Emergency Procedures

SECTION III

TABLE OF CONTENTS

ENGINE FAILURE.

Failure of rocket engines is, as a rule, the result of thrust chamber burnout. Specific information on this type engine failure is given in "Thrust Chamber Burnout" in this section. If engine failure is due to malfunction of the fuel control system or improper operating technique, a start can usually be made to restore engine operation, provided time and altitude permit. However, if the failure is an obvious failure within the engine, a start should not be attempted.

MALFUNCTION SHUTDOWNS.

Automatic malfunction shutdowns can occur during the engine start phase or during actual engine operation. The design of the malfunction shutdown circuits is such that restart attempts can safely be made after a malfunction shutdown. This is because a restart will not be successful if the malfunction which caused the original shutdown has not been corrected. Malfunction shutdowns which can occur during the start phase are those due to main or first stage propellant valve malfunction, stage 2 ignition malfunction, or engine turbopump overspeed. Malfunction shutdowns which can occur during engine operation are those caused by engine turbopump overspeed or excessive engine vibration. If a malfunction shutdown occurs, attempt a restart. Refer to "Engine Restart" in this section.

Causes of Pump Cavitation.

Failure to sufficiently prime the liquid oxygen pump discharge line to the engine, excessive heat absorption by the liquid oxygen together with excessive vapor pressure (normal liquid oxygen tank vapor pressure after tank has been filled is 20 to 24 psia), or insufficient liquid oxygen tank pressure can cause pump cavitation. When liquid oxygen pump cavitation occurs, the overspeeding turbopump is stopped by the overspeed protection system. When an engine is shut down by the turbopump overspeed protection system, the turbopump overspeed caution light is illuminated.

Indications of Pump Cavitation.

Cavitation is accompanied by the following indications:

- Increase of pitch in whine of turbine.
- No ignition.
- No flame from chamber.
- No noise from chamber.
- No thrust chamber pressure.
- Very high momentary fuel manifold pressure.
- Very low liquid oxygen manifold pressure.
- Turbopump stops and overspeed indicator light, in cockpit, comes on.

*At the time of publication of this flight manual, information for various specific procedures was not available. These will be supplied as soon as available.

ENGINE RESTART.

If the engine has failed or has been shut down automatically and it is determined that a restart is feasible, proceed as follows:

1. Throttle - OFF.
2. Engine reset button - Push (one second).
3. Engine prime switch - PRIME.

   Move engine prime switch to PRIME for one second and check ignition-ready light ON. Approximately 30 seconds is required to prime, with prime valve at high-flow orifice position.

4. Throttle - As desired.

THRUST CHAMBER BURNOUT.

Thrust chamber burnout can be determined by various engine indications which can be verified by the pilot or the chase pilot. These indications are as follows:

a. Fuel manifold pressure drops below oxygen manifold pressure, accompanying cylinder "groaning."

b. Engine emits loud scream or howl.

c. Yellow streak of flame or yellow bushy flame is evident.

d. Chamber pressure drops while manifold pressures are within specified range.

CAPTIVE OPERATION EMERGENCIES.

BEFORE TAKE-OFF.

In case a "FIRE" warning, "APU COMPT HOT," or "H_2O_2 HOT" light comes on before take-off, notify the carrier pilot that an X-15 emergency is in progress (refer to "Fire or Explosion" in this section), and prepare to abandon the airplane.

IN-FLIGHT.

In case of an emergency during captive flight, the carrier pilot must verify the emergency and ascertain the danger to the crew. It will be the carrier pilot's responsibility to initiate one or more of the following emergency procedures:

a. X-15 emergency launch. (Refer to "Emergency Launch" in this section.)

b. X-15 pilot ejection. (Refer to "Ejection" in this section.)

c. Abort mission or launch. (Refer to "Aborted Launch" in Section II.)

The five basic rules covering selection of the proper procedure are as follows:

a. X-15 hazardous to B-52 - Launch X-15. (This may be preceded by X-15 pilot ejection if the X-15 is hazardous to the X-15 pilot.)

b. B-52 hazardous to X-15 below critical altitude - Eject X-15 pilot and B-52 crew.

c. B-52 hazardous to X-15 above critical altitude - Launch X-15 and eject B-52 crew.

d. X-15 emergency not immediately hazardous - Return to base for landing.

e. B-52 emergency not immediately hazardous - Return to base for landing.

EMERGENCY LAUNCH.

In case of an emergency aboard the B-52 which endangers the X-15 or in case of an emergency in the X-15 which would endanger the B-52, it is possible to emergency-launch the X-15. If time and altitude permit a launching of this type, proceed as follows:

1. Oxygen system - Switch from carrier supply to X-15 Airplane supply.
2. Ventral arming switch - ARM.
3. Emergency battery - ON.

   If APU's are not operating at the time of emergency launch, the emergency battery must be on to enable APU start.

4. No. 1 and No. 2 APU switches - ON.

   Monitor hydraulic gages for both systems as APU's come up to speed.

5. No. 1 and No. 2 generator switches - To RESET momentarily, then to ON.
6. Ram-air lever - Recheck CLOSED.
7. Cockpit helium switch - ON.
8. Pressure-cooling lever - ON.
9. Blower switches - ON.
10. Launch light - On.
11. SAS function switches - ENGAGE.
12. Ventral jettison button - Push.
13. Instrumentation master switch - ON.
14. Data switch - ON.
15. Vent, pressurization, and jettison lever - JETTISON.

MAXIMUM GLIDE.

Glide distance may be varied with Mach to achieve the desired distance. During gliding flight, high rates of descent will be experienced; speed brakes will increase the rate of descent considerably and should only be used at speeds above Mach 1.5. Speeds above Mach 1.5 will usually occur at high altitude and will allow sufficient time to reduce the rate of descent before entering the landing phase. See figure 3-1 for maximum glide for given initial Mach numbers.

FORCED LANDING.

In case of either inability to retract the speed brakes or inadvertent extension of the landing gear before entering the landing pattern, certain precautions must be observed. (See figure 3-2.)

FIRE OR EXPLOSION.

In case of a fire or explosion, the procedures given in the following paragraphs should be accomplished. However, an important factor in determining the course of action to be taken depends on the effect the fire or explosion has on the flight control systems. Since a failure of the aerodynamic flight control system could occur as a result of the fire or explosion, a careful check of the aerodynamic system should be made to determine whether a safe landing can be made.

ENGINE FIRE.

If a fire-warning light comes on or if there are other indications of fire, proceed as follows:

1. Nitrogen or helium release selector switch - Check AUTO.

   With the nitrogen or helium release selector switch at AUTO when the fire-warning system is activated, the engine is automatically shut down and the engine compartment purged. If automatic shutdown is successful, proceed to step 3. However, if the engine fails to shut down, proceed to step 2.

2. Shut down engine.

   a. Engine master switch - OFF.

      Moving the engine master switch to OFF purges the engine with helium for approximately 17 seconds.

   b. Tank shutoff and N_2 bleed switch - OFF.

   c. Nitrogen or helium release selector switch - ON.

3. Throttle - OFF.

4. Igniter idle switch - OFF.

5. If fire cannot be confirmed, land as soon as possible.

   If fire cannot be confirmed or if it goes out, establish controllability and jettison propellants en route to the nearest available base where a landing can be made. Obtain assistance from chase pilot if possible. Reconfirm controllability before descent below safe ejection altitude.

6. If fire is confirmed or if aerodynamic control is lost - Eject.

ELECTRICAL FIRE.

In case of an electrical fire, attempt to isolate fire by moving circuit breakers off one at a time. Allow sufficient time for the indication of fire to cease. When source of fire is found, leave the affected circuit de-energized, and restore power to remaining circuits.

H_2O_2 COMPARTMENT OVERHEAT.

If the "H_2O_2 COMP HOT" light comes on, immediately notify the carrier pilot that an X-15 emergency is in progress. Then prepare for an emergency launch (refer to "Emergency Launch" in this section), in case an emergency launch becomes necessary.

H_2O_2 OVERHEAT (APU).

If the APU "H_2O_2 HOT" light comes on, immediately notify the carrier pilot that an X-15 emergency is in progress. Determine which APU system is overheated and proceed as follows:

1. APU switch - OFF.

   The APU system that is overheated must be shut down.

2. APU switch - JETT.

   Maximum time for jettison is approximately 27 seconds. Launch operator and chase pilot will monitor jettison pattern.

3. Prepare for emergency launch.

   (Refer to "Emergency Launch" in this section.)

H_2O_2 LOW CAUTION.

If the "H_2O_2 LOW" caution light comes on, notify the carrier pilot that an X-15 emergency is in progress. Shut down affected APU and prepare for an aborted launch.

APU COMPARTMENT OVERHEAT.

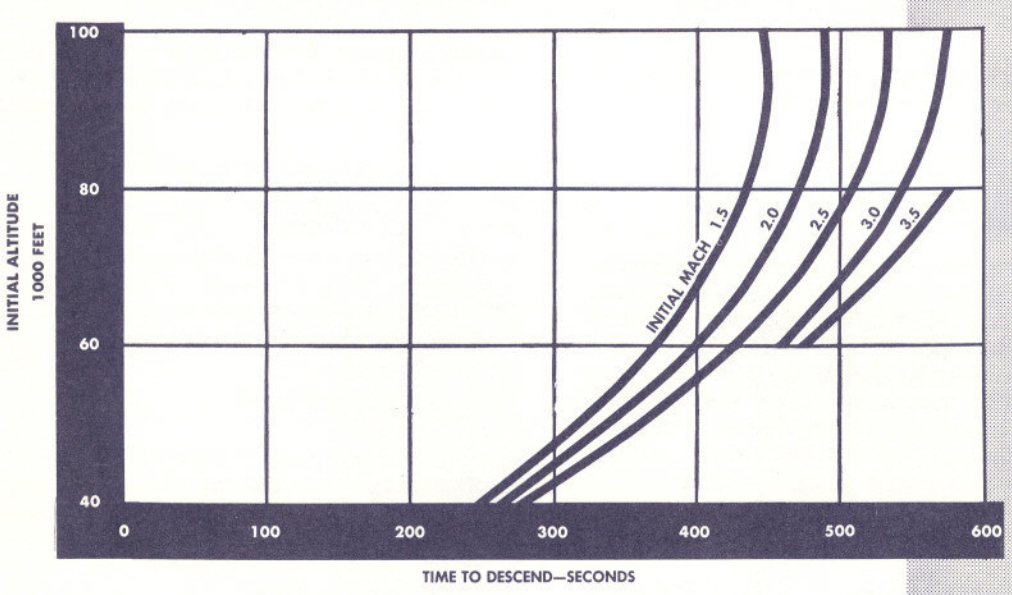
If the "APU COMP HOT" light comes on, immediately notify the carrier pilot that an X-15 emergency is in progress. Determine which APU system is overheated and proceed as follows:

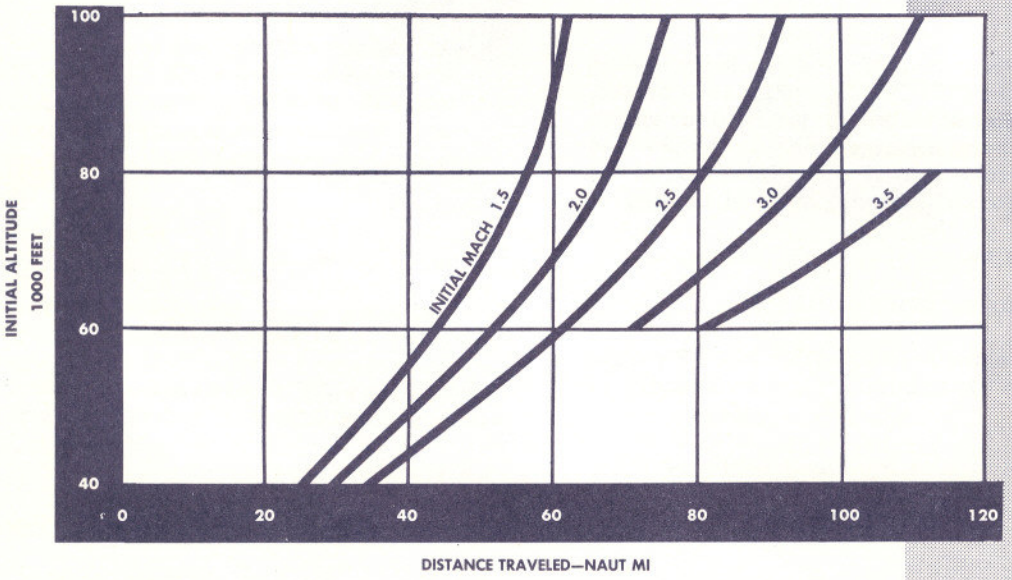
1. APU switch - OFF.

   The APU system that is overheated must be shut down.

MAXIMUM GLIDE DISTANCE AND TIME

(TO 20,000 FEET)





EXAMPLE: From 80,000 feet at Mach 2, 465 seconds will be required to descend to 20,000 feet and 68 nautical miles will be traveled.

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Figure 3-1

2. APU switch - JETT.

   Maximum time for jettison is approximately 27 seconds. Launch operator and chase pilot will monitor jettison pattern.

3 Prepare for emergency launch.

   (Refer to "Emergency Launch" in this section.)

EJECTION.

Escape from the airplane in flight must be made by means of the ejection seat. Ejection from 200 knots at zero altitude to any speed and altitude possible by the carrier airplane can be made while the airplane is attached to the carrier airplane. After launch, ejection is possible up to Mach 4 and any altitude up to 120, 000 feet. The basic seat ejection procedure is shown in figure 3-5.

VENTRAL JETTISON SYSTEM FAILURE.

The ventral is jettisoned when the ventral jettison button is pushed. If the ventral fails to jettison, as verified by the chase pilot, pulling the landing gear lowering lanyard should jettison the ventral. Receive verbal confirmation from the chase pilot that the ventral jettisoned.

EMERGENCY ENTRANCE.

Emergency entrance into the cockpit is made by manually opening the canopy, or if necessary, jettisoning it. In either case, the ejection seat must first be disarmed if the ejection handles are raised.

WARNING

Figure 3-4 shows two procedures for emergency entrance. The procedure to be used depends on the position of the ejection seat handgrips.

NOTE

Canopy removal by explosive remover is not considered a fire hazard, as fuel will be depleted or jettisoned before landing.

FUEL SYSTEM FAILURE.

AIRPLANE FUEL SYSTEM FAILURE.

If propellant system pressurization is lost, a caution light ("LOX" or "NH_3") will come on. System pressure can be restored for continued low thrust engine operation or propellant jettisoning by moving the propellant emergency pressurization switch toward the illuminated light.

NOTE

The emergency pressurization helium supply will provide sufficient emergency pressure for one tank only.

ENGINE FUEL SYSTEM FAILURE.

Failure of the engine fuel system would be the result of an engine turbopump failure. (Refer to "Turbopump Failure During Flight" in this section.)

FUEL LINE PRESSURE LOW.

In the event of a low fuel line pressure caution light during flight (above 40, 000 feet), proceed as follows:

1. Throttle - Reduce.

   Reduce engine thrust setting as necessary to maintain fuel inlet pressure at 30 psi. If pressure returns to normal, full throttle operation can be resumed.

2. Continue operation, or shut down.

   Operation can be continued at 50% thrust setting if fuel inlet pressure remains above 20 psi. If fuel inlet pressure cannot be maintained above 20 psi, even at 50% thrust, shut down engine immediately, provided a safe landing can be made.

WARNING

An engine restart is not to be attempted unless pilot or airplane safety necessitates resumption of power.

TURBOPUMP FAILURE DURING FLIGHT.

A turbopump failure will in most cases be caused by pump cavitation, or incorrect governor supply pressure. The possibility of a mechanical malfunction of the relatively simple turbopump assembly is not considered likely. Turbopump failure or shutoff, caused by the overspeed caution light coming on. If the overspeed caution light comes on, the engine may be restarted in the following manner:

1. Throttle - OFF.

2. Engine reset button - Depress (momentarily).

3. Engine precool switch - PRECOOL.

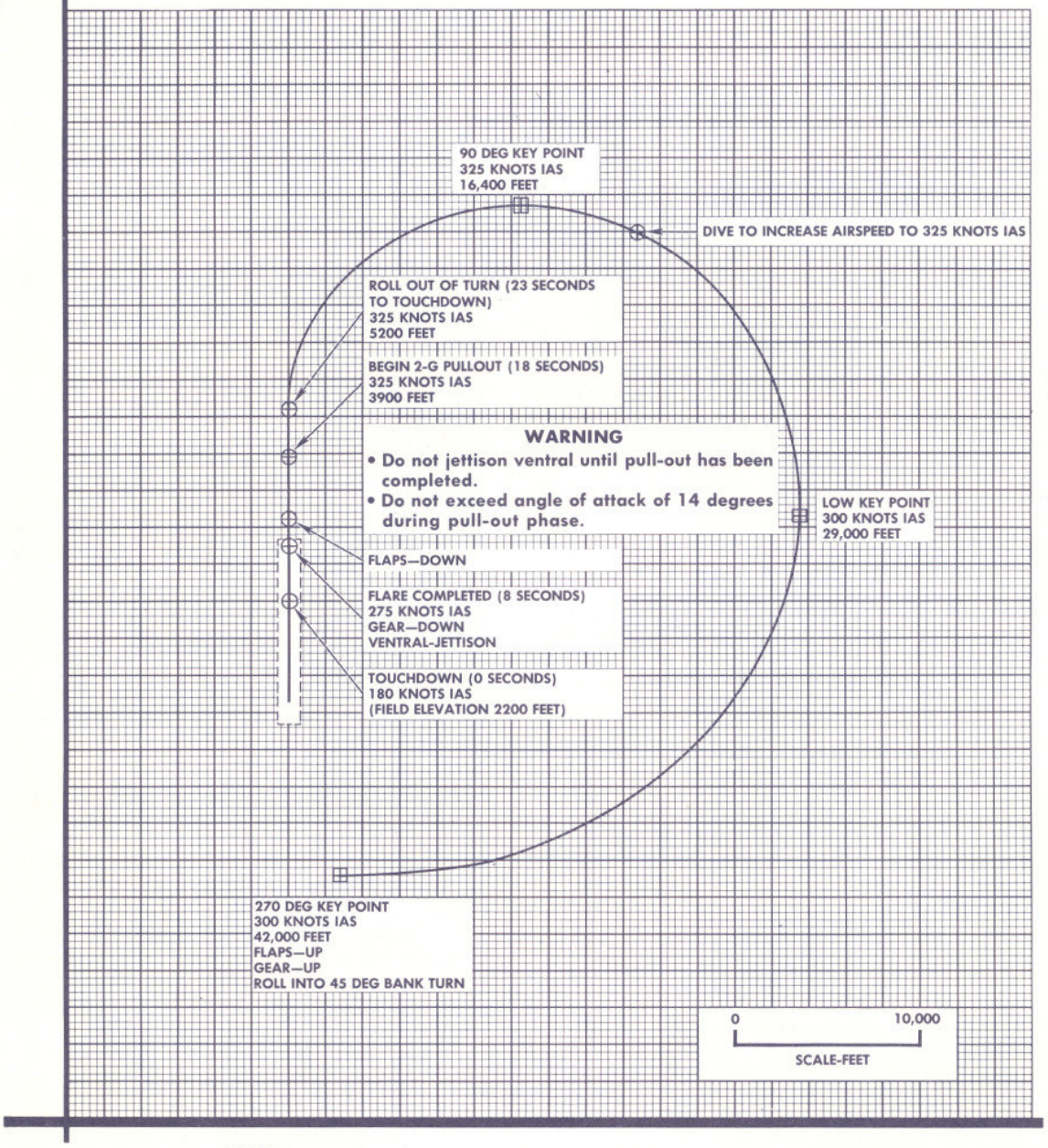
4. Engine prime switch - Check PRIME.

5. Throttle - 50%.

   Move throttle inboard to 50%; then advance as required.

FORCED LANDING PATTERNS
(LANDING GROSS WEIGHT 14,200 POUNDS)

SPEED BRAKES EXTENDED BEFORE ENTERING LANDING PATTERN



NOTE

- Maximum gliding distance with speed brakes extended is obtained at 200 knots IAS.
- If a key point cannot be made at indicated altitude, glide at 200 knots IAS until a later key point can be made with 3000 feet excess altitude; then dive off excess altitude to increase airspeed to 300 knots IAS.

WINGS LEVEL GLIDING DISTANCE SPEED BRAKES EXTENDED

KNOTS IAS	DISTANCE PER 10,000 FEET
200	5 N MI
300	3 N MI
325	2.5 N MI

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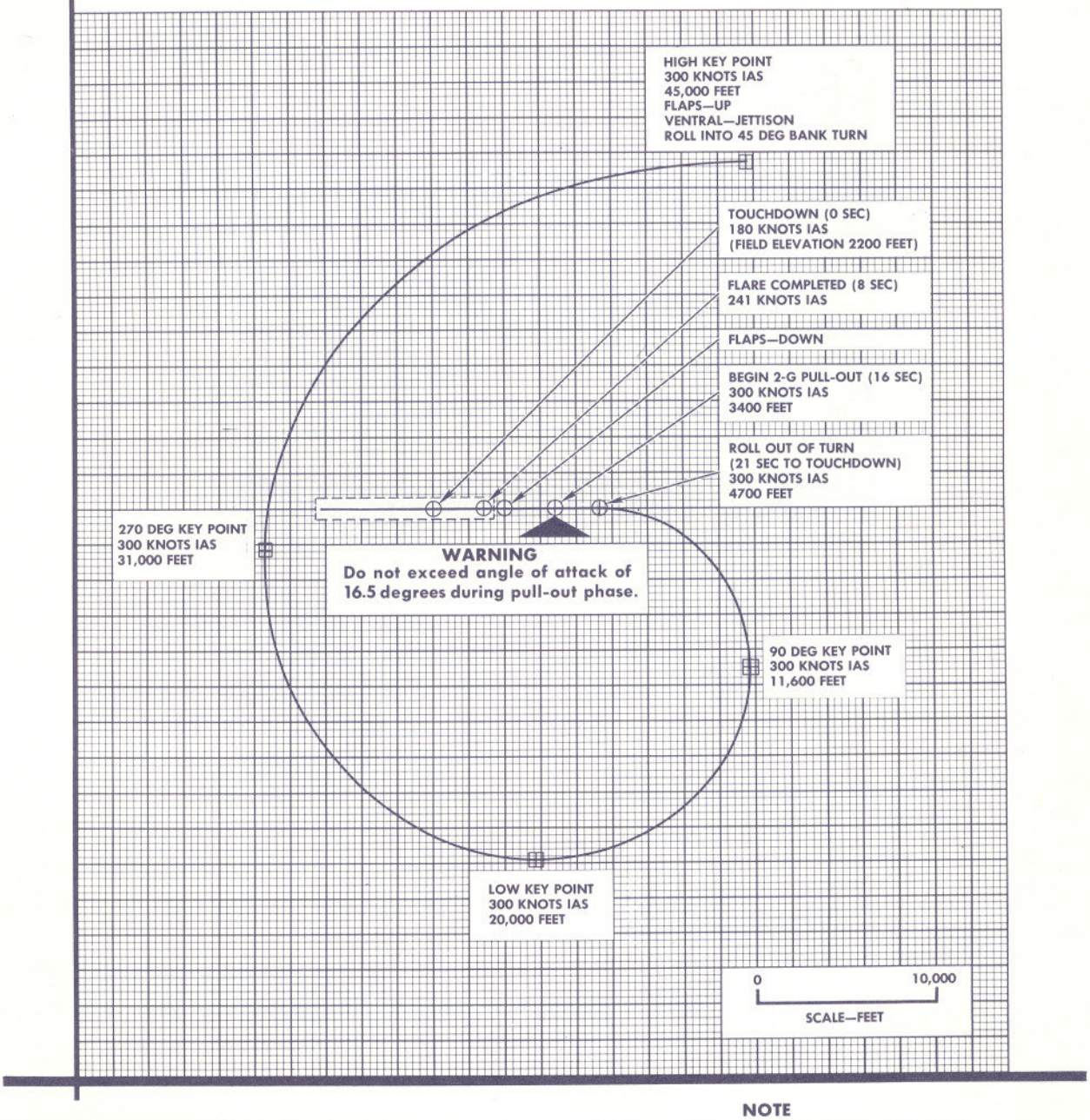
Figure 3-2

INADVERTENT LANDING GEAR LOWERING BEFORE ENTERING LANDING PATTERN



WINGS LEVEL GLIDING DISTANCE LANDING GEAR EXTENDED	
KNOTS IAS	DISTANCE PER 10,000 FEET
200	5 N MI
300	3 N MI

NOTE

- Maximum gliding distance with landing gear extended is obtained at 200 knots IAS.
- If a key point cannot be made at the indicated altitude, glide at 200 knots IAS until a later key point can be made with 3000 feet excess altitude; then dive off excess altitude to increase airspeed to 300 knots IAS.

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FUEL JETTISON

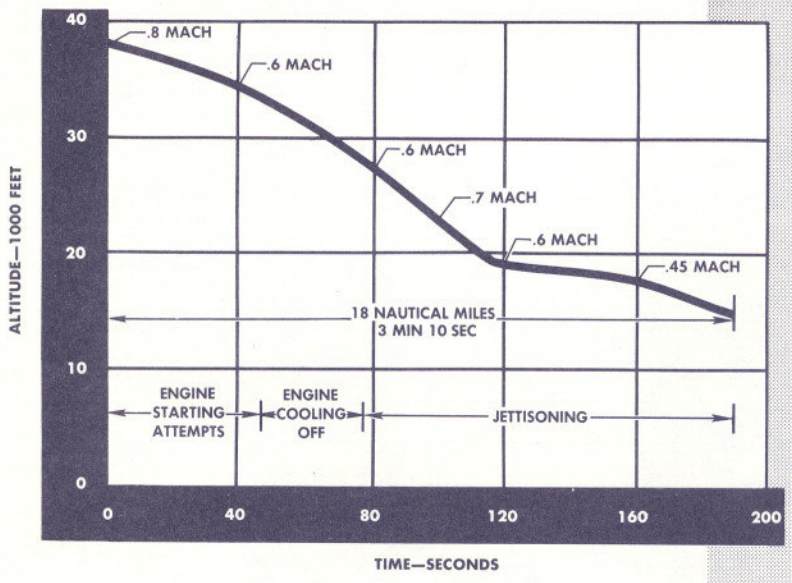

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Figure 3-3

PROPELLANT JETTISONING.

In an emergency where the engine propellants must be jettisoned, recheck jettison test switches at JETT; then move the vent, pressurization, and jettison lever to JETTISON, which allows the propellants to flow overboard. Approximate time required to jettison a full propellant load is 120 seconds. (See figure 3-3.)

APU SYSTEM FAILURE.

The dual APU's provided allow normal operation as long as one APU is operating. However, certain equipment not required for safe flight will be lost.

NOTE

The SAS emergency hydraulic system automatically provides hydraulic power for the SAS pitch and roll servos in the event of a No. 2 hydraulic system failure.

LOSS OF	RESULTS IN COMPLETE LOSS OF	NECESSITATES USE OF
APU No. 1	Ball nose SAS yaw	Mission abort may be required.
APU No. 1 & 2	All hydraulic power All electrical power	Emergency battery to attempt to restart APU. If restart fails, ejection is mandatory.

ELECTRICAL POWER SUPPLY SYSTEM FAILURE.

COMPLETE ELECTRICAL FAILURE.

If complete electrical failure occurs because of loss of both generators, the APU's will continue to operate. If the APU's are not operating, the emergency battery must be energized to start the APU's. With both generators failed, the airplane can be landed. If complete

electrical failure occurs because of failure of both APU's, the emergency battery switch must be turned ON, so that the APU's can be restarted. If the APU's cannot be restarted, ejection is mandatory.

GENERATOR FAILURE.

If either APU or generator fails and cannot be reset, certain missions may be flown, dependent on ground control. If a failure of this type should occur, proceed as follows:

1. No. 1 or No. 2 blower switch - OFF.
2. Vent suit heater switch - OFF.
3. Pressure suit ventilation knob - OFF.

   As soon as the unique research portion of the flight is over, continue with the following steps.

4. Instrumentation master switch - OFF.
5. Radar beacon circuit breaker - Pull.
6. Telemeter master and commutator switches - OFF.
7. No. 1 and No. 2 blower switches - BLOWER & LN_2.

NOTE

Operation of one equipment compartment blower at a time will substantially reduce the electrical load; however, operation of only one blower will appreciably shorten its life.

GENERATOR RESET PROCEDURE (APU RUNNING).

When a generator irregularity occurs, as shown by a generator failure light coming on, try to bring the generator back as follows:

1. Generator switch - RESET momentarily; then ON.

   Hold generator switch at RESET momentarily; then return switch to ON. Generator-out light should go out and remain out if failure was temporary.

2. Generator-out light - Check.

   If light is still on when generator switch is returned to ON, repeat reset procedure several times. If light remains on after several reset attempts, check voltmeter to determine generator output. Then proceed to step 3.

3. Voltmeter - Check.

   a. If voltmeter indication is normal, continue flight (leave generator switch ON).

   b. If voltmeter indicates no charge, continue flight. If no indication of charge is shown, continue flight but place generator switch OFF.

EMERGENCY BATTERY OPERATION.

If failure of both APU's or both generators occurs, the emergency battery must be energized to power the battery bus. The battery bus supplies power for restarting the APU's or to control the APU's.

HYDRAULIC SYSTEM FAILURE.

No emergency system is provided for the hydraulically operated aerodynamic flight control system, speed brakes, and wing flaps. Some airplanes have an SAS emergency hydraulic system which automatically provides hydraulic power to the SAS pitch and roll servos in the event of a No. 2 hydraulic system failure.

FLIGHT CONTROL HYDRAULIC SYSTEM FAILURE.

If failure of one flight control hydraulic system occurs, the other system assumes the entire load of aerodynamic flight control system operation. (Refer to "Aerodynamic Flight Control System" in Section I.) However, under such a condition, available control surface hinge moments will be one half their design value, because of reduction of hydraulic flow.

ARTIFICIAL-FEEL SYSTEM FAILURE.

The artificial-feel system failure can be indicated by a lightening of stick forces (resulting in overcontrol), lack of trim response, and poor stick-centering characteristics. If failure of flight control artificial feel is encountered, proceed as follows:

1. Airspeed - Reduce.

   Reduction of airspeed may relieve severe oscillations of the airplane.

2. If control cannot be maintained - Eject.

   Ejection is recommended if control cannot be maintained. If partial control is available, thoroughly check flight characteristics before descending below safe ejection altitude.

TRIM SYSTEM FAILURE.

If the trim system fails in either extreme-travel position, the maximum force required by the pilot to move the control surface to the opposite extreme is not beyond physical capabilities. If the pitch trim knob fails, the trim system can be controlled by the alternate trim switch. The trim control switch must be moved to ALTERNATE before the alternate trim switch is operable.

STABILITY AUGMENTATION SYSTEM (SAS).

The stability augmentation system provides aerodynamic damping on all axes of the airplane. If any axis of the SAS fails, control can be maintained by the pilot.

EMERGENCY ENTRANCE

EJECTION HANDLES NOT RAISED

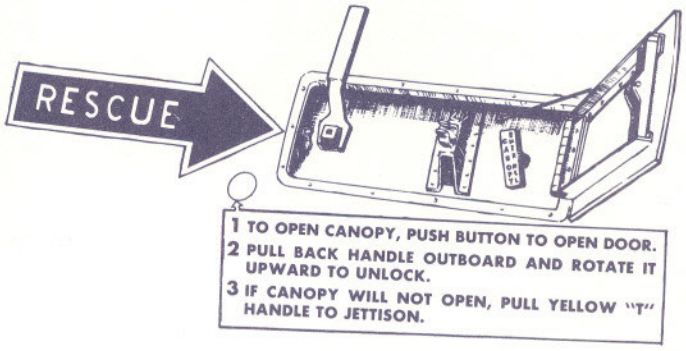
1. Push yellow button to unlatch cover door on right side of forward fuselage.
2. Pull out manual release handle and rotate handle up and back to unlatch canopy.
3. Lift canopy at forward end; then push canopy full open.

NOTE

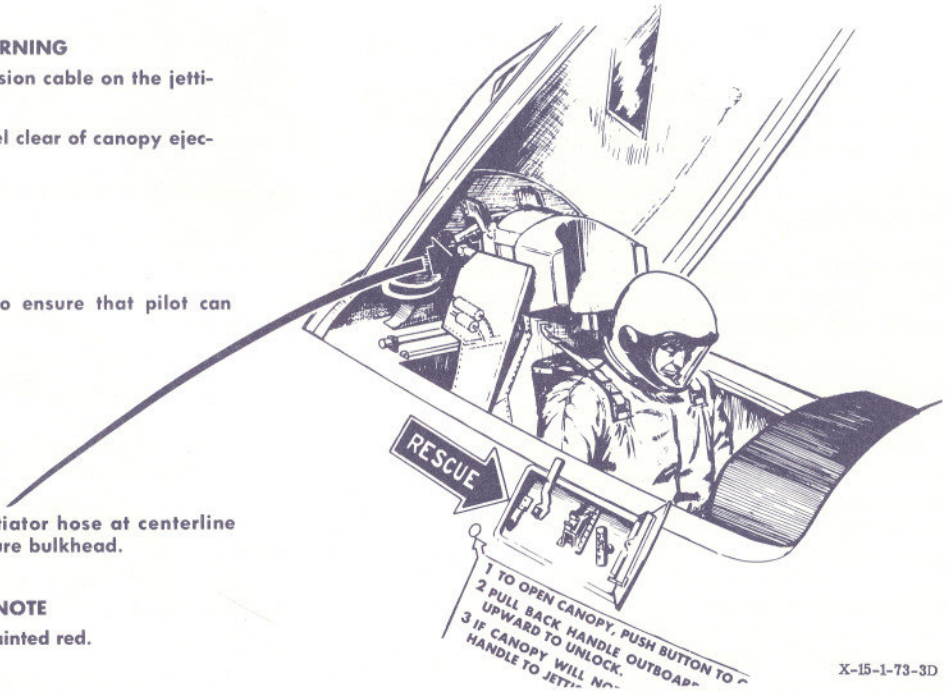
If canopy cannot be opened with manual release handle, jettison canopy by pulling yellow "T" handle just forward of manual release handle.

WARNING

- There is no extension cable on the jettison handle.
- Keep all personnel clear of canopy ejection path.



4. Open helmet visor to ensure that pilot can breathe.



5. Cut ejection seat initiator hose at centerline just forward of pressure bulkhead.

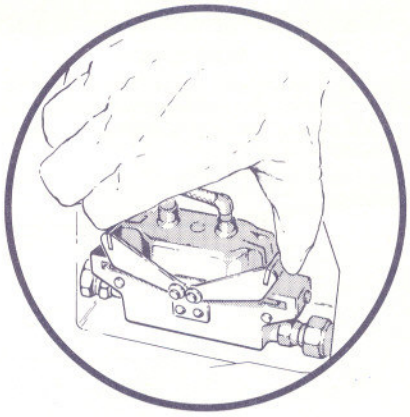
NOTE

Hose cut point is painted red.

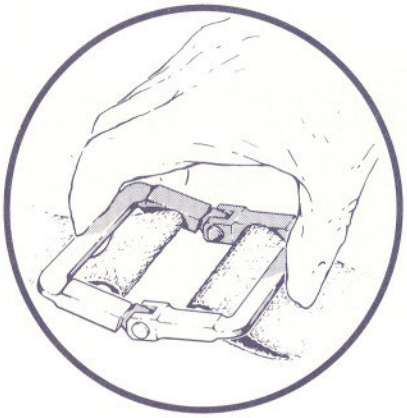
Figure 3-4 (Sheet 1 of 3)

6 Depress foot manacle release buttons if pilot's feet are locked in stirrups.

7 Disconnect personal leads.



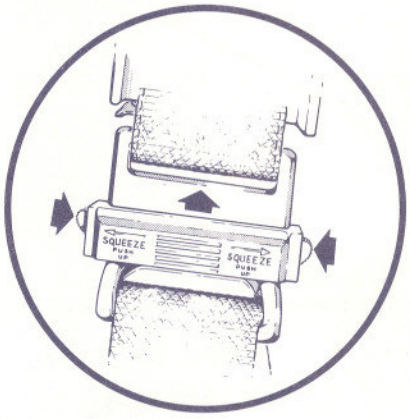
8 Open lap belt.



NOTE

If the lap belt is inside the sacrifice garment, the front zipper of the garment must be opened to reach the lap belt.

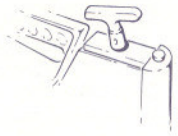
9 Disconnect parachute "D" ring retainer strap and both parachute risers, in that order.



10 Remove pilot.

NOTE

If time does not permit manual release of the pilot, push canopy completely off the airplane and pull restraint emergency release handle to free pilot of all restraints. Pilot's parachute container will remain with pilot.



WARNING

Do not stand above seat when restraint emergency release handle is pulled, because the headrest is ejected straight up with explosive force.

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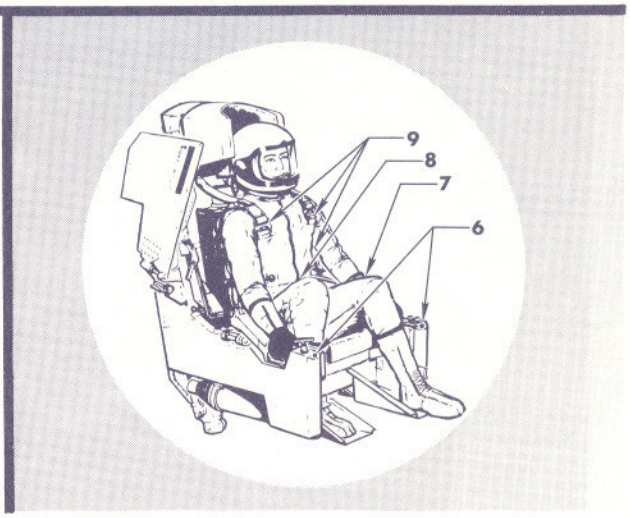


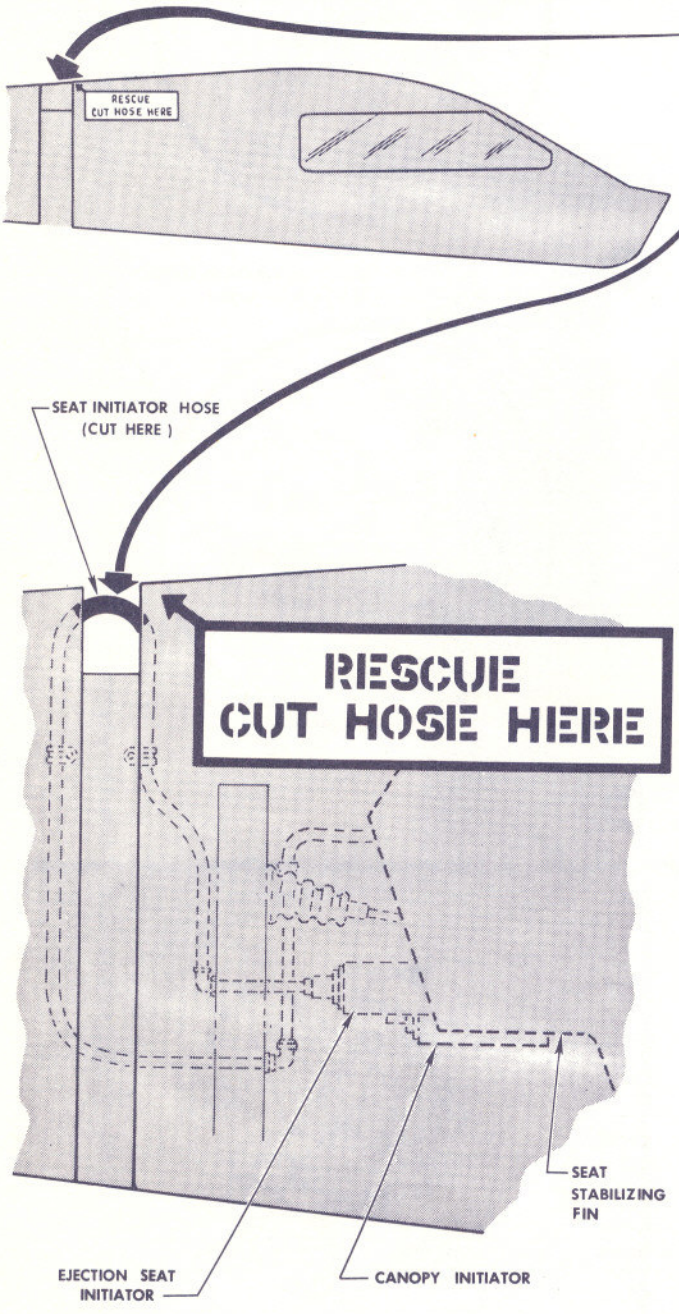
Figure 3-4 (Sheet 2 of 3)

1 EMERGENCY ENTRANCE

WARNING

If the ejection handles are raised, this procedure must be followed. Jettisoning the canopy or manually removing the canopy before the seat is disarmed will cause the seat to eject.

EJECTION HANDLES RAISED



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1. Remove access panel on top of fuselage, just aft of canopy.
2. Cut ejection seat initiator hose at centerline just forward of bulkhead.

NOTE

Hose cut point is painted red.

3. Push yellow button to unlatch cover door on right side of forward fuselage.
4. Pull out manual release handle and rotate handle up and back to unlatch canopy.
5. Lift canopy at forward end, then push up and aft until canopy completely separates from airplane.

NOTE

If canopy cannot be opened with manual release handle, jettison canopy by pulling yellow "T" handle just forward of manual release handle.

WARNING

- There is no extension cable on the jettison handle.
- Keep all personnel clear of canopy ejection path.

6. Open helmet visor to ensure that pilot can breathe.
7. Simultaneously push both ejection handles outboard and down to full stowed position.
8. Do steps 6 through 10 of "Ejection Handles Not Raised."

NOTE

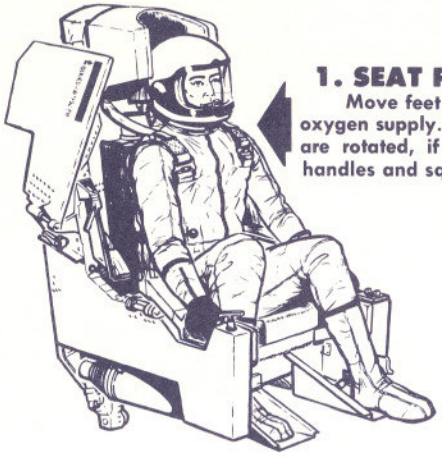
If both ejection handles will not move full down, pull restraint emergency release handle to free pilot of all restraints. Then disconnect parachute "D" ring retainer strap and both parachute risers and remove pilot from seat.

WARNING

Do not stand above seat when restraint emergency release handle is pulled, because the headrest is ejected straight up with explosive force.

Figure 3-4 (Sheet 3 of 3)

EJECTION



1. SEAT POSITION.

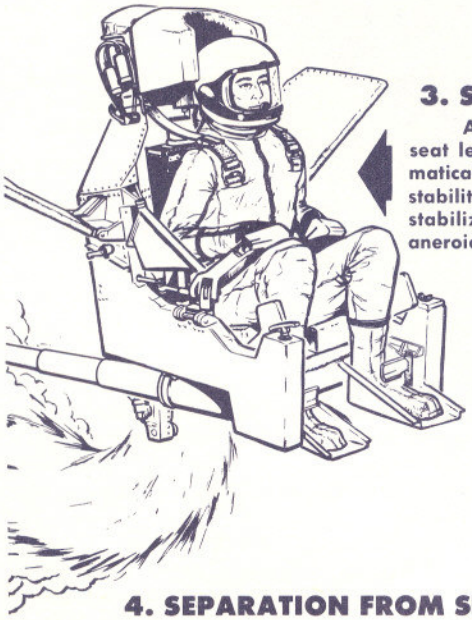
Move feet back and lock in foot restraints. Pull green ball for pilot's emergency oxygen supply. (The emergency supply is automatically actuated* when the handles are rotated, if time does not permit manual actuation.) Grip both seat ejection handles and squeeze either latch to release handles.

WARNING

Feet must be pulled full back into footrests to prevent injury by contact with the instrument panel or by wind blast.

2. PREPARING TO FIRE.

Move head back firmly against headrest and pull seat ejection handles up and in toward chest until locked. The canopy will fire in the last 15 degrees of movement. After the canopy fires, the seat is automatically ejected.



3. SEAT FIRES.

After the seat catapult fires, and just before the seat leaves the ejection rails, a small rocket is automatically fired to increase the seat trajectory and aid in stability. Also at this time, the stabilizing boom and stabilizing fins are extended, and the restraint system aneroid is armed.

4. SEPARATION FROM SEAT.

Seat separation below 15,000 feet or after freefall down to 15,000 feet occurs in 3 seconds in the following sequence:

Releasing of the integrated restraint harness from the seat; unlocking of the seat ejection handles and foot restraint; and finally firing the headrest, which releases the shoulder harness, and deploys the pilot chute, which in turn deploys the main parachute to pull the pilot free of the seat.

* Some airplanes

X-15-1-73-2D

Figure 3-5

BALLISTIC CONTROL SYSTEM FAILURE.

Failure of one system does not affect the operation of the other system, which is adequate to maintain attitude control. However, control will be at a reduced rate.

REACTION AUGMENTATION SYSTEM (RAS).

The reaction augmentation system provides pitch, roll, and yaw rate damping through the use of the No. 1 ballistic control system. If any axis of the RAS fails, attitude control is still maintained by the pilot. However, precise attitude control may deteriorate.