CHAPTER 2

AIRFRAME AND FLYING CONTROLS

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CHAPTER 2 AIRFRAME, FLYING CONTROLS AND STALL WARNING

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CHAPTER 2

AIRFRAME AND FLYING CONTROLS

1. Structure

A. General

The Jetstream 41 is a low wing monoplane of predominantly all metal stressed-skin construction. It is designed for a long fatigue life and built with extensive corrosion protection.

B. Fuselage

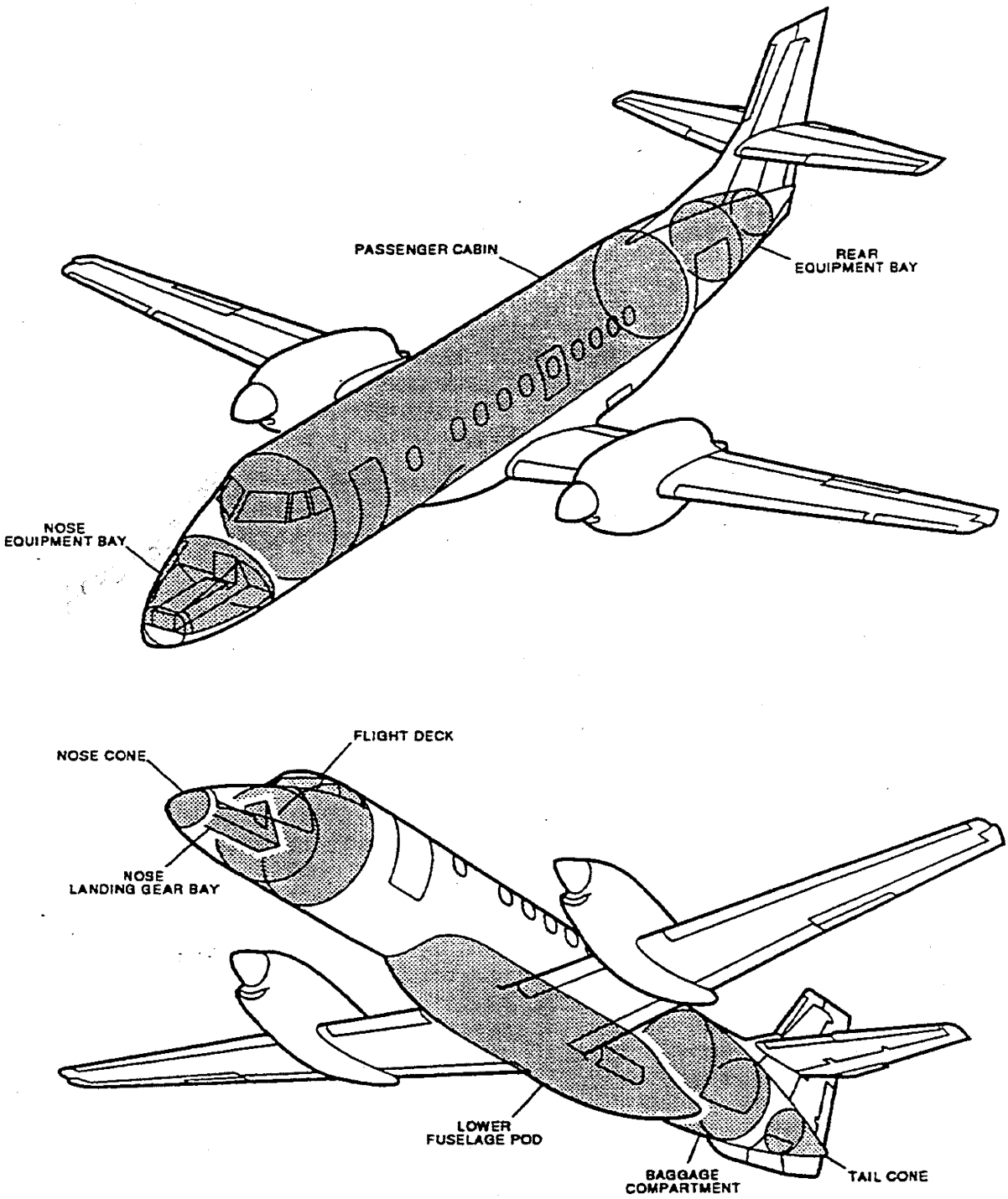
The fuselage structure is of conventional aluminium alloy construction. The passenger cabin has a circular cross section of maximum diameter 78 inches. Flat pressure bulkheads at the front of the flight deck and rear of the baggage compartment seal the pressurized section of the fuselage.

Drains are provided throughout the fuselage where liquids might collect. These drains are spring loaded to the open position when the fuselage is depressurized but close when the fuselage is pressurized.

The fuselage has seven main zones:

- The nose cone, which covers the radar and glideslope antennae
- The nose landing-gear bay, which contains the nose gear and related hydraulic equipment
- An unpressurized nose equipment bay, which contains electrical and avionic equipment
- A pressurized cabin, divided by bulkheads into three areas; flight deck, passenger cabin and main baggage compartment
- An unpressurized rear equipment bay, which contains flying control components and optional equipment
- A removable tail cone, which covers part of the rudder control system
- The ventral fairing, which contains, at its forward end, the cold air units for the air conditioning system and, at its aft end, hydraulic system components, fire extinguisher bottles, an electrical bay complete with batteries, and an unpressurized ventral pod baggage-compartment.

An emergency cut-in area is located on the top of the fuselage, approximately in-line with the first left hand/second right hand cabin window.



Fuselage - Main Zones

C. Wings

The wings are a full span box structure comprising front and rear spars joined by ribs and closed top and bottom by skin panels. The wing structure is connected to the fuselage by links bolted to fittings on the front and rear spar frames.

The structural box of each half-span is sealed to form an integral fuel tank in two sections, separated by the engine nacelle. The two sections of the fuel tank are connected by fuel transfer and vent pipes in the nacelle area. A part of the inboard section is divided to form a scavenge tank and a collector tank, a fuel standby pump is in each collector tank. The outer part of each outboard section is a vent/expansion tank.

A pressure refuelling point is located behind an access door in the leading edge of the right wing outboard of the engine. A gravity refuelling point is in the top outboard section of each half-wing span.

The wing rear spar carries the manually controlled ailerons and hydraulically operated flaps. Hydraulically operated spoilers are also fitted to the inboard top surface of each wing.

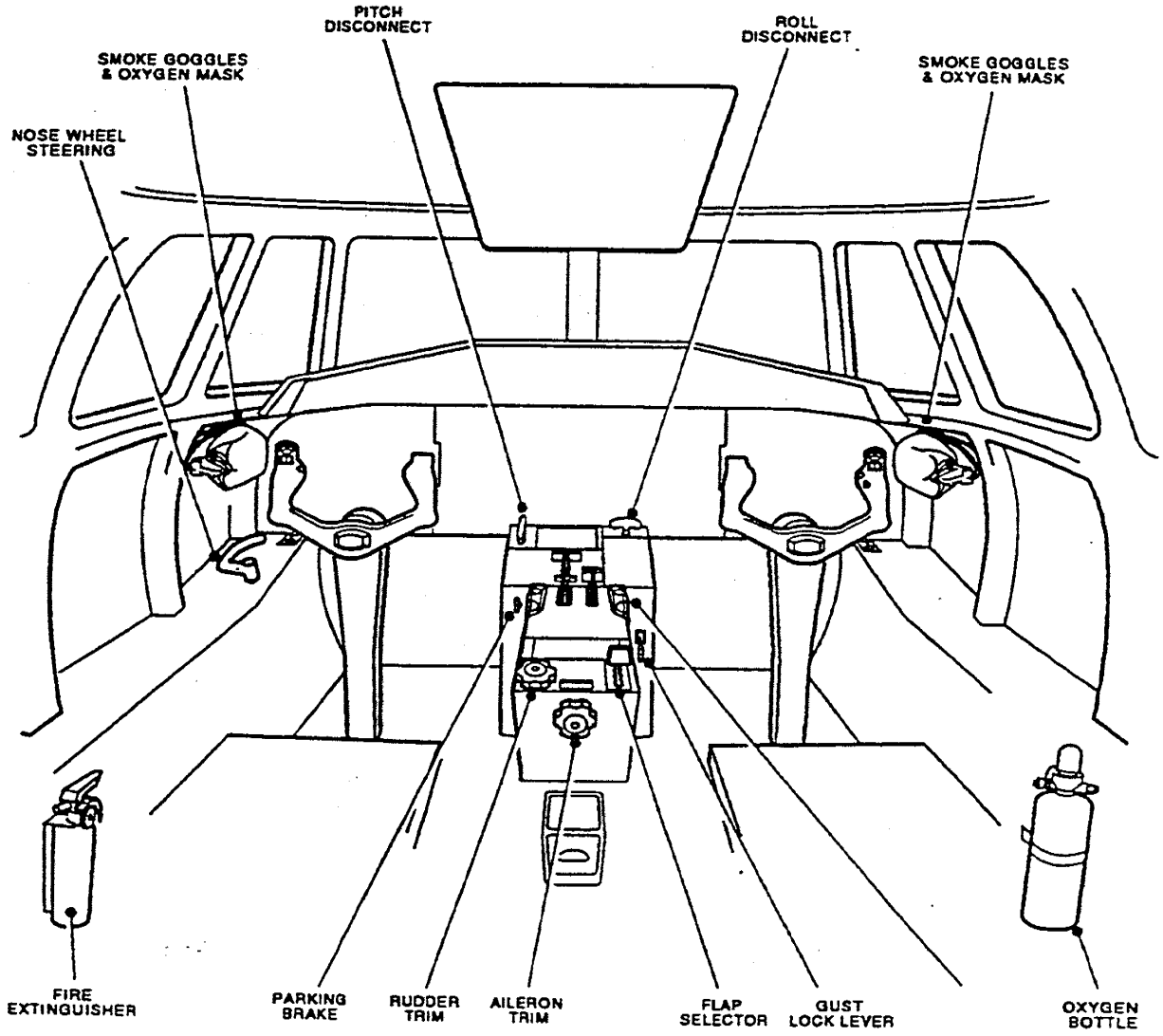
Pneumatically operated de-icing boots are fitted to the detachable leading edge of each wing.

D. Tail Unit

The tail unit, which is of conventional aluminium alloy construction, consists of a vertical stabiliser and rudder, and a horizontal stabiliser with split elevators.

A dorsal fairing is fitted to the upper fuselage forward of the vertical stabiliser. The leading edges of the vertical and horizontal stabilisers are fitted with pneumatically operated de-icing boots. The leading edges are detachable.

The rudder and elevators are fitted to the rear spars of the vertical and horizontal stabilisers respectively. The rudder and elevator surfaces are fitted with trim tabs. The elevator horns are fitted with electrically operated anti-icing mats.



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Flight Deck Layout

2. Furnishings

A. Flight Deck Stowage:

Stowage is provided on the flight deck for the following items:

- Hand fire extinguisher
- Electrical filaments
- Oxygen cylinder
- Oxygen mask/smoke visor
- Fire Axe
- Torches
- Escape ropes
- Flight bags.

B. Flight Crew Seats

The flight crew seats are mounted on rails. The seats are removable and are adjustable fore and aft, and for height. Each seat is equipped with a full restraint harness and adjustable arm-rests. The pilots seat provides stowage for two lifejackets (one for the observer) and the co-pilots seat provides stowage for one lifejacket.

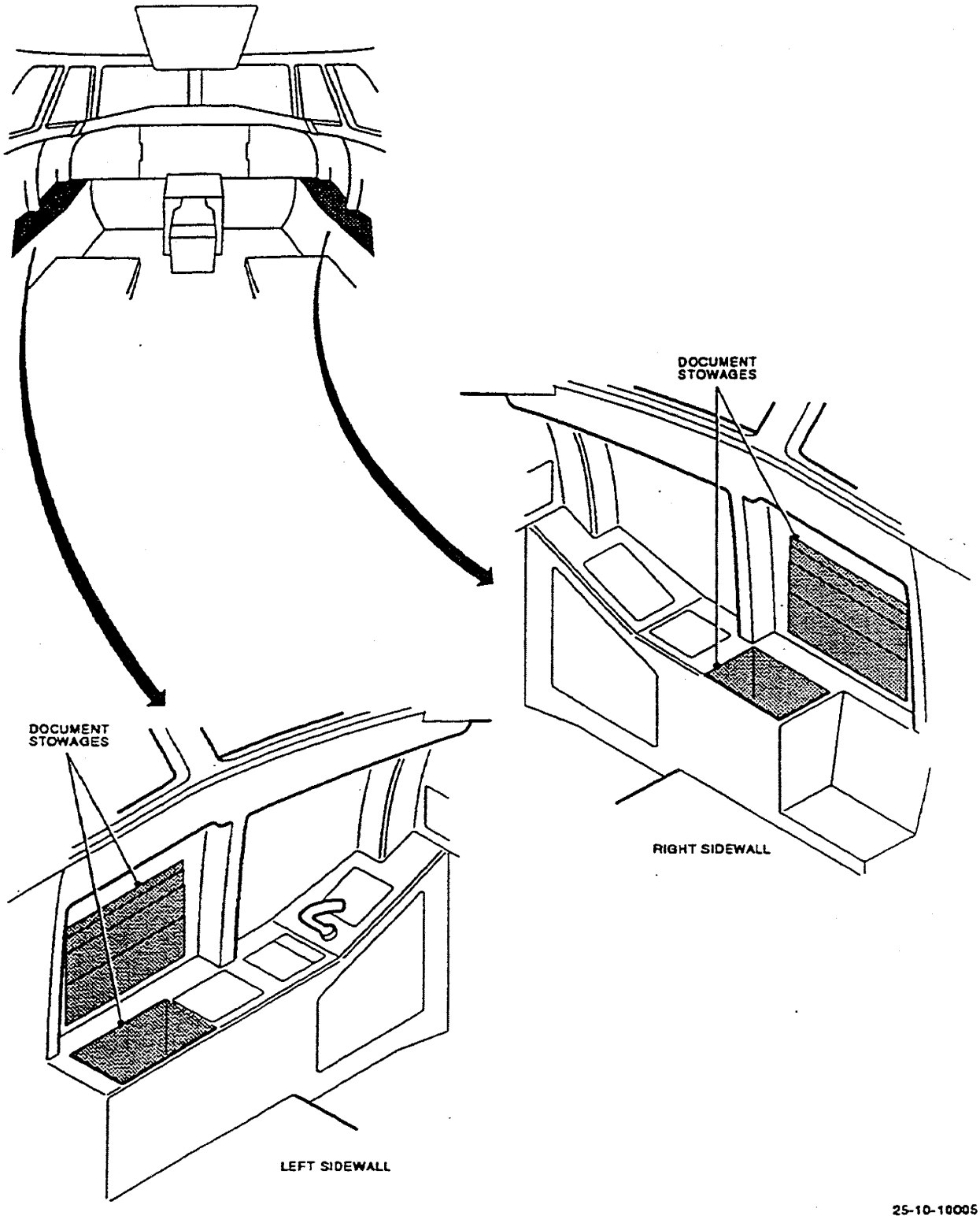
C. Flight Observer Seat

A folding seat with a 4-strap harness is provided for a flight observer. The seat base is hinged from the stowage unit located at the rear left side of the flight compartment.

The backrest of the seat is on the front face of the flight deck entrance door.

D. Passenger Seats

Seating for up to 30 passengers is provided by ten double seats on the right side and ten single seats on the left side of the cabin. The seats incorporate under-seat baggage space, lifejacket stowage and adjustable lap straps.



Flight Deck Stowages

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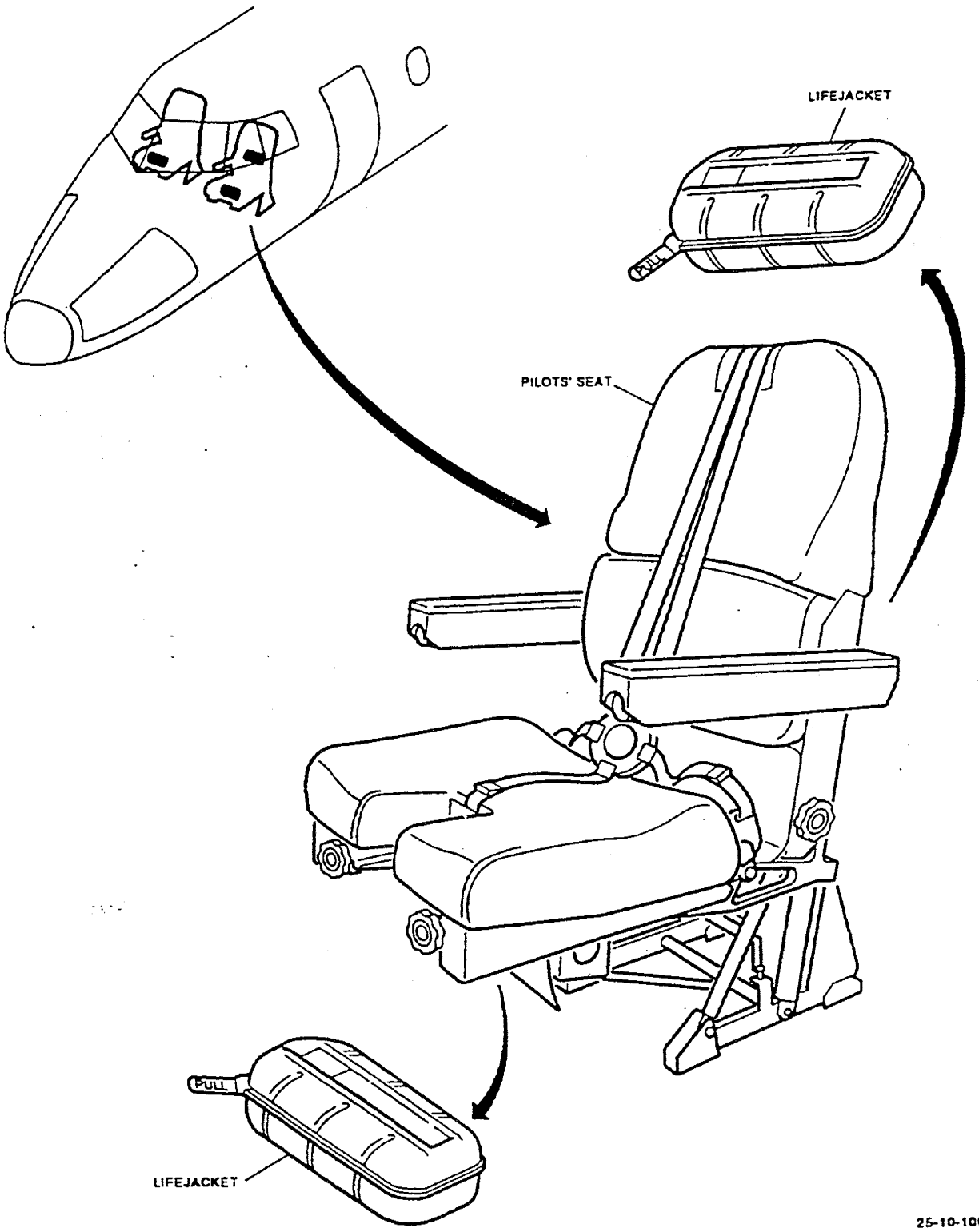
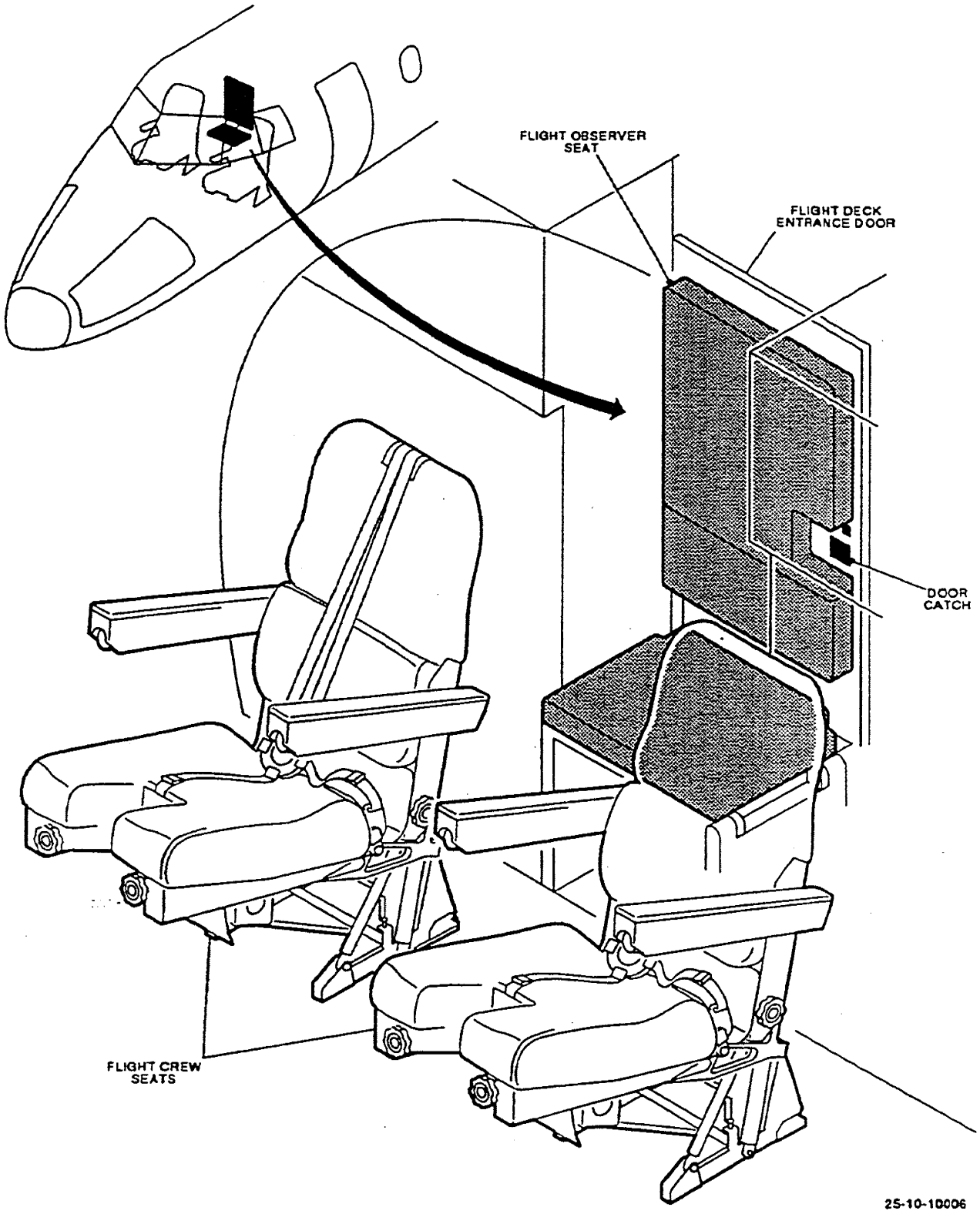
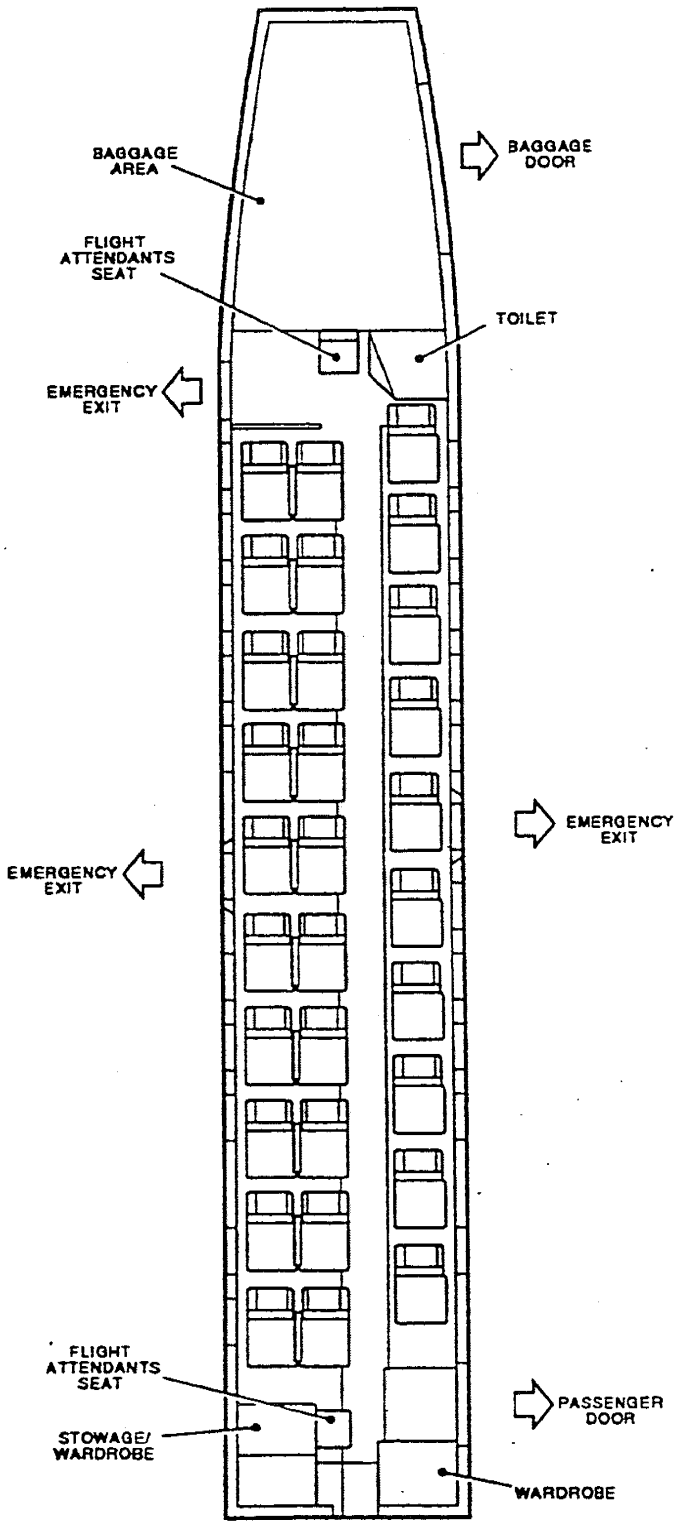


Flight Crew Seats



Flight Observer Seat



Passenger Seat Layout

E. Flight Attendant Seat

A folding seat is provided for the flight attendant. The seat is located on the bulkhead at the rear of the passenger cabin. It is equipped with a 4-strap adjustable harness.

NOTE: A debris guard is fitted under the seat hinge to prevent ingress of debris into the area below the cabin floor panels.

An additional folding flight attendant seat is located on the forward right hand stowage unit. It is not for use during take-off or landing it is only to supplement the existing attendant seat situated in the rear cabin area.

F. Passenger Service Unit (PSU)

The PSU's are above the passenger seats. The PSU's contain individual reading lights, fresh air outlets, flight attendant call buttons, no smoking annunciators and fasten seat belt annunciators.

G. Main Baggage Compartment

The main compartment for baggage stowage is in the pressurized fuselage aft of the passenger cabin. The compartment is separated from the passenger cabin by a bulkhead and is equipped with a smoke detector and baggage restraint nets.

Access to the baggage compartment is through a large upward opening door on the left side of the fuselage. An internal door is also fitted to the separation bulkhead to allow access to the compartment (in-flight) in the event of a fire in the main baggage compartment.

H. Ventral-Pod Baggage Compartment

The ventral-pod baggage compartment is in the rearward extension of the ventral fairing. The compartment is equipped with a smoke detector and access to it is through lockable doors, one on each side of the ventral-pod baggage compartment.

I. Carry-On Baggage Stowage

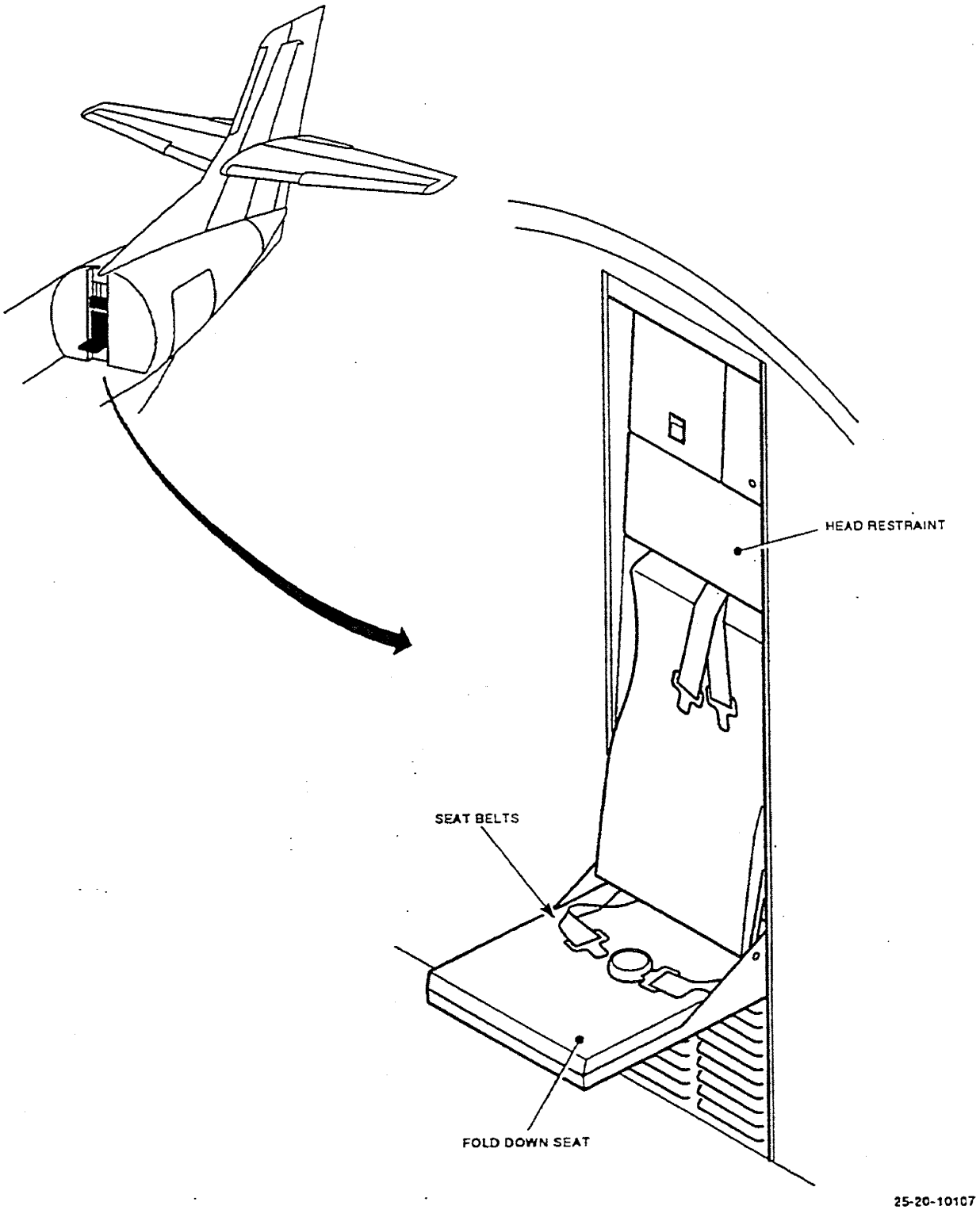
Stowage for passenger carry-on baggage is provided in two forward compartments and under the passenger seats.

J. Toilet Compartment

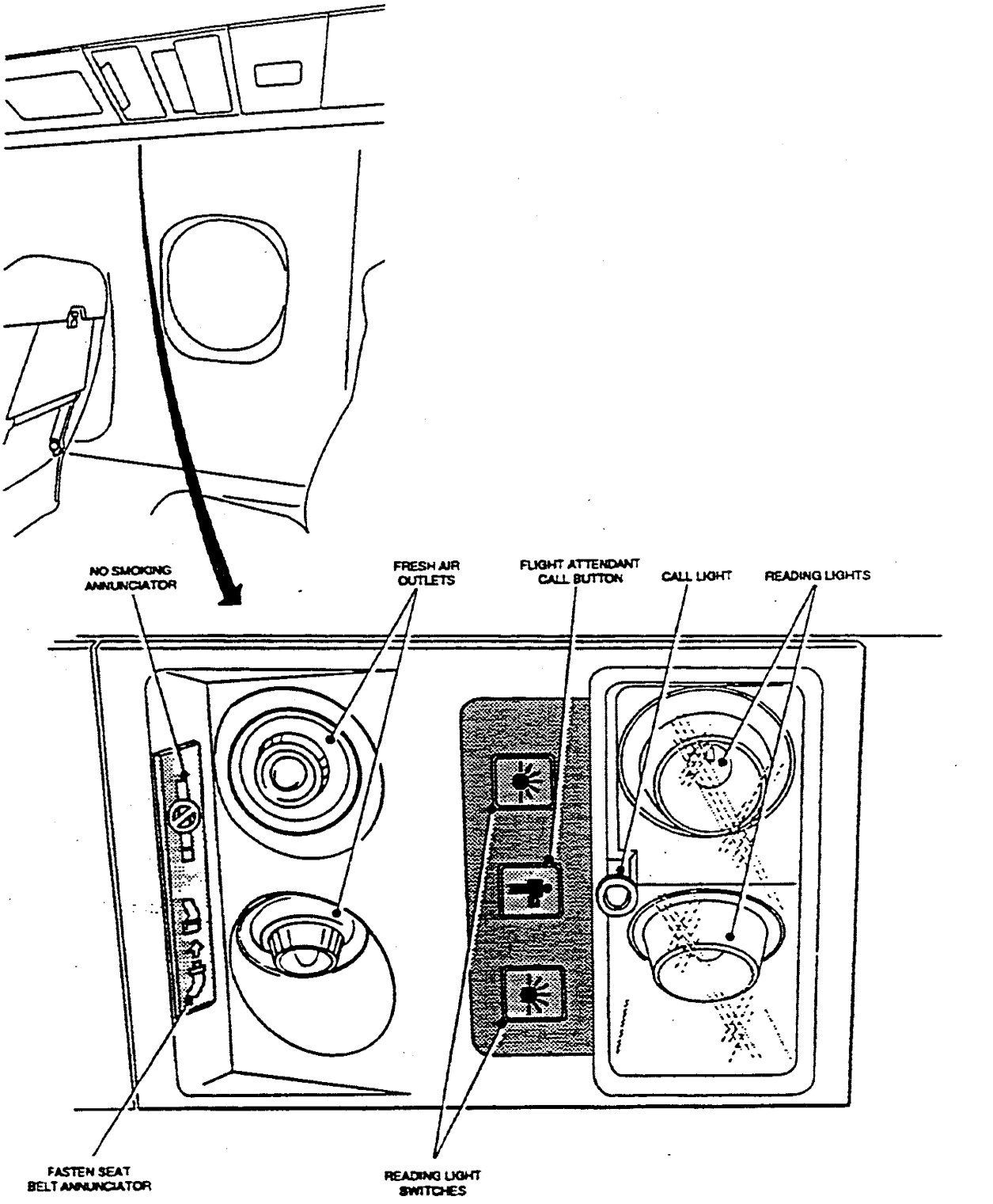
A toilet compartment is situated in the rear vestibule area on the left side of the aircraft directly opposite the rear emergency escape hatch. The toilet is a self contained, self-flushing type and is serviced from outside the aircraft.

K. Partitions

Removable internal partitions are fitted in the passenger cabin to screen the main entrance door and the rear vestibule areas from the rest of the main cabin.



Flight Attendant Seat



Passenger Service Unit (PSU)

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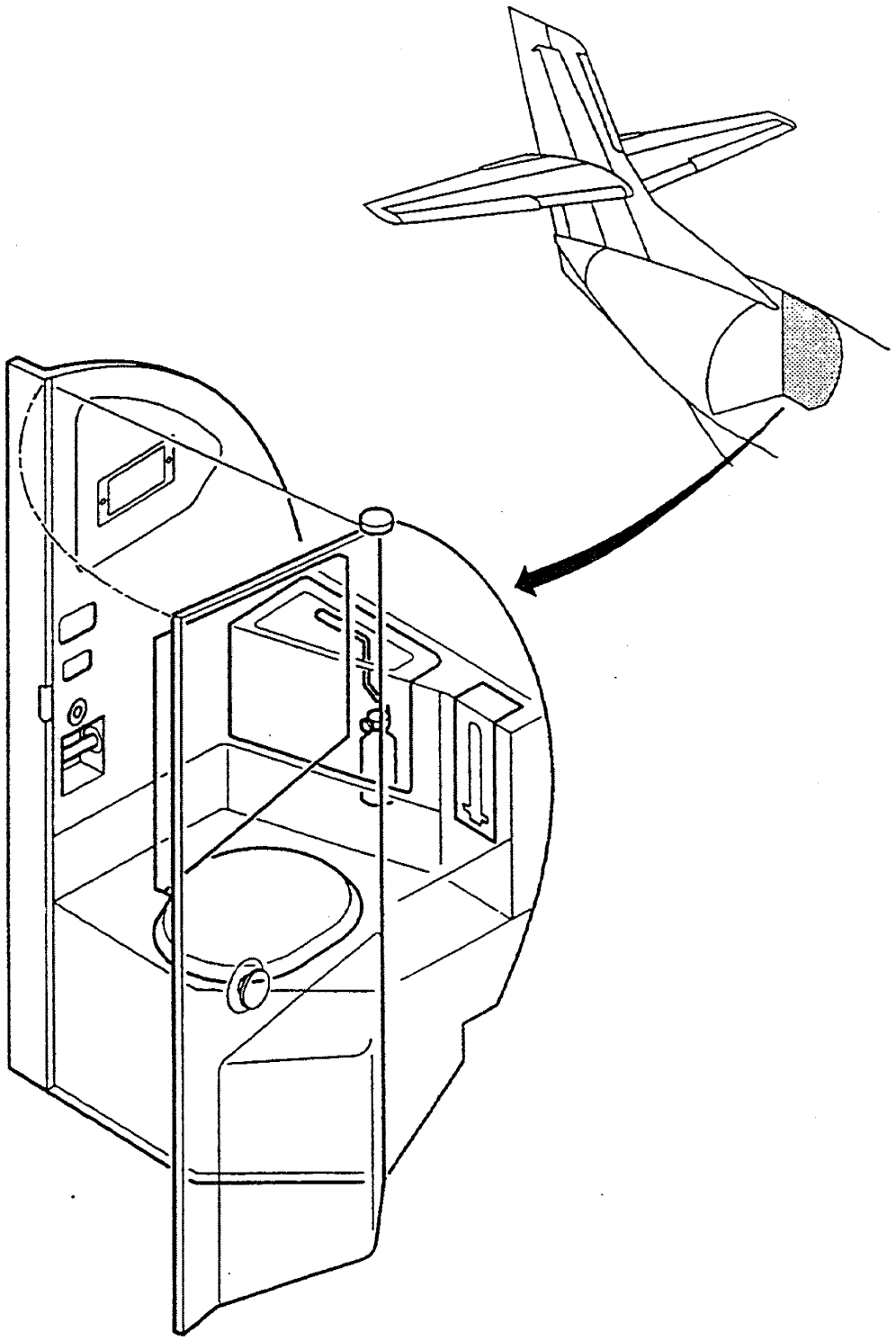

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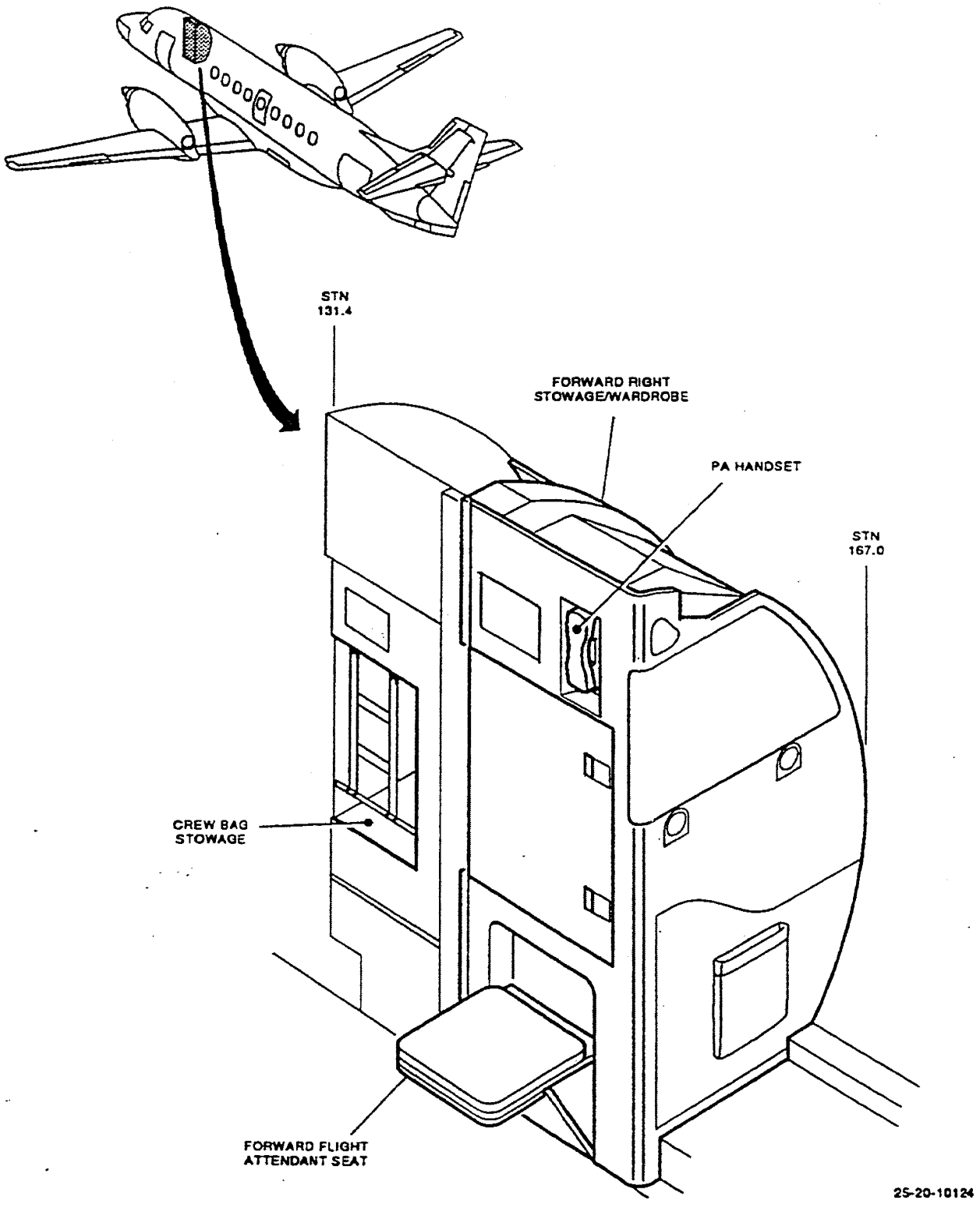
Toilet Compartment



Forward Right Hand Stowage and Cabin Attendant Seat

3. Doors

A. Passenger Door

A passenger door is provided at the forward end of the passenger cabin on the left side. The door can be opened from inside or outside of the aircraft. When the door is closed it is held in place by fixed abutments on the door side frames and by the door locking mechanism.

The door locking mechanism can be visually inspected to confirm that the locking mechanism bolts are correctly engaged. The orange/red bars, on the door locked indicator, are aligned when the door is closed and locked. The door locking mechanism is fitted with microswitches to signal a warning if the door is not correctly locked.

The door is opened, from inside the aircraft, by unlocking the handle, which lifts the door to disengage it from the guide blocks on the door side frames. The restraining cable should be lying free and not snagged. A simple push of the handrail, at approximately shoulder level, opens the door outwards and downwards. The handrail restraining cable should not be grasped tightly as this could result in the person losing balance if the door deploys quickly. The door locks in position by stepping onto the airstairs.

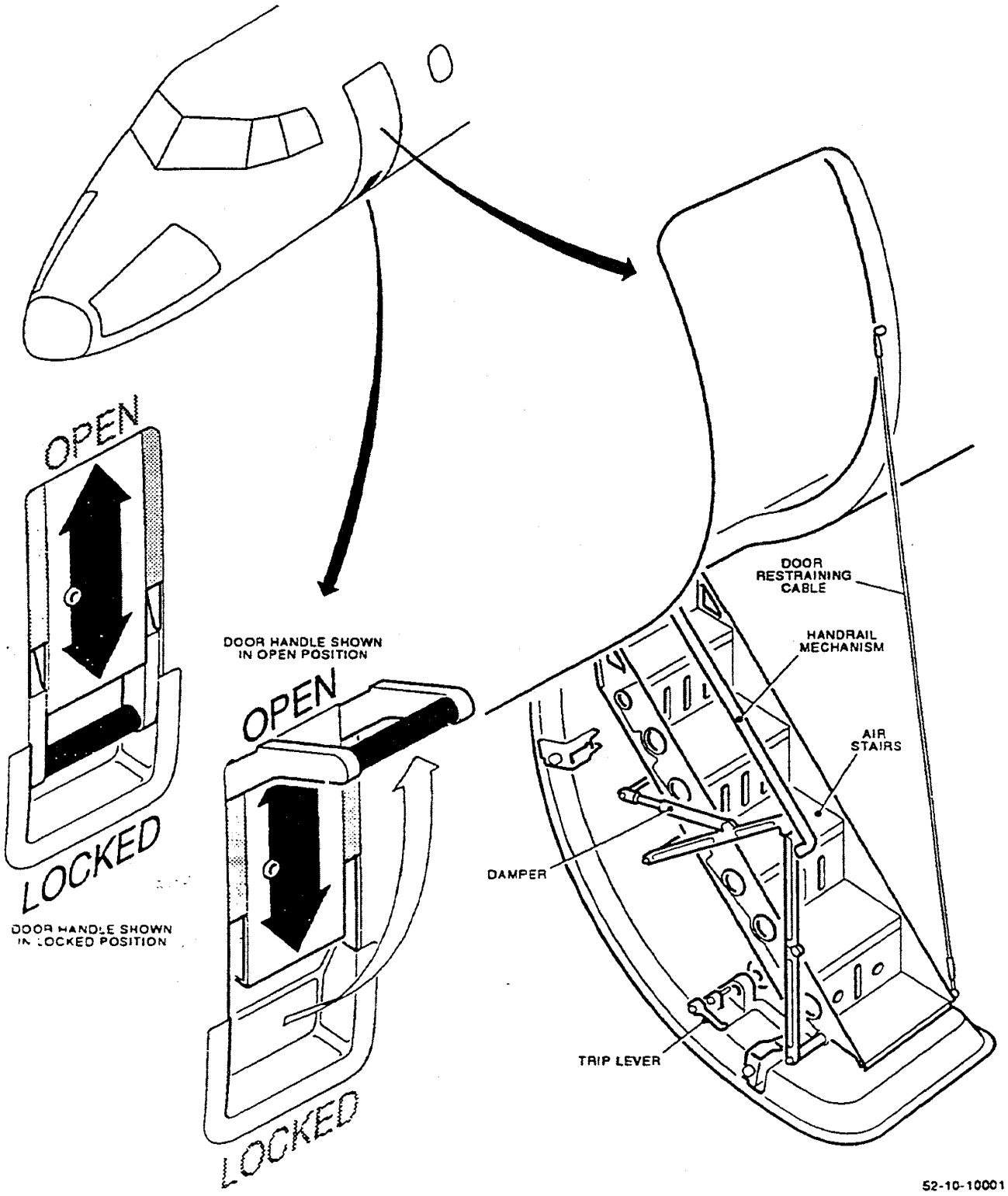
The door is opened, from outside the aircraft, by unlocking the handle on the door and pulling the door outward and downward, supporting the door by hand to the neutral point, checking on opening that the restraining cable is not snagged. The door then continues to open under its own weight, restricted by a gas strut. The door locks in position by stepping onto the airstairs.

The door is suspended on links from the airstairs. The airstairs are hinged from the fuselage and locked in position by a handrail, integral with the airstairs and fuselage. There is no load on the door structure during passenger embarkation and disembarkation.

The door is closed by unlocking the handrail integral downlock by either releasing the trigger on the lower end of the handrail or by depressing the integral foot pedal in the cabin. The door is then rotated upwards on its hinges, to engage it behind the guide blocks on the door side frames before closing the locking handle. When closing the door the restraining cable should be lying free and not snagged.

To prevent inadvertent unlocking of the door in flight a secondary speedlock, operated by a speed switch, is inserted into the door locking mechanism during the take-off roll.

NOTE: In the event that the secondary speedlock fails to automatically disengage during the landing roll, a manual release facility is provided which, when operated, will enable normal door opening.



Passenger Door

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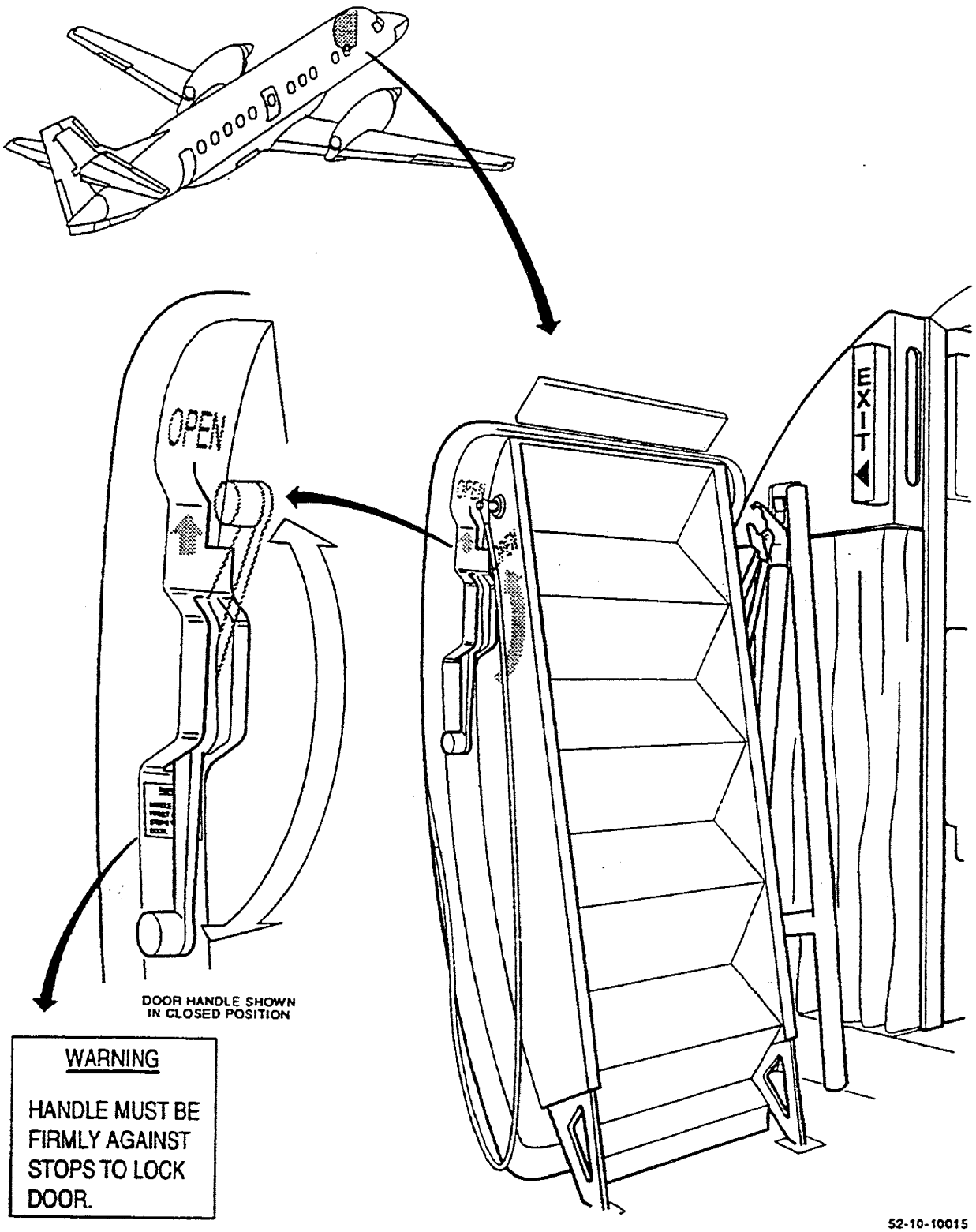

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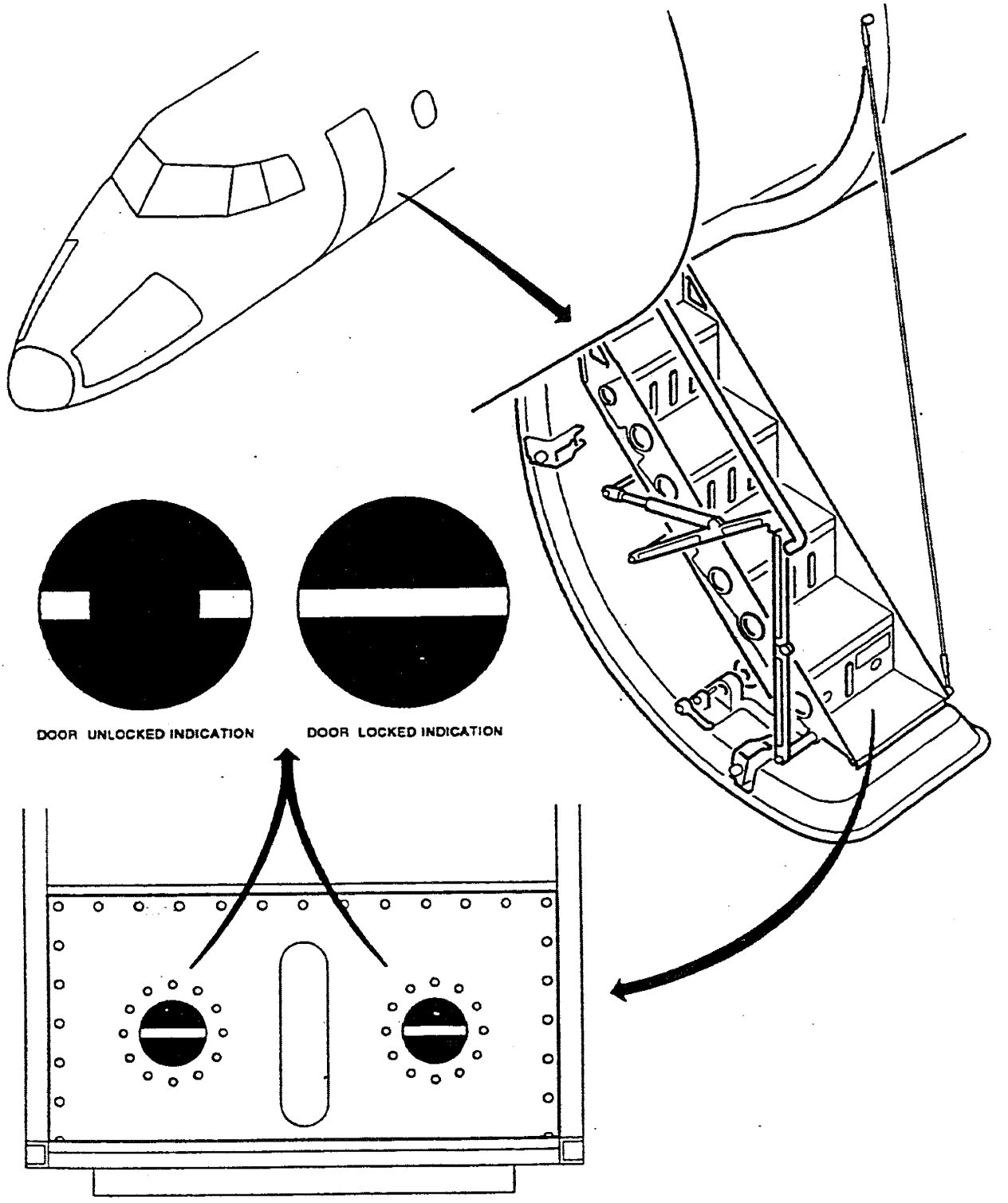
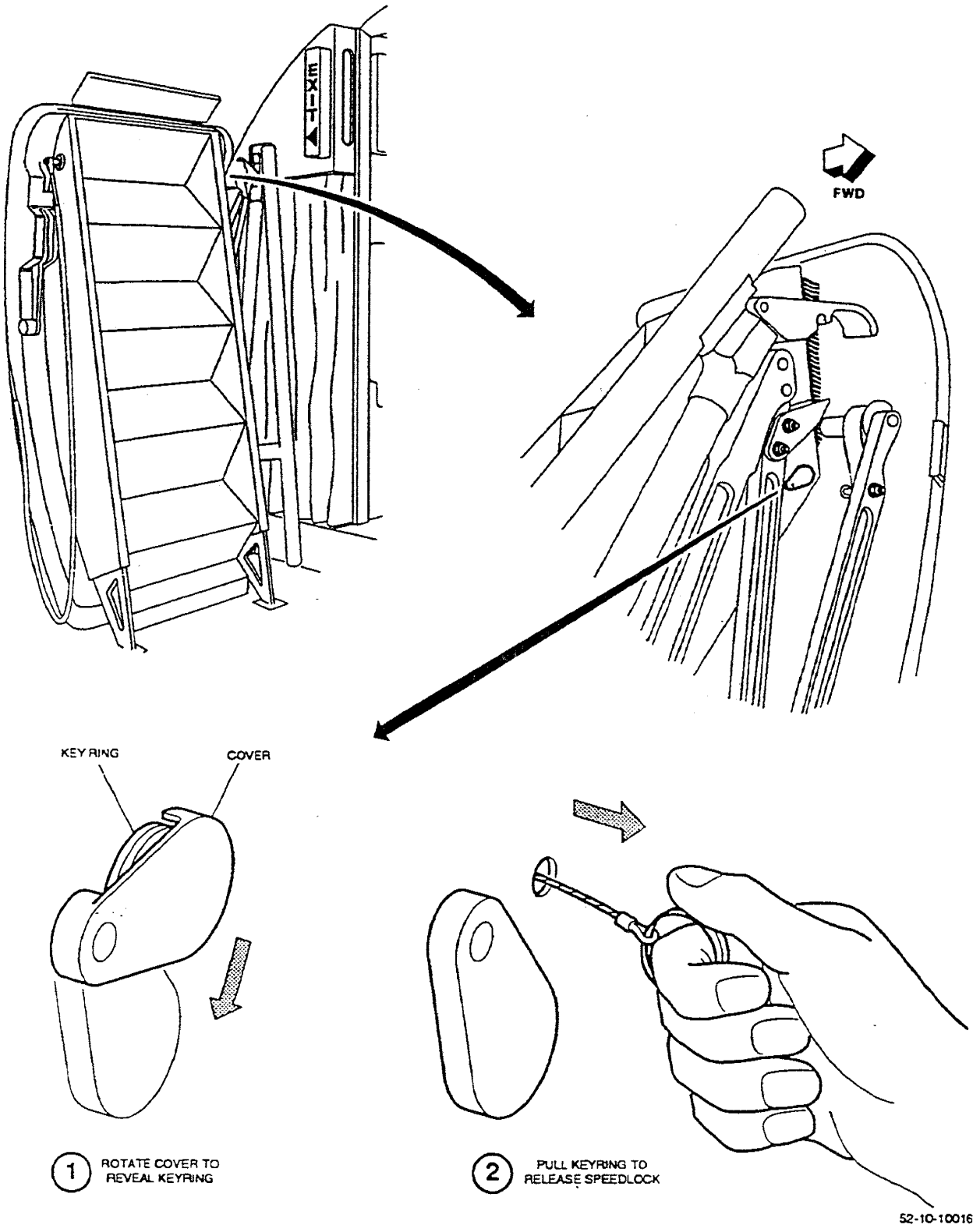
Passenger Door-Operation



Passenger Door-Indication



Passenger Door Speedlock Manual Release

B. Overwing Escape Hatches

Overwing escape hatches are provided, one on each side of the passenger cabin. They can be removed using the emergency handle on either the inside or the outside of the hatch. The hatch is hinged at the bottom and must be pulled or pushed into the aircraft and discarded to give access to the top of the wing for escape.

Microswitches signal a warning on the Central Annunciator Panel if the doors are not correctly closed and locked.

C. Aft Emergency Exit Door

An aft emergency exit door is provided on the right side of the fuselage at the rear of the passenger cabin. The emergency exit door can be opened using the internal or external release handle.

Upon release the emergency door rotates into the cabin around the bottom mounted hinges. The emergency door is removed and discarded outwards to allow emergency escape.

Microswitches signal a warning on the Central Annunciator Panel if the doors are not correctly closed and locked.

D. Main Baggage Compartment Door

The plug type door for the main baggage compartment is on the left side of the fuselage at the aft end of the pressure cabin.

The door is opened by pulling the handle to the unlocked position, rotating the handle to the open position, and pushing the door inwards and upwards. The door moves in tracks and movement is assisted by a balance spring. To close the door, pull it down in the track then outwards to the plug position before setting the handle to closed and locked.

Microswitches signal a warning on the Central Annunciator Panel if the doors are not correctly closed and locked.

E. Ventral-Pod Baggage Compartment Doors

The baggage compartment doors in the ventral pod are secured by three shoot bolts operated by a locking handle.

Microswitches signal a warning on the Central Annunciator Panel if the doors are not correctly closed and locked.

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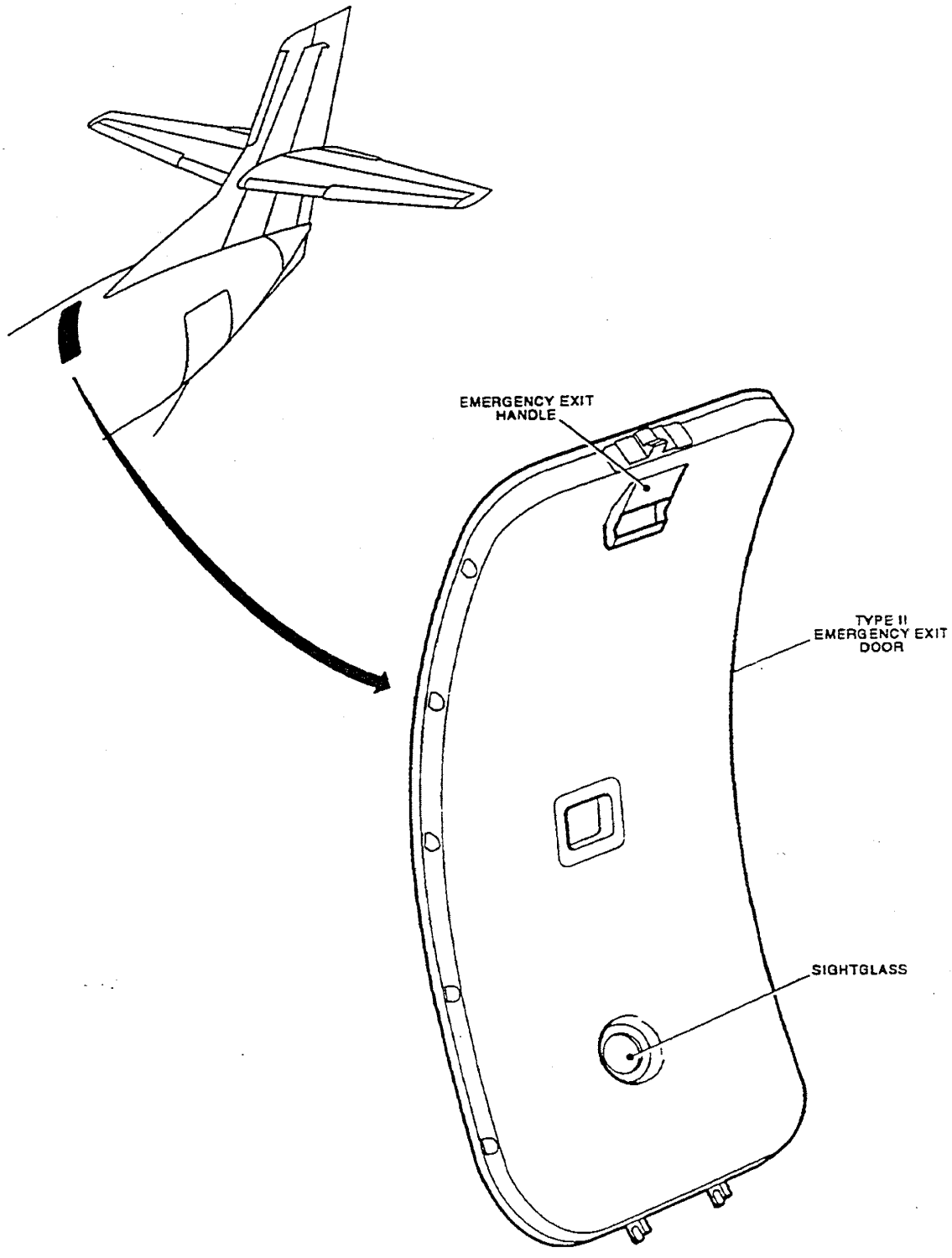

Type II Emergency Exit Door

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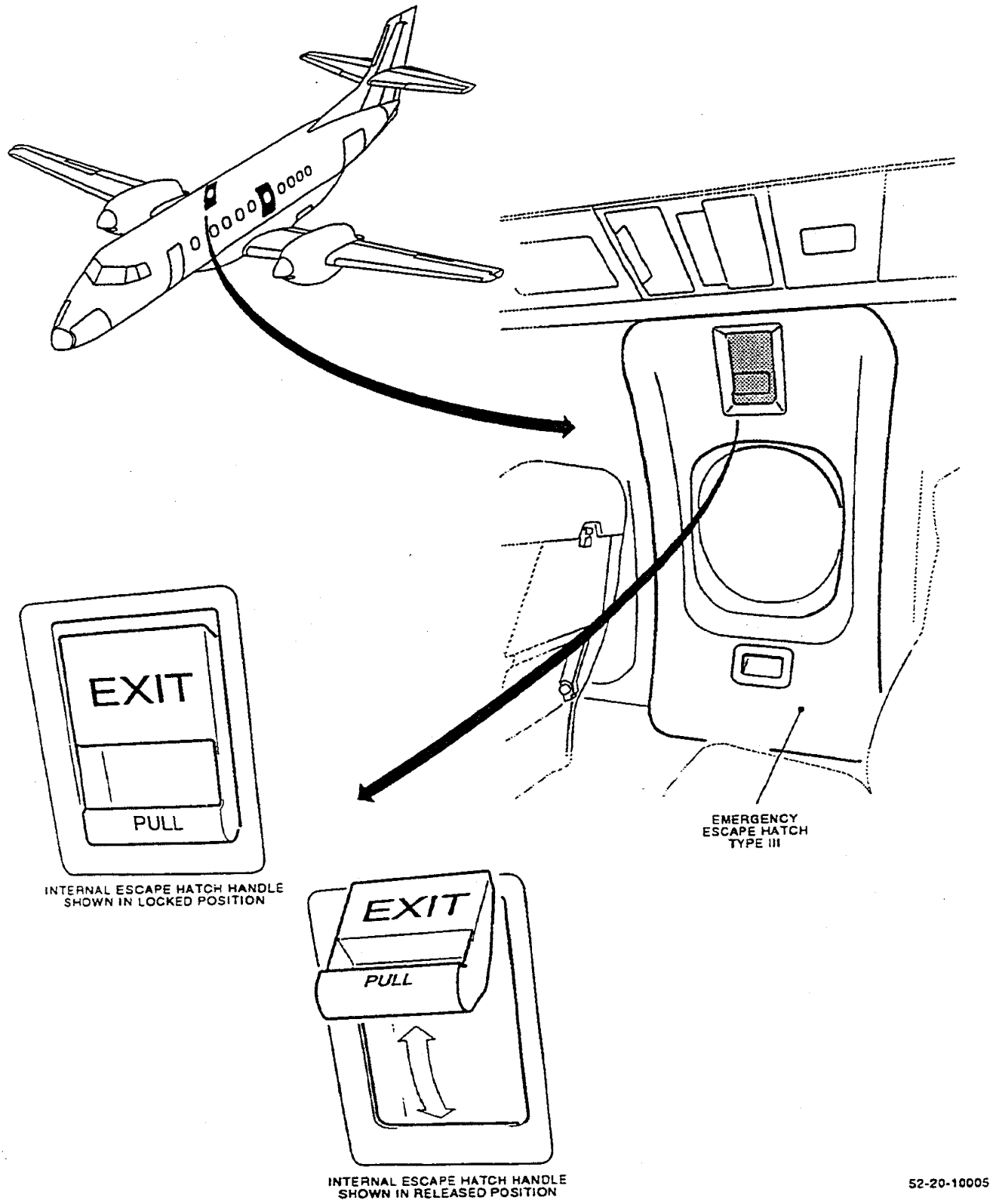

Type III Overwing Emergency Exit

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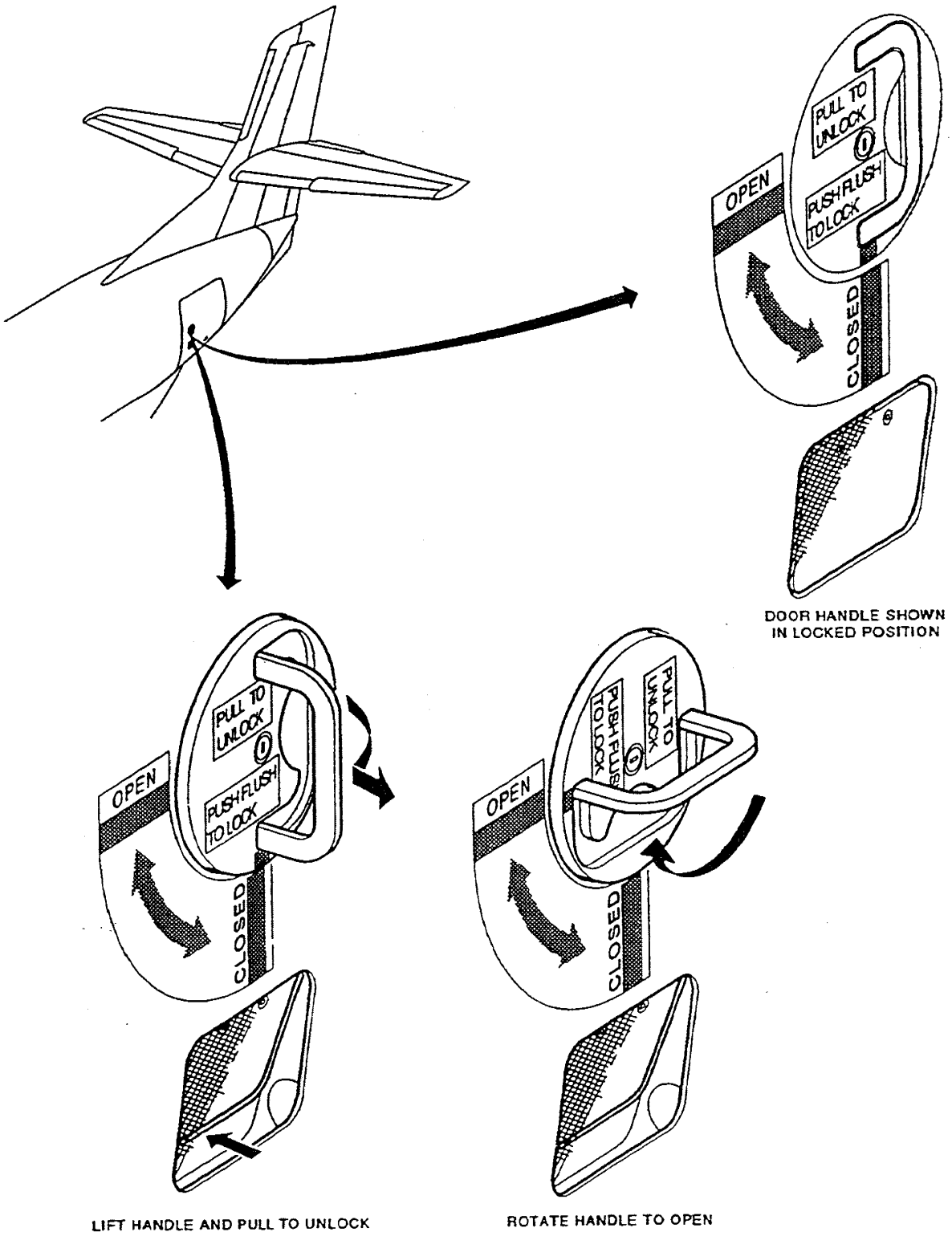

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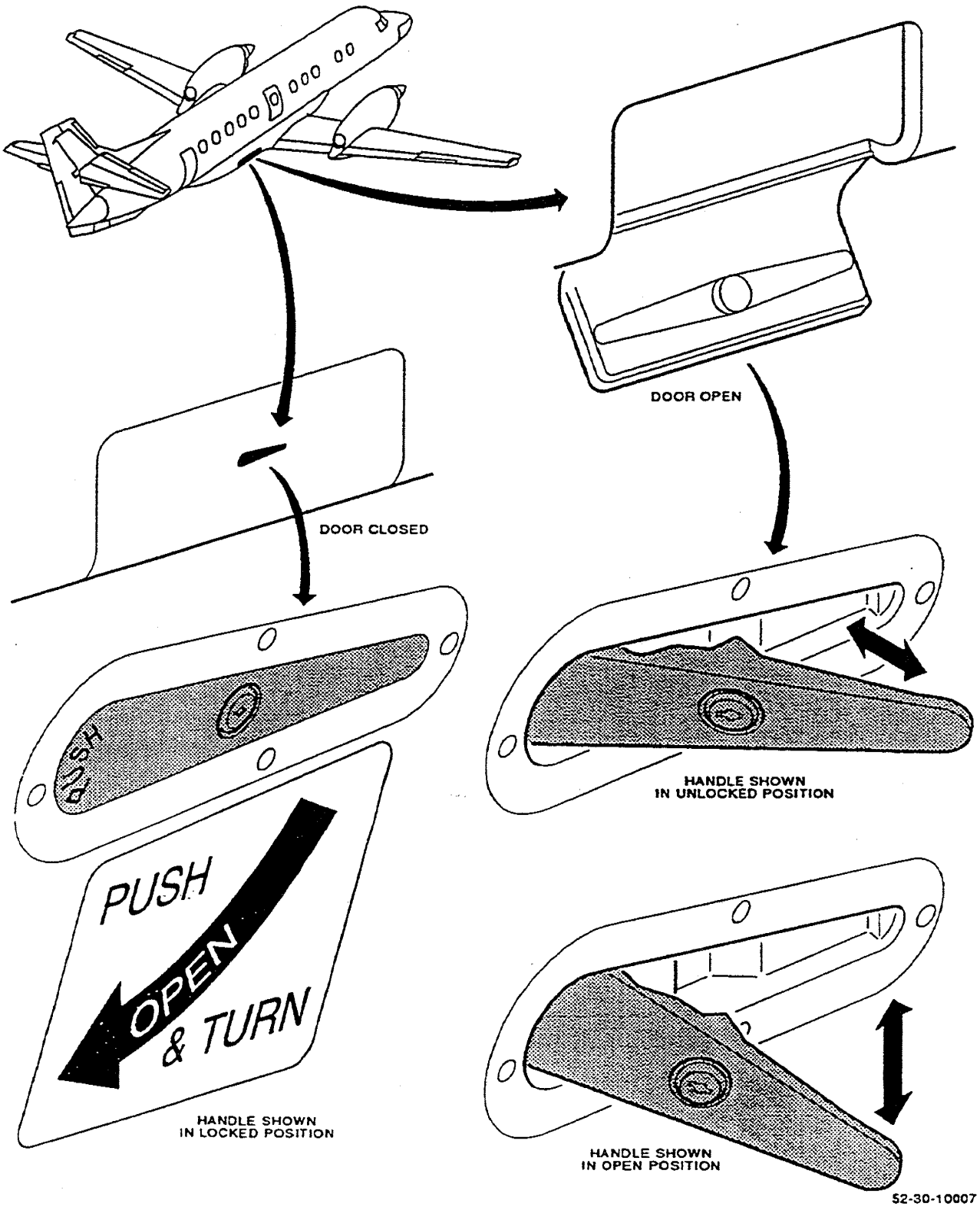
Baggage Compartment Door



Pod Baggage Door

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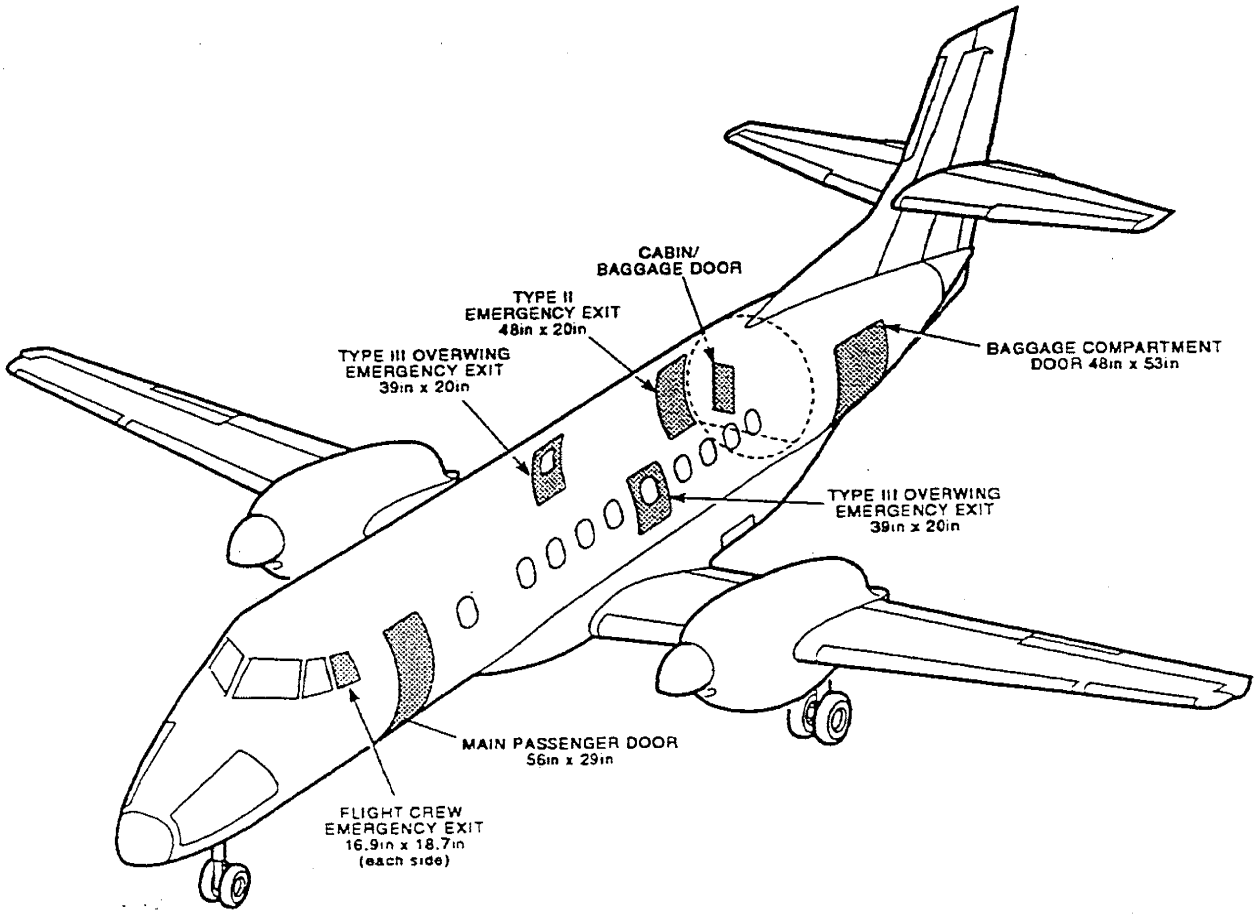

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Doors and Emergency Exits

F. Door Warnings

Amber caution lights on the central annunciator panel (CAP) indicate the unlocked condition of the:

- PAX DOOR
- BAG DOOR
- POD DOOR
- EMER EXIT

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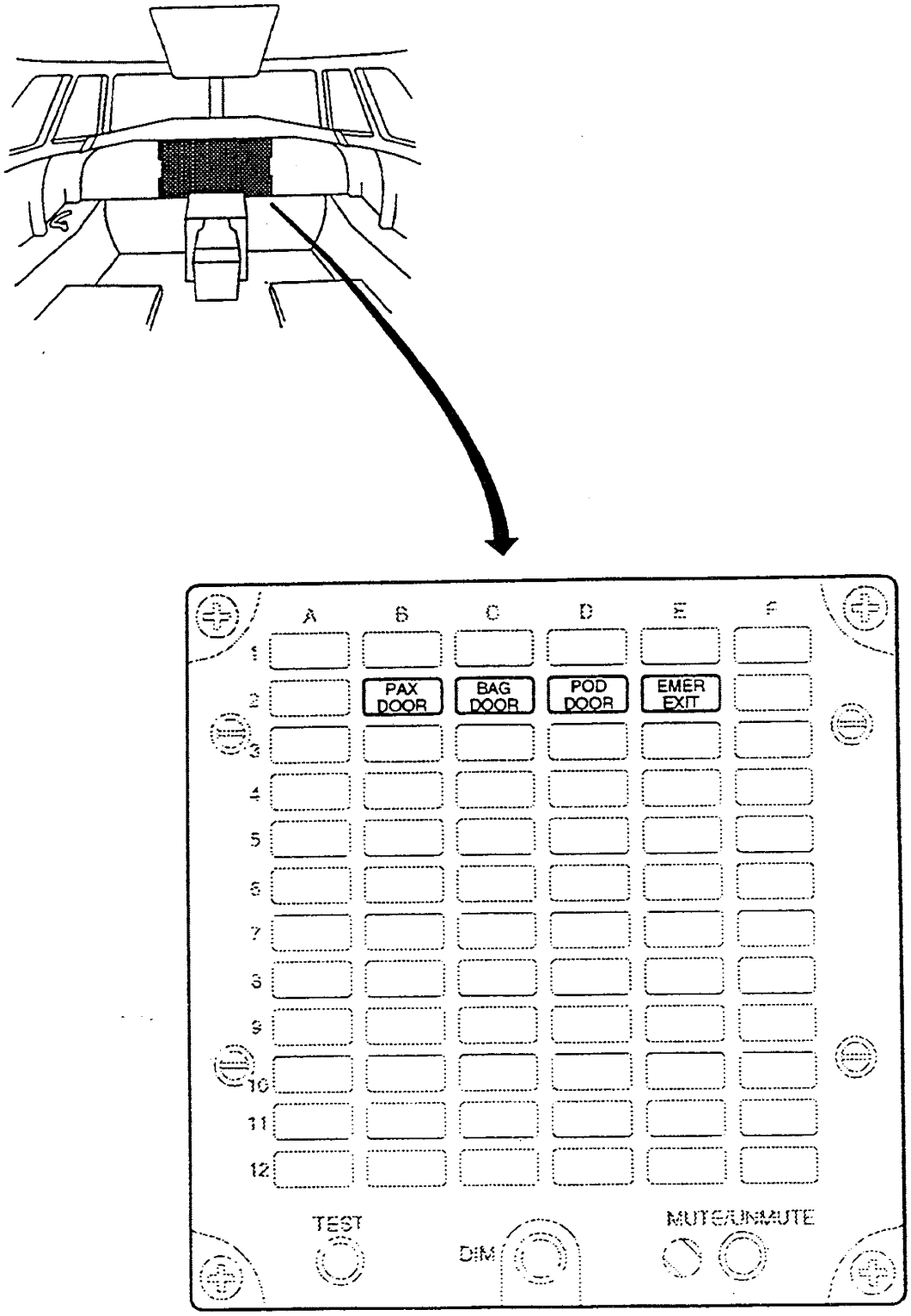

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Door Warning - CAP

4. Windows

A. Flight Deck Windows

The flight deck windshield consists of six panels arranged symmetrically about the aircraft centre-line. The two centre panels are electrically heated, which prevents ice build-up on the panels and gives greater protection against bird strikes. Windshield wash and wiper systems are also fitted.

The two aft panels are hinged at the bottom and secured at the top by a spring loaded lock mechanism. In an emergency the panels can be completely removed for flight deck crew escape. An escape rope is installed in the flight deck bulkhead, behind both pilot positions, above each aft window panel.

Demisting is achieved by conditioned air delivered from the environmental control system to diffusers on the windshield coaming.

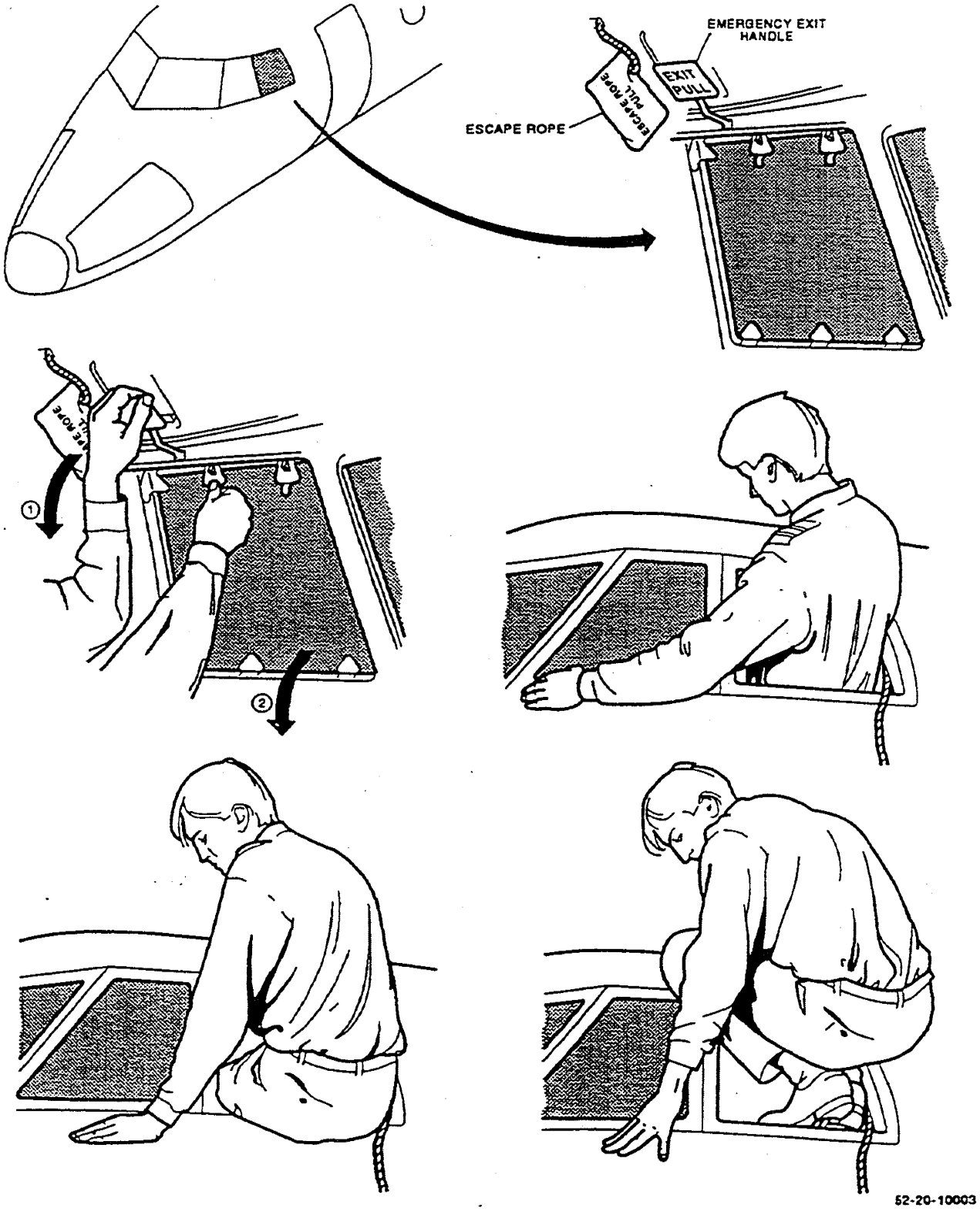
For flights with scratched or cracked windshields refer to the operations section of the MOM.

B. Cabin Windows

The cabin windows consist of two layers of acrylic glazing. The outer glazing is manufactured from stretched acrylic. The inner acrylic panel is provided as a fail safe fitting.

The pressure in the cabin is held by either the outer or inner major acrylic glazings.

For flights with scratched or cracked cabin windows, refer to the limitations section of the MOM.



Flight Deck Crew Escape

5. Flying Controls

A. General

The primary flying controls consist of manually operated ailerons, elevators and rudder. A conventional control column and adjustable rudder pedals at each pilot's position operate the control surfaces by cable and lever systems.

Secondary control is provided by the aileron, elevator and rudder trim systems.

A gust lock system is also provided. The wing flap and spoiler systems are described in Chapter 9, Hydraulics.

The elevator and aileron primary control circuits are duplicated so that in the event of a primary control disconnection, half the primary control will be available plus the trim circuits.

Adjustment of the geared tabs is by cable and chain driven non-reversible screw jacks. All tabs are connected to their jacks with dual rods to avoid flutter if a rod becomes disconnected.

B. Ailerons

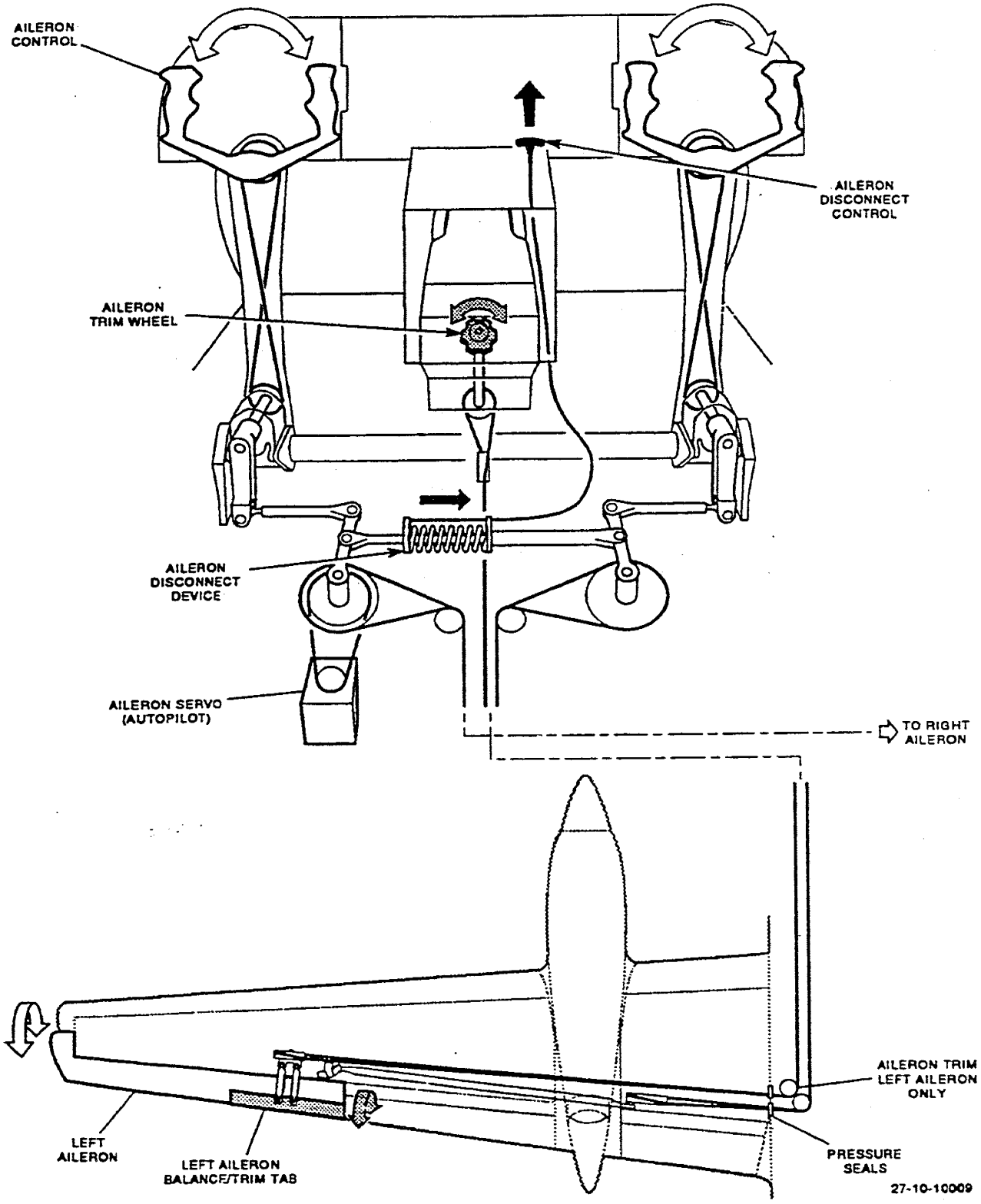
Two separate cable and rod systems connect the two control handwheels to the opposite ailerons. The two systems act together to provide differential aileron movement. This is achieved by interconnecting the two systems with a push rod.

The cable systems are separated in the fuselage and terminate at operating quadrants on the wing rear spar. A system of push rods along the rear spar connect the quadrants to the aileron. Each system has fixed stops at the control surface and adjustable stops at the control column.

The chain and sprocket mechanisms are totally enclosed within the control columns to prevent damage by foreign objects. All other mechanisms in the flight deck and cabin are covered by secured floor panels.

The interconnecting push rod between the two control columns is fitted with a disconnect device which is normally engaged. If the aileron system fails to move freely or does not operate within limits, the disconnect device is operated by a pull handgrip on the centre console. Operating the disconnect device separates the two cable and rod systems of the aileron, making control available through half the aileron system.

Once operated, the disconnect device cannot be reset without maintenance action on the ground.



Aileron Control Circuit

C. Aileron Trim

A geared balance tab mechanism is fitted on the left aileron, connected to the wing structure through a dual load path non-reversible screw jack.

The screw jack is controlled through chain and sprocket, and, cable and pulley systems from a handwheel at the rear of the centre console.

A trim position indicator is provided on the centre console.

D. Elevators

Two separate cable and rod systems connect the two floor mounted control systems to their respective elevator. The two control systems act together because the columns are mounted on a common torque tube.

The cable systems are separated in the fuselage and terminate at an operating quadrant at the base of the vertical stabiliser. Separate systems connect push rods to their associated elevator torque tubes. Each system is fitted with primary stops at the control surface and secondary stops at the control columns.

The two aft quadrants are spring loaded to give an elevator down bias. In flight the spring loads are balanced by trim application.

The torque tube between the control columns is fitted with a disconnect device which is normally engaged. If the elevator system fails to move freely or does not operate within limits, the disconnect device is operated by a pull handgrip on the centre console. Operating the clutch separates the two cable and rod systems of the elevator and allows control of one elevator and trim to be maintained.

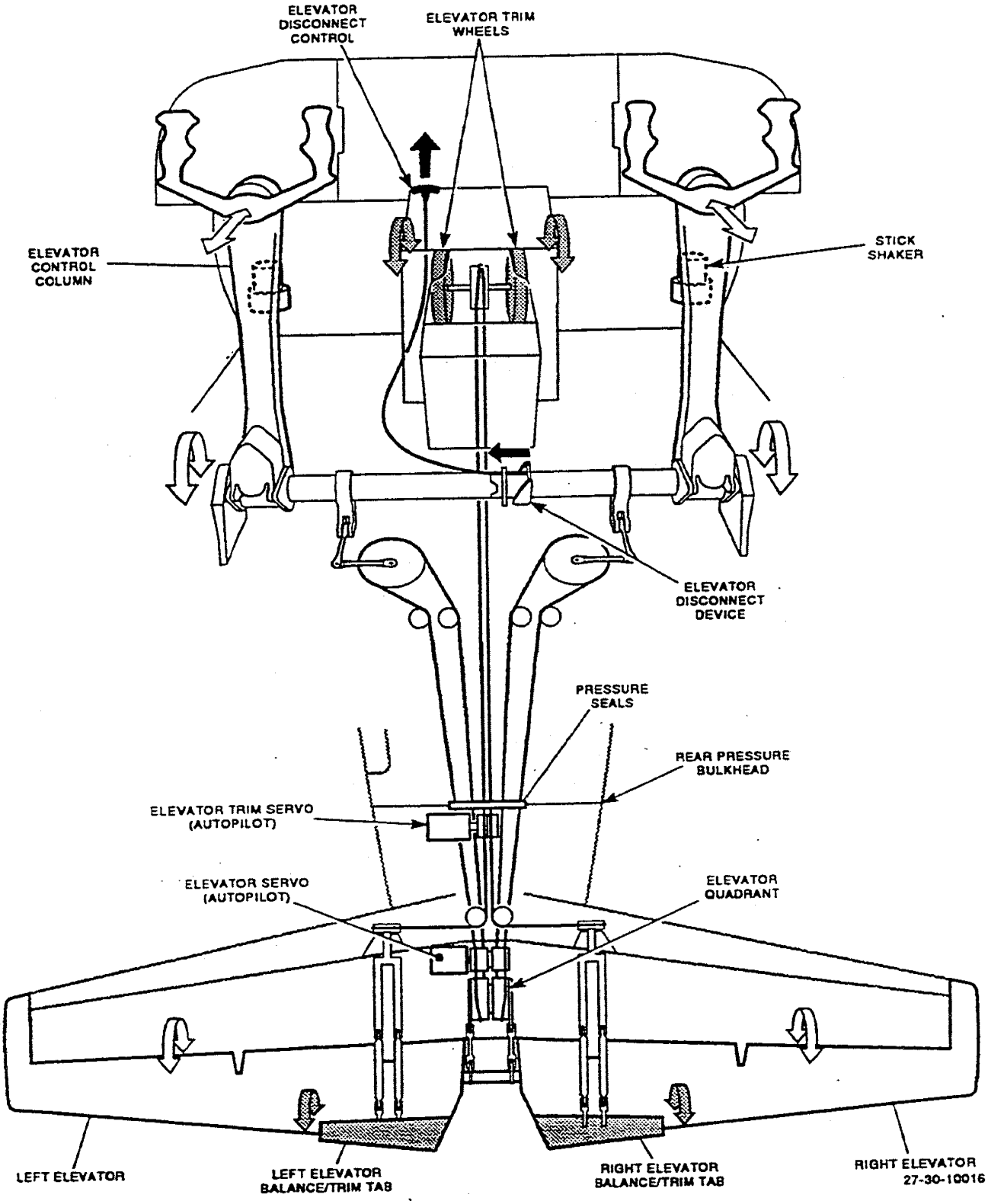
Once operated, the disconnect device cannot be reset without maintenance action on the ground.

E. Elevator Trim

Geared trim tabs are fitted to each elevator. Dual load path trim screw jacks are controlled by chain and sprocket and cable and pulley systems from handwheels on each side of the centre console. A trim position indicator, with the take off setting clearly marked, is provided on the centre console.

The scroll pulley of the elevator trim servo-motor, which is installed in the rear equipment bay on the rear pressure bulkhead, minimizes accidental mistrim caused by an elevator disconnect.

The Automatic Flight Control System (AFCS) and electric trim allow the scroll pulley to be driven by the trim servo-motor.



Elevator Control Circuit

F. Rudder

A cable system connects the output from both sets of floor mounted rudder pedals to the rudder drive quadrant at the base of the rudder post.

In the event of a single cable system becoming disconnected in the duplicated part of the system, the remaining part of the system gives 100% control.

In the event of a cable becoming disconnected other than in the duplicated part of the system, aircraft control is by use of trim and ailerons.

If the rudder system is jammed, aircraft control can be maintained by using the ailerons and differential engine power.

The cable system has stops at the rudder and at the forward pressure bulkhead mounted rudder torque shaft.

The rudder pedals can be adjusted for reach by rotating a handle mounted under the instrument panel. There is an adjustment handle for each set of pedals.

G. Rudder Trim

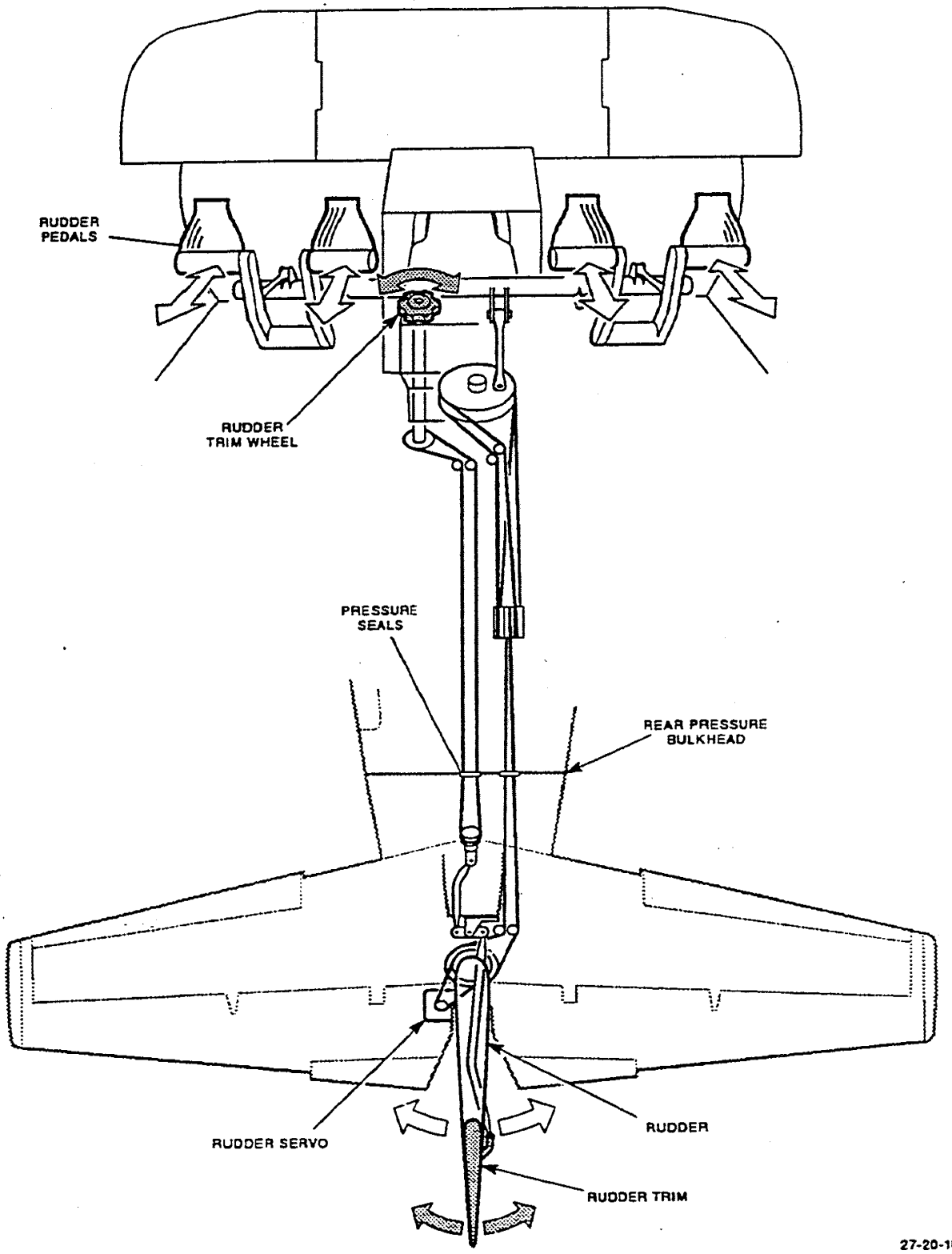
The rudder trim system is controlled from a handwheel at the rear of the centre console, through a chain and sprocket, and, a cable and pulley system. A trim position indicator is provided on the centre console.

The rudder trim balance tab drive mechanism is duplicated between the tab and the dual load-path trim screw jack, to prevent flutter in a single failure case.

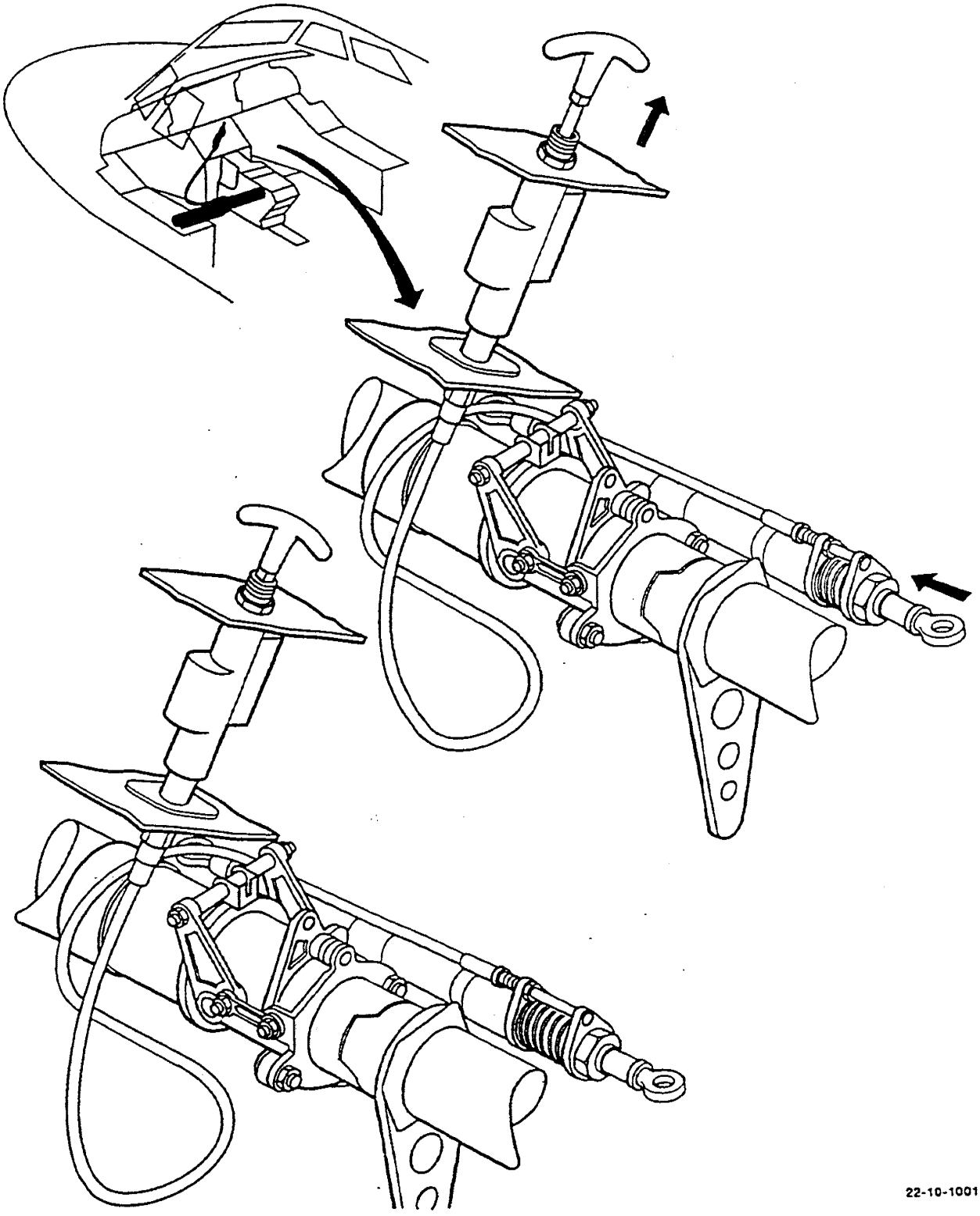
H. Failure Protection

The aileron and elevator primary control systems are provided with disconnect devices to protect the aircraft against failure of either system. When activated, in the event of a primary control restriction, the functioning half of the relevant system continues to operate. Maintenance action, on the ground, is required to reset an activated disconnect device.

The rudder remains fixed if it becomes jammed. Compensation for yaw can be achieved by the use of the ailerons and differential engine power.



Rudder Control Circuit



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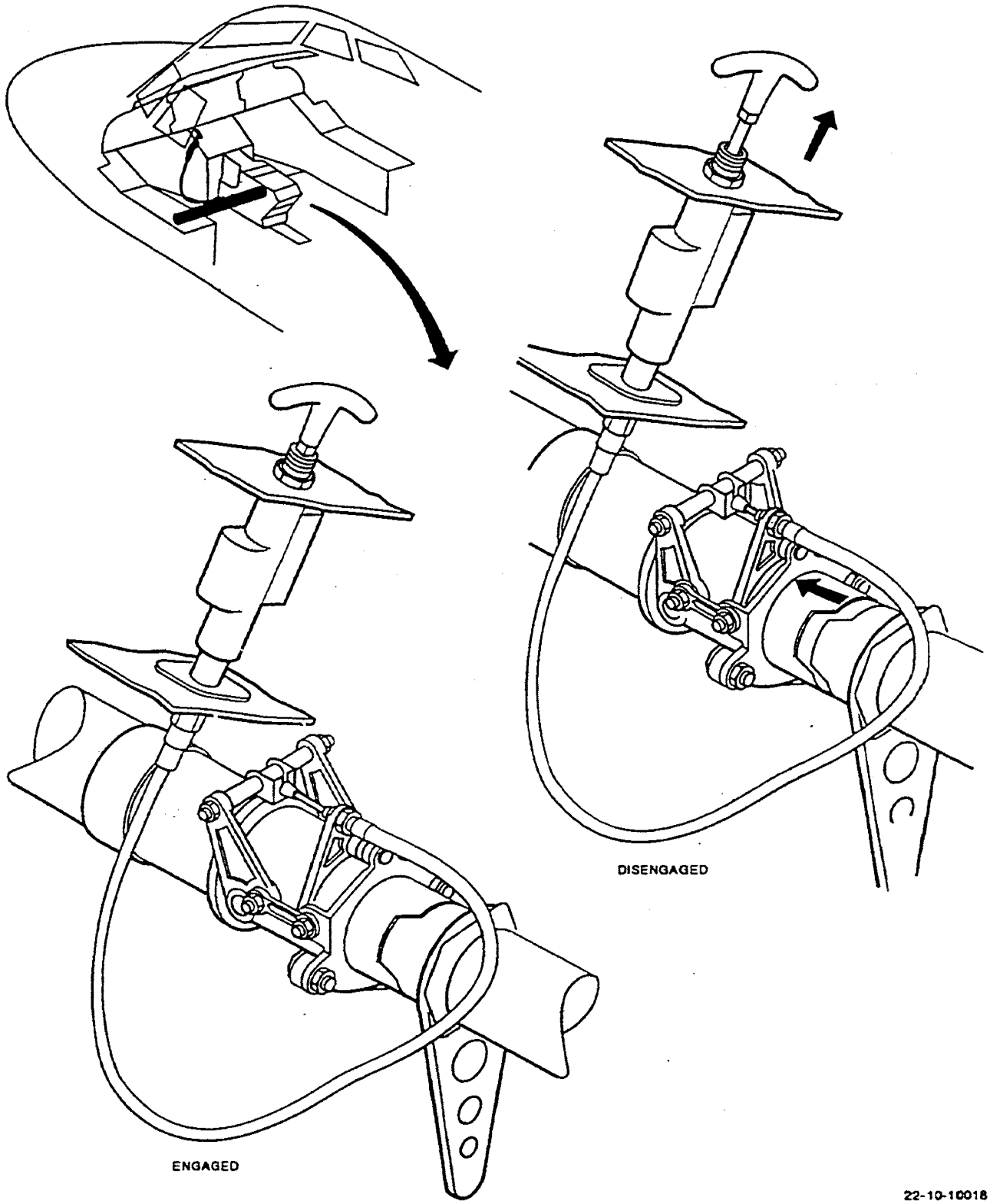
Decoupling Control (Roll)



Decoupling Control (Pitch)

The decoupling handles for the elevator and aileron control systems are on the lower centre panel and are marked PITCH and ROLL respectively. The handles are pulled to decouple the control systems.

When decoupling action has taken place, a CAP [CONT DISC] (amber) caption will come on.

The system ensures that no single failure will prevent continued safe flight and landing. The aileron and elevator primary control circuits are duplicated. Half the primary circuit and full trimming are still available following a disconnection. The aileron surfaces are protected against up-float to allow the remaining aileron to be fully effective. Although the rudder primary control is not duplicated, the trim circuit is still available if the rudder jams.

Protection against uncontained engine rotor failure and propeller debris is by duplication and separation of the primary flight controls and separation of the primary and trim controls. The primary flight controls are separated vertically in the right underfloor area and the trim controls are positioned in the left underfloor area.

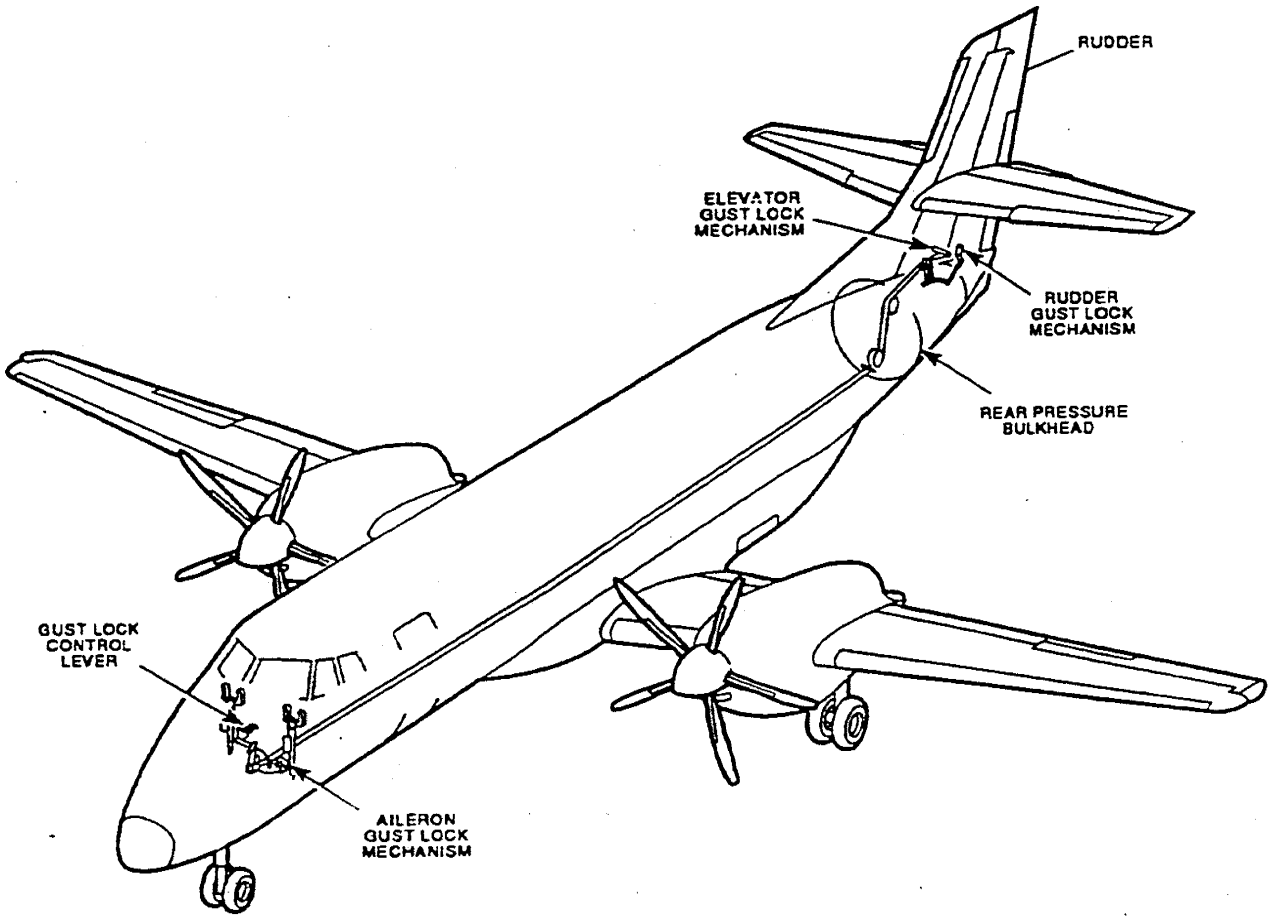
I. Gust Locks

Internal mechanical locks are provided for each primary control circuit. The aileron lock is located on the flight deck, the elevator lock in the rear equipment bay and the rudder lock in the base of the rudder.

The gust lock system is connected to a control lever mounted on the right side of the centre console. The lever position indicates the position of the locks. With the locks IN the lever is clearly visible to both pilots.

Each lock is spring loaded to the OUT position and can be withdrawn by gravity, as an additional safeguard, after the gust lock lever has been set to the UNLOCKED position.

A mechanical interlock provides a baulk to prevent simultaneous advancement of the POWER levers into the POWER range unless the control locks are all fully out. This interlock also prevents selection of the control locks to the LOCK position with both POWER levers in the flight range.



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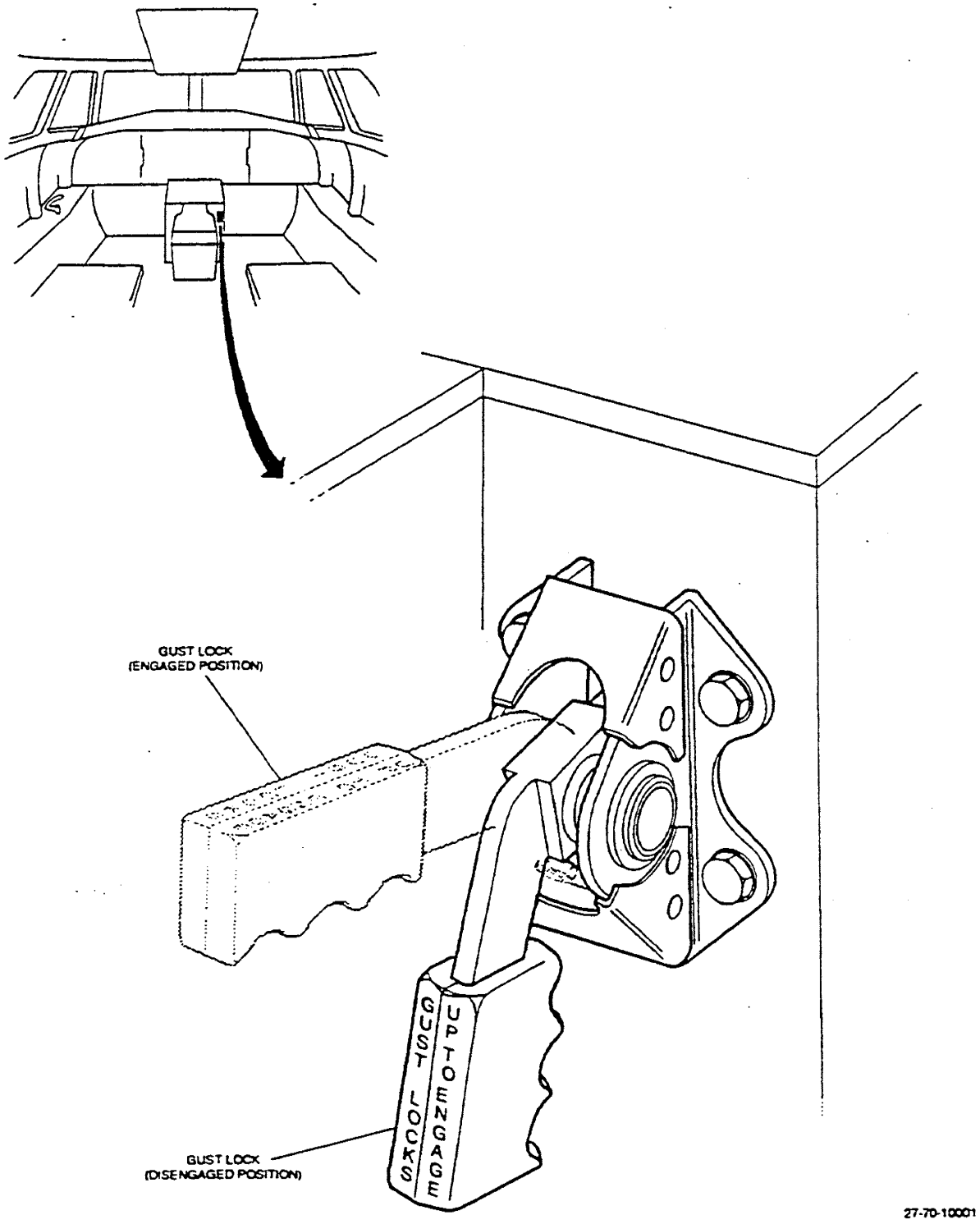
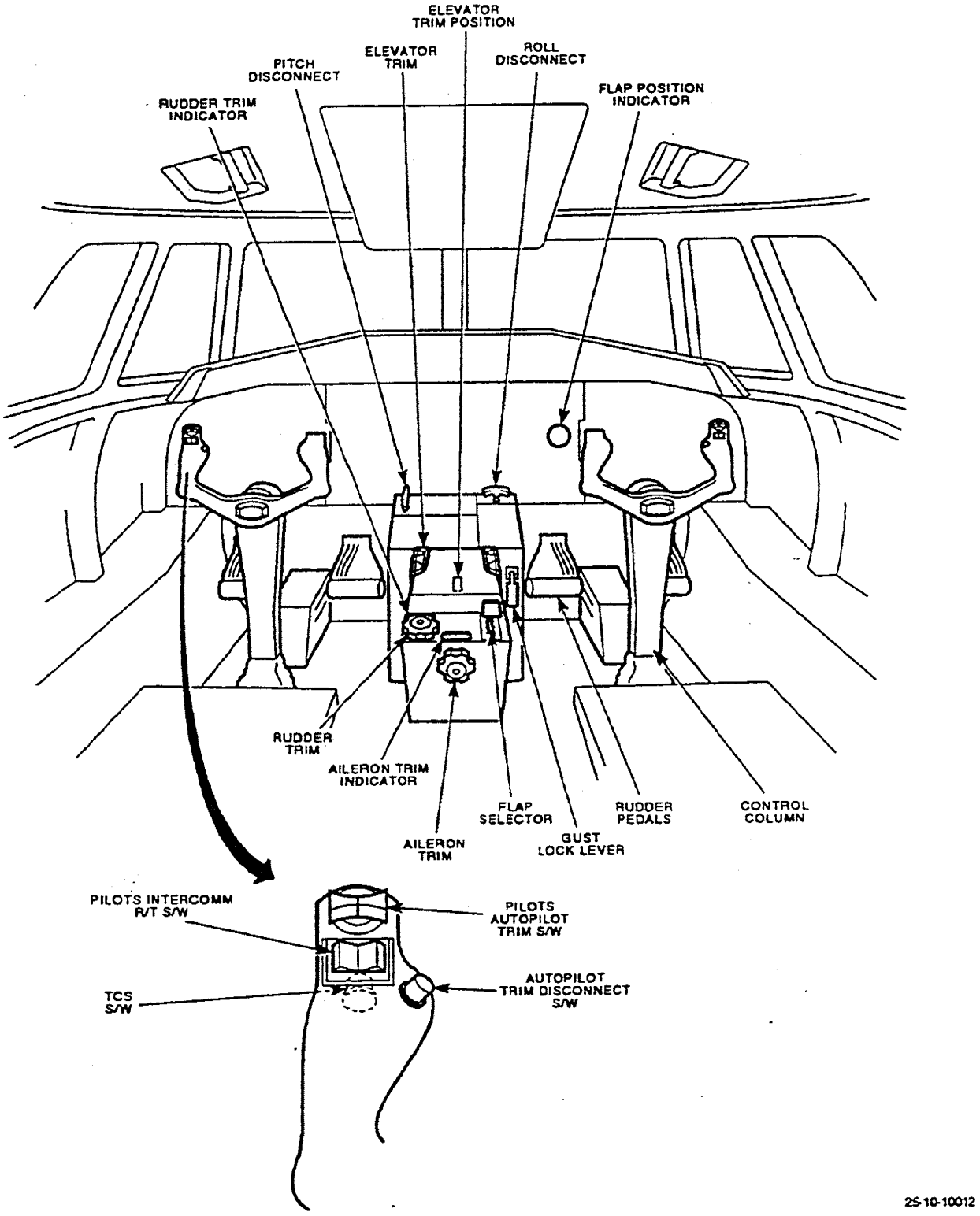
Gust Locks (System Layout)



Gust Lock-Operation



Flight Deck Flying-Control Layout

6. Stall Warning and Protection

A. General

The stall warning and protection system consists of two analogue signal processors, two angle-of-attack (AOA) sensors, two stick shakers operating on the control columns and a stick push acting on the left-elevator operating quadrant. These form two independent identical systems, left and right, each monitoring airflow angle and providing warnings to the crew.

The systems each provide independent indication of stall warning by stick shaker, and operate a solenoid in the hydraulic stick push system at stall identification. Both left and right system solenoids need to be energized before the stick push operates.

B. Angle of Attack (AOA) Sensor

The AOA sensors are mounted symmetrically on either side of the fuselage. Each AOA sensor provides local airflow angle and sends the information to both signal processors. The BITE in the processors cross monitor the AOA sensors.

The AOA sensors have integral vane and case heaters to prevent icing and condensation. The heating circuits are monitored by the BITE in the processors.

C. Signal Processor

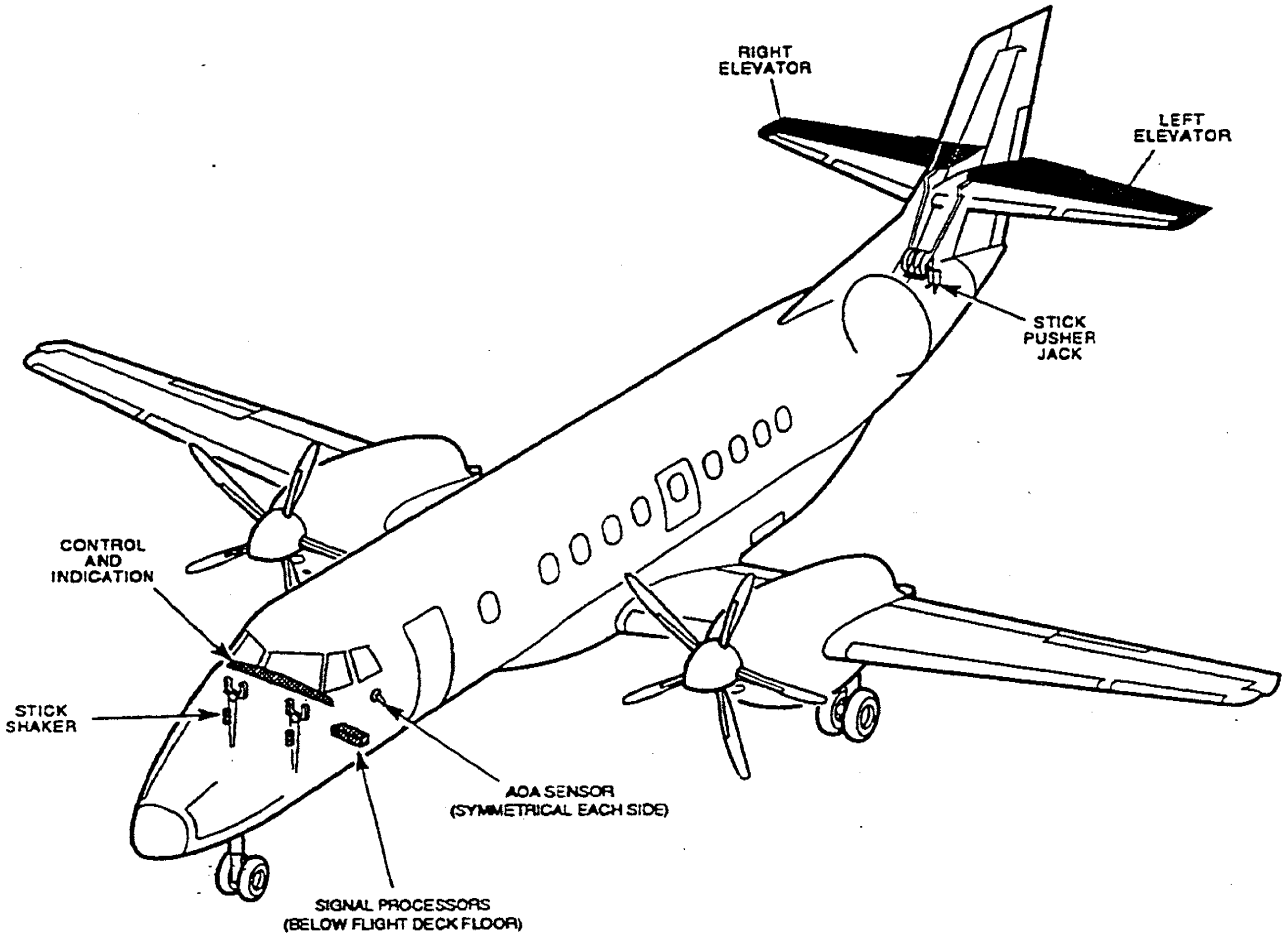
The signal processors are installed under the flight deck floor.

The signal processors have inputs from both AOA sensors and a fault warning is given if the local airflow angles differ by more than 6 degrees. The local airflow angle is then compared with a preset value dependant on the aircraft configuration. If the airflow angle exceeds the preset value (equivalent to the local angle at 1.07 V_S) a stall warning output is generated which operates the stick shaker, providing audible and tactile warnings to the crew.

NOTE When either the left or right stall warning system detects a stall condition, a stick shaker slave-relay in the autopilot system is also energized. The energized relay activates the GPWS audio suppression circuit, which disconnects the autopilot and inhibits the GPWS audio call-outs.

If the airflow angle exceeds a second preset value (equivalent to the local angle at V_S), a stall ident (stick push) function is generated. This provides a visual warning (STALL caption on coaming panel for each processor) and a stick push to 8° elevator down position.

Each signal processor has a 0.5 'g' switch which disables the stick push function when the aircraft experiences a negative vertical acceleration increment of 0.5 'g' or greater. This prevents excessive pitch rates in the landing flap configuration.



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Stall Protection-Component Location

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Inputs from the weight-on-wheels switches disable the system on the ground. A time delay disables the system until three seconds after take-off.

The stick push function is disabled if either pilot presses one of the four illuminated switch indicators mounted on the coaming. Stall warning will continue to operate but the stall identification/stick push system cannot be reset until the aircraft is on the ground. The reset switch, on the flight deck maintenance test panel, is not accessible to the pilots.

When the stick push is disabled, the stall identification light on the coaming goes out and the CAP L STALL or R STALL caption comes on (dependent on which stall identification output from the signal processor has been disabled).

D. Power Supplies

The left signal processor is powered from the 28v DC left essential busbar and the right processor from the 28v DC right essential busbar.

E. Flight Data Acquisition Unit (FDAU)

Both signal processors send data of local airflow angle to the FDAU.

F. BITE

The signal processor contains the following BITE:

- AOA sensor signal failure
- AOA sensor heater failure
- Flap input invalid
- Power supply failure
- Comparator valid.

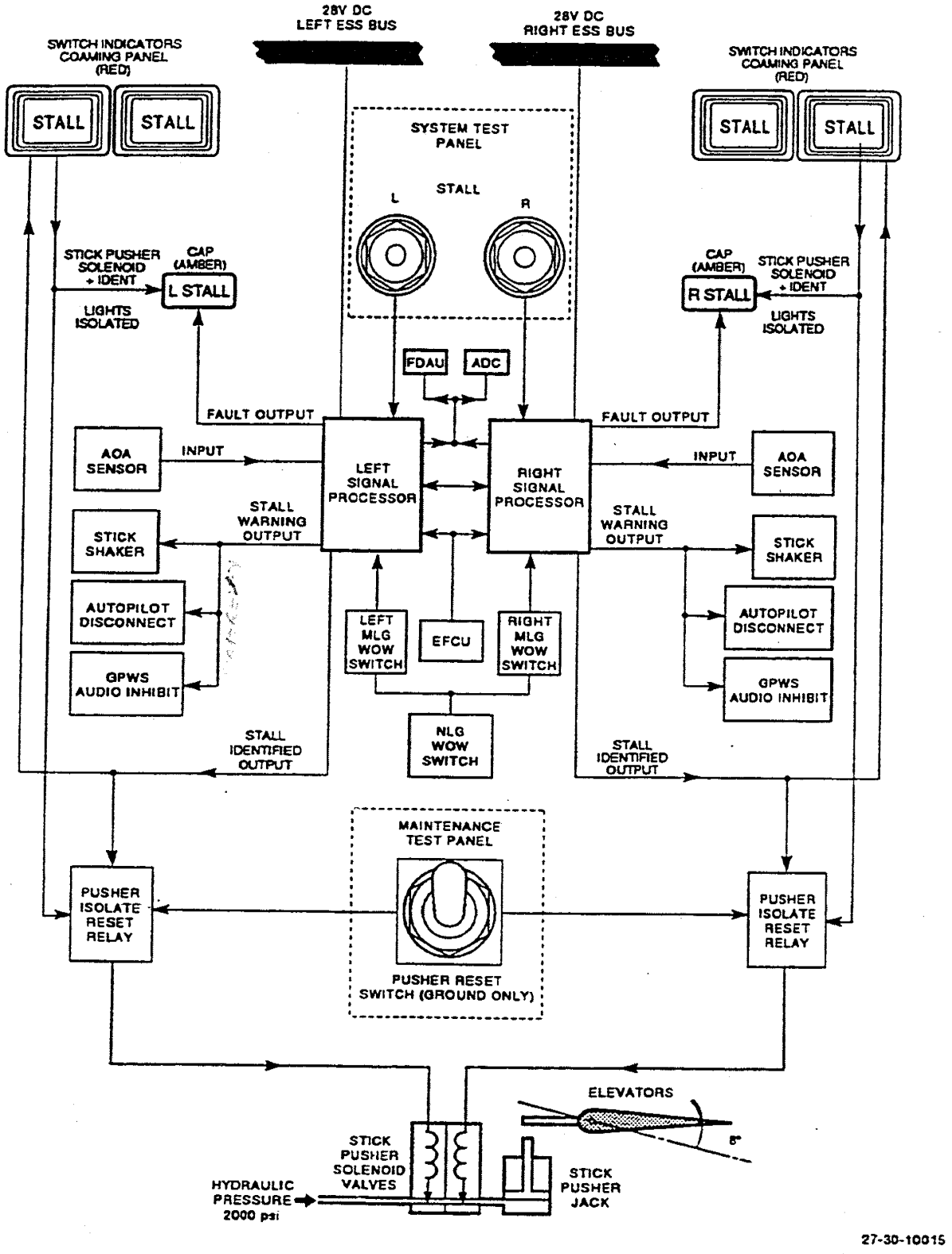
If a failure is detected the CAP L STALL and R STALL (amber) captions come on.

G. Self Test

Each signal processor and its associated AOA sensor can be tested by spring-loaded switches on the systems test panel of the right side console . Labelled L STALL and R STALL the switches induce stick shaker and audio indications through the signal processor. To operate the stick push, both systems must be tested together and the hydraulic pressure must be normal.

H. Stick Shaker

Independent stick shakers, one mounted on each control column, give tactile warning when stall warning output is received from the associated signal processor.



Stall Warning Protection System-Schematic

I. Stick Push

The stick push is a hydraulic ram controlled by two electric solenoids connected in series. The solenoids are independently controlled by the left and right signal processor stall identification outputs. Both solenoids must be energised to allow the flow of hydraulic fluid to activate the stick push. Hydraulic power is provided by the normal hydraulic power system at 2000 psi.

Visual warning is provided by [STALL] (red) switch indicators on the coaming panel when a stall identified signal is received from the associated signal processor.

When activated, the stick push operates on the left elevator operating quadrant to push the elevator down to the nose down eight degree position (8 degrees down from the mean aerodynamic chord).

The right elevator is also driven down because the left and right elevator control circuits are connected through the control column.

The stick push can be overpowered by pulling back on the control column with a stick force of approximately 75 lb.

J. Air Data Computers (ADC)

The left and right signal processors provide outputs to the left and right ADC's. The data is used by the ADC to calculate 1.07 Vs for display on the IAS tape EFIS EADI as a low speed awareness red band below 1.07 Vs.

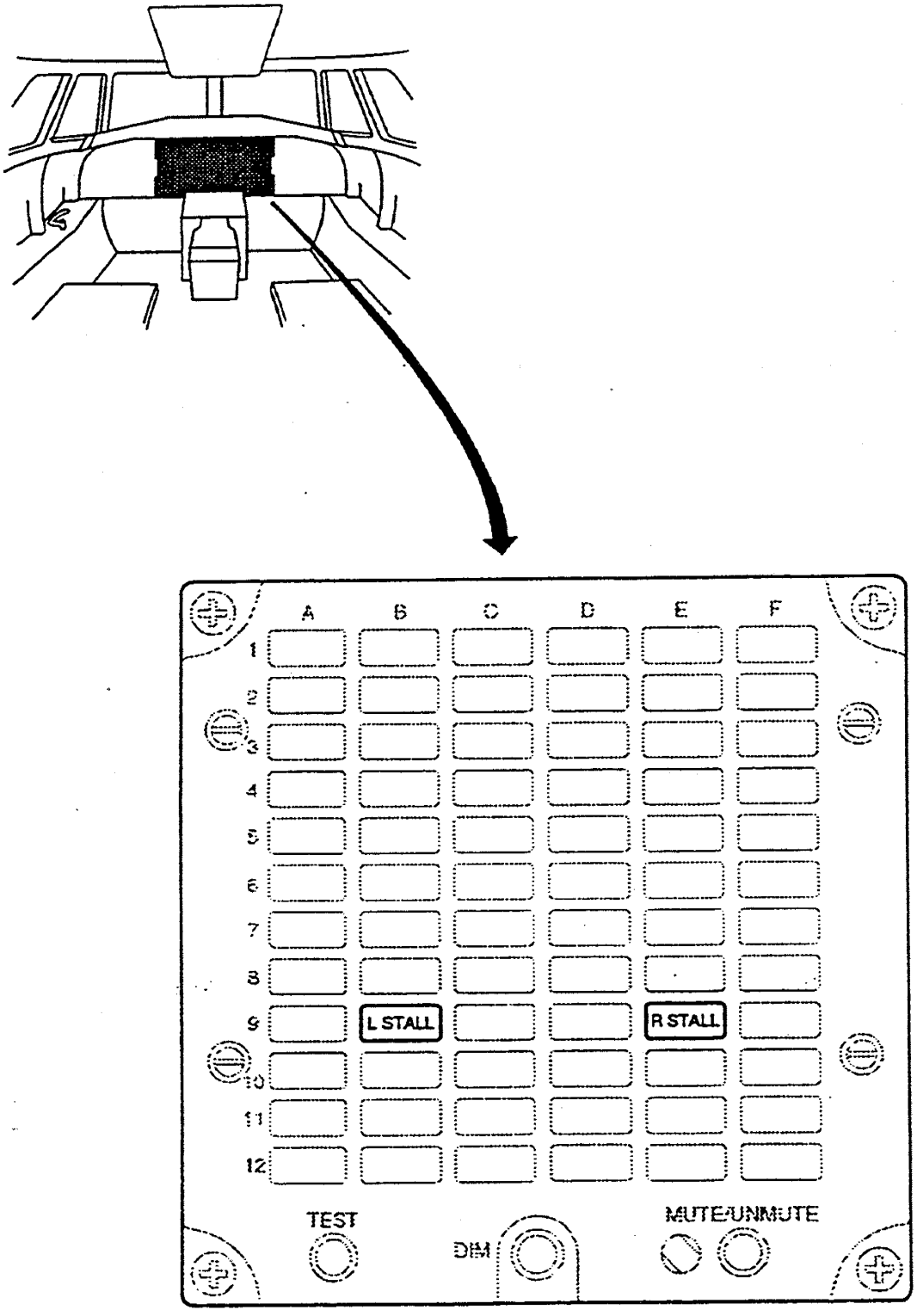
K. Modes of Operation

(1) Ground Mode

The system is in the ground mode when the weight on wheels switches indicate the aircraft is on the ground. In this mode the stall warning and identification functions are disabled and the test functions enabled.

(2) Air Mode

The system enters the air mode three seconds after the weight on wheels switches indicate that the aircraft is off the ground. The stall warning and identification functions are enabled and the test mode disabled for flight.



CAP-Stall (Fault/Stick Push Disabled) Indication

(3) Ice Mode

The ice mode can only be enabled with the system in the air mode and the left or the right engine intake anti-ice system active. When the system is in the ice mode the stall warning angles at which stick shake and stick push occur are reduced.

The system is in the ice mode when the left or the right ADC generates a speed signal of more than 145 kt IAS to the signal processors, and the left or the right ENG/ELEV ANTI-ICE switch is set to the ON position.

A STALL ICE MODE PUSH TO CANCEL switch/indicator is installed on the centre instrument panel, the indicator caption reads ICING AOA. When the ice mode is active the switch/indicator [ICING AOA] (green) caption comes on.

The ice mode stays active at all aircraft configurations and airspeeds, provided that an airspeed of more than 145 kt has been attained during the flight.

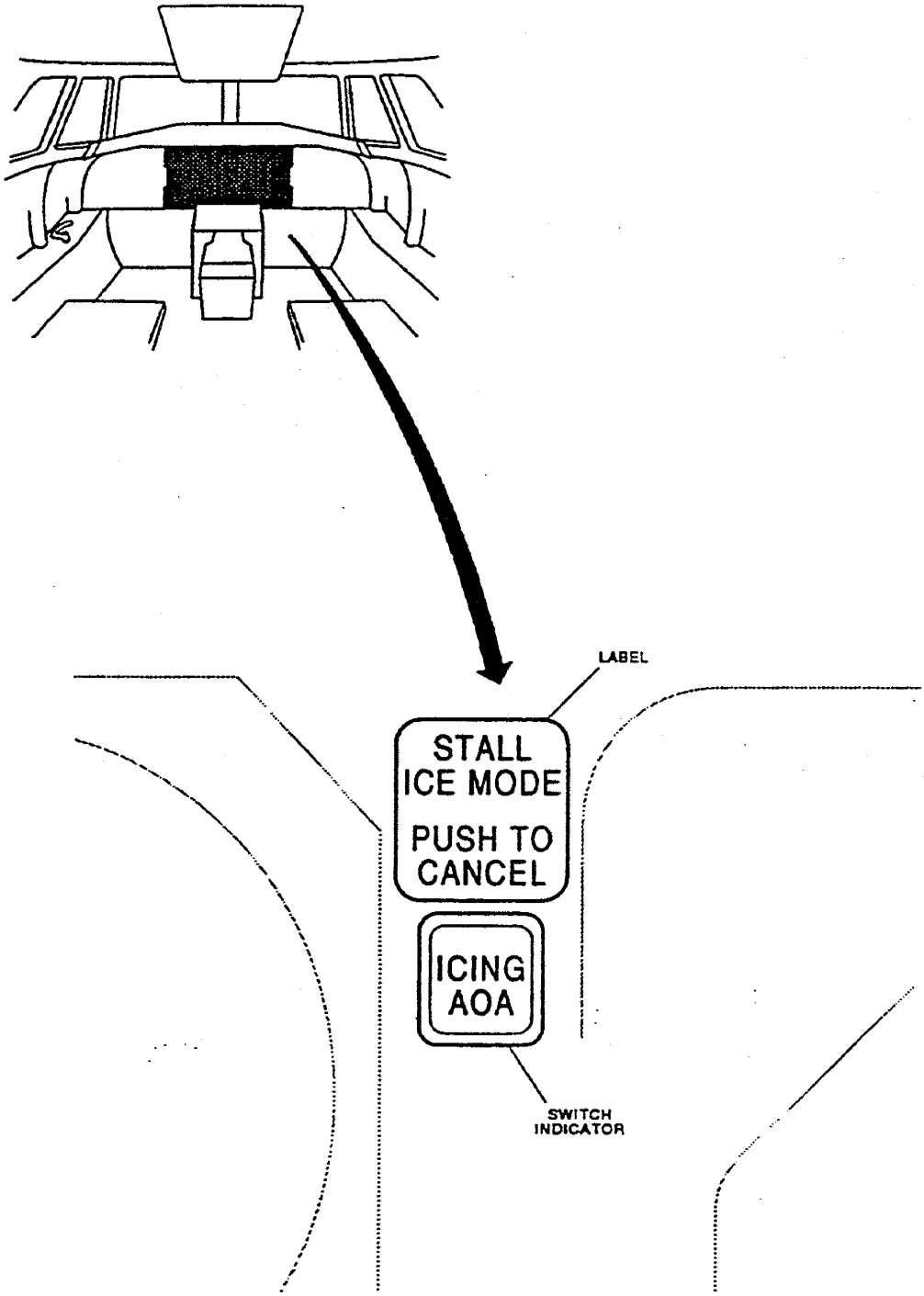
The ice mode is disabled and the system reverts to normal (no-ice) operation if the pilot sets the left and the right ENG/ELEV ANTI-ICE switches to OFF and presses the STALL ICE MODE PUSH TO CANCEL switch/indicator. The ice mode is disabled automatically when the engines stop at the end of the flight.

(4) Test Mode

The mode can only be enabled with the system in the ground mode. By operation of the L and R STALL TEST switches on the right side console the systems can be checked independently, to give stall warning stick shaker and audio indications, or together, to give stall identification stick push indications. The stick push will not operate without normal hydraulic pressure.

(5) Fail Mode

The system is in the fail mode when a failure is detected by the BITE. In this mode the amber CAP [L STALL] or [R STALL] (amber) captions are illuminated and the associated stall identification outputs are disabled.



Icing AOA Switch/Indicator