes out:

6. Land as soon as possible.

15.28 ELECTRICAL FIRE

-406/-408A Engine:

1. MFS — SELECT.

Note

Emergency MFS battery activation may be required if unable to select MFS.

All Aircraft:

2. Generator switch — OFF.

3. Cabin pressure switch — RAM.

4. Limit airspeed as follows:

   Below 5,000 feet - 0.4 Mach.
   5,000 to 10,000 feet - 0.6 Mach.
   10,000 to 15,000 feet - 0.7 Mach.

5. All electrical equipment — OFF.

If fire persists:

6. Battery switch — OFF ECS reverts to normal with battery switch OFF.

7. Emergency oxygen actuator — PULL.

   The OBOGS will not operate with the battery switch OFF.

8. Descend below 10,000 feet cockpit altitude.

9. Land as soon as practical.

15.29 ELIMINATION OF SMOKE AND FUMES

Consider all fumes in the cockpit as toxic. Do not confuse condensation from the air conditioning system with smoke. The most probable source of visible smoke or fumes in the cockpit is from engine bleed. This smoke is blue gray in color, has a characteristic pungent odor, and may cause the eyes to sting. Another source of smoke or fumes is an electrical malfunction or overheat of equipment located in the cockpit. In the event of electrical short or overload condition, this equipment may generate electrical smoke (usually white or gray in color) but should not cause an open fire since cockpit equipment uses very little electrical current. Cockpit electrical wiring insulation may smolder and create smoke, but will not erupt into a seriously damaging fire.

1. Emergency oxygen actuator — PULL.

2. Cabin pressure switch — RAM (requires DC power).

3. Limit airspeed as follows:

   Below 5,000 feet - 0.4 Mach.
   5,000 to 10,000 feet - 0.6 Mach.
   10,000 to 15,000 feet - 0.7 Mach.

4. Descend below 10,000 feet MSL.

If unable to clear smoke:

5. Slow aircraft.

6. MDC RING — PULL (eyes closed and visor down).

15.30 CROSSFEED FAILURE (R FEED WARNING LIGHT)

On the TAV-8B the R FEED warning light indicates automatic control of the crossfeed valve has failed and the valve is in the incorrect position. Three situations can result in this warning light. In all situations, placing the Fuel Quantity Indicator to FEED and checking the fuel quantity remaining in the feed tanks will determine subsequent required actions. The fuel quantity will require monitoring.

1. R FEED warning with less than 300 pounds in the left feed tank and 300 pounds or greater in the right fuel system — set the fuel proportioner switch to RT and check the R FEED advisory light comes on and the R FEED warning light goes out.

2. R FEED warning with both feed tanks full, 300 pounds in each fuel system — set the fuel proportioner switch to DL and verify the R FEED warning and advisory lights go out.

3. R FEED warning light with both right and left feed tanks indicating less than 300 pounds — set the fuel proportioner switch to OFF and verify the R FEED warning and advisory lights go out.

15.31 FUEL TRANSFER FAILURE (L TRANS/R TRANS CAUTION LIGHT)

Fuel transfer pressure failure may occur in one or both sides of the fuel system and is indicated by the illumination of the L TRANS and/or R TRANS caution light(s). With a fuel transfer pressure failure, internal fuel will still transfer via siphon. Care must be taken not to uncover the mouth of any transfer pipe in the fuel tanks or siphon transfer will be broken. If this occurs, the feed tanks, depending on aircraft fuel state, could deplete significantly before siphon transfer can be re-established. Restrict altitude to 30,000 feet to prevent the possibility of fuel cavitation due to low tank pressures. Do not maneuver excessively or exceed 5,000 feet/minute rate-of-descent to minimize negative pressures in the tanks and to avoid the possibility of uncovering the tank transfer pipes.

With a transfer pressure failure, the feed tank fuel quantities should be monitored closely. If the quantity gauge on the affected side indicates a steady reading of approximately 300 pounds, transfer is taking place. If the quantity gauge shows a continuing decrease and fuel is in the transfer tanks, transfer has ceased. If both feed tanks are decreasing after following checklist procedures, an immediate landing will be necessary due to fuel shortage.

If an external tank stops transferring fuel to the wing, transfer pressure is lost to that associated feed group. Transfer from the wing tank to the next tanks downstream will continue but pressure in the internal wing tank will decrease as fuel is consumed and the L TRANS or R TRANS caution light will eventually come on.

Transfer from the external tank may resume as the pressure in the wing tank decreases. If this does not occur, an attempt to reestablish transfer from the external tank can be made after the wing tank is empty by opening the fuel dump switch on the appropriate side. The dump switch must be held in the DUMP position. This will create an increased pressure differential between the external tank and wing, increasing the potential for fuel transfer. When fuel starts dumping from the dump mast, terminate dumping and check fuel gauges for continued transfer. If transfer is not sustained, repeat the procedure until transfer is established or the external tanks are empty.

If fuel does not transfer from the external tank with the dump valve open, close the dump valve. Leaving the fuel dump valve open for a prolonged period may result in a wing overtemperature condition.

Fuel jettison rates with transfer pressure failure will be slower than normal. If range is critical, jettison the failed side external tank. With the fuel selector switch set to TOTAL, monitor fuel quantity for asymmetry. Follow asymmetric landing procedures if wing fuel out-of-balance exceeds 250 pounds or if otherwise required.

WARNING

Only 250 pounds of fuel or less is available from the feed tank associated with the flashing FUEL caution. The engine will flameout when either feed tank empties while the fuel flow proportioner is ON.

15.32 FUEL LOW LEVEL (L FUEL/R FUEL CAUTION LIGHT(S) FLASHING)

A flashing L FUEL or R FUEL caution light indicates the respective feed tank fuel level is 250 ±50 pounds. If this light flashes when there is more than 300 pounds in the corresponding fuel group, the vapor release valve may have failed closed allowing a high pressure air bubble to form and stop fuel transfer. Place the fuel quantity indicator switch to FEED and check the feed tank fuel status. If the fuel level is low, apply negative and positive g's in an attempt to free the vapor release valve. If the fault persists, switch off the flow proportioner and failed side boost pump. If range is critical, the boost pump can be turned on to use available feed tank fuel. If range is not critical, leave the failed side boost pump off to conserve its fuel for landing. Place the quantity indicator switch to TOTAL to monitor fuel asymmetry. Follow asymmetric landing procedures if wing fuel out-of-balance exceeds 250 pounds or otherwise required.

WARNING

Only 250 pounds of fuel or less is available from the feed tank associated with the flashing FUEL caution. The engine will flameout when either feed tank empties while the fuel flow proportioner is ON.

15.33 EXTERNAL FUEL TANK TRANSFER FAILURE

1. Wing tank (failed side) — BURN USABLE FUEL.
2. Dump switch (failed side) — DUMP (hold if necessary).

CAUTION

Do not leave dump switch in DUMP for an extended period if fuel fails to transfer from external tank.

When fuel starts to dump from dump mast:

3. Dump switch — NORM.
4. Fuel quantity indicator — MONITOR FOR TRANSFER INDICATION.
5. Repeat procedure, as required, to use external fuel.

If fuel does not transfer from external fuel tank:

6. Balance internal wing tank fuel to minimize asymmetry for landing.

15.34 FUEL LEAK

1. Minimize maneuvering.
2. Air refueling switch — OUT.
3. Boost pumps — OFF.
4. Fuel flow proportioner — OFF.
5. Execute Inflight Fire procedure.

Note

Excessive maneuvering may discontinue fuel syphoning and may cause fuel pooling in the bottom of the fuselage to come in contact with hot motor sections. Use of nozzles may also increase the likely hood of igniting fuel pooled in the fuselage.

15.35 AIR REFUEL PROBE FAILS TO RETRACT

1. A/R switch — CYCLE - IN.

If probe remains out:

2. Do not exceed 300 knots.

If L TRANS/R TRANS caution(s) come on:

3. A/R switch — PRESS. (With the A/R switch in PRESS, automatic fuel transfer shutdown with an L TANK/R TANK warning light is lost.)

15.36 FLAPS CHANNEL FAILURE (FLAPS 1 OR FLAPS 2 CAUTION)

For aircraft without ECP-255 R1:

A FLAPS 1 failure may result in failure of the nozzle position indicator, the HUD nozzle indication in V/STOL, and the flap position indicator. A FLAPS 2 failure may result in failure of the HUD flap indication in V/STOL. Either a FLAPS 1 or FLAPS 2 failure may result in the ailerons being commanded out of the droop position when in the STOL mode below 165 knots.

For aircraft with ECP-255 R1:

Either a FLAPS 1 or FLAPS 2 failure may result in the ailerons being commanded out of the droop position when in the STOL mode below 165 knots.

15.37 AUTO FLAP FAILURE (AUT FLP CAUTION)

An AUT FLP caution may be an indication of ADC failure.

WARNING

- When STOL flaps are selected with the AUT FLP caution on, aileron droop and flap scheduling may occur as the nozzles are rotated past 25° regardless of airspeed. At high speed, a severe nose down pitch will occur. Ensure airspeed is below 165 knots and nozzles are 25° or greater prior to selecting STOL flaps.
- With an AUT FLP caution light the LIDS fence may extend when the gear is lowered regardless of airspeed. Ensure airspeed is below 200 KCAS before lowering the landing gear.

15.38 FLAP FAILURE (FLAP WARNING LIGHT)

Beeping the flaps under certain flap system failures may result in an upward or downward movement of a single flap at a significantly higher than normal rate. Momentarily depress emergency flaps retract button and monitor flaps for increased asymmetry. If significant divergence is apparent, do not attempt further flap retraction. After landing, beep flaps up to avoid flap damage.

WARNING

Rotation of the nozzles aft with failed flaps greater than 25° can cause a severe nose down pitch due to nozzle blast impingement on flap surfaces. The nose down pitch rate can be arrested by selecting a nozzle angle greater than 40°. The aircraft must then be recovered from the nose down attitude.

Note

- In aircraft without ECP-255 R1, a dual channel failure (FLAP-1 and FLAP-2 lights on) can result in a slow flap drift. Turning the flaps power switch off will preclude further movement of the flaps.
- In aircraft with ECP-255 R1, if the FLAPS warning light is not cleared, the FLAP FAILURE, FLAP FAILURE voice warning will recur once after 15 seconds if the flaps remain greater than 25°.

15.39 UNCOMMANDED FLAP MOTION

*1. Nozzles — 40 DEGREES OR GREATER.

2. Flaps power switch — OFF.

WARNING

- Cycling flap power, mode or resetting flaps may cause large uncommanded flap transient motion.
- Uncommanded programming of the flaps greater than 25° with nozzles less than 20° will cause a severe nose down pitch rate. The extreme attitudes coupled with the negative g's of up to –2.5, as experienced by the pilot, will be extremely disorienting and make cockpit functions difficult to perform. A combination of full aft stick and rotation of the nozzles to an angle greater than 40° are required to arrest this condition.

15.40 UNCOMMANDED NOSE DOWN PITCH MOVEMENT

*1. Nozzles — 40 DEGREES OR GREATER.

WARNING

For any uncommanded nose down pitching that is not recoverable with backstick, lowering the nozzles is the only remaining option to regain control. Any delay at low altitude in lowering the nozzles, if uncommanded nose down pitching occurs, may result in loss of aircraft.

15.41 RUDDER TRIM FAILURE

1. RUD SVO circuit breaker — PULL.

Rudder trim series servo will center. Rudder trim and yaw stab aug inoperative.

15.42 AILERON OR STABILATOR TRIM FAILURE

If circuit breaker is out:

1. Applicable circuit breaker — RESET (one time only).

If circuit breaker is in:

2. Applicable circuit breaker — CYCLE.

15.43 Q-FEEL FAILURE

1. Q–FEEL switch — OFF.
2. Maintain airspeed below 500 knots/0.8 Mach.

15.44 SAS FAILURE

1. AFC — RESET.

If erroneous input occurs:

2. Paddle switch — PRESS AND HOLD.

3. Appropriate stab aug switch(es) — OFF.

4. Paddle switch — RELEASE.

15.45 FLIGHT CONTROL MALFUNCTION

Stiff or jammed flight controls can be caused by improper maintenance, FOD, structural damage, ice, binding reaction control shutter, or flight control system malfunctions. When this occurs, the SAAHS should be checked as follows:

*1. Paddle switch — PRESS AND HOLD.

If condition has cleared:

2. Appropriate stab aug switches — OFF.

3. Paddle switch — RELEASE.

4. Land as soon as practical.

If condition has not cleared (possible jammed flight controls):

*5. Transition to conventional flight.

Note

If pitch control is restricted, nozzles may be used for pitch control. If roll control is restricted, rudder may be used for lateral flight control. Trim control may still be available with jammed flight controls.

6. Land as soon as possible.

15.46 HYD 1 FAILURE (HYD 1 CAUTION LIGHT)

If HYD 1 is not restored the following services will be lost:

Normal landing gear extension.
Fuel proportioner.
Air refueling probe.
LIDS Fence.
Speed brake.
Stab aug.
AFC.
Q-feel.
Aileron droop.
Powered rudder.

15.47 HYDRAULIC SYSTEM FAILURE (HYD WARNING LIGHT)

CAUTION

Use nosewheel steering judiciously. About 3 cycles (neutral to 3° L to 3° R and back to neutral) are available following dual hydraulic system failure.

15.48 GUN NOT CLEAR

Gun not clear is indicated by a NOT CLEAR legend on the DDI store display. The NATIP, NTRP 3–22.4–AV8B contains a thorough discussion of gun operation/malfunctions.

1. Master arm switch — OFF.
2. Gun — DESELECT.

WARNING

Failure to place the master arm switch to OFF and deselect the gun can result in gun damage, gun pack overheat, and cook–off of rounds in the breech area.

Before landing:

3. Notify landing facility of Hot Gun.

After landing:

4. Proceed immediately to Hot Gun area for dearming.

CHAPTER 16

Landing Emergencies

16.1 LANDING GEAR UNSAFE/FAILS TO EXTEND

An unsafe gear indication may result from HYD 1 failure, electrical failure, airframe damage, actuator failure, or a faulty gear position indicator. With a confirmed gear malfunction, perform a VL. If required, water may be selected to gain additional performance, with or without water on-board. If performance is inadequate for a VL, perform an RVL as slow as possible. Recommend use of an LSO. The approach/hover or aux light will come on only if the main landing gear is down and locked. The nose landing gear doors will close only if the nose landing gear is down and locked. If the nose landing gear microswitch malfunctions, the nose landing gear doors may not close, but the gear may still be down and locked. On AV-8B 165354 and up, an unsafe NLG may result in lo and hi gain steering failing to centered steering mode, in which case the NWS legend on the Caution/Advisory Panel will be illuminated. If the NLG doors are open due to a T handle failure (popped) the NWS will function normally. Blowing the gear down will eliminate the steering failures. In the event the emergency gear extension system does not function, the steering failures will persist. Steering should not be selected until there is no crab angle and the aircraft has an acceptable heading.

WARNING

If ground speed is excessive, NWS may not be adequate for directional control during an RVL with a wing gear in trail.

Landing Gear Status Unknown

If one or more gear fails to indicate down:

1. Lights test switch — TEST.
   Check 4 green, 4 amber, red GEAR and gear handle lights on. If green gear down light failed with red GEAR and gear handle lights and amber in transit lights out, consider the gear down.

If lights test good:

2. Gear handle — DOWN.

If gear indicates unsafe or gear status remains unknown:

3. Landing Gear Unsafe/Fails to Extend Procedures — PERFORM.

Landing Gear Unsafe/Fails to Extend

1. Landing gear circuit breaker — CHECK IN.
   (second circuit breaker from left on bottom row)

2. Request visual check (if circumstances permit).

3. Gear handle — CYCLE.

If gear does not extend:

4. Landing Gear Emergency Extension Procedures — PERFORM.

If gear still indicates unsafe after emergency extension:

5. Fuel/Stores — JETTISON TO MINIMUM GROSS WEIGHT FOR LANDING (as required).
6. Perform gentle VL . Throttle — OFF, IF GEAR COLLAPSES.
7. Do not taxi. Install wing gear locks before engine shutdown.

If nose gear fails to extend:

8. Perform gentle VL, slowly lowering nose to ground.
9. Throttle — OFF.

Note

Nozzles angles greater than hover stop may be used to decrease attitude.

Landing Gear Emergency Extension

1. Gear handle — DOWN.
2. Landing gear circuit breaker — PULL (second circuit breaker from left on bottom row).

With Airspeed below 210 knots:

3. Gear handle — ROTATE 90° CLOCKWISE AND PULL.
   If the gear is extended by the emergency method with a HYD1 failure, the speedbrake and LIDS will not extend and VL capability will be reduced by 500 pounds. If gear handle will not move, rotate the handle 90° and pull. The gear will extend by the emergency method with the gear handle up.

If gear still does not extend:

4. LDG GEAR EMER BATT — ACTUATE.
   (after AFC-328)

16.2 BLOWN TIRE

WARNING

Directional control will probably be lost if wing gear tire fails with taxi speed above 25 knots.

1. Perform vertical landing.

If vertical landing not feasible or tire blows during landing roll:

2. ANTISKID switch — NWS (if main tire blown).
3. Use maximum nozzle braking.
4. Use nosewheel steering and reaction controls to maintain directional control.

If hot brakes suspected:

5. Do not set parking brake.

WARNING

Due to the possibility of hydraulic seal failure with hot brakes and blown main tires, a hydraulic fire may develop. Parking brake application will increase the probability of fire.

16.3 NOSEWHEEL STEERING/CASTER FAILURE

16.3.1 Before AFC-391

To determine whether the caster system or antiskid system has failed, press the NWS button. If the SKID light goes out with the button pressed, suspect a caster failure. If the light stays on with the button pressed, suspect antiskid system failure. A NWS failure can mask a caster failure.

1. ANTISKID switch — NWS.
2. Perform VL.

If unable to land vertically:

3. Minimize crab angle.
4. Perform RVL as slow as practical.

WARNING

If the nosewheel steering system is suspected of a failure (i.e. failure to respond to commands, caster failure, etc.) a vertical landing should be performed. A failure of the nosewheel steering system during a rolling landing may result in a loss of control and subsequent loss of aircraft.

Note

- A timely decision to perform a touch and go while the aircraft is still on the runway may prevent damage or loss of the aircraft.
- When nosewheel steering failure is suspected, have wingman check for motion by pressing NWS button and cycling rudder to move nosewheel.
- If necessary, use reaction controls for steering. Nozzles should be near hover stop and rpm over 50 percent.

16.3.2 After AFC-391 (Hi/Lo Gain NWS System)

Illumination of NWS light on the caution/advisory panel is an indication of a NWS system failure. NWS failure mode is ascertained by comparing the mode selected by the pilot with the mode displayed on the HUD. If CAST displayed in the HUD with ANTISKID switch ON, engaging NWS button will result in either HI gain or centered steering mode. If NWS displayed in HUD with ANTISKID switch on, caster mode has failed to LO gain NWS (“hot” NWS) and will remain in LO gain when the NWS button is engaged. The mode displayed on the HUD is the active steering mode.

INFLIGHT.

1. Perform VL.

If unable to perform VL:

2. Determine failure mode.
3. Perform RVL as slow as practical with minimum crab angle.

WARNING

If the NWS system is suspected of a failure (i.e. failure to respond to commands, etc.) a vertical landing should be performed. Failure of the NWS system during a rolling landing may result in a loss of control and subsequent loss of aircraft.

Note

When NWS failure is suspected, have wingman check for motion by pressing NWS button and cycling rudder to move nosewheel. Alternatively, nosewheel motion can be verified by pressing the NWS button, cycling rudder pedals and observing the gear centered indication on the HUD cycles between displayed and non-displayed.

TAKEOFF/LANDING ROLL OUT.

*1. Attempt to get airborne.

If unable to get airborne:

*2. Engage NWS button at minimum practical ground speed.

WARNING

If CASTdisplayed in HUD, engaging NWS button will result in either HI gain or centered steering mode. If NWS displayed in HUD, engaging NWS button may result in HI gain. Failure of the NWS system during a rolling landing may result in loss of control and subsequent loss of aircraft.

Note

A timely decision to perform a touch and go while the aircraft is still on the runway may prevent damage or loss of the aircraft.

16.4 SPEEDBRAKE FAILURE

With an electrical or hydraulic failure, airloads will close the speed brake.

If SPD BRK light on with gear down:

1. Speed brake circuit breaker — PULL.

If SPD BRK light still on:

2. Perform gentle RVL. Do not taxi.

16.5 DAMAGED AIRCRAFT

When structural damage or any other failure is known or suspected that may adversely affect aircraft handling characteristics, a controllability check should be performed as follows:

1. Proceed to a safe altitude.

Note

If conditions allow climb above 10,000 feet AGL. If unable to climb to 10,000 feet AGL it is recommended to climb to the highest feasible altitude prior to performing a controllability check.

2. Reduce gross weight to minimum practical.

3. Perform controllability check with gear down.

4. Determine if and what type of landing can be made.

If wing leading edge damage is suspected or confirmed:

Plan for an auto flap conventional landing. In the approach do not slow below 10 AOA or, in any case to an airspeed where greater than 1/2 control input, in any axis, is required to maintain control. Use a 2° to 3° approach and make shallow turn. If desired after touchdown, nozzles may be moved to the braking stop position, but power left at idle, to assist in stopping the aircraft.

If wing trailing edge damage is suspected or confirmed:

Select flaps OFF, do not beep or extend flaps in order to avoid a split. Make only shallow AOB turns, if necessary use rudder to turn aircraft. Use nozzles as required, perform a FNSL, gradually increasing nozzle angle, ensure ground speed is below 180 knots at touchdown. If certain nozzles are not damaged a VNSL may be made.

5. If adequate control available, maintain configuration and make straight-in approach.

16.6 CRUISE FLAPS LANDING

A cruise landing is basically the same as a normal VL. For a CL or SL, the landing roll will increase due to the increased airspeed at the landing AOA. The pattern should be expanded slightly. If possible, perform an SL or VL. Do not touchdown above 180 knots ground speed, if possible.

16.7 SAAHS OFF RECOVERY AND LANDING

CAUTION

During a SAAHS off recovery and landing the pilot workload will be substantially increased. Care must be taken to perform all transitions early to allow the pilot time to trim the aircraft and gain familiarity with the changing flight characteristics in the SAAHS off condition. This will also allow time to assess the environmental conditions. Excursions from balanced flight must be corrected immediately to maintain adequate control power with the reaction control system.

1. Fly a straight-in approach if possible.

If wind, runway condition, aircraft malfunction(s) allow:

2. Perform a FNSL (Select a nozzle angle that produces a 90 to 120 KCAS approach).

Note

Many aircraft malfunctions that degrade the SAAHS will also require an RVL or VL to land due to other aircraft system degradations.

If wind, runway condition, aircraft malfunction(s) or other conditions prevent performing a FNSL:

3. Perform RVL or VL (Recommend a flatter than normal approach and avoid excessive closure).

WARNING

A high, fast approach SAAHS off, especially on a decelerating transition to a VL will increase likelihood of pilot over-controlling the aircraft leading to loss of altitude awareness, AOA excursions, loss of sideslip control and a possible loss of aircraft control in close proximity to the ground.

4. Prior to touchdown — Ensure pitch attitude is maintained on the horizon; minimize yaw and roll angle.

16.8 REACTION CONTROL FAILURE

Reaction control failure may be caused by loss of RCS pressure/flow or by disconnection of an RCS shutter.

Loss of RCS pressure/flow is most often accompanied by low duct pressure and/or excessive nose-up pitch as the nozzles are lowered. During a decelerating transition, the aircraft will become increasingly sluggish in response to control inputs and, eventually, all control will be lost. Loss of RCS may indicate a bleed air duct failure which can cause a fire.

Disconnect of an RCS shutter will cause degraded control authority or loss of control in one axis during jetborne flight. A disconnect during wingborne flight will not become apparent until below 120 knots where it will appear as an increasing pitch, roll, or yaw tendency as the aircraft slows. Disconnect of the front or rear pitch shutter will probably result in a closed shutter and a lack of response from the failed shutter. The position of the yaw shutter after a disconnect is not predictable. Disconnect of a roll shutter will probably result in full up-blowing on the failed side and will be indicated by increasing opposite lateral stick required to maintain wings level as the aircraft slows.

The type of failure can be distinguished by a general degradation in control in all axes with loss of RCS pressure/flow as opposed to degradation in only one axis with an RCS shutter disconnect. Disconnect of the rear pitch shutter may, at first, appear similar to loss of RCS pressure/flow but, in this case, normal yaw and roll control is still available.

For any reaction control failure, the proper corrective action is to transition to conventional flight as fast as possible or land immediately.

WARNING

With an RCS shutter disconnect, especially with a roll shutter disconnect, abrupt application of power may cause complete loss of control with shutters down.

*1. Transition to conventional flight.

If transition to conventional flight not feasible:

2. Land immediately or eject.

16.9 ASYMMETRIC LANDING

An asymmetric moment can result from fuel transfer failure or stores imbalance. An asymmetric vertical landing may require use of water or reduced weight due to JPT rise from increased RCS bleed requirements (about 4 °C per 10,000 inch-pounds asymmetry). For an asymmetric slow landing, lateral control is improved by use of AUTO vice STOL flaps. CG near the aft limit should be avoided during AUTO flap landings with more than 60° nozzles due to low longitudinal control margin. Combinations of lateral asymmetry and longitudinal fuel imbalance should be avoided due to inertia effects and decreased control authority. The relative wind should be placed under the heavy wing if possible. Time in ground effect should be minimized.

CAUTION

Flight test results have shown a drop off in handling qualities with asymmetries greater than 80,000 inch-pounds without the relative wind under the heavy wing.

16.9.1 Asymmetric Stores Landing

The inboard pylon is 75.17 inches from the aircraft centerline, the intermediate pylon is 127.49 inches from the aircraft centerline, and the outboard pylon is 157.06 inches from the aircraft centerline; therefore, a single store over 1,065 pounds on an inboard pylon, a single store over 628 pounds on an intermediate pylon, or a single store over 510 pounds on an outboard pylon will exceed the vertical landing limit. If two or more stores are retained, the algebraic sum of their individual moments must be calculated to determine if the asymmetric moment is in excess of the vertical landing limit (- for stations 1, 2, and 3; + for stations 5, 6, and 7). See Figure 16-1. For store and suspension equipment weights refer to the aircraft loading chart in part XI, A1-AV8BB-NFM-400. An AUTO flap slow landing using 50° fixed nozzles will generally provide the most comfortable lateral control margin and landing roll-out characteristics; however, nozzle setting may be varied depending on other factors such as touchdown speed versus runway length, longitudinal control margin, RCS condition, etc. The two most important items for controllability are use of AUTO flaps and limiting AOA to 12° maximum. Do not make sudden or large rpm reductions during approach to prevent RCS control power reduction.

If asymmetric load over VL limit and VL required:

1. External stores — JETTISON.

If asymmetric load over 80,000 inch-pounds:

2. Climb to a safe altitude (3,000 feet AGL).

Note

If conditions allow climb above 10,000 feet AGL. If unable to climb to 10,000 feet AGL it is recommended to climb to the highest feasible altitude prior to performing a controllability check.

3. Slow to 250 knots.
4. Landing gear — DOWN.
5. Flaps — AUTO.
6. Slow to desired approach speed using nozzles (recommend 50° nozzles) and rpm to limit AOA to 12°.
7. Perform controllability check. (If rudder pedal shakers fire with a centered yaw vane, turn shakers off. Retain stab aug.)

Note

All sideslip aids utilizing lateral accelerometer inputs (yaw stab, shakers, HUD sideslip symbol) will operate erroneously.

If lateral control margin inadequate and stores cannot be jettisoned:

8. EJECT.

16.9.2 Asymmetric Fuel Landing

Fuel imbalances will cause lateral asymmetry when the low side is above 1,400 pounds, and longitudinal cg shift when the low side is below 1,400 pounds.

Depending on aircraft loading, fuselage fuel imbalance as low as 250 pounds may place the cg out of limits. When a combination of lateral asymmetry and fuselage fuel imbalance exists, control authority may be substantially reduced due to abnormal stick position and/or excessive bleed requirements.

If fuel imbalance exceeds 250 pounds:

1. Fuel proportioner — OFF.
2. Low side boost pump switch — OFF UNTIL FUEL BALANCED.

If fuel does not balance:

3. Heavy side wing fuel — JETTISON.
4. Low side boost pump switch — ON FOR LANDING.
5. Land as soon as practical.

If low side fuel below 850 pounds:

6. Perform a Fixed Nozzle Slow Landing if possible.

If total asymmetry including fuel and stores exceeds 80,000 inch-pounds:

7. Refer to Asymmetric Stores Landing.

To calculate asymmetry due to wing tank imbalance, enter Figure 16-2 with fuel in each wing tank. Asymmetry in inch-pounds is (+) for the right wing tank and (-) for the left wing tank. Calculate the algebraic sum. Lateral control authority is degraded with asymmetries above 85,000 inch-pounds at airspeeds below 200 knots with nozzles aft.

16.10 LANDING WITH ENGINE FAILURE

Landing with the engine inoperative shall not be attempted.

16.11 PRECAUTIONARY EMERGENCY APPROACH

The standard precautionary emergency approach is a straight-in approach to a conventional or slow landing, modified as aircraft configuration and power available dictates. For conventional precautionary approaches, recommend landing as light and as slow as possible. For conventional landings when PNB is not an available option, such as for a fire light or nozzle malfunction, apply full brakes two seconds after touchdown. Do not cycle, pump or lightly ride the brakes.

CAUTION

Conventional landings greater than 140 KGS above 20,000 LBS gross weight without PNB will result in main tire fuse plug release. Landings at this weight have exhibited this characteristic approximately 1 minute after coming to a stop.

If engine control is in question but nozzles can be moved, recommend combining wheel brakes and idle PNB.

16.12 CANOPY SEAL FAILS TO DEFLATE

If the canopy seal fails to deflate after landing, the canopy cannot be opened in the normal manner.

1. Cabin pressure switch — RAM.
2. Attempt to manually open the canopy.

   With the canopy seal inflated, it takes at least 110 pounds of pull force to open the canopy.
3. Engine — SHUT DOWN.
4. Have maintenance personnel disconnect weight-on-wheels plug in main wheelwell.

If seal still inflated:

5. Have maintenance personnel check CS COOL circuit breaker — IN.

If canopy still will not open:

6. Puncture the canopy seal with a sharp object.

   The aircraft may be flown below 25,000 feet cabin altitude with a punctured canopy seal.

ASYMMETRY (INCH-POUNDS)
VL LIMIT 80,000 INCH-POUNDS

STORE			STATION 1(−) 7(+)	STATION 2(−) 6(+)	STATION 3(−) 5(+)
AIM−9L/M 1			29,684	24,096	—
AGM−65E 2			—	81,594	48,109
AGM−65F 2			—	85,291	50,289
TGM−65E			—	81,594	48,109
CATM−65F			—	85,291	50,289
TACTS 1			19,161	15,554	—
AN/AAQ 28, Litening Pod 5			—	62,470	36,833
CBU−78/B			76,802	62,343	36,758
CBU−99/100			79,315	64,382	37,961
Mk 20, Mod 9, 10, 11, 12			76,959	62,470	36,833
Mk 82, Conical 3			80,729	65,530	38,367
Mk 82, Mk 15 3			88,111	71,522	42,170
Mk 82, BSU−33 3			81,043	65,785	38,788
Mk 82, BSU−86 3			87,797	71,267	42,020
Mk 83, Conical 3			—	126,470	74,569
Mk 83, BSU−85 3			—	130,805	77,124
Mk 77 Mod 4, 5			—	69,482	40,968
Mk 36, Mk 15 3			88,425	71,777	42,321
Mk 36, BSU−86			86,540	70,247	41,419
Mk 40, MAU−91			—	134,502	79,304
GBU−12			—	77,641	45,779
GBU−16			—	139,729	82,386
GBU−32			—	131,060	77,275
GBU−38			—	73,307	43,223
Mk 76 4			—	26,390	15,560
BDU−33 4			—	26,008	15,335
Mk 106 4			—	18,741	11,050
BDU−48 4			—	20,271	11,952
LGTR			—	11,474	6,765
LGTR and ITR			—	27,920	16,462
LAU−10D/A (Full w/Fairings)					
WARHEAD	MOTOR	FUZE			
Mk 63	Mk 71	Mk 93	—	87,713	51,717
Mk 24	Mk 71	Mk 188	—	82,614	48,710
LAU−61C/A (Full w/Fairings)					
WARHEAD	MOTOR	FUZE			
M151	Mk 4	M427	—	70,629	41,644
Mk 1	Mk 4	Any	—	63,363	37,359
M151	Mk 66	M427	—	75,474	44,500

Figure 16-1. Asymmetric Stores Calculation (Sheet 1 of 2)

ASYMMETRY (INCH-POUNDS)
VL LIMIT 80,000 INCH-POUNDS

STORE			STATION 1(-) 7(+)	STATION 2(-) 6(+)	STATION 3(-) 5(+)
LAU-68D/A (Full w/Fairings)					
WARHEAD	MOTOR	FUZE			
M151	Mk 4	M427	—	29,577	17,439
Mk 1	Mk 4	Any	—	29,900	15,861
M151	Mk 66	M427	—	31,363	18,492
LUU-2B/B					
SUU-25 (full)			—	59,665	—
LAU-7A-5 (empty)			14,135	11,474	—
LAU-117A (empty)			—	17,211	10,148
BRU-42/A (ITER) (empty)			—	16,446	9,697
ADU-299A/A			—	3,060	—
SUU-25F/A (empty)			—	33,402	—
LAU-10D/A (empty)			—	17,339	10,223
LAU-61C/A (empty)			—	19,761	11,651
LAU-68D/A (empty)			—	10,837	6,389
300 Gal Tank (empty)			—	25,243	14,884
Fuel (per 100 lbs.)			—	12,700	7,500
			—		
MXU-648 (w/removable tail cone)					
Full			—	50,500	29,800
Empty			—	17,900	10,500
Outboard Pylon (sta. 1 and 7)			15,078	—	—
Intermediate Pylon (sta. 2 and 6)			—	16,701	—
Inboard Pylon (sta. 3 and 5)			—	—	10,749

NOTES:

1. Does not include Launcher LAU-7A-5 or Adapter ADU-299A/A.
2. Does not include Launcher LAU-117A.
3. Asymmetry calculated for thermal protected bombs.
4. Asymmetry calculated for full ITER.
5. Calculated for maximum pod weight.

Figure 16-1. Asymmetric Stores Calculation (Sheet 2)

WING TANK FUEL POUNDS	ASYMMETRY INCH-POUNDS
100	11,500
200	22,200
300	32,200
400	41,000
500	49,200
600	56,500
700	63,100
800	69,100
900	75,000
1,000	80,300
1,100	85,000
1,200	89,500
1,300	93,500
1,400	97,000
1,500	100,300
1,600	103,500
1,700	106,500
1,800	109,400
1,900	112,100
2,000	114,800
2,100	117,100
2,200	119,200
2,300	120,800
2,400	122,100

Figure 16-2. Asymmetric Fuel Calculations

CHAPTER 17

Emergency Egress

17.1 GROUND EGRESS

Rapid egress is essential after forced landing, ditching, runway overrun, or other ground emergencies. The fastest egress method is without the seat survival kit. On land, if the aircraft is burning, the extra time required to egress with the survival kit could cause serious injury or death. After egress, if practical, return to the aircraft and retrieve the survival kit.

If possibility of structural damage exists:

1. Emergency canopy shattering handle — PULL.

Note

- Before pulling the internal emergency canopy shattering handle, pull down the helmet visor (if time permits), close eyes and keep hands and body as far away as possible on the canopy.
- If aircraft is inverted, disconnect lap belt as last step.

To egress without survival kit:

2. Ejection Seat — SAFE.

Note

If unable to pull the ground safety handle to the up (SAFE) position, pulling the emergency restraint release handle will safe the ejection seat.

3. Fittings/connections — RELEASE.
4. EGRESS.

To egress with survival kit:

5. Emergency restraint release handle — PULL.
6. Fittings/connections — RELEASE (except lap restraint).
7. EGRESS.

17.2 DITCHING

Ditching the aircraft should be the pilots last choice. However, if the situation demands ditching, the following procedures should be observed.

17.2.1 Before Impact

1. Make radio distress call.
2. IFF — EMERGENCY.
3. External stores — JETTISON.

4. Landing gear — UP.
5. Flaps — AS REQUIRED.
6. Seat — MID-POSITION.
7. Emergency oxygen actuator — PULL.
8. Oxygen mask — TIGHTEN.
9. NVG — REMOVE (if in use).
10. Helmet visor — DOWN.
11. Shoulder harness — LOCKED AND TIGHT.
12. Lap belt — TIGHTEN.
13. If wingborne, land parallel to swell pattern. If jetborne, land into the wind.
14. Remain braced until shocks stop.

17.2.2 After Impact

1. Parachute riser release fitting — RELEASE.
2. Emergency restraint release handle — SQUEEZE, PULL UP AND AFT.
3. Close eyes and pull internal emergency canopy shattering handle.
4. Abandon aircraft.
5. Inflate life vest.
6. Raft release — PULL.
7. Oxygen mask — REMOVE.
8. Inflate raft and climb in.

WARNING

Do not eject under water.

Note

Canopy will implode at 8 to 12 feet under water.

Underwater egress will be complicated by:

a. Aircraft sink rate under water is 20 to 30 feet per second.

b. Automatic inflation of life preserver unit (LPU) will occur restricting movement.

17.3 EJECTION

Escape from the aircraft inflight and in some instances, from ground level or water should be made with the ejection seat (Figure 17-1). However, under water ejection is not recommended.

Study and analysis of escape techniques by means of the ejection seat reveals that:

1. During ejection seat development and testing the SJU-4/A was qualified for use by male aviators with nude weights from 136 to 213 pounds. Operation of the seat by personnel not within these parameters subjects the occupant to increased risk of injury.

2. Appreciable forces are exerted on the body when ejection is performed at airspeeds of 400 to 600 knots rendering escape more hazardous.

3. At speeds above 600 knots ejection is extremely hazardous because of excessive forces on the body.

4. When circumstances permit, slow the aircraft prior to ejection to reduce the forces exerted on the body.

5. Before AFC-449, because of the nature of the modes of operation of the seat, ejection near the transition area between modes 1 and 2 can result in high ejection forces. Ejection below 7,000 ±750 feet MSL at airspeeds between 180 and 260 KIAS (between 180 and 215 KIAS with IACC 658) increases the risk of injury.

WARNING

- The emergency restraint release handle should never be actuated before an ejection attempt.
- Should severe icing or damage occur causing the airspeed indicator to read either zero or an erroneous value, the ejection seat could function in the low speed (0.10 second) mode. If, at this time, the aircraft is actually above 180 knots and below 7,000 ±750 feet MSL, above 165 KIAS and below 7,000 ±100 feet MSL after AFC-449, the ejection forces on the body could be extreme and severe damage could occur to the main parachute. Thus, below 7,000 ±750 feet MSL, 7,000 ±100 feet MSL after AFC-449, with a faulty airspeed indication caused by icing or pitot systems damage, ejection must be made at airspeeds below 180 knots.
- Ejection near the transition area between modes 1 and 2 can result in high ejection forces. Ejection below 7,000 ±750 feet MSL at airspeeds between 180 and 260 KIAS (between 180 and 215 KIAS with IACC 658) increases the risk of injury.

17.3.1 Low Altitude Ejection

Low altitude ejection depends for its success on the observance of the sink rate, dive angle, bank angle, airspeed and altitude (AGL) limitations. See Figure 17-2 through 17-6 for minimum ejection altitudes for these parameters. The pilot must make the ultimate decision concerning the minimum safe altitude from which an ejection can be made in the prevailing conditions. Every effort must be made to initiate ejection before the aircraft has descended to the minimum safe altitude. Assuming that the aircraft is substantially straight and level, the ejection seat should provide safe escape as follows:

1. At zero and low airspeeds — ground level.

2. At airspeeds above 400 knots — 50 feet minimum AGL.

The optimal controlled ejection conditions before AFC-449, see Figure 17-7:

Mode 1: below 180 KIAS, straight and level, and greater than 2,000 feet AGL.

Mode 2: between 260 (215 AFTER IACC 658) and 400 KIAS, straight and level, and greater than 2,000 feet AGL.

The optimal controlled ejection conditions after AFC-449 are between 150 and 400 KIAS (trade airspeed for altitude).

17.3.1.1 Wingborne Flight

If the aircraft is controllable, and airspeed is not below approximately 150 knots, ejection from low altitude is facilitated by pulling the aircraft nose up and initiating a zoom maneuver before ejecting. This increases the ejection altitude and adds an upward component to seat velocity, thus allowing more time for man/seat separation and main parachute development than in the level flight case. Below approximately 150 knots (e.g., conventional landing approach) the zoom maneuver should not be attempted. If possible, and if time permits, any rate of descent should be reduced or arrested before ejection. Ejection must not be delayed when the aircraft is in a descending attitude from which it cannot be recovered.

17.3.1.2 Jetborne Flight

During low level flight, an engine or control failure demands an immediate ejection since critical sink rate, attitude and altitude conditions may prevent a successful ejection. Following engine/control failures, roll rates and pitch rates will quickly develop leading rapidly to an aircraft attitude from which successful ejection cannot be made; therefore, it is vital that ejection be initiated immediately after such a failure occurs.

WARNING

When circumstances demand an immediate ejection from low level, no attempt should be made to adjust aircraft attitude at the expense of further increase in sink rate and further altitude loss.

17.3.2 Ejection From Surface Level

At surface level, the ejection option exists as long as the seat and parachute harness remain fastened (occupant properly strapped in), the cockpit canopy remains closed and locked, and the aircraft is in a substantially upright attitude. Ejection must not be attempted unless each of these conditions is satisfied. It is stressed that following, say, a crash landing, where it is possible that damage to the canopy frame or front fuselage has occurred and where escape by ejection may be the best course, no attempt should be made to open the canopy. If such an attempt were made and resulted in the canopy jamming in a partially open position, the ejection option would be lost and manual egress from the cockpit might also be lost. On the other hand, manual use of the MDC does not invalidate the ejection option and does not prevent a subsequent manual escape. In such circumstances, the MDC must be used and the canopy must not be opened. Further, the occupant should not unstrap until it is evident that no danger is present which might prevent manual escape from the aircraft. In all circumstances, the pilot must make the ultimate decision as to whether ejection offers the best escape chance in the given conditions. If the seat fails to operate, manual escape is the only option. Refer to ground egress procedures, paragraph 17.1.

WARNING

If the aircraft is ditched (which should only be attempted if the ejection seat fails to provide escape from the airborne aircraft), a manual escape from the cockpit must be made. Refer to ditching procedures, paragraph 17.2. Consideration is given here only to escape by ejection from emergency circumstances during shipborne or water platform type operations.

Escape from circumstances which result, or may result, in the aircraft entering the water should be made by ejecting. Every effort must be made to initiate the ejection before impact with the surface.

17.3.3 High Altitude Ejection

For a high altitude ejection, the basic low level ejection procedure is applicable. Furthermore, the zoom up maneuver is still useful to slow the aircraft to a safer ejection speed or provide more time and glide distance as long as an immediate ejection is not mandatory. If the aircraft is descending uncontrolled as a result of a mid-air collision, control failure, spin, or any other reason, abandon the aircraft at a minimum altitude of 10,000 feet above the terrain if possible. If it is decided to abandon the aircraft while still in controlled flight at altitude, the pilot should abandon the aircraft at a minimum altitude of 2,000 feet above the terrain.

17.4 PARACHUTE DESCENT PROCEDURES

If the emergency oxygen is not activated during ejection, it can be activated by pulling the emergency oxygen actuator on the inside of the left thigh support.

1. Parachute condition — CHECK.
2. I — Inflate (LPU).
3. R — Release (raft).
4. O — Options (time permitting).
    a. Visor.
    b. Oxygen.
    c. Waist lobes.
    d. Gloves.
    e. Four-line release (with ACC-667 PART 2).
5. K — Koch fittings (release upon water entry).

After Water Entry:

6. A — Avoid parachute.
7. D — Disentangle.
8. R — Retrieve raft.

17.5 A/P22P-14(V)3 CHEMICAL, BIOLOGICAL, RADIOLOGICAL PROTECTIVE RESPIRATOR ASSEMBLY EMERGENCY PROCEDURES

The A/P22P-14(V)3 (OBOGS aircraft) respirator assembly (see Figure 17-8) is authorized to be worn by all T/AV-8B aircrew for protection against the elements of CBR warfare. For general information, donning and doffing, and routine usage, refer to Aviation Crew Systems Manual, NAVAIR 13-1-6.10, Special Mission Aircrew Equipment.

17.5.1 Emergency Egress On Land

1. Pusher fan — CONFIRM RUNNING.
2. If pusher fan is not operating hood outlet valve (Figure 17-9) — CLOSE.

Note

If in contaminated environment, CBR protection will be maintained, but the faceplate may fog and prevent wearer from seeing anything.

PREPARATION FOR EJECTION

IMMEDIATE EJECTION

Usually, the pilot will have enough time to accomplish several things to prepare himself for a successful ejection prior to pulling the ejection handle (see controlled ejection). However, when the emergency situation requires, ejection must be made without hesitation, ensure proper body position, grasp the ejection handle and pull until seat ejects.

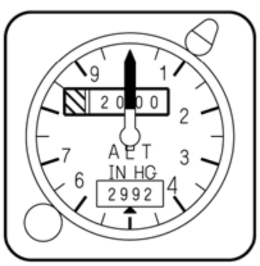
CONTROLLED EJECTION

Time permitting, do the following:

1. Night Vision Goggles - REMOVE FROM HELMET AND STOW
2. Visor - DOWN
3. Oxygen mask - TIGHTEN
4. All loose equipment - STOW
5. Airspeed - Before AFC-449:
   MODE 1: BELOW 180 KIAS, STRAIGHT AND LEVEL
   MODE 2: BETWEEN 260 (215 WITH IACC 658) AND 400 KIAS, STRAIGHT AND LEVEL

   Airspeed - After AFC-449:
   BETWEEN 150 AND 400 KIAS (TRADE AIRSPEED FOR ALTITUDE)

   Altitude - GREATER THAN 2,000 FEET AGL
6. IFF - SELECT EMERGENCY
7. MAYDAY position report - TRANSMIT
8. Shoulder harness lock lever - LOCK



9. Altimeter - CHECK

   NOTE

   Over 14,000 feet, calculate free fall time to automatic parachute opening altitude. (5 seconds per 1,000 feet)
10. Proper ejection body position - ASSUME
11. INITIATE EJECTION

EJECTION POSITION

NOTE

Proper body positioning is a critical factor in preventing ejection injuries.

1. Helmet secured.
2. Lap and shoulder restraints tightened.
3. Head pressed back against headrest.
4. Chin slightly elevated (10 ° up).
5. Back straight.
6. Hips against seat back.
7. Thighs flat on seat survival kit.
8. Feet against rudder pedals, heels in cups.

WARNING

Positioning the legs aft prior to ejection will cause the spine to flex and will increase the possibility of spinal injury.

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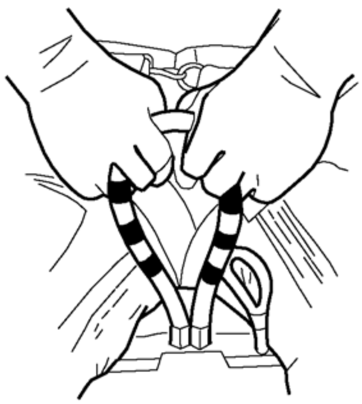
Figure 17-1. Ejection Procedures (Sheet 1 of 9)

EJECTION INITIATION

The recommended method for ejection initiation is depicted below.

1. During any combined low altitude/low airspeed situation, continue to fly the aircraft with the right hand, keeping wings level and maintaining altitude or the lowest possible sink rate, while initiating ejection sequence with the left hand.

During an uncontrolled ejection, when maintaining aircraft attitude is impossible, it is recommended that both hands be used to initiate ejection.

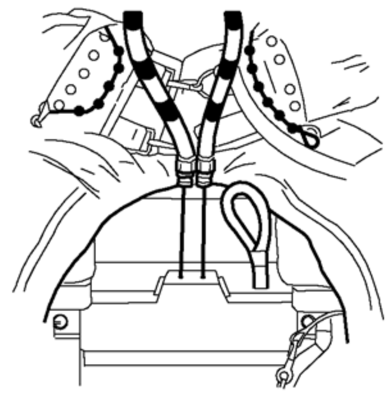


METHOD 1

Grip the ejection handle with the thumb and at least two fingers of each hand, palms toward body and elbows close to body.

METHOD 2

Grip handle with strong hand palms inward. Grip wrist of strong hand with other hand, palms toward body and elbows close to body



2. Pull handle sharply up and toward abdomen, keeping elbows in until handle reaches end of travel.

WARNING

Ejection must not be attempted unless the canopy is closed. Any attempt to eject while the canopy is partly or fully open will result in the collision of the seat/occupant and the canopy arch.

After ejection handle is pulled:

a. Canopy detonates.

b. The power retract mechanism on the inertia reel activates, pulling the shoulder restraint system taut.

c. Emergency oxygen and radio beacon set are automatically actuated.

d. One of the four modes of ejection seat operation is automatically selected and actuated.

e. Positive parachute deployment and man/seat separation are automatically provided.

f. Continue holding ejection handle until man/seat separation at which time the handle will remain attached to the seat.

NOTE

See Chapter 2 for details of ejection seat mechanical operation.

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Figure 17-1. Ejection Procedures (Sheet 2)

AUTOMATIC MAN/SEAT SEPARATION

Post ejection automatic sequencing is activated as part of the pitot-static system. The ejection seat is capable of four modes of operation, depending on ejection airspeed and altitude.

MODE 1 – Low Altitude/Low Airspeed
(below 225 knots and below 7,000 feet)
(below 165 knots depending on altitude and below 7,000 feet after AFC-449, see figure 2-26a)

MODE 2 – Low Altitude/High Airspeed
(above 225 knots and below 7,000 feet)
(above 180 knots and below 7,000 feet with IACC 658)
(above 122 knots depending on altitude and below 7,000 feet after AFC-449, see figure 2-26a)

MODE 3 – Intermediate Altitude
(above 7,000 feet and below 14,000 feet)

MODE 4 – High Altitude
(above 14,000 feet)

NOTE

See Ejection Sequences, Chapter 2, for mechanical sequencing of ejection procedure.

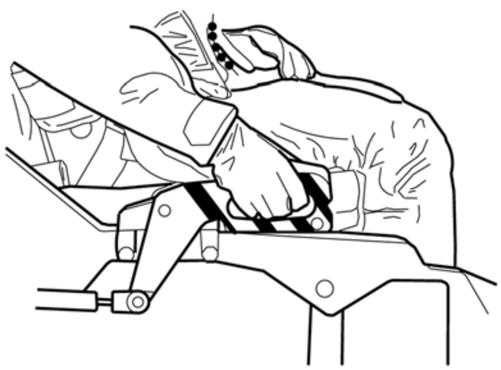
If after ejection from the aircraft and below 14,000 and automatic man/seat separation has not occurred, manual man/seat separation procedures must be performed.

WARNING

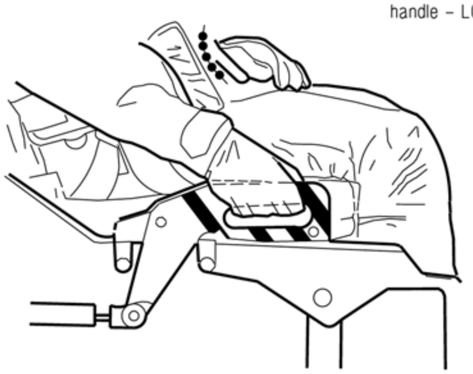
It is recommended that manual seat separation not be utilized at altitudes above 14,000 feet.

MANUAL MAN/SEAT SEPARATION

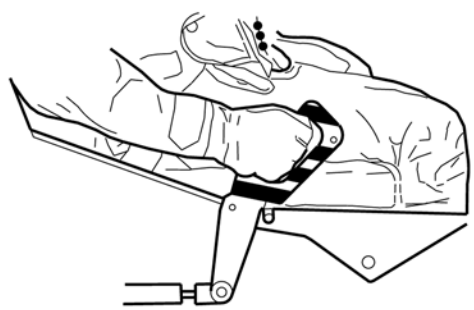
Perform the following procedures to effect man/seat separation:



1. Emergency restraint release handle – LOCATE



2. Emergency restraint release handle trigger – SQUEEZE



3. Emergency restraint release handle – PULL

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Figure 17-1. Ejection Procedures (Sheet 3)

PARACHUTE DESCENT PROCEDURES

*1. Parachute condition – CHECK

*2. I – Inflate (LPU)

*3. R – Release (raft)

*4. O – Options (time permitting)

a. visor

b. oxygen

c. waist lobes

d. gloves

e. four-line release
(with ACC-667 PART 2)

*5. K – Koch fittings
(release upon water entry)

After water entry

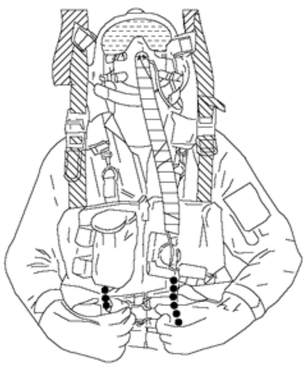
*6. A – Avoid parachute

*7. D – Disentangle

*8. R – Retrieve raft

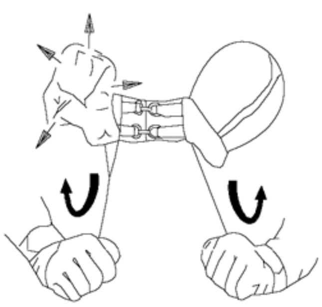
LPU INFLATION

1. Locate and pull LPU beaded handles down and straight out to inflate. If beaded handle inflation fails, use oral inflation tube located on right waist lobe.



WARNING

Although the FLU-8 automatic inflation device is designed to inflate the LPU upon water contact, manual operation remains the primary mode of operation. Automatic actuation is intended for disabled or unconscious survivors or if there is insufficient time to manually activate the LPU.



NOTE

The procedures outlined apply to over land or over water ejections. However, inflation of the LPU may be undesirable over land.

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Figure 17-1. Ejection Procedures (Sheet 4)

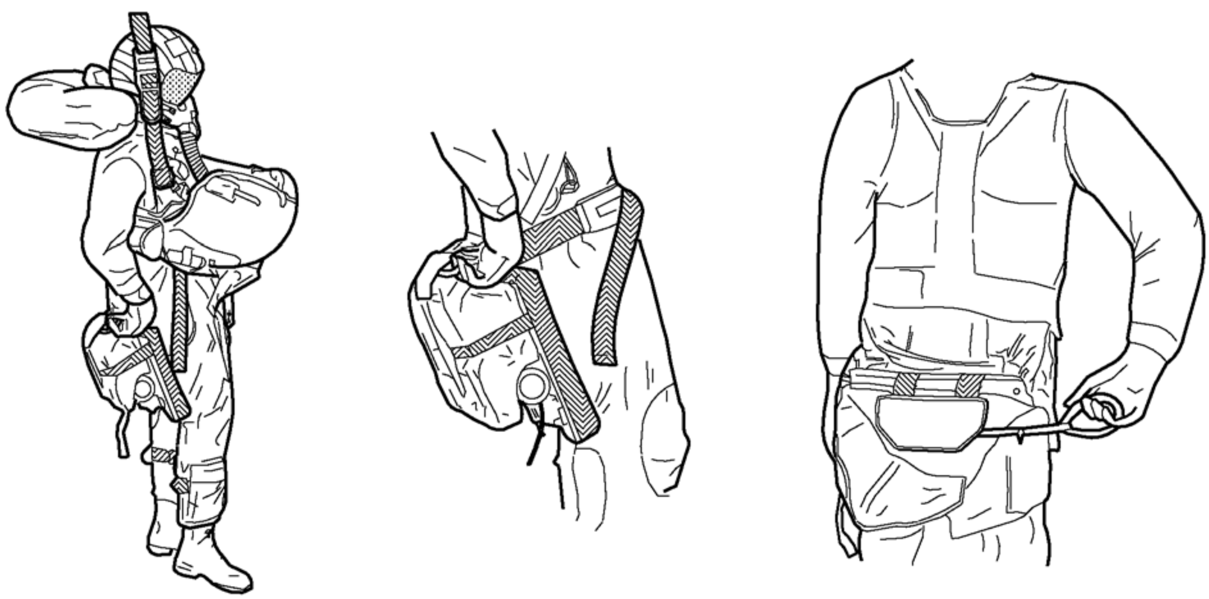
RAFT/SEAT KIT DEPLOYMENT

WARNING

Deploying the seat kit is not recommended over land.

NOTE:

If the seat kit is deployed after water entry, a snatch pull on the dropline near the CO_2 bottle is required to inflate the life raft.



1. After inflating the LPU, prepare to deploy the seat kit.
2. With right hand, locate the raft release handle on the right side of seat kit.
3. Pull outwards on the raft release handle until the seat kit is deployed.

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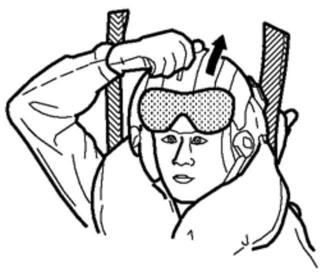
Figure 17-1. Ejection Procedures (Sheet 5)

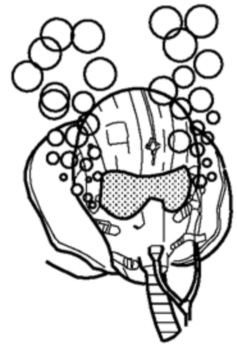
OPTIONS

If time permits, the following options may be accomplished in any order deemed appropriate.



Raise visor.

Remove oxygen mask. Oxygen mask/hose assembly may be disconnected from seat kit and discarded, if desired.



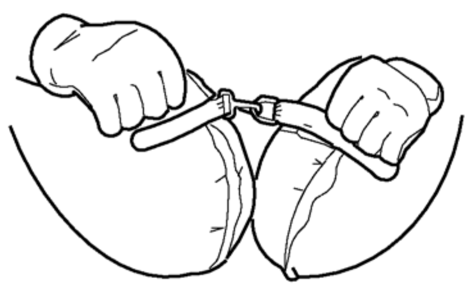
NOTE

The MBU series oxygen mask provides underwater breathing capabilities and should be retained in low level over water ejections.

Remove gloves.

NOTE

- Removal of gloves may facilitate subsequent release of parachute release fittings.
- Stow gloves in a secure place to prevent loss.



Snap lobes.

NOTE

Failure to snap waist lobes before water entry may result in face down floatation.

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Figure 17-1. Ejection Procedures (Sheet 6)

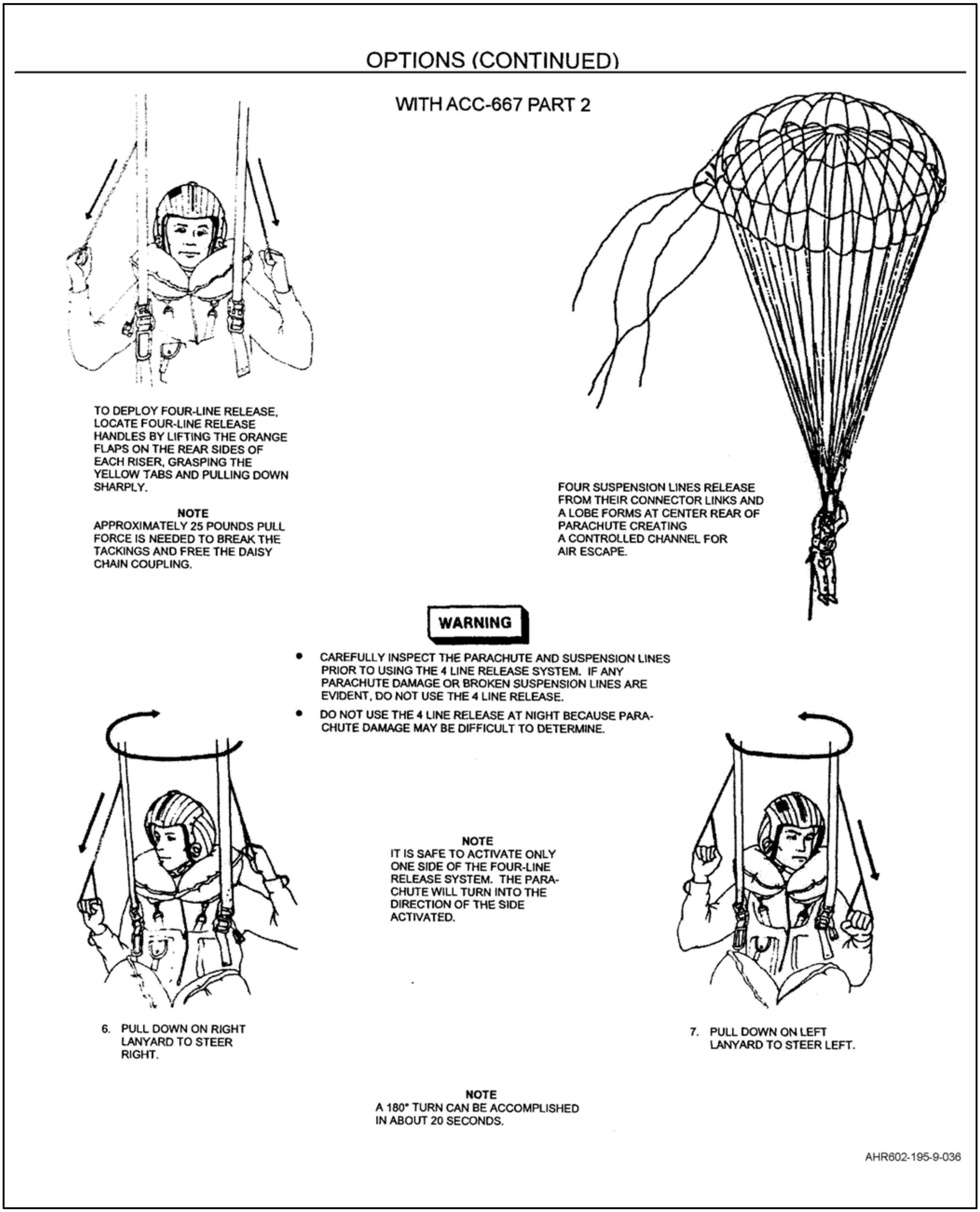

Figure 17-1. Ejection Procedures (Sheet 7)

LANDING PREPARATION

LANDING PROCEDURES

Try to determine the wind direction at the surface using white caps, smoke from the wreckage, or known surface winds in the vicinity. Winds at the surface may be quite different from those encountered at altitude. When nearing the surface, maneuver the parachute so that you are facing into the wind, then assume the proper body position for landing.

1. Assume proper body position.
   a. Feet and knees together.
   b. Knees slightly bent.
   c. Toes pointed slightly downward.
   d. Eyes on the horizon.
   e. Firmly grasp parachute release fittings
   f. Tuck elbows in prior to water entry.
2. Release Koch fittings – Release upon water entry (over water).

WARNING

Do not disconnect Koch fittings until after contact with water.

3. PLF – Perform (over land).

TREE LANDING PROCEDURES

Perform the same procedures as for over water landing, but with the following exceptions:

1. Visor – down.
2. Gloves – on.
3. DO NOT deploy seat kit.

NOTE

- Turning the parachute into the wind counteracts the prevailing wind to some degree and reduces chances of tree landing injury.
- Be prepared to execute a parachute landing fall (PLF) if entanglement does not occur.

4. After turning the parachute into the wind, assume the following tree landing body position.
   a. Feet and knees together.
   b. Knees slightly bent.
   c. Toes pointed slightly downward.
   d. Place hands in armpits, palms down.
   e. Tuck chin in and turn head to the side.

WARNING

Do not try to slow or stop descent by grabbing tree limbs.

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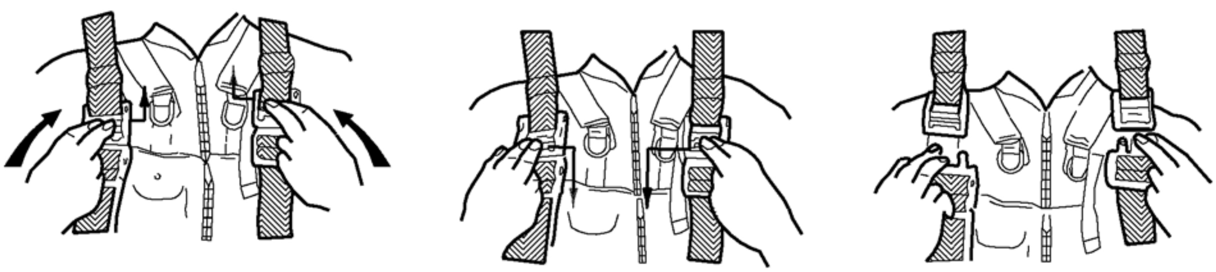
Figure 17-1. Ejection Procedures (Sheet 8)

KOCH FITTING RELEASE

NOTE
With SEAWARS installed the parachute fittings release automatically upon emersion in salt water.

WARNING

Do not disconnect Koch fittings until after contact with ground or water.



1. Push up on Koch fitting release cover.
2. Pull down on Koch fitting release lever.
3. Parachute released.

A – AVOID PARACHUTE, AFTER WATER ENTRY

1. Immediately look for canopy and face it.
2. Back away, sculling with hands only.
3. Minimize leg movement to reduce possibility of entanglement.

D – DISENTANGLE

1. Release upper Koch fittings.
2. If the canopy lands on top of you, reach up with both hands, push up and pull the canopy from "back to front". Continue pulling canopy until it is all in front of you.
3. All movements must be slow and deliberate. Do not kick feet. Scull away facing parachute.
4. Back away from chute, keep the chute in front of you, where you can see it.
5. As you back away, free the suspension lines that may be caught on your equipment.

R – RETRIEVE RAFT

1. Inflate life raft if necessary.
2. Locate retaining lanyard and attach it to D-ring.

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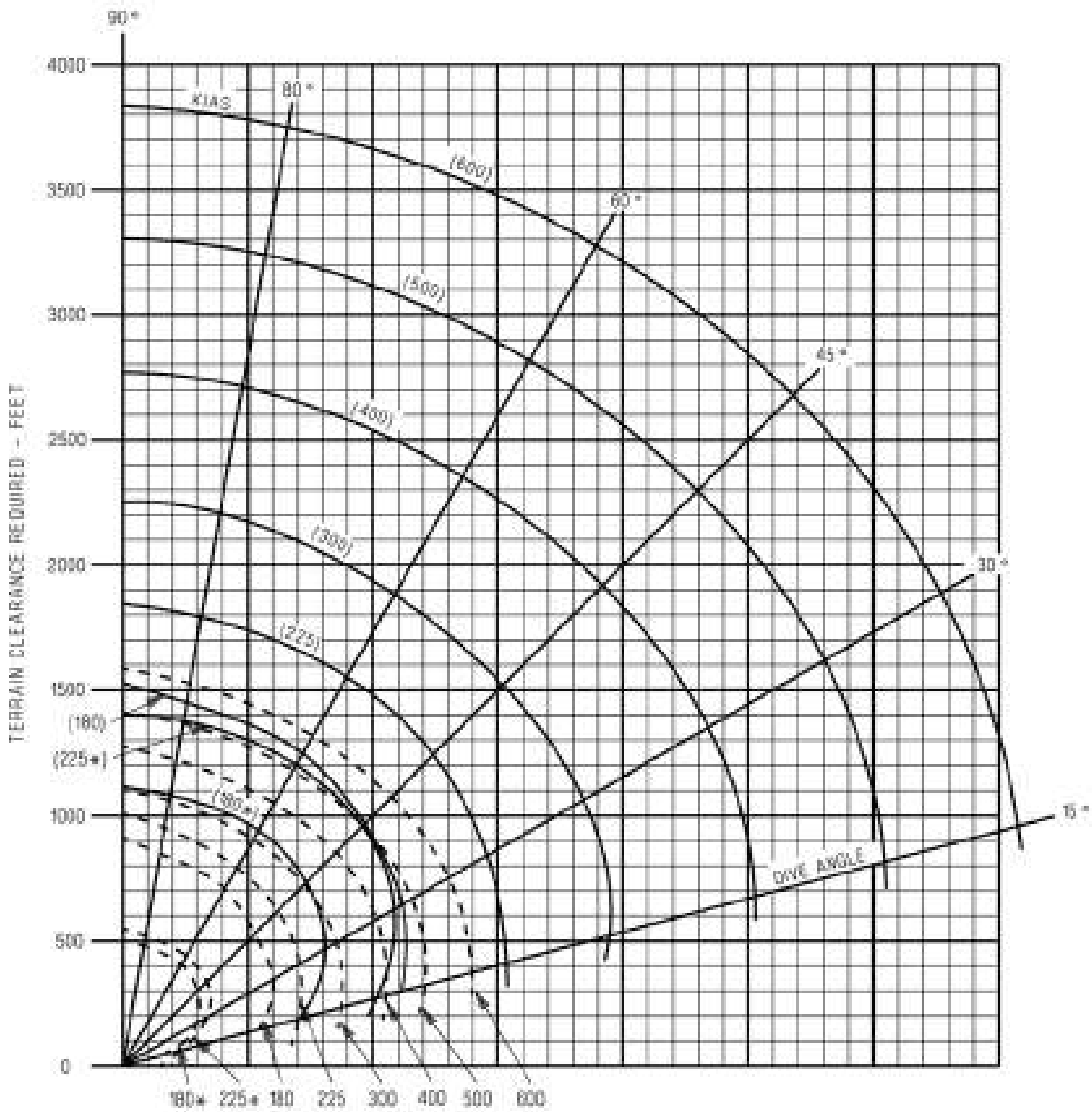
Figure 17-1. Ejection Procedures (Sheet 9)

SJU-4/A SEATS



∗ LOW SPEED MODE. TRANSITION POINT IS 225 ±20 KIAS (180 ±20 KIAS WITH IACC 658).
(BETWEEN 122 ±5 and 165 ±5 KIAS DEPENDING ON ALTITUDE AFTER AFC-449. SEE FIGURE 2-26A)

NOTES

- The altitudes shown by solid lines allow a pilot reaction time of 2 seconds.
- The altitudes shown by dashed lines are based on ejection seat sequence time only, and are included for reference only.
- Wings level and 0° angle of attack. Terrain clearance required is based on 5000 foot terrain and is conservative for lower terrain.

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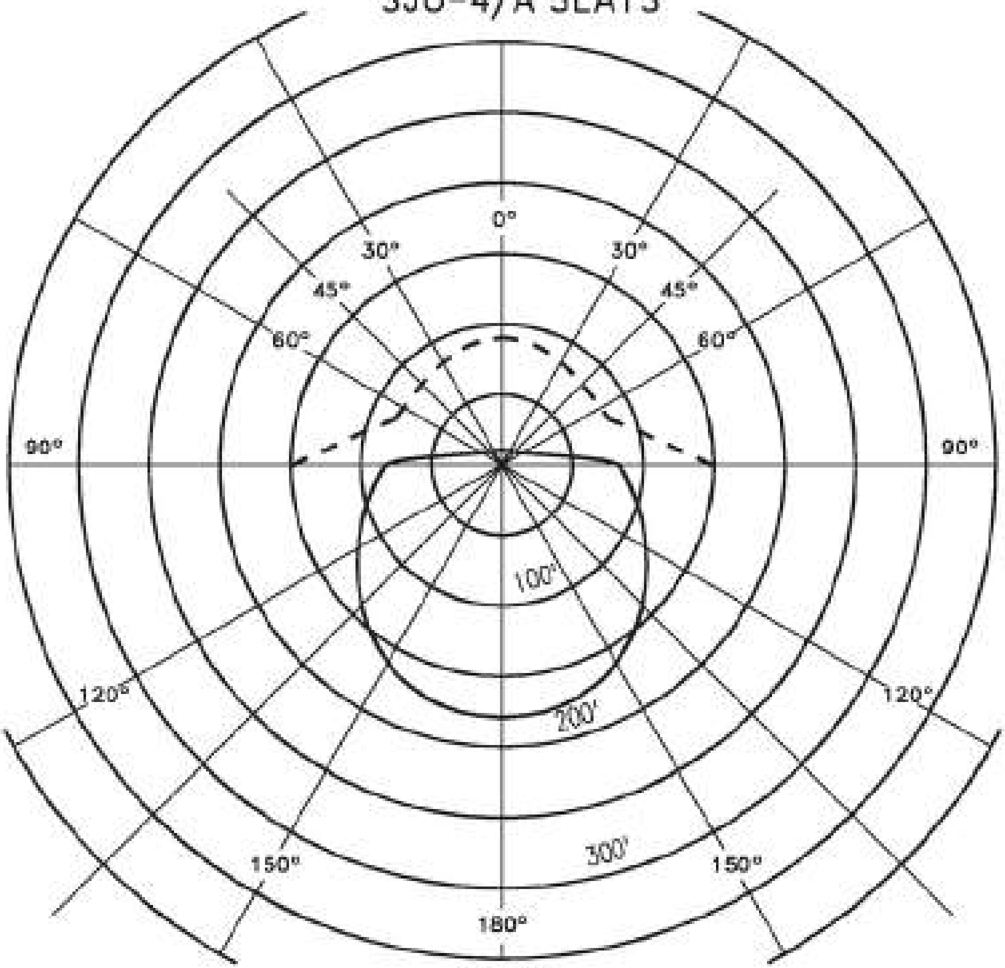
Figure 17-2. Minimum Ejection Altitude vs Airspeed and Dive Angle, AV–8B

SJU-4/A SEATS



NOTES

- Nose level and 0° angle of attack.
- Dashed line represents minimum altitudes for conditions 1 thru 4 with a 2-second pilot reaction time.
- Solid lines represent minimum altitudes for conditions 1 thru 4 without pilot reaction time, or minimum altitudes for conditions 5 thru 7 with or without pilot reaction time.

CONDITION	ATTITUDE	DESCENT RATE (fpm)	AIRSPEED (KIAS)
1	WINGS AND NOSE LEVEL	2400	100
2	30° BANK AND NOSE LEVEL	2000	50
3	45° BANK AND NOSE LEVEL	2000	100
4	90° BANK AND NOSE LEVEL	2000	100
5	120° BANK AND NOSE LEVEL	0	130
6	150° BANK AND NOSE LEVEL	0	130
7	180° BANK AND NOSE LEVEL	0	130

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Figure 17-3. Minimum Ejection Altitude (Terrain Clearance) vs Aircraft Attitudes, AV-8B

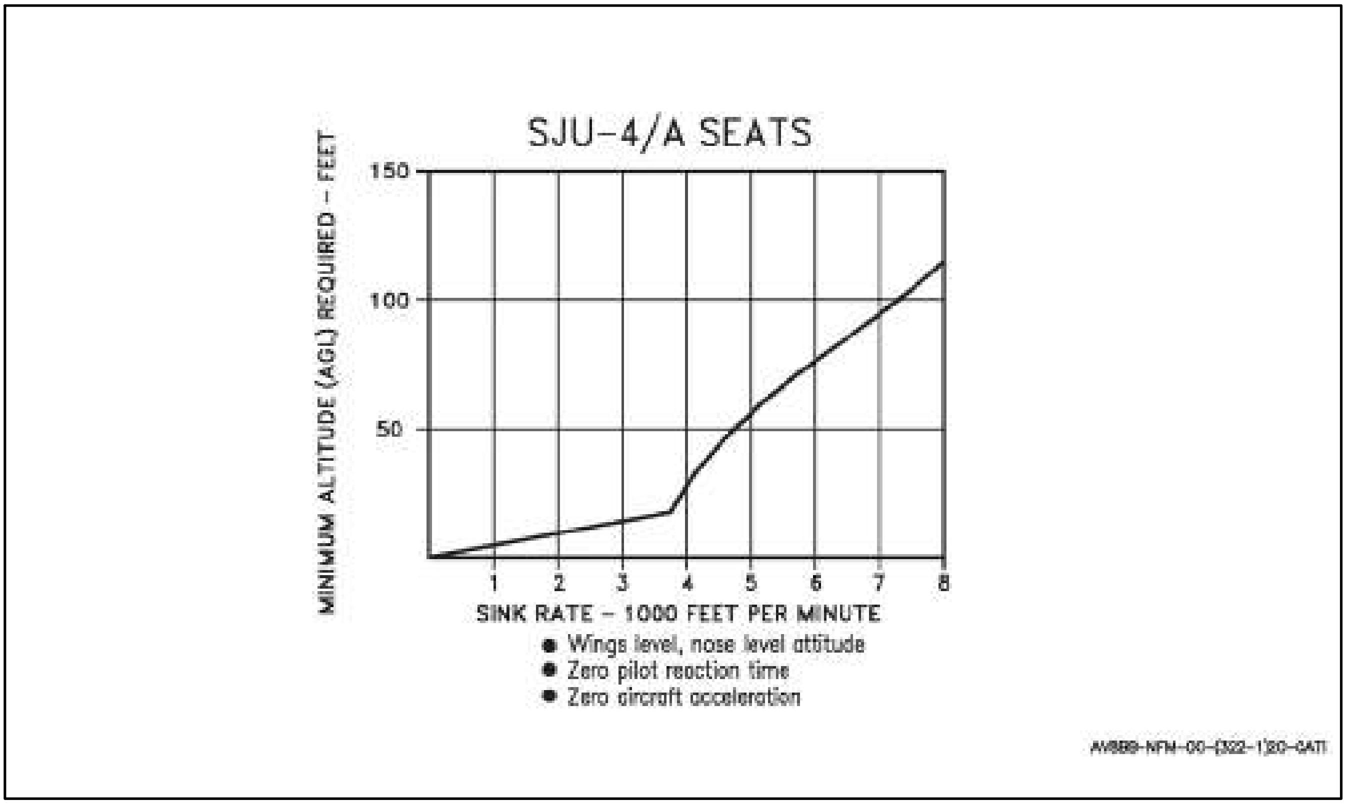


Figure 17-4. Minimum Ejection Altitude vs Sink Rate at Zero Forward Airspeed, AV-8B

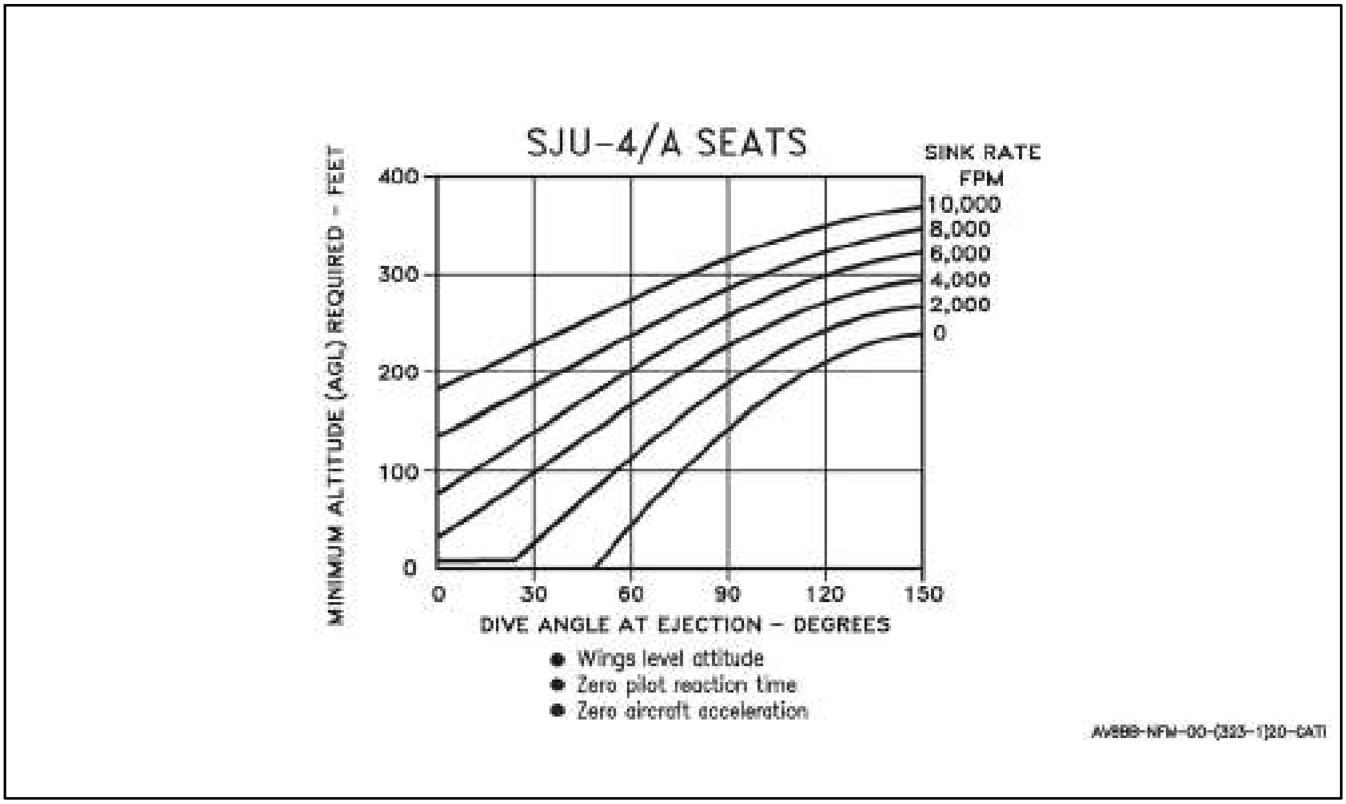


Figure 17-5. Minimum Ejection Altitude vs Dive Angle for Sink Rate at Zero Forward Airspeed, AV-8B

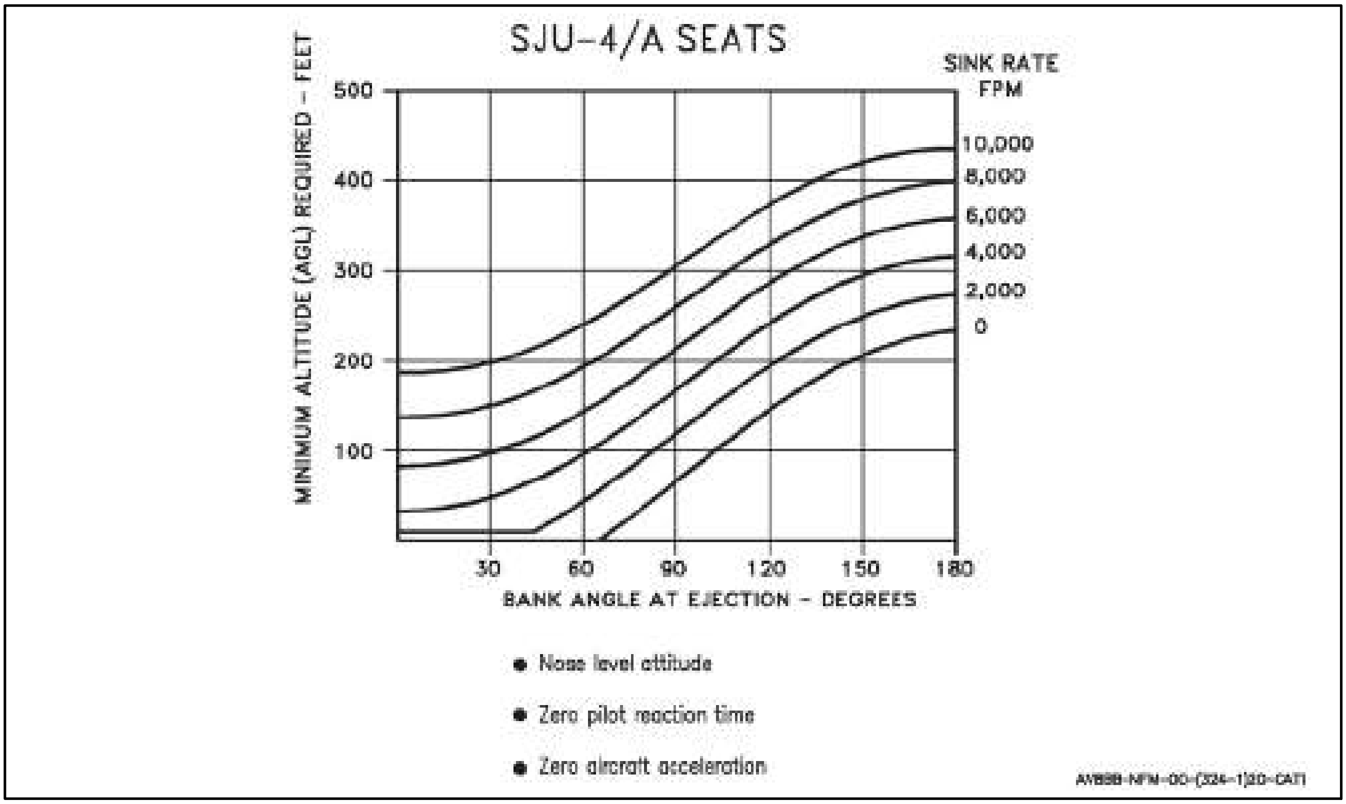


Figure 17-6. Minimum Ejection Altitude vs Bank Angle for Sink Rate at Zero Forward Airspeed, AV-8B

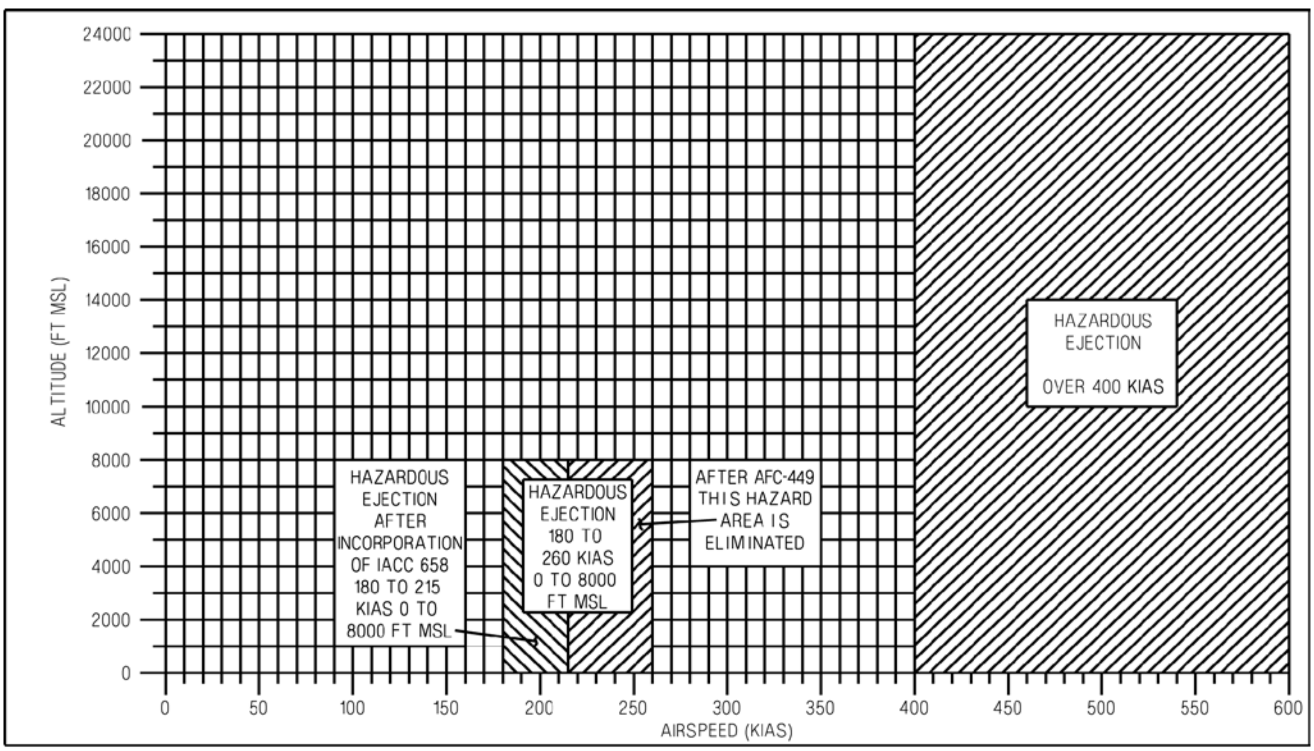


Figure 17-7. Optimal Controlled Ejection Conditions

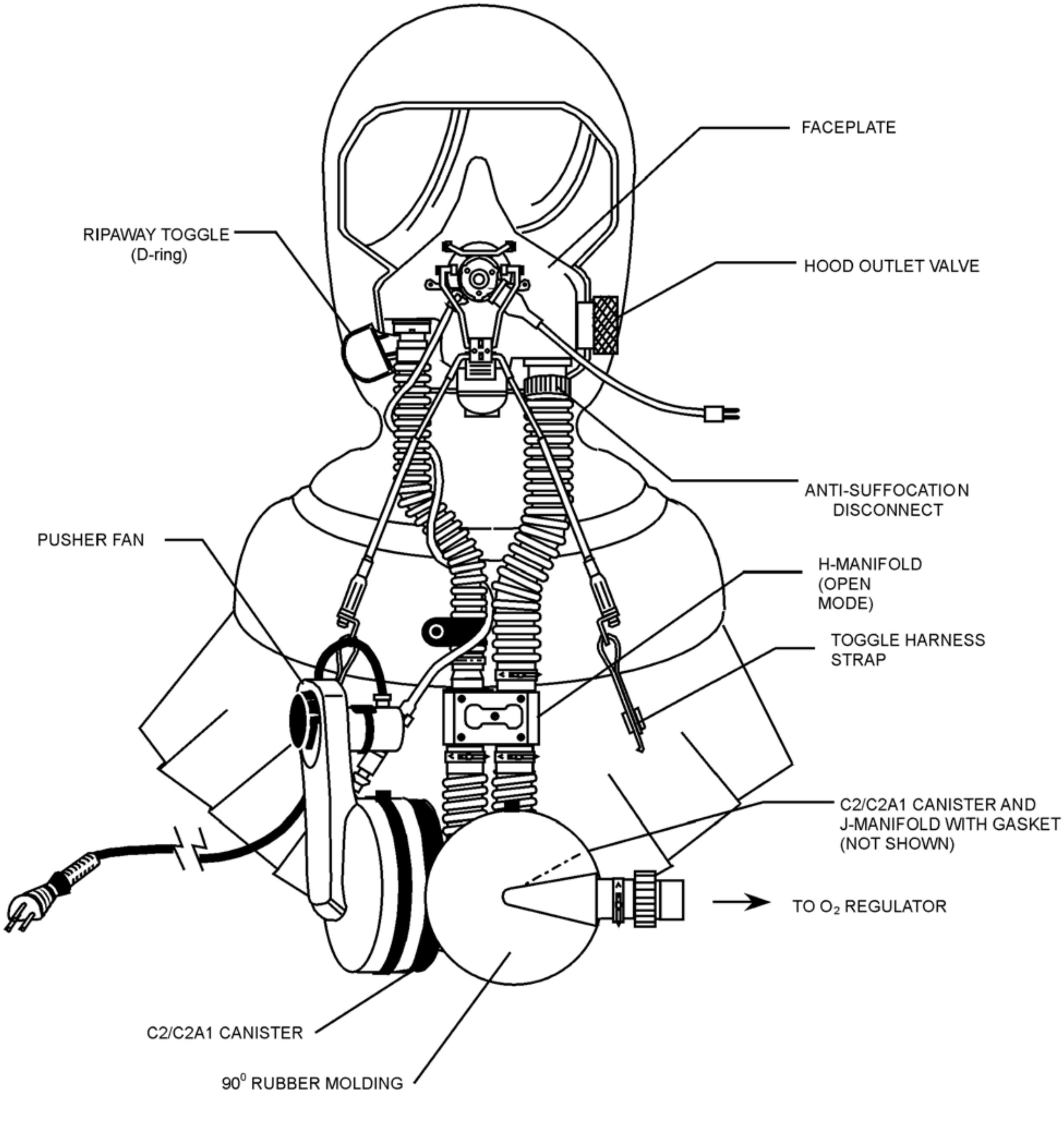


Figure 17-8. A/P22P-14(V)3 Respirator Assembly

17.5.2 Ejection Over Land (In a Non-Contaminated Environment) During the Option Phase of Parachute Descent

1. Helmet visor — RAISE.

Note

If insufficient time to activate ripaway facility proceed to step 3.

2. Mask — RIPAWAY (Figure 17-10).

WARNING

CBR protection will be lost.

   a. Locate and grasp ripaway D-ring.

   b. Pull D-ring until hood rips and tab ribbon separates from hood.

   c. Unsnap right-side toggle harness strap only.

WARNING

Unsnapping both toggle harness straps will allow the faceplate to fall and suspend from the hood and mask hoses resulting in a snag hazard.

   d. Rip faceplate away from face.

If Unable To Perform Ripaway:

3. Anti-suffocation disconnect (Figure 17-11) — LOCATE AND DISCONNECT BY TWISTING AND PULLING DOWN.

17.5.3 Ejection Over Land (In a Contaminated Environment) During the Option Phase of Parachute Descent

1. H-Manifold switch (Figure 17-12) — OPEN (Horizontal).
2. Pusher fan — CONFIRM RUNNING.

Note

The pusher fan will provide filtered ventilation and lens de-misting to the respirator assembly hood compartment and filtered air to the orinasal mask.

If pusher fan is not running:

3. Hood outlet valve (Figure 17-9) — CLOSE IMMEDIATELY (Pull out on DISC, twist and release).

Note

CBR protection will be maintained, but the faceplate may fog and prevent wearer from seeing anything.

17.5.4 Ejection Over Water (In Either Contaminated or Non-Contaminated Environment) During Option Phase of Parachute Descent

WARNING

Upon entering water, filter canisters will become blocked and not pass air or water into the mask.

1. Helmet visor — RAISE.
2. Mask — RIPAWAY (Figure 17-10).

WARNING

CBR protection will be lost.

   a. Locate and grasp ripaway D-ring.
   b. Pull D-ring until hood rips and tab ribbon separates from hood.
   c. Unsnap right-side toggle harness strap only.

WARNING

Unsnapping both toggle harness straps will allow the faceplate to fall and suspend from the hood and mask hoses resulting in a snag hazard.

   d. Rip faceplate away from face.

IF Unable to perform ripaway:

3. Anti-suffocation disconnect (Figure 17-11) — LOCATE AND DISCONNECT BY TWISTING AND PULLING DOWN.

After Contact With Water:

WARNING

Contact with water may have forced water through the mask inlet adapter into the orinasal mask.

4. If the anti-suffocation disconnect was activated, before taking a breath, forcibly exhale to blow water out of the mask.

17.5.5 Pusher Fan Malfunction

1. H-Manifold switch — OPEN (Horizontal) (Figure 17-12).

Note

Demand on the OBOGS oxygen supply will be twice the normal amount.

2. Battery switch — CONFIRM ON.
3. Power cord — CONFIRM SECURELY PLUGGED IN.

If pusher fan still not operating:

4. Battery — REPLACE.

If pusher fan operation is restored:

5. H-Manifold switch — CLOSED (Vertical).

17.5.6 Airsickness

If Airsick and Vomiting - Into Mask:

1. Release the helmet chin strap and toggle harness adapter straps.
2. Pull orinasal mask away from face.

Note

CBR protection will still be maintained.

3. Allow the vomit to collect in the respirator assembly neck dam.
4. Reconnect the helmet chin strap and toggle harness adapter straps.

In The Event of Extreme Airsickness:

5. Helmet visor — RAISE.
6. Mask — RIPAWAY (Figure 17-10).

WARNING

CBR protection will be lost.

a. Locate and grasp ripaway D-ring.
b. Pull D-ring until hood rips and tab ribbon separates from hood.
c. Unsnap right-side toggle harness strap only.

WARNING

Unsnapping both toggle harness straps will allow the faceplate to fall and suspend from the hood and mask hose resulting in a snag hazard.

d. Rip faceplate away from face.

17.5.7 OBOGS Failure

1. H-Manifold switch — OPEN (Horizontal) (Figure 17-12).
2. Immediately descend below 10,000 feet cockpit altitude.

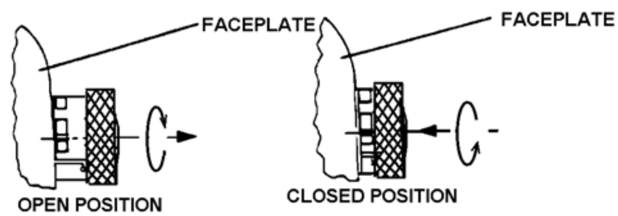


Figure 17-9. Hood Outlet Valve

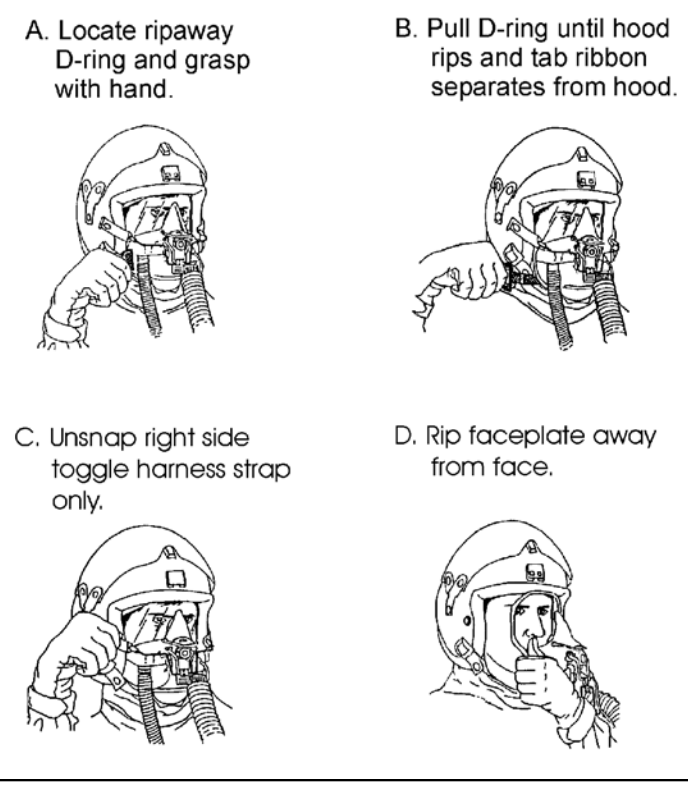


Figure 17-10. Orinasal Mask Ripaway Procedures

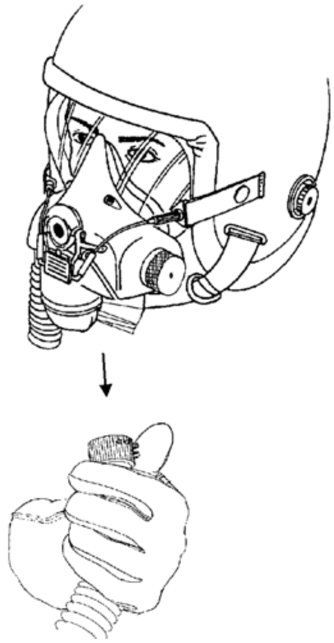


Figure 17-11. Anti-Suffocation Disconnect

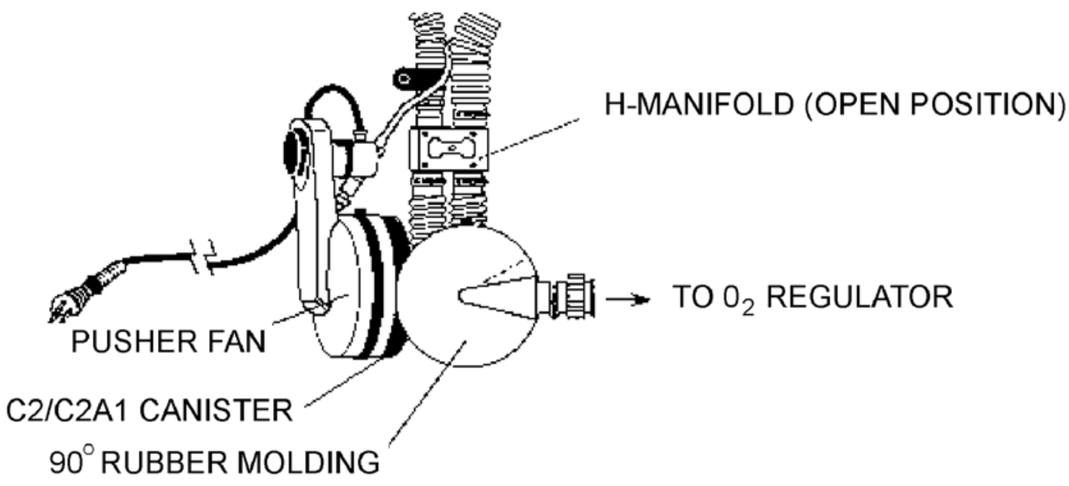


Figure 17-12. H-Manifold Switch

CHAPTER 18

Immediate Action Items

This chapter contains only immediate action items. It is intended for review only and does not contain any steps which are not immediate action nor does it contain notes, cautions, warnings, or explanatory matter associated with particular procedures.

18.1 ABNORMAL START

If the JPT rises rapidly between 350° and 400° (hot start), or if rpm stabilizes below idle (hung start), or if engine does not light off within 10 seconds after selecting idle (wet start):

*1. Throttle — OFF.

If wet start:

*2. Engine start switch — OFF.

18.2 LOSS OF ENGINE CONTROL ON GROUND

If engine RPM-JPT indications on EDP freeze at approximately 22 percent or display an abnormal indication during start, or if the voltmeter drops to zero when the DC test switch is set to STBY during standby TRU check, or during any undemanded engine acceleration:

*1. Throttle — OFF.

*2. Fuel shutoff handle — OFF.

18.3 EMERGENCY SHUTDOWN

*1. Throttle — OFF.

*2. Fuel shutoff handle — OFF.

*3. Engine start switch — OFF.

*4. APU GEN — OFF.

*5. Battery switch — OFF.

18.4 NWS CAUTION LIGHT (AFTER AFC-391)

TAKEOFF/LANDING ROLL OUT:

*1. Attempt to get airborne.

If unable to get airborne:

*2. Engage NWS button at minimum practical groundspeed.

18.5 BRAKE FAILURE/SKID CAUTION LIGHT

On ground:

*1. ANTISKID switch — NWS.

18.6 ABORT

18.6.1 Ashore (CTO or STO)

*1. Throttle — IDLE.

*2. Nozzles — BRAKING STOP.

*3. Throttle — AS REQUIRED.

*4. Brakes — AS REQUIRED.

18.6.2 Afloat

*1. Throttle — OFF.

*2. Brakes — FULL.

18.7 NO LIFTOFF ON STO ASHORE

*1. Nozzles — AFT.

*2. Increase speed 20 knots.

*3. Nozzles — STO STOP.

18.8 OVER ROTATION ON STO

*1. Stick — FULL FORWARD.

*2. Nozzles — REDUCE 20 DEGREES.

*3. Nozzles — STO STOP.

18.9 RPM STAGNATION/LOSS OF THRUST AFLOAT

If decision is made not to abort:

*1. MFS — SELECT.

*2. STO at nozzle rotation line.

*3. Stores — JETTISON (if required).

*4. Water switch — OFF.

18.10 L/R TANK WARNING LIGHT

18.10.1 During Air Refueling

*1. Break away.

18.10.2 During Hot Refueling

*1. Throttle — OFF.

18.11 FIRE

18.11.1 Ground Fire (Engine, GTS/APU, Brake)

*1. Execute Emergency Shutdown.

18.11.2 Takeoff/Landing/Vertical Operation

*1. Abort or land immediately.

*2. Execute Emergency Shutdown.

18.11.3 Inflight

*1. Nozzles — AFT AS SOON AS POSSIBLE.

*2. APU GEN — OFF.

*3. Master arm/gun — OFF.

*4. Throttle — MINIMUM REQUIRED.

If fire persists:

*5. EJECT.

18.12 OIL CAUTION LIGHT

*1. Throttle — MAINTAIN CONSTANT RPM.

a. 75 percent – 85 percent RPM (–406 engine).

b. 80 percent – 85 percent RPM (–408 engine).

18.13 DUAL DECS FAILURE (EFC WARNING LIGHT)

In V/STOL Flight (Takeoff/Approach/Landing) Time Critical:

*1. MFS — SELECT.

*2. Water switch — OFF.

In Conventional Flight:

*1. Throttle — IDLE.

*2. MFS — SELECT.

*3. Throttle — ADVANCE SLOWLY.

If unable to select MFS and sufficient power not available:

*4. EFC switch — CHANGE LANE.

18.14 LOSS OF ENGINE CONTROL INFLIGHT

In Conventional Flight:

*1. Menu – Engine – IGVs — MONITOR.

*2. Throttle — SLOWLY REDUCE TO IDLE.

If IGV failure indicated (stuck IGVs or wandering with constant throttle position):

*3. Execute IGV failure procedures.

If IGV failure not indicated:

*4. MFS — SELECT.

18.15 COMPRESSOR STALL

*1. Throttle — IDLE.

*2. AOA — REDUCE TO LEVEL FLIGHT AOA.

If JPT continues to rise; before 590 °C:

*3. Throttle — OFF.

18.16 AIRSTART

*1. Nozzles — AFT.

*2. Stores — JETTISON (if required).

*3. Throttle — OFF.

*4. Emergency oxygen actuator — PULL.

*5. MFS — AS REQUIRED.

*6. Airstart button — PRESS AND HOLD.

*7. Throttle — ADVANCE SLOWLY TO IDLE.

*8. JPT — MONITOR (475 °C MAX).

18.17 FLIGHT CONTROL MALFUNCTION

*1. Paddle switch — PRESS AND HOLD.

If condition not cleared (possible jammed flight controls):

*2. Transition to conventional flight as soon as possible.

18.18 REACTION CONTROL FAILURE

*1. Transition to conventional flight.

18.19 FLAP WARNING/UNCOMMANDED FLAP MOTION/UNCOMMANDED NOSE DOWN PITCH

*1. Nozzles — 40 DEGREES OR GREATER.

18.20 OUT-OF-CONTROL

18.20.1 Jetborne/Semi-Jetborne Out-of-Control Recovery

*1. Stick — FORWARD.

*2. Throttle — FULL.

*3. Stick — AGAINST ROLL.

*4. Rudder — AGAINST SIDESLIP.

If AOA not recovered and time and altitude permit:

*5. Nozzles — REDUCE 20 DEGREES.

When AOA recovered:

*6. Nozzles — AS REQUIRED.

SEE IC # 37

18.20.2 Out-of-Control/Spin/Falling Leaf Recovery

*1. Controls — NEUTRAL.

*2. Throttle — IDLE/OFF IF COMPRESSOR LOCKED IN STALL.

*3. Nozzles aft.

If spin positively confirmed after 2 turns with neutral controls:

*4. Rudder — FULL OPPOSITE SPIN DIRECTION.

*5. Aileron — FULL WITH SPIN IF UPRIGHT/NEUTRAL IF INVERTED.

If Falling Leaf positively confirmed after 5 seconds with neutral controls (TAV-8B and Radar aircraft only):

*6. Stick — FULL FORWARD.

When recovered:

*7. Initiate Airstart (if required).

*8. Nozzles aft.

If still out of control below 10,000 feet AGL:

*9. EJECT.

18.21 EMERGENCY DC BUS FAILURE

If above 10,000 feet cabin pressure.

*1. Emergency oxygen actuator — PULL.

*2. Descend below 10,000 feet cabin pressure.

With emergency oxygen activated or below 10,000 feet cabin pressure:

*3. DC test switch — SET TO STBY.

If power is not regained:

*4. DC test switch — SET TO MAIN.

18.22 CANOPY EXPLOSION INFLIGHT

*1. Emergency descent — IF REQUIRED.

*2. Lower seat — AS REQUIRED.

*3. Throttle — AVOID ABRUPT THROTTLE MOVEMENTS.

18.23 OXY CAUTION LIGHT

*1. Emergency oxygen actuator — PULL.

*2. Oxygen switch — OFF.

CHAPTER 19

Emergency Procedures Checklist Display

WARNING

Use of the emergency procedure checklist display without TAMMAC installed is not authorized.

In radar and night attack aircraft the emergency procedures checklist (EPC) display is selected by pressing the EMER pushbutton on the MENU display. The primary purpose of this display is to present selected digitized pages of emergency procedures from the NATOPS pocket checklist. The EPC pages are contained on data frames that reside in memory on the TAMMAC digital map computer. The EPC data frames are downloaded with the map theater from the MAP card in the AMU during a theater load.

19.1 EPC SELECTION

At power-up with weight-on-wheels, pressing EMER calls up the EPC menu (Figure 19-1). At any other time, pressing EMER calls up the last selected emergency subject and page. If the selected EPC has additional pages associated with it, as with the asymmetric stores chart (ASYM STR1), CONTINUED is displayed at the bottom of the page. The additional pages are selected by pressing the pushbutton for the next page in the subject sequence (ASYM STR2). Deselecting the emergency subject (boxed legend) recalls the emergency menu display.

If a frame is not available, NO FRAME is displayed in the center of the MPCD. If a frame is available but not yet ready for display, STBY is displayed in the lower left corner of the display while the frame is being called up.

When the EMER page is enabled, the MSC will disable any displayed maps (i.e. MAP is unboxed on the displayed map page's respective (MAPM)/EWM page). When the EMER page is exited, the map is enabled again. If a map is enabled while the EPC is displayed, the EMER page will be exited and the top level MENU page will be displayed.

19.2 UPDATING THE EPC

The date that the EPC was last updated is displayed centered on the EPC menu. The EPC is released during the normal Joint Mission Planning Station (JMPS) block upgrade cycle, and is updated as necessary. The EPC is updated in the TAMMAC DMC during a theater load.

Note

Once the EPC has been updated in JMPS, either through a block upgrade or an interim EPC update, the EPC must be loaded into the TAMMAC DMC by performing a theater load. Otherwise, the update will not display in the cockpit.

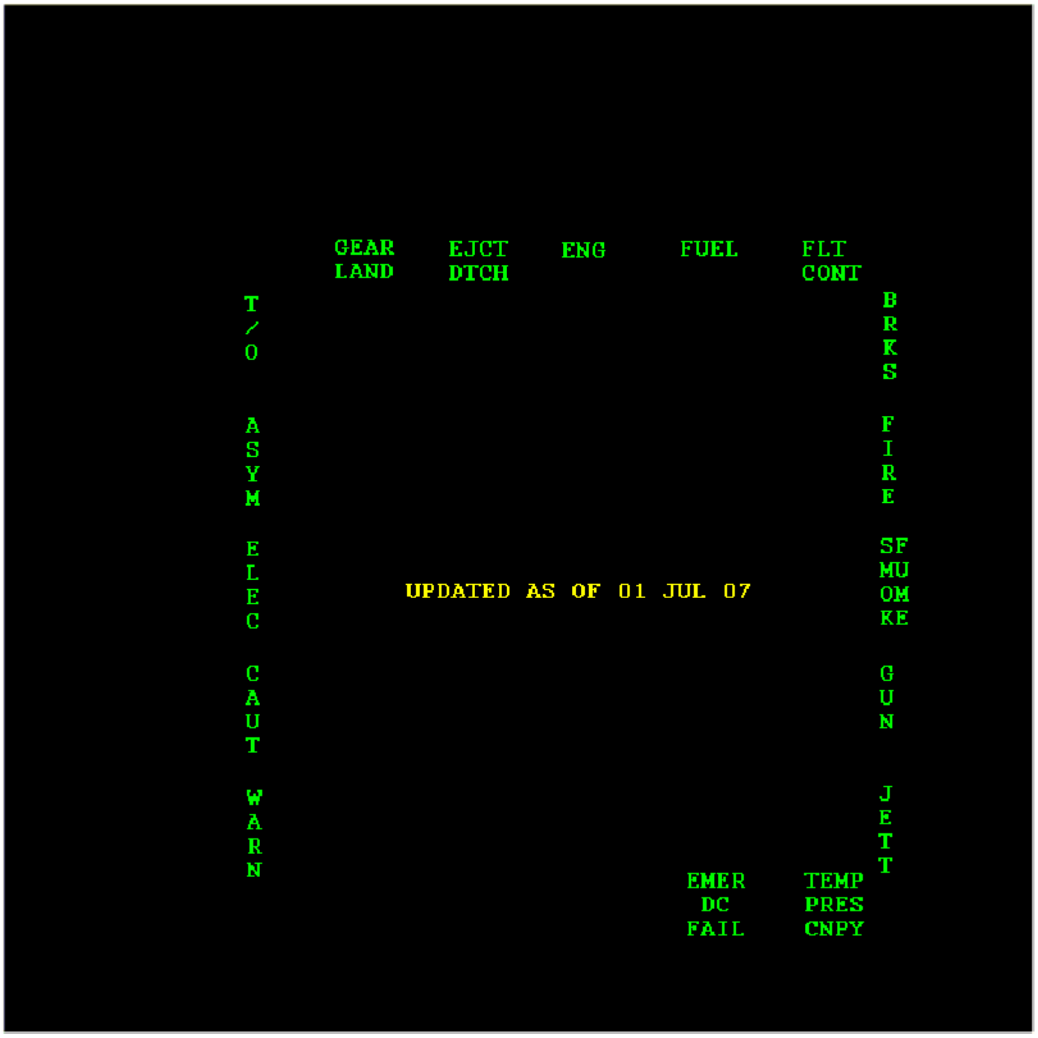


Figure 19-1. Emergency Procedures Checklist Display

PART VI

All–Weather Operation

CHAPTER 20

Instrument Procedures

20.1 SIMULATED INSTRUMENT PROCEDURES

Instrument flight is primarily a problem of time and distance navigation wherein all, or part, of the flight is conducted under instrument conditions. To complete a successful instrument flight, pilots must be properly prepared and have conducted the necessary planning. All pilots will maintain a current instrument rating and be guided by current OPNAV INSTRUCTION 3710.7 (General Flight and Operating Instructions for Naval Aircraft) and Federal Air Regulations.

20.1.1 Chase Plane Procedures

The chase pilot's duties on instrument flights are to act as lookout and to be a flight monitor. The best position for this is a loose tactical wing position where airspeed, attitude, and altitude may be monitored while maintaining a good lookout. During ground controlled approaches (GCA), the chase will fly a position as directed by GCA.

20.2 ACTUAL INSTRUMENT PROCEDURES

20.2.1 Instrument Flight

The ability of the aircraft to fly at slow speeds and to hover dictates some modification of standard instrument procedures.

It is recommended that certain critical operations such as shipboard IMC, restricted site, night, etc., be performed only with a fully functional head-up display. When flying aircraft with an ASN-130 and GPS into or through IMC, the aircraft should be flown with the INS in NAV. Also, the mission computer V/STOL master mode may be used in IMC in order to increase HUD attitude display reliability. Due to the way the INS information is translated for presentation in the HUD, the V/STOL master mode provides a more reliable IMC attitude presentation than the other master modes (NAV, AA, and AG). If INS velocity information begins to degrade, the other modes may present attitude information that is inaccurate. In IMC conditions this inaccurate presentation could result in an unrecognized spatial disorientation. This is a particular concern when operating the ASN-130 in a coupled mode with the GPS. Therefore, the V/STOL master mode should be the presentation of choice when flying in IMC conditions. Use of V/STOL will help to minimize attitude presentation errors when INS velocities are degrading and should provide a relatively stable attitude reference up to the point of INU failure.

20.2.1.1 Instrument Flight Planning

On instrument flights, delays in departure and descent and low climb rates to altitude are often required in high density control areas. These factors make fuel consumption and flight endurance critical. All instrument flights should be carefully planned and consideration given to the additional time and fuel which may be required. A complete weather briefing for all pilots on the flights will be obtained and the appropriate flight plan will be filed. For planning and filing purposes the AV-8B pilot should reference category C minimums (approach speeds of 121-140 knots). The pilot should file as an equipment code I in the equipment code block of the DD-175 (RNAV and transponder with mode C).

20.2.1.2 Before Starting Engine

When practical, an ATC clearance should be obtained before starting the engine.

20.2.1.3 Before Takeoff

It is essential that the instrument and navigation equipment be thoroughly checked prior to takeoff. INS ground speed should be checked when stopped to ensure minimum drift. Head up and head down displays should be cross checked. Selection of APU to ON is recommended.

20.2.1.4 Instrument Takeoff

Same as normal takeoff.

20.2.1.5 Instrument Climb

The simplified climb technique described in Part 4, Section XI of the Performance Chart Manual should be used to optimize fuel consumption and climb rates. Turns should be kept to a minimum during climb. Follow the clearance exactly as given. If unable to comply with the clearance, it is mandatory that ATC be advised immediately.

20.2.1.6 Penetration Procedures

Three to five minutes prior to making a descent, the cabin temperature control should be set at the maximum comfortable level and the cabin air switch should be set to MAX DEFOG to prevent the canopy from fogging up when descending to warmer altitudes. Instrument descent configuration should be based on wingman and aircraft limits. Selection of APU to ON is recommended during IMC. Contact approach control 10 minutes prior to ETA or as directed by ARTC, and conform to the provision of Section 2, Flight Planning Document. Three minutes prior to entering holding, adjust power to arrive at the holding fix with maximum endurance airspeed (230 knots maximum). Prior to descent, the pilot will check missed approach procedures and will obtain the latest weather information at the destination and at the alternate if required. Refer to Descent/Instrument Penetration procedures, Section III. Instrument descent configuration is briefed in consideration of wingmen and aircraft limits (recommend 250 knots, AUTO flaps, speedbrake, 8° to 10° AOA maximum on formation). Selection of APU to ON is recommended during IMC.

20.2.1.7 Radar Controlled Penetration

The approaches are basically the same as previously described with the following additions. The controlling activity will normally ask for turns or specific IFF squawks for positive identification. The controlling activity will advise of turns or headings which will produce the desired flight path. They will also advise as to distance from the destination and direct a descent to lower minimum altitudes as traffic and terrain permit.

20.2.1.7.1 GCA Approaches

Target 250 knots in the GCA pattern. Perform landing checks on base leg or as directed and maintain 8° to 10° AOA. One to two miles prior to intercepting the glide slope, select 25° nozzles and STOL flaps. Maintain 8° to 10° AOA on the glide slope until visual contact with the landing area is established. When visual contact is made, use nozzles as required to decelerate for the desired landing or take separation from wingman.

WARNING

The ability to counter nose down pitch with stick alone during flap programming and aileron droop may be significantly reduced due to decreased RCS pitch authority when the throttle is at minimum power. Abnormally fast approach speeds in combination with low throttle settings could lead to an unrecoverable condition if left unchecked in close proximity to the ground.

Note

- Be aware of flap programming if exceeding 25° nozzles and less than 165 knots while IMC. Flap programming can produce undesirable handling characteristics while IMC; however the added benefits of reduced groundspeeds may make the selection of nozzles greater than 25 and STOL flaps desirable.
- When wingman is a consideration, maintain airspeeds outside of the flap programming/droop transition range to ease wingman workload. AUTO flaps may also be utilized.

20.2.1.7.2 Minimum Fuel GCA

A minimum fuel GCA is flown by delaying gear extension until just prior to the descent point. The controller should notify the pilot when the aircraft is approximately 30 seconds from the glideslope. At this point, the aircraft is configured for landing, the checklist is completed and the remainder of the approach is flown normally.

20.2.2 Turbulent Air and Thunderstorm Operation

Intentional flight through thunderstorms should be avoided, because of the high probability of damage to the airframe by ice, hail, and lightning and possible compressor stall due to negative AOA encountered in turbulence. The aircraft is capable of climbing over the top of small and moderately developed thunderstorms. Thunderstorms have been reported to eject ice and lightning several miles from the buildup. Flight path should be planned accordingly.

20.2.2.1 Penetration

If necessary to penetrate, the basic structure of the aircraft is capable of withstanding the accelerations and gust loadings associated with the largest thunderstorms. The aircraft is stable and comparatively easy to control in the severe turbulence; however, the effects of turbulence becomes noticeably more abrupt and uncomfortable at airspeeds above optimum cruise and below 35,000 feet. The aircraft will not be displaced significantly from the intended flight path and desired heading. Altitude, airspeed, and attitude can be maintained with reasonable accuracy.

20.2.2.1.1 Penetration Airspeeds

The optimum thunderstorm penetration speeds, based on pilot comfort, controllability, and engine considerations are between optimum cruise and 280 knots. Engine rpm should be maintained below 85 percent to reduce compressor stall susceptibility.

20.2.2.2 Approaching the Storm

Adjust power to establish the recommended penetration speed (less than 85 percent). Do not try to top thunderstorms at the sacrifice of maintaining penetration speed. Flight through a thunderstorm at the proper airspeed and attitude is much more advantageous than floundering into the storm at a dangerously slow airspeed while attempting to reach the top. All cockpit lighting should be on at maximum brightness.

20.2.2.3 In the Storm

Maintain a normal instrument scan with added emphasis on the horizon bar. Attempt to maintain a constant pitch attitude and, if necessary, accept moderate altitude and airspeed fluctuations in heavy precipitation, a reduction in engine rpm may be necessary due to the increased thrust resulting from water ingestion. If compressor stalls or engine stagnation develop, attempt to regain normal engine operation by momentarily retarding the throttle to IDLE and then slowly advancing to the normal operating range. If the stall persists, shut down the engine and attempt a relight.

20.2.2.3.1 Angle-of-Attack System Failure

The angle-of-attack system may become temporarily inaccurate due to AOA probe icing with probe heat failure, or it may permanently fail due to structural damage of the probe from ice or hail. Icing of the AOA probe is usually characterized by zero angle of attack indication.

20.2.3 Ice and Rain

The possibility of engine and/or airframe icing is always present when the aircraft is operating under instrument conditions. Icing is most likely to occur when takeoffs must be made into low clouds with temperature at or near freezing. Normal flight operations are carried on above the serious icing levels, and the aircraft high performance capabilities will usually enable the pilot to move out of the dangerous areas quickly. When an icing condition is encountered, immediate action should be taken to avoid further accumulation by changing altitude and/or course and increasing the rate of climb or airspeed.

20.2.4 Hydroplaning

Operations on wet or flooded runways may produce three conditions under which tire traction may be reduced to an insignificant value.

1. Dynamic hydroplaning.
2. Viscous hydroplaning.
3. Reverted rubber skids.

Hydroplaning will not present a significant problem unless a conventional landing must be made. Nozzle braking is effective regardless of runway condition.

20.2.4.1 Dynamic Hydroplaning

As the tire velocity is increased, the hydrodynamic pressure acting on the leading portion of the tire footprint will increase to a value sufficient to support the vertical load acting on the tire. The speed at which this occurs is called total hydroplaning speed. This speed (in knots) can be computed by multiplying 9 times the square root of the tire pressure (105 knots for 135 psi tire pressure). Any increase in ground speed above this critical value lifts the tire completely off the pavement, leaving it supported by the fluid alone. Since the fluid cushion is incapable of sustaining any appreciable shear forces, braking and sideforce coefficients become almost nonexistent.

20.2.4.2 Viscous Hydroplaning

Viscous hydroplaning occurs due to the inability of the tire to penetrate the very thin fluid film found under damp runway conditions. This condition is aggravated when more viscous fluids such as oil, or road dust and water mixed are present, and is improved in the presence of a coarse textured runway surface. Viscous hydroplaning occurs at medium to high speed with rolling or skidding tires, and the speed at which it occurs is not dependent on tire pressure.

20.2.4.3 Reverted Rubber Skids

Reverted rubber skids occur after a locked-wheel skid has started on a wet runway. Enough heat may be produced to turn the entrapped water to steam. The steam in turn melts the rubber. The molten rubber forms a seal preventing the escape of water and steam. Thus the tire rides on a cushion of steam which greatly reduces the friction coefficient and may continue to do so to very low speeds.

20.3 UNUSUAL ATTITUDE RECOVERY

Unusual attitudes are entered due to pilot disorientation, vertigo, excessive task-loading, or unusual maneuvering while IMC. Timely recognition of an unusual attitude situation is paramount for achieving an effective recovery.

1. Altitude — CHECK.
2. Attitude and Airspeed — CHECK.

If nose-high, 200 to 300 KCAS:

3. Throttle — MAINTAIN THROTTLE SETTING.

If nose–high, 100 to 200 KCAS:

4. Throttle — FULL POWER.

Recovery:

5. Attitude — LOWER TO HORIZON.
6. ROLL TO UPRIGHT, WINGS–LEVEL (as required).

If nose–high, less than 100 KCAS:

7. Execute Out–of–Control procedures.

If nose–low:

8. Roll wings level and recover to horizon.

If airspeed exceeds 300 KCAS:

9. Throttle — IDLE.

WARNING

- If an unusual attitude situation occurs at low altitude, a timely ejection decision may be required based on altitude, attitude, airspeed, sink rate, and configuration.
- Ensure an inverted, nose–high attitude is not confused with an inverted, nose–low attitude.

CHAPTER 21

Extreme Weather Operation

Extreme weather operations include hot and cold ambient air temperatures and high altitudes, or combinations of both. Conditions are considered extreme when it becomes necessary to modify the normal shore-based procedures promulgated in Chapter 7. This chapter enumerates many considerations of extreme weather operations. However, the specific operating environment and mission requirements must be carefully assessed before modifying procedures in Chapter 7.

21.1 COLD WEATHER OPERATION

21.1.1 Preflight

Ensure that the aircraft is free of frost, snow, and ice. These accumulations present a major flight hazard resulting in loss of lift and increased stall speeds. Do not allow ice to be chipped or scraped from the aircraft: damage to the airframe may result. Inspect shock struts, actuating cylinders, pitot-static sources, and fuel vents for ice and dirt accumulation.

21.1.2 Interior Check

In temperatures below 0 °F, difficulty may be experienced when connecting the oxygen mask hose to the connector, due to a stiff O-ring in the connector. Application of a small amount of heat to the connector will alleviate this problem. Also, if the oxygen mask is not fastened, keep it well clear of the face to prevent freezing of the inhalation valves.

21.1.3 Engine Start

If any abnormal sounds or noises are present during starting, discontinue starting and apply intake duct preheating for 10 to 15 minutes.

21.1.4 Before Taxi

If the outside ambient air temperature is below freezing and the aircraft has not flown recently, initial movement of controls in the line should be mild and gradual for 3 to 5 minutes to minimize stress on possible frozen hydraulic lines and seals. Place the PROBE HEAT switch to HT prior to taxi to allow sufficient warmup time. Insufficient warmup time may result in erroneous airspeed and altitude displays and cause the system to improperly revert to POS/ADC in flight.

21.1.5 Taxiing

Avoid taxiing in deep or rutted snow; frozen brakes will probably result. Increase the interval between taxiing aircraft to insure a safe stopping distance and to prevent icing of the aircraft surfaces by the snow and ice melted by the jet blast of the preceding aircraft. Trim 4° ND to keep nose puffer duct closed.

21.1.6 Before Takeoff

During the engine runups, an ice-free area should be selected if possible. The engine thrust is noticeably greater at low temperatures and the probability of skidding the aircraft is likely. Engine performance will likely be RPM limited Use of power hex will preclude confusion regarding maximum corrected rpm power margins.

Note

- Certain environmental conditions may require modifications of established takeoff procedures (i.e., ice, snow, FOD, etc.).
- Certain items may not be safely accomplished while stationary due to ice, FOD, etc. (i.e., acceleration checks, duct pressure check, etc). When required these checks should be accomplished during taxi. If these checks cannot be completed, the operational necessity of the flight must be considered.

21.1.7 Landing

Perform an RVL or VL landing, if feasible, to reduce rollout distance.

21.1.8 Before Leaving Aircraft

Weather permitting, leave the canopy partially open to allow for air circulation. This will help prevent canopy cracking from differential cooling and decreases the possibility of windshield and canopy frosting.

21.2 HOT WEATHER OPERATION

Conditions associated with hot weather operations include high ambient temperatures, gusty winds, and blowing sand and dust. In addition to affecting engine performance, high temperatures adversely affect avionics systems, especially during ground operations when temperatures exceed 90 °F (32 °C). Due to decreased effectiveness of the ground cooling fan when temperatures exceed 90 °F (32 °C), minimize prolonged operation of avionics systems to avoid damage.

21.2.1 Ground Procedures

Avoid applying power to avionics systems until absolutely necessary based on mission requirements, airfield procedures (i.e. arming and dearming), and/or ground crew coordination. The TPOD, RADAR, IFF, TACAN and NAVFLIR should not be on for more than 10 minutes when the temperature exceeds 90 °F (32 °C) to prevent system damage and ensure proper airborne operation. Specifically, radar installation is divided between the forward and aft avionics bays. All radar components in the aft bay are mounted on the avionics shelf. With aircraft weight on wheels, the cooling air for the aft bay is ambient air drawn from the ram air inlet at the base of the vertical stabilizer by the aft avionics auxiliary cooling fan. Components in the forward bay are cooled by conditioned air from the forward ECS except the transmitter, which is cooled by liquid coolant. The radar liquid coolant is in turn cooled by conditioned air from the aft ECS in a heat exchanger located in the aft bay. At high ambient air temperature, cooling airflow to the aft equipment rack with weight on wheels may be insufficient to properly cool the RTDP and CPS. In this case, the radar may not successfully complete the ORT.

When the outside air temperature is reported to be greater than 90 °F, secure power to avionics equipment until ready for taxi. If verification of the avionics system(s) is required for the mission, apply power, allow the system to warm-up, execute the applicable BIT, and then secure power if a significant ground delay is expected.

21.2.2 Engine Start

Do not operate the engine in a sand or dust storm if avoidable. To initially increase the amount of cool air flow during engine start, allow rpm to build to 6 to 8 percent prior to selecting idle. Maintain JPT during engine start. With JP-4, high ambient temperature, and hot engine, an intermittent beat similar to the chuffing noise of a helicopter rotor may be emitted by the engine below about 50 percent rpm. Avoid prolonged operation in this condition.

21.2.3 Takeoff

The required takeoff distances and ground speed increases as air temperature increases. Acceleration checks may not have a valid time due to high idle rpm at high altitudes. Ensure takeoff does not exceed 180 knots ground speed to maintain tire limits (consider wet takeoffs). Note IGV band for appropriate temp range.

21.2.4 Landing

At high density altitudes, there will be high airspeeds associated with normal KCAS and AOA. Landing speed must remain below 180 knots ground speed. Reduce gross weight to maximum extent practical. At high density altitudes a compromise must be achieved between power committed to the total lift vector and maintaining an adequate margin for wave-off. Therefore, to reduce landing speeds and maintain wave-off capability, execute a STOL flap, VNSL landing, water armed. No later than the 180 position, select 50° nozzles and throttle to 104 percent. Gradually increase nozzle angle until 8 to 10 AOA achieved (this may be 50° to 70° depending upon conditions). At 50 feet, go to throttle and complete the landing.

21.2.5 Post Landing

Once the post-landing checks are complete and the aircraft is safely taxiing back for shutdown, initiate an AUTO BIT as soon as practical. As avionics components complete their BIT sequence, record any failure indications, and secure power to each component. Consider securing power to the following components as soon as practical: RADAR, NAVFLIR, IFF, TACAN, RWR, RADALT, and AWLS.

PART VII

Communications – Navigation Equipment and Procedures

CHAPTER 22

Communications

This chapter promulgates standards and procedures associated with administrative flight operations and the communications systems of the AV-8B. For information on the description, components, controls, displays, and modes of operations of communication systems, refer to NTRP 3-22.4-AV8B.

22.1 STANDARDS

22.1.1 Communication Brevity

Utilize communication brevity terms in accordance with MCRP 3-25B Multi-service Air-Air, Air-Surface, Surface-Air Brevity Codes published by the Air, Land, and Sea Application (ALSA) Center. Although brevity is preferable, do not sacrifice accuracy and/or clarity. If there is a possibility of misunderstanding, use plain language. Clear, concise, situational awareness enhancing communications is always the objective.

22.1.2 Priority Communications

The flight member with priority communication is the flight lead or the tactical lead. All other flight members will limit communications to that specific to safety-of-flight, mission accomplishment, or as directed. The division lead and/or section lead have priority communication.

22.1.3 Cockpit Management

With two operative radios, R/T 1 should be used for communications external to the flight and R/T 2 should be used for intra-flight communications and/or safety of flight frequencies.

22.1.4 Nomenclature

For directing actions referable to the aircraft radios (i.e. direct a frequency change) proper nomenclature is “Comm 1” and “Comm 2” respectively vice “#1/#2”, “front/back” or “left/right”.

22.1.5 Callsigns

All tactical radio transmissions will be initiated and acknowledged with full tactical callsigns. Do not abbreviate callsigns on the radio by using only the numbered portion, “Razor 11” vice “11.” Callsigns may be abbreviated using the flight callsign (“Razor”). Be diligent to ensure you do not clip your transmission. Key the Mike, pause, and then talk. Administrative transmissions (frequency changes/check ins) will be acknowledged with flight position number (“Razor 1, check”, “2, 3, 4”) on the same radio as the check-out/check in is initiated.

22.1.6 Directive and Descriptive Communications

Descriptive calls are started with your own callsign (“Razor 01, Joker”). Directive calls are started with the unit or aircraft addressed (“Razor 02, Break Right!”).

22.2 PROCEDURES

22.2.1 Communication Checks

If there are no alibis, the comm procedures will start when the flight lead initiates the Comm-Checks as depicted in Figure 22-1.

COMM-1	COMM-2
VMA TAC Freq (Single Channel Clear 21) **[2 mins prior to taxi]** **(Get Well Freq)** “Razor 51 – check Comm 1” "… 2, … 3, … 4" "Razor 51, push SECURE" **VMA TAC Freq (Single Channel Secure 21)** "Razor 51 - check" "Razor 52" “Razor 53" “Razor 54” Flight lead deselects Cipher on Channel 21 and states All other flight members deselect Cipher on Channel 21 and push Channel 25 **(VMA TAC Freq – Active Clear).** **VMA TAC Freq (Active Clear Channel 25)** "Razor 51 - check" "2, … 3, … 4" "Razor 51, PUSH 21 clear, Comm 1” "Razor 51 - check" "2, … 3, … 4" “Swap Radios” Flight selects 20 on Comm 1 and 21 on Comm 2	**Monitor Base / VMA Common Channel 20**
	VMA TAC Freq (Single Channel Clear 21) **(Get Well Freq)** “Razor 51 – check Comm 2” "… 2, … 3, … 4" "Razor 51, push SECURE" **VMA TAC Freq (Single Channel Secure 21)** "Razor 51 - check" "Razor 52" “Razor 53" “Razor 54” Flight lead deselects Cipher on Channel 21 and states "Razor 51, PUSH 25 Comm 2" All other flight members deselect Cipher on Channel 21 and push Channel 25 **(VMA TAC Freq – Active Clear).** **VMA TAC Freq (Active Clear Channel 25)** "Razor 51 - check" "2, … 3, … 4" The flight remains on Channel 25 for the remainder of the flight.
"Base Razor 51 flight is outbound, any words?" “Negative words, Good Flight" “Razor 51 push button 3 Comm 1” **Ground Control Channel 3** "Ground … Razor 51 flight of four taxi with information Alpha"	

Note: (1) If no communications within 15 seconds during comm checks, flight members POGO to Get Well.
(2) This example uses preset channels 21 and 25. If those are used by another flight, use secondary or tertiary VMA Tac frequencies.

Figure 22-1. Communication Checks

22.2.2 Frequency Changes

The standard format for a changing frequencies is: Callsign, Action, COMSEC status, Channel/Frequency/NET, RT assigned. Frequency changes are signaled by the term “PUSH” or “GO”.

- “PUSH” – Indicates positive check in only.
- “GO” – Positive check out and check in. If a wingman is known single radio, the standard is to use “GO” in order to confirm acknowledgement.
- “Clear” – Unencrypted, or un–secure.
- “Single–channel” – Singular frequency, non–hopping.
- “ACTIVE” – Anti–jam frequency hopping.
- “SECURE” – Encrypted, or secure.
- “Channel” – Implies a pre–set.
- “NET” – SINGARS, HQ I or II NET ID.

Example 1: “Razor 11, PUSH ACTIVE, clear, Channel 2, Comm–1” means the entire flight will meet on pre–set channel 2 anti–jam, clear.

Example 2: “Razor 11, PUSH 318.925, Comm–2” means the entire flight will meet on a manual inputted UHF frequency on comm.–2. Single–channel, un–secure is implied unless otherwise stated.

Example 3: “Razor 11, PUSH 318.925 SECURE, Comm–2” means the entire flight will meet on a manual inputted UHF frequency on comm.–2. The frequency will be encrypted.

22.2.3 Degraded Communications

22.2.3.1 Single Radio

If single radio, tune it to the R/T 1 planned frequencies unless otherwise briefed or directed.

22.2.3.2 Get Well

The frequency used whenever the flight becomes “lost lead on the radios.” If no transmission is received within 30 seconds after a frequency change, or during single radio operation, switch to the briefed “get well” frequency.

22.2.3.3 Microphone Failure

In the event of microphone failure, key the transmit button to communicate as follows:

- 1 click – “NO”
- 2 clicks – “YES”
- 3 clicks – “SAY AGAIN”

22.2.3.4 NORDO

References governing two–way radio failure procedures for a single aircraft are provided in Federal Aviation Regulations part 91 and the DOD Flight Information Handbook. These procedures do not alleviate a pilot to remain predictable in recovering NORDO (No radio) aircraft.

22.2.3.4.1 V/STOL Considerations

NORDO aircraft will attempt to execute recovery to the last known duty runway, or the primary runway for which an instrument approach is designated, in order to predictably enter the landing pattern. If unable to determine the duty runway, select MENU–DATA–AC to attempt to estimate wind velocity. Additionally, conduct a search for other aircraft, blowing smoke or other physical signs of wind velocity. If the crosswind component for a rolling landing cannot be reasonably ascertained, then execute a vertical landing.

22.2.3.4.2 Formation NORDO Recovery

In formation, a NORDO aircraft will normally fly a wingman position unless other conditions dictate that the NORDO aircraft assume or retain the lead. If the flight was larger than a section, the remainder of the flight will separate and execute the mission or return to base as briefed.

22.2.3.4.3 NORDO as Wingman

In the event the wingman loses the capability to communicate, the NORDO aircraft will join on the flight lead, collapse into parade formation, and use hand and arm signals to communicate the aircraft status. Or if separated, proceed to the briefed Lost Communication/Lost Lead rendezvous point and hold as briefed. If join-up does not occur, return-to-base as a single aircraft once JOKER fuel is reached.

Once joined, point at the mask and ear independently with a follow on thumbs-up or thumbs-down to indicate the capability to transmit and/or receive respectively. No HEFOP signal will indicate that the only problem is with the radios. The NORDO aircraft will remain as the wingman during recovery.

If an emergency occurs, utilize standard HEFOP hand or light signals (see Figure 22-2). During the day, the NORDO aircraft will give a weeping signal and then indicate with number of fingers associated with the affected system. At night, the NORDO aircraft will use the flashlight. Holding the flashlight close to the top of the canopy and pointed toward the wingman, the NORDO aircraft will signal his wingman the affected system with 1 to 5 dashes as appropriate.

22.2.3.4.4 NORDO as Lead

If the NORDO aircraft is the flight lead, then the lead pilot will rock his wings to "knock-off" the training and maneuver his aircraft to collapse the flight into a parade formation. Or if separated, proceed to the briefed Lost Communication/Lost Lead rendezvous point and hold as briefed. If join-up does not occur, return-to-base as a single aircraft once JOKER fuel is reached. Once joined, the lead pilot will communicate his status via hand and arm signals, pass the lead, and remain as the wingman during recovery.

22.2.3.4.5 Recovery Procedures

The standard recovery is a straight-in section approach to an appropriate roll-on landing. If a vertical landing is needed, the NORDO pilot will signal the lead this requirement with an open hand, palm down, up and down motion. For dual runway airfields, lead shall position the NORDO aircraft on the left or right wing to correspond to the left or right runway in use. The lead will, at a minimum, clear the flight to land on the duty runway and all available pads.

To change configurations during the day, use the hand and arm signals as depicted in Figure 22-2. In all cases, the NORDO aircraft should attempt to match the escort's configuration for approach to landing. If an IMC approach is anticipated and situation permits, configure the flight for landing before encountering IMC.

When the flight is cleared to land, the lead will indicate clearance to land via passing the lead to the NORDO aircraft. The NORDO aircraft will consider the landing clearance is valid unless the escort flies past the NORDO aircraft with his landing gear retracted and anti-collision light off. In this event, the NORDO aircraft will initiate a wave-off and rejoin the escort as wingman.

22.2.3.4.6 Night Considerations

The NORDO aircraft signals lost communications by cycling the exterior lights master switch and collapses the flight. Once the flight is joined, the NORDO aircraft keeps the anti-collision light on and slides aft into parade position. The non-NORDO aircraft assumes the lead and extinguishes the anti-collision light to signal taking the lead.

Light signals to configure the aircraft to land are depicted in Figure 22-2. With clearance to land, the lead aircraft will illuminate the anti-collision light signaling the NORDO aircraft is cleared to land and has the lead. The escort aircraft will then detach to monitor the NORDO aircraft's landing. If clearance for landing is revoked, the escort flies by the NORDO aircraft with landing gear retracted and the NORDO aircraft should execute a wave-off and rejoin on lead. The NORDO aircraft should attempt to match the escort's configuration during the wave-off.

22.2.4 Loading GPS time for HAVEQUICK and SINGCARS

1. 1. Ensure both C1 and C2 are in FF or MX channelization mode.

Note

MX channelization is only valid if the mixed list frequencies are mapped to the fixed frequency list.

2. Select MENU-COMM on the MPCD.
3. Select HQ (PB14) on the COMM card page.
4. Select GPS (ODU option 4) to set GPS time in both radios.
5. Set both C1 and C2 to AJ channelization mode and a valid AJ preset.
6. Verify that TIME, DAY and FILL indication is blank on HQ TIME page.
7. Deselect HQ (PB 14) and verify GPS time is displayed under the upper COMM 1 and COMM 2 label of the FF, AJ or MX COMM Card.

Note

GPS must be on-line and GPS time valid.

22.2.5 Time of Day Operations for HAVEQUICK

1. Select MENU-COMM on the MPCD.
2. Select HQ (PB14) on the COMM card page.
3. Select TIME (PB6) on the MPCD (if not already boxed).
4. ODU Selection:
   a. Select XMT (ODU option1) then C1 or C2 (ODU option 4 and 5) to transmit the time of day using the desired radio (COMM1 or COMM 2).
   b. Select RCV (ODU option 2) to receive the time of day.
   c. Select TRST (ODU option 3) then ACPT (ODU option 4) to reset the time or REJ (ODU option 5) to cancel TRST.

Note

Prior to XMT or RCV operations, the radio(s) must be set to the proper FF or MX preset (user defined or pointed to FF preset).

22.2.6 Time of Day Operations for SINGCARS

1. Ensure both C1 and C2 are set to AJ channelization mode and the preset is set to a SINGCARS Net.
2. Select MENU-COMM on the MPCD.

3. Select SG (PB13) on the FF, AJ or MX COMM Cards.
4. Select TIME (ODU option 3) if not already colonized.
5. Enter the desired day and time to the minute.

Note

A two digit entry changes the minutes, a four digit entry changes the hour and minutes, and a six digit entry changes the day, hour, and minutes.

22.2.7 HAVEQUICK MWOD Operations

1. Select MENU-COMM from the MPCD.
2. Select HQ (PB14) from the FF, AJ or MX COMM Card.
3. Select MWOD (PB7) on the MPCD (if not already boxed).
4. Program:

To program MWOD:

a. Select MWOD (ODU option 1).

b. Program all segments (20-15) and the Day (segment 14) and select LOAD (PB11).

To load Day into the radios:

c. Select LDAY (ODU option 2).

d. Enter the date to be loaded (0-31).

Note

A 1000 Hz tone is heard in the headset indicating that the day had been loaded and accepted in the radios.

To verify that a radio has an MWOD loaded for a specific day:

e. Select VDAY (ODU option 3).

f. Enter the date to be checked (0-31).

g. Select C1 or C2 (for COMM 1 or COMM 2 in ODU windows 4 and 5).

Note

- A 1000 Hz tone is heard in the headset indicating that the current radio has a valid MWOD loaded.
- Tones must be enabled to hear the associated 1000 Hz tones. From the AJ or MX COMM Cards, COMM 1 (PB20) and COMM 2 (PB17) must be unboxed.

22.2.8 Electronic Remote Fill (Cold Start)

1. Select CS (Coldstart frequency) using the channel select knob.
2. Colonize CS (ODU option 5).

3. Select HSET (ODU option 3) or LSET (ODU option 4), whichever is to be received or transmitted.
4. Receive/Send:

To receive ERF data:

a. Enter the AJ preset where the ERF data is to be stored and select RCV.

Note

A 1000 Hz tone indicates successful storage of the ERF data.

To send ERF data:

b. Enter the preset of the data to be transmitted in the UFC.

c. Select HSET or LSET the select XMIT.

Note

XMIT is briefly cued and the transmission is heard in the headset.

5. Repeat step 4 as necessary.

22.2.9 Mixed Mode Editing

1. Press the desired radio knob to activate the UFCs.
2. Cycle ODU option 5 to MX.
3. Select MENU — COMM on the MPCD.
4. Select MX (PB9) on the COMM page.
5. Select the preset to be changed using the channel select knob or direct access entry.
6. Select EDIT (PB15) or re-enter the selected channel to activate the ODU for channel editing.
7. Select FF, AJ or UD on the ODU as desired.
8. Enter the desired Channel, Net ID, or frequency.
9. Repeat steps 4-7 as necessary.

22.2.10 Comm Alert Mode Procedures

The following are the procedures for comm. alert mode:

1. Battery switch — ALERT.
2. ACNIP controls — SET.

a. Successively actuate the code/mode switch to MODE until PL is displayed in KY 1 or 2 windows.

b. Baseband/diphase switches 1 and 2 — BB.

c. Ground and auxiliary volume control knobs — AS DESIRED.

d. Microphone switch — COLD or HOT.

e. MODE switch — MAN.

3. V/UHF RSC — SET.
    a. Squelch switch — SQL.
    b. UHF mode selector switch — AS REQUIRED.
    c. Brightness control knob — AS DESIRED.
    d. Frequency mode selector knob — MAN.
    e. Mode selector knob — T/R OT T/R + G.
4. UFC comm. 1 and 2 volume control knobs — AS DESIRED.
5. RSC frequency slew switches — SET DESIRED FREQUENCY.
6. PRGM switch — 1 or 2.
7. RSC mode selector knob — OFF (to conserve power); T/R OR T/R + G (to change frequency then OFF).

For KY-58 operations:

8. Successively actuate ACNIP code/mode switches to MODE until CY is displayed in KY 1-2 window.
9. Successively actuate ACNIP code/mode switches to CODE until desired code is displayed in KY 1 or 2.

22.2.11 Built-In-Test

BIT should be initiated anytime the FREQ/(CHAN) display blanks or indicates an erroneous readout. BIT is performed as follows:

Note

BIT will fail if radio transmissions received during test.

1. To avoid reception, insert the frequency of an unused channel and key both comm. 1 and comm. 2.
2. MODE selector switch — TEST.
3. PRGM switch — 1.
4. BIT requires approximately 5 to 8 seconds, observe FREQ/(CHAN) display. No fault is indicated by 888.888.
5. MODE selector switch — T/R.
6. PRGM switch — 1.

Steady tone in headset stops.

7. Repeat the procedure for position 2 on the PRGM switch.

22.2.12 KY-58 Operation

With control-monitor set:

1. ACNIP controls — SET.
    a. Baseband/diphase switch — BB.
    b. MODE switch — UFC.

2. ODU — SET.

   a. Option 4 pushbutton — PRESS TO CIPH (tone heard).

      On some aircraft, the tone is momentary and is automatically cleared. On other aircraft, the tone must be cleared by pressing the comm. switch.

   b. Option 5 pushbutton — PRESS (code displayed on scratch pad).

3. Comm switch — PRESS (tone stops).

With ACNIP controls:

4. ACNIP controls — SET.

   a. MODE switch — MAN.

   b. Successively actuate the code/mode switches to MODE until CY is displayed in KY-1/KY-2 window.

   c. Successively actuate the code/mode switches to CODE until desired code is displayed.

22.3 VISUAL COMMUNICATIONS

Communications between aircraft are visual whenever practical. Flight leaders shall ensure that all pilots in the formation receive and acknowledge signals when given. The visual communications chapters of NAVAIR 00-80T-113 should be reviewed and practiced by all pilots. Common visual signals applicable to flight operations are listed in Figure 22-2.

22.3.1 Deck/Ground Handling Signals

Communications between aircraft and ground personnel are visual whenever practical, operations permitting. The visual communications chapters of Aircraft Signals NATOPS Manual (NAVAIR 00-80T-113) should be reviewed and practiced by all flightcrew and groundcrew personnel. For ease of reference, visual signals applicable to deck/ground handling are listed in Figure 22-3. During night operations, wands shall be substituted for hand and finger movements.

GENERAL SIGNALS

SIGNAL		MEANING	RESPONSE
DAY	NIGHT		
Thumbs up, or nod of head. Thumbs down, or turn of head from side to side.	Flashlight moved vertically up-and-down repeatedly. Flashlight moved horizontally back-and-forth repeatedly.	Affirmative. ("Yes," or "I understand.") Negative. ("No," or, "I do not understand.")	
Hand cupped behind ear as if listening.		Question. Used in conjunction with another signal, this gesture indicates that the signal is interrogatory.	As appropriate.
Hand held up, with palm outward.		Wait.	
Employ fingers held vertically to indicate desired numerals 1 through 5. With fingers horizontal, indicate number which added to 5 gives desired number from 6 to 9. A clenched fist indicates 0. (Hold hand near canopy when signaling).		Numerals as indicated.	A nod of the head ("I understand"). To verify numerals, addressee repeats. If originator nods, interrogation is correct. If originator repeats numerals, addressee should continue to verify them until they are understood.
Make hand into cupshape, then make repeated pouring motions.		I am going to dump fuel.	
Slashing motion of index finger across throat.		I have stopped dumping fuel.	
Raised fist with thumb extended in drinking position.		How much fuel have you?	Indicate remaining fuel in hundreds of pounds by finger numbers.

Figure 22-2. Visual Communications (Sheet 1 of 11)

CONFIGURATION CHANGES

SIGNAL		MEANING	RESPONSE
DAY	NIGHT		
Rotary movement of clenched fist in cockpit as if cranking wheels, followed by head nod.	Rotary motion of flashlight.	Lower or raise landing gear and flaps to STOL/AUTO, as appropriate.	Execute when leader changes configuration.
Forearm held vertically while nodding, clenched fist followed by extending number of fingers for each 10° of nozzle rotation.	Horizontal movement of flashlight followed by number of flashes for each 10° of nozzle.	Rotate nozzles.	Execute when leader changes configuration.
Open and close four fingers and thumb.		Extend or retract flaps, as appropriate.	Execute upon head nod from leader or when leader's flaps extends/retract.
Rapid opening and closing four fingers and thumb.		Extend or retract speed brake as appropriate.	Execute upon head nod from leader or when leader's speedbrake extends/retracts.

Figure 22-2. Visual Communications (Sheet 2)

ARMAMENT

SIGNAL		MEANING	RESPONSE
DAY	NIGHT		
1. Pistol-cocking motion with either hand. 2. Followed by question-signal. 3. Followed by thumbs-down signal.		1. Ready or safety guns. 2. How much ammo do you have? 3. I am unable to fire.	Repeat signal, and execute. Thumbs up-“over half”; thumbs down-“less than half.” Nod head (“I understand”).
1. Shaking fist. 2. Followed by question-signal. 3. Followed by thumbs-down signal.		1. Arm or safety bombs, as applicable. 2. How many bombs do I have? 3. I am unable to drop.	1. Repeat signal and execute. 2. Indicate with appropriate finger-numerals. 3. Nod head (“I understand”).
1. Shaking hand, with fingers extended downward. 2. Followed by question-signal. 3. Followed by thumbs-down signal.		1. Arm or safety missile/rockets as applicable. 2. How many missiles/rockets do I have? 3. I am unable to fire.	1. Repeat signal and execute. 2. Indicate with appropriate finger-numerals. 3. Nod head (“I understand”).
Pistol-cocking motion with either hand, followed by fore and aft pulling motion with a clenched fist.	1. Rotating beacon ON and OFF by lead aircraft. 2. Rotating beacon turned ON for second time (allow time for setting up switches).	Jettison external stores: 1. Set up your switches for jettison. 2. Your are cleared to drop.	Repeat signal and execute: 1. Set up jettison ordnance switches. 2. Execute.
Pistol-cocking motion followed by head nod.		Expendable check. First head nod for flares, second head nod for chaff.	Wingman replies with thumbs up or down for each head nod.

Figure 22-2. Visual Communications (Sheet 3)

MALFUNCTIONING EQUIPMENT (HEFOP CODE)

SIGNAL		MEANING	RESPONSE
DAY	NIGHT		
Weeping signal and then indicating by finger-numbers 1 to 5 the affected system.	Flashlight held close to top of canopy, pointed toward wingman, followed by 1 to 5 dashes to indicate system affected.	Number of fingers or dashes means: 1. Hydraulic system. 2. Electric system. 3. Fuel system. 4. Oxygen system. 5. Power.	Day; not, or thumbs up (“I understand”). Night; Vertical movement of flashlight. Pass lead to disable plane or assume lead, if indicated.

Figure 22-2. Visual Communications (Sheet 4)

ELECTRONIC COMMUNICATIONS AND NAVIGATION

SIGNAL		MEANING	RESPONSE
DAY	NIGHT		
Tap earphones, followed by patting of head, and point to other aircraft.		Take over communications.	Repeat signals, pointing to self, and assume communications lead.
Tap earphones, followed by patting of head.		I have taken over communications.	Nod (“I understand”).
Tap earphones and indicate by finger-numerals, number of channel to which shifting.		Shift to radio frequency indicated by numerals.	Repeat signal and execute.
Tap earphones, followed by question signal.		What channel (or frequency) are you on?	Indicate channel (or frequency) by finger-numerals.
Vertical hand, with fingers pointed ahead and moved in a horizontal sweeping motion, with four fingers extended and separated.		What is bearing and distance to the tacan station?	Wait signal, or give magnetic bearing and distance with finger-numerals. The first three numerals indicate magnetic bearing and the last two or three, distance.

Figure 22-2. Visual Communications (Sheet 5)

FORMATION

SIGNAL		MEANING	RESPONSE
DAY	NIGHT		
Open hand held vertically and moved forward or backward, palm in direction of movement.		Adjust wing position forward or aft.	Wingman moves in direction indicated.
Open hand held horizontally and moved slowly up or down, palm in direction of movement.		Adjust wing position up or down.	Wingman moves up or down as indicated.
Open hand used as if beckoning inboard or pushing outboard.		Adjust wing position laterally toward or away from leader.	Wingman moves in direction indicated.
Hand opened flat and palm down, simulating dive or climb.		I am going to dive or climb.	Prepare to execute.
Hand moved horizontally above glareshield, palm down.		Leveling off.	Prepare to execute.
Head moved backward.		Slow down.	Execute.
Head moved forward.		Speed up.	Execute.
Head nodded right or left.		I am turning right or left.	Prepare to execute.
Thumbs waved backward over shoulder.		Take cruising formation or open up.	Execute.
1. Holds up right (or left) forearm vertically, with clenched fist or single wing-dip. 2. Same as above, except with pumping motion or double wing-dip.		1. Wingman cross under to right (or left) echelon or in direction of wing-dips. 2. Section cross under to right (or left) echelon or in direction of wing-dips.	1. Execute. 2. Execute.

Figure 22-2. Visual Communications (Sheet 6)

FORMATION (CONT)

SIGNAL		MEANING	RESPONSE
DAY	NIGHT		
Triple wing-dip.		Division cross under. Form a Vee or balanced formation.	Execute. Execute.
Porpoising of aircraft.		Close up or join up; join up on me.	Execute.
Lead patting shoulder.		Airborne: Join in parade Ground: Section taxi.	Execute.
Rocking of wings by leader.		Prepare to attack.	Execute preparation to attack.

Figure 22-2. Visual Communications (Sheet 7)

TAKEOFF, CHANGING LEAD, LEAVING FORMATION, BREAKUP, LANDING

SIGNAL		MEANING	RESPONSE
DAY	NIGHT		
1. Flight leader or wingman signal one finger. 2. Flight leader or wingman signal thumbs up. 3. Flight leader or wingman signal two finger. 4. Flight leader nods head.	1. Flight leader/wingman turn approach light on. 2. Flight leader/wingman turn approach light off. 3. Flight leader or wingman turn approach light on. 4. Flight leader turns exterior master switch off and back on.	1. I have completed my takeoff checklist and I am ready for takeoff. 2. I am in position for takeoff. 3. I have completed my two finger checks. 4. When head touches headrest, I will begin takeoff roll.	1. Return signal to flight leader/wingman when ready for takeoff. 2. Return signal to flight leader/wingman when in position for takeoff. 3. Return signal to flight leader/wingman when two finger checks are complete. 4. Execute.
1. Leader pats self on the head, points to wing.	1. Lead aircraft cycles rotating beacon ON/OFF. 2. If external lights are inoperative, leader shines flashlight on hard-hat, then shines light on wingman.	Leader shifting lead to wingman.	1. Wingman pats head and assumes lead. 2. Wingman turns rotating beacon OFF and assumes lead. 3. If external lights are inoperative, wingman shines flashlight at leader, then on his hard-hat and assumes lead.
Leader pats self on head and holds up two or more fingers.		Leader shifting lead to division designated by numerals.	Wingman relays signal; division leader designated assumes lead.
Pilot blows kiss to leader.		I am leaving formation.	Leader nods (“I understand”) or waves good-bye.
Leader blows kiss and points to aircraft.		Aircraft pointed out leave formation.	Wingman indicated blows kiss and executes.

Figure 22-2. Visual Communications (Sheet 8)

TAKEOFF, CHANGING LEAD, LEAVING FORMATION, BREAKUP, LANDING (CONT)

SIGNAL		MEANING	RESPONSE
DAY	NIGHT		
Leader points to wingman, then points to eye, then to vessel or object.		Directs plane to investigate object or vessel.	Wingman indicated blows kiss and executes.
Division leader holds up and rotates two fingers in horizontal circle, preparatory to breaking off.		Section break off.	Wingman relays signal to section leader. Section leaders nods ("I understand") or waves good-bye and executes.
Leader describes horizontal circle with forefinger.	Series of I's in code, given by external lights.	Breakup (and rendezvous).	Wingman take lead pass signal after leader breaks, and follows.
Landing motion with open hand: 1. Followed by patting head. 2. Followed by pointing to another aircraft. **Note** Landing motion with open hand can be modified to signal a roll-on landing or vertical landing.	Lower landing gear: 1. Followed by selection of approach light ON. 2. Selection of approach light ON.	Refers to landing of aircraft, generally used in conjunction with another signal. 1. I am landing. 2. Directs indicated aircraft to land.	 1. Nods. ("I understand") or waves goodbye. 2. Aircraft indicated repeats signal, blows a kiss and executes.

Figure 22-2. Visual Communications (Sheet 9)

ARMING

SIGNAL		MEANING	RESPONSE
DAY	NIGHT		
1. Arming supervisor: Hands over head.	Same.	Pilot: Check all armament switches OFF and SAFE.	Pilot: Execute. Raise both hands to view of arming supervisor after checking switch position. (Hands remain in view during check and hook-up.)
2. Arming supervisor points at crew member (used if applicable).	Same.	Crew: Perform stray voltage checks.	Arming crew: Execute. Give arming supervisor THUMBS UP if no stray voltage exists.
3. Arming supervisor; raises fist, thumb extended upward, to meet horizontal palm of other hand.	Same.	Arming crew: (as applicable). Hook up rocket pigtails and/or arm 20 MMs.	Arming crew: Execute. Give arming supervisor THUMBS UP when arming completed and clear immediate area.
4. Arming supervisor gives pilot: a. Thumbs up. b. Thumbs down.	Same.	a. Aircraft is armed and all personnel and equipment clear of area. b. Aircraft is down.	a. Hold until arming crew clear of arming. b. Return to line.
5. Arming supervisor gives pilot: Rotating hand with index finger and pinkey extended.	Arming supervisor gives pilot: Rotating horizonal wand.	Apply/secure generator power.	Repeat signal. Turn on/off generator.

Figure 22-2. Visual Communications (Sheet 10)

DEARMING

SIGNAL		MEANING	RESPONSE
DAY	NIGHT		
1. Dearming supervisor: Hands over head.	Same.	Pilot: Check all armament switches OFF or SAFE.	Pilot: Execute. Raise both hands to view of dearming supervisor after (checking switch positions). (Hands remain in view during dearming.)
2. Dearming supervisor points at crew member.	Same.	Crew: Disconnect rocket pigtail and/or disconnect feed mech air supply hose, clear rounds from feed mech throat. (If jammed, also disconnect electrical lead to feed mech to disable firing circuit). Comply with appropriate local and technical instructions for the type armament concerned.	Crew: Execute.
3. Dearming supervisor give pilot: Thumbs-up.	Same.	Pilot: Aircraft is dearmed and crew and equipment clear of aircraft.	Pilot: Hold until arming crew clear of arming area - then return to line.

Figure 22-2. Visual Communications (Sheet 11)

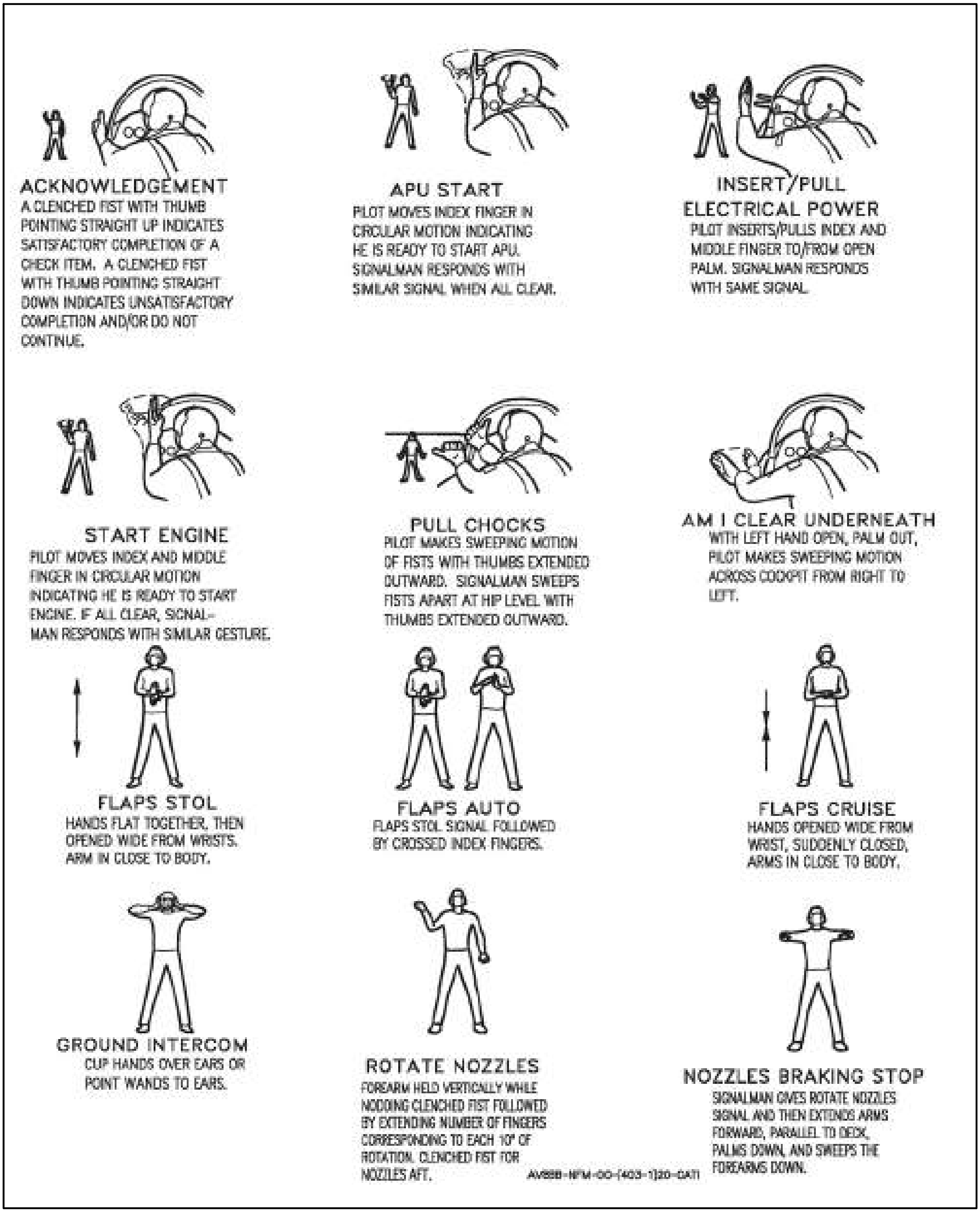


Figure 22-3. Deck/Ground Handling Signals (Sheet 1 of 3)

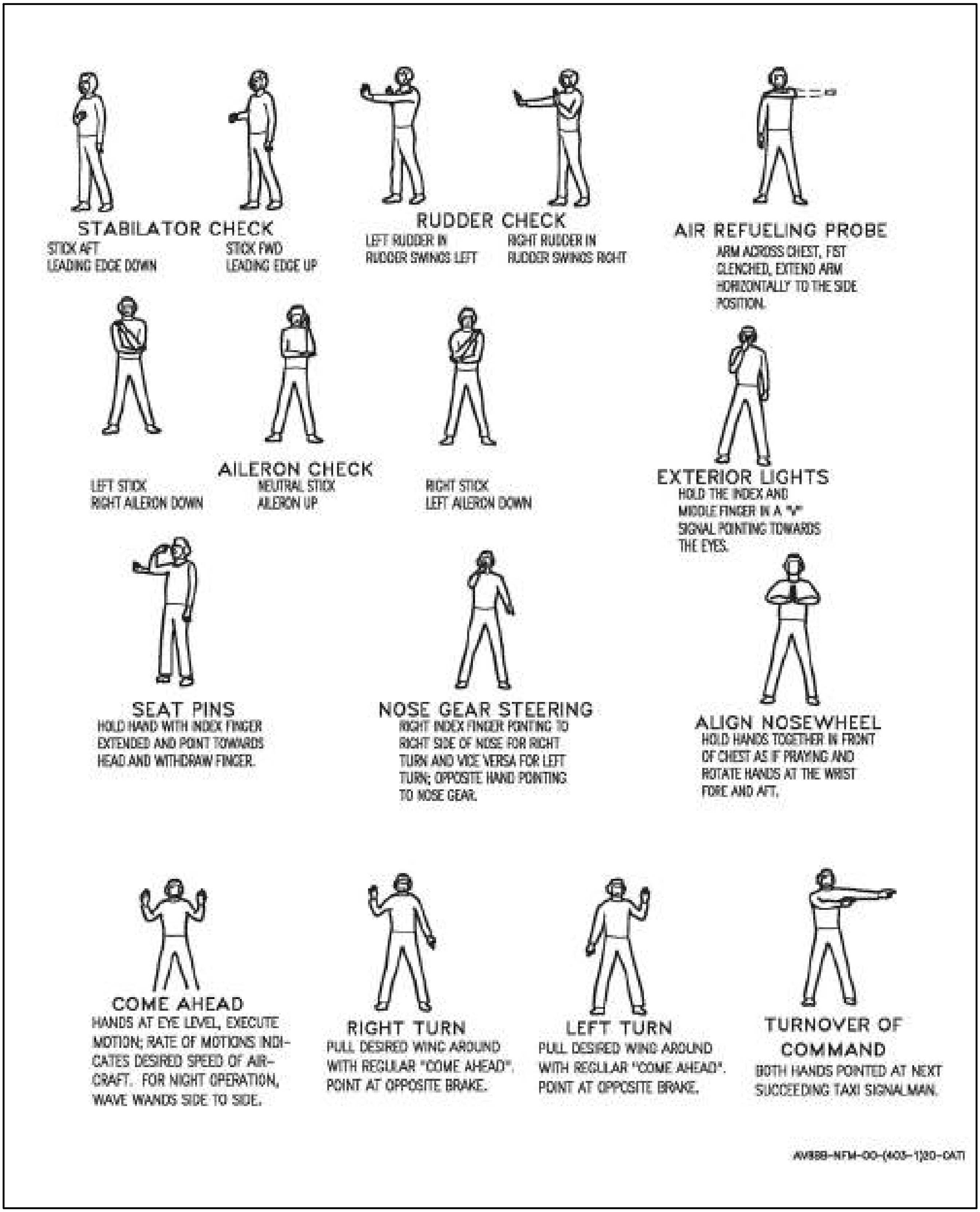


Figure 22-3. Deck/Ground Handling Signals (Sheet 2)

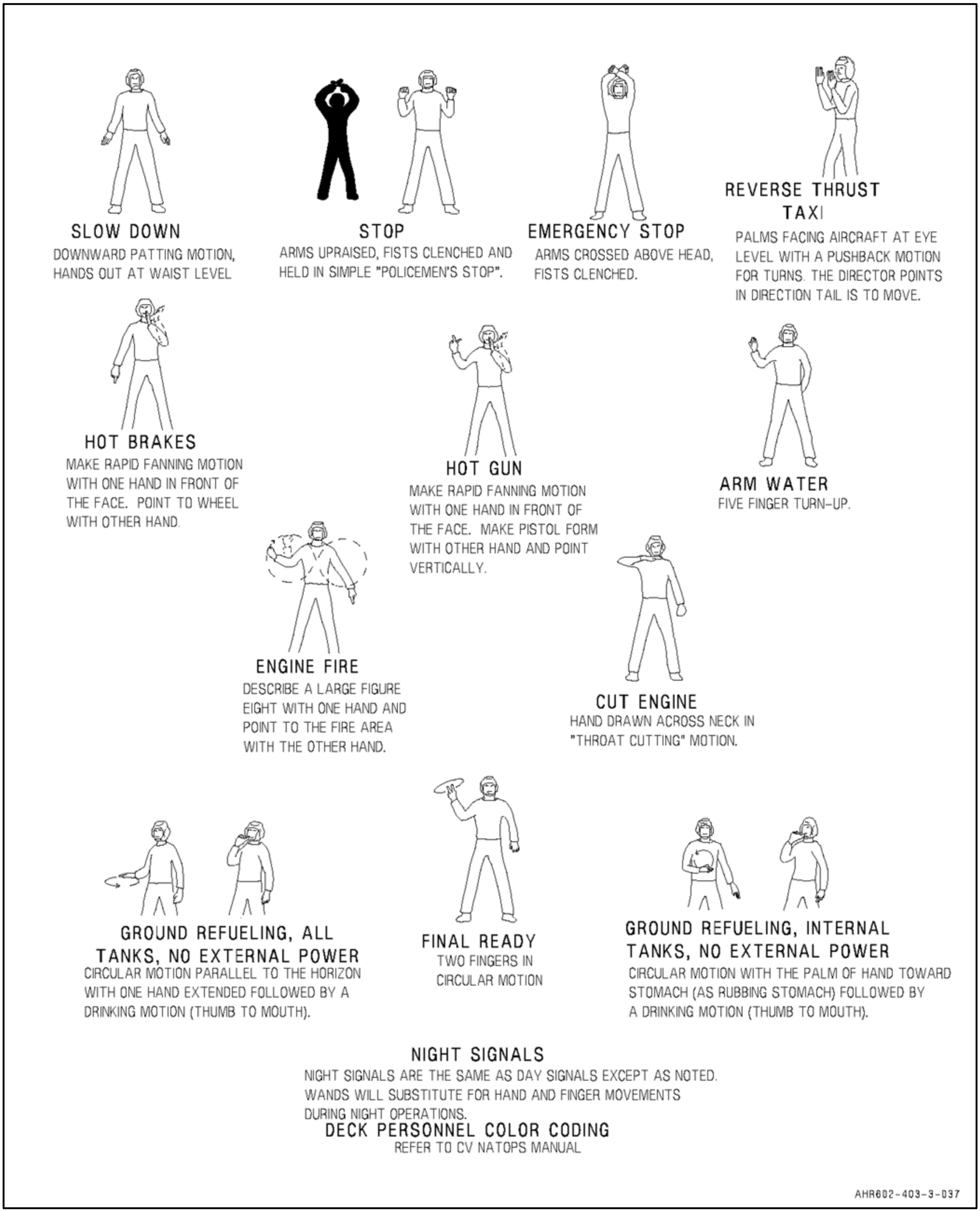


Figure 22-3. Deck/Ground Handling Signals (Sheet 3)

CHAPTER 23

Navigation

This chapter promulgates procedures associated with navigation systems of the AV-8B. For information on the description, components, controls, displays, and modes of operations of communication systems, refer to NTRP 3-22.4-AV8B.

23.1 INERTIAL NAVIGATION SYSTEMS PROCEDURES

23.1.1 Ground Alignment Procedures

The following are the procedures for performing an Inertial Navigation Systems (INS) Ground Alignment:

1. Select MENU-EHSD-DATA-A/C on the MPCD.
2. Enter the correct current latitude (N-S) of the aircraft on the UFC and press ENTER.
3. Enter the correct current longitude (E-W) of the aircraft on the UFC and press ENTER.
4. Place the INS mode selector knob to GND position without pausing in the SEA position.

Note

During the first 1 to 2 minutes of alignment the indicator has ATT NOT OK displayed to the right of QUAL.

5. Place the INS mode selector knob to NAV anytime after the alignment quality (QUAL) number drops below 3.0.

Note

- If maximum accuracy is desired, wait until OK is displayed and then select NAV or IFA.
- With AN/ASN-139, the time required to achieve an OK can be less than 4 minutes and temperature has no effect.
- If the parking brake is released during alignment the INS switches to align hold and the time digits on the MPCD display will flash on and off.
- The INS caution light will illuminate if the INS present position and the GPS Navigation data are both valid and the INS mode selector knob is set to NAV. This is to indicate that the system should be in IFA.

23.1.2 SINS Sea Alignment Procedures

The following are the procedures for a SINS alignment aboard the ship:

Note

Entering current aircraft position prior to initiating a SINS alignment will greatly enhance alignment accuracy and decrease its duration.

With SINS cable connected:

1. Select MENU-EHSD-DATA-A/C on the MPCD.
2. Enter the correct current latitude (N-S) of the aircraft on the UFC and press ENTER.
3. Enter the correct current longitude (E-W) of the aircraft on the UFC and press ENTER.
4. Place the INS mode selector knob to SEA position.
5. Place the INS mode selector knob to NAV anytime after the alignment quality (QUAL) number drops below 3.0.

RF SINS alignment with no SINS cable:

1. Select MENU-EHSD-DATA-A/C on the MPCD.
2. Enter the correct current latitude (N-S) of the aircraft on the UFC and press ENTER.
3. Enter the correct current longitude (E-W) of the aircraft on the UFC and press ENTER.
4. Enter the SINS radio frequency in COMM 1 or COMM 2 as desired.
5. Place the INS mode selector knob to SEA position.
6. Colonize COM1 or COM2 on the ODU as appropriate.

Note

The ODU will be enabled for selection of SINS data source when the INS mode selector knob is initially placed to the SEA position or whenever the SINS option is re-boxed on the EHSD. The ODU defaults to DECK with a SINS data cable connected and to COM2 if the avionics system does not detect a cable. For RF SINS alignments with H4.0, due to a software anomaly, colonize DECK prior to colonizing COM1 or re-colonizing COM2.

7. Place the INS mode selector knob to NAV anytime after the alignment quality (QUAL) number drops below 3.0.

Note

- If maximum accuracy is desired, wait until OK is displayed and then select NAV or IFA.
- With AN/ASN-139, the time required to achieve an OK can be less than 4 minutes and temperature has no effect.
- If the parking brake is released during alignment the INS switches to align hold and the time digits on the MPCD display will flash on and off.
- The INS caution light will illuminate if the INS present position and the GPS Navigation data are both valid and the INS mode selector knob is set to NAV. This is to indicate that the system should be in IFA.

23.1.3 Manual Sea Alignment Procedures

The following are the procedures for a Manual Sea Alignment:

1. Select MENU-EHSD-DATA-A/C on the MPCD.
2. Enter the correct current latitude (N-S) of the aircraft on the UFC and press ENTER.

3. Enter the correct current longitude (E–W) of the aircraft on the UFC and press ENTER.
4. Press the SHIP option on the ODU. Enter the ships heading and speed in the UFC.
5. Press the THDG option on the ODU. Enter the aircraft true heading in the UFC.
6. Place the INS selector knob to the SEA position.
7. Select EHSD display and box the MAN legend at the top of the MPCD.

Note

- During the first 1 to 2 minutes of alignment the indicator has ATT NOT OK displayed to the right of QUAL. The INS caution light will illuminate until ATT NOT OK is replaced by a QUAL number.
- With AN/ASN–139 when the INS alignment is completed, the QUAL number will be less than 1.0 and the time should be less than 10 minutes and an OK is displayed.

8. Place the INS mode selector knob to NAV or IFA.

23.1.4 GPS Carrier Alignment

The following are the procedures to initiate a GPS carrier alignment:

1. Place the INS mode selector knob to IFA.

Note

- During the GPS carrier alignment, the MC must provide valid GPS data from the MAGR. The magnetic heading input is not required since the INS performs a wide angle alignment.
- If GPS velocity become invalid before wide angle alignment complete (HDG displayed in the MPCD), the alignment will restart. This is due to the Kalman filter extrapolations which require valid reference velocities without interruption before high order AHRS.

23.1.5 Ground Stored Heading Alignment Procedures

This procedure can be performed if the aircraft is parked and an INS complete ground alignment has been done; if the aircraft has not been moved since the alignment, and if NAV has not been selected on the miscellaneous control panel. A stored heading alignment is indicated by SHDG option displayed on the upper left corner of the ground align display. The procedures are as follow:

Note

The SHDG pushbutton should be selected as quickly as possible after selecting a ground alignment. A recently operated system would be warm and the SHDG option is displayed only as long as its use would assist in the alignment. When the alignment progresses past the point that its use would assist, the option is removed from the display.

1. Place the INS mode selector knob to GND. The MPCD will display INS ground alignment.
2. Press the SHDG pushbutton on the MPCD.
3. Observe the MPCD for ground alignment indications.

Note

During the first portion of alignment the indicator may have ATT NOT OK displayed to the right of QUAL. QUAL digits start counting down and TIME digits start counting up. When INS heading is valid, HDG will be displayed after the quality digits. When the INS alignment is completed, OK will be displayed next to QUAL with less than 5 minutes.

4. Place the INS mode selector knob to NAV.

Note

Stored Heading Alignment is only available in C1+ aircraft.

23.1.6 INS Gyro Alignment Procedure

The following are procedures for INS gyro alignment:

1. Select MENU–EHSD–DATA–A/C on the MPCD.
2. Enter the correct current latitude (N–S) of the aircraft on the UFC and press ENTER.
3. Enter the correct current longitude (E–W) of the aircraft on the UFC and press ENTER.
4. Place the INS mode selector knob to GYRO.

Note

On the MPCD, after approximately 15 seconds HDG/COMP is replaced by HDG/SLV. These options will disappear from the MPCD within 33 seconds.

5. Press the SYNC pushbutton on the MPCD to slave the magnetic heading from the magnetic azimuth detector (MAD) to the platform heading.
6. Press the ERECT pushbutton to fast level the platform.

23.1.7 RADAR In–Flight Align

The procedures for a radar in–flight alignment (RIFA) are as follows:

Note

A complete RIFA may be initiated after a total INS shutdown and may take up to 20 minutes to complete. During the RIFA the ADC must be available to provide magnetic heading information and the radar must be capable of providing continuous position velocity updates.

1. Ensure NAV master mode is selected.
2. Place the INS mode selector knob to IFA.
3. Select RIFA on the GPS Data page for C1+ aircraft and A/C Data page for H4.0 aircraft.
4. Observe that time begins to increment during the first 1 to 2 minutes of the alignment.

When RIFA displays an OK after the QUAL number:

5. Place the INS mode select switch to the NAV position.

23.1.8 Post Evaluation Procedure

The post evaluation procedures are:

Note

To prevent erroneous results this procedure should only be performed ashore.

1. On MPCD select — MENU, BIT, MAINT, INS, POST.

POST 1 data display appears for flight 1.

2. Record — ALN TIME, AQ (align quality), and PER (positional error rate).
3. Select — POST 1.

POST 2 data display appears for flight 1.

4. Record — UPDATE.
5. Select — POST 2.

POST 1 data display appears for flight 2.

6. Repeat steps 1 through 5 to record all stored flights.

23.2 POSITION UPDATE PROCEDURES

23.2.1 TACAN Position Update

There are two types of TACAN Position updates: 1) Single TACAN update; and 2) Two TACAN update. A single TACAN update uses the range and bearing to the TACAN and its known position to calculate the aircraft's position. A two TACAN update uses the range and bearing from two TACANs to triangulate aircraft position. A TACAN Position update will update the aircraft position and the INS position.

Note

- TACAN Position updates can only be performed using TACANs that are entered on the EHSD-DATA-TCN page. The current aircraft TACAN channel and mode (X/Y) must match a TACAN channel and mode entered on the EHSD-DATA-TCN page. In the case where more than one TACAN entry has the same channel and mode combination, the system will pick the first match (TCN 0 - TCN 4).
- A TACAN Position update cannot be performed while AWLS Steering or EMCON is enabled.
- The range and bearing to the selected TACAN/TACANs must be valid.

23.2.1.1 Single TACAN Position Update

1. Place the INS mode selector knob to NAV. Select DGD/INS or DGD/ADC.
2. Turn on TACAN power and select the desired TACAN channel and X/Y mode.
3. Select UPDT on the EHSD, FLIR, A/G RDR, or DMT page.
4. Select TCN in ODU window 1.

5. The TACAN bearing and range error is displayed in the scratchpad.

6. Select ACPT to accept the displayed bearing and range adjustments. Select REJ or unbox UPDT to cancel the update.

23.2.1.2 Two TACAN Position Update

1. Perform steps 1 through 5 of the Single TACAN Position update.

2. Select TCN2 in ODU window 2. The scratchpad will display the TACAN number (as entered in the EHSD-DATA-TCN page) and the TACAN's channel number. Select TCN2 again to cycle to the next TACAN station.

3. If the range and bearing to the second TACAN is valid, the ERR2 option will appear in option window 3 after approximately 5 seconds.

4. Select ERR2 to display the two TACAN Position update bearing and range error in the scratchpad. Select ERR1 in ODU window 1 to display the single TACAN Position update bearing and range error.

5. Select ACPT to accept the displayed bearing and range adjustments. Select REJ or unbox UPDT to cancel the update.

23.2.2 Designate Position Update

There are two types of Designation Position updates: 1) WYPT Designate update; and 2) MAP Designate update. A WYPT designation update uses the designation's known location and its slewed position in the HUD to calculate the aircraft's position. A MAP designation update uses the slant range and bearing of a HUD designation and its slewed position on the map to calculate the aircraft's position. A Designate Position update will update the aircraft position and the INS position.

Note

A designation is required before the Designate Position update can calculate the error in the aircraft's position. Although, a designation can be made after a Designation Update is initiated, a known software anomaly will sometimes cause the system to automatically reject the update. Therefore, best practice would be to make a designation before selecting DESG on the ODU.

23.2.2.1 WYPT Designate Update

1. Place the INS mode selector knob to NAV. Select DGD/INS or DGD/ADC.

2. Designate a waypoint, markpoint, or targetpoint.

3. Select UPDT on the EHSD, FLIR, A/G RDR, or DMT page.

4. Select DESG in ODU window 2.

5. Slew the diamond in the HUD over the designation.

6. The WYPT Designate bearing and range error is displayed in the scratchpad.

Select ACPT to accept the displayed bearing and range adjustments. Select REJ, unbox UPDT, or undesignate to cancel the update.

23.2.2.2 MAP Designate Update

1. Place the INS mode selector knob to NAV. Select DGD/INS or DGD/ADC.
2. Designate a landmark on the HUD.
3. Select UPDT on the EHSD center or decenter page.

Note

An update can be initiated from the EHSD, FLIR, A/G RDR, or the DMT page, but the EHSD center or decenter page must be displayed before MAP appears on the ODU in window 2. Additionally a map set must be installed in the aircraft and EMCON must be disabled.

4. Select DESG in ODU window 2.
5. Select MAP in ODU window 2. A crosshair is displayed in the center of the map. The center of the map is moved to the designation's location.
6. Slew the crosshair on the map until it is over the landmark that is designated in the HUD.
7. The MAP Designate bearing and range error is displayed in the scratchpad.
8. Select ACPT to accept the displayed bearing and range adjustments. Select REJ, unbox UPDT, or undesignate to cancel the update.

Note

A MAP Designate will be cancelled if the EHSD page is exited, if the decenter compass rose is selected, or if the type of map (CHRT, DTED, or CIB) is changed after MAP has been cued on the ODU. WYPT Designation update can be reselected by uncolonizing MAP.

23.2.3 Overfly Position Update

There are three types of Overfly Position update: 1) WYPT Overfly update; 2) MAP Overfly update; and 3) Navigation Fix Overfly update. A WYPT overfly update is used to update the aircraft's position to the steer-to point's known location. It is also used to update the aircraft's altitude. A MAP overfly update uses the map to select the aircraft's position. A navigation fix update allows the pilot to enter the aircraft's latitude and longitude or 10-digit UTM. An Overfly Position update will update the aircraft position and the INS position. If the radar altimeter is valid, a WYPT overfly update can also be used to update the aircraft's altitude.

23.2.3.1 WYPT Overfly Update

1. Place the INS mode selector knob to NAV. Select DGD/INS or DGD/ADC.
2. Select UPDT on the EHSD, FLIR, A/G RDR, or DMT page.
3. Select OVFY in ODU window 3 when the current waypoint, markpoint, or targetpoint is overflown.
4. The WYPT Overfly bearing and range error is displayed in the scratchpad.
5. Select ACPT to accept the displayed bearing and range adjustments. Select REJ to not accept the displayed bearing and range adjustments.
6. The WYPT Overfly altitude error is displayed in the scratchpad if the radar altitude is valid.
7. Select ACPT to accept the altitude adjustments. Select REJ or unbox UPDT to cancel the update.

23.2.3.2 MAP Overfly Update

1. Place the INS mode selector knob to NAV. Select DGD/INS or DGD/ADC.
2. Select UPDT on the EHSD center or decenter page.

Note

An update can be initiated from the EHSD, FLIR, A/G RDR, or the DMT page, but the EHSD center or decenter page must be displayed before MAP appears on the ODU in window 2. Additionally a map set must be installed in the aircraft.

3. Select OVFY in ODU window 3 when the desired map location is overflown.
4. Select MAP in ODU window 2. A crosshair is displayed in the center of the map. The center of the map remains at the aircraft location.
5. Slew the crosshair on the map until it is over the landmark that was overflown.
6. The MAP Overfly bearing and range error is displayed in the scratchpad.
7. Select ACPT to accept the displayed bearing and range adjustments. Select REJ or unbox UPDT to cancel the update.

Note

A MAP Overfly will be cancelled if the EHSD page is exited, if the decenter compass rose is selected, or if the type of map (CHRT, DTED, or CIB) is changed after MAP has been cued on the ODU.

23.2.4 Manual GPS Update

A GPS update is used to update the aircraft's position and the INS position if the position keeping mode/source is DGD/INS or DGD/ADC. If the position keeping mode source is DGD/GPS, only the INS position is updated.

1. Place the INS mode selector knob to NAV. Select DGD/INS, DGD/GPS, or DGD/ADC.
2. Select UPDT on the EHSD, FLIR, A/G RDR, or DMT page.
3. Select GPS in ODU window 4.
4. The GPS bearing and range error is displayed in the scratchpad.
5. Select ACPT to accept the displayed bearing and range adjustments. Select REJ or unbox UPDT to cancel the update.

23.3 ALL WEATHER LANDING SYSTEM PROCEDURE

1. UFC – AWLS. Defaults to ON.
2. Cycle ON or OFF via UFC.
3. ODU option 1 – enter channel (1–20) via UFC.
4. ODU option 2 – enter glideslope (2.0 –6.0 in 0.1° increments) via UFC.
5. ODU option 3 – enter azimuth offset option (+/– 310 feet) via UFC.
6. ODU option 4 – enter TACAN channel (1–126; alternate depressions of “TCN” option on ODU cycle between X and Y) via UFC.

7. ODU option 5 - enter elevation offset option (0-31 feet) via UFC.
8. EHSD box AWLS option to select AWLS steering.

23.4 BUILT-IN-TEST PROCEDURES

23.4.1 TACAN Built-In-Test

1. Press BIT button on the MPCD menu.
2. Press the CNI pushbutton.
3. Observe TEST next to TCN (test takes 25 seconds).
4. If 1 next to TCN (TCN 1) — TACAN failed BIT check.
5. If space next TCN remains blank — TACAN passed BIT check.

23.4.2 AWLS BIT Check

1. Press BIT button on the MPCD menu.
2. Press the CNI pushbutton.
3. Observe TEST next to AWLS (test takes approximately 15 seconds).
4. If any number next to AWLS — AWLS failed BIT check.
5. If space next to AWLS remains blank — AWLS passed BIT check.

23.5 GLOBAL POSITIONING SYSTEM

The Global Positioning System (GPS) is a space-based radio positioning system which provides accurate position, velocity, and time data to various targeting, navigation, and communication systems aboard the aircraft. See NATIP NTRP 3-22.4 for in-depth theory and system operation.

23.5.1 Component Description

The aircraft components of the GPS system are the GPS antenna and the Miniaturized Airborne GPS Receiver (MAGR).

23.5.1.1 GPS Antenna

The GPS antenna is a fixed radiation pattern low profile antenna mounted on door 51 next to the water fill tank door. The antenna provides omnidirectional coverage above 10° elevation from its surface.

23.5.1.2 MAGR

The MAGR receives ranging codes and a navigation data message from the NAVSTAR satellites through the GPS antenna. The MAGR can track five GPS satellites and calculate the aircraft exact position from the four best satellites being tracked. The MAGR provides UTC time, aircraft position, aircraft velocity, and altitude data to the MC. The MAGR contains a battery to provide power for a clock and to maintain memory when aircraft power is not supplied. The MAGR has a built-in-test used for determining the status of the receiver and the battery.

23.5.2 GPS Controls and Indicators

The controls and indicators for the GPS include the upfront control, option display unit, multipurpose color display, INS mode select switch, and GPS caution light.

23.5.2.1 Upfront Control

The scratch pad display on this control is used for displaying the position error when a GPS navigation update is performed. The display is also used to display GPS time, in UTC, when REAL is selected in the ODU.

23.5.2.2 Option Display Unit

This control/indicator provides a way of displaying and selecting the various options available for a GPS navigation update and provides the option (REAL) for selecting the GPS time display on the UFC.

23.5.2.3 Multipurpose Color Display

The EHSD display, BIT display, and GPS waypoint and data displays are presented on the MPCD. The 20 pushbutton switches surrounding the crt provide display selection and control

23.5.2.4 INS Mode Select Switch

Selecting IFA initiates the in-flight alignment and enables a tightly-coupled navigation mode. Selecting NAV enables a loosely coupled, degraded, navigation mode.

23.5.2.5 GPS Caution Light

When enabled, indicates aggressive maneuvering, GPS data is not valid or has stopped updating, or GPS horizontal and vertical position error is not within the tolerance required for GPS navigation steering modes, normal (NORM) and approach (APPR). The GPS light on the CAUTION/ADVISORY panel is illuminated along with the MASTER CAUTION light if a GPS failure has been detected or if the GPS horizontal error exceeds a specified tolerance. If the GPS is being used as the position keeping source and normal mode is selected, the GPS caution light is illuminated when the horizontal position error exceeds 333 meters for greater than 5 seconds. If the GPS is being used as the position keeping source, approach mode is selected, true airspeed is valid and less than 300 knots, the GPS caution light is illuminated when the horizontal position error exceeds 33 meters for greater than 5 seconds. With MAGR not installed the system disables the GPS caution light, however it lights up with DC backup running.

Note

The GPS caution light will also illuminate if the INS present position and the GPS navigation data are both valid and the INS mode selector knob is set to NAV. This is to indicate that the system should be in IFA.

23.5.3 EHSD Display Format

The EHSD display format shows the aircraft position keeping source, navigation system coupling mode, and additional information when utilizing the in-flight alignment mode or courseline feature.

23.5.4 GPS Flight Mode Selection

The GPS flight mode selections, APPR or NORM are available on the aircraft data display (POS/GPS or DGD/GPS, DATA, A/C, NORM, or APPR). See Figure 23-1. These options specify a corridor (navigation tolerance) about the desired aircraft course. If GPS position keeping is selected and the estimated error of the GPS exceeds the selected mode tolerance, a cockpit warning is provided by a GPS advisory and MASTER CAUTION light. The default flight mode selection at aircraft power-up with weight-on-wheels is normal mode. The flight mode selection option is only available in POS/GPS and DGD/GPS position keeping modes. Currently GPS in USN aircraft is for tactical use only and does not meet FAA standards for enroute or the terminal phase of flight. GPS is not used as the primary means of navigation to file or fly in the National Airspace System. Reference CNO/N88/021214Z Aug 94.

23.5.5 GPS Data

The GPS data display format is enabled by selecting the GPS option from the EHSD-DATA display format with OMNI 7.1 and C1+. The GPS data display format is enabled by selecting the GPS option from the SDAT-TFER display format in H4.0. See Figure 23-2. The GPS data display format contains GPS and tactical waypoint/markpoint information, including the identifier, latitude, longitude, datum, elevation, and magnetic variation. The GPS data display format is used to:

1. Upload waypoints into the MAGR from the data storage unit (DSU) or AMU mission card.
2. Transfer waypoint data stored in the MAGR into a tactical waypoint/markpoint/targetpoint.

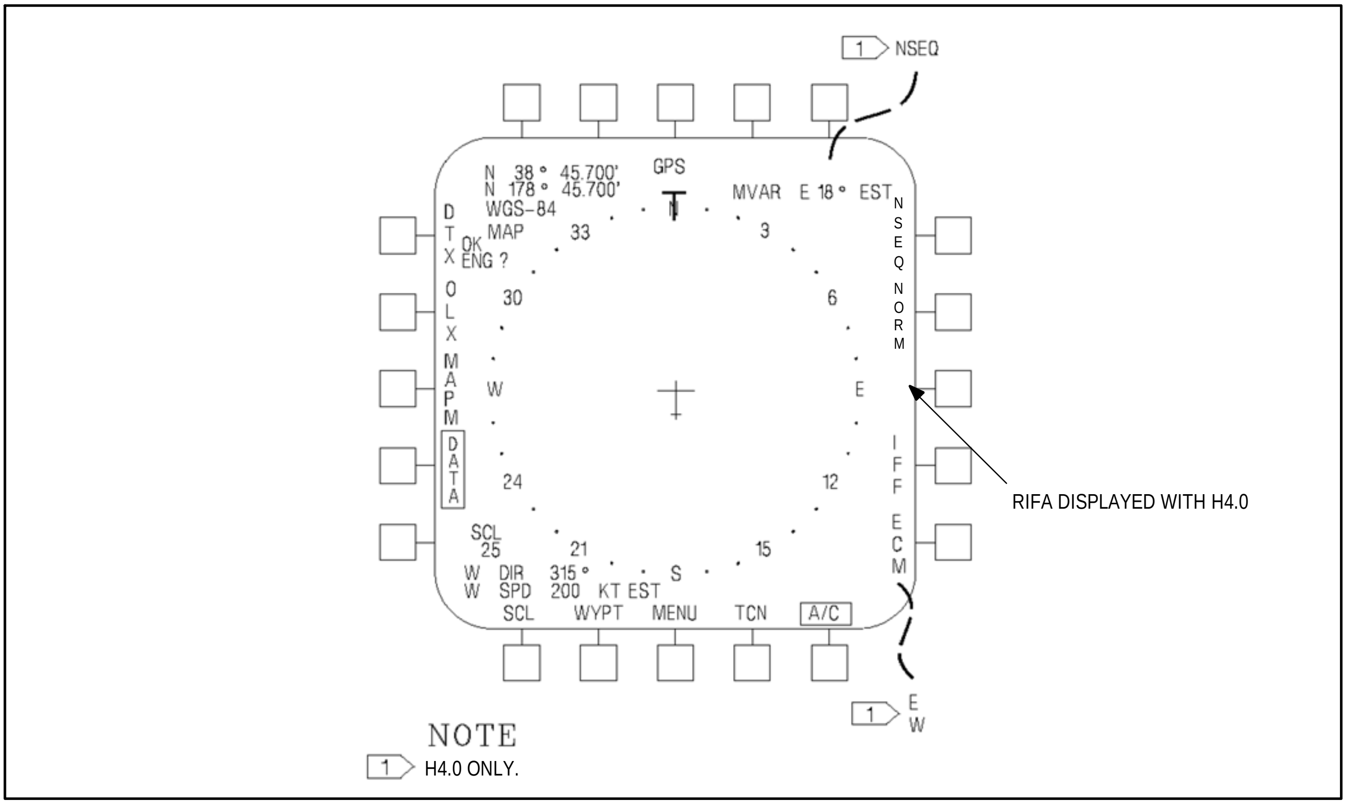


Figure 23-1. Aircraft Data Display

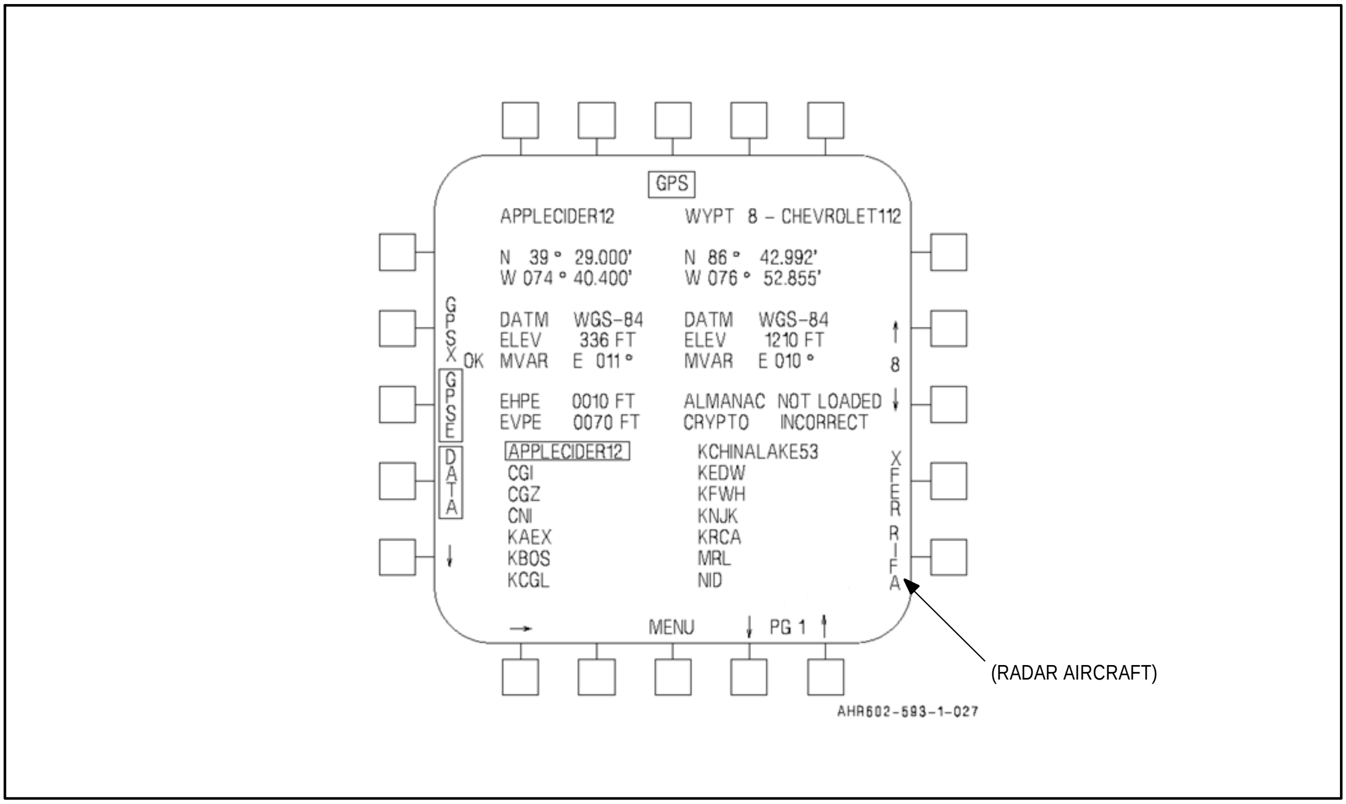


Figure 23-2. GPS Data Display (OMNI 7.1 and C1+)

3. Examine the GPS almanac and crypto-key status (OMNI 7.1 and C1+ only).
4. Inspect the current estimated GPS position errors (OMNI 7.1 and C1+ only).

Note

With H4.0, the estimated GPS position errors are displayed on the EHSD page and the GPS almanac and crypto-key status lines are displayed on BIT page 2.

23.5.5.1 GPS Waypoint Data Upload

Selection of the GPSX option transfers the GPS waypoint database from the DSU or the AMU mission card to the GPS. To get to the GPSX option select EHSD-DATA-GPS with OMNI 7.1 or C1+, or select SDAT-TFER-GPS with H4.0. OK indicates the transfer was successful. ?? indicates an error occurred during transfer. OK or ?? is displayed until another pushbutton is pressed. With H4.0, GPS waypoints that are corrupted on the DSU/AMU mission card or were corrupted when read from the DSU/AMU mission card are displayed with the waypoint ID ????????????. These corrupted GPS points are moved to the end of the list. Corrupted GPS waypoints cannot be transferred into waypoints, markpoints, or targetpoints.

23.5.5.2 GPS Waypoint Data Transfer (OMNI 7.1 and C1+)

To transfer waypoint data from over 200 waypoints stored in the MAGR into one of the tactical waypoints/markpoints (0 through 24, MK1, MK2, MK3) do the following:

1. Select a tactical waypoint/markpoint.
2. Select a GPS waypoint.
3. Select XFER option.

The tactical waypoints/markpoints are selected by scrolling to the desired waypoint/markpoint number using the increment or decrement arrow option on the right side of the display format. The GPS waypoint is selected by scrolling to the desired page using the page up or page down arrow option and then by using the down and/or right arrow option, the selection box is placed around the desired GPS waypoint. The transfer of the GPS waypoint data into the tactical waypoint/markpoint is accomplished by selecting the XFER option. When the XFER option is pressed, if the GPS waypoint is stored in the DSU, the MC transfers the waypoint and any associated offset data into the tactical waypoint/markpoint. However, if the MC is forced to retrieve the GPS waypoint data from the MAGR, only the waypoint data without any associated offset is transferred to the tactical waypoint/markpoint. The MAGR does not store offset data.

23.5.5.3 GPS Almanac and Crypto-Key Status

After aircraft power-up with OMNI 7.1 or C1+, the GPS-Data page display format should be selected to examine the almanac and crypto-key loading status. With H4.0, the GPS almanac and crypto-key status is located on the BIT page.

1. Almanac Status. If the almanac data is not loaded in the MAGR, the NOT LOADED legend is displayed adjacent to the ALMANAC legend. When the almanac data is loaded into the MAGR, LOADED is displayed adjacent to ALMANAC . If no almanac is loaded, the MSC will attempt to transfer the almanac file from the DSU or AMU mission card to the MAGR. Regardless of whether the almanac is LOADED or not, the MAGR will strip a complete almanac from the satellite signal once it finds any satellite. This takes approximately 14 minutes after a satellite is located. Once an almanac is loaded , the MAGR will retain it even after shutdown. Whenever the MAGR is changed or batteries in the MAGR are changed, the MAGR should be run on ground power until a fix is obtained. There is no power switch or ON/OFF switch for the MAGR. The MAGR functions any time APU or main generator power is available.
2. Crypto-Key Status. After communication with a satellite is established, the MAGR reports whether the crypo-keys are correct. If the crypto keys are not loaded in the MAGR, NOT LOADED is displayed adjacent to the CRYPTO legend. When the crypto keys are loaded into the MAGR and the MAGR has not verified whether the keys are correct, LOADED is displayed adjacent to the CRYPTO legend. INCORRECT is

displayed adjacent to the CRYPTO legend if the MAGR determines that the loaded keys are incorrect. OK legend is displayed adjacent to the CRYPTO legend after the MAGR has determined that the loaded keys are correct. Crypto-key verification may take up to 12 minutes.

23.5.5.4 GPS Estimated Position Error Status

To inspect the current estimated horizontal and vertical position errors of the GPS with OMNI 7.1 or C1+, the GPSE option on the GPS data page can be selected. With H4.0, the estimated Horizontal Position Errors (abbreviated as H) and Estimated Vertical Position Errors (abbreviated as V) are continuously displayed on the EHSD center, decenter, and EW pages (see Figure 23-11). Leading zeroes are not depicted on the EHSD and EW pages.

Note

It is especially important to monitor GPS position errors when using the GPS (POS/GPS or DGD/GPS) for low-level night navigation.

If a GPS failure exists an asterisk (*) is displayed adjacent to the position errors, almanac, and crypto-key status. The GPSX option is removed if a DSU, AMU, or AMU mission card failure exists or the DSU/AMU mission card does not contain GPS waypoints. The XFER option, the cursor arrow options, and the GPS waypoint data are not displayed until valid GPS waypoints have been uploaded from the DSU or the AMU mission card. An asterisk is displayed next to the GPS waypoint data when there are no GPS waypoints. See Figure 23-3.

23.5.6 Built-In-Test Format

The GPS BIT reporting status can be inspected by selecting the BIT display format. In Radar and Night Attack Aircraft the BIT display format is split into two displays, see Figure 23-4. The BIT1 format contains the weapon and sensor subsystem BIT reporting and the BIT2 format contains the communication, identification, and navigation subsystem BIT information. The default BIT display format at power-up with weight-on-wheels is the BIT2 display format. The GPS BIT reporting information, found on the BIT2 format, includes receiver, battery, velocity, and communication status. With H4.0, the BIT format also reports GPS antenna status. The GPS can only be placed into initiated BIT with weight-on-wheels by selecting the GPS pushbutton option. The GPS option is not available with weight-off-wheels.

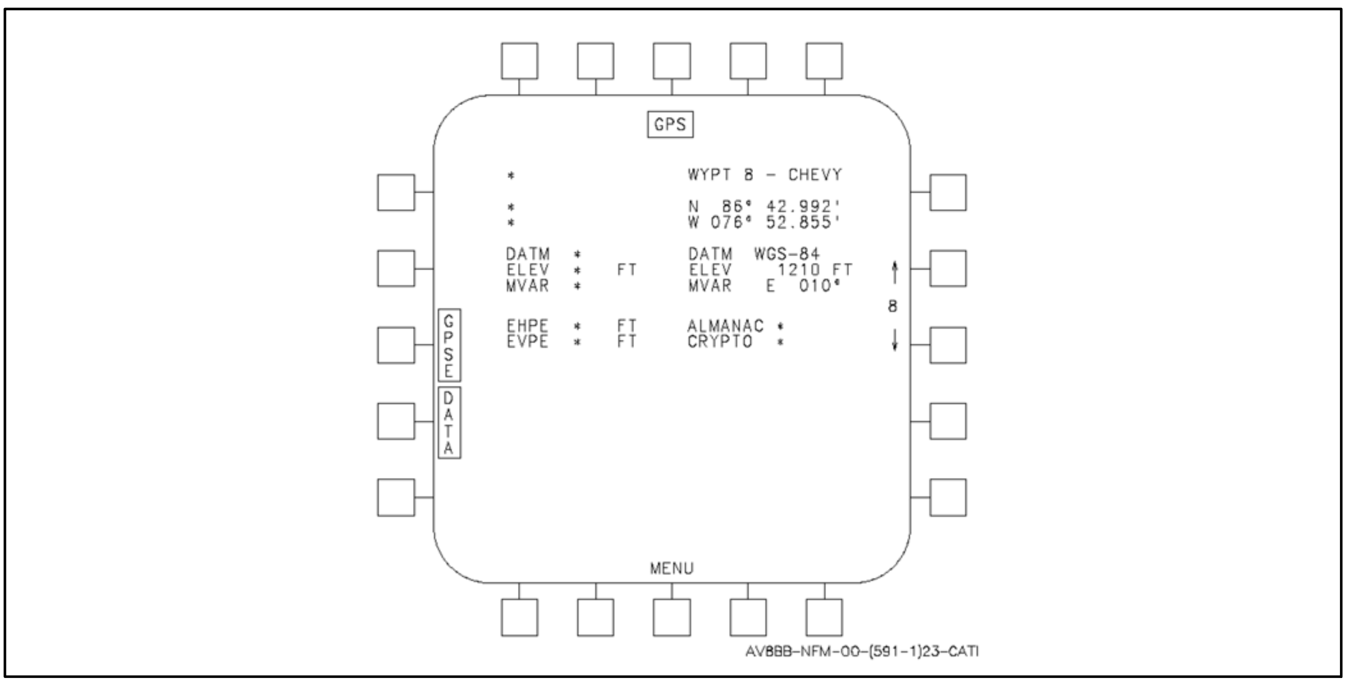


Figure 23-3. GPS Failure and GPS Waypoints Not Present (OMNI 7.1 and C1+ page shown)

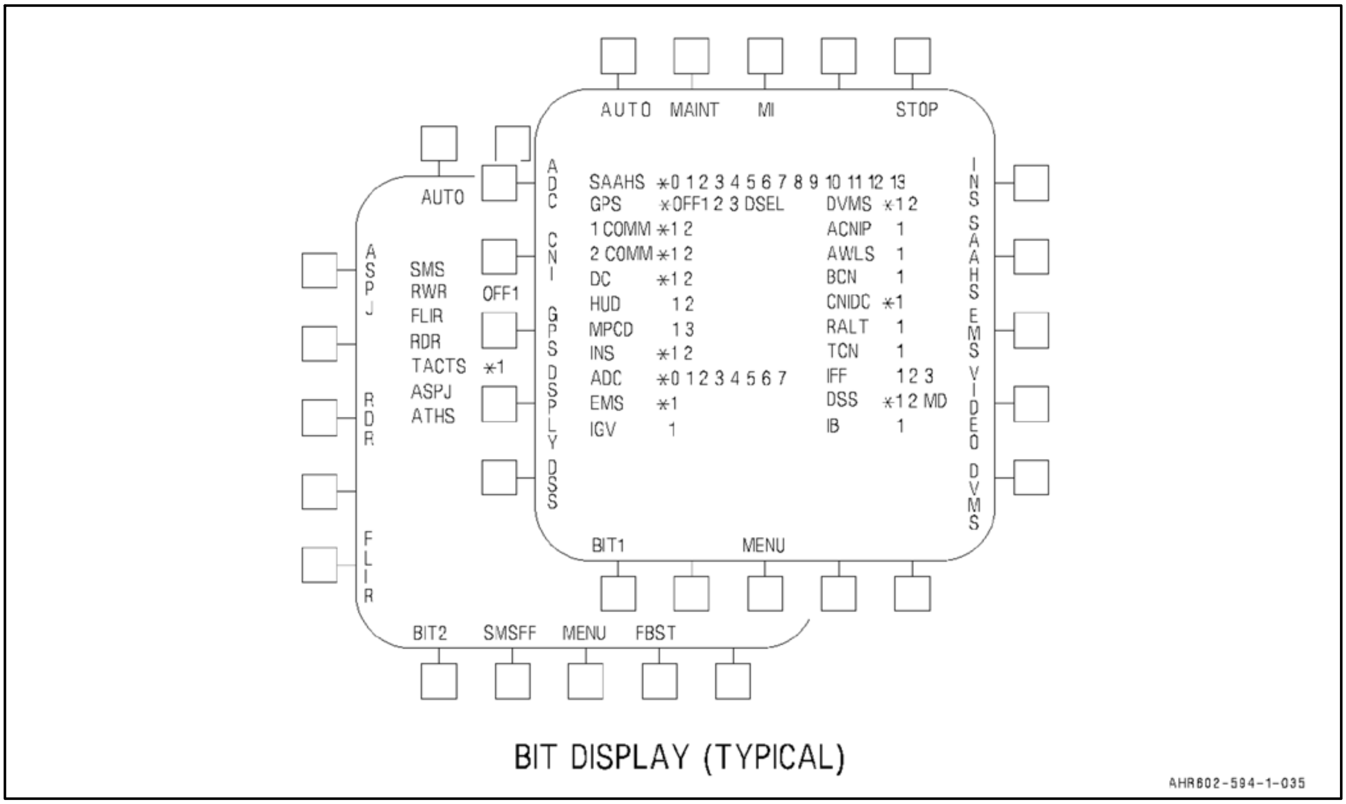


Figure 23-4. GPS Bit (C1+ BIT page shown)

23.5.6.1 GPS BIT Reporting Status

GPS Asterisk (*) – GPS MAGR present but not communicating.

GPS Off – GPS MAGR not present or power off to it.

GPS 1 – GPS Receiver Fail.

GPS 2 – GPS Battery Fail.

GPS 3 – Velocity Reasonableness Test Failure.

GPS 4 – GPS Antenna Fail (H4.0 only).

GPS DSEL – GPS was deselected as the position keeping source during the last flight because GPS data did not meet quality/sanity checks.

23.6 POSITION KEEPING

23.6.1 Aircraft Without GPS

There are two methods of maintaining aircraft present position. INS, which is the primary mode, uses inertial velocities and true heading to maintain present position. ADC position keeping uses true airspeed, magnetic heading, attitude, angle of attack, and pilot entered wind data to keep track of present position. The system automatically initializes to INS position keeping. This is indicated by the DGD/INS nomenclature above the lower right pushbutton on the EHSI/EHSD display. If ADC position keeping is desired, the pushbutton should be pressed to deselect the INS. Also, if the INS velocities are not valid while in INS position keeping, the system automatically reverts to the ADC position keeping mode. When DGD/ADC is selected or reverted to filtered values of ADC true airspeed (TAS) and ADC AOA are used to determine all velocities, and therefore the velocity vector position on the HUD. On radar aircraft INS velocities can be updated using the precision velocity update mode (PVU) of the radar. Refer to A1–AV8BB–TAC–000.

23.6.2 Aircraft With GPS

There are three sources for maintaining aircraft present position. The three sources in order of priority are: INS, GPS, and ADC. The position keeping mode legend on the EHSD (i.e., POS/INS) identifies the navigation sensor that is used to determine aircraft present position. The aircraft position keeping source is pilot selectable by scrolling the pushbutton option on the bottom right of the EHSD display (and also on the EW, STRS, FLIR, DMT and Maverick display formats when in A/G master mode only). At power–up, the aircraft will initialize to ADC position keeping. When the GPS completes initialization, the position keeping mode will automatically upgrade from ADC to GPS. When the INS present position becomes valid, the position keeping mode will automatically upgrade from either ADC or GPS to INS. The MC will automatically upgrade to the best available position keeping mode when the better mode becomes available for the first time following aircraft power–up with weight–on–wheels. The MC also degrades to the next best available position keeping source in the event the current source is deemed erroneous or unavailable. The position keeping mode is selectable independent of the navigation system coupling mode (tightly–coupled or loosely–coupled), with one exception that ADC position keeping is not allowed in a tightly–coupled mode (INS and GPS valid). The navigation system coupling mode, which controls the interface between the GPS and INS, is pilot selectable using the INS mode select switch.

23.6.2.1 Navigation System Coupling Modes

Selecting IFA on the INS mode select switch causes the navigation system to enter into tightly–coupled mode. Whenever the navigation system is in tightly–coupled mode, the POS legend will appear as part of the position keeping mode legend (i.e., POS/INS or POS/GPS).

Tightly–coupled refers to a navigation system in which the GPS is aided by ADC and INS data and continually returns corrections to the INS platform. The aiding data permits the GPS to keep satellite lock and to stabilize the internal Kalman filter. The platform correction data provides the INS with data it can use to better estimate its internal platform errors. A tightly–coupled mode is accessible when: (1) an INS with GPS compatible software is installed in the aircraft, (2) GPS navigation data is valid, and (3) the INS is in either in–flight align mode or aided navigation mode.

Loosely–coupled refers to a navigation system in which the GPS is aided by an external source, but the GPS does not continually provide corrections to the INS platform. Selection of free inertial navigation mode, NAV on the INS mode select knob, causes the navigation system to enter into loosely–coupled mode. In loosely–coupled mode, the INS is not aided by the GPS. Whenever the navigation system is in loosely–coupled or uncoupled mode the DGD (degraded) legend will appear as part of the position keeping mode legend (i.e., DGD/INS, DGD/GPS or DGD/ADC). An uncoupled mode is not selectable by the pilot and is only entered when the INS and ADC, and/or GPS are not providing valid data.

A complete list of definitions of the combinations of navigation system coupling and position keeping modes is given below:

1. POS/INS – Indicates a tightly–coupled navigation system in which the INS is being used as the position keeping source.

2. POS/GPS – Indicates a tightly–coupled navigation system in which the GPS is being used as the position keeping source.

3. POS/ADC – Not a possible configuration.

   IFA
4. POS/INS – Indicates a tightly–coupled navigation system in which the INS is being used as the position keeping source. The INS is currently being aligned inflight using GPS data. (This legend will appear in the final stages of an INS in–flight alignment.)

   IFA
5. POS/GPS – Indicates a tightly–coupled navigation system in which the GPS is being used as the position keeping source. The INS is currently being aligned in–flight using GPS data. (This legend will appear in the initial stages of an INS in–flight alignment.)

IFA

6. POS/ADC – Not a possible configuration.
7. DGD/INS – Indicates a loosely–coupled/uncoupled navigation system in which the INS is being used as the position keeping source.
8. DGD/GPS – Indicates a loosely–coupled/uncoupled navigation system in which the GPS is being used as the position keeping source.
9. DGD/ADC – Indicates a loosely–coupled/uncoupled navigation system in which the ADC is being used as the position keeping source.
10. DGD/blank – Indicates that the navigation system does not have a valid position keeping source. (This mode is not pilot selectable).

In summary:

1. POS – Indicates the INS is automatically updated by GPS data. No manual updates are required.
2. DGD – Indicates the INS is not automatically updated by the GPS. Manual updates are required to limit navigation system errors and INS drift.

23.6.3 Velocity Reasonableness Test

Like the position keeping source, the aircraft velocity source (used for navigation and weapon delivery calculations) is automatically selected by the MC and is based on the best available velocity source. The three sources of aircraft velocity data are, in order of priority, INS, GPS, and ADC. The MC automatically upgrades to the best available velocity source when the better source becomes available. The MC also degrades to the next best available velocity source in the event the current source is unavailable or deemed erroneous by the velocity reasonableness tests. Delta terms are added to aircraft velocity to provide a smooth transition during degradation from using INS to GPS as the velocity source. The choice of velocity source is independent of the navigation system coupling and position keeping mode, with the exception of ADC position keeping mode. When ADC position keeping is selected and the navigation system is loosely–coupled, the ADC is used as the velocity source.

There are three different velocity reasonableness tests: INS vs GPS, INS vs ADC, and GPS vs ADC. For the INS vs GPS velocity reasonableness test to pass, the difference between the INS velocity and the GPS velocity must be 20 ft/s or less. For the INS vs ADC or GPS vs ADC tests to pass the difference between the INS or GPS velocity and ADC true airspeed must be less than a threshold value for wind magnitude. The threshold value value for wind magnitude is altitude dependent. The INS vs GPS velocity reasonableness test must not pass for 5 seconds to be considered failed, and likewise; it must pass for 5 seconds to be considered passed. Both the INS vs ADC and the GPS vs ADC velocity reasonableness tests must not pass for 3 seconds to be considered failed, and likewise; they must pass for 3 seconds to be considered passed.

The best velocity source is indeterminate or unresolved if: 1) all three velocity reasonableness tests fail; 2) the INS velocity is invalid and the GPS vs ADC velocity reasonableness test fails; 3) the GPS velocity is invalid and the INS vs ADC velocity reasonableness test fails; or 4) the ADC velocity is invalid and the INS vs GPS velocity reasonableness tests failed. In the event the best velocity source is indeterminate, the velocity source is tied to the aircraft position keeping source selected by the pilot and VEL? appears above the current position keeping source selected by the pilot. The system automatically degrades to DGD/ADC position keeping source if DGD/ADC is a valid position keeping source.

The pilot is notified as to which velocity sources failed the velocity reasonableness tests on the BIT page. Whenever the INS fails both of its velocity reasonableness tests, a code of 2 is displayed in the INS BIT codes on the BIT page. In addition, the INS caution light on the caution/advisory light panel is lit. The INS caution light is also lit whenever the INS experiences BIT failures or the horizontal velocity from the INS is invalid. A code of 3 is displayed in the GPS BIT codes whenever the GPS fails both of its velocity reasonableness tests. A code of 7 is displayed in the ADC BIT codes whenever the ADC fails both of its corresponding velocity reasonableness tests. These BIT codes are for pilot information only and are not maintenance issues.

Note

While weight-on-wheels, all velocity reasonableness tests are automatically passed, therefore the BIT failures and VEL? are never displayed while weight-on-wheels.

23.7 TACAN SYSTEM

The TACAN system gives precise bearing and/or slant range distance to a TACAN ground station or suitably equipped aircraft. The TACAN system is limited to line of sight range which depends upon aircraft altitude. The maximum operating range is 390 nautical miles when the selected TACAN station is a surface beacon and 200 nautical miles when the selected TACAN beacon is airborne beacon. The aircraft receives a three letter audio station signal to identify the beacon being received. When operating in conjunction with aircraft having air-to-air capability the A/A T/R mode provides the same as A/A REC mode. Additionally, it indicates line of sight distance to the nearest complementary aircraft and transponds up to five complementary aircraft interrogations. A/A REC mode indicates bearing to a suitable equipped aircraft (AWACS, KC 10, etc.).

23.7.1 TACAN Controls and Indicators

The controls and indicators for TACAN operation are on the UFC, ODU, DDI, ACNIP, and on TAV-8B and Day Attack aircraft the HSI. See Figure 23-5.

23.7.1.1 Upfront Control

The pushbuttons and indicators on this control that are used for TACAN operation and display are the TACAN function selector pushbutton (labeled TCN), the ON/OFF selector pushbutton, the EMCON pushbutton, the pushbutton keyboard, and scratch pad.

23.7.1.1.1 TACAN Function Selector Pushbutton

Pressing the TCN pushbutton enables TACAN options to be displayed on the option display windows, enables the TACAN status window on the scratch pad to ON, if TACAN is enabled, and allows the TACAN channel number to be displayed on the scratch pad when entered on the keyboard.

23.7.1.1.2 On/Off Selector Pushbutton

Pressing this pushbutton turns the TACAN system on or off after first pressing the function selector pushbutton.

23.7.1.1.3 Emission Control

Selecting EMCON puts the TACAN in a non-transmitting mode by switching the system to a receive mode if it is in the transmit/receive mode. At the same time, option displays 1 through 5 on the ODU are first blanked when EMCON is selected, then option 1 displays :EMCN. A colon appears to the left of the option to indicate selection. When the pushbutton is pressed again, deselecting EMCON returns the TACAN to its previous operating mode.

23.7.1.2 Option Display Unit

The pushbuttons and indicators on the ODU used for TACAN operation and display are the option select pushbuttons and the option display windows.

23.7.1.2.1 Option Select Pushbuttons

The option select pushbuttons are numbered downward 1, 2, and 3 on the right side, and 4 and 5 on the left side. These pushbuttons select the TACAN mode of operation. When TACAN is enabled, a colon appears to the left of the option display windows to indicate the last mode and channel selection.

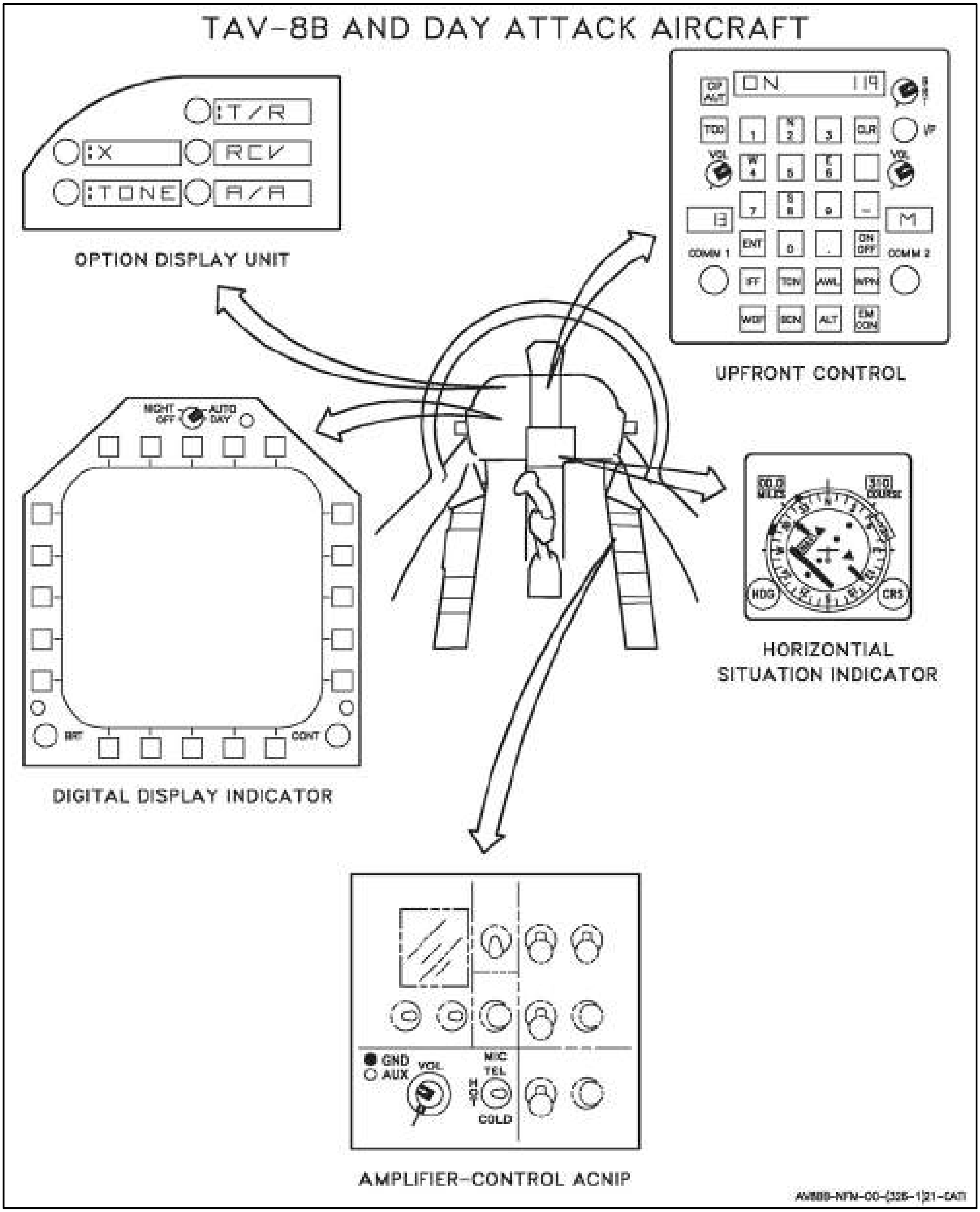


Figure 23-5. TACAN Controls and Indicators (Sheet 1 of 2)

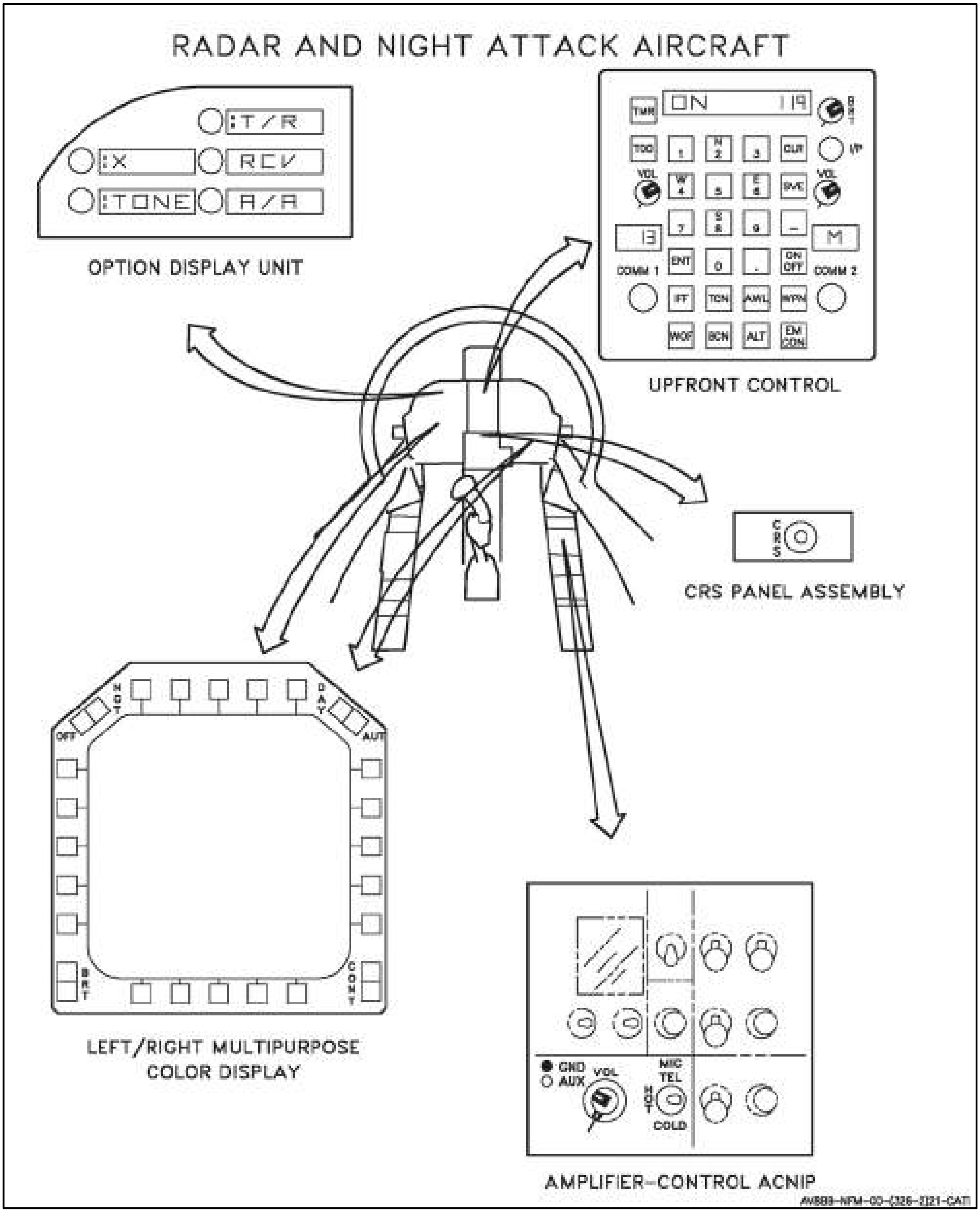


Figure 23-5. TACAN Controls and Indicators (Sheet 2)

1. Option 1. Selecting the :T/R option commands the TACAN Receiver–Transmitter (R/T) to operate in that mode. Air–to–ground range and bearing information is provided by the R/T for display on the DDI (EHSI/EHSD display), the HUD, and on TAV–8B and Day Attack aircraft the HSI. When :T/R is selected range and bearing information is provided by a ground station, when :A/A is selected range and bearing is provided by another aircraft.
2. Option 2. Selecting the :RCV option commands the TACAN R/T to operate in the air–to–ground receive mode. Bearing information is provided by the receiver for display on the DDI (EHSI/EHSD display), the HUD and on TAV–8B and Day Attack aircraft the HSI. The T/R and RCV options are mutually exclusive. In RCV mode only bearing (not range) is provided by the ground station.
3. Option 3. Selecting the :A/A option commands the TACAN R/T to operate in the air–to–air mode. In A/A T/R mode distance information is provided for display on the DDI (EHSI/EHSD display), and on TAV–8B and Day Attack aircraft the HSI. Bearing to a suitably equipped cooperating aircraft (AWACS, KC–10, etc.) is also displayed on the EHSI/EHSD display and on TAV–8B and Day Attack aircraft the HSI. In A/A T/R mode the TACAN R/T transmits a distance replay to an interrogating aircraft. Selecting :A/A again displays :PROX in window 3 and enables A/A TACAN proximity warning. To disable A/A TACAN select :PROX in window 3. Deselecting A/A causes the TACAN to operate in the air–to–ground mode.
4. Option 4. Pressing this pushbutton selects either X or Y channel for R/T operation. The channel number may be entered on the keyboard. Successive pressing of the pushbutton alternates between the X and Y channels.
5. Option 5. Pressing the TONE pushbutton allows the TACAN identification tone to be turned on or off. A colon appears on the left side of the option display window when the tone is enabled.

23.7.1.3 DDI

For TACAN operation, pressing the TCN pushbutton on the DDI turns the TACAN on, if not on, and enables steering data from the digital computer to be displayed on the EHSI/EHSD display on the DDI and the HUD. The symbols, pointers and displays which appear on the DDI are the aircraft symbol, TACAN station symbol, TACAN bearing pointer, TACAN course pointer and various digital TACAN displays. See Figure 23-6. The aircraft symbol represents the aircraft position and the TACAN symbol represents the TACAN station position. The TACAN bearing pointer indicates the bearing to the selected TACAN station. The TACAN course pointer indicates the course to/from the selected TACAN station. The digital TACAN displays which appear on the DDI are the range, bearing, and time–to–go to the station.

23.7.1.4 TACAN Volume Control

The volume control for the TACAN identification tone (when tone is enabled) is on the ACNIP. The control used for TACAN volume is the outer knob (AUX).

23.7.1.5 Course Set Control (TAV–8B and Day Attack)

The course set knob on the HSI on the main instrument panel is used to set a course for steering to or from the TACAN station.

CAUTION

The course line displayed on the EHSI/EHSD and the course in the course selector window of the HSI is not necessarily the same. The bearing displayed in the course line data block in the lower right corner of the EHSI/EHSD and the course line displayed on the EHSI/EHSD should be used instead of the bearing in the course selector window of the HSI. See Figure 23-6.

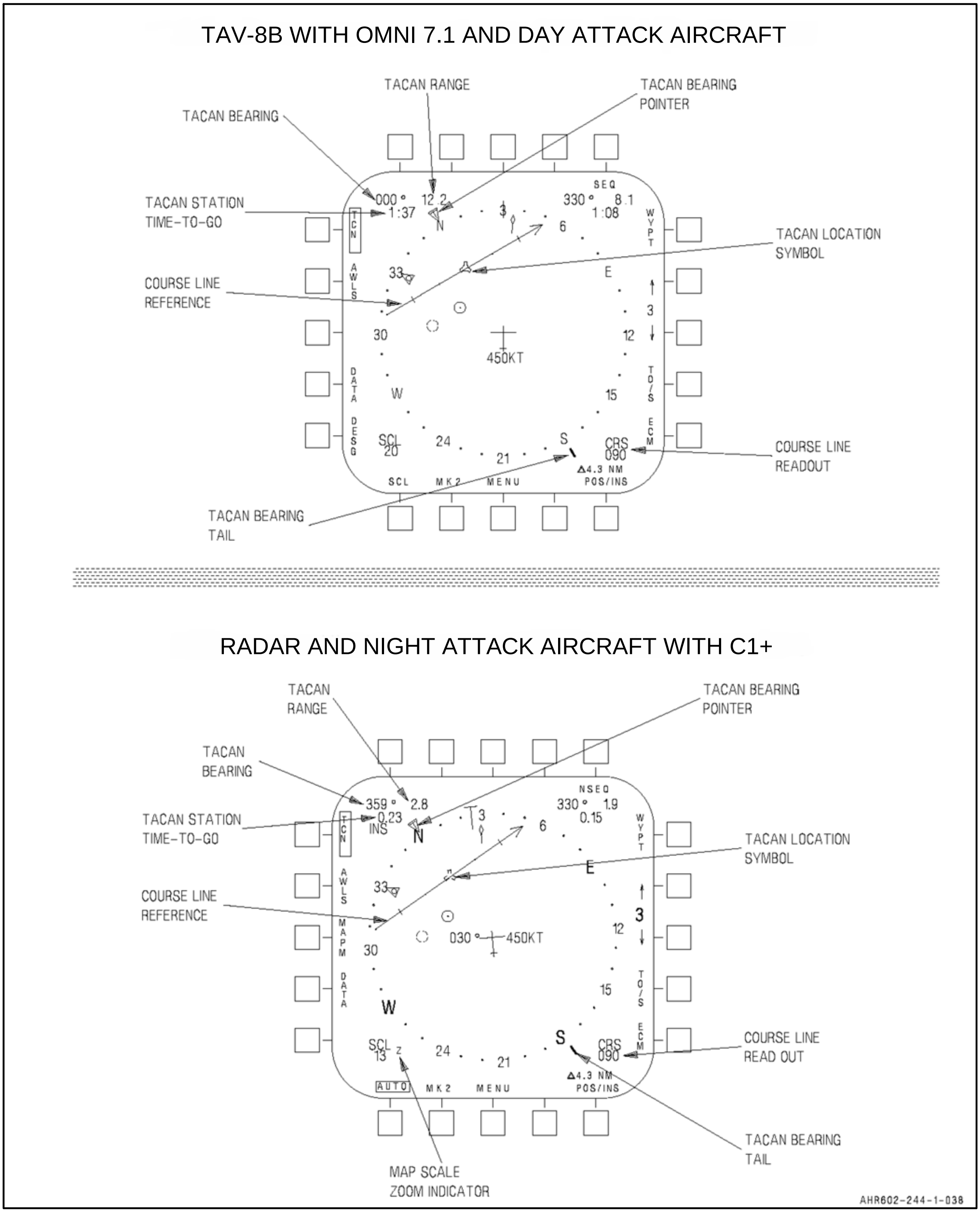


Figure 23-6. TACAN Display

23.7.1.6 Course Set Switch (Radar and Night Attack Aircraft)

The course set switch is on the CRS panel assembly on the main instrument panel (see Figure 23-5). This switch is used to set a course for steering to or from the TACAN station when TACAN steering is selected. Holding the switch to the right slews the course arrow in a cw rotation, to the left a ccw rotation.

23.7.2 TACAN BIT Checks

To perform an initiated TACAN BIT check, press the BIT pushbutton on the DDI menu display to initiate a BIT display. Press the CNI pushbutton and the word TEST appears next to TCN. After about 25 seconds the word TEST disappears. If a number one then appears next to TCN the TACAN has failed the BIT check. If the space next to TCN remains blank the TACAN has checked good.

23.7.3 TACAN and TACAN Offset Data

The pilot has the option of programming an offset for the selected TACAN station. TACAN offsets can be utilized for area navigation on cross country flights. This allows the aircraft to fly a great circle route between two distant points when the appropriate TACAN stations are not geographically located along the direct line of flight.

23.7.4 TACAN Data Entry

TACAN station data is stored for five TACAN stations. TACAN channel, position, elevation, and magnetic variation are stored in the mission computer for use in updating the INS. Navigation can not be performed using the stored TACAN information. On the DDI, press the EHSI/EHSD and then the DATA pushbutton. The WYPT data is displayed. Press the TCN pushbutton and the DDI shows the TACAN data display. Pressing the down arrow or up arrow pushbutton changes the TACAN station number (0 through 4). The option display unit and the upfront control are used to manually enter TACAN data, as follows:

1. On the option display unit, press the CH X or CH Y (channel) option pushbutton.

   A colon appears to the left of the option display window. If X is displayed, press CH X pushbutton again and Y is displayed.

2. Type desired new channel on keyboard, then press ENT. Channel number appears on scratch pad.

3. Press POS (position) option pushbutton.

   A colon appears to the left of the option display window. Stored latitude of selected TACAN channel is displayed.

4. Type N or S on keyboard, then type desired new latitude and press ENT.

   If N093105 is typed, the scratch pad blanks momentarily and then displays N 09°31’05’’. Six numerics must be entered for a degrees-minutes-seconds entry. The TACAN latitude may be entered to the thousandth of a minute. If N0931.083 is typed, the scratch pad blanks momentarily and then displays N 09°31.083’. A minimum of four numerics must be entered before the system will accept the entry.

5. Press POS option pushbutton.

   A colon appears to the left of the option display window. Stored longitude of selected TACAN channel is displayed.

6. Type E or W on keyboard, then type desired longitude and press ENT.

   Scratch pad blanks momentarily and then displays new longitude. Seven numerics must be entered for a degrees-minutes-seconds entry. The TACAN longitude may be entered to the thousandth of a minute. A minimum of five numerics must be entered before the system will accept the entry.

7. Press ELEV option pushbutton.

   A colon appears to the left of the option display window. Stored elevation of the selected TACAN channel is displayed.

8. Type elevation in feet, then press ENT.

   Elevation display blanks momentarily on scratch pad and then new elevation is displayed.

9. Press MVAR option pushbutton.

   A colon appears to the left of the option display window. Stored magnetic variation of the selected TACAN channel is displayed. If there is no stored magnetic variation for the selected TACAN then the scratch pad will be blank.

10. Type E or W and two digits, then ENT.

    Magnetic variation display blanks momentarily on scratch pad, then new magnetic variation is displayed. The magnetic variation must always be typed as 2 digits. For 9° east type E 09. With H4.0, it is possible to enter the magnetic variation to the nearest tenth of a degree.

23.7.5 TACAN Offset Data Entry

The selected TACAN has an associated offset capability. TACAN selection on the DDI EHSI/EHSD display changes the waypoint offset (WO/S) option legend to the TACAN offset (TO/S) option legend. Selecting the TO/S option boxes the legend and displays the currently selected TACAN offset on the DDI within the compass rose, changes the waypoint data block to reflect current TACAN offset data, and displays the TACAN offset bearing and range options on the ODU. The BRG (bearing) option initializes selected (cued) and the last entered value is displayed on the scratch pad. The TO/S options are mutually exclusive with respect to UFC usage. Selecting an option on the ODU automatically deselects the current option. The new selection is cued and the last entered data is displayed on the scratch pad. The pilot enters TACAN offset data in terms of bearing and range from the associated TACAN. TACAN offset data entry is as follows:

1. On the option display unit, press the BRG (bearing) option pushbutton.

   A colon appears to the left of the option display window.

2. Type bearing in degrees magnetic, then press ENT.

   Enter bearing in increments of 0.01°. Entry of leading zeroes is not required.

3. On the option display unit, press the RNG (range) option pushbutton.

   A colon appears to the left of the option display window.

4. Type range in nautical miles , then press ENT.

   Entries up to 999.999 nautical miles with 0.001 precision may be entered.

23.7.6 TACAN Steering

In TACAN steering, the pilot's display shows the aircraft's situation relative to the TACAN station. TACAN steering is selected by pressing the TCN pushbutton on the EHSI/EHSD display. When TACAN steering is selected, the TACAN option is boxed (see Figure 23-7) and the commanded heading marker (bug) on the HUD heading scale shows relative bearing. The heading bug is corrected for drift. DME slant range is shown on the bottom right of the HUD display. The bearing to the station is indicated by the pointer outside the compass rose. A digital readout of bearing and distance to the station is provided in the upper left corner of the EHSI/EHSD display. Time to go to the station in minutes and seconds is provided under the bearing and distance. Once the heading bug is positioned straight ahead, heading is maintained to fly directly to the TACAN station.

The mission computer uses the elevation and magnetic variation from the stored TACAN information to calculate the position of the TACAN station on the EHSI/EHSD page and the steering information on the EHSI/EHSD page and HUD. If the information for the selected TACAN is not stored in the mission computer, a default elevation of 0 FT MSL and the aircraft's current magnetic variation are used instead.

CAUTION

The mission computer uses the TACAN channel to search for the stored information, instead of the unique three letter station ID. It is possible that the system can mistakenly use the elevation and magnetic variation belonging to a different TACAN station that happens to use the same channel number as the currently selected TACAN. An incorrect stored magnetic variation will result in erroneous TACAN steering information.

To fly a selected course to or from a TACAN station, the course is set in with the course set knob on the HSI (TAV-8B and Day Attack aircraft) or course set switch (Radar and Night Attack aircraft). The course appears on the bottom right of the EHSI/EHSD display. A course line also appears on the display. The course line's rate of movement is used to anticipate when to turn to intercept the course.

CAUTION

In the TAV-8B and Day Attack aircraft, the course line displayed on the EHSI/EHSD and the course in the course selector window of the HSI is not necessarily the same. The bearing displayed in the course line data block in the lower right corner of the EHSI/EHSD and the course line displayed on the EHSI/EHSD should be used instead of the bearing in the course selector window of the HSI. See Figure 23-6.

23.7.7 TACAN Offset Steering

TACAN offset steering (see Figure 23-7) may be used to steer to or away from an offset selected from any TACAN station. The associated TACAN must be in the T/R mode and the aircraft operating in the NAV or V/STOL master mode. TACAN offset steering is selected in the same manner as TACAN steering except that TO/S option must be selected after selecting TCN. After selecting TO/S, enter the bearing and range of the offset from the TACAN station selected. When TO/S is boxed, the TACAN bearing pointer stays on the bearing of the selected TACAN station, the offset bearing pointer rotates around the inside of the compass rose to the bearing of the TO/S from the aircraft. The waypoint data in the upper right corner of the EHSI/EHSD display changes to reflect TO/S data for the TACAN station selected. A course to the TACAN offset may be selected in the same manner as described for TACAN steering. When TACAN offset steering is selected a bearing bug is displayed on the HUD. Ground range to the offset in nautical miles is indicated next to the TO/S legend on the HUD. If EMCON is selected, TACAN offset data is removed from the HUD and EHSI/EHSD display.

23.7.8 TACAN Cone of Confusion (H4.0 Only)

The TACAN steering data on the EHSD page is displayed using green symbology during the initial power up BIT and anytime the aircraft calculates that it is within a 60 degree half angle cone (from the vertical) positioned at the calculated TACAN position. A green CC legend also appears next to the TACAN range in the TACAN steering block.

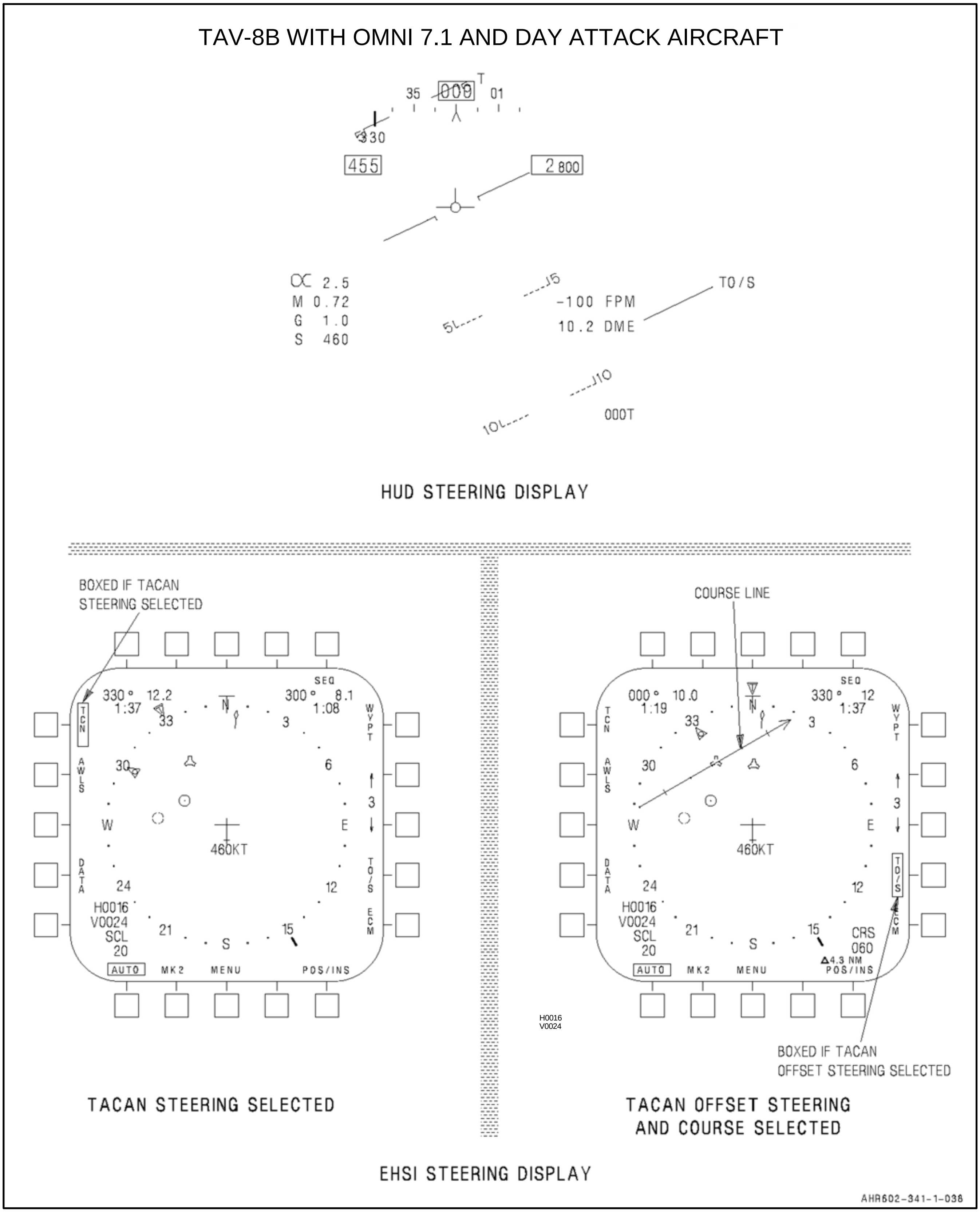


Figure 23-7. TACAN or TACAN Offset Steering (Sheet 1 of 3)

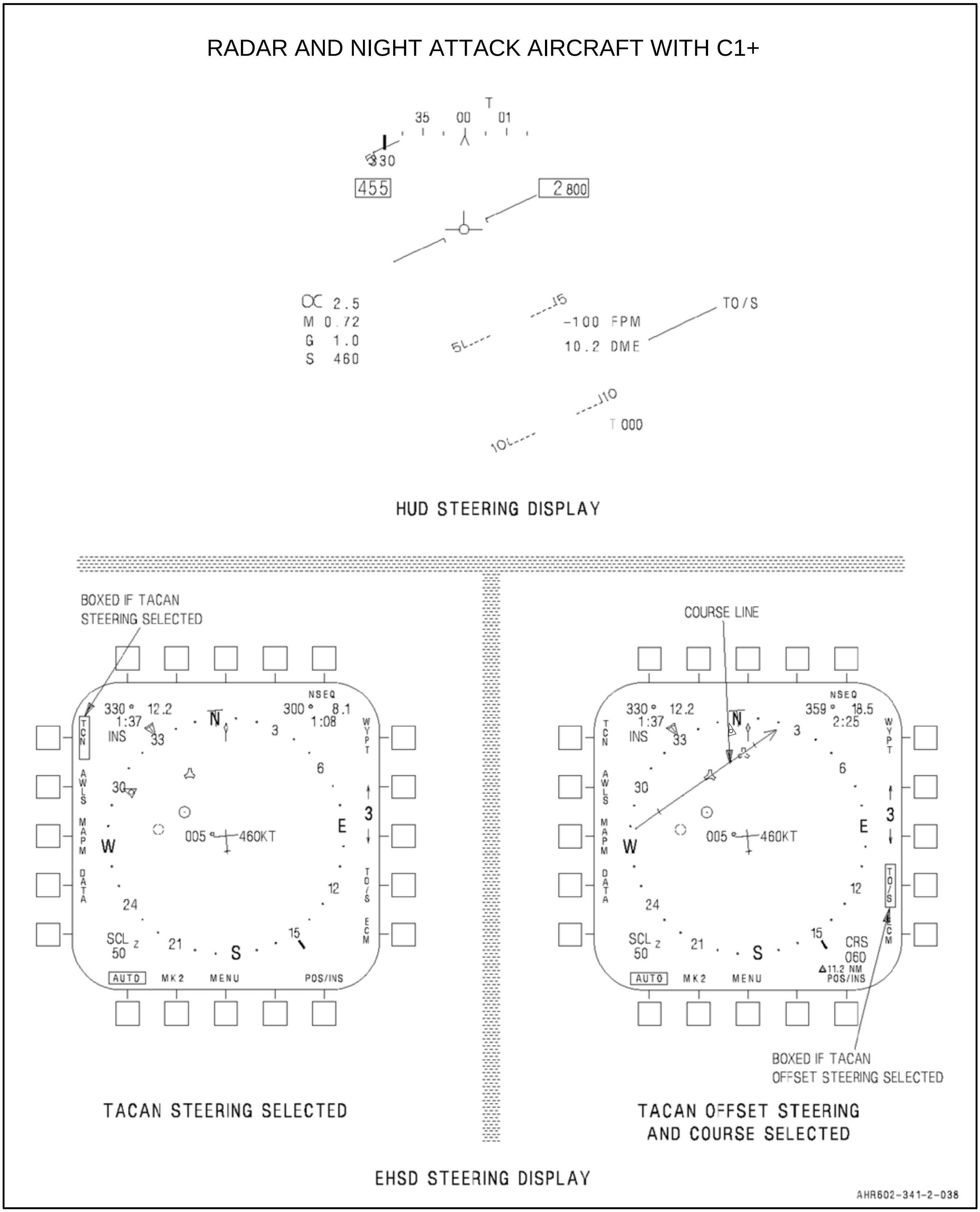


Figure 23-7. TACAN or TACAN Offset Steering (Sheet 2)

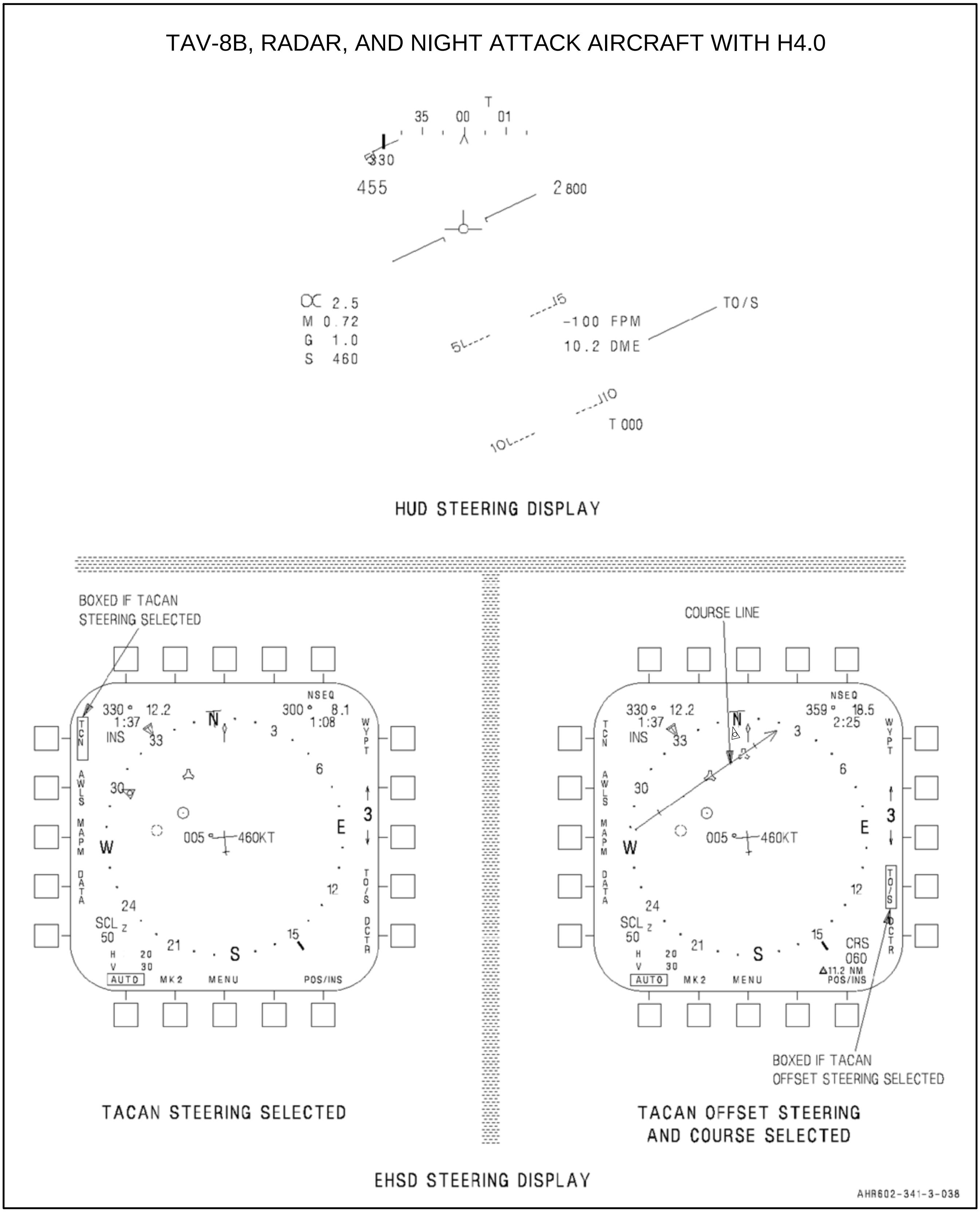


Figure 23-7. TACAN or TACAN Offset Steering (Sheet 3)

23.8 ALL WEATHER LANDING SYSTEM

The all weather landing system (AWLS) provides the aircraft with steering information to fly a selected glideslope and localizer. The AWLS operates in conjunction with a ground system which provides azimuth and elevation angle information along with range derived from TACAN DME. AWLS steering provides situation steering displays on the HUD, representing aircraft position to maintain the localizer and selected glideslope. The azimuth steering bar is displayed when the azimuth signal is valid. The elevation steering bar is displayed only when both elevation and azimuth signals are valid. DME range is displayed when valid TACAN signals are present. Azimuth and elevation offsets can be entered by the pilot if required to offset the steering signals to a station offset.

An obstacle clearance warning is provided when the aircraft descends below a predetermined elevation angle set on the ground station. When the AWLS senses it is at or below the obstacle clearance angle, the elevation bar on the HUD flashes at a 2 Hz rate. On AV-8B 161573 through 163518, TAV-8B 162747 through 163207, in addition, when the obstacle clearance region is first entered a warning tone is generated for 3 seconds. The warning consists of a 1000 Hz tone pulsed at a 1 Hz rate (same as radar altimeter LAW tone). On AV-8B 163519 and up, TAV-8B 163856 and up, an OBSTACLE, OBSTACLE voice warning is provided in conjunction with the flashing elevation bar on the HUD.

23.8.1 Controls and Indicators

Controls and indicators for the AWLS include the upfront control, the option display unit, the DDI, and the HUD (see Figure 23-8).

23.8.1.1 Upfront Control

The pushbuttons and indicators on this control that are used for AWLS operation and display are the AWLS function selector pushbutton (labeled AWL), the on/off selector pushbutton, the pushbutton keyboard, and the scratch pad.

23.8.1.1.1 AWLS Function Selector Pushbutton

Pressing the AWL pushbutton enables AWLS and displays the options associated with the AWLS system on the ODU. The AWLS system will initialize on an AWLS channel and display the previously entered channel on the scratch pad.

23.8.1.1.2 On/Off Selector Pushbutton

Pressing this pushbutton turns AWLS on or off after first pressing the AWLS function selector pushbutton. When AWLS is first turned ON, the system goes through a 10 second warm-up and is commanded by the MC to perform an AWLS BIT (15 seconds). Selection of AWLS on the DDIs EHSI/EHSD display also turns on the system.

23.8.1.2 Option Display Unit

The pushbuttons and indicators on this panel are the option select pushbuttons and the option display windows.

23.8.1.2.1 Option Select Pushbuttons

The option select pushbuttons are numbered downward 1, 2, and 3 on the right side, and 4 and 5 on the left side. A colon displayed on the left side of an option display window indicates that option has been selected on the pushbutton.

1. Option 1. Displays the current AWLS ground station channel (CH 1 through 20). When the option is enabled, the channel number appears on the scratch pad and the keyboard can be used to change channel number.

2. Option 2. Displays the letters GS. When the option is enabled, the scratch pad also displays the current glideslope and allows the keyboard to be used to change glideslope (2° to 6° with resolution to 0.1°).

3. Option 3. Displays the letters AZ (Azimuth). When the AZ option is selected, the scratch pad displays the current azimuth offset and the keyboard can be used to change the value. Azimuth offsets up to ±310 feet in 1 foot increments can be entered. Minus numbers mean centerline of runway is left of AWLS station and positive numbers mean centerline of runway is right of the AWLS station. Zero is a valid azimuth offset entry.

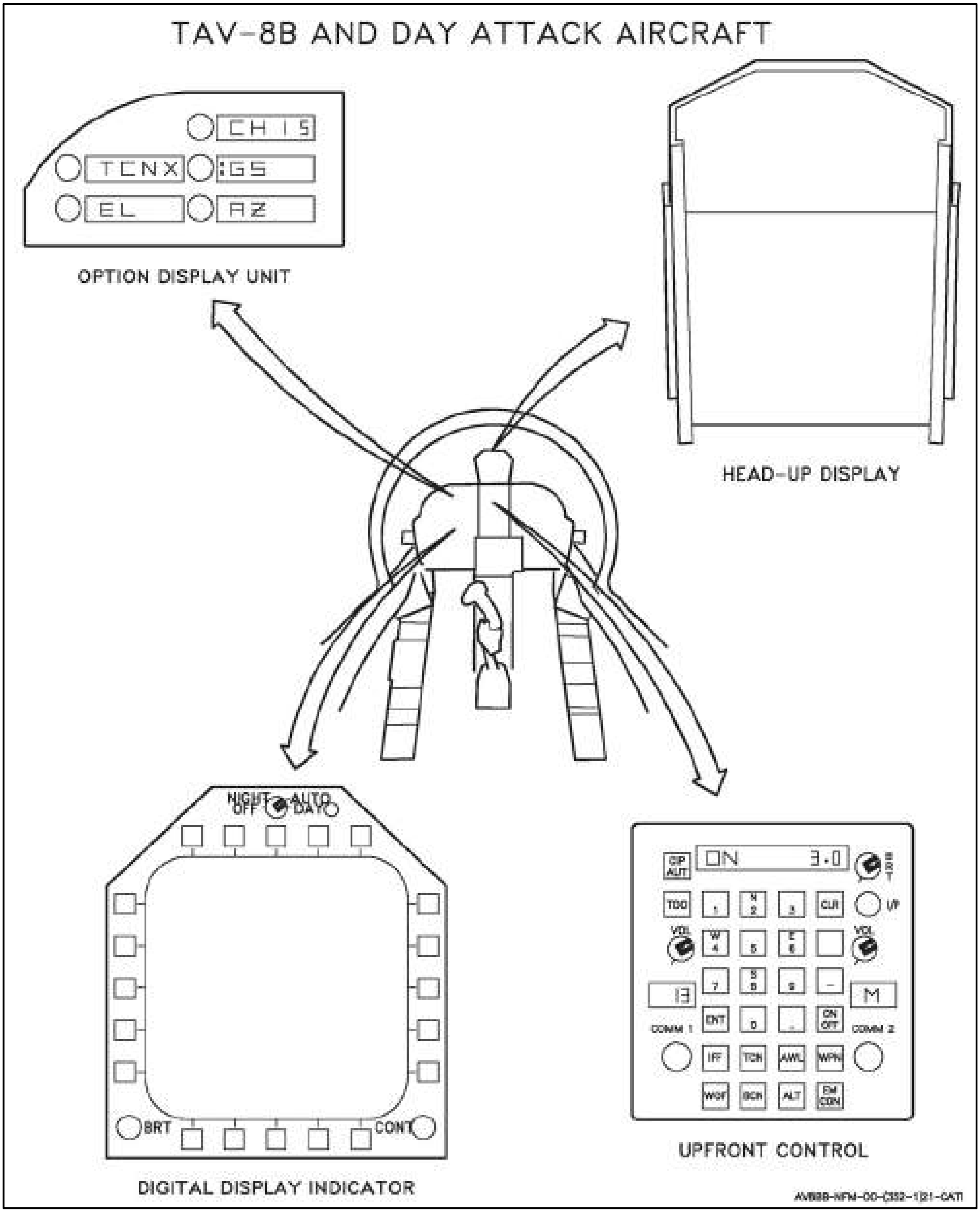


Figure 23-8. AWLS Controls and Indicators (Sheet 1 of 2)

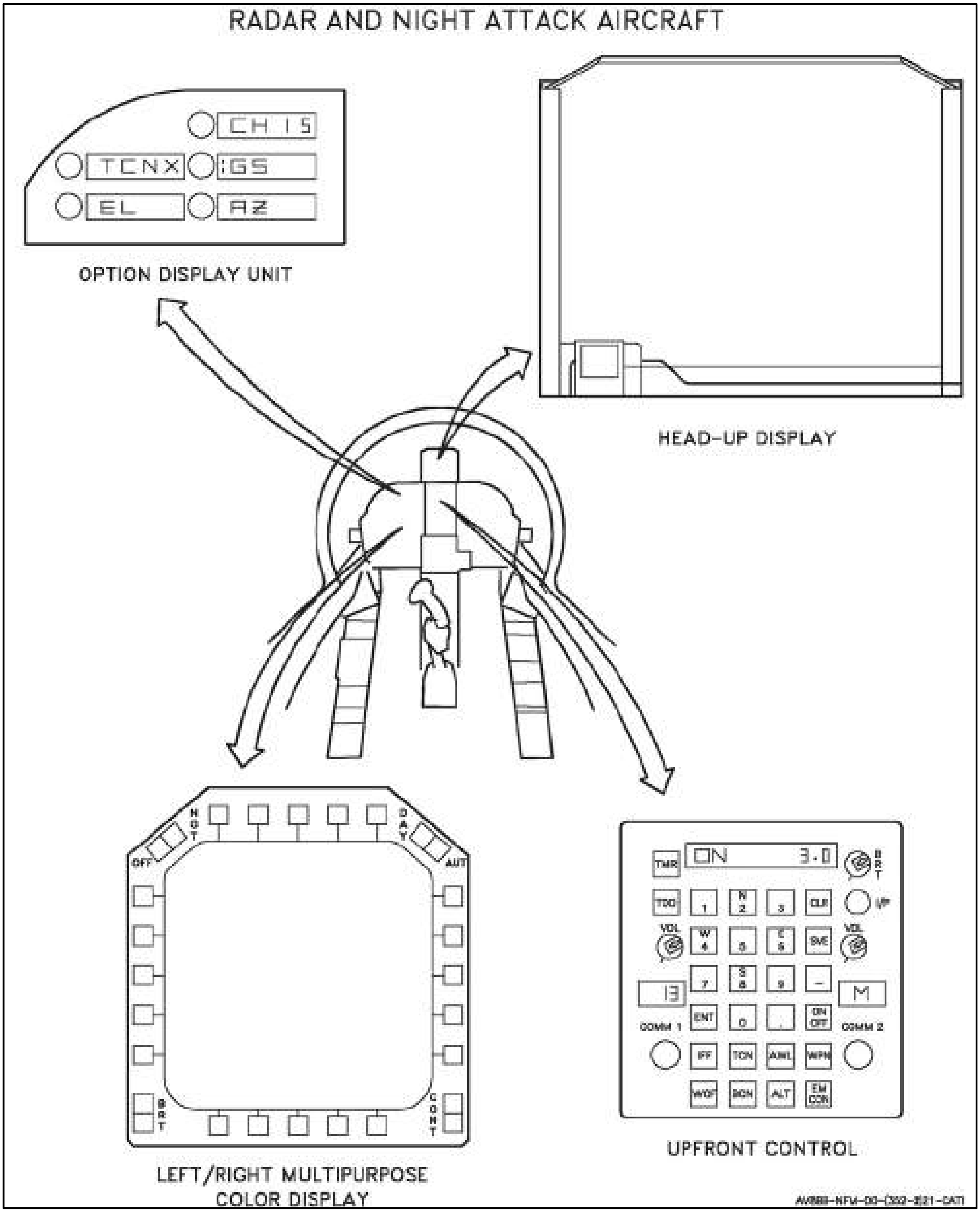


Figure 23-8. AWLS Controls and Indicators (Sheet 2)

4. Option 4. Displays the letters :TCNX or :TCNY. Successive pressing of the option 4 pushbutton alternates X and Y and displays the TACAN channel number on the scratch pad and current X and Y selection in window 4.

5. Option 5. Displays the letters EL (Elevation). When the EL option is selected, the scratch pad displays the current elevation offset and the keyboard can be used to change the value. Elevation offsets up to 31 feet in 1-foot increments can be entered. Zero is a valid azimuth or elevation offset entry. Offsets are automatically zeroed upon changing AWLS stations.

23.8.1.3 DDI

If the DDI does not have a menu displayed, press the menu pushbutton. Then press the EHSI/EHSD pushbutton to obtain an EHSI/EHSD display. On the display, press the AWLS pushbutton and AWLS is displayed in a box (see Figure 23-9). AWLS steering mode is now selected and the AWLS display is seen on the HUD if in the guidance beam. Selection of the AWLS steering mode activates the AWLS and the TACAN, and tunes the TACAN to the preselected channel. Selection of AWLS also deselects any other steering mode.

To prevent the TACAN from remaining in the channel associated with AWLS steering after AWLS steering deselection, the TACAN channel prior to selecting AWLS steering is automatically saved. This TACAN channel is restored when AWLS steering is deselected.

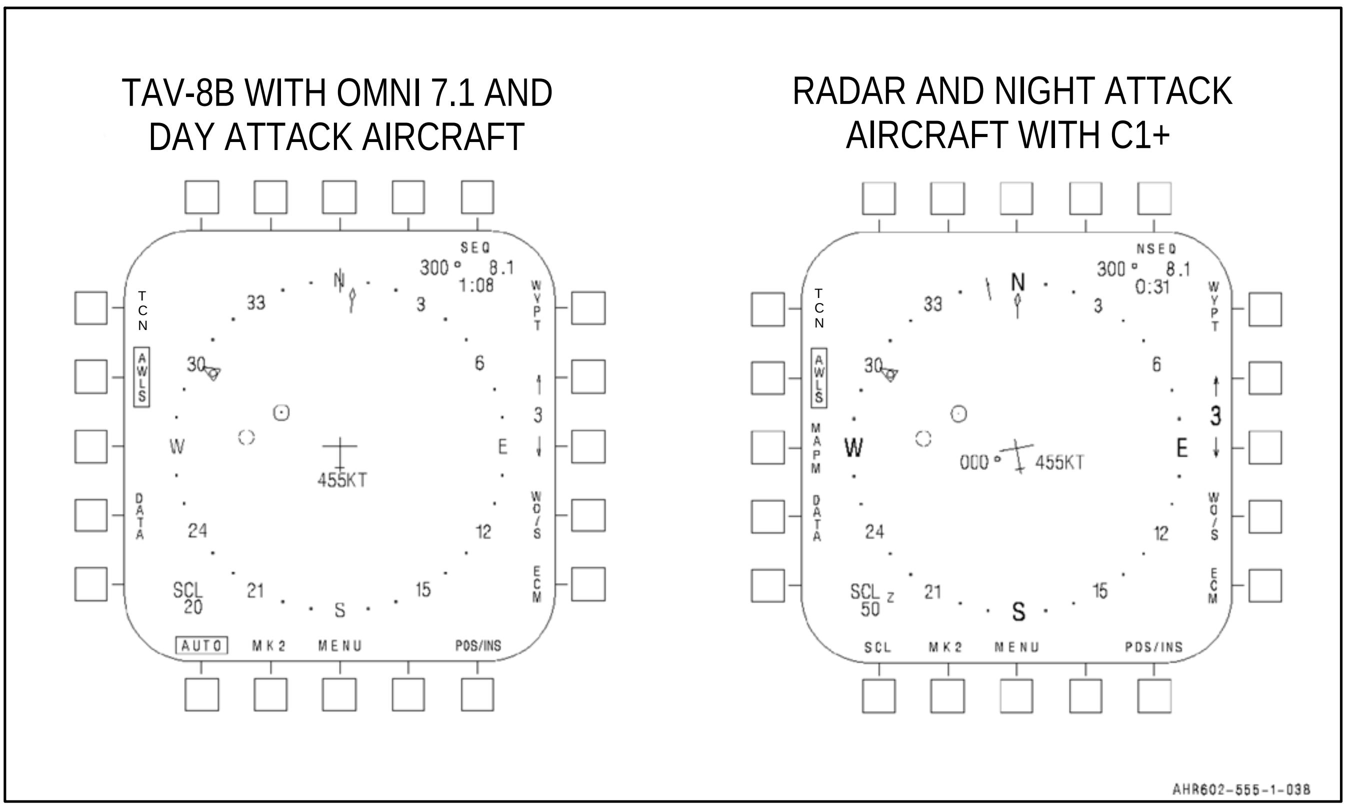


Figure 23-9. AWLS DDI Steering Displays

23.8.1.4 HUD

TACAN or waypoint steering can be initially selected by the pilot until the 40° wide and 20° high guidance beam is intercepted, at which time the pilot can select AWLS steering. When the beam is acquired, a vertical azimuth steering bar and a horizontal elevation steering bar are displayed (see Figure 23-10). Both bars are referenced to the velocity vector in the NAV mode and to the vertical flightpath symbol in the VSTOL mode. The azimuth bar represents aircraft azimuth angle from the localizer and the horizontal bar represents elevation angle from glideslope. Full deflection of the steering bars on the HUD represents ±2° for elevation and ±6° for azimuth. Azimuth steering reference marks are provided adjacent to the velocity vector/vertical flightpath symbol when the AWLS steering mode is selected. The reference markers denote 3° and 6° steering deviation (left and right).

The OFST (offset) legend appears when the azimuth and elevation steering bars are referenced to a station offset. If the TACAN DME or offset data becomes invalid, the OFST legend is removed and steering reverts to beam centerline.

Glideslope angles of less than 2° or in excess of 6° should not be used. The pilot must keep the elevation bar centered on the velocity vector to fly the selected glideslope.

23.8.2 AWLS BIT Check

To perform an initiated AWLS BIT check, press the BIT pushbutton on the DDI menu display to initiate a BIT display. Press the CNI pushbutton and the word TEST appears next to AWLS. After approximately 15 seconds the word TEST disappears. If a number then appears next to AWLS the system has failed the BIT check. If the space next to AWLS remains blank the system has checked good. AWLS initiated BIT is commanded automatically when AWLS power is turned on.

23.9 NAVIGATION CONTROLS AND INDICATORS

The symbols and digital readouts that normally appear on the DDI display (see Figure 23-11 through Figure 23-14) are discussed below. Targetpoints and the EW page are only available with H4.0.

23.9.1 Aircraft Symbol

The aircraft symbol represents the position of the aircraft.

23.9.2 Bearing Pointer

The bearing pointer indicates bearing to the selected waypoint, markpoint, targetpoint, waypoint/markpoint offset or TACAN offset. With C1+, the bearing pointer does not indicate bearing to the TACAN offset.

23.9.3 Waypoint, Markpoint or Targetpoint Location Symbol

A circle represents the location of the selected waypoint or markpoint. With H4.0, triangles represent the location of all targetpoints (except T0) currently within the compass rose, not just the selected targetpoint. Small numbers next to each triangle identify the targetpoints.

23.9.4 Bearing (Upper Right Digital Readout)

This readout indicates the bearing to the selected waypoint, markpoint, targetpoint, waypoint/markpoint offset, TACAN offset, or designated point. With C1+, the bearing does not indicate bearing to the TACAN offset.

23.9.5 Range (Upper Right Digital Readout)

This readout indicates the ground range to the selected waypoint, markpoint, targetpoint, waypoint/markpoint offset, TACAN offset, or designated point. With C1+, the range does not indicate ground range to the TACAN offset.

23.9.6 Time-to-Go (Upper Right Digital Readout)

This readout indicates the time-to-go to the selected waypoint, markpoint, targetpoint, waypoint/markpoint offset, TACAN offset, or designated point. With C1+, the time-to-go does not indicate time-to-go to the TACAN offset.

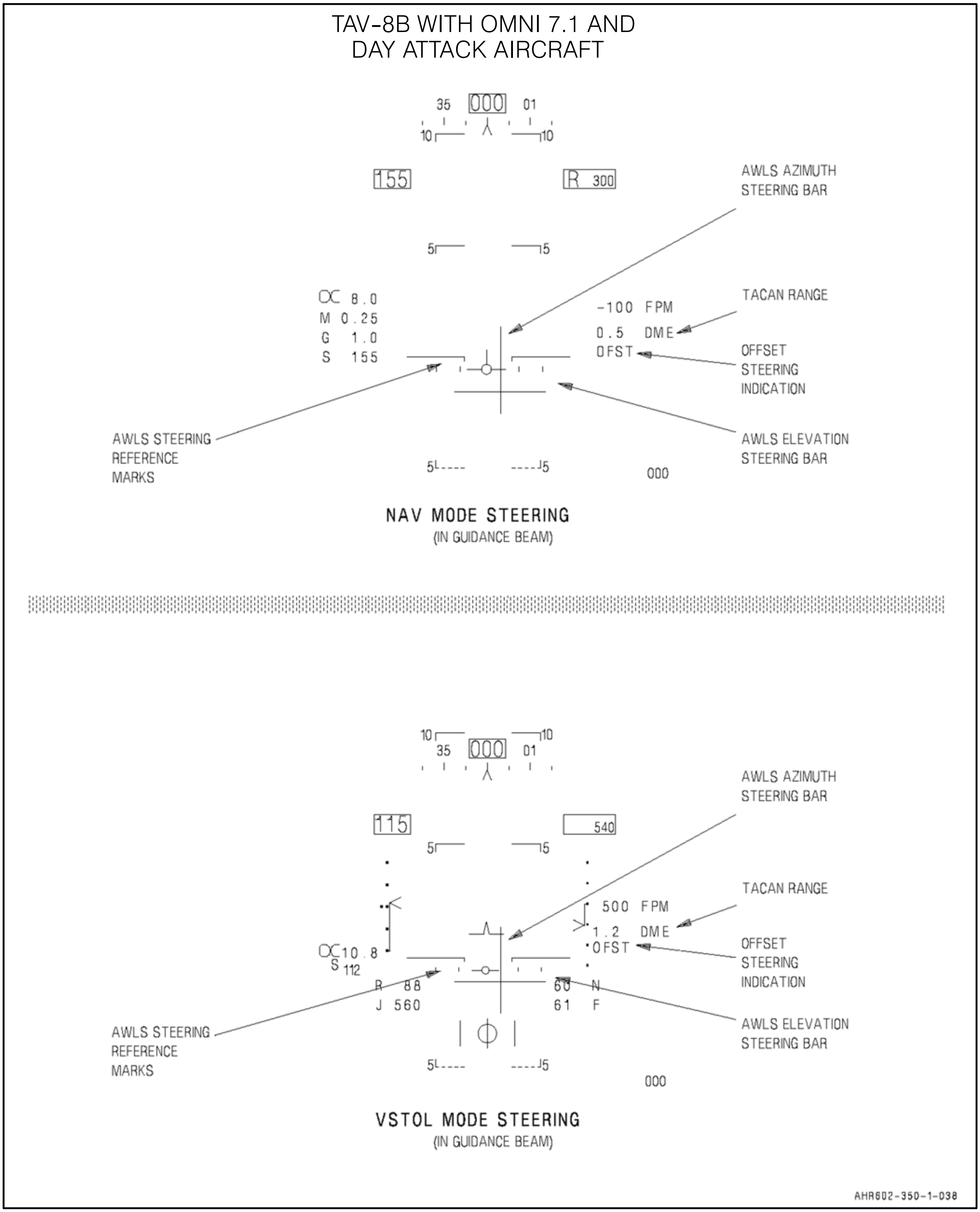


Figure 23-10. AWLS HUD Steering Displays (Sheet 1 of 2)

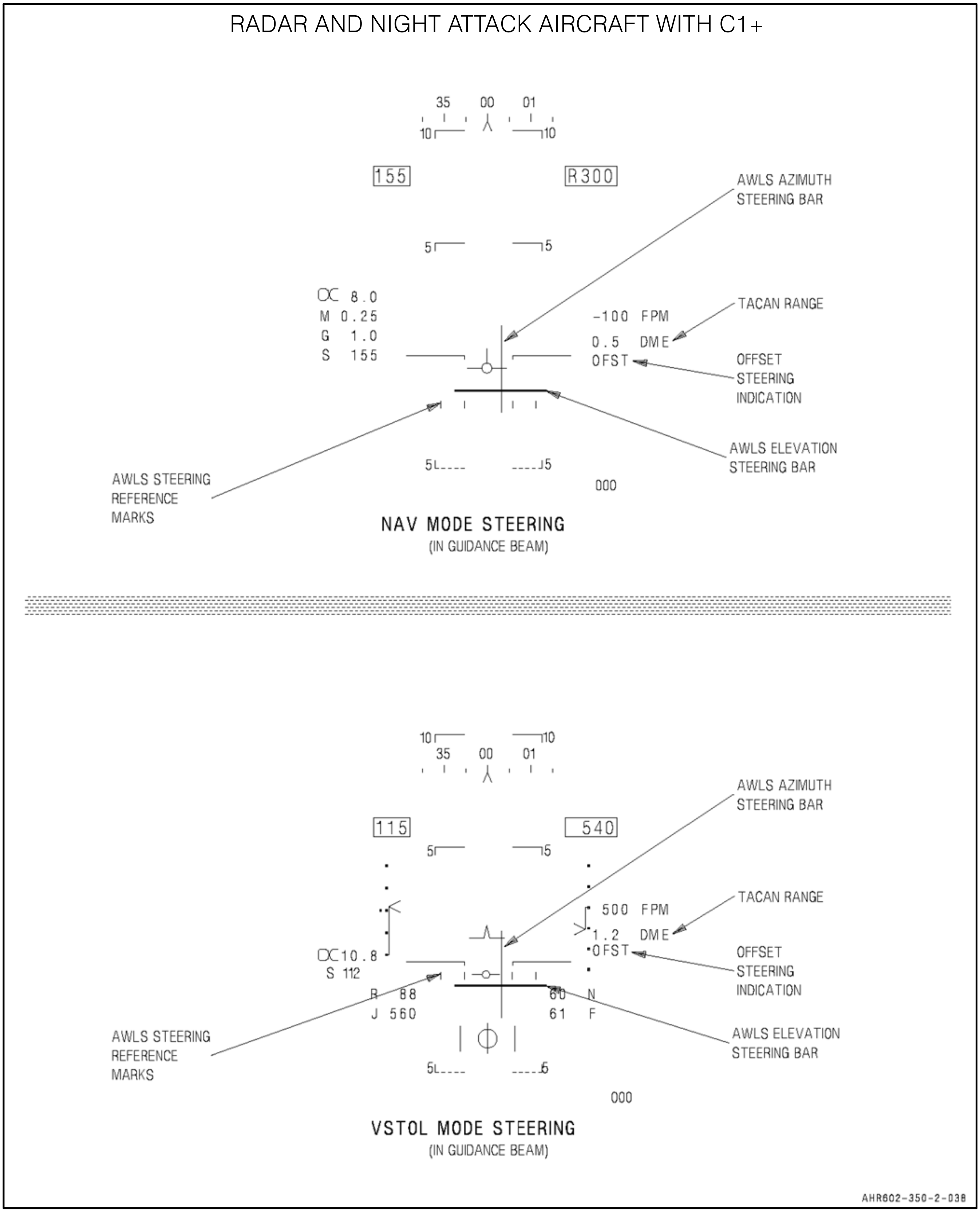


Figure 23-10. AWLS HUD Steering Displays (Sheet 2)

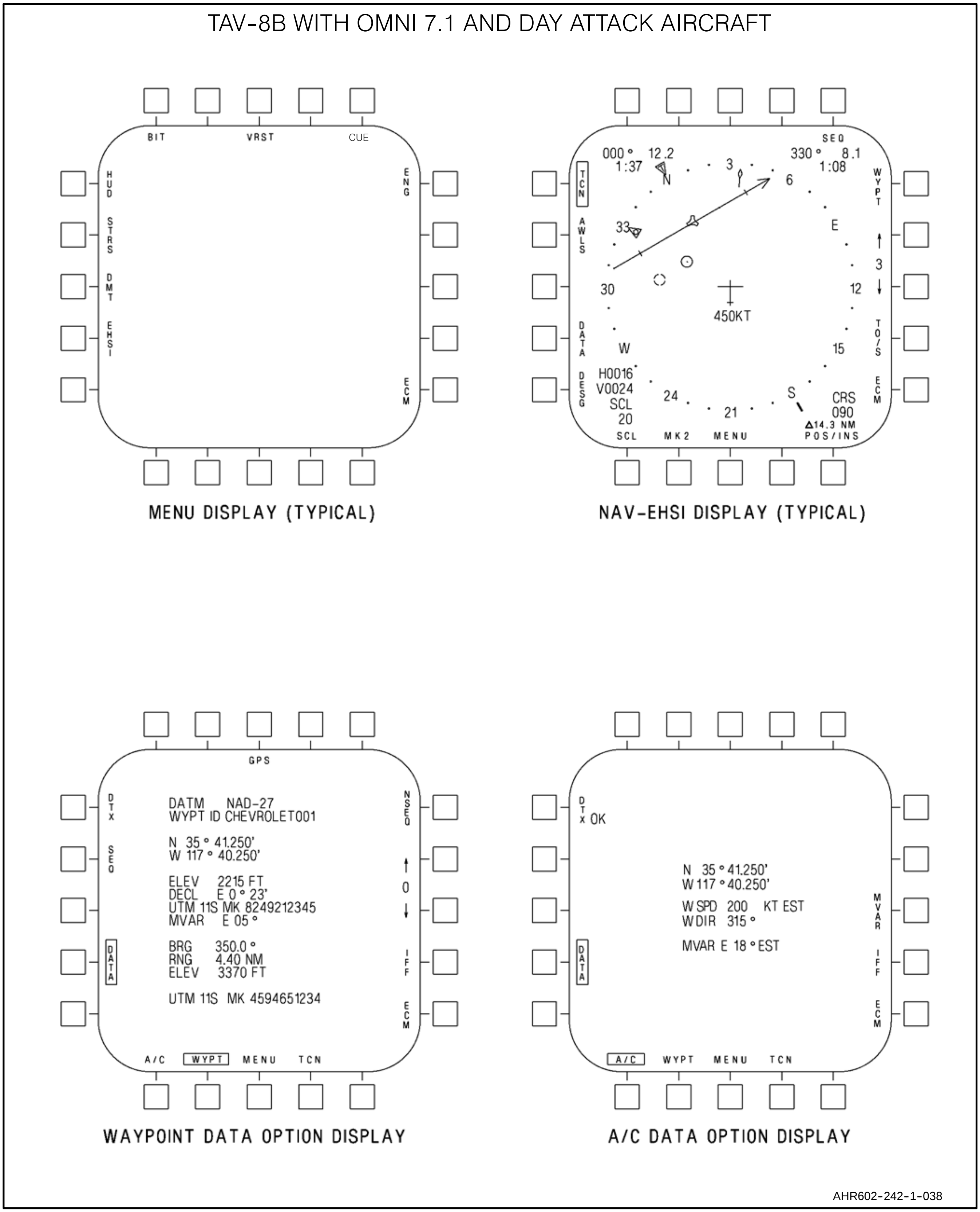


Figure 23-11. Navigation Controls and Indicators (Sheet 1 of 5)

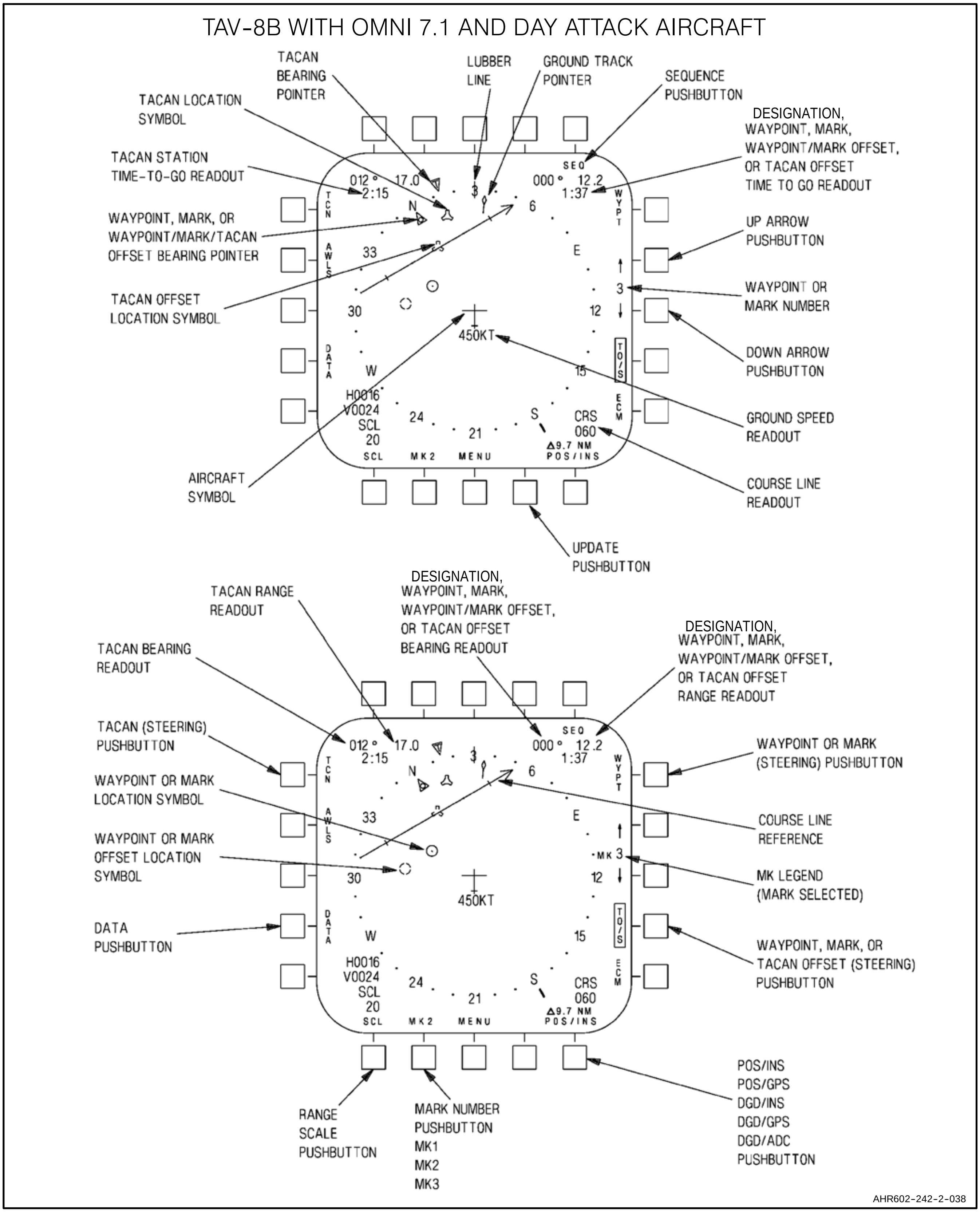


Figure 23-11. Navigation Controls and Indicators (Sheet 2)

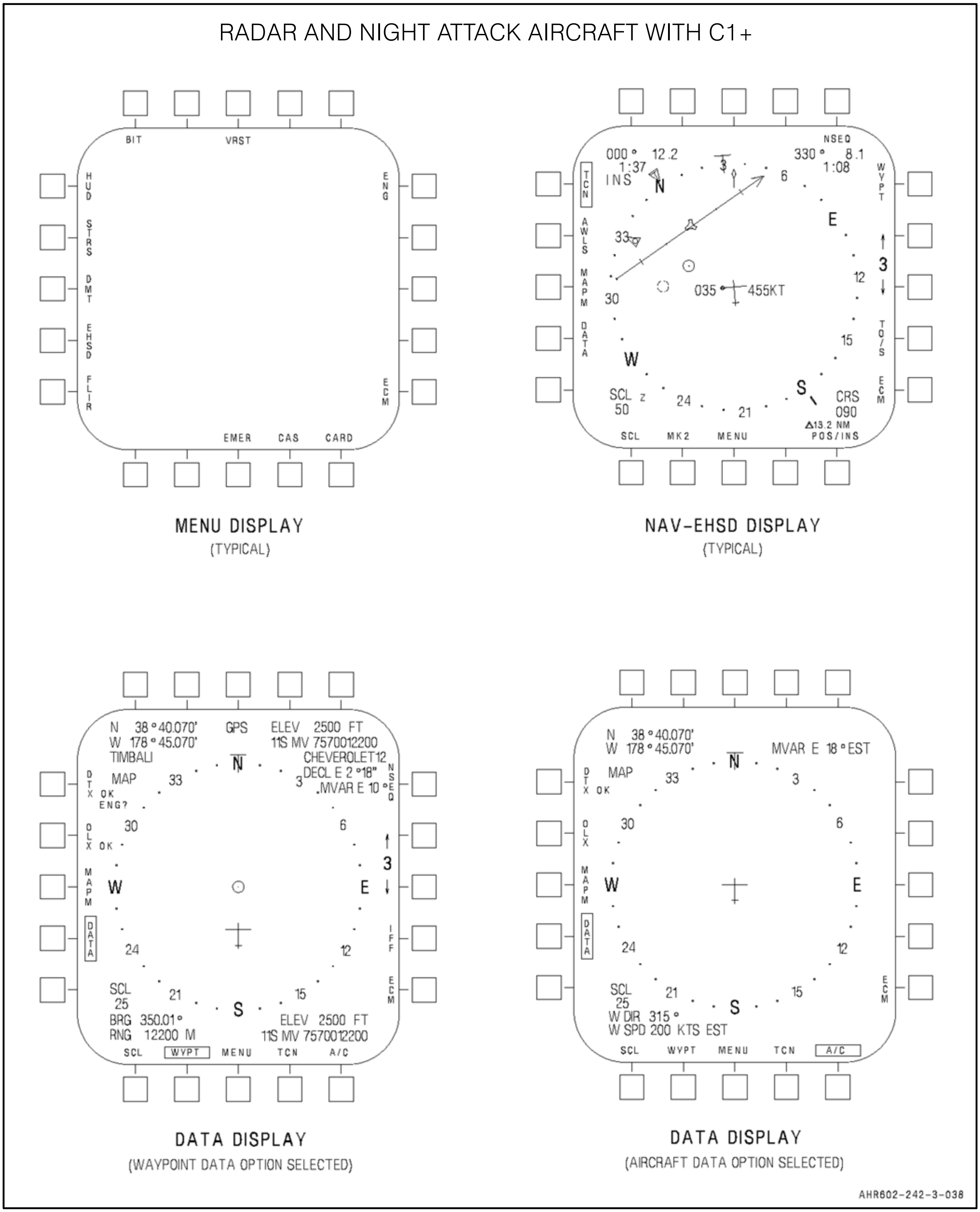


Figure 23-11. Navigation Controls and Indicators (Sheet 3)

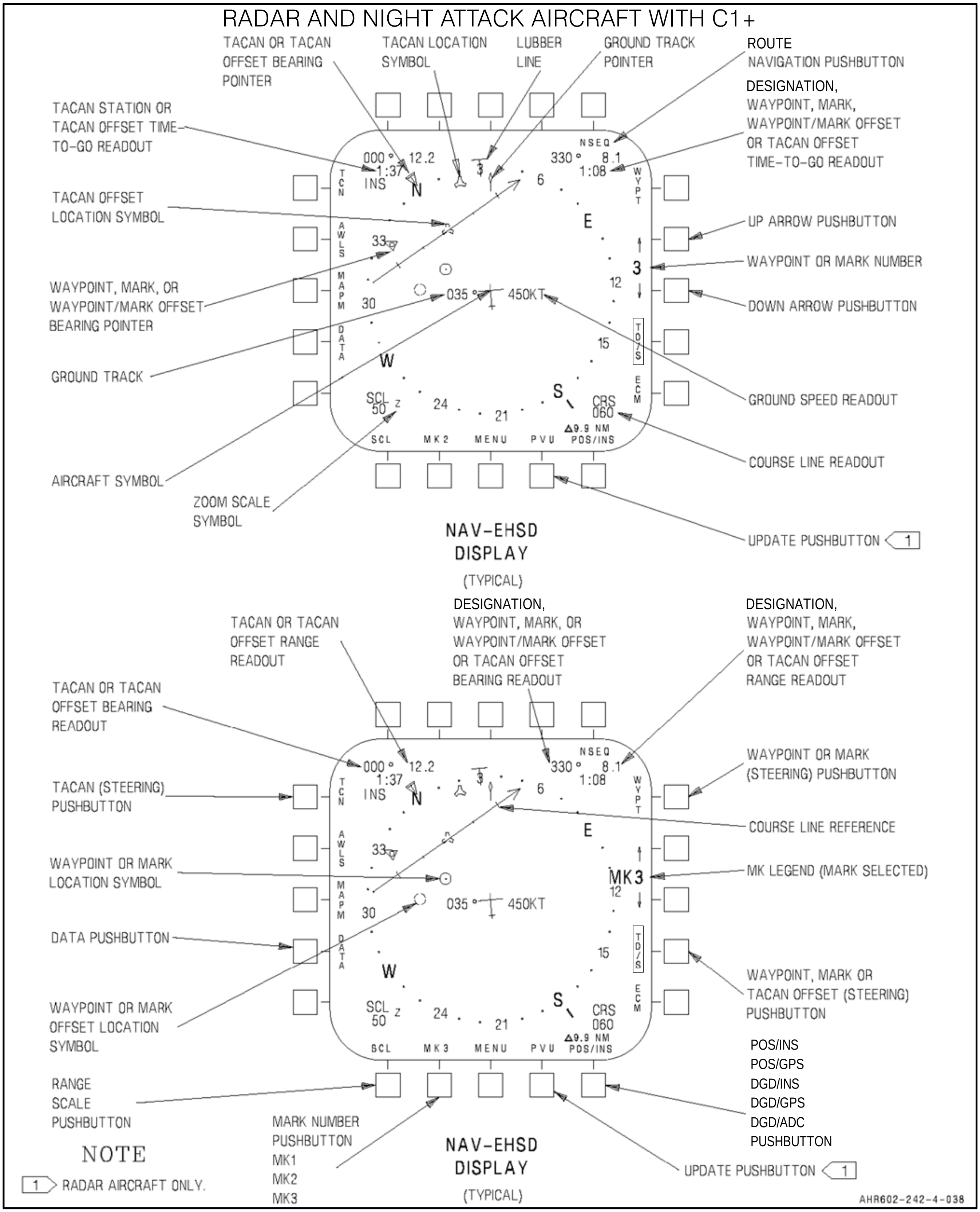
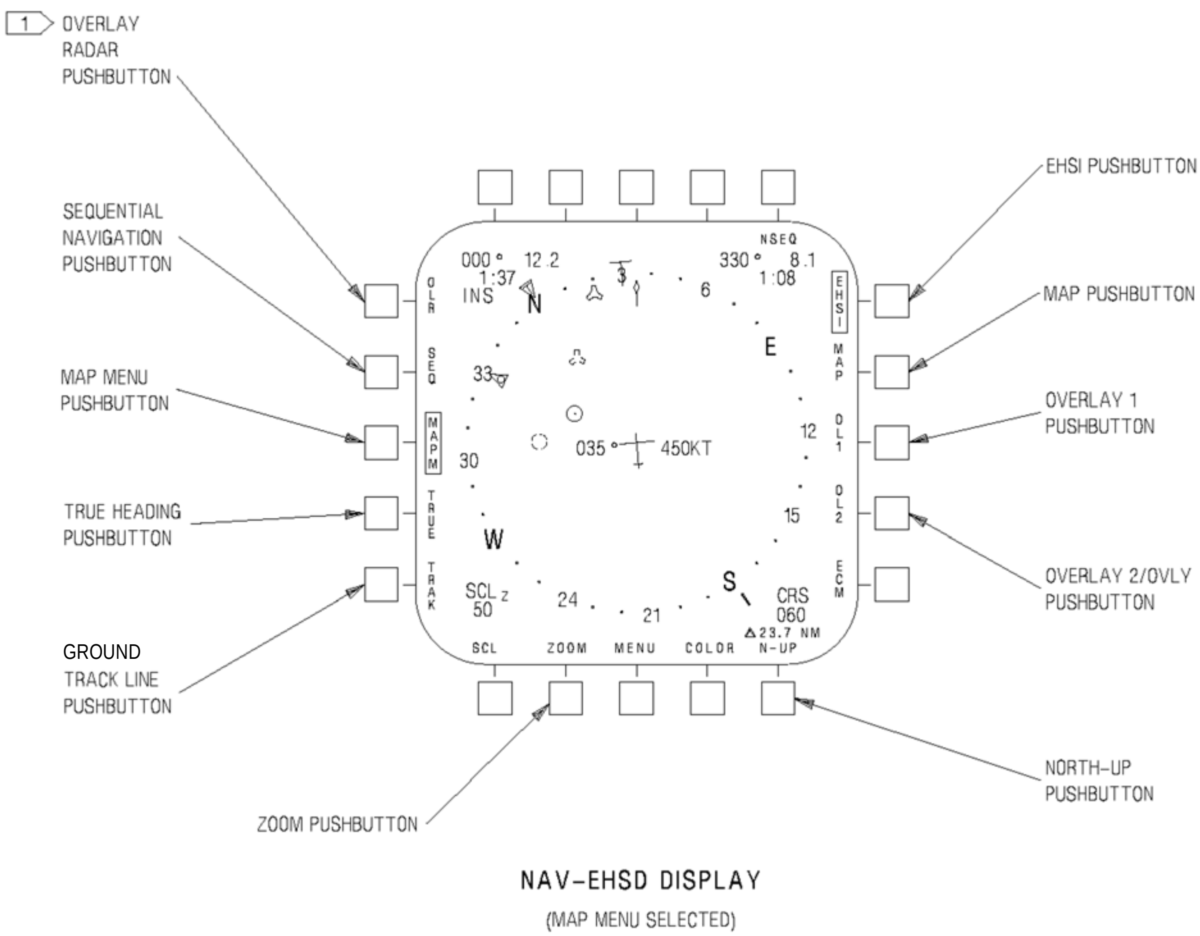


Figure 23-11. Navigation Controls and Indicators (Sheet 4)

RADAR AND NIGHT ATTACK AIRCRAFT WITH C1+

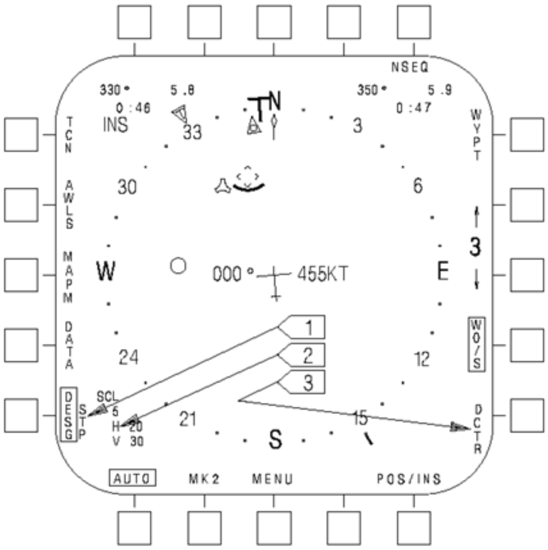


NOTE

1 RADAR AIRCRAFT

AHR602-242-5-038

Figure 23-11. Navigation Controls and Indicators (Sheet 5)



NOTES

1. WHEN DESG IS BOXED, EITHER STP OR TGT WILL BE DISPLAYED NEXT TO THE DESG LEGEND. STP IS DISPLAYED WHEN THE DESIGNATION IS THE STEER TO POINT. THE STEER TO POINT IS THE POINT LOCATED BETWEEN THE ARROWS ALONG THE RIGHT SIDE OF THE EHSD. IF SOMETHING OTHER THAN THE STEER TO POINT IS DESIGNATED (E.G. HUD OR RADAR DESIGNATION), TGT IS DISPLAYED NEXT TO THE DESG LEGEND.

2. THE GPS HERS AND VERS ARE DEPICTED ON THE EHSD PAGE.

3. THIS OPTION CYCLES FROM THE CENTER MAP TO THE DECENTER MAP TO THE EW DISPLAY.

Figure 23-12. EHSD with Steer to Point Designation (H4.0)

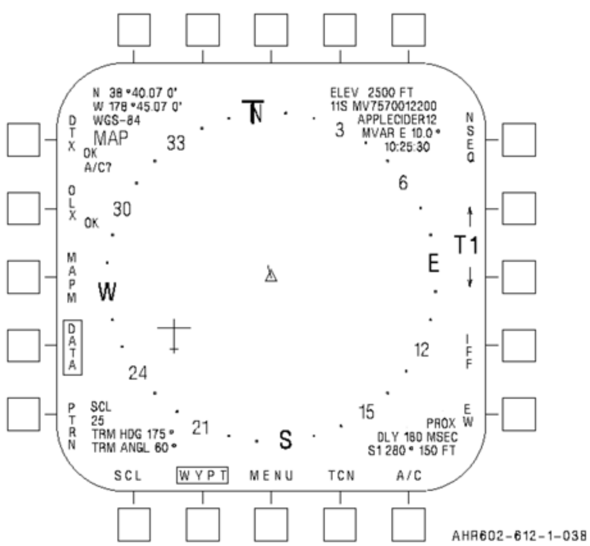


Figure 23-13. Waypoint Data Page with Targetpoint Selected (H4.0)

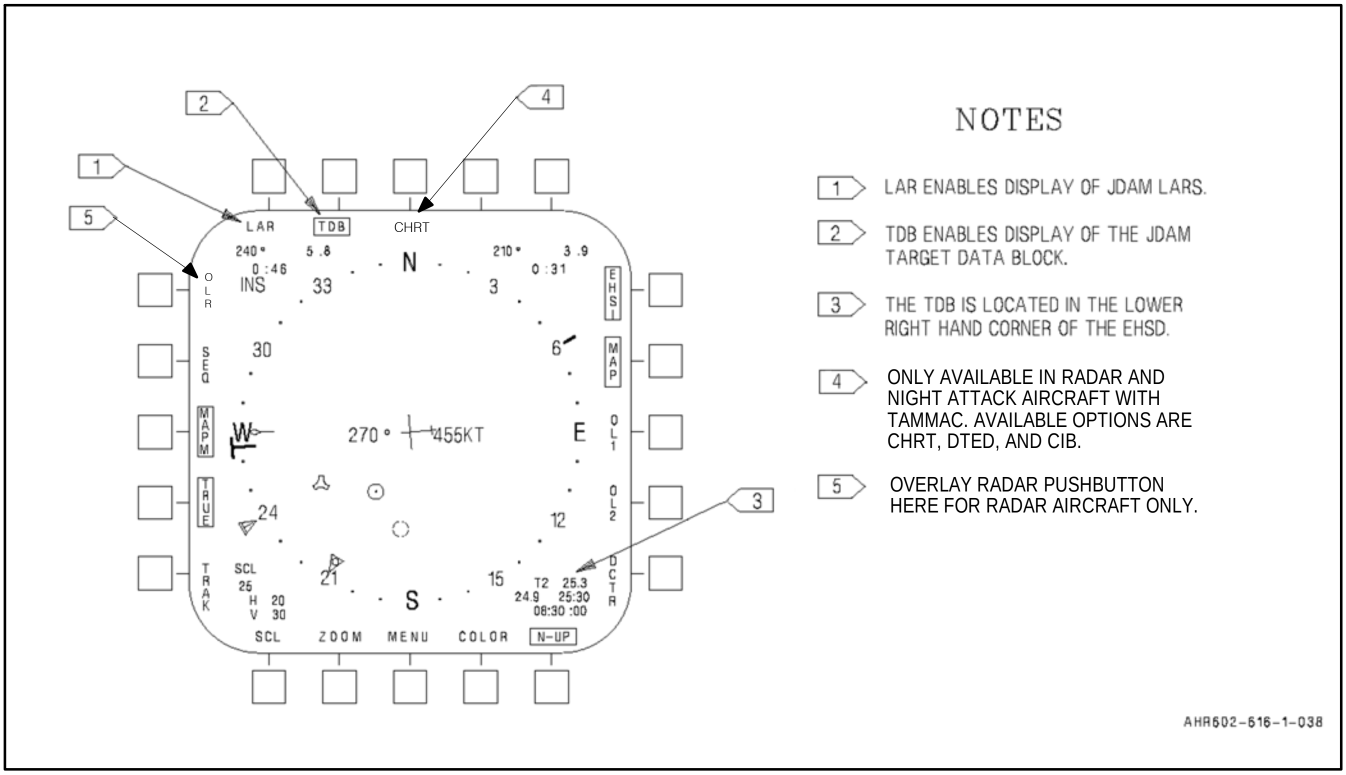


Figure 23-14. EHSD MAPM Option (H4.0)

23.9.7 Ground Track (Digital Readout) and Ground Track Pointer

This pointer indicates the aircraft true ground track. On Radar and Night Attack aircraft ground track is also a digital readout. Trainer aircraft with H4.0 have a digital readout of ground track as well.

23.9.8 Ground Speed (Digital Readout)

This readout indicates ground speed.

23.9.9 Waypoint, Markpoint or Targetpoint Steering Pushbutton

This pushbutton selects waypoint (WYPT), markpoint (MK), or targetpoint steering for display on the HUD and on TAV–8B and Day Attack aircraft, the HSI. When a targetpoint (other than T0) is selected, it is automatically designated. It may be manually undesignated.

23.9.10 Up Arrow Pushbutton

This pushbutton, when depressed, selects the next waypoint, markpoint, or targetpoint as the steer–to–point for display on the HUD. When this pushbutton is selected the WYPT option will box if not already boxed. With OMNI 7.1 and C1+ when waypoint 24 is reached, pressing this pushbutton selects markpoint 1. Likewise, when markpoint 3 is reached, pressing this pushbutton selects waypoint 0. With H4.0, the list of available waypoints, markpoints, and targetpoints are limited to points that are not null. Therefore, when the last non–null waypoint is reached, pressing this pushbutton selects waypoint 0, when the last non–null markpoint is reached, pressing this pushbutton selects markpoint 0, and when the last non–null targetpoint is reached, pressing this pushbutton selects targetpoint 0. If route steering is enabled, pressing this pushbutton selects the next point in the route or the first point in the route if the last point was displayed. With H4.0, depressing this pushbutton for greater than 0.8 seconds causes the system to enter the quick access mode. See paragraph 23.9.40 for a description of quick access.

23.9.11 # (Number)

This digital readout indicates the waypoint, markpoint, or targetpoint selected. Waypoints are represented by only numbers. Markpoints are represented by numbers preceded by MK (OMNI 7.1 and C1+) or M (H4.0). Targetpoints are represented by numbers preceded by T.

23.9.12 Down Arrow Pushbutton

This pushbutton, when depressed, selects the previous waypoint, markpoint, or targetpoint as the steer–to–point for display on the HUD. When this pushbutton is selected the WYPT option will box if not already boxed. With OMNI 7.1 and C1+ when waypoint 0 is reached, pressing this pushbutton selects markpoint 3. Likewise, when markpoint 1 is reached, pressing this pushbutton selects waypoint 24. With H4.0, the list of available waypoints, markpoints, and targetpoints are limited to points that are not null. Therefore, when waypoint 0 is reached, pressing this pushbutton selects the last non–null waypoint, when markpoint 0 is reached, pressing this pushbutton selects the last non–null markpoint, and when targetpoint 0 is reached, pressing this pushbutton selects the last non–null targetpoint. If route steering is enabled, pressing this pushbutton selects the previous point in the route or the last point in the route if the first point was displayed. With H4.0, pressing this pushbutton for greater than 0.8 seconds causes the system to enter the quick access mode. See paragraph 23.9.40 for a description of quick access.

23.9.13 WO/S or TO/S Pushbutton

Pressing the offset pushbutton commands the mission computer system to provide steering information to an offset point from the selected waypoint, markpoint, or TACAN.

23.9.14 POS/ or DGD/ Pushbutton

This pushbutton indicates the data source that the mission computer system is using to compute the aircraft position latitude and longitude. When pressed it scrolls the POS/ option or DGD/ option pushbutton legend. IFA appears above this legend when the INS is being aligned inflight.

23.9.15 UPDT/PVU Pushbutton

Pressing this pushbutton provides an update (UPDT) option display on the coordinate data monitor, or a PVU. UPDT is available only when the navigation system is not tightly–coupled, while PVU is only available on Radar aircraft when the navigation system is tightly–coupled.

23.9.16 Data Pushbutton

Pressing this pushbutton provides the DATA option display.

23.9.17 TRUE Heading Pushbutton (TAV–8B with OMNI 7.1 and Day Attack Aircraft)

The TRUE pushbutton is located on the WYPT Data page. See Figure 23-16. Pressing this pushbutton selects true heading for display. T legend appears in place of lubber line on EHSI display and a T appears above heading display on HUD to indicate true heading displayed.

23.9.18 SCL Pushbutton (TAV–8B with OMNI 7.1 and Day Attack Aircraft)

Pressing this pushbutton decreases the scale once each time it is pressed. The scales displayed are 160, 80, 40, 20, or 10. Numbers indicate nautical miles from the top to the bottom of the display. Symbology representing waypoints, markpoints, waypoint/markpoint offsets, TACAN stations and TACAN offsets must be within selected scale range to appear on display. There is an AUTO scaling option which appears after the 10 mile scale. When AUTO is selected the EHSI scale changes based on sensor mode, steering selection, and TACAN, waypoint, mark, and waypoint, mark, or TACAN offset ranges.

23.9.19 SCL Pushbutton (TAV–8B with H4.0 and Radar and Night Attack Aircraft)

Pressing this pushbutton decreases the scale once each time it is pressed. The scales displayed for the CHRT and DTED (only available in aircraft with TAMMAC installed) map types are 100, 25, 13, or 5 unless ZOOM is selected. With ZOOM selected the displayed scales are 50, 13, 6, or 3. The scales displayed for the CIB (only available in aircraft with TAMMAC installed) map type are 3 or 1 unless ZOOM is selected. With ZOOM selected the displayed scales are 1 or 1. Numbers indicate the nautical miles from the top to the bottom of the display. Symbology representing waypoints, markpoint, targetpoints, waypoint/markpoint offsets, TACAN stations and TACAN offsets must be within selected scale range to appear on display. There is an AUTO scaling option which appears after the

5 (or zoomed to 3) mile scale. When AUTO is selected the EHSD scale changes based on sensor mode, steering selection, and TACAN, waypoint, markpoint, and waypoint, markpoint, or TACAN offset ranges. See Figure 23-15. The AUTO option is not available on the DATA page or when the CIB map type is selected in aircraft with TAMMAC installed. With TAMMAC installed, the SCL pushbutton works differently on the DATA page. The scales displayed are 100, 25, 13, 5, 3, or 1 (or 50, 13, 6, 3, 1 or 1 if ZOOM is enabled) unless DTED is the selected map type. When the map scale transitions from 5 to 3 (or 3 to 1 when ZOOM is enabled) the map type changes from CHRT to CIB. When the map scale transitions from 1 to 100 (or 1 to 50 when ZOOM is enabled) the map type changes from CIB to CHRT. This provides the pilot a way to quickly access the CIB map display while on the DATA page. If the map type is DTED, the displayed scales on the DATA page are 100, 25, 13, or 5 (or 50, 13, 6, or 3 with ZOOM enabled).

DISPLAY SCALE	ZOOM	CENTERED		DECENTERED		EW (H4.0 ONLY)	
		SCALE DOWN	SCALE UP	SCALE DOWN	SCALE UP	SCALE DOWN	SCALE UP
100		8.0	NA	16.0	NA	6.0	NA
25		4.0	9.0	8.0	18.0	3.0	6.75
13		1.6	4.5	3.2	9.0	1.2	3.38
5		NA	1.8	NA	3.6	NA	1.35
50	Yes	4.0	NA	8.0	NA	3.0	NA
13	Yes	2.0	4.5	4.0	9.0	1.5	3.38
6	Yes	0.8	2.25	1.6	4.5	0.6	1.69
3	Yes	NA	0.9	NA	1.8	NA	0.68

Figure 23-15. Auto Scaling

23.9.20 Mark Number Pushbutton

If no designation exists, pressing the MK pushbutton stores aircraft present position as a markpoint. The source of the altitude stored in the markpoint is dependent upon sensor validity at the time MK is depressed. With OMNI 7.1 and C1+ if RALT is valid, aircraft barometric altitude minus RALT is used. With H4.0 if RALT is valid, GPS altitude minus RALT altitude is used if GPS is cued, otherwise aircraft barometric altitude minus RALT altitude is used. In the absence of valid RALT, the altitude of the current steer to point is used. If a system designation exists with C1+ and H4.0, the calculated designation position is stored in the markpoint when the MK pushbutton is pressed. Only 3 markpoints (1–3) are available with OMNI 7.1 and C1+. With H4.0, 10 markpoints (0–9) are available. With OMNI 7.1 and C1+, the system initializes the MK pushbutton to MK1 during initial power–up. With H4.0, the system initializes the MK pushbutton to the markpoint number displayed during during the previous shut down (assuming the MSC has not been reloaded, in which case the system initializes to MK0). Each time MK is depressed, position and altitude data is written to the markpoint number displayed above the MK pushbutton, and the markpoint number is incremented. If data exists in the markpoint displayed on the MK pushbutton, and the pushbutton is subsequently depressed, the previously stored data is overwritten with current data.

23.9.21 Waypoint or Mark Offset Location Symbol

The symbol indicates relative location of the selected waypoint or mark offset.

23.9.22 TACAN Offset Location Symbol

The symbol indicates the relative location of the selected TACAN offset.

23.9.23 SEQ Pushbutton (TAV-8B with OMNI 7.1 and Day Attack Aircraft)

The SEQ pushbutton is located on the WYPT and TCN Data pages. Pressing the pushbutton provides display of up to five above and two below the currently selected waypoint if in the selected range scale (see Figures 23-16 and 23-17). The number next to the small waypoint circle indicates their associated waypoint number. Only the waypoint offset to the selected waypoint is displayed. If waypoint steering is selected, the steering and data block displayed are to the selected waypoint. If one of the markpoints is currently selected, waypoints 23, 24, 0, 1, 2, 3, and 4 are displayed if in the selected range scale. SEQ waypoint circles are not available on the DATA page format or in A/G master mode.

23.9.24 NSEQ Pushbutton

(Located on the EHSI/EHSD page). Pressing this pushbutton enables nonsequential or sequential waypoint navigation (see Figure 23-17). Refer to NTRP 3-22.4-AV8B to learn how to choose between sequential and nonsequential routes. A programmed subset of waypoints are selected for navigation. Pressing the waypoint step button or the waypoint increment button steps through each waypoint and offset in the sequential string, or steps through each waypoint and offset in the ingress sequence and then step through each waypoint in the egress sequence. With H4.0 only the offset to the terminal point in the sequential string or the terminal point of the ingress string of a nonsequential route shall be included in a route. The button is not displayed, but the function is present in A/G master mode. Waypoints, markpoints, and targetpoints are available for use in the NSEQ string with H4.0. A targetpoint can be placed at the end of a sequential string with H4.0.

23.9.25 MAPM/EWM Pushbutton (TAV-8B with H4.0 and Radar and Night Attack Aircraft)

Pressing this pushbutton enables map menu pushbutton options. Options differ with different modes (CENTER, DECENTER, EW (H4.0 only) and DATA). The legends EHSI, MAP, OL1/OL2, OVLY, N-UP, COLOR, ZOOM, SCL/AUTO, TRAK, TRUE, and SEQ (also OLR on radar aircraft, LAR and TDB on aircraft with H4.0, and CHRT/DTED/CIB in aircraft with TAMMAC installed) are displayed for 10 seconds and then return to the previous display if no other pushbutton is pressed. Selecting or deselecting one of these functions restarts the 10 second timer and enables display of these legends for another 10 seconds. A box displayed around the legend indicates the function is enabled.

23.9.26 EHSI Pushbutton (TAV-8B with H4.0 and Radar and Night Attack Aircraft)

Selecting map menu (MAPM) on the centered or decentered EHSD display, any DATA display, or the EWM (with H4.0) display enables the EHSI pushbutton legend. Selection of EHSI is independent for each MAPM. Pressing this pushbutton on the Center, Decenter, or EW MAPM enables display of the compass rose, lubber line and T legend, ground track pointer, waypoint and waypoint offset, TACAN and TACAN offset and target (with H4.0) bearing pointers on the Center, Decenter and EW page. Pressing this pushbutton on the WYPT or TCN Data MAPM enables display of the compass rose, lubber line and T legend, and aircraft symbol on the WYPT and TCN Data pages. Pressing this pushbutton on the A/C Data MAPM enables display of the compass rose, and lubber line and T legend on the A/C Data pages. When enabled the EHSI legend is boxed.

23.9.27 MAP Pushbutton (Radar and Night Attack Aircraft)

Pressing this pushbutton enables display of map video if location is covered by map and if map scene is ready for display. When enabled MAP legend is boxed. Selection of MAP is independent for each MAPM. Although this option is available in TAV-8B with H4.0 it is non-functional without a DMS.

23.9.28 OL1 Pushbutton (Radar and Night Attack Aircraft)

Pressing this pushbutton enables display of overlay 1. Selection of OL1 is independent for each MAPM. When enabled OL1 legend is boxed. Although this option is available in TAV-8B with H4.0 it is nonfunctional without a DMS.

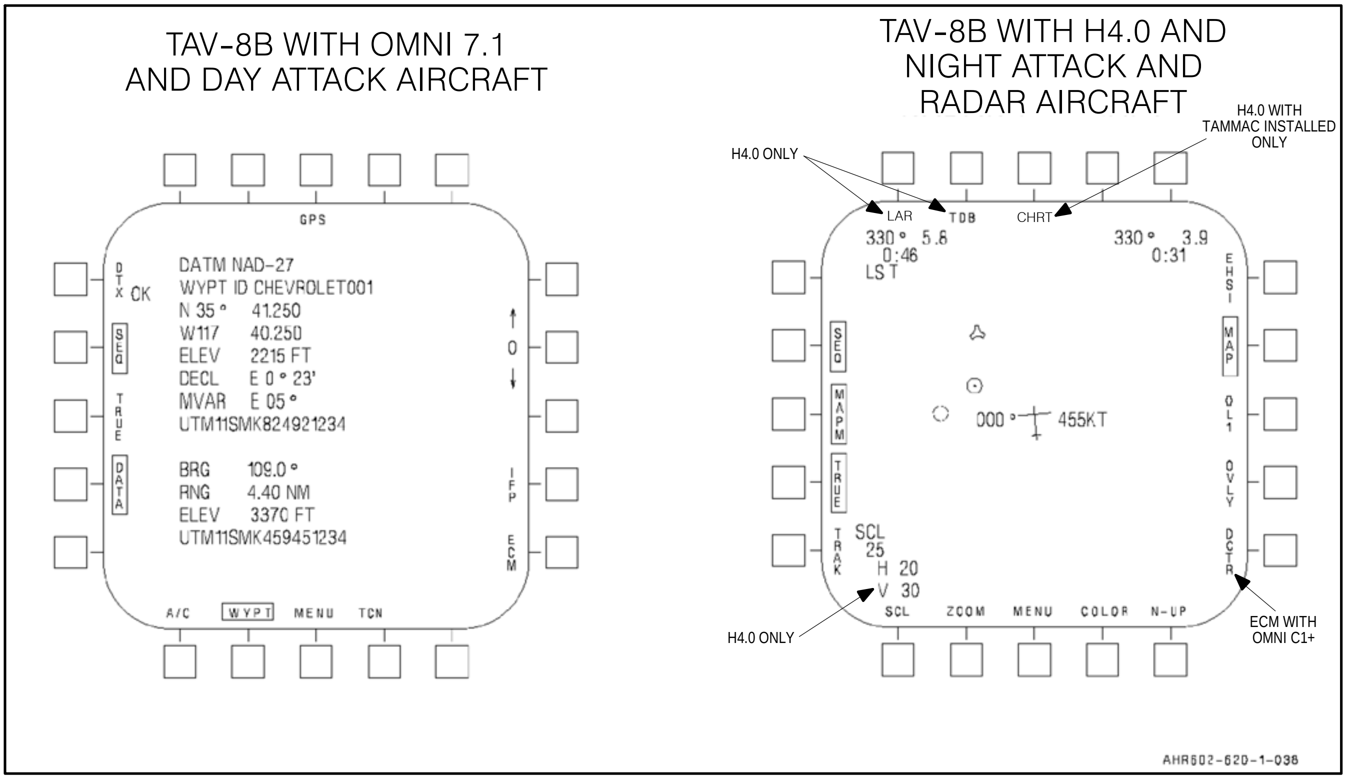


Figure 23-16. SEQ and TRUE Navigation Display

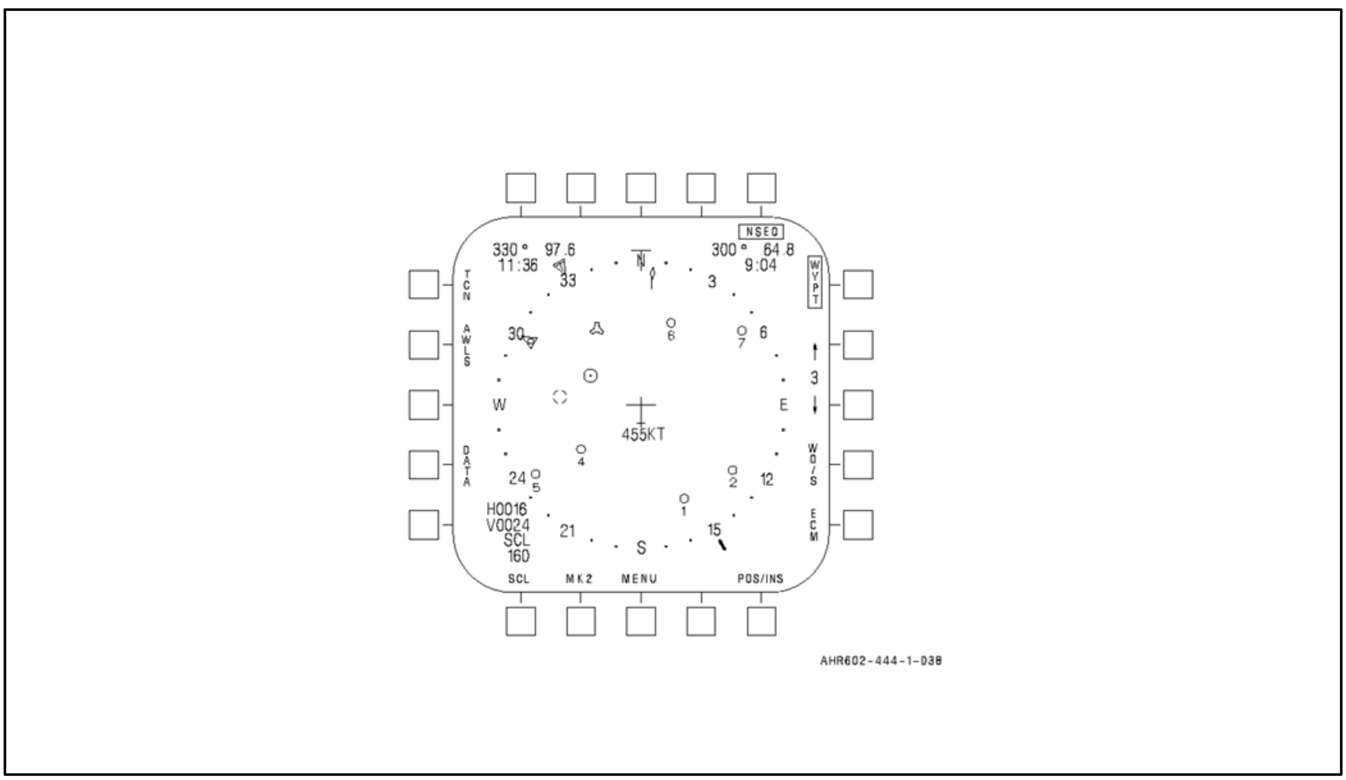


Figure 23-17. SEQ and NSEQ Navigation Display

23.9.29 OL2/OVLY Pushbutton (Radar and Night Attack Aircraft)

OL2 or OVLY is dependent on NSEQ selection. Pressing OL2 (NSEQ not boxed) pushbutton enables display of overlay 2. When enabled OL2 legend is boxed. Pressing OVLY (NSEQ boxed) pushbutton enables the nonsequential programmed ingress/egress route lines or the sequential route lines. When enabled OVLY is boxed. Selection of OL2/OVLY is independent for each MAPM. Although this option is available in TAV-8B with H4.0 it is non-functional without a DMS.

23.9.30 N-UP Pushbutton (TAV-8B with H4.0 and Radar and Night Attack Aircraft)

Pressing this pushbutton selects north-up or track-up mode. When N-UP legend is boxed north-up mode is enabled, else track-up mode is enabled. Selection of N-UP is independent for each MAPM. N-UP legend is not displayed in decenter mode or on the EW page.

23.9.31 ZOOM Pushbutton (TAV-8B with H4.0 and Radar and Night Attack Aircraft)

Magnifies map display by two. When selected ZOOM legend is boxed and Z legend is displayed next to SCL legend. Selection of ZOOM is independent for each MAPM.

23.9.32 SCL Pushbutton (TAV-8B with H4.0 and Radar and Night Attack Aircraft)

Pressing this pushbutton selects the default map scale for the top-level page (CENTER, DECENTER, EW (with H4.0) and DATA). The default map scale is the map scale that will be selected when first entering the corresponding top-level page. Selection of SCL is independent for each MAPM. Pressing this pushbutton decreases the scale once each time it is pressed. The scales displayed are 100, 25, 13, 5, and AUTO unless ZOOM is selected or the map type is CIB. The scales displayed for the CIB map type (only available in aircraft with TAMMAC installed) are 3 and 1 unless ZOOM is selected. With ZOOM selected the displayed scales are 50, 13, 6, 3, and AUTO. The scales displayed for the CIB map type with ZOOM enabled are 1 and 1. The AUTO option is not available on the DATA MAPM page. With TAMMAC installed, the SCL pushbutton works differently on the DATA MAPM page. The scales displayed are 100, 25, 13, 5, 3, and 1 (or 50, 13, 6, 3, 1 and 1 if ZOOM is enabled) unless the selected map type is DTED. When the map scale transitions from 5 to 3 (or 3 to 1 when ZOOM is enabled) the map type changes from CHRT to CIB. When the map scale transitions from 1 to 100 (or 1 to 50 when ZOOM is enabled) the map type changes from CIB to CHRT. If the map type is DTED, the displayed scales on the DATA MAPM page are 100, 25, 13, and 5 (or 50, 13, 6, and 3 with ZOOM enabled).

23.9.33 TRAK Pushbutton (TAV-8B with H4.0 and Radar and Night Attack Aircraft)

Pressing this pushbutton enables display of ground track line. When selected TRAK legend is boxed. TRAK legend not displayed in DATA mode. Selection of TRAK is independent for each MAPM.

23.9.34 TRUE Pushbutton (TAV-8B with H4.0 and Radar and Night Attack Aircraft)

When selected the system uses true heading to compute the orientation of the compass rose, aircraft symbol, ground track pointer, map heading and bearing to waypoint, offset or TACAN station. The selection of true or magnetic also affects the display of TACAN, waypoint, and markpoint offset bearing, targetpoint terminal heading and pattern heading, and radar BRAA (bearing, range, altitude, aspect) and cursor data block displays. A T legend appears in place of lubber line and also a T appears above heading display on HUD to indicate true heading display. When TRUE legend is boxed true heading is enabled, else magnetic heading is enabled. Selection of TRUE is NOT independent for each MAPM. Selecting TRUE on any MAPM affects all displays.

23.9.35 SEQ Pushbutton (TAV-8B with H4.0 and Radar and Night Attack Aircraft)

Pressing the pushbutton provides display of up to five above and two below the currently selected waypoint if in the selected range scale (see Figures 23-24 and 23-25). The number next to the small waypoint circle indicates their associated waypoint number. Only the waypoint offset to the selected waypoint is displayed. If waypoint steering is selected, the steering and data block displayed are to the selected waypoint. With C1+, if one of the markpoints is currently selected, waypoints 23, 24, 0, 1, 2, 3, and 4 are displayed if in the selected range scale. With H4.0, if a markpoint or targetpoint is currently selected, the four waypoints above and the two waypoints below the last selected waypoint and the last selected waypoint itself are displayed if in the selected range scale. SEQ waypoint circles are not available on the Data page format or in A/G master mode. Selection of SEQ is NOT independent for each MAPM. Selecting SEQ on any MAPM affects all displays.

23.9.36 OLR Pushbutton (Radar Aircraft with H4.0)

Pressing this pushbutton will display a corral on the EHSD which corresponds to the radar display corral when using an EXPAND MODE. This feature aids the pilot in accurately placing expand corrals on the radar display by allowing comparison between map and radar. The OLR legend is not displayed in DATA mode. Selection of OLR is NOT independent for each MAPM. Selecting OLR on any MAPM affects all non-DATA displays.

23.9.37 LAR Pushbutton (with H4.0)

Selecting this option enables the display of the Launch Acceptable Region (LAR) for the Joint Direct Attack Munitions (JDAM) on the EHSD. When selected LAR legend is boxed. The LAR legend is not displayed in DATA mode. Selection of LAR is independent for each MAPM.

23.9.38 TDB Pushbutton (with H4.0)

Selection of the option enables the display of the targetpoint data block in the lower right hand corner of the EHSD display. See Figure 23-18. The targetpoint data block is displayed after TDB has been boxed and a targetpoint has been selected as a target contributor. This requires that at least one JDAM is loaded on the aircraft or training mode is selected with a JDAM stores code loaded. When selected TDB legend is boxed. The TDB legend is not displayed in DATA mode. Selection of TDB is independent for each MAPM.

23.9.39 CHRT/DTED/CIB Pushbutton (Radar and Night Attack Aircraft with TAMMAC Installed)

Selection of this option will scroll through the available map imagery formats. The pushbutton legend will scroll from CHRT (chart) to DTED to CIB and back to CHRT. Selection of map format is independent for each MAPM. The CIB map format is not available on the EWM page, instead the legend scrolls from CHRT to DTED and back to CHRT. The map format legend is removed when the TAMMAC is not communicating with the MSC or is not installed. CHRT is the default map format on all map pages after a fresh MSC load. See Figure 23-18.

23.9.40 Quick Access (with H4.0)

Pressing an up arrow, a down arrow, or the WINC button for greater than 0.8 seconds will cause entry into the Quick Access (QA) mode. There are two types of quick access sessions. Steer-to-point (STP) quick access can be initiated using the WINC button or the up and down arrows on the EHSD and the EW pages. Point-of-Interest (POI) quick access can be initiated by using the up and down arrows on the WYPT Data page, NSEQ Data page, Radar Data page, TFER page, or any of the six different VREST pages. STP QA is used to change the steer to point on the EHSD page and therefore the steering cues presented in the HUD. POI QA is used to change the point on the page that is used to initiate the QA session (i.e. WYPT Data page, NSEQ Data page, TFER Data page, Radar Data page, or any of the six different VREST pages). The ODU displays WYPT in window 1, MKPT in window 2, TGPT in window 3, NSEQ in window 4 (NSEQ is displayed only during a STP QA session), and TOT in window 5 (TOT is displayed only if the current point is targetpoint 1-4 or the terminal point in a sequential, ingress, or egress string). Selecting the NSEQ option toggles NSEQ on the EHSD page. Selecting the TOT option enables the scratch pad for programming a time-on-target for the selected point. If a system designation exists (radar designation, waypoint designation, etc.) TGPT defaults to colonized and 0 is presented in the scratchpad when a STP QA session is initialized. If a system designation does not exist, the current point displayed on the current page (or the EHSD page if QA was initiated using the WINC option) is the initial default selection on the ODU and scratchpad. Quick accessing a point that is not in the NSEQ string when NSEQ steering is selected causes NSEQ to become deselected. A QA session will time out after 15 seconds of inactivity, or a QA session can be manually exited by pressing ENT on the UFCS when there is no pending entry flashing on the scratch pad.

23.9.41 Null Points (with H4.0)

A Nullpoint is a point (waypoint, markpoint, or targetpoint) that has its null flag set true. The null flag is set in mission planning and is meant to indicate a point that cannot be used as a STP or as a point of interest on the VREST and Radar Data pages. WYPT 0, MKPT 0 and TGPT 0 cannot be null points. When stepping through points on the EHSD page, null points are skipped. A null point can be converted to a non-null point by accessing the point on the EHSD DATA page or the TFER DATA page.

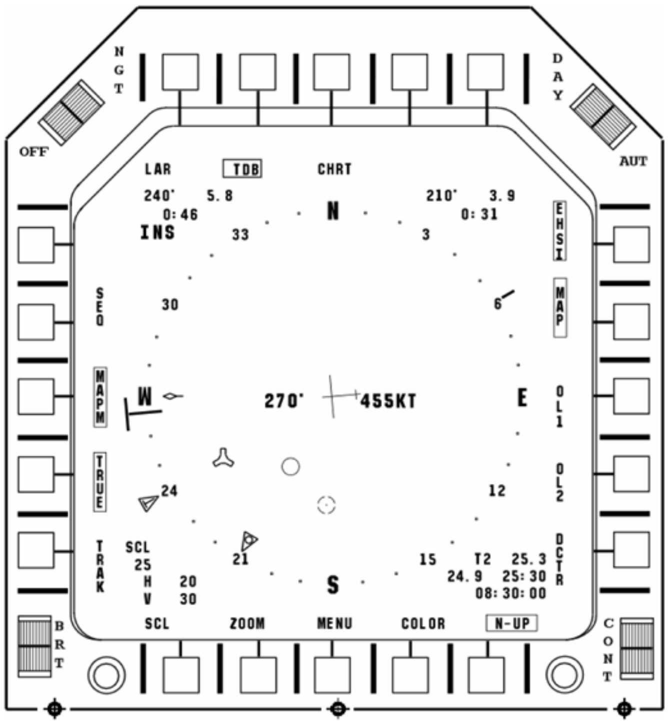


Figure 23-18. Center EHSD Map Menu Page with TAMMAC Installed

23.9.42 Electronic Warfare Page (with H4.0)

The EW page is intended to help increase defensive situational awareness. The EW page can be selected by pressing pushbutton 15 from the Basic Menu page, or it can be selected via Sensor Select Switch Left when not in Air Combat Maneuvering (ACM) sensor mode or TPOD sensor mode. The EW page is the third page in the EHSD display sequence (Center, De–Center, then EW).

23.9.42.1 EW Page Unique PB Options (with H4.0)

Depression of the EWM pushbutton (PB) selects the EW Menu page that provides the capability to control map, waypoint, RWR and Radar footprint (radar aircraft only) symbology displayed on the EW page. See Figure 23-19. A 10 second timeout applies to the EWM, similar to the MAPM selections, while the page is presented.

Pressing the RWR PB selects the RWR Page. Note that the Expendables information has been moved from the RWR page to the CMDS page.

Pressing the CMDS PB selects the Countermeasures Dispensing System page.

23.9.42.1.1 EWM Page Unique Options (with H4.0)

Nav Option.

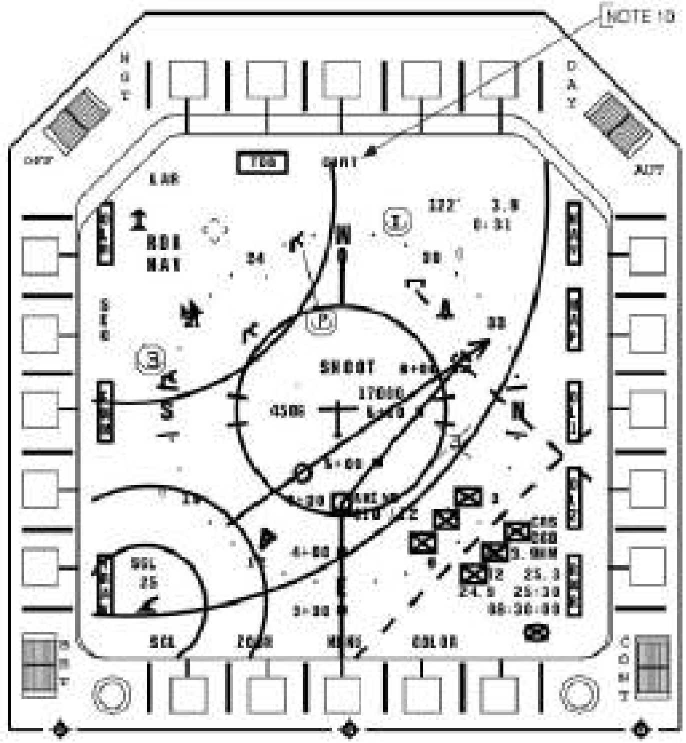
Selecting the NAV option displays the waypoint or waypoint offset steering information, waypoint or waypoint offset data block, waypoint or waypoint offset symbols, course line and course line data block, and the GPS HERS and VERS in the lower left corner.

RWR Option.

Selecting the RWR option displays the RWR threat symbols (maximum of six), critical ring and beam Cues. RWR symbols are drawn in a brighter intensity of the color selected for the rest of the legends using the COLOR option on the EW menu page.

EW MENU DISPLAY

:EWM SELECTED
:NAV, MAP, OL1, OL2, RWR, TRAK, TDB, OLR SELECTED
:TAMMAC INSTALLED



NOTES:

1. THE EMW PAGE ALLOWS SELECTION OF SYMBOLOGY/INFORMATION TO BE DISPLAYED ON THE EW PAGE. FIRST SELECTION OF THIS PAGE AFTER FRESH MSC LOAD WILL DEFAULT TO SCALE 25, COLOR YELLOW AND THE FOLLOWING OPTIONS BOXED: NAV. MAP, OL1, OL2, RWR, TRAK, AND LAR. THE ZOOM, AND SEQ OPTIONS DEFAULT UNBOXED. SUBSEQUENT SELECTIONS OF THIS PAGE WILL DISPLAY SETTINGS AS LAST SELECTED ON THE EW OR EWM PAGE.
2. SELECTION OF NAV WILL ENABLE THE FOLLOWING SYMBOLOGY: WAYPOINT OR WAYPOINT O/S STEERING INFORMATION, WAYPOINT OR WAYPOINT O/S DATA BLOCK, WAYPOINT OR WAYPOINT O/S SYMBOL, COURSE LINE, COURSE LINE DATA DISPLAY. UNBOXING NAV WILL DECLUTTER THE DISPLAY BY REMOVING THE ABOVE INFORMATION.
3. SELECTION OF MAP ENABLES DISPLAY OF THE MAP UNDER THE COMPASS ROSE.
4. SELECTION OF TRAK ENABLES DISPLAY OF THE TRACK LINE.
5. THE RADAR TRACK FILES AS MECHANIZED ON THE EHSD ARE ALWAYS DISPLAYED ON THE EW MENU PAGE.
6. SELECTION OF RWR ENABLES DISPLAY OF RWR THREAT SYMBOLS, CRITICAL RING, CRITICAL TAILS AND BEAM CUES. ORIENTATION OF RWR THREATS IS LETHALITY IN.
7. OL1, OL2, COLOR, ZOOM, SCL, SEQ, AND OLR PROVIDE THE SAME FUNCTIONALITY AS CURRENT AV-8B EHSD FOR THE TOP LEVEL EW PAGE.
8. LAR (P/B #6) IS DISPLAYED WHEN JDAMS ARE INVENTORIED ON THE AIRCRAFT. BOXING IT DISPLAYS THE JDAM LARS.
9. TDB (P/B #7) CONTROLS DISPLAY OF THE JDAM DATA BLOCK IN THE LOWER RIGHT HAND CORNER OF THE EW PAGES. BOXING IT DISPLAYS THE TARGET DATA BLOCK IN THE LOWER RIGHT HAND CORNER OF THE EW PAGES.
10. LEGEND ONLY AVAILABLE WHEN TAMMAC SYSTEM IS INSTALLED. PUSHBUTTON ALLOWS SELECTION OF MAP IMAGERY. ROTARY PUSHBUTTON DISPLAYS CHART (CHART), DTED BACK TO CHRT DEFAULTS TO CHRT, SCALE 25 WITH NEW MSC LOAD, CAN BE MISSION PLANNED AFTER THAT.

Figure 23-19. Electronic Warfare Menu Page

23.9.42.2 Threat Symbols

With the RWR option selected on the EWM page, the RWR Threat Information is displayed on the EW page based on lethality using the same symbology as the RWR page. Critical and missile launch RWR threats are positioned along the inside circumference of the critical ring and have a tail extending from the critical ring to the compass rose. Lethal RWR threats are positioned along the outside circumference of the critical ring. Nonlethal RWR threats are positioned along the outside circumference of the compass rose.

23.9.42.3 Beam Cues

With the RWR option selected on the EWM page, the beam cues are displayed. The beam cues are broken X centered about the aircraft symbol and extending out slightly over the compass rose. The beam cues are referenced to the ground track of the aircraft and are fixed relative to the three/nine o’clock position on the compass rose. The cues are offset from the beam by ±7.5 degrees (15 degrees total between tic marks).

23.9.42.4 SHOOT Cue

The avionics system displays a SHOOT cue in the center of the EW pages above the aircraft symbol only in A/A master mode concurrent with the SHOOT cue on the HUD.

23.10 WAYPOINT, MARKPOINT, TARGETPOINT, AND OFFSET DATA ENTRY

With OMNI 7.1 and C1+, the mission computer can store 25 waypoints, numbered 0 through 24, and 3 mark points, numbered 1 through 3. Scrolling past the end of the waypoints accesses the markpoints. Markpoints are denoted by the MK legend.

With H4.0, the mission systems computer can store 60 waypoints, numbered 0 through 59, 10 markpoints, numbered 0 through 9, and 5 targetpoints, numbered 0 through 4. Markpoints are denoted by the M legend and Targetpoints by the T legend. Quick Access must be used to change between point types (waypoint, markpoint, or targetpoint). See paragraph 23.9.40 for a description of Quick Access. The waypoint, markpoint, or targetpoint currently selected for navigation is indicated by the number located between the up and down arrows on the right side of the EHSI/EHSD and EW display (see Figure 23-21). The point between the arrows is also called the steer to point.

23.10.1 Waypoint Data Display

The waypoint data display allows for viewing and/or inputting the data required for each waypoint, markpoint, targetpoint, and their associated offsets. The display is enabled by selecting the DATA pushbutton on the EHSI/EHSD display. The display is also available for selection on the DMT display when DMT video is not available in the Day Attack and TAV-8B with OMNI 7.1. The display is also available for selection on the EW display with H4.0. The display initializes with waypoint data selected, indicated by the boxed DATA and WYPT legends. The waypoint, markpoint, or targetpoint position and elevation as well as the associated offset range, bearing and elevation are displayed for the waypoint, markpoint, or targetpoint last selected on the EHSI/EHSD and EW displays. Cycling the waypoint/markpoint/targetpoint number to inspect the other waypoints, markpoints, or targetpoints does not affect the waypoint or markpoint, or targetpoint selected for navigation on the EHSI/EHSD and EW display. This allows for data change in flight without effecting the steering information on the HUD. Deselecting DATA brings up the last selected display, EHSI, EHSD, EW, or DMT. Data is entered into the system automatically by way of the data storage set or manually by way of the UFC keyboard and ODU options.

23.10.2 Manual Data Entry

Manual data entry utilizes the UFC keyboard and scratch pad, and the ODU options. When entering data on the UFC keyboard the scratch pad blanks with the first key depression. The last digit of a sequence being entered will flash to indicate the entry is not complete. When the ENT key is pressed the scratch pad will blank momentarily and then display the new entry, if the entry is valid. If the entry is not valid, incorrect number of keystrokes etc., the scratch pad will flash until cleared. Valid entries are also displayed on the DDI.

23.10.2.1 Entering Waypoint or Markpoint, or Targetpoint Data

Selecting the waypoint data display enables the UFC and ODU for waypoint data entry. This is indicated by the colon next to the WYPT (or TGPT) and POS options on the ODU, and the stored latitude of the selected waypoint, markpoint, or targetpoint on the scratch pad.

If a valid offset is stored for the selected waypoint or markpoint, the system initializes with the WO/S options selected on the ODU. The WYPT and WO/S options are mutually exclusive, and successive depression of the associated option pushbutton provides alternate displays of WYPT and WO/S in the first window on the ODU (with OMNI 7.1 and C1+). With H4.0, the first window of the ODU cycles from WYPT to WO/S to TGPT. If a number is entered into the UFC after ODU window 1 cycles to TGPT and the enter button is pressed, the waypoint offset for the current waypoint transfers into the targetpoint number that was entered.

To re-energize the DATA page ODU options, simply select the desired data entry pushbutton on the DATA page (i.e. WYPT, TCN, or A/C). The data entry pushbuttons are boxed as an indication of what DATA page is currently active. Selecting the data entry pushbuttons on the DATA page has the effect of energizing or de-energizing the ODU options, so selecting a boxed data entry pushbutton will not deselect the DATA page.

23.10.2.1.1 Targetpoint Data Programming (with H4.0)

Targetpoints have additional data referred to as JDAM target data (terminal parameters and fuzing data) associated with them that is primarily pertinent to JDAM deliveries. The TDB PB on the EHSD MAPM page controls whether this information is displayed on the EHSD when a targetpoint is selected.

The initial ODU options displayed when the DATA page is active for a targetpoint are similar to those for a typical waypoint except that TGPT is displayed in ODU window 1. Pressing PB 1 causes the ODU to cycle through the display shown in Figure 23-20. Selection of the TGPT option changes the ODU to the terminal parameter options ODU (TERM for terminal parameters options, HDG for heading, ANG for angle, and INV for invalidate in ODU windows 1-3, and 5). HDG specifies the final heading that the JDAM tries to obtain at impact with the targetpoint. ANG specifies the final angle (measured from the horizontal) that the JDAM tries to obtain at impact with the targetpoint. INV is used to invalidate the HDG or ANG entries, whichever one is cued when INV is pressed. If the HDG is invalid, the JDAM will proceed directly from the aircraft position at weapon release to the target. The type of heading entered reflects the aircraft system mode (true or magnetic). If the ANG is invalid, the JDAM will try to obtain a default value of 65 degrees. Changing the location or elevation of a targetpoint does not change the terminal parameters associated with that targetpoint.

Pressing the TERM option changes the ODU to the pattern options ODU (PTRN for pattern options, SYM for symmetric or AREA for area or LINE for line, PHDG for pattern heading, and INT for interval in ODU windows 1-4). SYM represents the currently selected pattern that is used if pattern is enabled on the EHSD. Pressing the SYM ODU button cycles the pattern option through the three types of defined patterns (SYM, AREA, and LINE). Refer to NATIP, NTRP 3-22.4-AV8B for a detailed description of the patterns available. The PTRN (for pattern) PB must be selected on the EHSD DATA page for the pattern options to be enabled. The PTRN PB is not displayed unless JDAMs are inventoried on the aircraft. Pressing PHDG enables the UFC scratchpad for entry of the heading on which the pattern is based. Pressing INT enables the UFC scratchpad for entry of the interval (in feet) used in the pattern calculations.

Pressing the PTRN option changes the ODU to the fuze options ODU (FUZE for fuze options, MSEC for milliseconds of delay, MIN for minutes of delay, HRS for hours of delay, and PROX for the proximity option in ODU windows 1-5). Refer to NATIP, NTRP 3-22.4-AV8B for additional fuze option details.

Pressing the FUZE option changes the ODU to the time on target (TOT) option ODU that displays TOT in ODU window 1. This enables the UFC scratchpad for TOT entry.

Pressing the TOT option returns the ODU to the TGPT options display.

23.10.2.1.2 Elevation

To enter the ELEV option on the ODU. A colon appears next to the ELEV option indicating selection and the scratch pad displays the stored elevation for the selected waypoint, mark point, or targetpoint. The elevation range is -2,000 feet to 25,000 feet. Enter new elevation by selecting a negative sign and 1 to 4 digits if the elevation is below sea level, or 1 to 5 digits if above sea level.

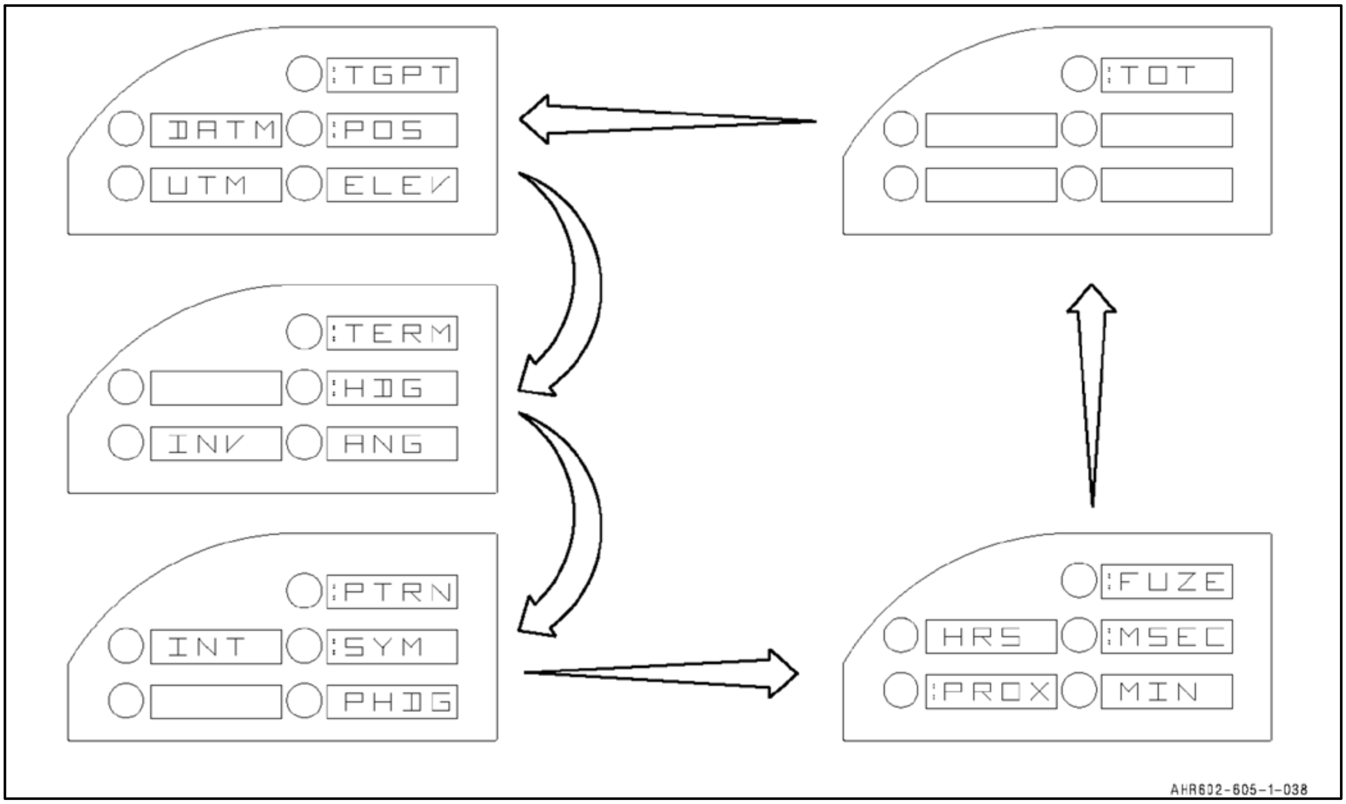


Figure 23-20. Programming Targetpoints (with H4.0)

23.10.2.1.3 Magnetic Variation

To enter magnetic variation select the ELEV option twice. This option toggles between ELEV and MVAR. A colon appears next to the MVAR option indicating selection, while the scratch pad displays the stored magnetic variation for the selected waypoint. Magnetic variation can be entered to the nearest degree from W 90 degrees to E 90 degrees. With H4.0 magnetic variation can be entered to the nearest tenth of a degree.

23.10.2.1.4 Datum

To enter a datum select the DATM option on the ODU. A colon appears next to the DATM option indicating selection and the ODU displays last entered datum. Initial default shall be 47. If the DATM is invalid a blank scratchpad will be displayed. Entries of 1 through 47 will be allowed for the appropriate datums. If an invalid DATM is entered the invalid entry will flash.

23.10.2.1.5 Bearing

To enter bearing select the BRG option on the ODU. A colon appears next to the BRG option indicating selection and the scratch pad displays the stored bearing for the selected offset. On the UFC keyboard, enter the new bearing by sequentially entering values from 0 to 360° in 0.1° increments with OMNI 7.1 and 0.01° increments with C1+ and H4.0. Entry of leading zeros is not required. If TRUE is boxed on the MAPM/EWM page, then the entered bearing is true. If TRUE is not boxed on the MAPM/EWM page, then the entered bearing is magnetic.

23.10.2.1.6 Offset Elevation

To enter offset elevation select the ELEV option on the ODU. A colon appears next to the ELEV option indicating selection and the scratch pad displays the stored elevation for the selected waypoint offset or markpoint offset. The elevation range is −2,000 feet to 25,000. Enter new elevation by selecting a negative sign and 1 to 4 digits if the elevation is below sea level, or 1 to 5 digits if above sea level.

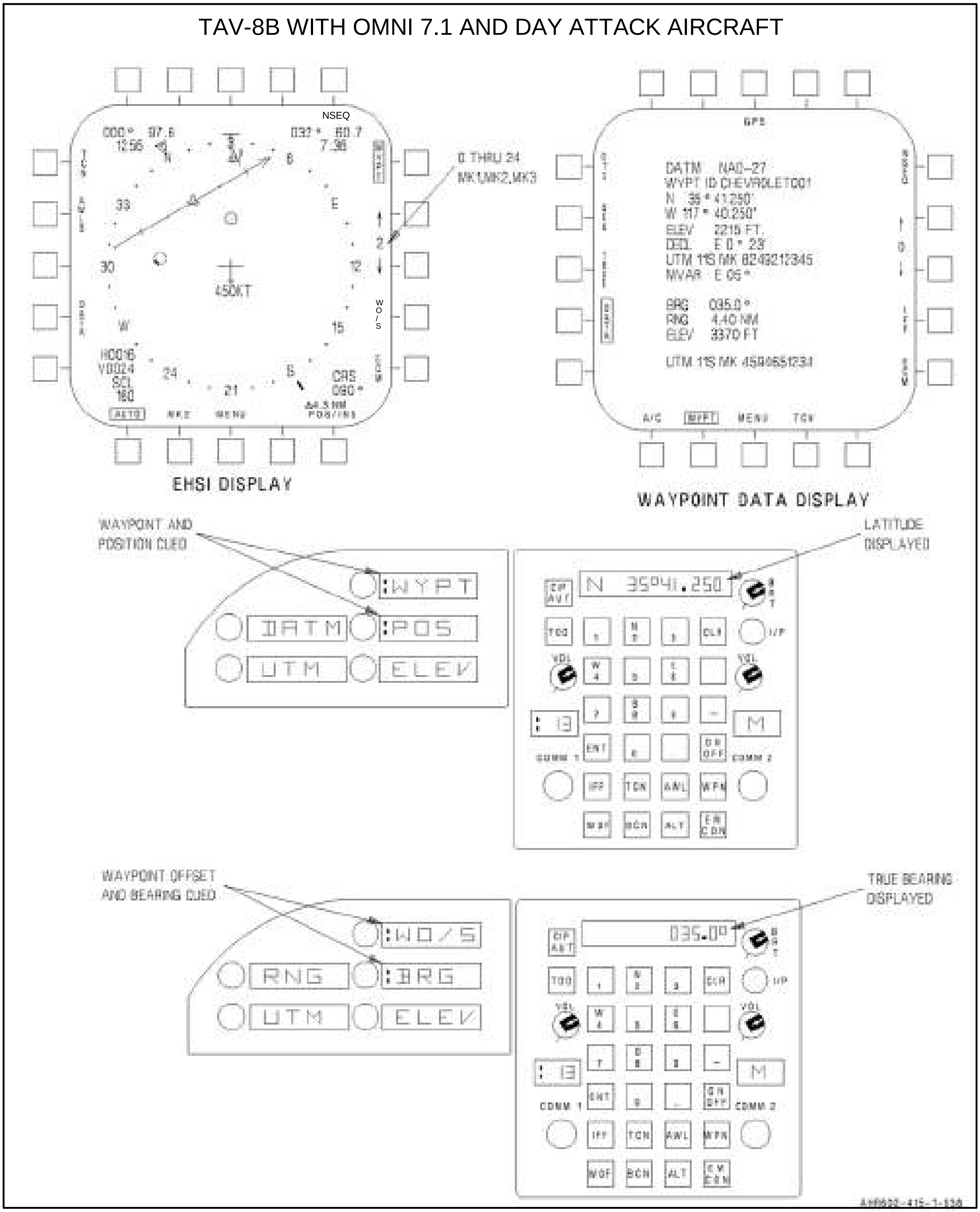


Figure 23-21. Waypoint, Mark, or Waypoint/Mark Offset Data Entry (Sheet 1 of 4)

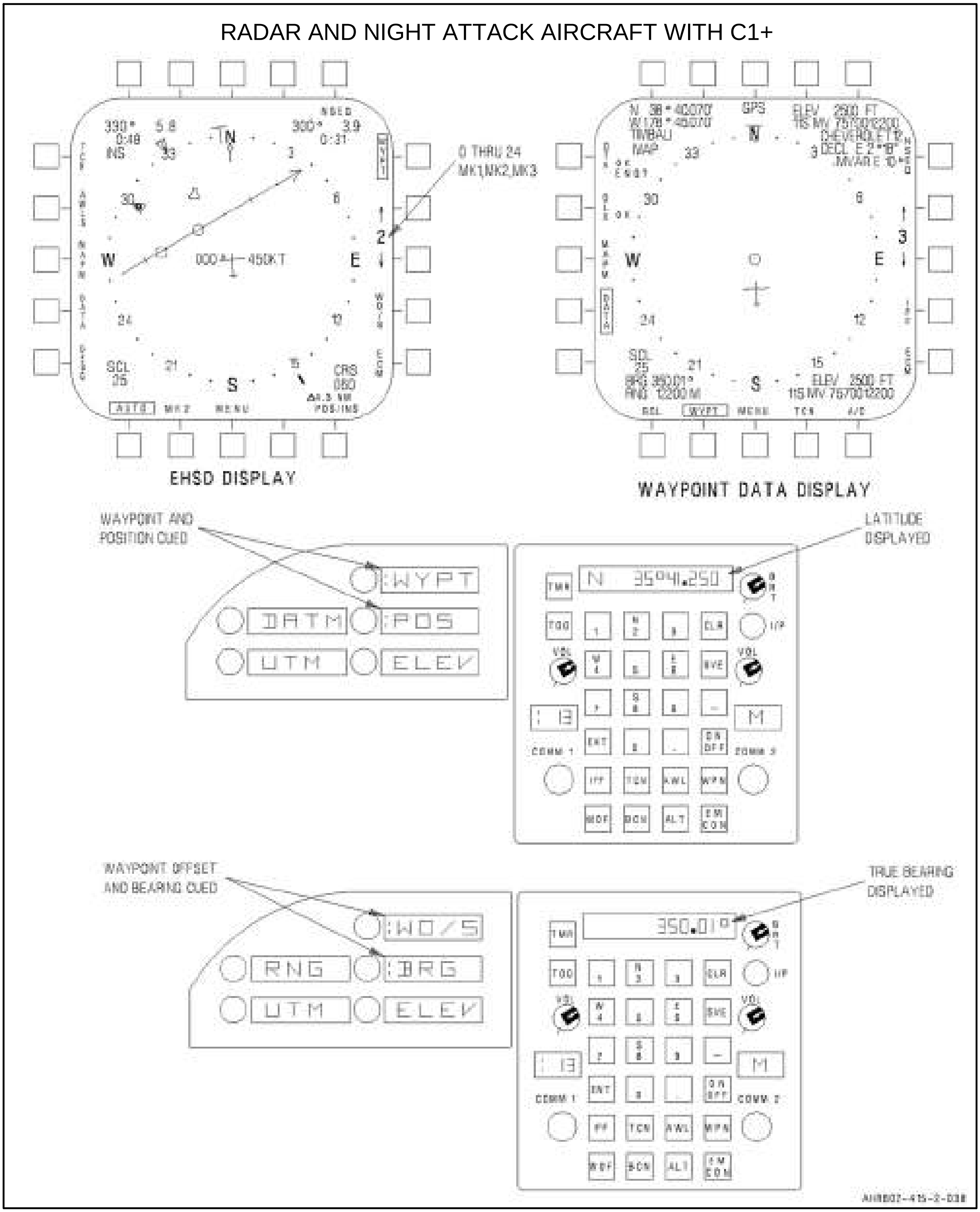
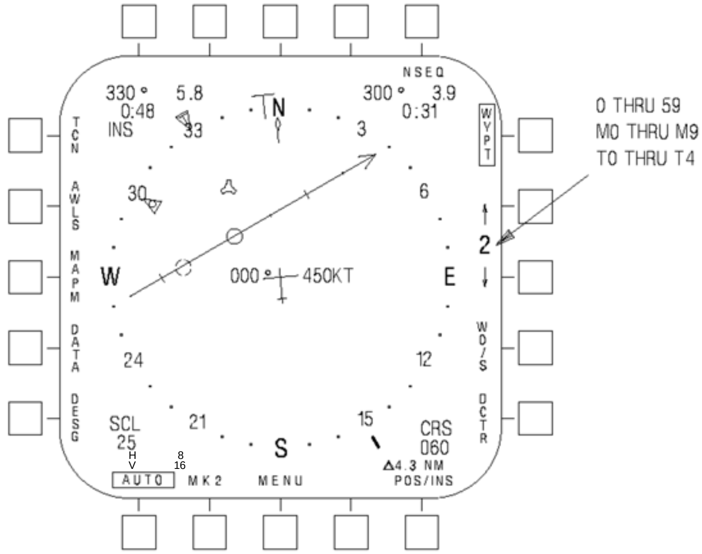
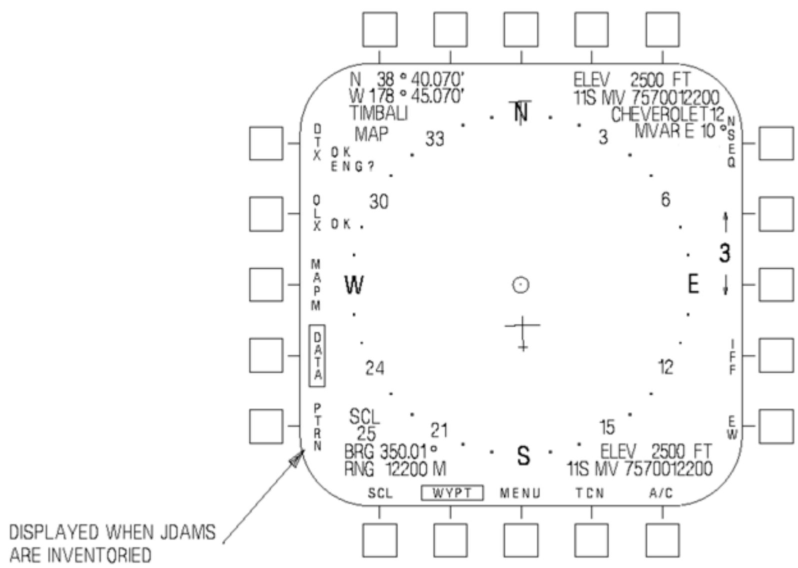


Figure 23-21. Waypoint, Mark, or Waypoint/Mark Offset Data Entry (Sheet 2)

TAV-8B WITH H4.0 AND RADAR AND NIGHT ATTACK AIRCRAFT



EHSD DISPLAY



WAYPOINT DATA DISPLAY

AHR602-415-3-038

Figure 23-21. Waypoint, Mark, or Waypoint/Mark Offset Data Entry (Sheet 3)

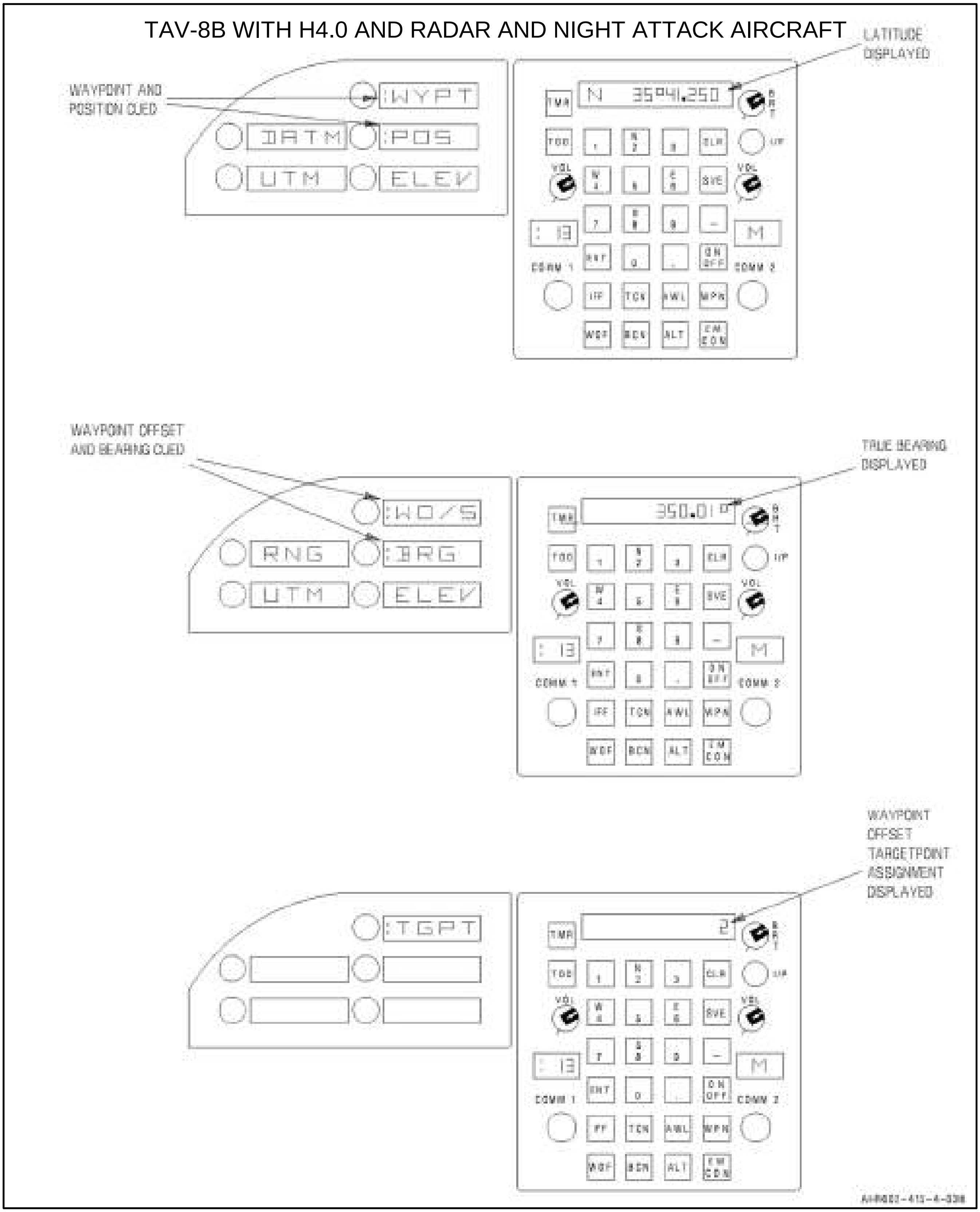


Figure 23-21. Waypoint, Mark, or Waypoint/Mark Offset Data Entry (Sheet 4)

23.10.2.1.7 Range

To enter range select the RNG option on the ODU. A colon appears next to the RNG option indicating selection and the scratch pad displays the stored range for the selected offset. Range is displayed in nautical miles or meters. Successive depression of the cued RNG option provides alternate displays of range in nautical miles or meters. On the UFC keyboard enter the new range. Entries of 100.000 or less are interpreted as nautical miles. Entries greater than 100 are interpreted as meters. Nautical mile entries can be to the hundredths of a mile with OMNI 7.1 or to the thousandths of mile with C1+ and H4.0 if a decimal is entered. Meter entries must be an integer from 101 to 185,200. A range entry of zero forces the bearing entry to zero and sets the elevation equal to the waypoint or markpoint and blanks the offset data on the DDI. With H4.0, it is possible to create an offset with 0 range, by entering an elevation that is different than the waypoint's elevation. Entering a range of 0 still removes the offset from the waypoint.

23.10.3 Transfer Data Page (with H4.0)

Selection of the TFER option on the SDAT page, displays the data point transfer page. See Figure 23-22. This page provides the ability to transfer waypoints, GPS waypoints, markpoints, and targetpoints (current, pre–planned, and another aircraft's flight position) that have been located on the DSU or the AMU mission card, into a selected waypoint, markpoint, or targetpoint. The aircrew must select both the point to be transferred (the transfer–from point on the left side of the MPCD) and the point into which the data will be transferred (the transfer–to point on the right side of the MPCD). The point data for both points is displayed at the top of each column.

23.10.3.1 Transfer–from Point

Waypoints, markpoints, targetpoints, and stored GPS points can be selected using PB 2–5. They are listed in alphabetical order with the waypoint, markpoint, or targetpoint number displayed to the right of the point's name. The arrows at PB 1, 16, 17, and 20 can then be used to select the actual point number to be transferred. Since there are only 10 markpoints, PB 16, 17 and 20 are not displayed if the transfer–from point is a markpoint. There are up to three pages of targetpoint data available for selection. The first page contains T0–T4. The second page contains the first twenty of the pre–planned targetpoints. The third page contains the last twelve pre–planned targetpoints.

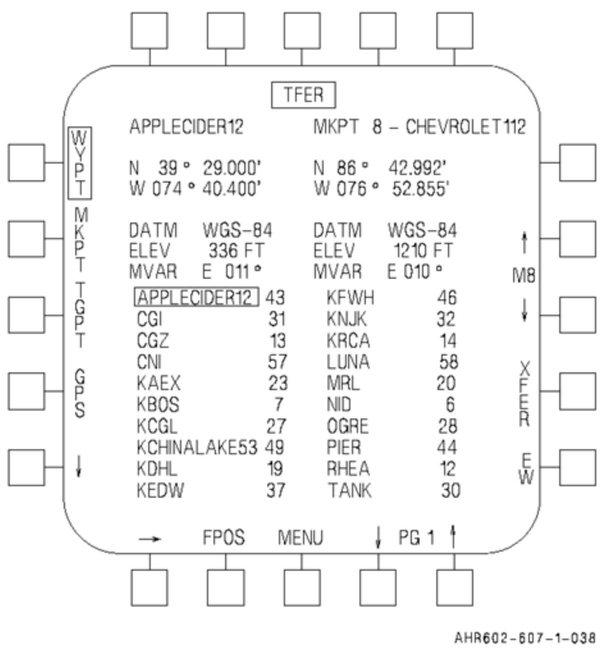


Figure 23-22. Transfer Data (TFER) Page

23.10.3.2 Transfer-to Point

Quick access must be used to switch between point types. The arrows at PB 12 and 13 can then be used to select the actual point number to be overwritten.

23.10.3.3 Flight Position Transfer Page

Depression of the FPOS option (PB 19) displays the first page of the flight position data. See Figure 23-23. The arrows at PB 1, 16, 17, and 20 are used to select the desired targetpoint set for transfer. Selection of the FPOS transfer option moves all targetpoints (T1-T4) and the associated targetpoint data (terminal heading, impact angle, TOT, etc.) from that FPOS into the current aircraft targetpoints. If less than four targetpoints are transferred, the aircraft will reset the remainder to default values and set them null.

23.10.3.4 XFER

Depressing the XFER option (PB 14) transfers data into the selected point. Offsets are only transferred between waypoints, markpoints, and stored GPS points that are not read from the MAGR. Targetpoint data (terminal parameters, pattern data, TOT, and fuze data) is transferred with the rest of the targetpoint data when transferred into another targetpoint. If a waypoint, markpoint, or stored GPS point is transferred into a targetpoint, the targetpoint remains the terminal parameters, pattern data, TOT, and fuze data.

23.11 UTM DATA ENTRY (OMNI 7.1 AND C1+)

Data may be entered in universal transverse mercator (UTM) coordinates for all 25 waypoints and 3 marks. The UTM system subdivides 6° by 8° earth zones into a 300 km by 300 km segment (see Figure 23-24). This segment is subdivided into nine 100 km by 100 km segments which are each further subdivided into 10 km by 10 km segments. The UTM coordinates of a selected waypoint and offset are entered into the MC as 10 digit numbers if they are both located within the same 100 km by 100 km grid segment. If the offset is located in an adjacent grid segment it must have a 11 digit UTM number. Using the single waypoint entry method, only one waypoint or markpoint needs to be in the same or adjacent grid segment for each offset. In this method accuracy is a function of latitude, offset range, and declination angle. To use UTM data, the selected waypoint (within a 100 km by 100 km segment) must be entered into the system in both earth and UTM coordinates. To manually enter UTM data, perform the following:

1. On the upfront control the latitude and longitude of the selected waypoint has been initially selected.
2. Press UTM pushbutton.

   A colon appears to the left of the option display window. Stored UTM coordinates are displayed on the scratch pad.
3. Type in ten-digit UTM numbers representing Eastings and Northings taken from a standard UTM grid map, then press ENT.

   The new UTM coordinates for the selected waypoint are displayed on the scratch pad and on the DDI.
4. Select UTM again, which brings up declination (DECL). UTM toggles between UTM and DECL.

   A colon appears to the left of the option display window.
5. Type declination angle (difference between true north and UTM grid north), then press ENT.

   The scratch pad and DDI display declination angle. The declination angle is a four key entry, E or W plus X° XX’, and is limited to 9° 59’ East or West.
6. Press WYPT pushbutton on the ODU.

   The ODU displays offset options in the display windows.

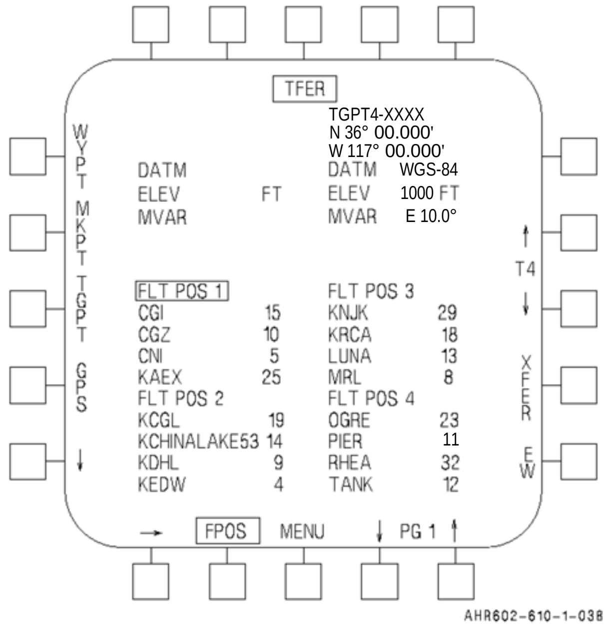


Figure 23-23. Flight Position Data Page

7. Type in 10 or 11 digit UTM of the offset or target, then press ENT.

   The UTM coordinates for the selected offset or target are displayed on the scratch pad and on the DDI. The UTM will only be 10 digits if it lies within the same grid segment as the waypoint. If the offset range extends to an adjacent grid segment, the first digit entered is the number of the adjacent grid segment in which the offset is located. For ease of entry, the adjacent grid segments correspond to the numbered buttons on the upfront control and their position in relation to one another. The next 10 digits represent the offset Eastings and Northings.

   When the entries are completed, the range and bearing to the offset (target) from the waypoint is displayed on the DDI. If required, these steps may be repeated to enter offsets for all the waypoints and markpoints.

On TAV-8B and Day Attack aircraft, there are two different ways to enter UTM coordinates as follows:

1. If UTM data has been transferred from the data storage set the ODU will initialize with the first of four selections of two-letter alpha identifiers of the UTM coordinates for the waypoint/mark point selected and the adjacent grid segments (see Figure 23-25). Pressing the UTM option scrolls through the four quadrants of selection. The two-letter alpha identifier corresponds to the applicable segment on the mercator chart. The numeric preceding the alpha (e.g., 3-QM) corresponds to the same numeric on the UFC keyboard. Each grid segment corresponds to a keyboard number. To enter the UTM coordinates select the desired alphas on the ODU. The scratchpad displays the corresponding grid segment alpha identifier and related keyboard number. Enter the ten-digit Northing and Easting on the keyboard. Entering a Northing or Easting, or selecting a new alpha grid segment will recalculate the UTM bearing and range. If waypoint data for segment five is altered the alphas on the ODU will be blanked.

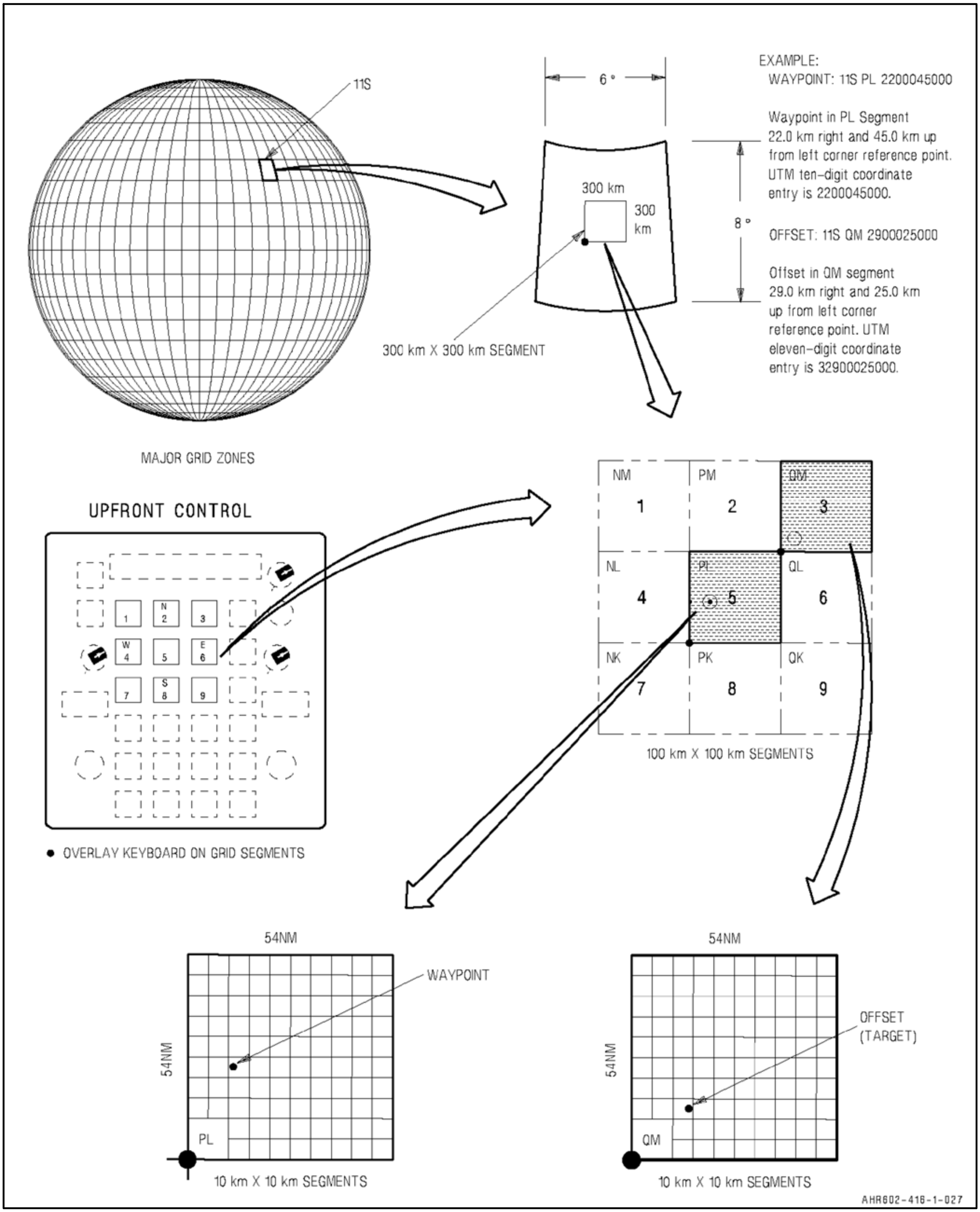


Figure 23-24. UTM Grid System

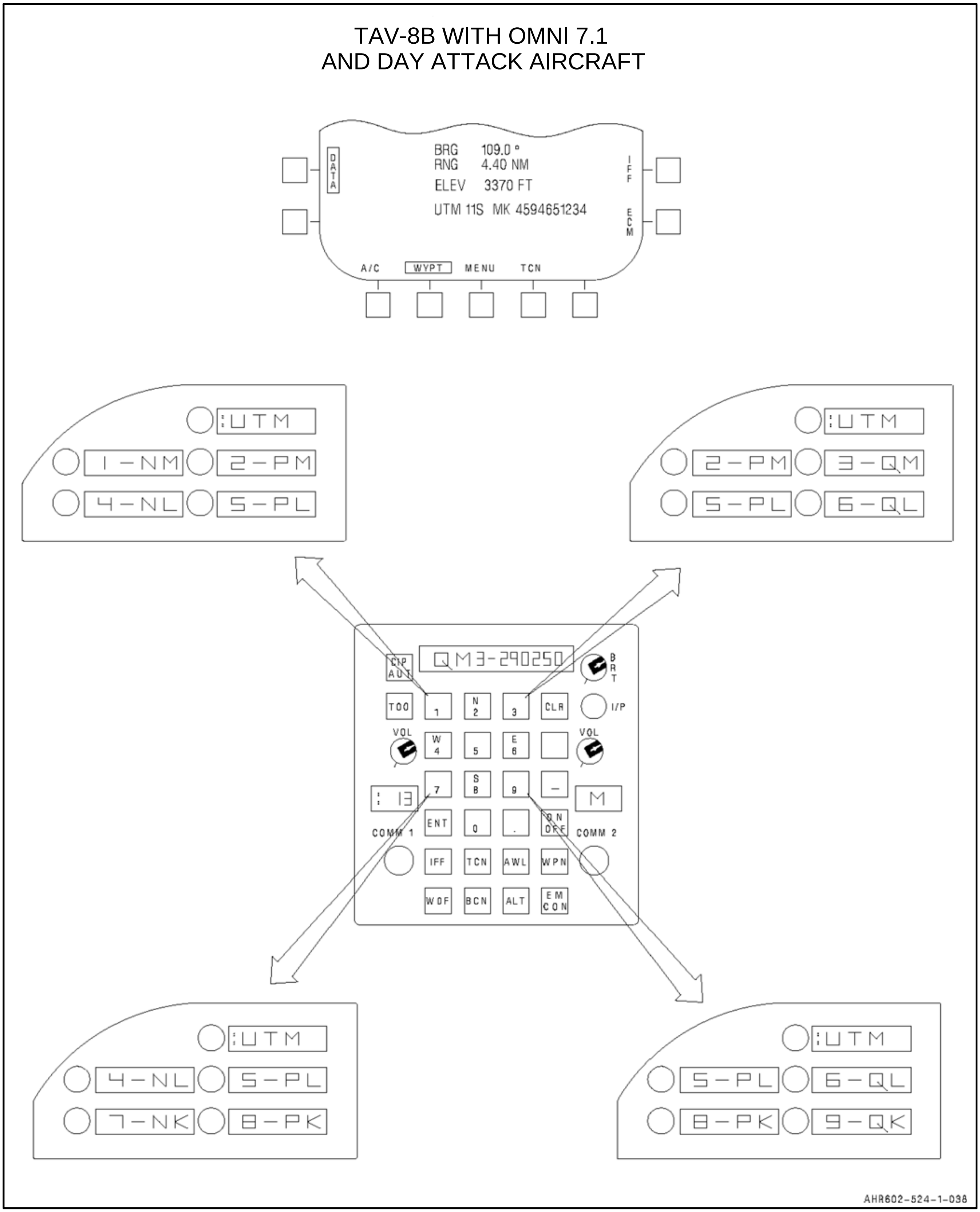


Figure 23-25. UTM Alpha Identifiers

2. If UTM alpha segment identifiers are not available the offset UTM segment must be selected using the UFC keyboard. As with the alpha segment identifier method, the waypoint or mark point is always the center key, number five. The adjacent keys correspond to the eight surrounding UTM grid segments. To enter the UTM coordinates select the desired segment on the keyboard and enter the ten-digit offset Easting and Northing. If the UTM offset lies within the same grid segment as the waypoint or mark point only the offset Easting and Northing needs to be entered.

On Radar and Night Attack aircraft, alpha segment identifiers are not available for waypoint or markpoint offset data entry. The UTM segment is selected and the Northings and Eastings are entered using the UFC keyboard as stated in the previous paragraph.

23.11.1 UTM Error vs Range (OMNI 7.1 and C1+)

When using the UTM to define offset, the system derives true bearing and range using declination data and a comparison of the waypoint/markpoint UTM coordinates. Since this calculation makes a flat plate earth assumption, the accuracy of the derived target location suffers as range from the waypoint/markpoint and the offset increase. See Figure 23-26.

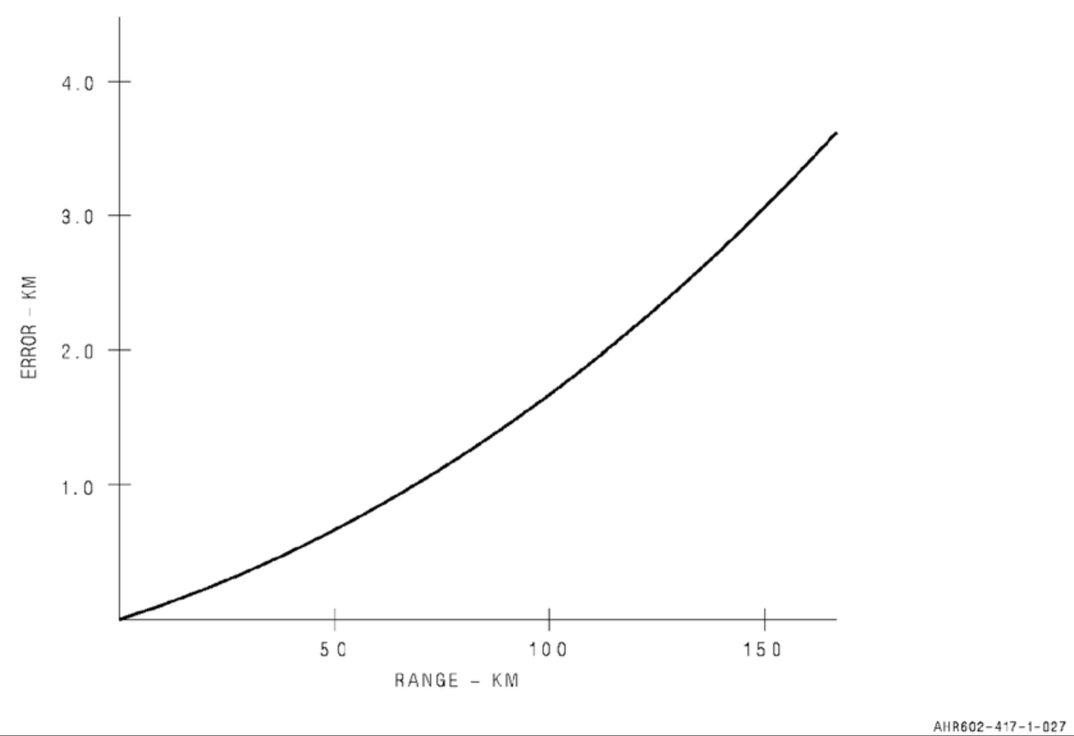


Figure 23-26. UTM Error vs. Range

23.12 UTM DATA ENTRY (WITH H4.0)

Positional data may be entered in universal transverse mercator (UTM) coordinates for all 60 waypoints and their offsets, for all 10 markpoints and their offsets, and for all 5 targetpoints. The UTM system subdivides 6 degree by 8 degree earth zones into a 300 km segment (see Figure 23-24). This segment is subdivided into nine 100 km by 100 km segments segments which are each further subdivided into 10 km by 10 km segments. The UTM coordinates of a selected waypoint and offset are entered into the MC as 10 digit numbers if they are both located in the same 100 km by 100 km grid segment. If the new point location or offset is located in an adjacent grid segment it must have an odd digit UTM number (7, 9, or 11). The first digit entered is the number of the adjacent grid segment in which the offset is located. For ease of entry, the adjacent grid segments correspond to the numbered buttons on the upfront control and their position in relation to one another. The next 10 digits represent the offset Easting and Northing. The system does not allow the selection of an adjacent grid segment if that segment lies in another major grid zone (see Figure 23-24). In other words, if the current row alpha is A then none of the segments south of the current segment can be selected; if the current row alpha is V then none of the segments north of the current segment can be selected; if the current column alpha is A then none of the segments west of the current segment can be selected; and if the current column alpha is Z then none of the segments east of the current segment can be selected.

1. Press UTM pushbutton on the WYPT or TGPT ODU. A colon appears to the left of the option display window. The stored 10–digit UTM coordinates of the point are displayed on the scratch pad preceded by an asterisk.

2. Type in 6 to 11 digit UTM numbers representing Easting and Northing, and then press ENT. The new UTM coordinates for the selected point are displayed on the scratch pad and on the DDI. The point's latitude and longitude are updated to correspond to the entered UTM position. The UTM displayed on the scratch is 10 digits preceded by the segment number (1–9). If an even number of digits were entered then the segment number is 5. The UTM displayed in the upper right data block on the DDI is the complete 15–digit UTM.

The position of a waypoint or markpoint offset can be moved within a grid segment or to an adjacent grid segment by entering a UTM. After the UTM is entered, the MC recalculates and displays the new latitude and longitude. The UTM will retain its 15 digit format. To manually enter UTM data for an offset from a point, perform the following:

1. Press WYPT pushbutton on the ODU. The ODU displays offset options in the display windows with a colon next to UTM. The stored 10–digit UTM coordinates of the offset are displayed on the scratch pad preceded by an asterisk.

2. Type in 6 to 11 digit UTM numbers representing Easting and Northing, and then press ENT. The new UTM coordinates for the offset are displayed on the scratch pad and on the DDI. The range and bearing from the point to the offset are updated to correspond to the entered UTM position. The UTM displayed on the scratch pad is 10 digits preceded by the segment number (1–9). If an even number of digits were entered then the segment number is 5. The UTM displayed in the lower right data block on the DDI is the complete 15–digit UTM.

If required, these steps may be repeated to enter offsets for all the waypoints and markpoints.

23.13 POSITION MARKING

With OMNI 7.1 and C1+, the mission computer has the capability to store three mark locations, MK1, MK2, MK3. With H4.0, 10 markpoints numbered 0 through 9 are available for use. This is done by pressing the MK pushbutton at the bottom of the EHSI/EHSD display on the DDI or by pressing the TOO pushbutton on the UFC. If MK1 is displayed above the pushbutton, that is the storage location that is used when the pushbutton is pressed. Press the pushbutton and the latitude and longitude of the ground point beneath the aircraft is stored in the mark 1 location. MK2 is then displayed above the pushbutton in preparation for the next mark. With OMNI 7.1 and C1+, after the second and third marks are stored, the system recycles and stores the next mark in the mark 1 location. With H4.0, after the tenth mark is stored, the system recycles and stores the next mark in the mark 0 location. A mark location can be used like a waypoint, including entry of offsets. With OMNI 7.1 and C1+, the three marks are stored at the end of the 25 waypoints.

On night attack and radar aircraft and all aircraft with H4.0 position marking has been enhanced to allow marking all designated points regardless of mode of designation. This allows the pilot to slew and designate the desired ground point using the HUD, map, or radar sensors. Pressing the MK option on the EHSD will store the designation as a markpoint.

With OMNI 7.1 and C1+, pressing the TOO pushbutton on the UFC stores the latitude and longitude of the ground point beneath the aircraft in the mark location represented by the MK pushbutton at the bottom of the EHSI/EHSD page regardless of whether a designation exists or not. With H4.0, pressing the TOO pushbutton on the UFC stores the latitude and longitude of the ground point beneath the aircraft in the mark location represented by the MK pushbutton at the bottom of the EHSI/EHSD only if a designation does not exist. If a designation exists, then pressing the TOO pushbutton on the UFC stores the designation as a markpoint.

With H4.0, the system also allows the pilot to enter the TOO position into a targetpoint (1 through 4). The default targetpoint number is displayed on the scratch pad. Press ENT to accept the default targetpoint or enter a different targetpoint number on the UFC. An entry of 0 on the UFC will cancel the targetpoint assignment portion of the TOO. The default targetpoint is the first null targetpoint or targetpoint 1 if none of the targetpoints are null. A targetpoint position can be sweetened by designating the targetpoint, slewing the position, and then selecting TOO on the UFC. The updated position is put into the targetpoint. The targetpoint retains its previous identifier. If a targetpoint is updated in this way, the MC replaces T0 in the JDAM priority list and the target data block (if displayed) with the slewed targetpoint's number.

23.14 POSITION UPDATE

There are four methods of correcting or updating the present position of the aircraft and one method (radar aircraft only) of correcting the velocity of the aircraft. TACAN, overfly, designate, GPS, or VEL (Radar only). When the update pushbutton is pressed on the EHSI/EHSD, FLIR, Radar, or DMT display, available only when the navigation system is in a loosely coupled position keeping mode, the four (or five) update options are displayed on the option display unit. In trainer aircraft with OMNI 7.1 and Day Attack aircraft, the reject option is also displayed in case it is desired to cancel the update.

On radar aircraft, position updating using the radar display can be performed by comparing the map or previously entered waypoint coordinates to a point on the radar map. Refer to NATIP, NTRP 3-22.4 AV8B.

23.14.1 TACAN Position Update

The system stores five TACAN stations and coordinates. A TACAN update can be performed anytime one of the five stored stations is selected and is within operating range. After selection of the TACAN option, the position of the aircraft is calculated using the range and bearing to the TACAN station. The computed position is then compared to the aircraft position derived from either INS or air data. The error in degrees and nautical miles is displayed on the scratch pad. Pressing the ACPT or REJ option select pushbutton on the option display unit either updates present position or rejects the update as desired.

A two TACAN station update can be performed to improve TACAN ranging accuracy. If this is desired, the TCN2 option is selected to initialize the TACAN to the next stored channel of the five station sequence. If this is not the desired station, successive pressing of the TCN2 pushbutton scrolls through the remaining stations excluding the station used in the first update. After lockon, the second station is displayed on the EHSI/EHSD display. Pressing the ERR2 pushbutton on the ODU displays bearing and range error on the scratch pad based on both TACAN stations. Pressing the ERR1 pushbutton on the ODU displays bearing and range error on the scratch pad based on the first TACAN station. Pressing the ACPT or REJ option select pushbutton on the ODU either updates present position or rejects the update as desired.

23.14.2 Overfly Position Update

This method is the same as waypoint designate position update, except the aircraft is flown directly over the waypoint and the OVFY option select pushbutton on the option display unit is pressed. The system then computes the position error in degrees and nautical miles using the position derived by the onboard system compared with the stored waypoint position. The error is displayed on the scratch pad. The update can then be accepted or rejected or, another overfly position update may be made. If a second overfly position update is made without accepting or rejecting the first update, the first update is automatically rejected.

23.14.2.1 Navigation Fix Update

A navigation fix update provides the capability to quickly update the navigation system on an unplanned navigation point. To perform a FIX update, the aircraft is flown directly over the navigation point and the OVFY option select pushbutton on the option display unit is pressed followed by the FIX option on the ODU. The fix (FIX) option on the ODU enables position entry or UTM entry as a source for an update. With the position (POS) option pressed and enabled, the latitude and longitude are entered and displayed on the scratch pad. When entry is completed the ERR option is displayed and the UTM option blanks. Pressing the error (ERR) pushbutton displays the navigation error on the scratch pad. The update can then be accepted or rejected.

To make a UTM entry as an update source, the UTM option pushbutton is pressed and the overfly UTM coordinates relative to the selected waypoint are entered. When entry is completed the ERR option is displayed and the POS option blanks. Pressing the error pushbutton displays the navigation error which can then be accepted or rejected.

23.14.3 Designate Position Update

This method allows the aircraft to update its position by designating one of the stored waypoints, markpoints, or targetpoints using the HUD or the dual mode tracker. A waypoint is selected and the designate (DESG) option is then selected on the option display unit. The waypoint is visually acquired and then designated using either the HUD or the dual mode tracker. The system then computes the position error by comparing the derived position from the designated point with the existing present position and displays it on the upfront control scratch pad. The update can then be accepted or rejected as desired.

23.14.4 MAP Position Update (Night Attack and Radar only)

A map position update is available when a map page is displayed. There are two types of map updates: overfly (OVFY) and designate (DESG). In an overfly map update the aircraft position can be updated by over flying a landmark that is on the digital map. Crosshairs are slewed over the location on the map. The navigation errors are displayed in the scratchpad. The update can then be accepted or rejected.

The designation map update method allows the aircraft to update its position by slewing the position of a HUD designation on the digital map. The system then computes the position error by comparing the derived position from the designated point with the existing present position and displays it on the upfront control scratch pad. The update can then be accepted or rejected as desired.

In aircraft with TAMMAC installed, map updates cannot be performed if the map type format is CIB. Map updates are cancelled if the map type format changes (CHRT to DTED or DTED to CIB) during the update.

23.14.5 Manual GPS Update

This method allows the aircraft to update its position by using current GPS position as the source for the update. The update displays current position errors as range and bearing errors. The update can then be accepted or rejected as desired.

23.15 WAYPOINT, MARKPOINT, TARGETPOINT OR WAYPOINT/MARKPOINT OFFSET STEERING

Waypoint, markpoint, targetpoint, or waypoint/markpoint offset steering is provided to any of the waypoints, the markpoints, the targetpoints, or their associated offsets. Waypoint, markpoint, or targetpoint steering is selected by selecting the desired waypoint, markpoint, or targetpoint and pressing the WYPT pushbutton on the DDI. The WYPT option is boxed (see Figure 23-27) and the bug (heading marker) on the heading scale indicates relative bearing to the waypoint or mark. The bug is wind corrected. The waypoint, markpoint, or targetpoint range and number are shown at the bottom right on the HUD. A digital readout of bearing and distance to the waypoint, markpoint, or targetpoint is provided in the upper right corner of the EHSI/EHSD display. Time to go to the waypoint, markpoint, or targetpoint in minutes and seconds is displayed under the bearing and distance.

To fly a selected course to a waypoint or mark, set in the course with the course knob on the HSI (TAV-8B and Day Attack aircraft) or course set switch on the CRS panel (Radar and Night Attack aircraft). The course appears on the bottom right of the EHSI/EHSD display and the course line is also displayed to indicate the position of the aircraft relative to the course. The course line rate of movement is used to anticipate when to turn to intercept the course. Steering to an offset from a waypoint or markpoint is also available by selecting the WO/S pushbutton to transfer the steering to the offset point. In this case the HUD range nomenclature would change from WYPT to WO/S.

CAUTION

In the TAV-8B and Day Attack aircraft, the course line displayed on the EHSI/EHSD and the course in the course selector window of the HSI are not necessarily the same. The bearing displayed in the course line data block in the lower right corner of the EHSI/EHSD and the course line displayed on the EHSI/EHSD should not be used instead of the bearing in the course selector window of the HSI. See Figure 23-27.

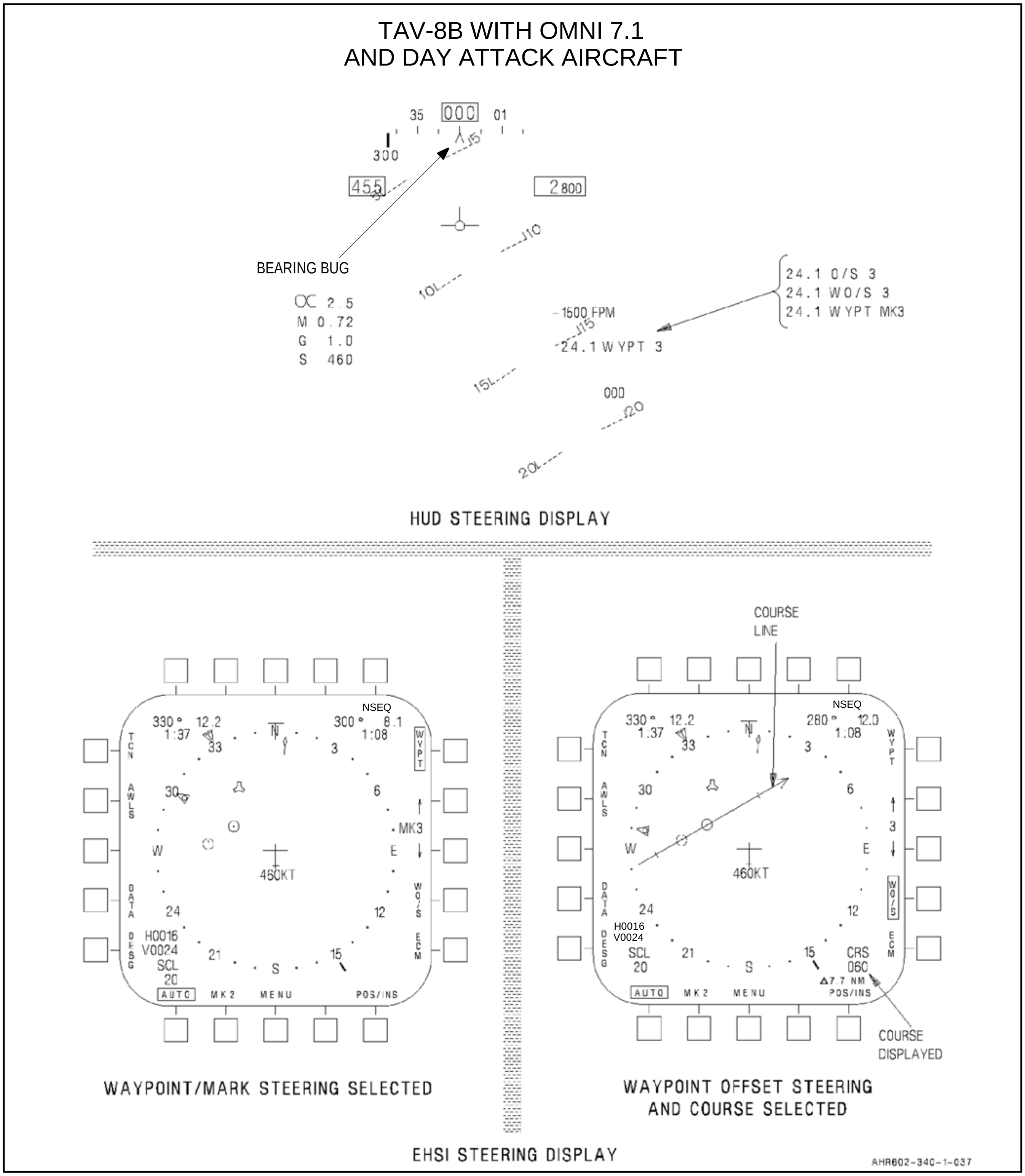


Figure 23-27. Waypoint, Mark, or Waypoint/Mark Offset Steering (OMNI 7.1) (Sheet 1 of 2)

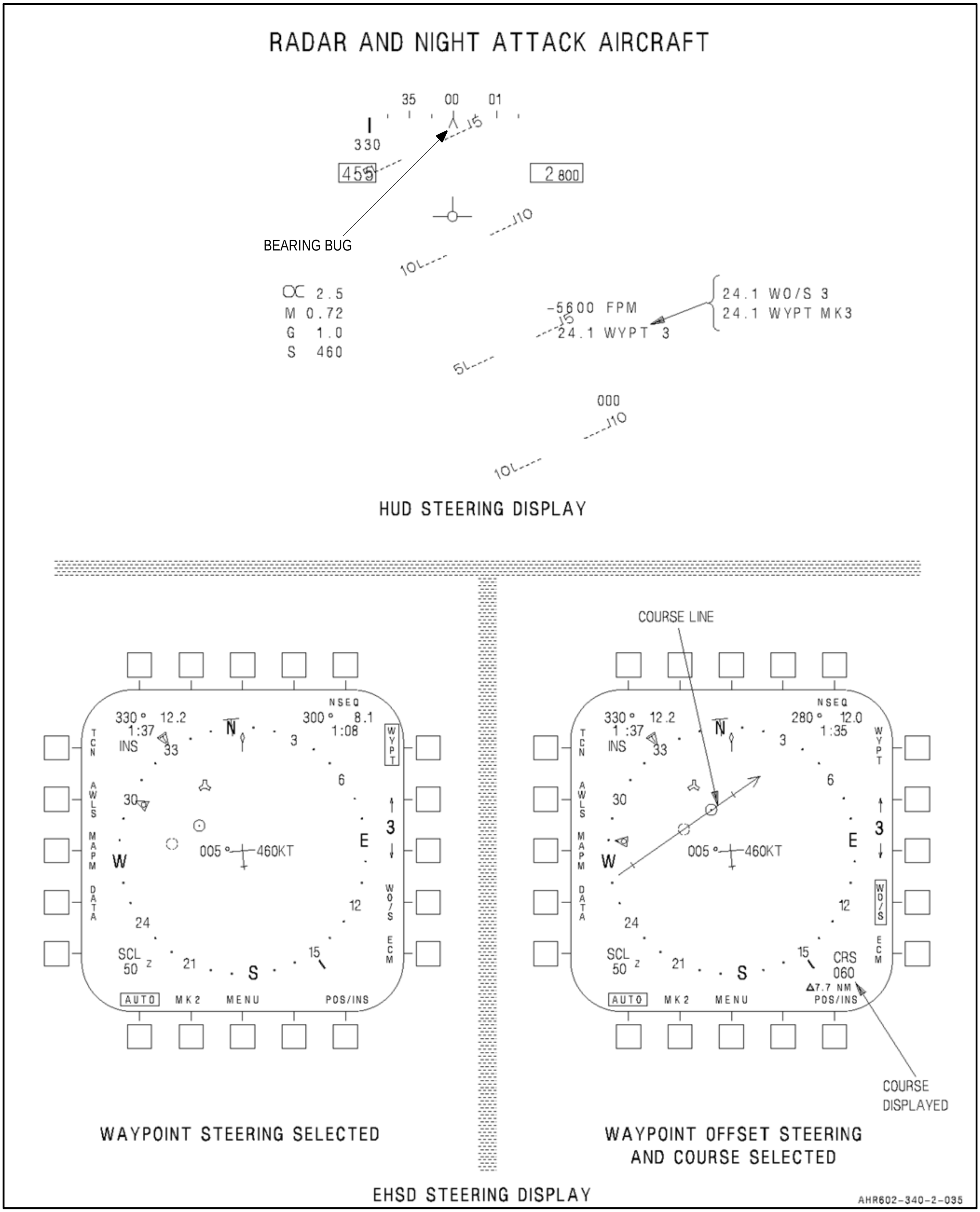


Figure 23-27. Waypoint, Mark, or Waypoint/Mark Offset Steering (OMNI C1+) (Sheet 2)

23.16 NAVIGATION MASTER MODE

Navigation master mode is selected by pressing the NAV mode pushbutton on the main instrument panel. In the navigation mode, primary flight information is presented on the HUD and aircraft horizontal situation is provided on the EHSI/EHSD display on the DDI. Three navigation steering modes are provided and selectable from the EHSI display: (1) waypoint, markpoint, targetpoint, or waypoint/markpoint offset steering, (2) TACAN or TACAN offset steering, and (3) AWLS steering. Waypoint steering provides great circle steering to a selected waypoint, markpoint, targetpoint, or waypoint/markpoint offset. TACAN steering provides the same capability to the selected TACAN station or TACAN offset. AWLS steering provides localizer and glideslope steering to the AWLS ground station. The basic flight data presented on the HUD (see Figure 23-28) is described in the following paragraphs:

23.16.1 Heading

The aircraft true heading is indicated by the moving 360° scale. True heading is the initial heading with OMNI 7.1 and C1+ and T appears on the HUD display. If magnetic heading is desired the TRUE pushbutton on the DDI is pressed and the box is removed from around the TRUE legend and the T is removed from the HUD display. Magnetic heading is the initial heading and no T appears on the HUD display with H4.0. If true heading is desired the TRUE pushbutton on the MAPM page is pressed and the box is displayed around the TRUE legend and the T appears on the HUD display. The actual aircraft heading is directly above the caret. The moving heading scale provides trend information during turns. As the aircraft turns right, the scale moves from right to left.

23.16.2 Airspeed

Calibrated airspeed from the air data computer is provided in the box on the left side of the HUD. With H4.0, the box is no longer displayed around the calibrated airspeed.

23.16.3 Altitude

The altitude presented in the box on the right side of the HUD may be either barometric altitude or radar altitude depending on the setting of the altitude switch on the HUD control panel. When the altitude switch is in the BARO position, barometric altitude is displayed. When the altitude switch is in the RDR position, radar altitude is displayed and is identified by an R next to the altitude. If the radar altitude becomes invalid, barometric altitude will be displayed and a flashing B is displayed to the right of the box indicating barometric altitude. The flashing B remains until either radar altitude becomes valid again or the altitude switch is placed in BARO. With H4.0, the box is no longer displayed around the altitude.

23.16.4 Barometric Setting

The barometric setting used by the air data computer (ADC) is the value set in the standby altimeter. When the barometric setting is changed on the standby altimeter by at least .02 inches of mercury, the ADC barometric setting is presented below the altitude on the HUD to provide a head-up baroset capability. The display remains for 5 seconds after the change is made.

23.16.5 Angle of Attack

Angle of attack in degrees is displayed at the left center of the HUD.

23.16.6 Mach Number

The aircraft mach number (M) is displayed immediately below the angle of attack.

23.16.7 Aircraft G

Normal acceleration (G) is displayed immediately below the mach number.

23.16.8 Ground Speed

Ground speed (S) is displayed immediately below the aircraft G.

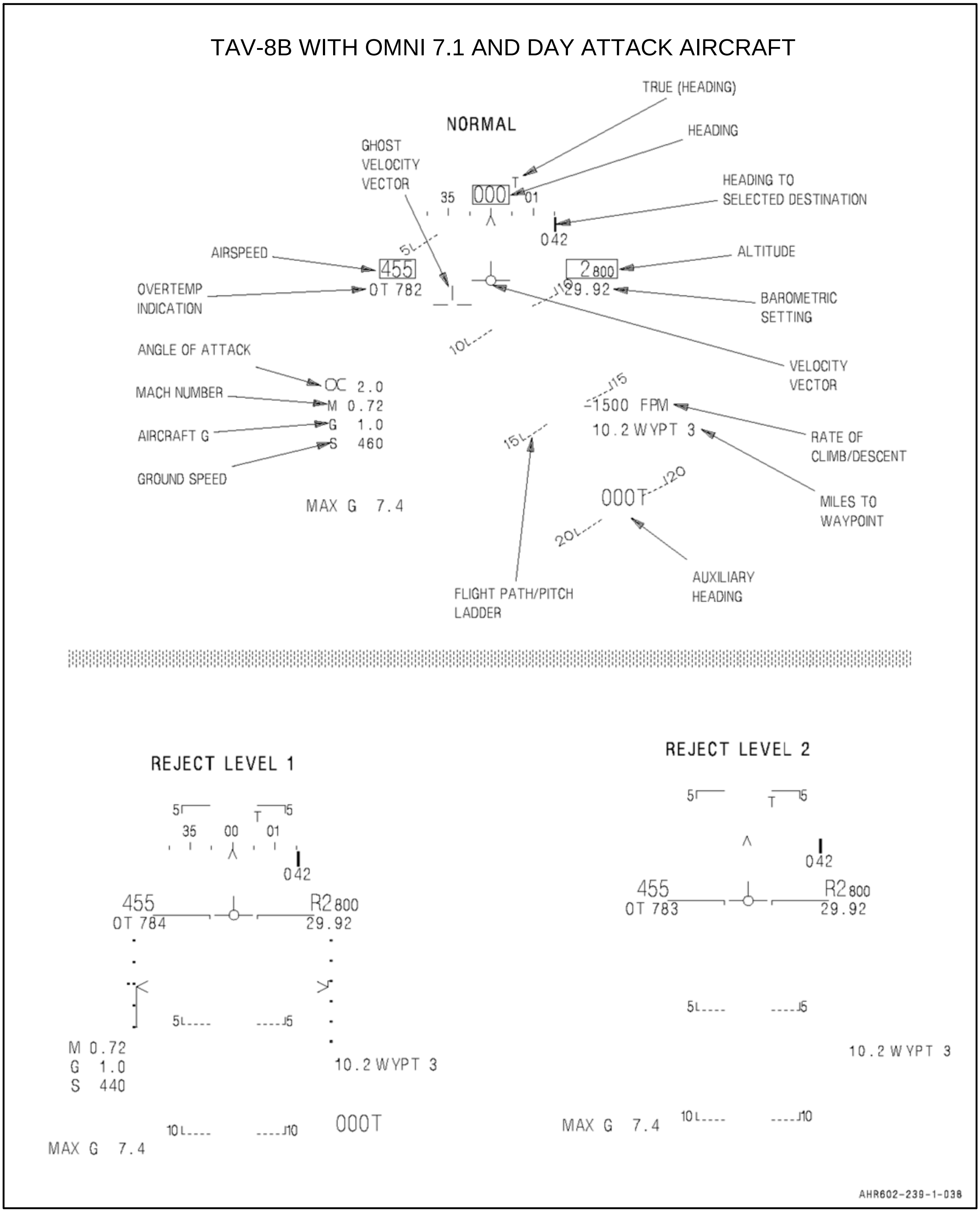


Figure 23-28. Nav Mode HUD Symbology (Sheet 1 of 2)

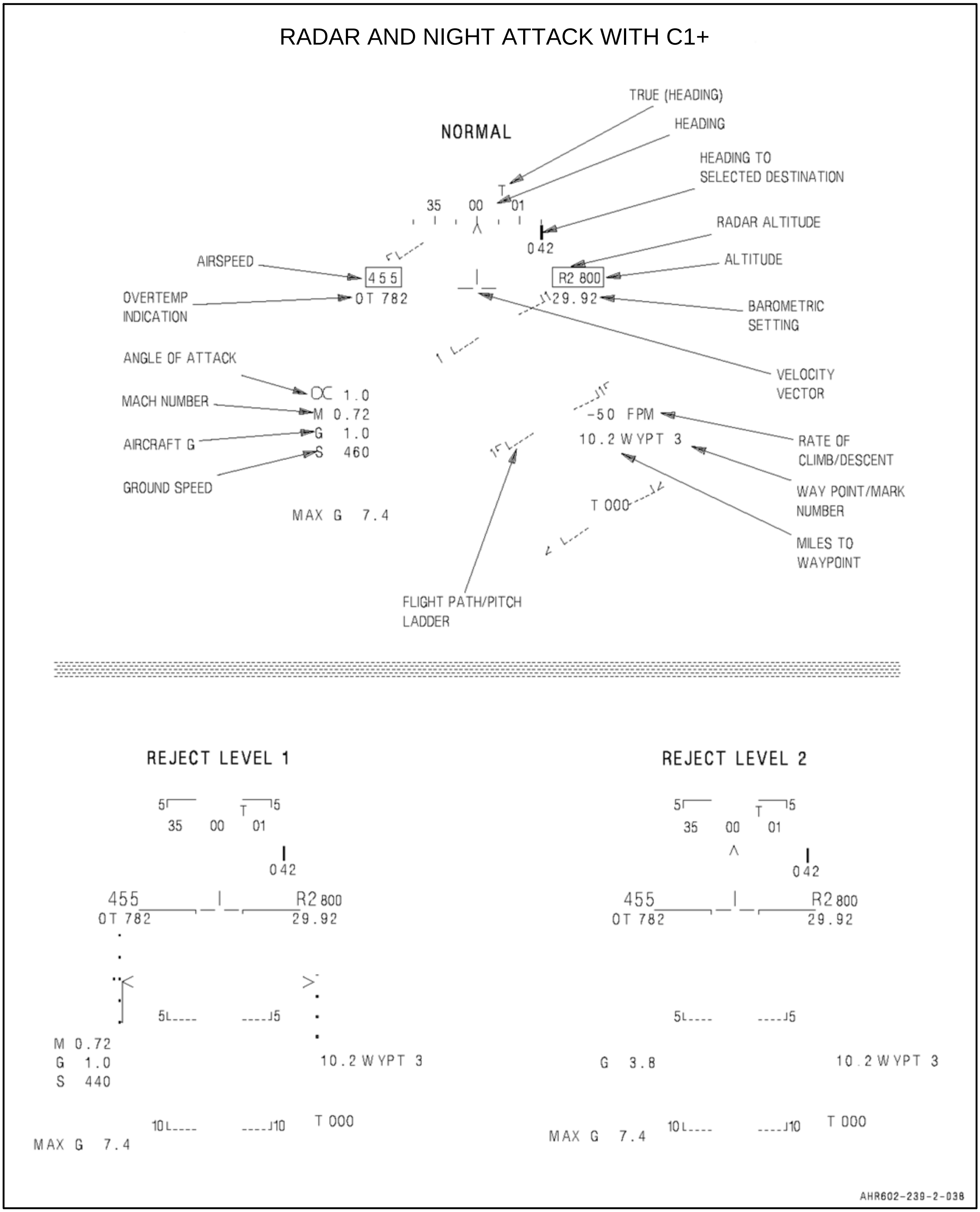


Figure 23-28. Nav Mode HUD Symbology (Sheet 2)

23.16.9 Maximum G

Maximum normal acceleration (MAX G) attained since it was last reset is displayed below the ground speed providing the maximum g exceeded 4.5g's.

Note

It should be noted that, at gross weights above 20,000 pounds or with lateral stick, the aircraft g–limit can be exceeded without exceeding 8g's on either the HUD or FLC.

23.16.10 Velocity Vector

The velocity vector provides the pilot with an outside world reference with regard to actual aircraft flight path. The velocity vector represents the point towards which the aircraft is flying (aircraft flight path). In the NAV master mode, the velocity vector is always caged to the vertical center line of the HUD. A ghost velocity vector is displayed at the true velocity vector position if that position is more than 2° from the caged position. The flight path/pitch ladder and steering information are referenced to the caged position. The ghost velocity vector will flash when limited. The velocity vector is normally positioned by inertial velocities, derived from either INS or GPS velocities. When these are invalid, filtered values of ADC TAS and ADC AOA are used to determine all velocities and therefore position of the velocity vector.

23.16.11 Flight Path/Pitch Ladder

The vertical flight path angle of the aircraft is indicated by the position of the velocity vector on the flight path/pitch ladder. The horizon and flight path/pitch angle lines represent the horizon and each 5° angle between plus and minus 30° and each 10° between 30° and 90°. Positive pitch lines are solid and are above the horizon line. Negative pitch lines are dashed and are below the horizon line. The outer segments of the lines point toward the horizon. Each line is numbered and the numbers rotate with the lines so that inverted flight can easily be determined. To aid in determining flight path angle when it is changing rapidly, the pitch lines are angled toward the horizon at an angle half that of the flight path angle. For example, in a 50° climb, the pitch lines are angled 25° toward the horizon. In level flight, pitch lines are not angled. The zenith is indicated by a circle and the nadir is indicated by a circle with an X in it. However, since the flight path/pitch ladder normally rotates about the velocity vector, determination of pitch angle may be difficult at high roll angles.

23.16.12 Waypoint/Markpoint or Targetpoint Number

This number indicates the number of the waypoint, markpoint, targetpoint, or offset selected. With OMNI 7.1 and C1+, MK precedes the number when a markpoint is selected. With H4.0, M precedes the number when a markpoint is selected, and T precedes the number when a targetpoint is selected.

23.16.13 True Heading

The letter T is displayed when true heading is selected on the DDI. If there is no T displayed, magnetic heading is being displayed.

23.16.14 Rate of Climb/Descent

This number indicates the feet per minute that the aircraft is climbing or descending. A minus sign indicates the aircraft is descending.

23.16.15 Range

The range to the selected waypoint, markpoint, targetpoint, waypoint/markpoint offset, TACAN station or TACAN offset is displayed in nautical miles.

23.16.16 Heading Marker

The heading marker (bug) indicates relative bearing to the selected waypoint, markpoint, targetpoint, waypoint/markpoint offset, TACAN, TACAN offset, or designated point. The heading marker position varies along the heading scale and will peg at scale limit. When pegged, the bearing numerals are displayed below the heading marker.

23.16.17 Overtemp Indication

If the JPT exceeds the engine threshold value, the maximum JPT recorded is displayed on the HUD beneath the air speed box adjacent to the OT legend. The OT indication is removed when the HUD reject level is changed if the overtemp condition no longer exists. If another overtemp condition occurs, the current JPT at that time is displayed.

23.16.18 Auxiliary Heading

The auxiliary heading is displayed in all master modes and is a repeat of the HUD aircraft heading. The auxiliary heading provides a way to view aircraft heading during video playback. A T is displayed if true heading is being displayed. Auxiliary heading is not displayed in reject level 2 in the TAV-8B with OMNI 7.1 and the Day Attack aircraft.

23.17 VSTOL MASTER MODE

The VSTOL mode is selected by pressing the VSTOL mode pushbutton on the main instrument panel. With VSTOL selected while weight-on-wheels, two options are displayed on the option display unit. They are NRAS (nozzle rotation airspeed) and PC (pitch carets). The basic flight data of heading, airspeed, altitude, barometric setting, angle of attack, waypoint number, T, waypoint, markpoint, targetpoint, waypoint/markpoint offset, DME, or TACAN offset range, and heading marker are displayed and function the same as described in the navigation master mode. Additional and different functions in the VSTOL mode are described in the following paragraphs. See Figure 23-29.

23.17.1 Vertical Speed Analog Scale

The vertical speed analog scale provides trend information during climbs and dives. The scale range is +1,500 to -2,000 feet per minute with graduations at +1,000, +500, 0, -500, -1,000 and -1,500 feet per minute. The moving caret is displayed on the inboard side of the scale and when displaced from zero has a reference line connecting the caret to the zero graduation.

23.17.2 FPM

Digital vertical velocity is displayed in feet per minute (FPM) with a limit of ±9,950 fpm and a resolution of 50 fpm. Plus or minus signs are not displayed on the FPM display. Below 60 knots, the vertical speed analog scale and FPM digital vertical velocity are not corrected for pitot static source error. Therefore, these displays should not be used for sink rate information when the displayed vertical velocity is greater than 500 feet per minute.

23.17.3 N (Nozzle)

Digital nozzle position is displayed in degrees.

23.17.4 F (Flap)

Digital flap position is displayed in degrees.

23.17.5 Auxiliary Heading

The auxiliary heading is displayed in all master modes and is a repeat of the HUD aircraft heading. The auxiliary heading provides a way to view aircraft heading during video playback. A T is displayed if true heading is being used. Auxiliary heading is not displayed in reject level 2 in the TAV-8B with OMNI 7.1 and the Day Attack aircraft.

23.17.6 Vertical Flight Path Symbol

The vertical flight path symbol is caged laterally and above 60 knots provides climb and dive angle information and is referenced to the flight path/pitch ladder. Below 60 knots, the vertical flight path symbol indicates vertical speed in feet per minute. When referenced against the flight path/pitch ladder, 1° of displacement from the horizon line equals 100 fpm vertical speed.

23.17.7 Sideslip Indicator

Sideslip is indicated by horizontal movement of the sideslip ball in relation to three vertical lines. Full movement of the ball to either side is equal to 0.09g and is represented by the ball being bisected by an outer vertical line.

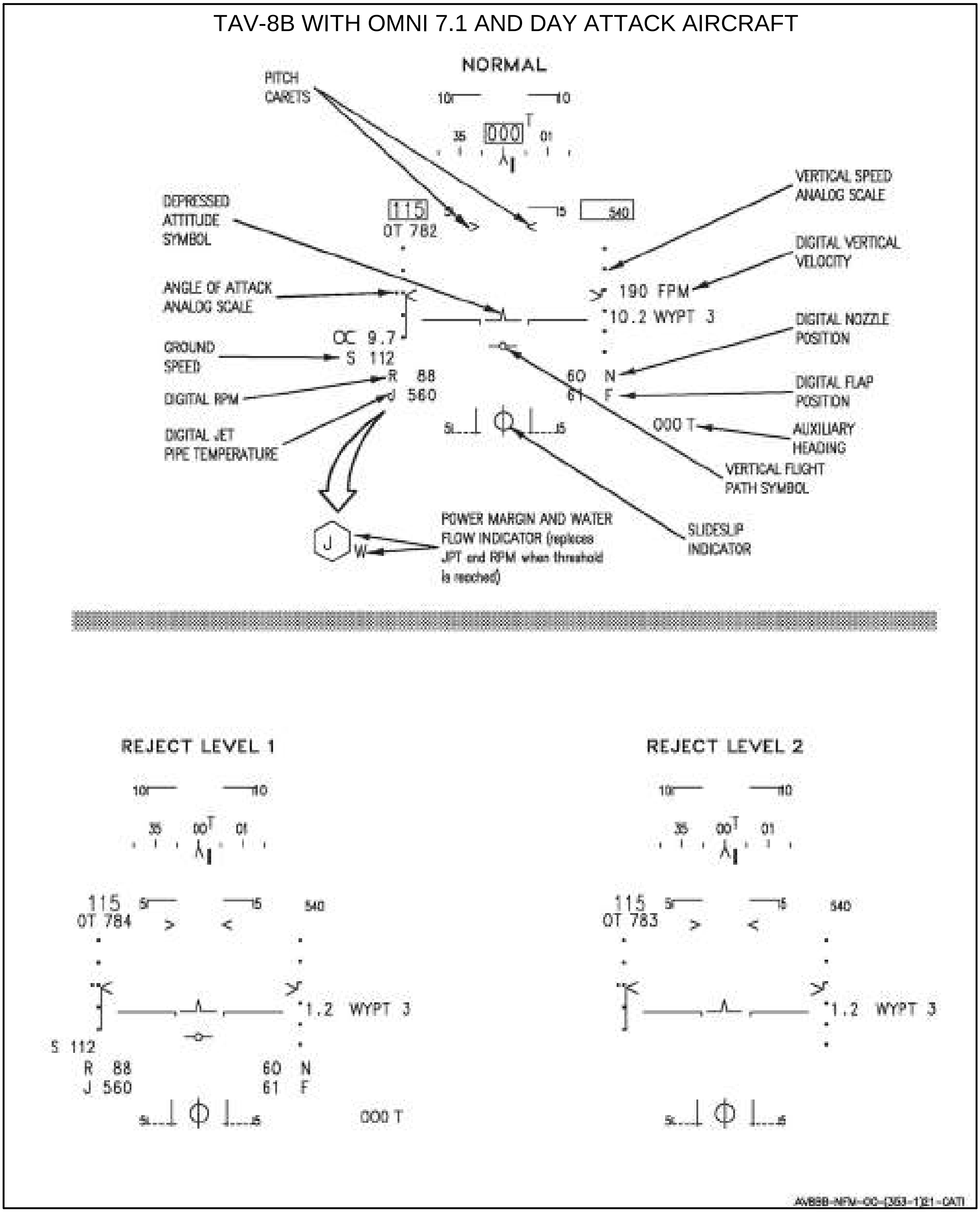


Figure 23-29. VSTOL Mode HUD Symbology (Sheet 1 of 2)

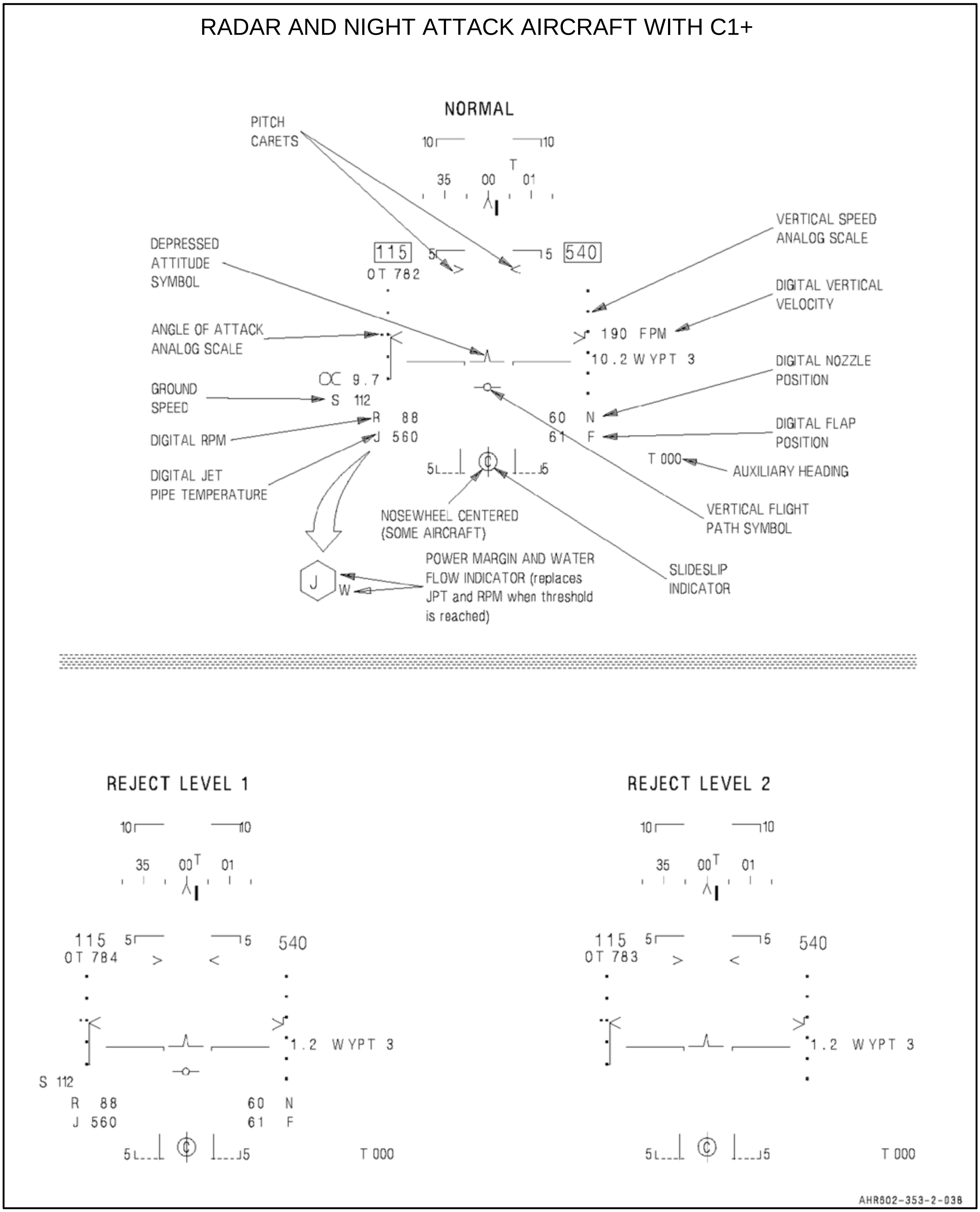


Figure 23-29. VSTOL Mode HUD Symbology (Sheet 2)

23.17.8 Nosewheel Steering Mode (Aircraft After AFC-391)

Steering modes are displayed in V/STOL master mode in all reject levels with landing gear extended. The four modes are displayed to the right of the sideslip indicator. CAST, CTR, NWS, or NWS HI is displayed depending on which steering mode is selected. Aircraft will also display a C inside the sideslip ball when the nosewheel is within 3° of neutral steering angle.

23.17.9 Power Margin Display and W

The power margin display (see Figure 23-30) replaces the JPT and rpm display when JPT is approximately 60° below maximum JPT or when rpm is approximately 6 percent below maximum rpm. The display is a growing hexagon around the letter J or R with each completed side representing 10 °C JPT or 1 percent rpm. The W is displayed when water injection is selected (SLW) and water is flowing.

With the -406 engine the power margin threshold for JPT starts at 640 °C dry or 665 °C wet; the threshold for indicated rpm starts at 96.5 percent dry or 100.0 percent wet, and corrected rpm starts at 100.5 percent. See Figure 23-30.

With the -408 engine the power margin threshold for JPT starts at 715 °C dry or 735 °C wet; the threshold for indicated rpm starts at 107.0 percent dry or 113.5.0 percent wet, and corrected rpm starts at 110.3 percent. See Figure 23-30.

406 ENGINE

JPT - °C				RPM - %		
DRY	WET	DISPLAY		DRY	WET	*
640	665	J	R	96.5	100.0	100.5
650	675	J	R	97.5	101.0	101.5
660	685	J	R	98.5	102.0	102.5
670	695	J	R	99.5	103.0	103.5
680	705	J	R	100.5	104.0	104.5
690	715	J	R	101.5	105.0	105.5
700	725	J	R	102.5	106.0	106.5
703	727	J	R	103.5	107.0	107.5

408 ENGINE

JPT - °C				RPM - %		
DRY	WET	DISPLAY		DRY	WET	*
715	735	J	R	107.0	113.5	110.3
725	745	J	R	108.0	114.5	111.3
735	755	J	R	109.0	115.5	112.3
745	765	J	R	110.0	116.5	113.3
755	775	J	R	111.0	117.5	114.3
765	785	J	R	112.0	118.5	115.3
775	795	J	R	113.0	119.5	116.3
780	800	J	R	113.5	120.0	116.8

* Corrected rpm wet or dry.

Figure 23-30. Power Margin Displays Series Engine

There is no pilot indication that rpm threshold is reached by indicated or corrected rpm. The threshold reached first determines whether J or R power margin is displayed. If JPT or rpm is still increasing after the hexagon is complete, the last leg of the hexagon continues in a straight line. The length of this line is proportional to the increase in JPT or rpm.

23.17.10 J (Jet Pipe Temperature)

Digital jet pipe temperature (JPT) is displayed in degrees Celsius with a resolution of 10 °C.

23.17.11 R (Rpm)

Digital engine rpm is displayed in percent with a resolution of 1 percent.

23.17.12 S (Ground Speed)

Digital ground speed is displayed in knots. Ground speed is removed in reject level 2.

23.17.13 Angle of Attack Analog Scale

The angle of attack analog scale has a range of +25° to –5° AOA with graduations at +20°, +15°, +10° (double dot), +5° and 0°. The moving caret is displayed on the inboard side of the scale and when displaced from zero has a reference line connecting the caret to the zero graduation.

23.17.14 Depressed Attitude Symbol

The depressed attitude symbol is fixed at 8° below the waterline. When the horizon bar of the flight path/pitch ladder is aligned with the depressed attitude symbol, the aircraft is at the proper hover attitude. GS angle (2.0° through 6°) entered through the upfront control will be maintained.

23.17.15 Pitch Carets Cue

The pitch carets (PC) initialize at 14° and provide a cue for pitch. The carets are adjustable from 0° to 30° in 1° increments. When VSTOL mode is selected the PC option is displayed on the ODU. The carets are set by pressing the PC option, typing the desired degrees of pitch (0° through 30°) on the UFC, then pressing ENT. The pitch carets are referenced to the depressed attitude symbol and move with the pitch ladder.

23.17.16 Nozzle Rotation Airspeed Cue

With VSTOL mode selected while weight–on–wheels, the nozzle rotation airspeed (NRAS) cue is set by pressing the NRAS option on the ODU, typing the desired airspeed (up to 160 knots) on the UFC, then pressing ENT. With OMNI 7.1 and C1+ and with normal or reject 1 selected, the airspeed display is boxed when the set airspeed is reached. With reject 2 selected, the airspeed box is removed when the set airspeed is reached. With H4.0 in all master modes, the airspeed box is displayed when the set airspeed is reached and then removed when 160 knots indicated airspeed is reached.

Note

With H4.0, if the NRAS airspeed is set close to or at the maximum (160 knots), the cue may appear only momentarily or not at all.

23.18 HUD SYMBOLOGY CHANGES (WITH H4.0)

With the additional HUD symbology, the time required to write all of the HUD symbology exceeded the time available. This resulted in flickering HUD symbology. Changes in HUD symbology were made to decrease the occurrence of flickering HUD symbology. The following actions were taken (see Figure 23-31):

1. Some symbology is written at a lower intensity in the A/G and A/A master modes with the HUD in the Day mode. Examples include Mach Number, AOA, normal G, ground speed, RWR cues, and other text symbols located on the sides of the HUD.

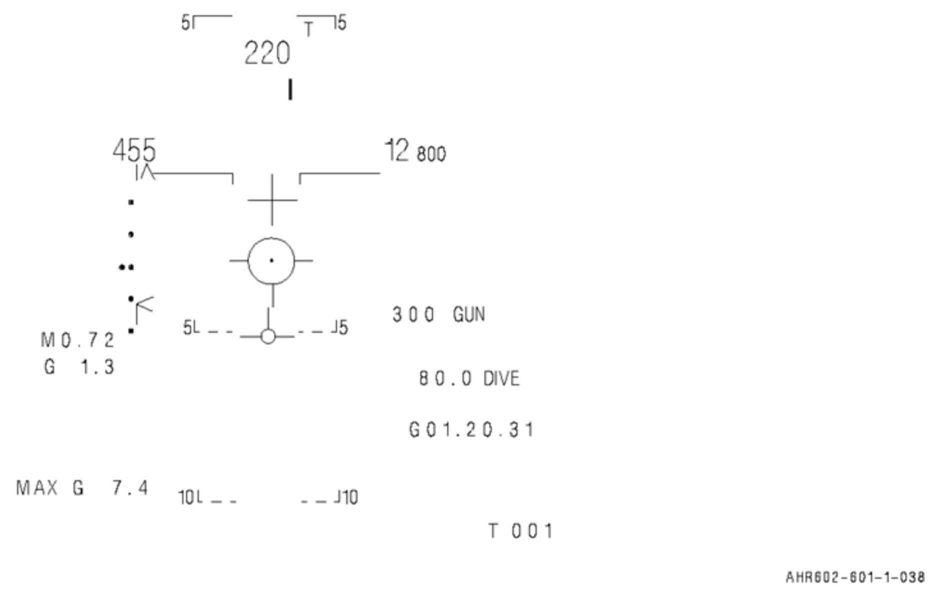


Figure 23-31. Sample HUD with Write Time Changes

2. Some symbology is removed based upon the master mode. Examples include:

   a. Nav, A/G, A/A modes – altitude and airspeed boxes have been removed regardless of the HUD reject level.

   b. A/G and A/A mode – aircraft heading is a three digit number only. The heading tape has been removed. The AOA and vertical analog scales have been removed regardless of the HUD reject level selected. There is no difference between the NORM and REJ1 HUD reject levels.

3. The most important symbology is still written at the full intensity. Examples include the velocity vector, pitch ladders, airspeed, altitude, steer to point circle, and main weapon symbology.

23.19 HUD STEERING (WITH H4.0)

The steering bug and range depicted in the HUD always reference the steer to point (STP). The STP is the steering reference selected on the EHSD (waypoint, markpoint, targetpoint, TACAN, or an offset). When a non–TACAN STP is within the HUD FOV, a circle represents the STP position unless it is designated, in which case a diamond represents it. See Figure 23-32. The reattack symbology always references the system designation (e.g. waypoint designation, radar designation, HUD designation). Since designations are always stored in targetpoint zero, steering and range to the system designation can be obtained by selecting targetpoint zero.

23.20 BACKUP/DEGRADED OPERATIONS

23.20.1 Backup Mode Initialization

Whenever the backup mode is entered the following items are affected as indicated:

1. HUD – Reverts to backup display.
2. DDI – On TAV–8B with OMNI 7.1 and Day Attack aircraft, displays HUD display.
3. Left DDI – On Radar and Night Attack aircraft, displays map display.

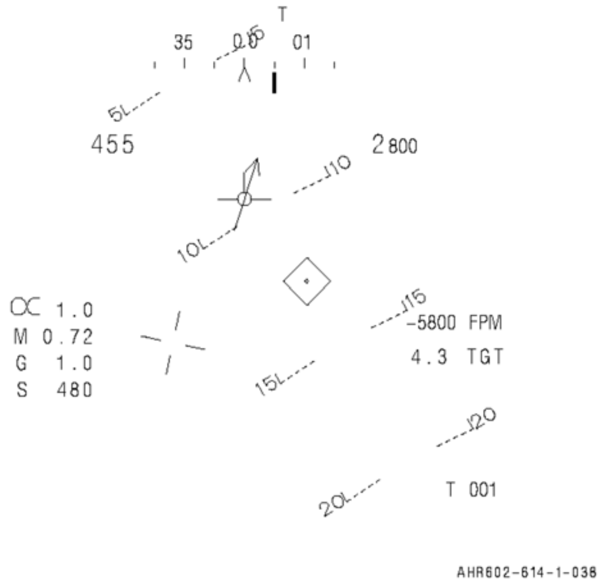


Figure 23-32. HUD Steering (with H4.0)

4. Right DDI – On Radar and Night Attack aircraft, displays HUD display.
5. SAAHS – Degraded mode.
6. VHF/UHF radio – Operates in manual mode using radio set control and ACNIP.
7. INS – No steering. Pitch, roll, true heading, and present position displayed.
8. IFF – Turned off but can be turned back on. Mode 3 code initialized to 0000 but can be reset. Mode 4A/B usable. Modes 1 and 2 inoperative.
9. Radar altimeter – Turned off but can be turned back on. Low altitude warning light fixed at 200 feet.
10. HOTAS functions – TDC inoperative. Sensor control switch depressed position functions as HUD scene reject. Waypoint increment button on the stick functions as the DAT button, alternating the HUD repeater and the map display between the DDIs.
11. SMS – No computed deliver modes, CIP/AUT light on. Weapon deliver possible in DSL, DSL–1, and DIR modes using the roll stabilized sight.
12. RWR – No head–down ECM threat lethality display. Head–up ECM display on HUD and right DDI.
13. EMCON – Turned off but can be turned back on.
14. FLIR – On Radar and Night Attack aircraft, reverts to default mode. Sensor select switch depressed position alternately enables and disables FLIR video on HUD.

23.20.2 Attitude Heading Reference System

The attitude heading reference system is an INS backup mode. The INS system provides automatic INS degrading to AHRS when INS BIT detects a significant fault in the system. When AHRS options appear automatically as a result of INS failure, the best available heading source is displayed and used. AHRS display on the EHSI is one of two types, first order or higher order. Higher order is available when gyro is selected on the miscellaneous control panel on the ground. First order AHRS may be displayed when NAV is selected and INS BIT detects a failure which degrades INS outputs or when GYRO is selected in flight. Full up INS mode cannot be regained in flight after selection of GYRO mode. For full description of GYRO mode, see INS gyro alignment (AHRS) procedures paragraph 23.1.6. See Figure 23-33 for AHRS displays on the DDI. A description of the AHRS displays follows:

23.20.2.1 DG (Directional Gyro)

The DG legend appears as an AHRS option when directional gyro signals are available in the event of degraded INS outputs. The box around DG means that directional gyro heading is displayed.

23.20.2.2 COMP (Compass)

The COMP legend appears as an AHRS option when magnetic azimuth detector (MAD) signals are available in the event of degraded INS outputs. The box around COMP means that magnetic heading is displayed.

23.20.2.3 SLV (Slave)

The SLV legend appears when AHRS options become available due to INS failure in which INS outputs are degraded. Since slave heading is a mixture of HDG/COMP and HDG/DG, the SLV legend will appear only if magnetic heading and directional gyro outputs are available. The box around SLV means that slave heading is displayed.

23.20.2.4 ERECT

The ERECT legend appears when INS is in AHRS mode of operation. Pressing this pushbutton sends fast erect signal to the INS for fast leveling of the platform. The signal continues for as long as this pushbutton is pressed.

23.20.2.5 HDG/DG

The HDG/DG legend appears and directional gyro heading is displayed when the mission computer system has determined DG heading to be the best available AHRS option. Pressing the HDG/DG pushbutton causes available AHRS options to be displayed with a box around DG.

23.20.2.6 HDG

The HDG legend appears when DG heading is selected. Pressing left arrow pushbutton causes compass rose to rotate counterclockwise for as long as the pushbutton is pressed. Pressing right arrow pushbutton causes compass rose to rotate clockwise for as long as the pushbutton is pressed. This is done to slew compass rose to applicable heading due to processing of the directional gyro.

23.20.2.7 SYNC

The SYNC legend appears when slave heading is selected. Pressing SYNC pushbutton slaves the platform heading to magnetic heading.

23.20.2.8 HDG/CMP

The HDG COMP legend appears and magnetic heading is displayed when the mission computer system has determined the magnetic heading to be the best available AHRS option. Pressing the HDG/COMP pushbutton causes available AHRS option to be displayed with a box around COMP.

23.20.2.9 HDG/SLV

The HDG/SLV legend appears and slave heading is displayed when the mission computer system has determined the slave heading is the best available AHRS option. Pressing the HDG/SLV pushbutton causes available AHRS option to be displayed with a box around SLV.

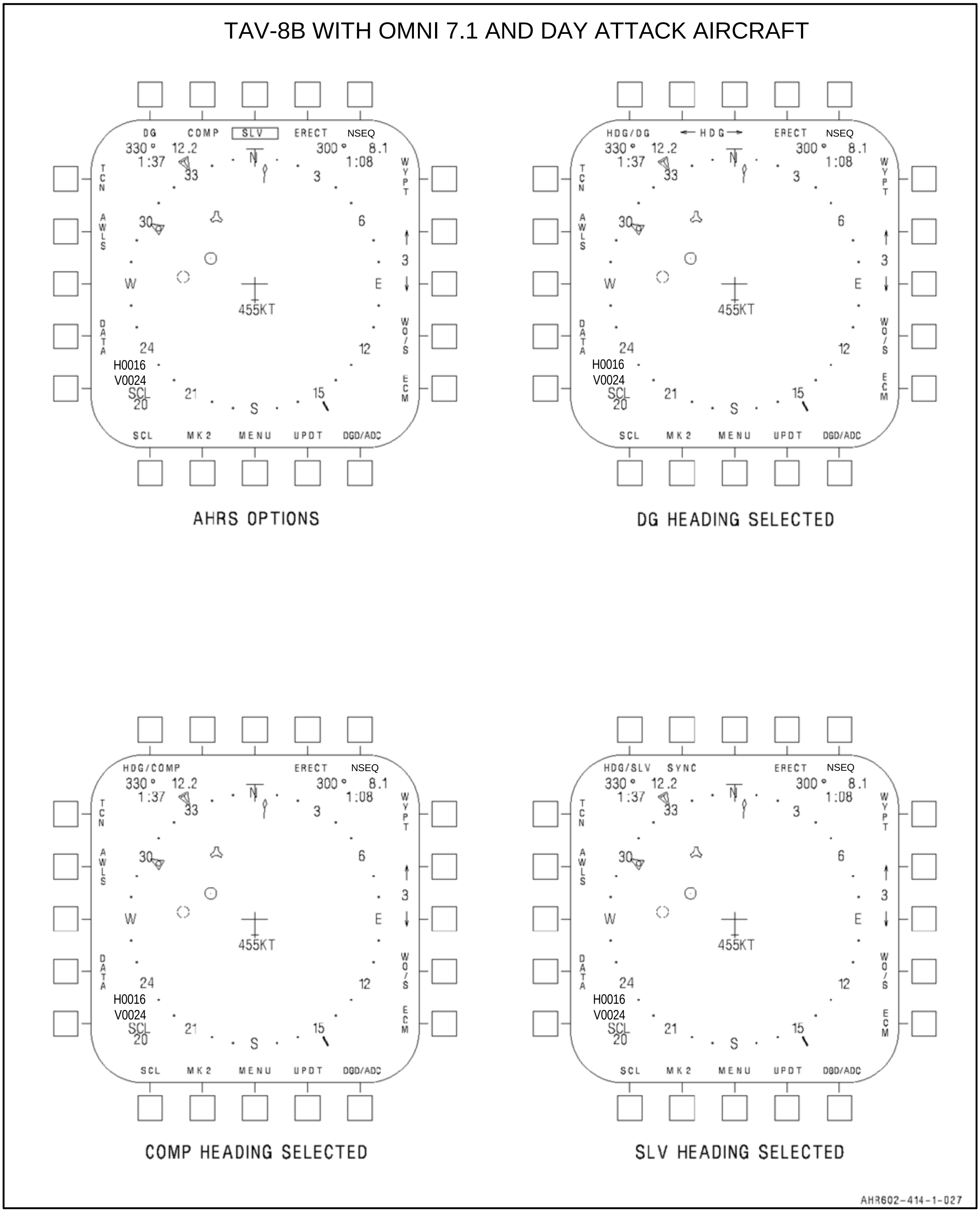


Figure 23-33. AHRS Display (Sheet 1 of 2)

TAV-8B WITH H4.0 AND RADAR AND NIGHT ATTACK AIRCRAFT

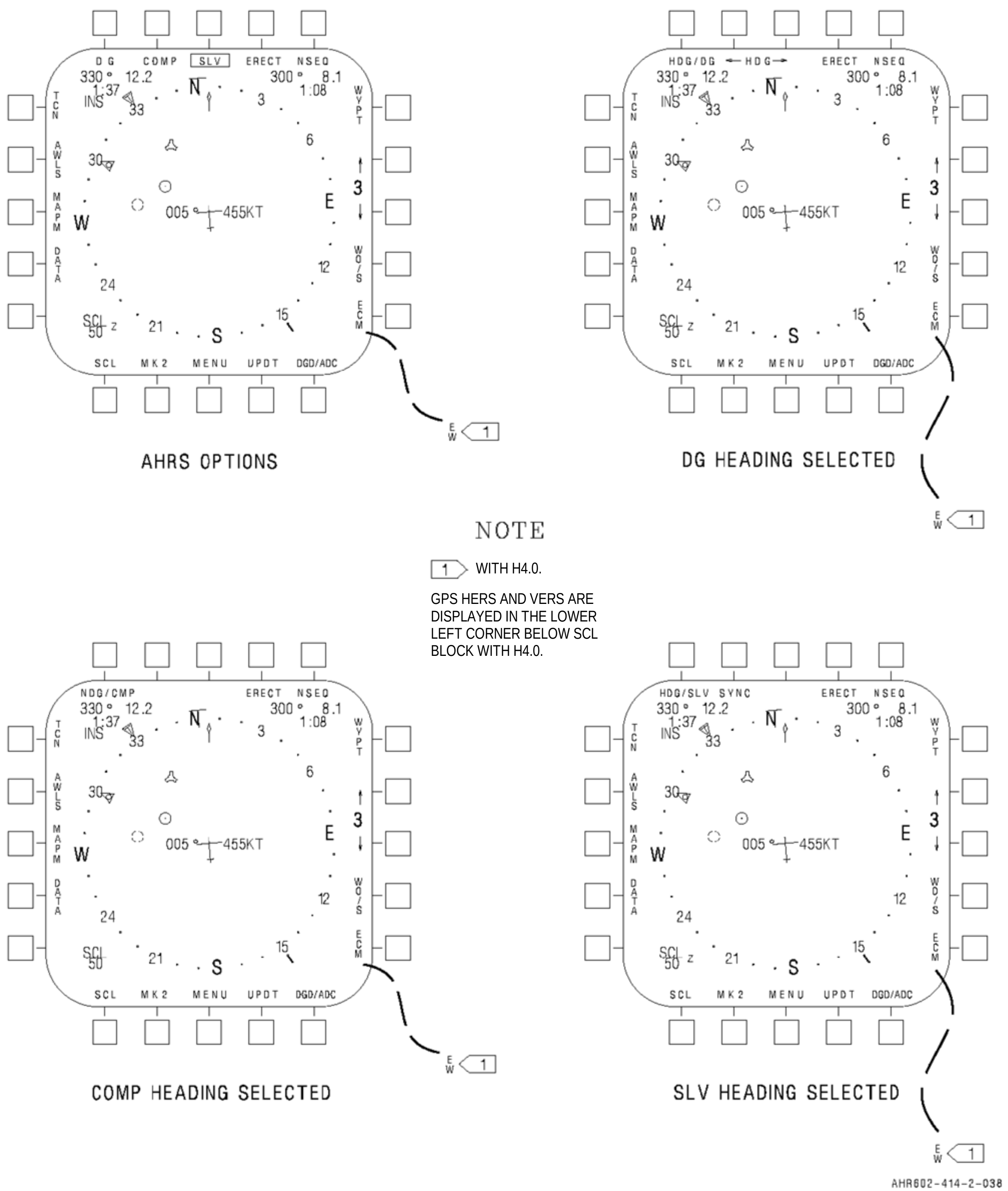


Figure 23-33. AHRS Display (Sheet 2)

PART VIII

Weapons Systems

Refer to NTRP 3.22-4-AV8B

PART IX

Flight Crew Coordination

CHAPTER 24

Crew Resource Management

The AV–8B crew resource management (CRM) program shall be conducted IAW OPNAV 3710.7 and OPNAV 1542.7. The goal of CRM is to improve mission effectiveness by minimizing crew preventable errors, maximizing crew coordination, and optimizing risk management. This will allow aircrew to use and integrate all available skills and resources to collectively achieve and maintain crew efficiency, situational awareness, and mission effectiveness. For a single seat aircraft this translates to close coordination with outside sources such as LSIs, LSSs, LSOs, wingman, flight leaders, air traffic controllers, and ground personnel. The seven critical CRM behavioral skills shall be integrated throughout the Harrier community's academics, simulators and flight training. Aircrew shall receive annual CRM ground training from an AV–8B trained CRM Instructor or Facilitator and the annual NATOPS check shall serve as the annual CRM flight evaluation.

24.1 SEVEN CRITICAL SKILLS

24.1.1 Decision Making

The ability to choose a course of action using logical and sound judgment based on available information. Effective decision–making requires:

1. Assessing the situation.
2. Verifying information.
3. Identifying solutions.
4. Anticipating decision consequences.
5. Making the decision.
6. Telling others of the decision and rationale.
7. Evaluating the decision.

24.1.2 Assertiveness

An individual's willingness to actively participate, state, and maintain a position, until convinced by the facts that other options are better. Assertiveness is respectful and professional, used to resolve problems appropriately, and to improve mission effectiveness and safety.

24.1.3 Mission Analysis

The ability to develop short–term, long–term, and contingency plans and to coordinate, allocate, and monitor crew and aircraft resources. Effective planning leads to flight conduct that removes uncertainty, increases mission effectiveness, and enhances safety.

24.1.4 Communication

The ability to clearly and accurately send and acknowledge information, instructions, or commands, and provide useful feedback. Effective communication is vital to ensure that all crewmembers understand aircraft and mission status.

24.1.5 Leadership

The ability to direct and coordinate the activities of other crewmembers or wingmen, and to encourage the crew to work together as a team. There are two types of leadership.

24.1.5.1 Designated Leadership

Leadership by authority, crew position, rank, or title. This is the normal mode of leadership.

24.1.5.2 Functional Leadership

Leadership by knowledge or expertise, Functional leadership is temporary and allows the most qualified individual to take charge of the situation.

24.1.6 Adaptability/Flexibility

The ability to alter a course of action based on new information, maintain constructive behavior under pressure, and adapt to internal and external environmental changes. The success of a mission depends upon the the crew's ability to alter behavior and dynamically manage crew resources to meet situational demands.

24.1.7 Situational Awareness

The degree of accuracy by which one's perception of the current environment mirrors reality. Maintaining a high level of situational awareness will better prepare crews to respond to unexpected situations.

24.2 LOSS OF AIRCREW COORDINATION

The loss of aircrew coordination often results in one or more of the following:

1. Fixation on one task to the detriment of others.
2. Confusion.
3. Violation of NATOPS/flight minimums/SOP.
4. No one in charge/lack of flight leadership.
5. No lookout doctrine.
6. Absence of communication.
7. Failure to meet timeline or accomplish the mission.

24.3 FLIGHT MEMBER POSITIONS

24.3.1 Mission Commander

The mission commander shall be a qualified aviator designated by appropriate authority. The mission commander shall be responsible for all phases of the assigned mission except those aspects of safety of flight which are related to the physical control of aircraft and fall within the prerogatives of the pilot in command. The mission commander shall direct a coordinated plan of action and be responsible for effectiveness of the mission. The mission commanders responsibilities include, but are not limited to:

1. Allocation of assets.
2. Supervise and allocate planning tasks.
3. Assess capabilities and limitations of the flight.
4. Establish go/no-go criteria.
5. Assign roles and responsibilities.
6. Ensure compliance with applicable orders, directives, rules of engagement (ROE)/rules of conduct (ROC), and training rules.
7. Delegate authority as required.

24.3.2 Formation Leader

A formation of two or more Naval aircraft shall be under the direction of a formation leader who is authorized to pilot Naval aircraft. The formation leader may also be the mission commander when so designated. The status of each member of the formation shall be clearly briefed and understood prior to takeoff. The formation leader is responsible for the safe and orderly conduct of the formation. The formation leaders responsibilities are the same as the mission commanders responsibilities with regard to his flight and in accordance with the mission commanders directives. A section leader is a formation leader of two aircraft and may be part of a larger element. A division leader is a formation leader of three or more aircraft and may be subordinate to a larger element formation leader or mission commander.

24.3.3 Wingman

A wingman is any member of a flight which is not specifically designated/assigned as a formation leader. A wingman is responsible for the safe and orderly conduct of his aircraft. Additional responsibilities include but are not limited to:

1. Understand the mission requirements.
2. Be involved in the planning process.
3. Be capable of assuming the lead when required.
4. Notify the leader of deficiencies (lost, confused, systems degradation, etc.).
5. Assist in look-out responsibilities.
6. Collision avoidance.

24.4 AIRCREW RESPONSIBILITIES BY FLIGHT PHASE

24.4.1 Mission Planning

All members of the flight should be involved in the mission planning process and must be familiar with the mission requirements prior to the flight brief.

24.4.2 Brief

The flight brief shall be conducted with all members of the flight present. Any supporting assets (ground controlled intercept (GCI), fighter escort, EW, etc.) shall be briefed face-to-face if possible. Flights requiring special coordination or control should also be briefed face-to-face. Each type of flight or phase of flight may require unique briefing requirements. The following is a partial list of flights and associated briefing requirements:

1. Shipboard operations — LSO.
2. Forward site operations — LSS.
3. FCF — QA, AMO, or designated representative.
4. Single aircraft operations — Operations Officer or designated representative.
5. Multi-element flights — Mission Commander, formation leader, subordinate formation leader.
6. Ground controlled intercept/vectoring — GCI, CCI, Strike vectoring controller, ASRT, etc.
7. Instrument flights — weather forecasters.
8. Ordnance flights — ordnance crew for loadout, weapon/fuzing selection, restrictions and arm/dearm considerations/procedures.

24.4.3 Pre-Takeoff

As a single piloted aircraft, much of the preflight, prestart and post-start evolutions will be conducted individually or with the aid of the ground maintenance crew (plane captain, ordnance, etc). Timing must be considered when operating with coordinating activities. Marshalling and taxi with a flight should be in order with special emphasis on FOD avoidance. Squadrons should establish a minimum taxi interval based upon the local FOD situation. Engine acceleration clears should be held until clear of other aircraft and in a relatively FOD free location (i.e., Takeoff position or approaching takeoff position). Although the wheel brakes are not designed for lengthy taxi evolutions and nozzles are recommended for speed control, this must be tempered with FOD and interval considerations when operating in formation. Section taxi may be the most expeditious method, but like airborne, the wingman cannot focus on other tasks while taxiing and allow himself to get behind.

24.4.4 Departure

The AV-8B is capable of several types of takeoffs, and formations of AV-8Bs have several options. In addition to the typical takeoff considerations such as gross weight, performance, surface type and abort capability, when conducting a formation takeoff the following should also be considered and briefed: interval for FOD avoidance, staggered line-up for abort, cross wind handling characteristics, jet exhaust/turbulence patterns and avoidance, abort criteria and configuration changes prior to IMC. Departure procedures are dependent upon the takeoff type, weather and mission requirements. The following are some considerations: clearance compliance, climb schedule and interval of multi-plane-formations, weather avoidance or penetration and individual departure to join on top.

24.4.5 En route

En route procedures differ greatly with mission type but some special considerations are: formation type, position, altitude, airspeed and role assignment and execution, navigation/INS management, lookout, command and control requirements, coordination, deconfliction, ordnance and attack procedures and switchology, reconstitution and rendezvous, support requirements, timing, fuel planning and management.

24.4.6 Recovery

Egress, approach and landing options are numerous and dependent upon mission objectives, weather, and landing types. The following is a list of considerations: course rule, re-entry procedures, approach and landing weather, landing type and capabilities (i.e., gross weight, performance, cross winds, ceiling and visibility), fuel for normal and alternate recoveries, formation size and composition based upon maneuverability and landing area congestion, instrument recovery-penetration procedures with two or more aircraft in formation and power/maneuvering margins for wingmen, jet wash/turbulence avoidance, landing interval and priorities, dearming procedures, FOD mechanisms for landing and taxi, navigation, either internal (INS, TACAN, VISUAL) or external (GCI, GCA, APPROACH CONTROL), terminal control and use or LSO, LSS.

24.4.7 Mission Critique

Mission assessment is critical following a flight whether the mission was a multi-aircraft strike, an FCLP period, or a functional check flight. A critical and credible debrief will improve future mission success and evaluate current mission effectiveness. A proper debrief should provide flight members and supporting agencies with information on strengths and weaknesses so that future training and mission planning can address problem areas and exploit strong areas.

24.5 EMERGENCIES

Mission planning and briefing should address contingencies which may affect the flight. Proper planning will minimize the effect of deviations from the planned mission. The possibility of a mission abort or even the loss of an aircraft or pilot can be significantly reduced by anticipating critical phases of flight and preparing for potential emergency situations. An example is the thorough brief of bird strike emergencies and alternate landing areas along a low-level navigation route. Part V of this manual provides emergency procedures for the pilot, but each formation leader should state the procedures to be followed by other members of the flight in the event of an emergency situation. An example may be for the aircraft experiencing the emergency to operate as a single aircraft and the other member of the section to assume a chase position and provide assistance in the form of navigation, communication, reading checklist procedures and acting as an observer for external indications and look-out. Standardized procedures for downed aircraft and search and rescue (SAR) operations should be stated by the formation leader. Role assignments for visual identification, comm relay and location should be stated.

PART X

NATOPS Evaluation

CHAPTER 25

NATOPS Evaluation

25.1 CONCEPT

The standard operating procedures prescribed in this manual represent the optimum operation of the AV-8B/TAV-8B. The NATOPS evaluation is intended to evaluate systems knowledge and compliance with NATOPS procedures through observation of pilots and squadrons. The objective of the NATOPS evaluation program is to assist the commanding officer in improving unit readiness, safety, and standardization through constructive comment.

25.2 IMPLEMENTATION

The NATOPS Evaluation program shall be carried out in every unit operating naval aircraft. Pilots desiring to attain/retain qualification in the AV-8B/TAV-8B shall be evaluated initially in accordance with OPNAV Instruction 3510.9 series, and at least once during the 12 months following initial and subsequent evaluations. Individual and unit NATOPS Evaluations will be conducted annually; however, instruction in and observation of adherence to NATOPS procedures must be on a daily basis within each unit to obtain maximum benefits from the program. The NATOPS Coordinators, Evaluators, and Instructors shall administer the program as outlined in OPNAV 3710.7 series. Evaluees who receive a grade of Unqualified on a ground or flight evaluation shall be allowed 30 days in which to complete a re-evaluation. A maximum of 60 days may elapse between the date the initial ground evaluation was commenced and the date the flight evaluation is satisfactorily completed.

25.3 DEFINITIONS

The following terms, used throughout this section, are defined as to their specific meaning within the NATOPS program.

25.3.1 NATOPS Evaluation

A periodic evaluation of individual pilot standardization consisting of an open book examination, a closed book examination, an oral examination, and a flight evaluation.

25.3.2 NATOPS Re-Evaluation

A partial NATOPS Evaluation administered to a pilot who has been placed in an Unqualified status by receiving an Unqualified grade for any of his ground examinations or the flight evaluations. Only those areas in which an unsatisfactory level was noted need be observed during a re-evaluation.

25.3.3 Qualified

Well standardized; evaluee demonstrated highly professional knowledge of and compliance with NATOPS standards and procedures; momentary deviations from or minor omission in non-critical areas are permitted if prompt and timely remedial action is initiated by the evaluee.

25.3.4 Conditionally Qualified

Satisfactorily standardized; one or more significant deviations from NATOPS standards and procedures, but no errors in critical areas and no errors jeopardizing mission accomplishment or flight safety.

25.3.5 Unqualified

Not acceptably standardized; evaluee fails to meet minimum standards regarding knowledge of and/or ability to apply NATOPS procedures, one or more significant deviations from NATOPS standards and procedures which could jeopardize mission accomplishment or flight safety.

25.3.6 Area

A routine of preflight, flight, or postflight.

25.3.7 Sub-Area

A performance sub-division within an area, which is observed and evaluated during an evaluation flight

25.3.8 Critical Area/Sub-Area

Any area or sub-area which covers items of significant importance to the overall mission requirements, the marginal performance of which would jeopardize safe conduct of the flight.

25.3.9 Emergency

An aircraft component, system failure, or condition which requires instantaneous recognition, analysis, and proper action.

25.3.10 Malfunction

An aircraft component or system failure or condition which requires recognition and analysis, but which permits more deliberate action than that required for an emergency.

25.4 GROUND EVALUATION

Within 15 days of commencing the flight evaluation, an evaluee must achieve a minimum grade of 3.5 on the open book examination and a grade of 3.3 on closed book examinations on a 4.0 scale. Achieving these minimum grades constitutes an adjective grade of Qualified. Not achieving these minimum grades constitutes an adjective grade of Unqualified.

25.4.1 Open Book Examination

The open book examination shall include, but not be limited to, the open book examination question bank promulgated by the AV-8B NATOPS Model Manager.

25.4.2 Closed Book Examination

The closed book examination shall include, but not be limited to, the immediate action emergency procedures and a selection of aircraft limitations and system questions from the closed book examination question bank promulgated by the AV-8B NATOPS Model Manager.

25.5 FLIGHT EVALUATION

25.5.1 Standards

The flight evaluation shall be conducted in the simulator unless operational requirements and resources preclude simulator availability. In such cases, a flight evaluation shall be conducted on any flight with the exception of flights launched for FCLP/CQ, FAM or FBO training. A NATOPS Instructor shall be a member of the flight. Emergencies shall not be simulated in the aircraft.

The flight evaluation shall be conducted and graded in the areas of mission planning, briefing, normal operating procedures, crew resource management, emergency procedures, and debriefing. The focus is on normal and emergency procedures, not tactical execution. The flight evaluation objectives are:

1. Evaluate adherence to and execution of NATOPS normal and emergency procedures.
2. Evaluate Crew Resource Management skills.
3. Demonstrate takeoff and landing proficiency.

MAGs and squadrons should develop standardized scenarios to promote consistent evaluation. The flight evaluation should be of a tactical nature in order to present realistic decision making opportunities but tactical execution proficiency shall not be specifically evaluated. Scenarios should be tailored to the pilot's experience and flight qualifications.

Concurrently, the flight evaluation shall also be the annual CRM evaluation. However, NATOPS Instructors and Assistant NATOPS Instructors must be qualified Crew Resource Management Facilitators in order to conduct a CRM evaluation.

Note

The number of flights required to complete the flight evaluation should be kept to a minimum; normally one flight. The areas and sub-areas to be observed and graded on a flight evaluation are outlined in the grading criteria with critical areas marked by an asterisk (*). Sub-area grades will be assigned in accordance with the grading criteria. These sub-areas shall be combined to arrive at the overall grade for the flight. Area grades, if desired, shall also be determined in this manner.

25.5.2 Evaluated Areas and Sub-Areas

25.5.2.1 Mission Planning, Briefing, and Debriefing

1. Oral examination shall be conducted to evaluate system knowledge, aircraft limitations, normal and emergency procedures. At a minimum, three questions will be asked.
2. Flight planning shall be IAW Air NTTP 3-22.1-AV8B AV-8B Employment standards.
3. Flight brief shall be IAW the MAWTS-1 AV-8B Mission Planning, Briefing, and Debriefing Guide.
4. Demonstrate knowledge of the contents and function of all components of flight equipment.
5. Flight debrief shall be IAW the MAWTS-1 AV-8B Mission Planning, Briefing, and Debriefing Guide.

25.5.2.2 Ground Procedures

Demonstrate proficiency in the following:

1. Aircraft Discrepancy Book (ADB) review.
2. Engine start procedures and checklist.
3. Before taxiing procedures and checklist.
4. Post landing procedures and checklist.
5. Shut-down procedures and checklist.

25.5.2.3 Takeoff and Departure (*)

Demonstrate proficiency and proper procedures of the following:

1. Pre-positioning procedures and checklist (CWAIVER).
2. Takeoff checklist.
3. A minimum of one STO with aircraft gross weight greater than 30,000 pounds and outside air temperature greater than 30 °C.
4. A minimum of one CTO.
5. A minimum of one VTO.
6. Departure, climb, and level-off flight regimes.
7. 10,000-foot checklist.
8. 18,000-foot checklist.

25.5.2.4 Approach and Landing (*)

Demonstrate proficiency and proper procedures of the following:

1. Descent checklist (SWIFT-A checks).
2. Landing checklist.
3. A minimum of one of each of the following landings with at least one executed SAAHS off:
   a. CL
   b. VNSL
   c. RVL
   d. VL

25.5.2.5 Communications

Demonstrate proficiency and proper procedures of the following:

1. Standard radio communications.
2. Standard visual signals.

25.5.2.6 Emergency Procedures (*)

At a minimum, respond to the number of emergencies specified in each phase of flight. One emergency shall result in the necessity to execute a timely ejection.

1. Ground Emergencies: one.
2. Takeoff Emergencies: two.
3. In-flight Emergencies to a full-stop landing: one.
4. Emergencies during landings: two.

25.5.2.7 Crew Resource Management

Demonstrate proficiency IAW Chapter 24 of this manual.

25.5.2.8 Mission Evaluation

This area includes missions covered in the NATOPS Flight Manual, Tactical Employment, ANTTP 3-22.1-AV8B, NWP, and NWIPs for which standardized procedures/techniques have been employed.

25.5.3 Applicable Publications

The NATOPS Flight Manual contains the standard operations criteria for AV-8B/TAV-8B aircraft. Publications relating to environmental procedures peculiar to shorebased and shipboard operations and tactical missions are the AV-8B NATIP, Tactical Employment, ANTTP 3-22.1-AV8B, NWP, NWIPs, ATC/CATCC Manual, Local Air Operations Manual, Ship Operations Manual, and local range regulations SOPs as long as these publications are not in violation of the NATOPS flight manual.

25.5.4 Flight Evaluation Grading

Only the areas and sub-areas listed in paragraph 25.5.2 shall be graded. Critical areas are marked by an asterisk (*). The grade assigned is determined by assessing the degree of adherence and proficiency to standard operating procedures. Momentary deviations from standard operating procedures should not be considered unqualifying provided such deviations do not jeopardize flight safety and the evaluee applies prompt corrective action. A grade of Unqualified in any critical area and/or sub-area will result in an overall grade of Unqualified for the flight evaluation. Otherwise, flight evaluation grades shall be determined by assigning the numerical grade equivalents to the adjective grade for each sub-area. Only the numerals 0, 2 or 4 shall be assigned. No interpolation is allowed.

Unqualified	0.0
Conditionally qualified	2.0
Qualified	4.0

To determine the numerical grade for each area and the overall grade for the flight, add all the points assigned to the sub-areas and divide this sum by the number of sub-areas graded. The adjective grade shall then be determined on the basis of the following scale.

Unqualified	0.0 to 2.19
Conditionally Qualified	2.2 to 2.99
Qualified	3.0 to 4.0

25.6 FINAL GRADE DETERMINATION

The final NATOPS Evaluation grade shall be the same as the grade assigned to the flight evaluation. An evaluee who receives an Unqualified grade on any ground examination or the flight evaluation shall be placed in an Unqualified status until achieving a grade of Conditionally Qualified or Qualified on a re-evaluation.

25.7 RECORDS AND REPORTS

A NATOPS Evaluation Report (OPNAV From 3710-7) shall be completed for each evaluation and forwarded to the evaluee's commanding officer only. This report shall be filed in the individual NATOPS Flight Personnel Training/Qualification jacket and retained therein permanently.

25.8 CRITIQUE

The critique is the terminal point in the NATOPS evaluation and will be given by the Evaluator/Instructor administering the check. Preparation for the critique involves processing, reconstructing data collected, and oral presentation of the NATOPS Evaluation Report. Deviations from standard operating procedures will be covered in detail using all collected data and worksheets as a guide. Upon completion of the critique, the pilot will receive the completed copy of the NATOPS Evaluation Report for certification and signature. The completed NATOPS Evaluation Report will then be presented to the Unit Commanding Officer.

NATOPS EVALUATION QUESTION BANK

NAME: ____

DATE: ____

1. The red flashing light in the gear handle indicates? ____

2. The red steady light in the gear handle indicates? ____

3. The BINGO profile is based on a fuel reserve of ____

4. The max range profile is based on a fuel reserve of ____

5. Fuel may be dumped to a level of ________________________ lbs. (total fuselage fuel).

6. All landing gear are mechanically locked in the down position.

   a. True

   b. False

7. All landing gear are mechanically locked in the up position.

   a. True

   b. False

8. The DECS provides engine control throughout the engine operating range in response to

   a. _________________________ , b. _________________________ , c. _________________________ ,
   d. _________________________ , e. _________________________ , f. _________________________

9. With the MFS activated, the engine is cleared for operation in all flight regimes.

   a. True

   b. False

10. As the nozzles pass approximately ____ ° down from full aft, a microswitch changes the JPT limiter from max thrust to short lift.

11. In the LDG mode of water augmentation:

	–406 engine	–408 engine
a. water flows when below	________ knots	________knots
b. with JPT above	________°C	________°C
c. and throttle above	________ percent rpm	________ percent rpm

12. The JPTL limits are:

	–406 engine	–408 engine
a. Short lift wet	__________________ °C	__________________°C
b. Short lift dry	__________________ °C	__________________ °C
c. Combat	______________________ °C	__________________ °C

d. Max thrust ____________________°C ___________________ °C

e. Gear up, nozzles aft ______________ percent rpm ___________________ percent rpm

13. The 15 SEC light comes on at:

–406 engine ___________________ °C dry or ___________________ °C wet.

–408 engine ___________________ °C dry or ___________________ °C wet.

14. The left fuel feed group consists of which tanks?____
____
____
____

15. The right fuel feed group consists of which tanks?____
____
____
____

16. The fuel low level lights illuminate steady at ______ ± ______ lbs and flash at ______ ± ______ lbs of fuel remaining.

17. The fuel low level indicating system is completely independent of the fuel quantity indicating system.

a. True

b. False

18. During a generator failure the generator should be cycled to off, then on.

a. True

b. False

19. The battery is normally charged by the STBY TRU.

a. True

b. False

20. The HYD 2 loads are: a. ____________________________ , b. ____________________________ ,

c. ____________________________ , and a backup for d. ____________________________ .

21. STOL flap selection provides _____________ ° of flaps if airspeed is over _____________ knots.

22. AUTO flap selection provides ___________________ ° of flaps with gear down.

23. Aileron droop occurs when _____________________ selected, with airspeed below _________________ KCAS and nozzles greater than _____________________ °.

24. Both the AFC and SAS are operational throughout the entire flight envelope.

a. True

b. False

25. What are the recommended controlled ejection conditions?______________________________________
____
____
____

26. What are the procedures for ground egress? ____
____
____
____

27. The emergency jettison and selective jettison are inoperative unless weight is off the wheels.

    a. True

    b. False

28. Below 0.45 Mach, the maneuvering tone will initially be heard when AOA exceeds __________ °.

29. Water injection is prohibited below ambient temperatures of _____________ °C (-406 engine) or _____________ °C (-408 engine).

30. Maximum continuous rpm is:

    -406 engine _______________ percent, and JPT is _______________ °C.

    -408 engine _______________ percent, and JPT is _______________ °C.

31. The optimum airstart envelope is:

    -406 engine _______________ to _______________ KCAS.

    -408 engine _______________ to _______________ KCAS.

32. Maximum altitude for starting the APU is:

    With seals _________________ feet.

    Radar aircraft _______________ feet.

33. Maximum airspeed for gear down and locked is _____________________ KCAS.

34. IGV limits for a standard day at 55percent rpm for the -406 engine are ________ ° to ________ ° and at 60percent rpm for the -408 engine are _________ ° to _________ °.

35. What are the crosswind limits for approach speeds greater than 140 knots? Less than 140 knots?
____
____
____

36. Vertical landing capability is based on a hover ______________ °C below the JPTL limiter, to account of re-ingestion.

37. After initiating a penetration descent at 65 percent, the rpm will decrease approximately 1 percent per 1,000 feet of altitude loss.

    a. True

    b. False

38. Approximately what duct pressure should you read at 55 percent rpm with the -406 engine? _________ psi, and at 60 percent rpm with the -408 engine? ________ psi.

39. If a dual DECU failure occurs with the engine at a steady rpm, the rpm may _____________________
____
____
____

40. Give three indications of sideslip buildup:

 a. ____

 b. ____

 c. ____

41. While in MFS, moving the throttle from the idle stop to the mid-throttle position in less than ____________________ or moving the throttle without appropriate engine response greatly increases the risk of ____________________ .

42. The ______________________ are provided to a stepper motor which in turn operates a ____________________ to properly meter fuel for a desired engine response.

43. What actions can cause fuel system datum cut-back?

____

____

____

44. What does the action of arming the water injection switch result in?

____

____

____

45. Selecting water to LDG with the rpm at 88 percent, what indications will you have of DECU datum shift?

____

____

____

46. To avoid overheating the GTS starter motor, not more than ____________________ GTS/APU starting cycles may be made in any ________________ minute period.

47. If the water tank empties during "wet" lift, the JPTL automatically resets to dry datum with a resultant loss of thrust.

 a. True

 b. False

48. What is the minimum precharge pressure for the brake accumulator? ______________.

49. The MFS solenoid changeover valve must have ______________________ and ______________________ to successfully select MFS.

50. The maximum AOA which should not be exceeded above 50 knots with landing gear down is? ____________.

51. What are the limitations associated with in-flight nozzle vectoring?

____

____

____

52. What are the acceleration limits (LBA)? ______________________________

 a. Symmetrical ______________________________________

 b. Asymmetrical ______________________________________

53. Maximum recommended altitude for engine airstart is:

-406 engine DECS ________________ MFS ____

-408 engine DECS ________________ MFS ____

54. The optimum configuration for max range descent is ____________ KCAS, ____________ flap.

55. What four immediate actions should you take if the aircraft starts an uncontrolled roll?

a. ____

b. ____

c. ____

d. ____

56. What is the spin recovery procedure?____
____
____
____

57. The _______________________________________ is located on the left console below the landing gear position indicators. The battery is a ___________________________ for the extension of the landing gear when electrical power is lost.

58. A vertical landing is recommended if any landing gear malfunction is suspected.

a. True

b. False

59. What action should be taken if an over-rotation occurs? ____
____
____
____

60. A maximum performance STO is performed at ___________________________ degrees pitch attitude.

61. Three legs of the power hexagon indicate a JPT of:

-406 engine _________________ °C or rpm of _________________ percent.

-408 engine _________________ °C or rpm of _________________ percent.

62. State the proper technique to decel down a line feature with a crosswind.
____
____
____

63. State the configuration and technique for an optimum climb to cruise altitude.
____
____
____

64. Vertical landing weight is based on _____________________ percent of hover capability.

65. State the abort procedures for a CTO or STO. ____
____
____
____

66. State the procedures for a sudden rpm loss/engine failure to accelerate during V/STOL flight.
____
____
____
____

67. State the procedures, speed, and rpm for thunderstorm penetration.
____
____
____

68. State the rpm limits for the following:

	–406 engine	–408 engine
a. Short lift wet	____________________ percent	____________________ percent
b. Short lift dry	____________________ percent	____________________ percent
c. Max thrust	____________________ percent	____________________ percent
d. Combat thrust	____________________ percent	____________________ percent
e. Idle	____________________ percent	____________________ percent

69. Max airspeed for selection of STOL flaps is ______________________ KCAS.

70. When executing the landing checklist, ensure _______________________ of nozzles or greater before selecting STOL flaps.

71. The landing gear emergency battery must be activated with the landing gear handle in the EMER position.

a. True

b. False

PART XI

Performance Data

Refer to NATOPS Flight Manual Performance Charts A1-AV8BB-NFM-400.

INDEX

B

C

H

I

J

K

L

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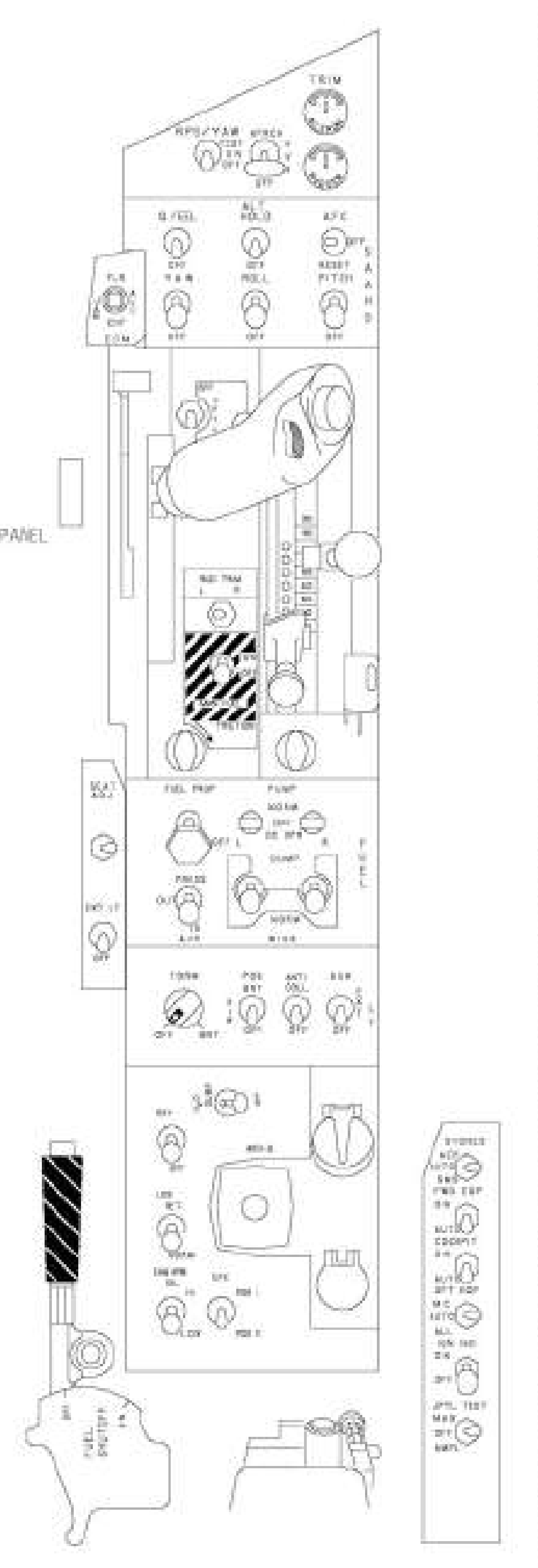
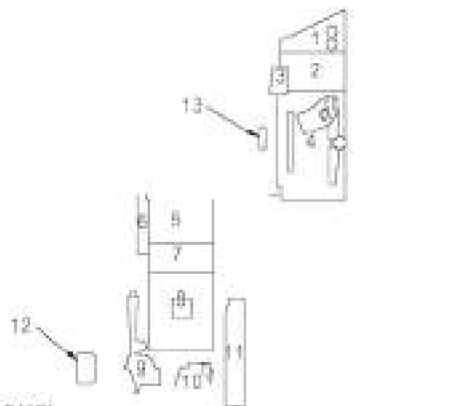
O

T

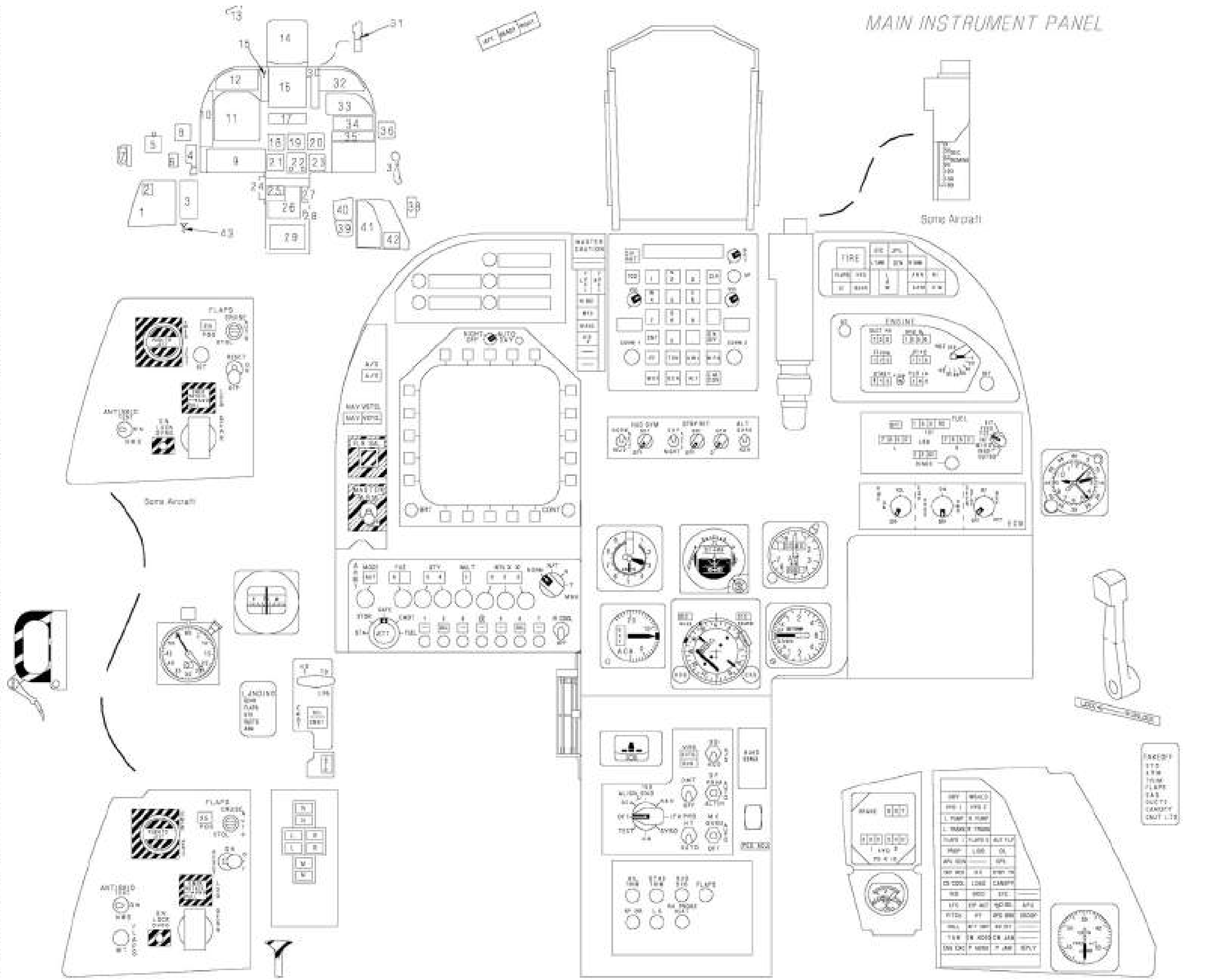
Z

LEFT CONSOLE

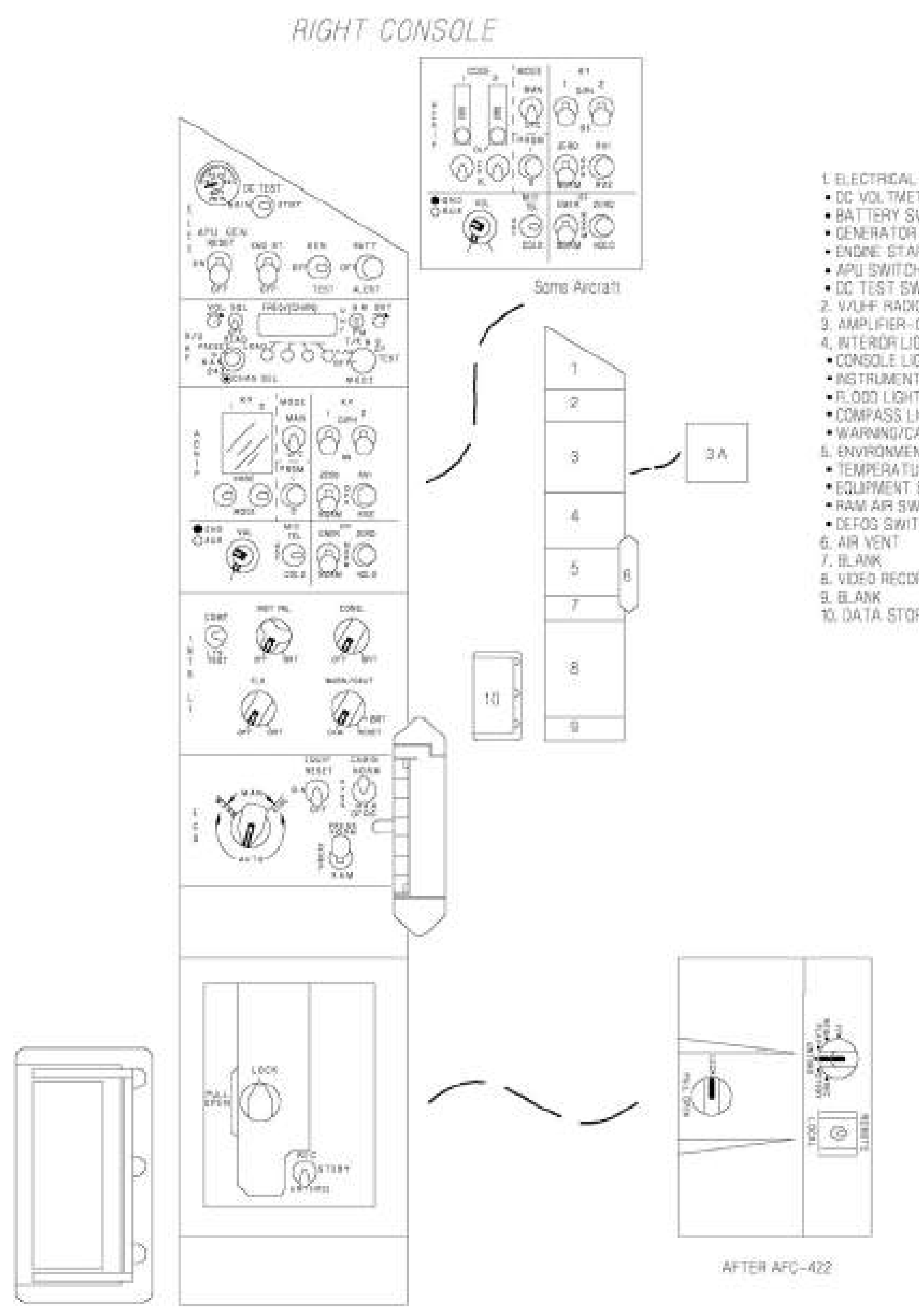
1. TRIM PANEL
 - RUDDER TRIM INDICATOR
 - AILERON TRIM INDICATOR
 - LANDING LIGHT SWITCH
 - RUDDER PEDAL SHAKER (RPS) SWITCH
2. STABILITY AUGMENTATION ATTITUDE HOLD SYSTEM (SAAHS) PANEL
 - ALTITUDE HOLD SWITCH
 - STAB AUG SWITCHES
 - Q FEEL SWITCH
 - AFC SWITCH
3. ECM DISPENSE PANEL
4. THROTTLE QUADRANT
 - ENGINE TEMPERATURE/PRESSURE RATIO LIMITERS SWITCH
 - STO STOP
 - HOVER/VTO STOP
 - NOZZLE CONTROL
 - THROTTLE
 - SPEED BRAKE SWITCH
 - EMERGENCY FLAP RETRACT BUTTON
 - SLEW CONTROL/DESIGNATOR
 - AIRSTART BUTTON
 - CAGE/UNCAGE BUTTON
 - COMMUNICATION SWITCH
 - RUDDER TRIM AND MANUAL FUEL SWITCHES
 - FRICTION CONTROL
 - PARKING BRAKE HANDLE
5. FUEL PANEL
 - FLOW PROPORTIONER
 - L AND R FUEL PUMP SWITCH
 - L AND R WING FUEL DUMP SWITCH
 - AIR REFUELING (A/R) SWITCH
6. SEAT ADJUST AND EXTERIOR LIGHTS MASTER SWITCH
7. EXTERNAL LIGHTS PANEL
 - FORMATION LIGHTS KNOB
 - POSITION LIGHTS SWITCH
 - ANTI-COLLISION LIGHTS SWITCH
 - AUXILIARY LANDING LIGHT SWITCH
8. PILOT SERVICES PANEL
 - ANTI-G SUIT DISCONNECT
 - OXYGEN DISCONNECT
 - ANTI-G VALVE
 - WATER DUMP SWITCH
 - OXYGEN SWITCH
 - LIDS SWITCH
 - ENGINE RPM SELECT SWITCH
 - ENGINE FUEL CONTROL SWITCH (Some Aircraft)
9. LOW PRESSURE FUEL SHUTOFF HANDLE
10. OXYGEN MONITOR
 - BIT BUTTON
11. GROUND POWER PANEL
12. DECS ENABLE SWITCH (Some Aircraft)
13. MFS EMERGENCY BATTERY

MAIN INSTRUMENT PANEL



1. LANDING GEAR/FLAPS CONTROL PANEL
 - LANDING GEAR HANDLE
 - ANTISKID SWITCH
 - FLAP MODE SELECT SWITCH
 - FLAP POSITION INDICATOR
 - FLAP POWER SWITCH
2. EMERGENCY JETTISON SWITCH
3. LANDING GEAR POSITION INDICATORS
4. COMBAT/WATER PANEL
5. STOP WATCH (GFE)
6. LANDING CHECKLIST
7. INTERNAL EMERGENCY CANOPY SHATTERING HANDLE
8. STANDBY MAGNETIC COMPASS
9. ARMAMENT CONTROL PANEL
10. MASTER ARMAMENT PANEL
 - A/G MODE SWITCH
 - NAV MODE SWITCH
 - VSTOL MODE SWITCH
 - FLR SAL SWITCH
 - MASTER ARM SWITCH
11. DIGITAL DISPLAY INDICATOR (DDI)
12. OPTION DISPLAY UNIT
13. REFUEL LIGHTS
14. HEAD-UP DISPLAY (HUD)
15. PRIORITY CAUTION LIGHT
16. UPFRONT CONTROL
17. HUD CONTROL PANEL
18. STANDBY AIRSPEED INDICATOR
19. STANDBY ATTITUDE INDICATOR
20. STANDBY ALTIMETER
21. STANDBY ANGLE-OF-ATTACK INDICATOR
22. HORIZONTAL SITUATION INDICATOR
23. STANDBY VERTICAL VELOCITY INDICATOR
24. AIR VENT
25. TURN AND SLIP INDICATOR
26. MISCELLANEOUS SWITCH PANEL
 - VIDEO RECORDER LIGHTS/SWITCH
 - VRS DISPLAY SELECT SWITCH
 - DISPLAY PROCESSOR SWITCH
 - DUAL MODE TRACKER SWITCH
 - MISSION COMPUTER SWITCH
 - PROBE HEAT SWITCH
 - INS MODE SELECTOR KNOB
27. BUREAU NUMBER
28. RUDDER PEDAL ADJUST CONTROL
29. CIRCUIT BREAKER PANEL
30. HUD VIDEO CAMERA
31. MOTION PICTURE CAMERA
32. WARNING/THREAT LIGHTS (latest configuration)
33. ENGINE PERFORMANCE INDICATOR
 - BIT SWITCH
 - DUCT PRESSURE
 - TACHOMETER
 - JET PIPE TEMPERATURE
 - NOZZLE POSITION
 - DISPLAY BRIGHTNESS CONTROL
 - WATER QUANTITY
 - WATER FLOW LIGHT
 - STABILATOR POSITION
 - FUEL FLOW
34. FUEL QUANTITY INDICATOR
 - FUEL QUANTITY INDICATIONS
 - BINGO FUEL SET
 - INDICATION SELECT SWITCH
 - ON/OFF INDICATOR
35. ECM CONTROL PANEL
36. CLOCK
37. CANOPY UNLOCK HANDLE
38. TAKEOFF CHECKLIST
39. BRAKE ACCUMULATOR PRESSURE INDICATOR
40. HYDRAULIC PRESSURE INDICATORS
 - BRAKE PRESSURE
 - HYDRAULIC PRESSURE SYSTEM NO. 1 AND NO. 2
41. CAUTION/ADVISORY LIGHT PANEL (latest configuration)
42. COCKPIT ALTIMETER
43. LDG GEAR EMERGENCY BATTERY

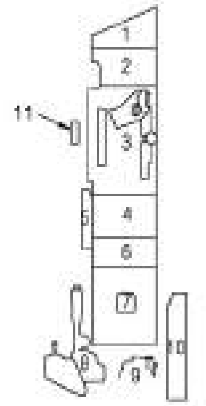
RIGHT CONSOLE

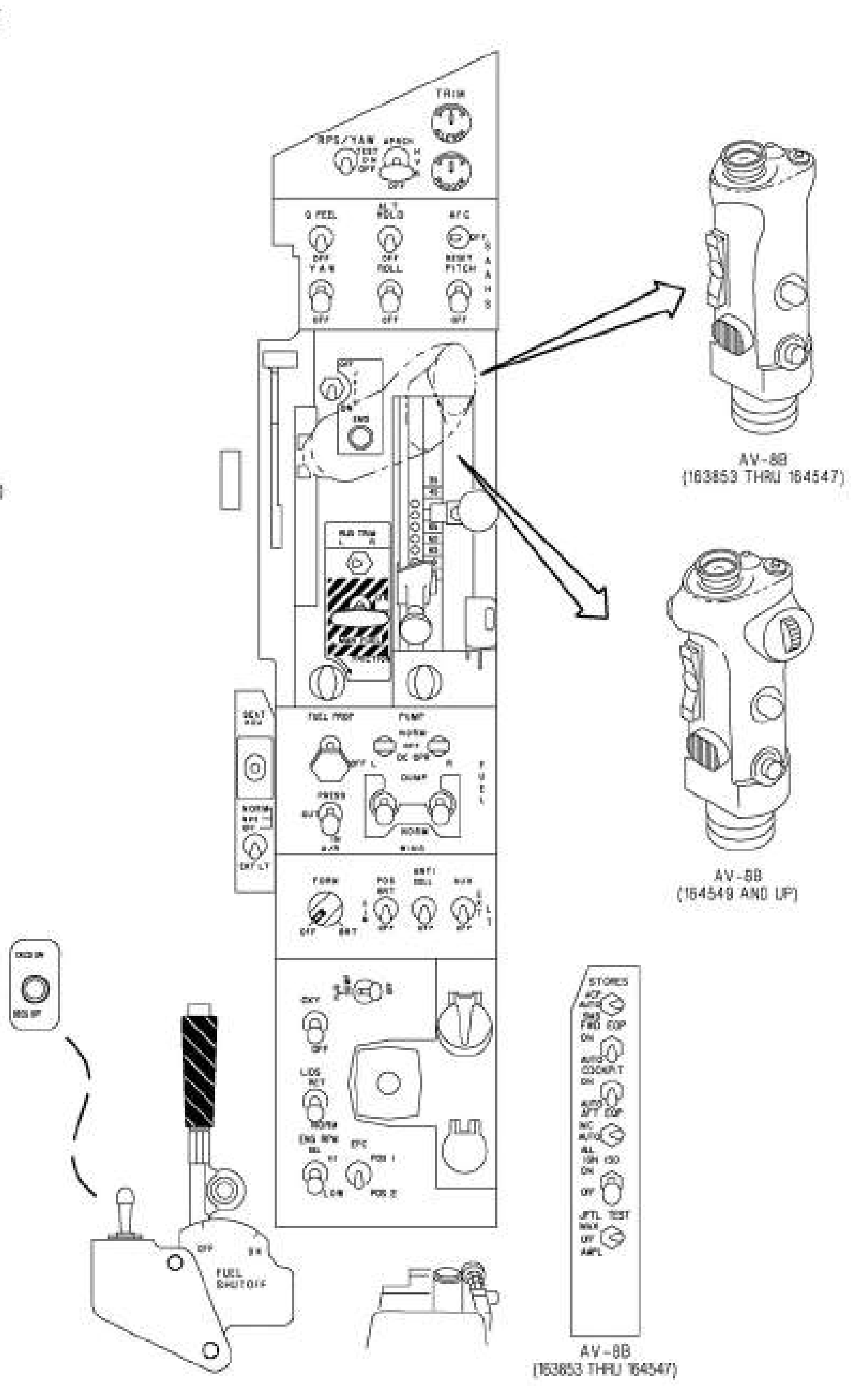


1. ELECTRICAL PANEL
 - DC VOLTMETER
 - BATTERY SWITCH
 - GENERATOR SWITCH
 - ENGINE START SWITCH
 - APU SWITCH
 - DC TEST SWITCH
2. V/UHF RADIO SET CONTROL (RSC)
3. AMPLIFIER-CONTROL (ACNIP)
4. INTERIOR LIGHTS CONTROL PANEL
 - CONSOLE LIGHTS KNOB
 - INSTRUMENT LIGHTS KNOB
 - FLOOD LIGHTS KNOB
 - COMPASS LIGHT/LIGHTS TEST SWITCH
 - WARNING/CAUTION LIGHTS KNOB
5. ENVIRONMENTAL CONTROL PANEL
 - TEMPERATURE CONTROLLER
 - EQUIPMENT BAY COOL SWITCH
 - RAM AIR SWITCH
 - DEFOG SWITCH
6. AIR VENT
7. BLANK
8. VIDEO RECORDER
9. BLANK
10. DATA STORAGE SET (DSS) RECEPTACLE

Cockpit, AV-8B 161573 Thru 163852

LEFT CONSOLE





1. TRIM PANEL
   - RUDDER TRIM INDICATOR
   - AILERON TRIM INDICATOR
   - LANDING LIGHT SWITCH
   - RUDDER PEDAL SHAKER (RPS) SWITCH
2. STABILITY AUGMENTATION ATTITUDE HOLD SYSTEM (SAAHS)
   - ALTITUDE HOLD SWITCH
   - STAB AUG SWITCHES
   - Q FEEL SWITCH
   - AFC SWITCH
3. THROTTLE QUADRANT
   - ENGINE TEMPERATURE/PRESSURE RATIO LIMITERS SWITCH
   - STO STOP
   - NOZZLE CONTROL
   - THROTTLE
   - SPEED BRAKE SWITCH
   - EMERGENCY FLAP RETRACT BUTTON
   - SLEW CONTROL/DESIGNATOR
   - AIRSTART BUTTON
   - CAGE/UNCAGE BUTTON
   - COMMUNICATION SWITCH
   - RUDDER TRIM AND MANUAL FUEL SWITCHES
   - FRICTION CONTROL
   - BRAKE LOCK LEVER
   - ECM DISPENSE SWITCH
   - A/A RADAR SWITCH (AV-8B 164549 AND UP)
   - ANTENNA ELEVATION SWITCH (AV-8B 164549 AND UP)
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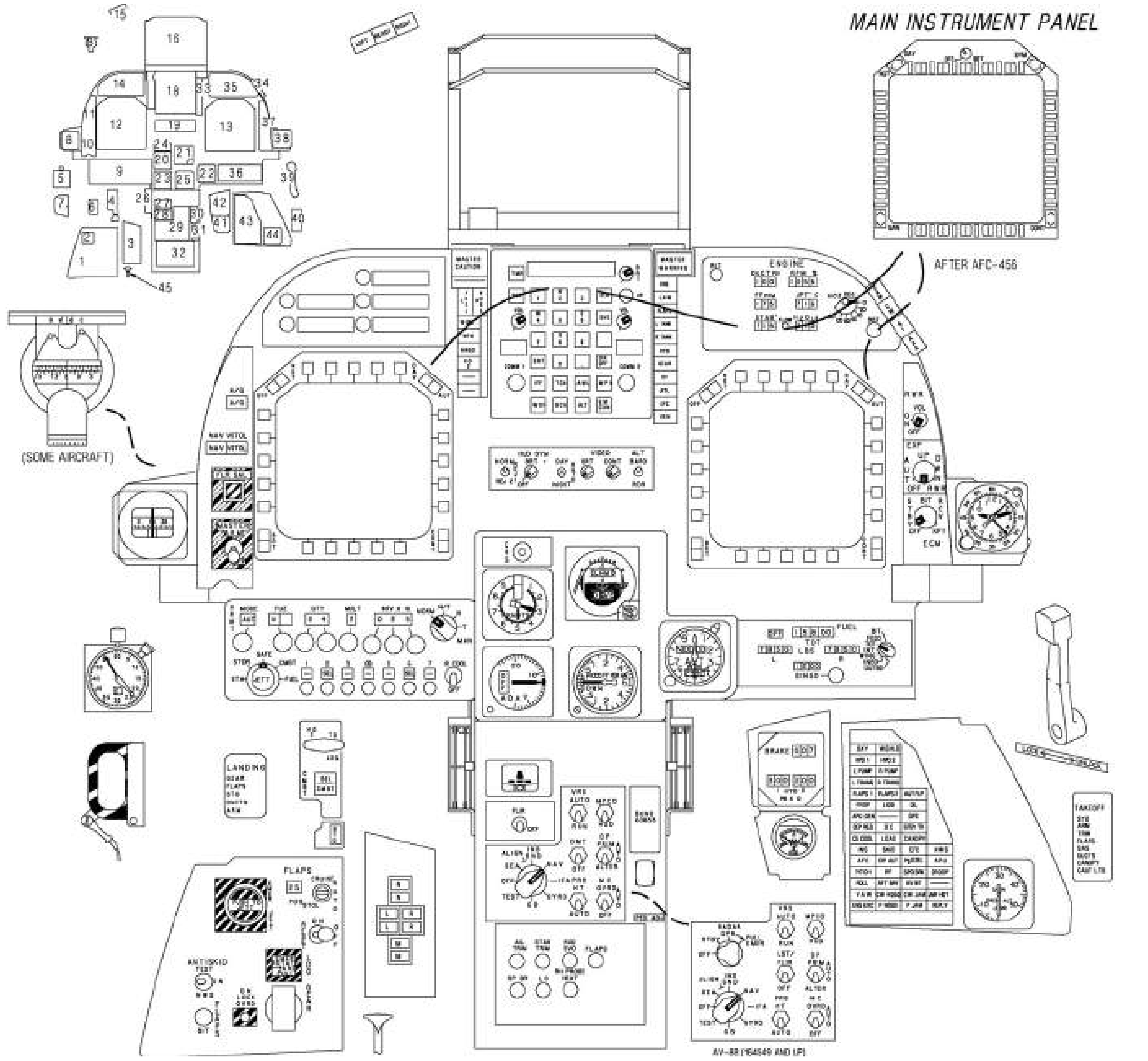
   - L AND R FUEL PUMP SWITCH
   - L AND R WING FUEL DUMP SWITCH
   - AIR REFUELING (A/R) SWITCH
5. SEAT ADJUST AND EXTERIOR LIGHTS MASTER SWITCH
6. EXTERNAL LIGHTS PANEL
   - FORMATION LIGHTS KNOB
   - POSITION LIGHTS SWITCH
   - ANTI-COLLISION LIGHTS SWITCH
   - AUXILIARY LANDING LIGHT SWITCH
7. PILOT SERVICES PANEL
   - ANTI-G SUIT DISCONNECT
   - OXYGEN/COMMUNICATION DISCONNECT
   - ANTI-G VALVE
   - WATER DUMP SWITCH
   - OXYGEN SWITCH
   - LIDS SWITCH
   - ENGINE RPM SELECT SWITCH
   - ENGINE FUEL CONTROL SWITCH
8. FUEL SHUTOFF HANDLE
   - DECS ENABLE SWITCH
9. OXYGEN MONITOR
   - BIT BUTTON
10. GROUND POWER PANEL (AV8B 163853 THRU 164547)
11. MFS EMERGENCY BATTERY

MAIN INSTRUMENT PANEL



1. LANDING GEAR/FLAPS CONTROL PANEL
   - LANDING GEAR HANDLE
   - ANTI SKID SWITCH
   - FLAP MODE SELECT SWITCH
   - FLAP POSITION INDICATOR
   - FLAP POWER SWITCH
2. EMERGENCY JETTISON SWITCH
3. LANDING GEAR POSITION INDICATORS
4. COMBAT/WATER PANEL
5. STOP WATCH (GFE)
6. LANDING CHECKLIST
7. INTERNAL EMERGENCY CANOPY SHATTERING HANDLE
8. STANDBY MAGNETIC COMPASS
9. ARMAMENT CONTROL PANEL
10. MASTER ARMAMENT PANEL
11. MODE SWITCHES
    - NAVIGATION
    - AIR/GROUND
    - V/STOL
12. LEFT MULTIPURPOSE COLOR DISPLAY (MPCD)
13. RIGHT MULTIPURPOSE COLOR DISPLAY (MPCD)
14. OPTION DISPLAY UNIT
15. REFUEL LIGHTS
16. HEAD-UP DISPLAY (HUD)
17. PRIORITY CAUTION LIGHT
18. UPFRONT CONTROL
19. HUD CONTROL PANEL
20. STANDBY AIRSPEED INDICATOR
21. STANDBY ATTITUDE INDICATOR
22. STANDBY ALTIMETER
23. STANDBY ANGLE-OF-ATTACK INDICATOR
24. COURSE (CRS) CONTROL SWITCH PANEL
25. STANDBY VERTICAL VELOCITY INDICATOR
26. AIR VENT
27. TURN AND SLIP INDICATOR
28. FLIR POWER PANEL (AV-8B 163853 THRU 164547)
29. MISCELLANEOUS SWITCH PANEL
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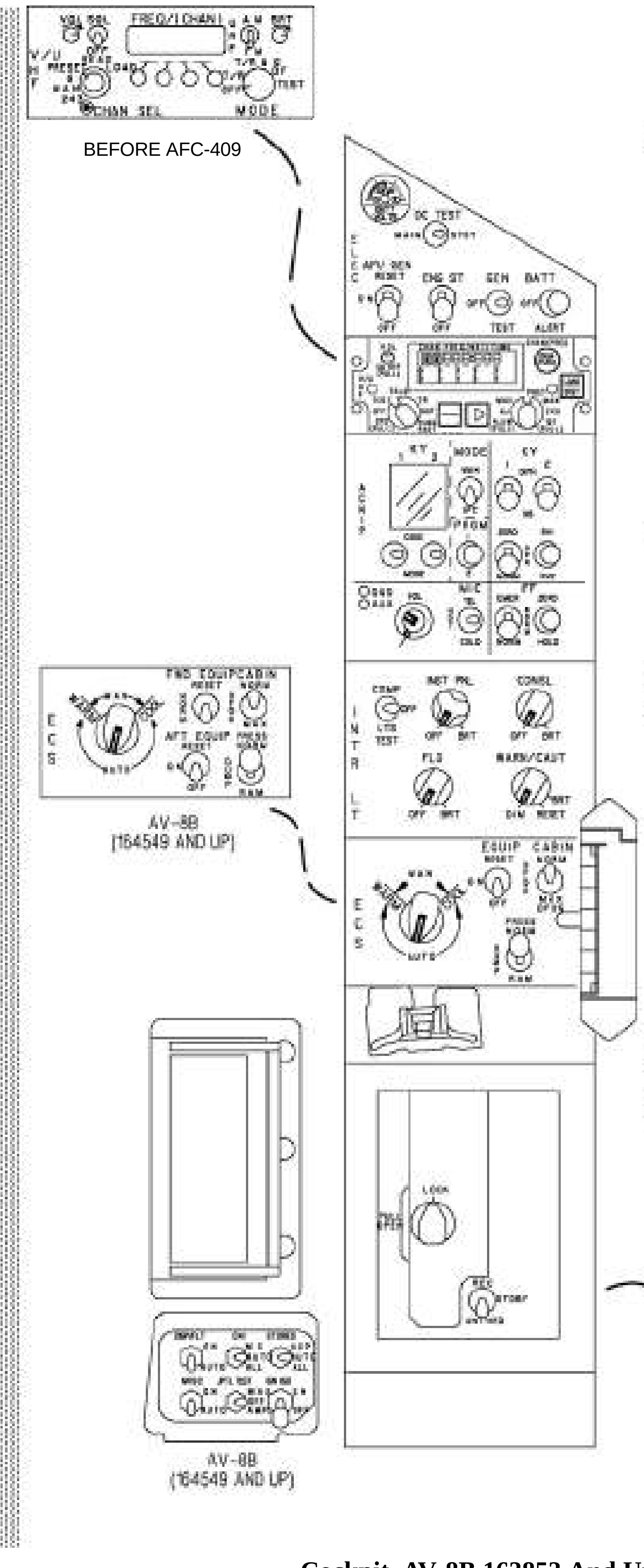
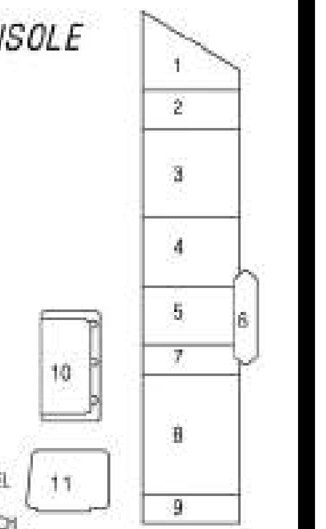
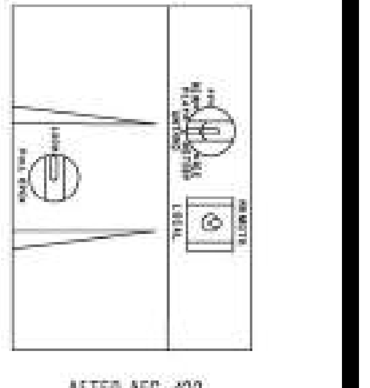
    - VRS DISPLAY SELECT SWITCH
    - DISPLAY PROCESSOR SWITCH
    - PROBE HEAT SWITCH
    - LST/FLIR SWITCH (164549 AND UP)
    - MISSION COMPUTER SWITCH
    - DUAL MODE TRACKER SWITCH (AV-8B 163853 THRU 164547)
    - INS MODE SELECTOR KNOB
    - RADAR SWITCH (AV-8B 164549 AND UP)
30. BUREAU NUMBER
31. RUDDER PEDAL ADJUST CONTROL
32. CIRCUIT BREAKER PANEL
33. WARNING LIGHTS PANEL
34. THREAT LIGHTS
35. ENGINE DISPLAY PANEL
    - STABILATOR POSITION
    - NOZZLE POSITION
    - TACHOMETER
    - JET PIPE TEMPERATURE
    - FUEL FLOW
    - BIT SWITCH
    - DUCT PRESSURE
    - WATER QUANTITY
    - WATER FLOW LIGHT
36. FUEL QUANTITY INDICATOR
    - FUEL QUANTITY INDICATIONS
    - BINGO FUEL SET
    - INDICATION SELECT SWITCH
    - ON OFF INDICATOR
37. ECM CONTROL PANEL
38. CLOCK
39. CANOPY UNLOCK HANDLE
40. TAKEOFF CHECK LIST
41. BRAKE ACCUMULATOR PRESSURE INDICATOR
42. HYDRAULIC PRESSURE INDICATORS
    - BRAKE PRESSURE
    - HYDRAULIC PRESSURE SYSTEM NO. 1 AND NO. 2
43. CAUTION/ADVISORY LIGHT PANEL
44. COCKPIT ALTIMETER
45. LDG GEAR EMERGENCY BATTERY

RIGHT CONSOLE





1. ELECTRICAL PANEL
   - DC VOLTMETER
   - BATTERY SWITCH
   - GENERATOR SWITCH
   - ENGINE START SWITCH
   - APU SWITCH
   - DC TEST SWITCH
2. V/UHF RADIO SET CONTROL (RCS)
3. AMPLIFIER-CONTROL (ACNIP)
4. INTERIOR LIGHTS CONTROL PANEL
   - CONSOLE LIGHTS KNOB
   - INSTRUMENT LIGHTS KNOB
   - FLOOD LIGHTS KNOB
   - COMPASS LIGHT/LIGHTS TEST SWITCH
   - WARNING/CAUTION LIGHTS KNOB
5. ENVIRONMENTAL CONTROL PANEL
   - TEMPERATURE CONTROLLER
   - EQUIPMENT BAY COOL SWITCH (AV-8B 163853 THRU 164547)
   - RAM AIR SWITCH
   - DEFOG SWITCH
   - FWD EQUIPMENT COOL SWITCH (AV-8B 164549 AND UP)
   - AFT EQUIPMENT COOL SWITCH (AV-8B 164549 AND UP)
6. AIR VENT
7. NVG STOWAGE
8. VIDEO RECORDER
9. BLANK
10. DATA STORAGE SET (DSS) RECEPTACLE
11. GROUND POWER PANEL (AV8B 164549 AND UP)



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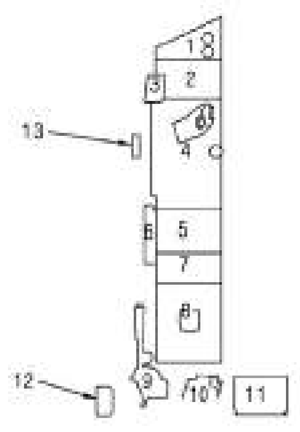
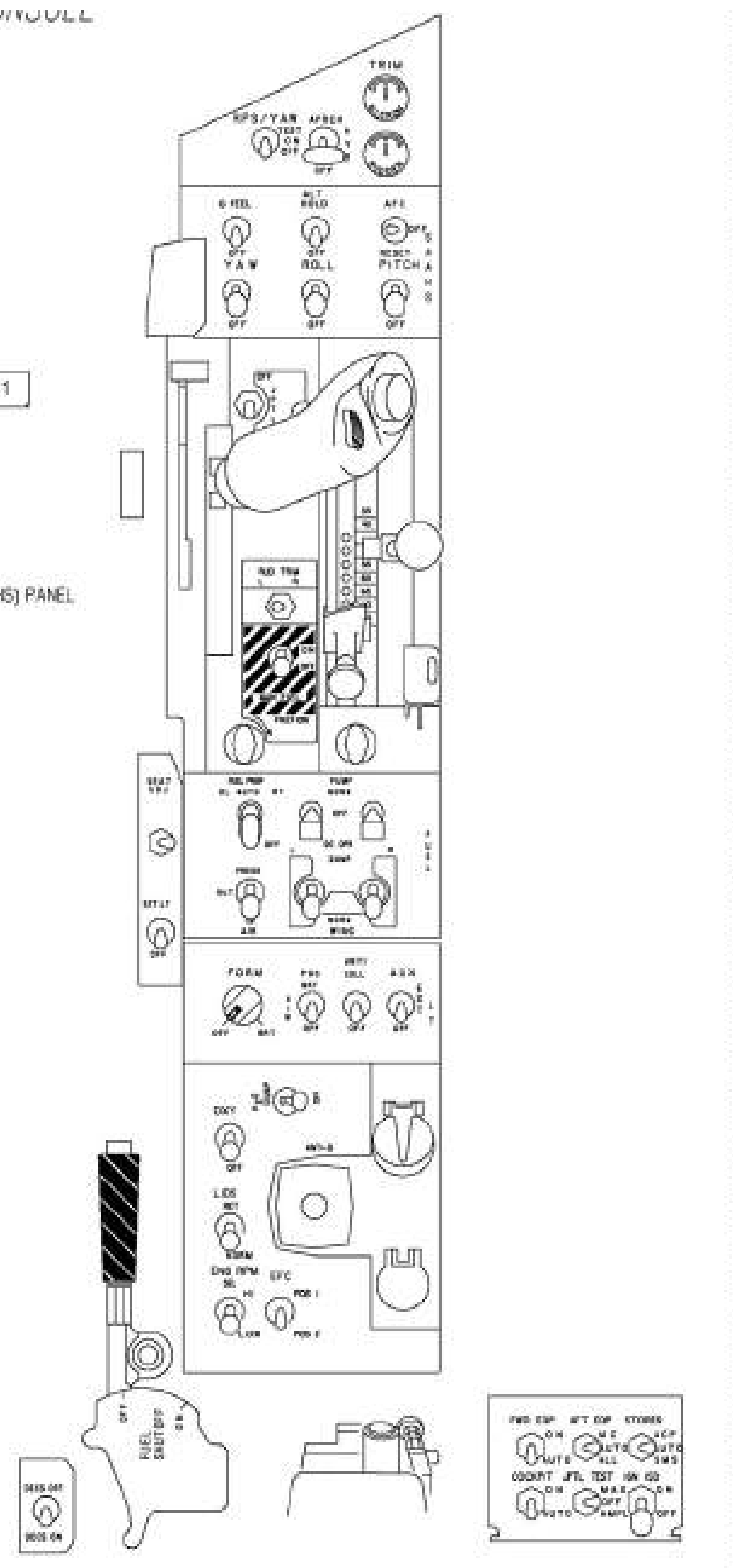
Cockpit, AV-8B 163853 And Up

FO-2 (Reverse Blank)

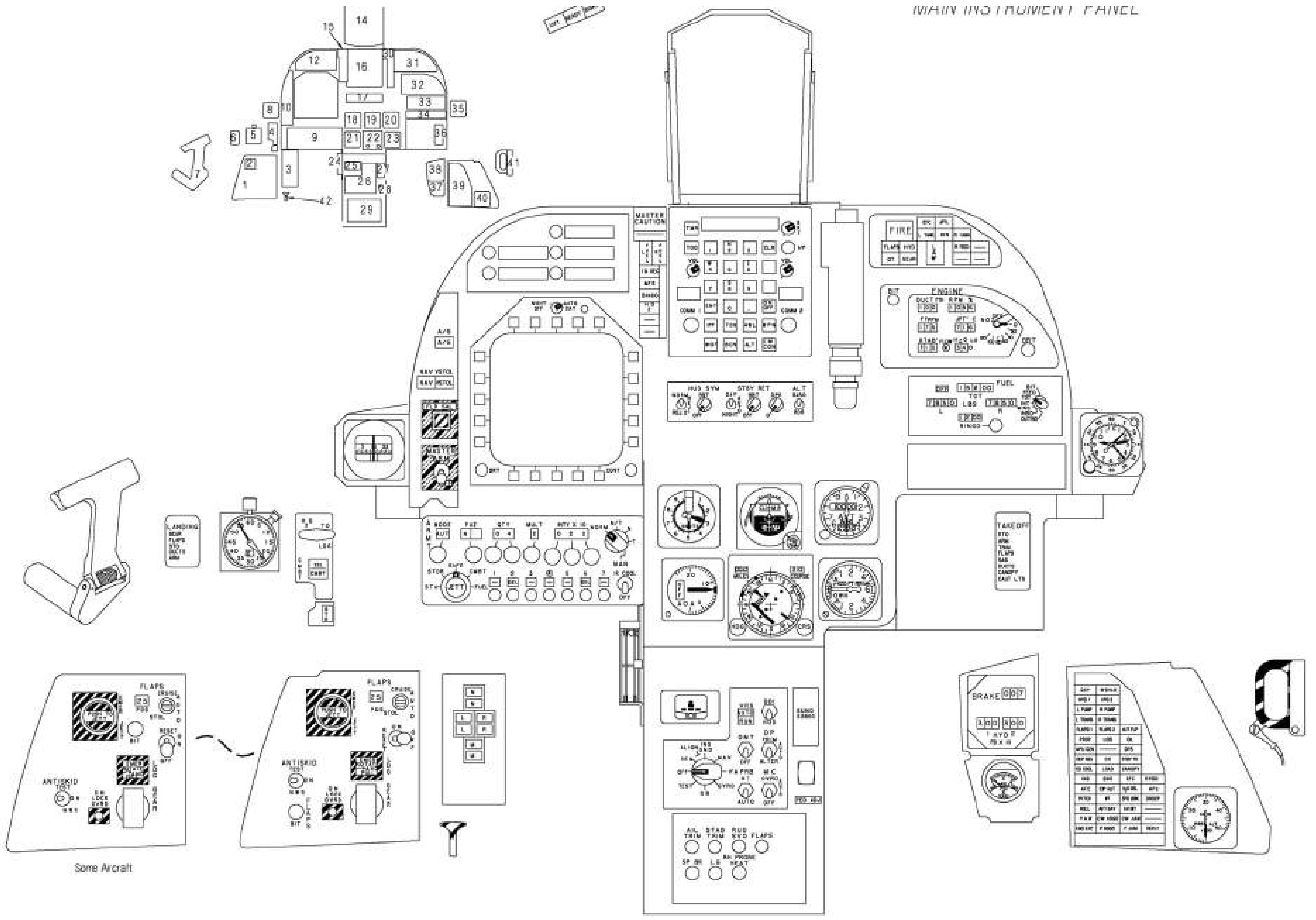
LEFT CONSOLE





1. TRIM PANEL
   - RUDDER TRIM INDICATOR
   - AILERON TRIM INDICATOR
   - LANDING LIGHT SWITCH
   - RUDDER PEDAL SHAKER (RPS) SWITCH
2. STABILITY AUGMENTATION ATTITUDE HOLD SYSTEM (SAAHS) PANEL
   - ALTITUDE HOLD SWITCH
   - STAB AUG SWITCHES
   - Q FEEL SWITCH
   - AFC SWITCH
3. BLANK
4. THROTTLE QUADRANT
   - ENGINE TEMPERATURE/PRESSURE RATIO LIMITERS SWITCH
   - STO STOP
   - HOVER/VTO STOP
   - NOZZLE CONTROL
   - THROTTLE
   - SPEED BRAKE SWITCH
   - EMERGENCY FLAP RETRACT BUTTON
   - SLEW CONTROL/DESIGNATOR
   - AIRSTART BUTTON
   - CAGE/UNCAGE BUTTON
   - COMMUNICATION SWITCH
   - RUDDER TRIM AND MANUAL FUEL SWITCHES
   - FRICTION CONTROL
   - PARKING BRAKE HANDLE
5. FUEL PANEL
   - FLOW PROPORTIONER
   - L AND R FUEL PUMP SWITCH
   - L AND R WING FUEL DUMP SWITCH
   - AIR REFUELING (A/R) SWITCH
6. SEAT ADJUST AND EXTERIOR LIGHTS MASTER SWITCH
7. EXTERNAL LIGHTS PANEL
   - FORMATION LIGHTS KNOB
   - POSITION LIGHTS SWITCH
   - ANTI-COLLISION LIGHTS SWITCH
   - AUXILIARY LANDING LIGHT SWITCH
8. PILOT SERVICES PANEL
   - ANTI-G SUIT DISCONNECT
   - OXYGEN DISCONNECT
   - ANTI-G VALVE
   - WATER DUMP SWITCH
   - OXYGEN SWITCH
   - LIDS SWITCH
   - ENGINE RPM SELECT SWITCH
   - ENGINE FUEL CONTROL SWITCH (Some Aircraft)
9. LOW PRESSURE FUEL SHUTOFF HANDLE
10. OXYGEN MONITOR
    - BIT BUTTON
11. GROUND POWER PANEL
12. DECS ENABLE SWITCH (Some Aircraft)
13. MFS EMERGENCY BATTERY

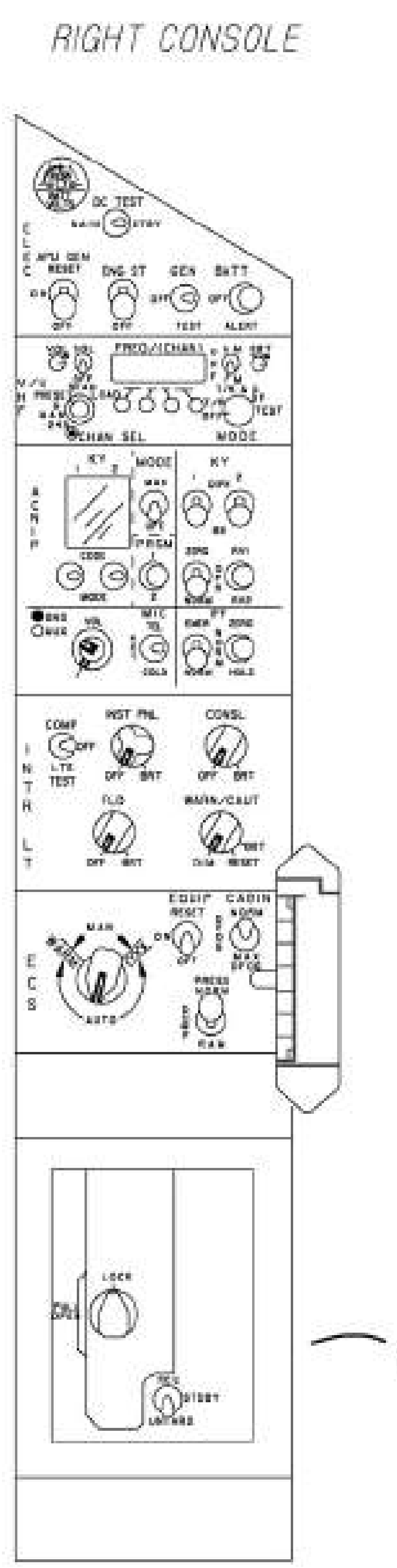
MAIN INSTRUMENT PANEL

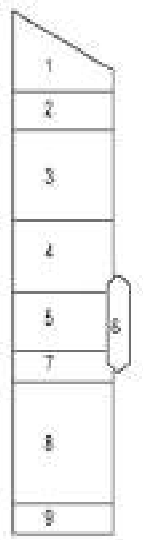


Some Aircraft

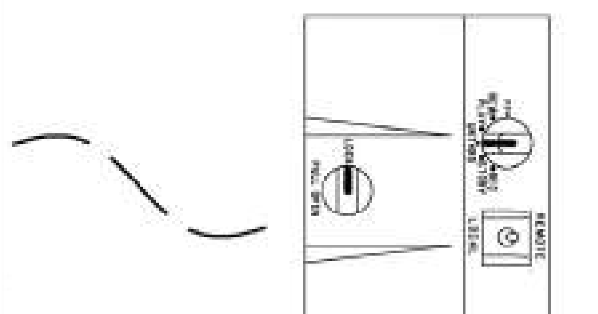
1. LANDING GEAR/FLAPS CONTROL PANEL
   - LANDING GEAR HANDLE
   - ANTISKID SWITCH
   - FLAP MODE SELECT SWITCH
   - FLAP POSITION INDICATOR
   - FLAP POWER SWITCH
2. EMERGENCY JETTISON SWITCH
3. LANDING GEAR POSITION INDICATORS
4. COMBAT/WATER PANEL
5. STOP WATCH (GFE)
6. LANDING CHECKLIST
7. INTERNAL CANOPY LOCK HANDLE
8. STANDBY MAGNETIC COMPASS
9. ARMAMENT CONTROL PANEL
10. MASTER ARMAMENT PANEL
    - A/G MODE SWITCH
    - NAV MODE SWITCH
    - VSTOL MODE SWITCH
    - FLIR SAL SWITCH
    - MASTER ARM SWITCH
11. DIGITAL DISPLAY INDICATOR (DDI)
12. OPTION DISPLAY UNIT
13. REFUEL LIGHTS
14. HEAD-UP DISPLAY (HUD)
15. PRIORITY CAUTION LIGHT
16. UPFRONT CONTROL
17. HUD CONTROL PANEL
18. STANDBY AIRSPEED INDICATOR
19. STANDBY ATTITUDE INDICATOR
20. STANDBY ALTIMETER
21. STANDBY ANGLE-OF-ATTACK INDICATOR
22. HORIZONTAL SITUATION INDICATOR
23. STANDBY VERTICAL VELOCITY INDICATOR
24. AIR VENT
25. TURN AND SLIP INDICATOR
26. MISCELLANEOUS SWITCH PANEL
    - VIDEO RECORDER LIGHTS/SWITCH
    - VRS DISPLAY SELECT SWITCH
    - DISPLAY PROCESSOR SWITCH
    - DUAL MODE TRACKER SWITCH
    - MISSION COMPUTER SWITCH
    - PROBE HEAT SWITCH
    - INS MODE SELECTOR KNOB
27. BUREAU NUMBER
28. RUDDER PEDAL ADJUST CONTROL
29. CIRCUIT BREAKER PANEL
30. HUD VIDEO CAMERA
31. WARNING/THREAT LIGHTS (latest configuration)
32. ENGINE DISPLAY PANEL
    - BIT SWITCH
    - DUCT PRESSURE
    - TACHOMETER
    - JET PIPE TEMPERATURE
    - NOZZLE POSITION
    - DISPLAY BRIGHTNESS CONTROL
    - WATER QUANTITY
    - WATER FLOW LIGHT
    - STABILATOR POSITION
    - FUEL FLOW
33. FUEL QUANTITY INDICATOR
    - FUEL QUANTITY INDICATIONS
    - BINGO FUEL SET
    - INDICATION SELECT SWITCH
    - ON/OFF INDICATOR
34. BLANK
35. CLOCK
36. TAKEOFF CHECKLIST
37. BRAKE ACCUMULATOR PRESSURE INDICATOR
38. HYDRAULIC PRESSURE INDICATORS
    - BRAKE PRESSURE
    - HYDRAULIC PRESSURE SYSTEM NO. 1 AND NO. 2
39. CAUTION/ADVISORY LIGHT PANEL (latest configuration)
40. COCKPIT ALTIMETER
41. INTERNAL EMERGENCY CANOPY SHATTERING HANDLE
42. LDG GEAR EMERGENCY BATTERY

RIGHT CONSOLE





1. ELECTRICAL PANEL
   - DC VOLTMETER
   - BATTERY SWITCH
   - GENERATOR SWITCH
   - ENGINE START SWITCH
   - APU SWITCH
   - DC TEST SWITCH
2. V/UHF RADIO SET CONTROL (RSC)
3. AMPLIFIER - CONTROL (ACNIP)
4. INTERIOR LIGHTS CONTROL PANEL
   - CONSOLE LIGHTS KNOB
   - INSTRUMENT LIGHTS KNOB
   - FLOOD LIGHTS KNOB
   - COMPASS LIGHT/LIGHTS TEST SWITCH
   - WARNING/CAUTION LIGHTS KNOB
5. ENVIRONMENTAL CONTROL PANEL
   - TEMPERATURE CONTROLLER
   - EQUIPMENT BAY COOL SWITCH
   - RAM AIR SWITCH
   - DEFOG SWITCH
6. AIR VENT
7. BLANK
8. VIDEO RECORDER
9. BLANK



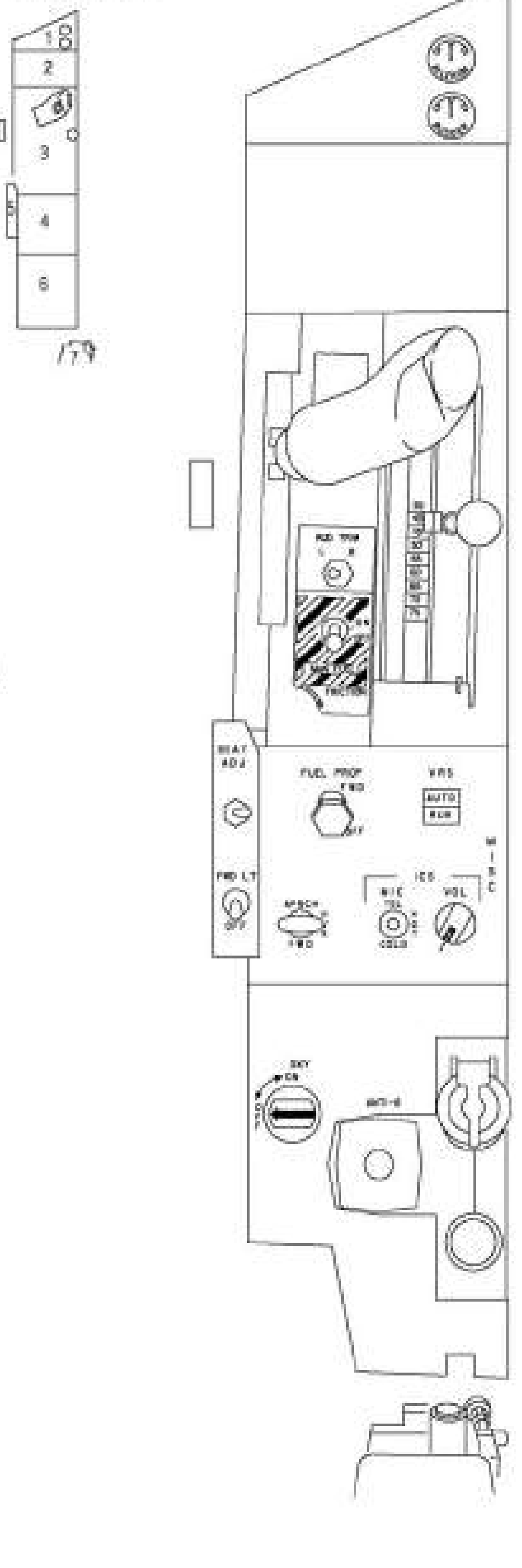
AFTER AFC-422

AHR602-486-1-037

Cockpit, TAV-8B

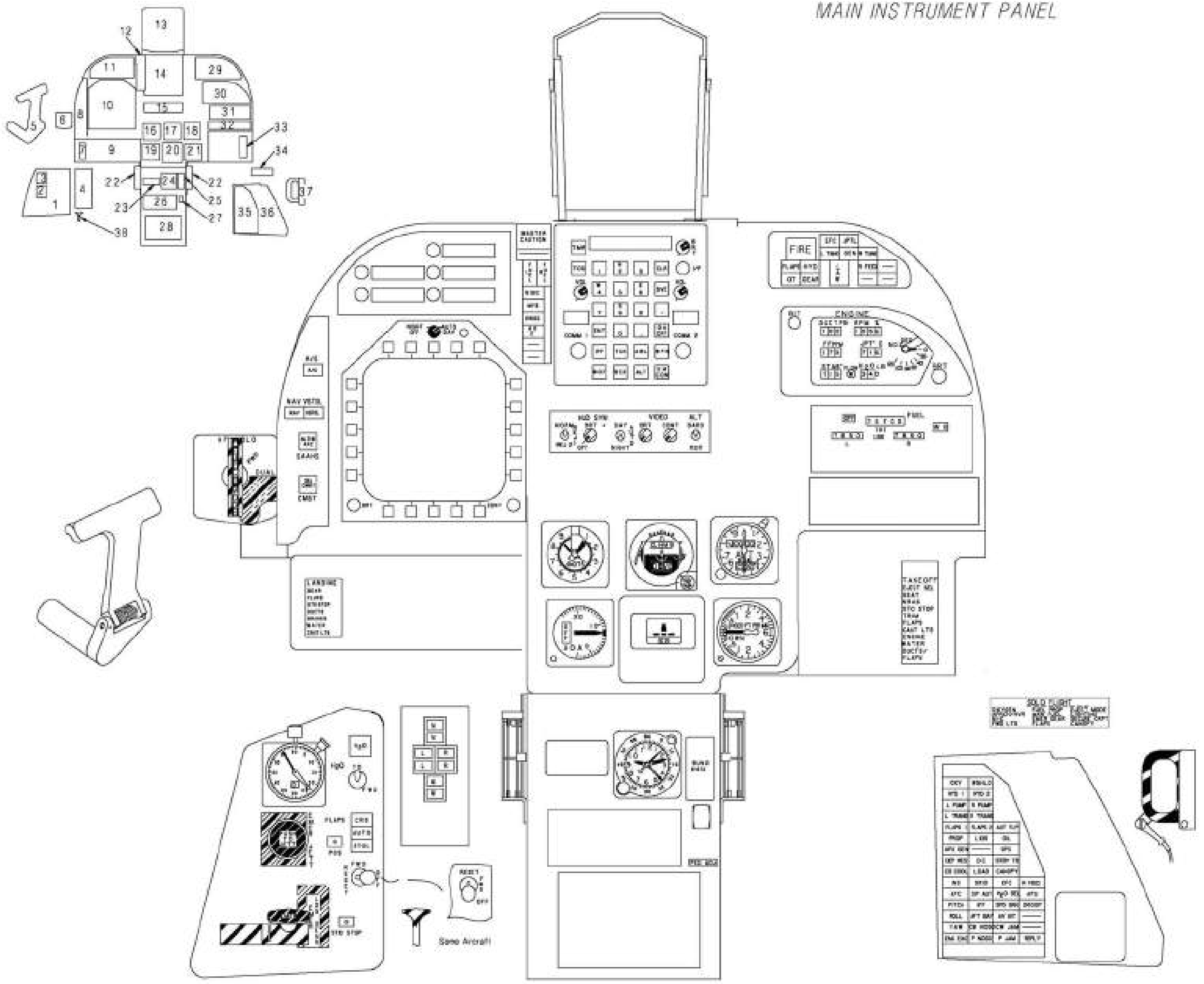
FO-3 (Reverse Blank)

LEFT CONSOLE



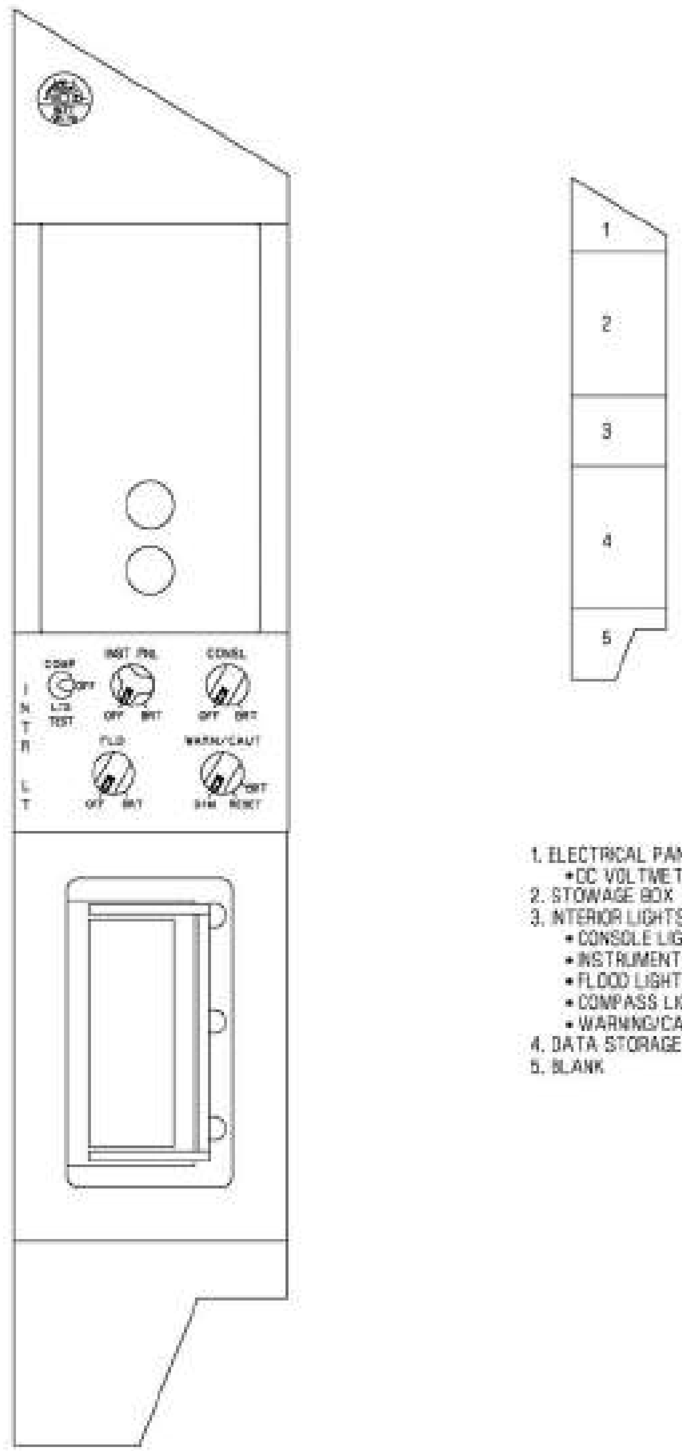
1. TRIM PANEL
   - RUDDER TRIM INDICATOR
   - AILERON TRIM INDICATOR
2. BLANK
3. THROTTLE QUADRANT
   - NOZZLE CONTROL
   - THROTTLE
   - SPEED BRAKE SWITCH
   - EMERGENCY FLAP RETRACT BUTTON
   - SLEW CONTROL/DESIGNATOR
   - AIRSTART BUTTON
   - CAGE/UNCAGE BUTTON
   - COMMUNICATION SWITCH
   - RUDDER TRIM AND MANUAL FUEL SWITCHES
4. MISCELLANEOUS PANEL
   - FUEL FLOW PROPORTIONER
   - LANDING LIGHT SWITCH
   - VIDEO RECORDER SET SWITCH
   - ICS MIC SWITCH
   - ICS VOLUME CONTROL
5. SEAT ADJUST AND EXTERIOR LIGHTS MASTER SWITCH
6. PILOT SERVICES PANEL
   - ANTI-G SUIT DISCONNECT
   - OXYGEN DISCONNECT
   - ANTI-G VALVE
   - OXYGEN VALVE
7. OXYGEN MONITOR
   - BIT BUTTON
8. MFS EMERGENCY BATTERY

MAIN INSTRUMENT PANEL



1. EMERGENCY LANDING GEAR/FLAPS CONTROL PANEL
   - EMERGENCY LANDING GEAR HANDLE
   - FLAP POSITION INDICATOR
   - STO STOP INDICATOR
   - FLAP POWER SWITCH
   - H_2O TO/FWD SWITCH
   - H_2O LIGHT
2. EMERGENCY JETTISON
3. STOP WATCH (GFE)
4. LANDING GEAR POSITION INDICATORS
5. INTERNAL CANOPY LOCK HANDLE
6. EJECT MODE SELECTOR
7. LANDING CHECKLIST
8. MASTER MODE PANEL
   - A/G MODE SWITCH
   - NAV MODE SWITCH
   - VSTOL MODE SWITCH
   - SAAHS LIGHT
   - CMBT LIGHT
9. BLANK
10. DIGITAL DISPLAY INDICATOR (DDI)
11. OPTION DISPLAY UNIT
12. PRIORITY CAUTION LIGHT
13. HEAD-UP DISPLAY (HUD)
14. UPFRONT CONTROL
15. HUD CONTROL PANEL
16. STANDBY AIRSPEED INDICATOR
17. STANDBY ATTITUDE INDICATOR
18. STANDBY ALTIMETER
19. STANDBY ANGLE-OF-ATTACK INDICATOR
20. TURN AND SLIP INDICATOR
21. STANDBY VERTICAL VELOCITY INDICATOR
22. AIR VENT
23. BLANK
24. CLOCK
25. BUREAU NUMBER
26. BLANK
27. RUDDER PEDAL ADJUST CONTROL
28. BLANK
29. WARNING/THREAT LIGHTS
30. ENGINE DISPLAY PANEL
   - BIT SWITCH
   - DUCT PRESSURE
   - TACHOMETER
   - JET PIPE TEMPERATURE
   - NOZZLE POSITION
   - DISPLAY BRIGHTNESS CONTROL
   - WATER QUANTITY
   - WATER FLOW LIGHT
   - STABILATOR POSITION
   - FUEL FLOW
31. FUEL QUANTITY INDICATOR
   - FUEL QUANTITY INDICATIONS
   - ON/OFF INDICATOR
   - SELECTION INDICATOR
32. BLANK
33. TAKEOFF CHECK LIST
34. SOLO FLIGHT CHECKLIST
35. CAUTION/ADVISORY LIGHT PANEL (Latest configuration)
36. BLANK
37. INTERNAL EMERGENCY CANOPY SHATTERING HANDLE
38. LDG GEAR EMERGENCY BATTERY

RIGHT CONSOLE

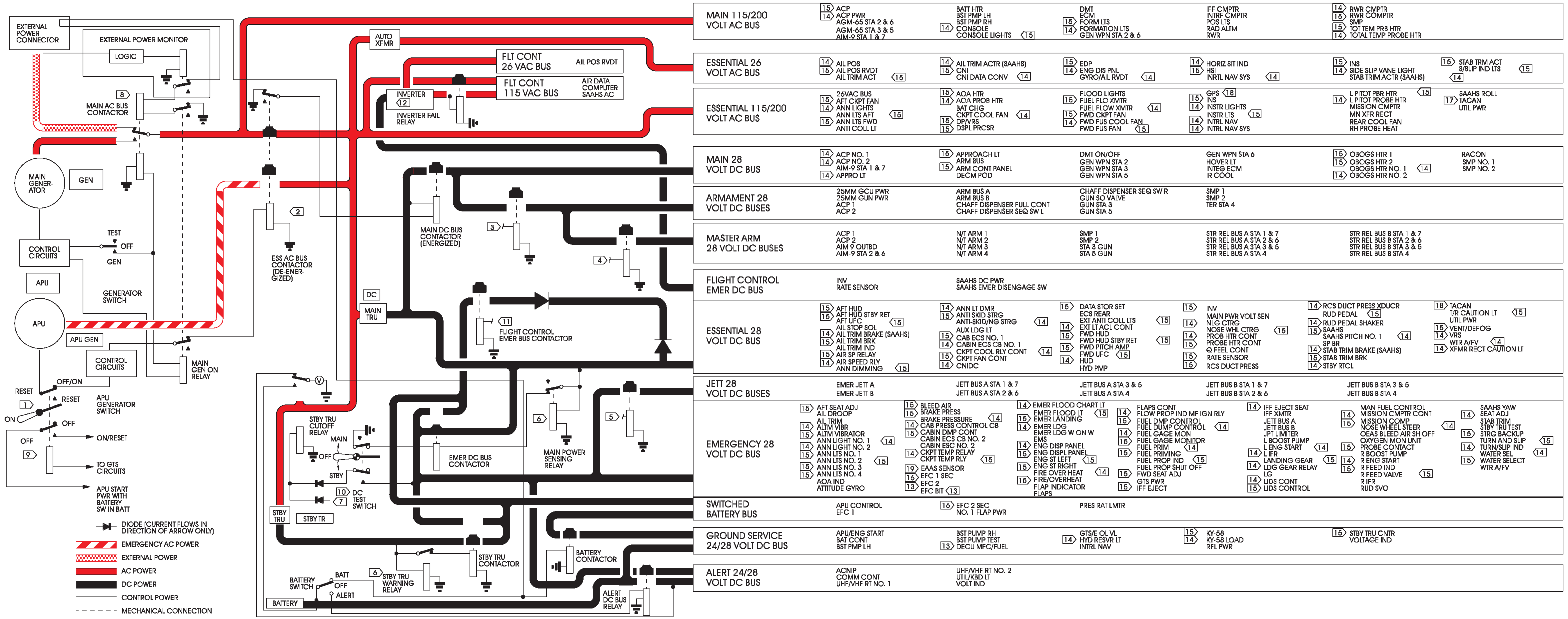


1. ELECTRICAL PANEL
   - DC VOLTMETER
2. STOWAGE BOX
3. INTERIOR LIGHTS CONTROL PANEL
   - CONSOLE LIGHTS KNOB
   - INSTRUMENT LIGHTS KNOB
   - FLOOD LIGHTS KNOB
   - COMPASS LIGHT/LIGHTS TEST SWITCH
   - WARNING/CAUTION LIGHTS KNOB
4. DATA STORAGE SET (DSS)
5. BLANK

Rear Cockpit, TAV-8B

Aircraft and Engine Fuel System

FO-5 (Reverse Blank)



EXTERNAL POWER APPLIED

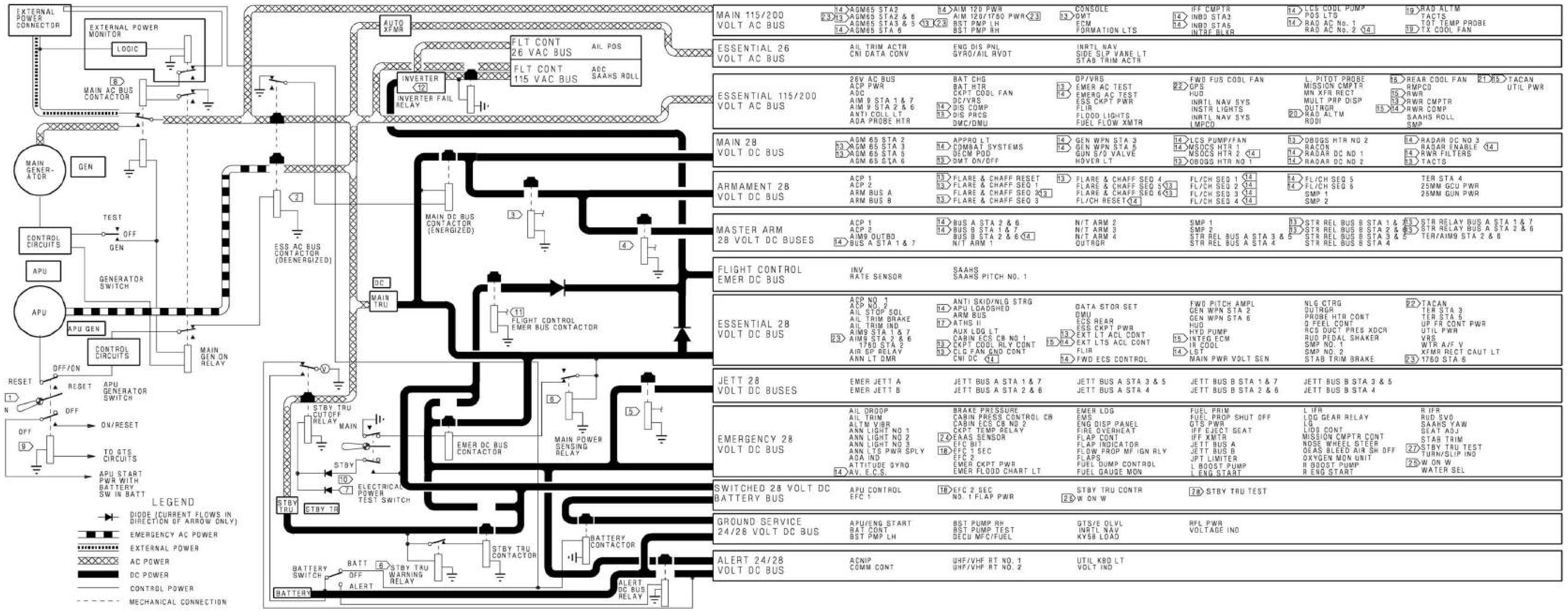
NOTES

Nomenclature callouts on the individual buses are circuit breaker nomenclatures. These nomenclatures do not necessarily identify each system powered by

1. Switch shown in OFF position.
2. Essential ac bus contactor energized with main generator OFF the line and APU generator operating and producing the proper power output.
3. Armament buses energized with gear handle UP and weight OFF landing gear. It will also energize with armament bus override switch on, provided gear handle is DOWN.
4. Master arm buses energized with armament buses energized and master arm switch in ARM.
5. Jettison buses energized with weight OFF landing gear, or gear handle UP, or with armament override switch on and with gear handle DOWN.
6. Voltage sensing relay de-energized if TRU output drops below 24.75 volts dc for approximately 3.5 seconds.
7. Standby TRU cutoff relay energizes during GTS start.
8. External power is applied to system provided the external power is connected and of proper quality, the battery switch is in BATT, and the main generator is not on the line.
9. Switch is electromagnetically held in the ON position when selected with the battery switch in BATT, and will remain in the ON position until any of the following occurs: (1) battery switch placed out of BATT, (2) engine start selected, (3) APU selected ON while on the ground or airspeed exceeds 325 knots with the main generator on the line.
10. Main position energizes the stanby TRU cut off relay to shutdown the standby TRU. The STBY TR light is on and main TRU output (28 volts) is indicated on the voltmeter, which indicates main TRU is charging the battery. STBY position de-energizes emer dc bus contactor to switch power on emergency dc and alert buses from main TRU to standby TRU. Standby TRU charging of the battery is indicated by voltmeter indicating 26 volts or greater.
11. Above Mach 0.4 and 8 ° AOA the flight control emergency bus contactor energizes. If power to the main TRU is lost or interrupted the circuit breakers on the flight control emergency dc bus will remain energized by the standby TRU. If both main TRU and standby TRU fail, the bus is energized by battery power. Once energized the contactor remains energized for a minimum of 30 seconds even though the aircraft goes below Mach 0.4 and/or 8° AOA. The contactor also provides battery power to the flight control ac bus inverter.
12. The inverter powers the ac flight control buses. If the inverter fails, the inverter fail relay de-energizes causing the ac light control buses to be powered by generator power.
13. AV-8B 162068 and up.
14. AV-8B.
15. TAV-8B.
16. AV-8B 161573 thru 163852, TAV-8B 162747 thru 163861 after AFC-370.
17. AV-8B 161573 thru 163852, TAV-8B 162963 thru 163861 before AFC-354 Part 3.
18. AV8-B 161573 thru 163852, TAV-8B 162963 thru 163861 after AFC-354 Part 3.
19. After AFC-449.

AHR602-234-1-036

Electrical System, AV-8B 161573 Thru 163852, TAV-8B 162747 Thru 163861



Electrical System and Circuit Breaker Identification,

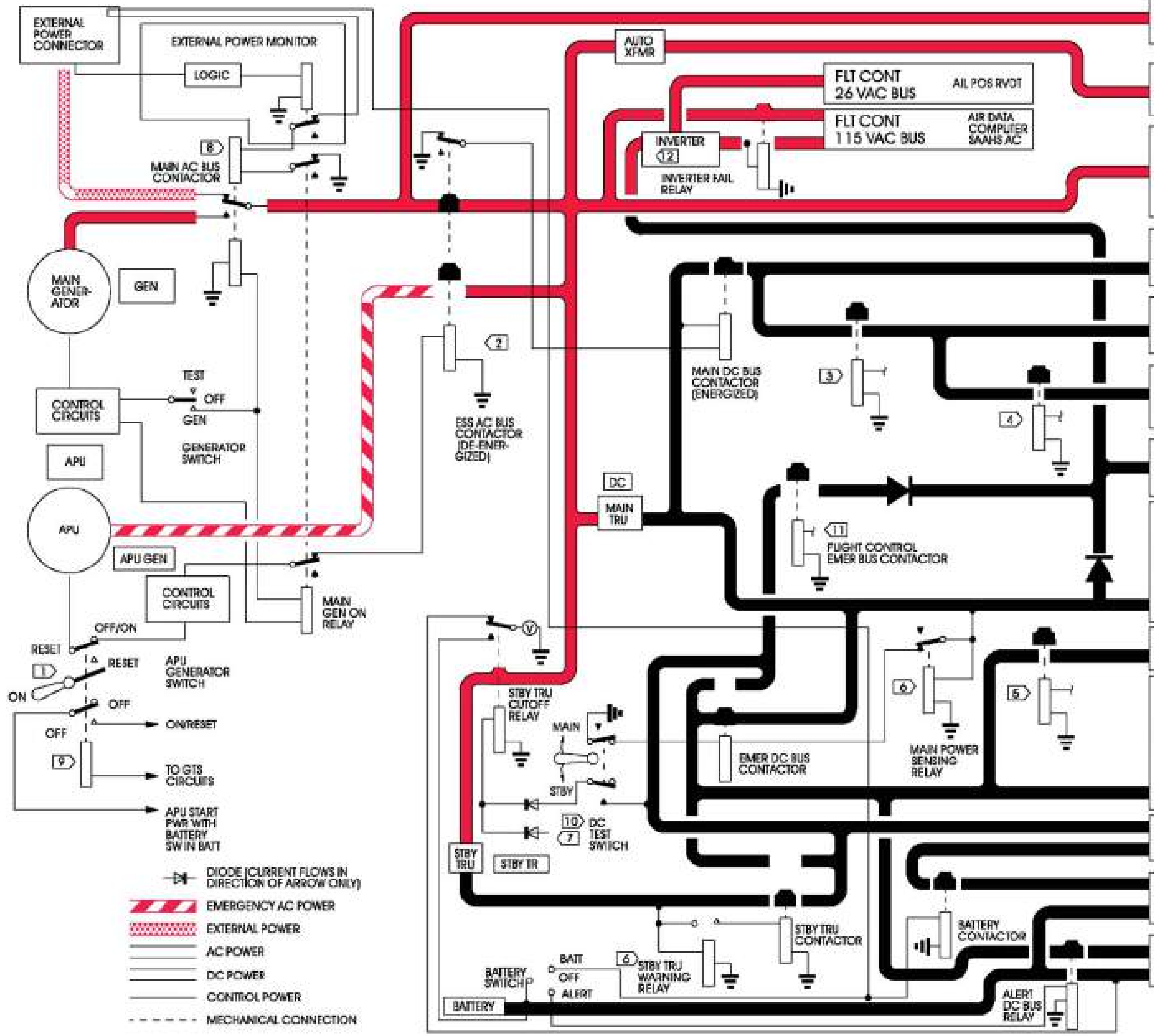
EXTERNAL POWER APPLIED

NOTES

Nomenclature callouts on the individual busses are circuit breaker nomenclatures. These nomenclatures do not necessarily identify each system powered by the circuit breakers.

1. Switch shown in OFF position.
2. Essential AC bus contactor energized with main generator OFF the line and APU generator operating and producing the proper power output.
3. Armament buses energized with gear handle UP and weight OFF landing gear. It will also energize with armament bus override switch on, provided gear handle is DOWN.
4. Master arm buses energized when armament buses energized and master arm switch in ARM.
5. Jettison buses energized with weight OFF landing gear, or gear handle UP, or with armament override switch on and gear handle DOWN.
6. Voltage sensing relay deenergized if TRU output drops below 24.75 volts DC for approximately 3.5 seconds.
7. Standby TRU cutoff relay energizes during GTS start.
8. External power is applied to system provided the external power is connected and of proper quality, the battery switch is in BATT, and the main generater is not on the line.
9. Switch is electromagnetically held in the ON position when selected with the battery switch in BATT, and will remain in the ON position until any of the following occurs:
   (1) engine start selected, (2) APU selected ON while on the ground and (3) airspeed exceeds 325 knots with the main generator on the line.
10. Main position energizes the standby TRU cut off relay to shutdown the standby TRU. The STBY TR light is on and main TRU output (28 volts) is indicated on the voltmeter, which indicates main TRU is charging the battery. STBY position deenergizes emer DC bus contactor to switch power on emergency DC and alert buses from main TRU to standby TRU. Standby TRU charging of the battery is indicated by voltmeter indicating 26 volts or greater.
11. Above Mach 0.4 and 8° AOA, the flight control emergency bus contactor energizes. If power on the main TRU is lost or interrupted, the circuit breakers on the flight control emergency DC bus will remain energized by the standby TRU or the battery if both TRU's fail. Once energized, the contactor remains energized for a minimum of 30 seconds, even though the aircraft goes below Mach 0.4 and/or 8° AOA. The contactor also provides battery power to the flight control AC bus inverter.
12. The inverter powers the AC flight control buses. If the inverter fails, the inverter fail relay deenergizes causing the 115 VAC flight control bus to be powered by generator power.
13. AV-8B 163853 thru 164547 (Night Attack).
14. AV-8B 164549 and up (Radar).
15. On AV-8B 164549 and up, power is disabled with APU on line and weight-on-wheels.
16. On AV-8B 164549 and up, power is disabled with APU on line and weight-off-wheels.
17. AV-8B 165305 and up; also AV-8B 163853 thru 165006 after AFC-326/Part 3.
18. AV-8B 165354 and up, also AV-8B 163853 thru 165312 after AFC-395.
19. AV-8B 163853 thru 164547 before AFC-366.
20. AV-8B 164549 and up, also AV-8B 163853 thru 164547 after AFC-366.
21. AV-8B 163853 thru 164547 before AFC-354 Rev A.
22. AV-8B 165384 and up; also AV-8B 163853 thru 165383 after AFC-354 Rev A/Part 3.
23. AV-8B 165413 and up, also AV-8B 163853 thru 165412 after AFC-420.
24. After AFC-449.
25. Before AFC-464.
26. After AFC-464.
27. Before AFC-481.
28. After AFC-481.

AV8B02-557-1-037



MAIN 115/200 VOLT AC BUS	AGM-65 (STA 2 & 6) AGM-65 (STA 3 & 5) BST PUMP LH	BST PUMP RH CONSOLE DMT	ECM FORMATION LTS IFF CMPTR	INTRF BLANKER POS LTS (14) RAD ALTM	TOTAL TEMP PROBE HTR	
ESSENTIAL 26 VOLT AC BUS	AIL TRIM ACTR CNI DATA CONV	ENG DIS PNL GYRO/AIL RVDT HORIZ SIT IND	INRTL NAV SIDE SLP VANE LT STAB TRIM ACTR			
ESSENTIAL 115/200 VOLT AC BUS	ACP PWR AFT CKPT FAN AFT HUD AFT MPD AIM 9 STA 1 & 7 AIM 9 STA 2 & 6	ANN LTS AFT ANTI COLL LT AOA PROBE HTR BAT CHG BAT HTR CKPT COOL FAN	DIS PRCS DMC/DMU DP/VRS EMER AC TEST ESS CKPT PWR FLOOD LIGHTS	FUEL FLOW XMTR FWD FUS COOL FAN (17) GPS HORIZ SIT IND HUD INRTL NAV SYS INSTR LIGHTS	L PITOT PROBE MISSION COMPTR MN XFR RECT MULT PRP DISP (LEFT) (15) RAD ALTM REAR COOL FAN RH PROBE HEAT	RWR RWR COMPTR SMP (16) TACAN UTIL PWR 26 VAC BUS
MAIN 28 VOLT DC BUS	AGM 65 STA 2 AGM 65 STA 3 AGM 65 STA 5	AGM 65 STA 6 APPRO LT DECM POD	DMT ON/OFF GUN S/O VALVE HOVER LT	OBOGS HEATER NO. 1 OBOGS HEATER NO. 2 RACON		
ARMAMENT 28 VOLT DC BUS	ACP 1 ACP 2 ARM BUS A	ARM BUS B FLARE & CHAFF DIST CONT FLARE & CHAFF SEQ 1	FLARE & CHAFF SEQ 2 SMP 1 SMP 2	TER STA STA 4 25MM GCU PWR 25MM GUN PWR		
MASTER ARM 28 VOLT DC BUSES	ACP 1 ACP 2 AIM-9 BUS A AIM-9 STA 1 & 7	N/T ARM 1 N/T ARM 2 N/T ARM 3 N/T ARM 4	SMP 1 SMP 2 STR RELAY BUS A STA 1 & 7	STR RELAY BUS A STA 2 & 6 STR RELAY BUS A STA 3 & 5 STR RELAY BUS A STA 4 STR RELAY BUS B STA 1 & 7	STR RELAY BUS B STA 2 & 6 STR RELAY BUS B STA 3 & 5 STR RELAY BUS B STA 4 TER/AIM-9 2 & 6	
FLIGHT CONTROL EMER DC BUS	INV RATE SENSOR	SAAHS SAAHS PITCH NO. 1				
ESSENTIAL 28 VOLT DC BUS	ACP NO. 1 ACP NO. 2 AFT HUD AFT UFC AIL STOP SOL AIL TRIM BRAKE AIL TRIM IND AIM-9 STA 1 & 7	AIR SP RELAY ANN LT DMR ANTI SKID/NLG STRG ARM BUS AUX LDG LT CABIN ECS CB NO. 1 CKPT FAN CONT CLG FAN GND CONT	CNI DC DATA STOR SET DMU ECS REAR ESS CKPT PWR EXT LT ACL CONT FWD PITCH AMPL GEN WPN STA 2	GEN WPN STA 6 HYD PUMP HUD INTEG ECM IR COOL MAIN PWR VOLT SENS NLG CTRG OUTRGR	PROBE HTR CONT Q FEEL CONT RCS DUCT PRES XDCR RUD PEDAL SHAKER SMP NO. 1 SMP NO. 2 SP BR STAB TRIM BRAKE STBY RET	(17) TACAN TER STA 3 TER STA 5 UP FR CONT PWR UTIL PWR VENT/DEFOG VRS WTR A/F V XFMR RECT CAUT LT
JETT 28 VOLT DC BUSES	EMER JETT A EMER JETT B	JETT BUS A STA 1 & 7 JETT BUS A STA 2 & 6	JETT BUS A STA 3 & 5 JETT BUS A STA 4	JETT BUS B STA 1 & 7 JETT BUS B STA 2 & 6	JETT BUS B STA 3 & 5 JETT BUS B STA 4	
EMERGENCY 28 VOLT DC BUS	AFT SEAT ADJ AIL DROOP AIL TRIM ALTM VIBR ANN LIGHTS NO. 1 ANN LIGHTS NO. 2 ANN LIGHTS NO. 3 ANN LTS NO. 4 AOA IND ATTITUDE GYRO	BRAKE PRESSURE CABIN ECS CB NO. 2 CABIN PRES CONTROL CB CKPT TEMP RELAY (18) EAAS SENSOR EFC BIT (13) EFC 1 SEC EFC 2 EMER CKPT PWR EMER FLOOD CHART LT EMER LDG	EMS ENG DISP PANEL FIRE OVERHEAT FLAP CONT FLAP INDICATOR FLAPS FLOW PROP MF ING RLY FUEL DUMP CONTROL FUEL GAUGE MON FUEL PROP SHUTOFF FUEL PRIM	GTS POWER IFF EJECT SEAT IFF XMTR JETT BUS A JETT BUS B JPT LIMITER L BOOST PUMP L ENG START L IFR LDG GEAR RELAY	LG LIDS CONT MISSION CMPTR CONT NOSEWHEEL STEER OEAS BLEED AIR SH OFF OXYGEN MON UNIT R BOOST PUMP R ENG START R IFR RIGHT FEED IND	RIGHT FEED VALVE RUD SYO SAAHS YAW SEAT ADJ STAB TRIM (19) STBY TRU TEST TURN/SLIP IND W ON W WATER SEL
SWITCHED 28 VOLT DC BATTERY BUS	APU CONTROL EFC 1	(13) EFC 2 SEC NO. 1 FLAP PWR	STBY TRU CONTR	(20) STBY TRU TEST		
GROUND SERVICE 24/28 VOLT DC BUS	APU/ENG START BAT CONT BST PMP LH	BST PUMP RH BST PUMP TEST DECU/MFC/FUEL	GTS/E OLVL INRTL NAV KY58 LOAD	RFL PWR VOLTAGE IND		
ALERT 24/28 VOLT DC BUS	ACNIP COMM CONT	UHF/VHF RT NO. 1 UHF/VHF RT NO. 2	UTIL KBD LT VOLT IND			

NOTES

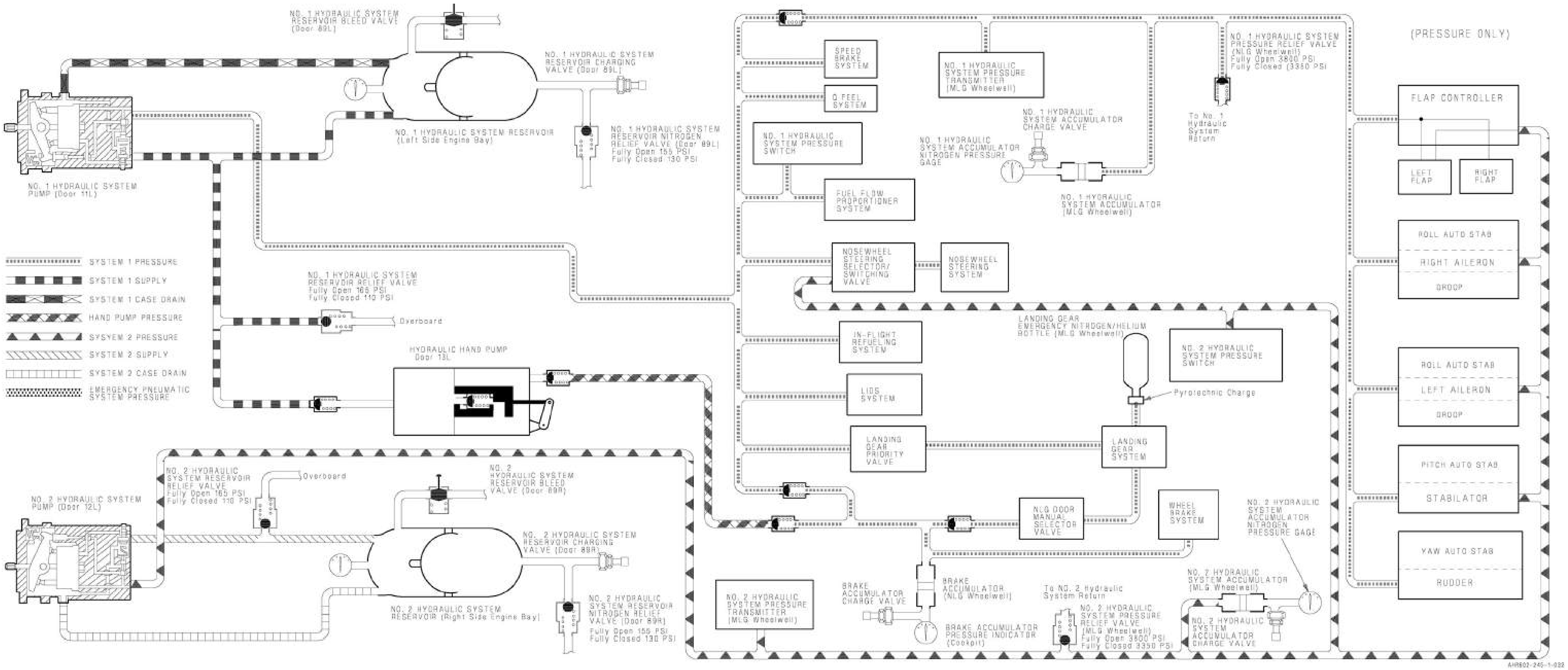
Nomenclature callouts on the individual buses are circuit breaker nomenclatures. These nomenclatures do not necessarily identify each system powered by the circuit breakers.

1. Switch shown in OFF position.
2. Essential AC bus contactor energized with main generator OFF the line and APU generator operating and producing the proper power output.
3. Armament buses energized with gear handle UP and weight OFF landing gear. It will also energize with armament bus override switch on, provided gear handle is DOWN.
4. Master arm buses energized when armament buses energized and master arm switch in ARM.
5. Jettison buses energized with weight OFF landing gear, or gear handle UP, or with armament override switch on and with gear handle DOWN.
6. Voltage sensing relay de-energized if TRU output drops below 24.75 volts DC for approximately 3.5 seconds
7. Standby TRU cutoff relay energizes during GTS start.
8. External power is applied to system provided the external power is connected and of proper quality, the battery switch is in BATT, and the main generator is not on the line.
9. Switch is electromagnetically held in the ON position when selected with the battery switch in BATT, and will remain in the ON position until any of the following occurs: (1) engine start selected, (2) APU selected ON while on the ground and (3) airspeed exceeds 325 knots with the main generator on the line.
10. Main position energizes the standby TRU cut off relay to shutdown the standby TRU. The STBY TR light is on and main TRU output (28 volts) is indicated on the voltmeter, which indicates main TRU is charging the battery. STBY position de-energizes emer DC bus contactor to switch power on emergency DC and alert buses from main TRU to standby TRU. Standby TRU charging of the battery is indicated by voltmeter indicating 26 volts or greater.
11. Above Mach 0.4 and 8 AOA, the flight control emergency bus contactor energizes. If power on the main TRU is lost or interrupted, the circuit breakers on the flight control emergency DC bus will remain energized by the standby TRU or the battery if both TRUs fail. Once energized, the contactor remains energized for a minimum of 30 seconds, even though the aircraft goes below Mach 0.4 and/or 8 ° AOA. The contactor also provides battery power to the flight control AC bus inverter.
12. The inverter powers the AC flight control buses. If the inverter fails, the inverter fail relay de-energizes causing the 115vac flight control bus to be powered by generator power.
13. TAV-8B 164113 thru 164542 after AFC-395.
14. TAV-8B 164113 thru 164542 before AFC-368.
15. TAV-8B 164113 thru 164542 after AFC-368.
16. TAV-8B 164113 thru 164542 before AFC-354 Rev A.
17. TAV-8B 164113 thru 164542 after AFC-354 Rev A.
18. After AFC-449.
19. Before AFC-481.
20. After AFC-481.

EXTERNAL POWER APPLIED

AV8B02-493-1-036

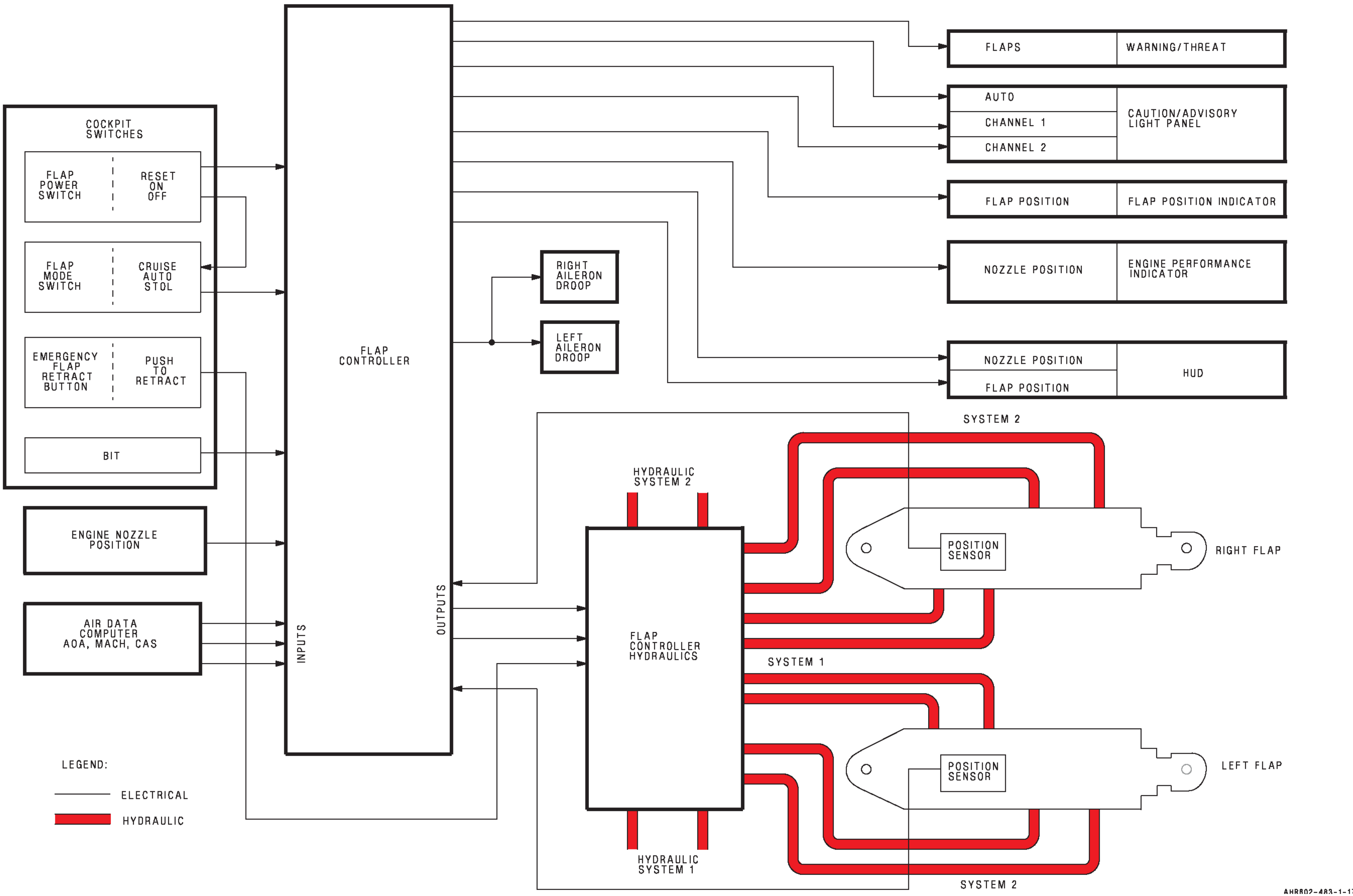
Electrical System, TAV-8B 164113 And Up



Hydraulic System (Pressure Only)

Environmental Control System, TAV-8B, AV-8B 161573 Thru 164547

Environmental Control System, AV-8B 164549 And Up



Flap System

FO-12 (Reverse Blank)