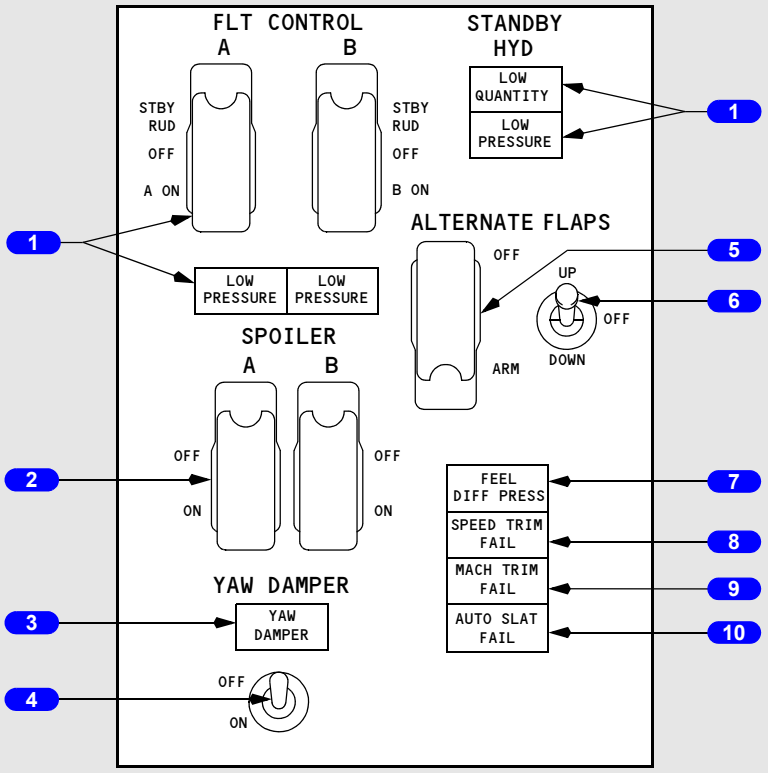
Flight Control Panel (before Rudder System Enhancement Program (RSEP) modification)



FORWARD OVERHEAD PANEL

1 Refer to Chapter 13 – Hydraulics

2 Flight SPOILER Switches (guarded to ON)

Used for maintenance purposes only.

OFF – closes the respective flight spoilers shutoff valve.

3 YAW DAMPER Light

Illuminated (amber) – yaw damper is not engaged.

4 YAW DAMPER Switch

OFF – disengages yaw damper.

ON – engages yaw damper to rudder power control unit.

5 ALTERNATE FLAPS Master Switch (guarded to OFF)

OFF – normal operating position.

ARM – closes trailing edge flap bypass valve, activates standby pump, and arms the ALTERNATE FLAPS position switch.

6 ALTERNATE FLAPS Position Switch

Functions only when the ALTERNATE FLAPS master switch is in ARM.

UP –

- electrically retracts trailing edge flaps
- leading edge devices remain extended and cannot be retracted by the alternate flaps system.

OFF – normal operating position.

DOWN (spring loaded to OFF) –

- (momentary) fully extends leading edge devices using standby hydraulic pressure
- (hold) electrically extends trailing edge flaps.

7 Feel Differential Pressure (FEEL DIFF PRESS) Light

Armed when the trailing edge flaps are up.

Illuminated (amber) – indicates excessive differential pressure in the elevator feel computer.

8 SPEED TRIM Failure (FAIL) Light

Illuminated (amber) –

- indicates failure of the speed trim system
- indicates failure of a single FCC channel when MASTER CAUTION light recall is activated and light extinguishes when master caution system is reset.

9 MACH TRIM Failure (FAIL) Light

Illuminated (amber) –

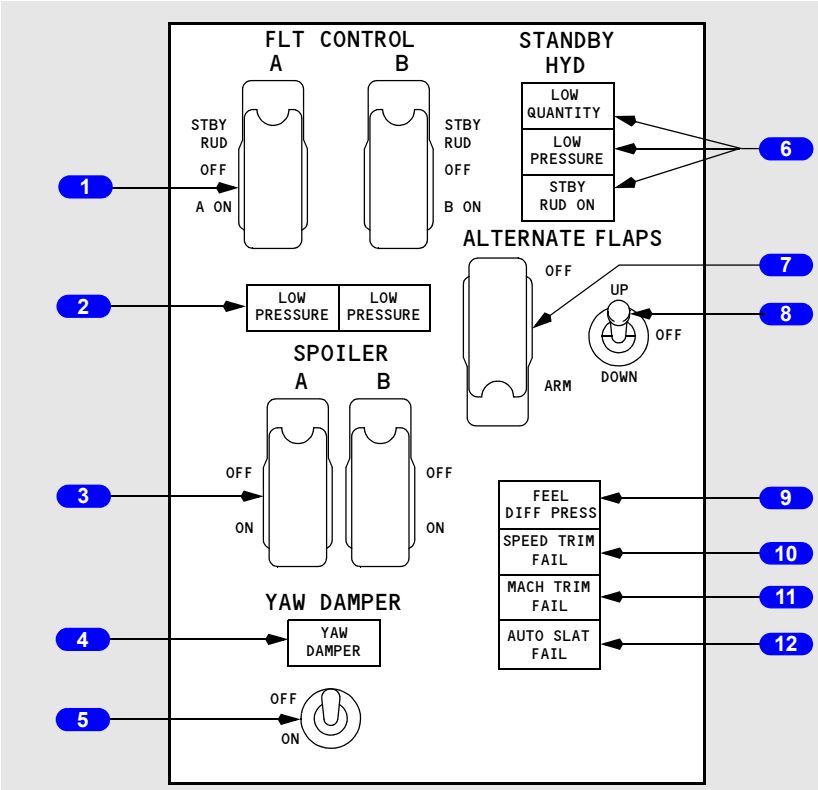
- indicates failure of the Mach trim system
- indicates failure of a single FCC channel when MASTER CAUTION light recall is activated and light extinguishes when master caution system is reset.

10 Automatic (AUTO) SLAT Failure (FAIL) Light

Illuminated (amber) –

- indicates failure of both auto slat computers.
- indicates failure of a single autoslat computer when illuminated during MASTER CAUTION recall and extinguishes when master caution system is reset.

Flight Control Panel (after RSEP modification)



FORWARD OVERHEAD PANEL

1 FLIGHT CONTROL Switches

STBY RUD - activates standby pump and opens standby rudder shutoff valve to pressurize standby rudder power control unit.

OFF - closes flight control shutoff valve isolating ailerons, elevators, and rudder from associated hydraulic system pressure.

ON (guarded position) - normal operating position.

2 Flight Control LOW PRESSURE Lights

Illuminated (amber) -

- indicates low hydraulic system (A or B) pressure to ailerons, elevator and rudder
- deactivated when associated FLT CONTROL switch is positioned to STBY RUD and standby rudder shutoff valve opens
- the A system light indicates A system pressure is low when full RPR pressure is commanded.

Note: The A system light will remain illuminated for approximately five seconds after A hydraulic system is activated.

3 Flight SPOILER Switches (guarded to ON)

Used for maintenance purposes only.

OFF - closes the respective flight spoilers shutoff valve.

4 YAW DAMPER Light

Illuminated (amber) - yaw damper is not engaged.

5 YAW DAMPER Switch

OFF – disengages yaw damper.

ON – engages yaw damper to rudder power control unit.

6 STANDBY HYD Lights

STANDBY HYDRAULIC LOW QUANITY Light

Illuminated (amber) -

- indicates low quantity in standby hydraulic reservoir
- always armed.

STANDBY HYDRAULIC LOW PRESSURE Light

Illuminated (amber) -

- indicates output pressure of standby pump is low
- armed only when standby pump operation has been selected or automatic standby function is activated.

STBY RUD ON Light

Illuminated (amber) - indicates the standby hydraulic system is commanded on to pressurize the standby rudder power control unit.

7 ALTERNATE FLAPS Master Switch

OFF - (guarded position) - normal operating position.

ARM - closes trailing edge flap bypass valve, activates standby pump, and arms ALTERNATE FLAPS position switch.

8 ALTERNATE FLAPS Position Switch

Functions only when the ALTERNATE FLAPS master switch is in ARM.

UP –

- electrically retracts trailing edge flaps
- leading edge devices remain extended and cannot be retracted by the alternate flaps system.

OFF – normal operating position.

DOWN (spring loaded to OFF) –

- (momentary) fully extends leading edge devices using standby hydraulic pressure
- (hold) electrically extends trailing edge flaps.

9 Feel Differential Pressure (FEEL DIFF PRESS) Light

Armed when the trailing edge flaps are up.

Illuminated (amber) – indicates excessive differential pressure in the elevator feel computer.

10 SPEED TRIM Failure (FAIL) Light

Illuminated (amber) –

- indicates failure of the speed trim system
- indicates failure of a single FCC channel when MASTER CAUTION light recall is activated and light extinguishes when master caution system is reset.

11 MACH TRIM Failure (FAIL) Light

Illuminated (amber) –

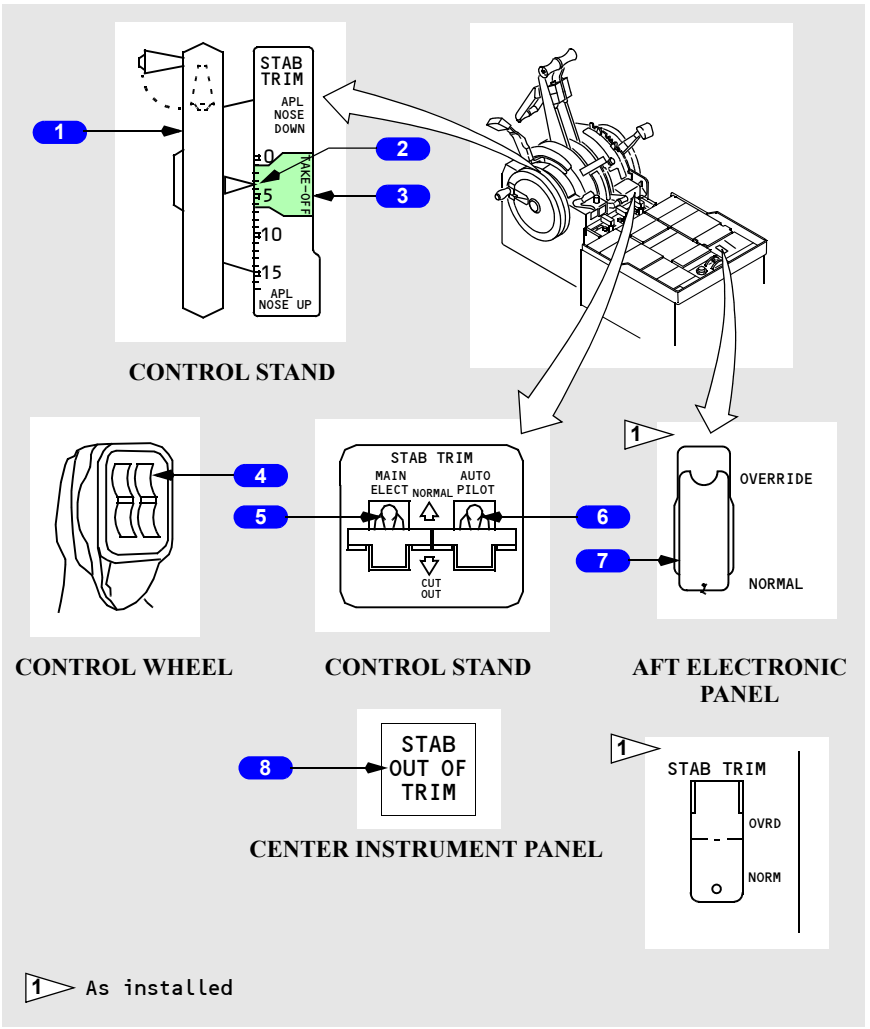
- indicates failure of the Mach trim system
- indicates failure of a single FCC channel when MASTER CAUTION light recall is activated and light extinguishes when master caution system is reset.

12 Automatic (AUTO) SLAT Failure (FAIL) Light

Illuminated (amber) –

- indicates failure of both auto slat computers.
- indicates failure of a single autoslat computer when illuminated during MASTER CAUTION recall and extinguishes when master caution system is reset.

Stabilizer



1 Stabilizer Trim Wheel

- provides for manual operation of stabilizer
- overrides any other stabilizer trim inputs
- rotates when stabilizer is in motion.

Note: handle should be folded inside stabilizer trim wheel for normal operation

2 Stabilizer Trim Indicator

Indicates units of airplane trim on the adjacent scale.

3 Stabilizer Trim Green Band Range

Corresponds to allowable range of trim settings for takeoff

4 Stabilizer Trim Switches (spring–loaded to neutral)

Push (both) –

- electrically commands stabilizer trim in desired direction
- autopilot disengages if engaged.

5 Stabilizer Trim Main Electric (MAIN ELECT) Cutout Switch

NORMAL – normal operating position.

CUTOUT – deactivates stabilizer trim switch operation.

6 Stabilizer Trim AUTOPILOT Cutout Switch

NORMAL – normal operating position.

CUTOUT –

- deactivates autopilot stabilizer trim operation
- autopilot disengages if engaged.

7 Stabilizer Trim Override Switch

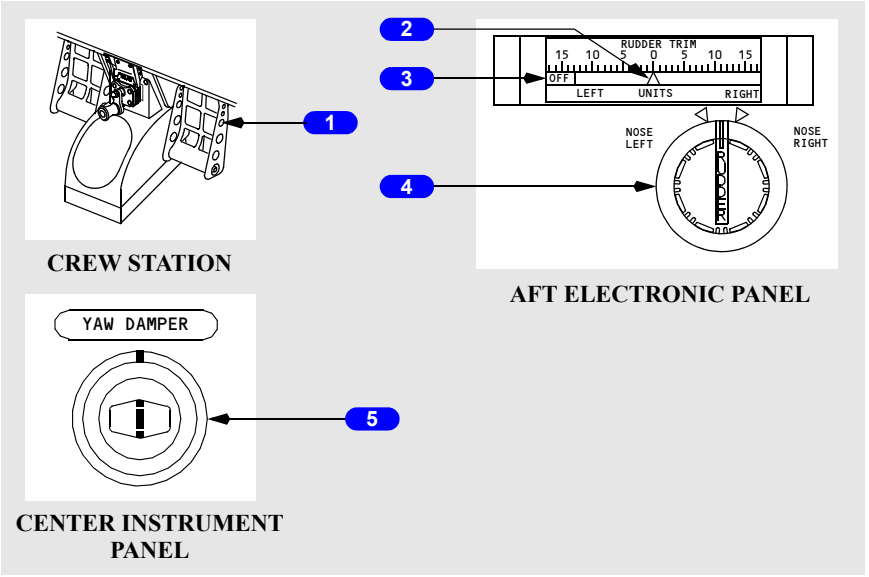
OVERRIDE – bypasses the control column actuated stabilizer trim cutout switches to restore power to the stabilizer trim switches

NORM – normal operating position.

8 STAB OUT OF TRIM Light

Refer to Chapter 4 – Automatic Flight

Rudder



1 Rudder Pedals

Push –

- controls rudder position
- permits limited nose gear steering up to 7 degrees each side of center.

2 Rudder Trim Indicator

Indicates units of rudder trim.

3 Rudder Trim OFF Flag

Illuminated (amber) (in view) – rudder trim indicator is inoperative.

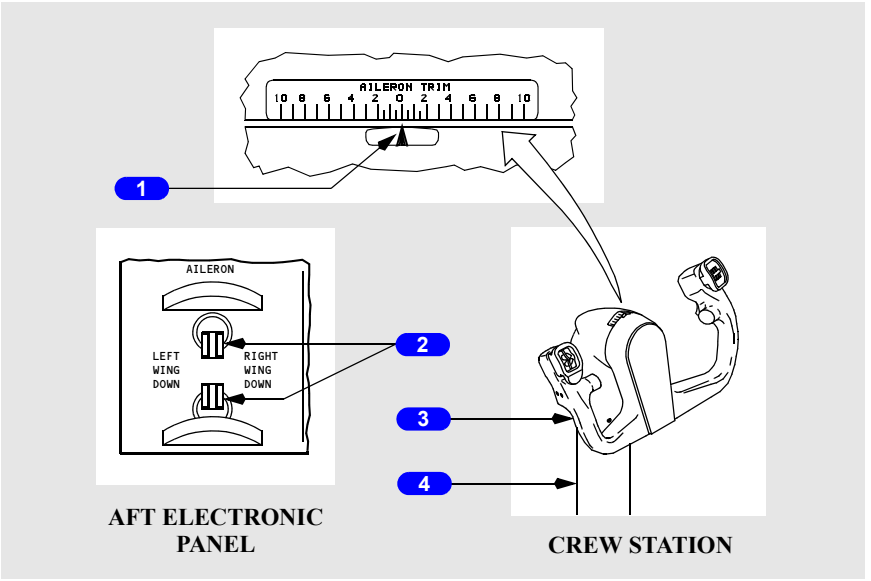
4 Rudder Trim Control (spring–loaded to neutral)

Rotate – electrically trims the rudder in the desired direction.

5 YAW DAMPER Indicator

- indicates yaw damper movement of rudder
- pilot rudder pedal inputs are not indicated.

Aileron / Elevator / Flight Spoilers



1 AILERON TRIM Indicator

Includes units of aileron trim.

2 AILERON TRIM (spring–loaded to the neutral position)

Movement of both switches repositions the aileron neutral control position.

3 Control Wheel

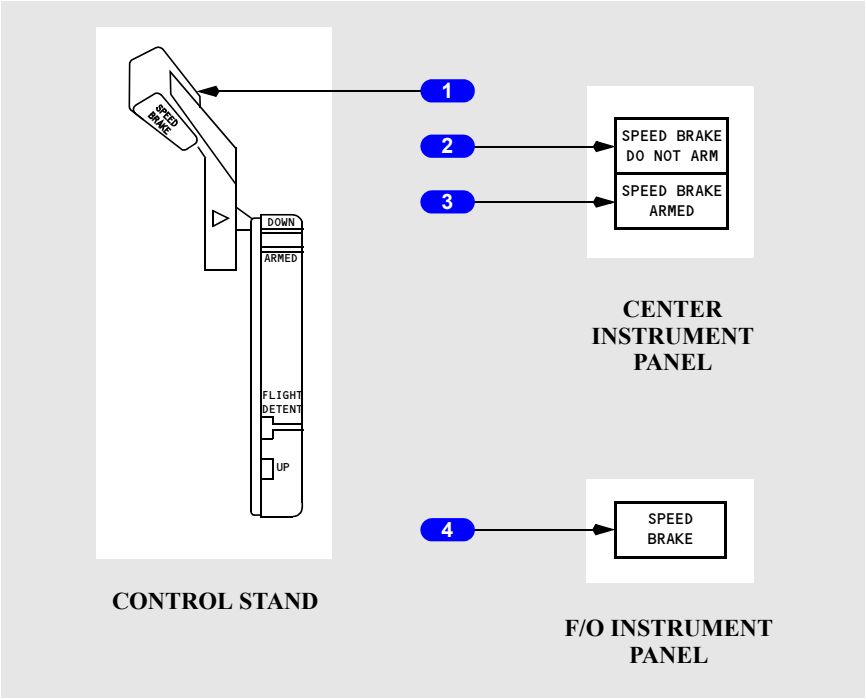
Rotate – operates ailerons and flight spoilers in desired direction.

4 Control Column

Push/Pull –

- operates elevators in the desired direction
- movement opposing stabilizer trim stops electric trimming.

Speed Brakes



1 SPEED BRAKE Lever

DOWN (detent) – all flight and ground spoiler panels in faired position.

ARMED –

- automatic speed brake system armed
- upon touchdown, the SPEED BRAKE lever moves to the UP position, and all flight and ground spoilers extend.

FLIGHT DETENT – all flight spoilers are extended to their maximum position for inflight use.

UP – all flight and ground spoilers are extended to their maximum position for ground use.

2 SPEED BRAKE DO NOT ARM Light

Light deactivated when SPEED BRAKE lever is in the DOWN position.

Illuminated (amber) – indicates abnormal condition or test inputs to the automatic speed brake system.

3 SPEED BRAKE ARMED Light

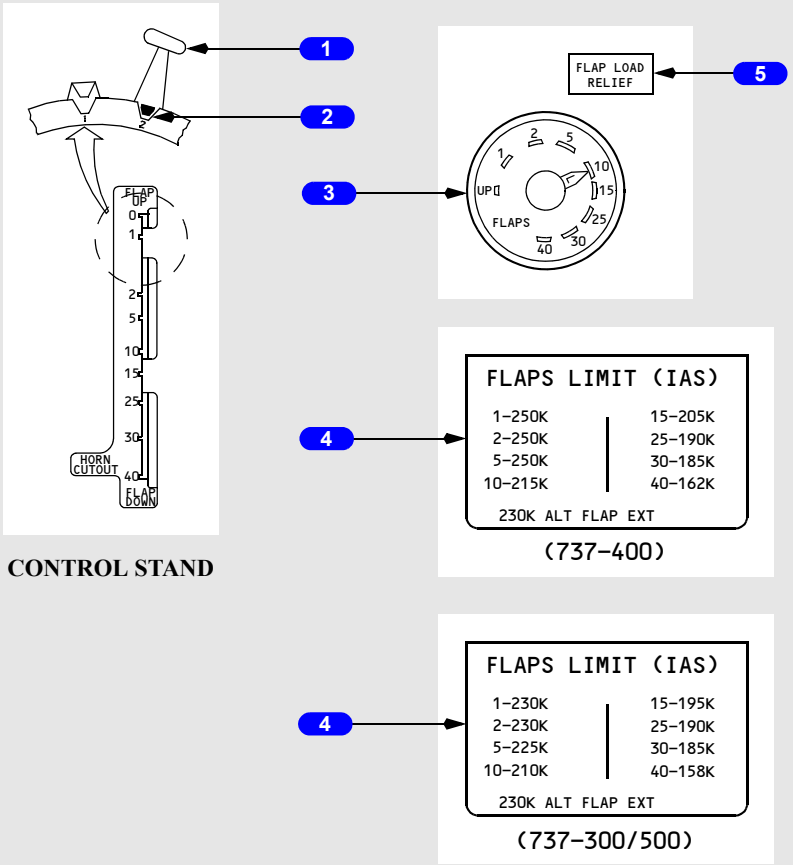
Light deactivated when SPEED BRAKE lever is in the DOWN position.

Illuminated (green) – indicates valid automatic speed brake system inputs.

4 SPEED BRAKE Caution Light

Flashing (amber) – indicates air/ground sensor in air position, SPEED BRAKE lever aft of ARMED position and flaps extended beyond position 10.

Trailing Edge Flaps



CONTROL STAND

CENTER INSTRUMENT PANEL

1 Flap Lever

- selects position of flap control valve, directing hydraulic pressure for flap drive unit
- position of the leading edge devices is determined by selecting trailing edge flap position
- flap position 40 arms the flap load relief system.

2 Flap Gates

Prevents inadvertent flap lever movement beyond:

- position 1 – to check flap position for one engine inoperative go–around
- position 15 – to check flap position for normal go–around.

3 Flap Position Indicator

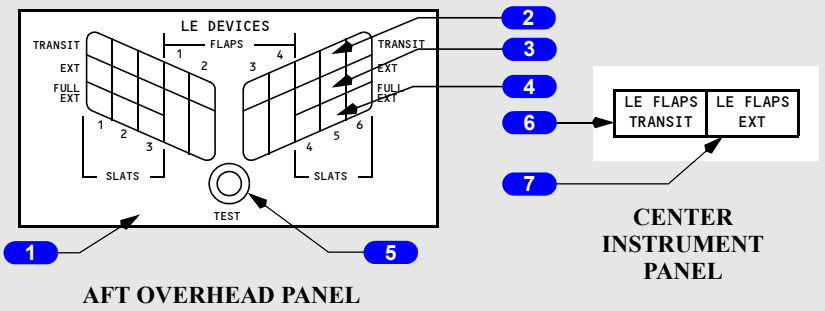
- indicates position of left and right trailing edge flaps
- provides trailing edge flaps asymmetry protection.

4 FLAPS LIMIT Placard

5 FLAP LOAD RELIEF Light

Illuminated (amber) – indicates flaps have retracted from 40 to 30 due to excess airspeed.

Leading Edge Devices



1 Leading Edge Devices (LE DEVICES) Annunciator Panel

Indicates position of individual leading edge flaps and slats.

Extinguished – related leading edge device retracted.

2 Leading Edge Devices TRANSIT Lights

Illuminated (amber) – related leading edge device in transit.

3 Leading Edge Devices Extended (EXT) Lights

Illuminated (green) – related leading edge slat in extended (intermediate) position.

4 Leading Edge Devices FULL Extended (EXT) Lights

Illuminated (green) – related leading edge device in full extended position.

5 Leading Edge Annunciator Panel TEST Switch

Press – tests all annunciator panel lights.

6 Leading Edge Transit (LE FLAPS TRANSIT) Light

Illuminated (amber) – any leading edge device in transit, or not in programmed position with respect to trailing edge flaps.

Note: Light is inhibited during autoslat operation in flight.

7 Leading Edge (LE) FLAPS Extended (EXT) Light

Illuminated (green) –

- all leading edge flaps extended and all leading edge slats in extended (intermediate) position (trailing edge flap positions 1, 2 and 5)
- all leading edge devices in full extended position (trailing edge flap positions 10 through 40).

Introduction to Flight Controls

The primary flight control system uses conventional control wheel, column, and pedals linked mechanically to hydraulic power control units which command the primary flight control surfaces; ailerons, elevators and rudder. The flight controls are powered by redundant hydraulic sources; system A and system B. Either hydraulic system can operate all primary flight controls. The ailerons and elevators may be operated manually if required. The rudder may be operated by the standby hydraulic system if system A and system B pressure is not available.

The secondary flight controls, high lift devices consisting of trailing edge (TE) flaps and leading edge (LE) flaps and slats (LE devices), are powered by hydraulic system B. In the event hydraulic system B fails, the TE flaps can be operated electrically. Under certain conditions the power transfer unit (PTU) automatically powers the LE devices. (Refer to Chapter 13, Hydraulics, Power Transfer Unit). They can also be extended using standby hydraulic pressure.

Pilot Controls

The pilot controls consist of:

- two control columns
- two control wheels
- two pairs of rudder pedals
- SPEED BRAKE lever
- FLAP lever
- STAB TRIM cutout switches
- STAB TRIM override switch
- stabilizer trim switches
- stabilizer trim wheel
- AILERON trim switches
- RUDDER trim control
- YAW DAMPER switch
- ALTERNATE FLAPS master switch
- alternate flaps position switch
- FLT CONTROL switches
- flight SPOILER switches

The control wheels are connected through transfer mechanisms which allow the pilots to bypass a jammed control or surface.

There is a rigid connection between both pairs of rudder pedals.

The SPEED BRAKE lever allows manual or automatic symmetric actuation of the spoilers.

Flight Control Surfaces

Pitch control is provided by:

- two elevators
- a movable horizontal stabilizer.

Roll control is provided by:

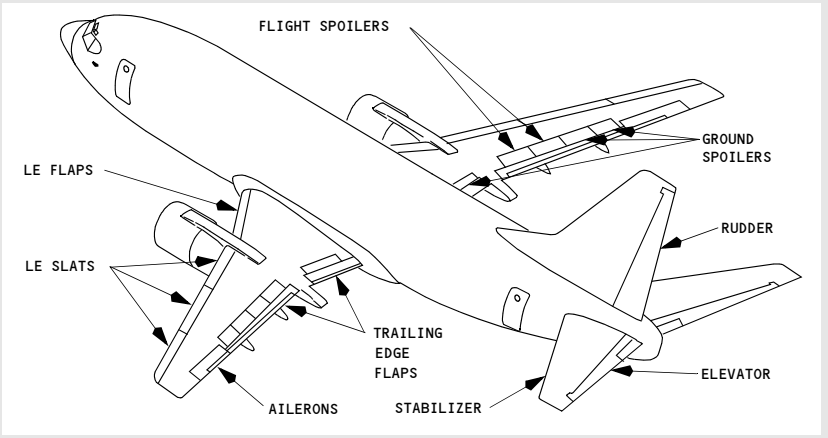
- two ailerons
- four flight spoilers.

Yaw control is provided by a single rudder. During takeoff, the rudder becomes aerodynamically effective between 40 and 60 knots.

TE flaps, and LE flaps and slats provide high lift for takeoff, approach, and landing.

In the air symmetric flight spoilers are used as speed brakes. On the ground symmetric flight and ground spoilers destroy lift and increase braking efficiency.

Flight Control Surfaces Location



Roll Control

The roll control surfaces consist of hydraulically powered ailerons and flight spoilers, which are controlled by rotating either control wheel.

Ailerons

The ailerons provide roll control around the airplane’s longitudinal axis. The ailerons are positioned by the pilots' control wheels. The A and B FLT CONTROL switches control hydraulic shutoff valves. These valves can be used to isolate ailerons, elevators and rudder, from the related hydraulic system pressure.

The Captain’s control wheel is connected by cables to the aileron power control units (PCUs) through the aileron feel and centering unit. The First Officer’s control wheel is connected by cables to the spoiler PCUs through the spoiler mixer. The two control wheels are connected by a cable drive system which allows actuation of both ailerons and spoilers by either control wheel. With total hydraulic power failure the ailerons can be mechanically positioned by rotating the pilots' control wheels. Control forces are higher due to friction and aerodynamic loads.

Aileron Transfer Mechanism

If the ailerons or spoilers are jammed, force applied to the Captain’s and the First Officer’s control wheels will identify which system, ailerons or spoilers, is usable, and which control wheel, Captain’s or First Officer’s, can provide roll control. If the aileron control system is jammed, force applied to the First Officer’s control wheel provides roll control from the spoilers. The ailerons and the Captain’s control wheel are inoperative. If the spoiler system is jammed, force applied to the Captain’s control wheel provides roll control from the ailerons. The spoilers and the First Officer’s control wheel are inoperative.

Aileron Trim

Dual AILERON trim switches, located on the aft electronic panel, must be pushed simultaneously to command trim changes. The trim electrically repositions the aileron feel and centering unit, which causes the control wheel to rotate, and redefines the aileron neutral position. The amount of aileron trim is indicated on a scale on the top of each control column.

If aileron trim is used with the autopilot engaged, the trim is not reflected in the control wheel position. The autopilot overpowers the trim and holds the control wheel where it is required for heading/track control. Any aileron trim applied when the autopilot is engaged can result in an out of trim condition and an abrupt rolling movement when the autopilot is disconnected.

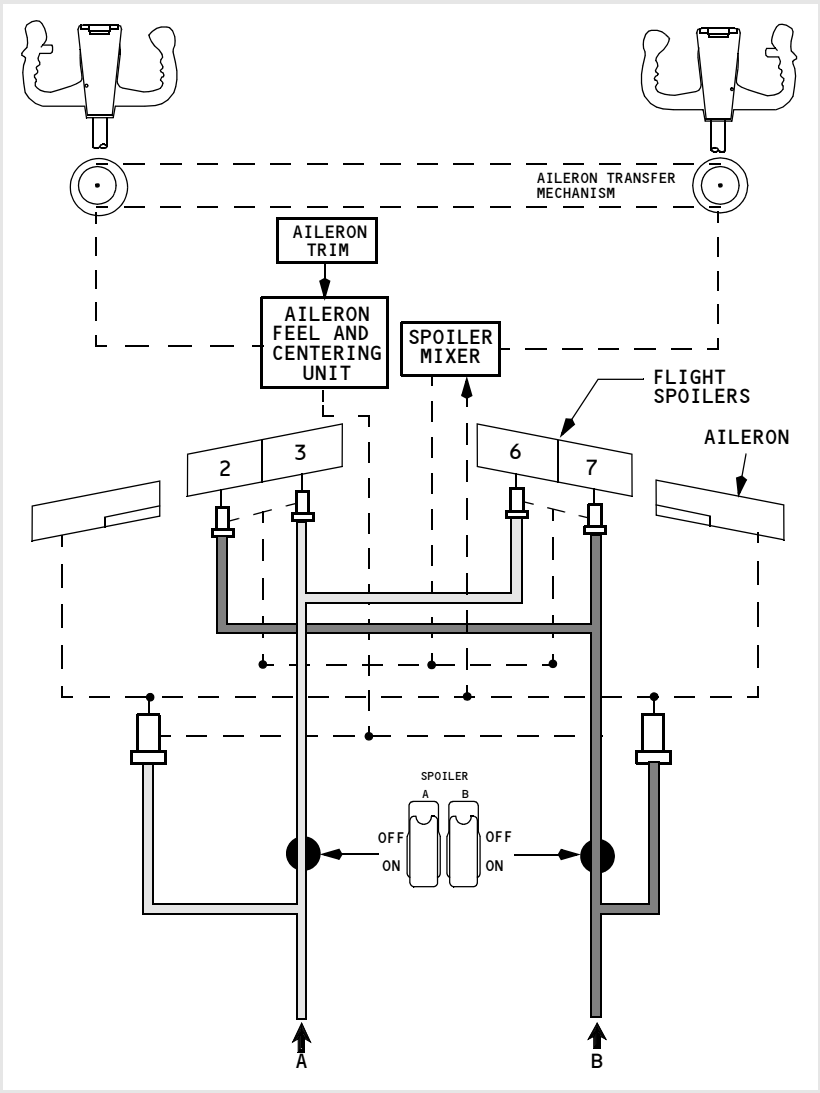
Flight Spoilers

Two flight spoilers are located on the upper surface of each wing. Each hydraulic system, A and B, is dedicated to a different set of spoilers to provide isolation and maintain symmetric operation in the event of hydraulic system failure. Hydraulic pressure shutoff valves are controlled by the two flight SPOILER switches.

Flight spoiler panels are used as speed brakes to increase drag and reduce lift, both in flight and on the ground. The flight spoilers also supplement roll control in response to control wheel commands. A spoiler mixer, connected to the aileron cable–drive, controls the hydraulic power control units on each spoiler panel to provide spoiler movement proportional to aileron movement.

The flight spoilers rise on the wing with up aileron and remain faired on the wing with down aileron. When the control wheel is displaced more than approximately 10°, spoiler deflection is initiated.

Roll Control Schematic



Pitch Control

The pitch control surfaces consist of hydraulically powered elevators and an electrically powered stabilizer. The elevators are controlled by forward or aft movement of the control column. The stabilizer is controlled by either the stabilizer trim switches on the control wheel, the autopilot, or manual trim.

Elevators

The elevators provide pitch control around the airplane's lateral axis. The elevators are positioned by the pilots' control columns. The A and B FLT CONTROL Switches control hydraulic shutoff valves for the elevators.

Cables connect the pilots' control columns to elevator power control units (PCUs) which are powered by hydraulic system A and B. The elevators are interconnected by a torque tube. With loss of hydraulic system A and B the elevators can be mechanically positioned by forward or aft movement of the pilots' control columns. Control forces are higher due to friction and aerodynamic loads.

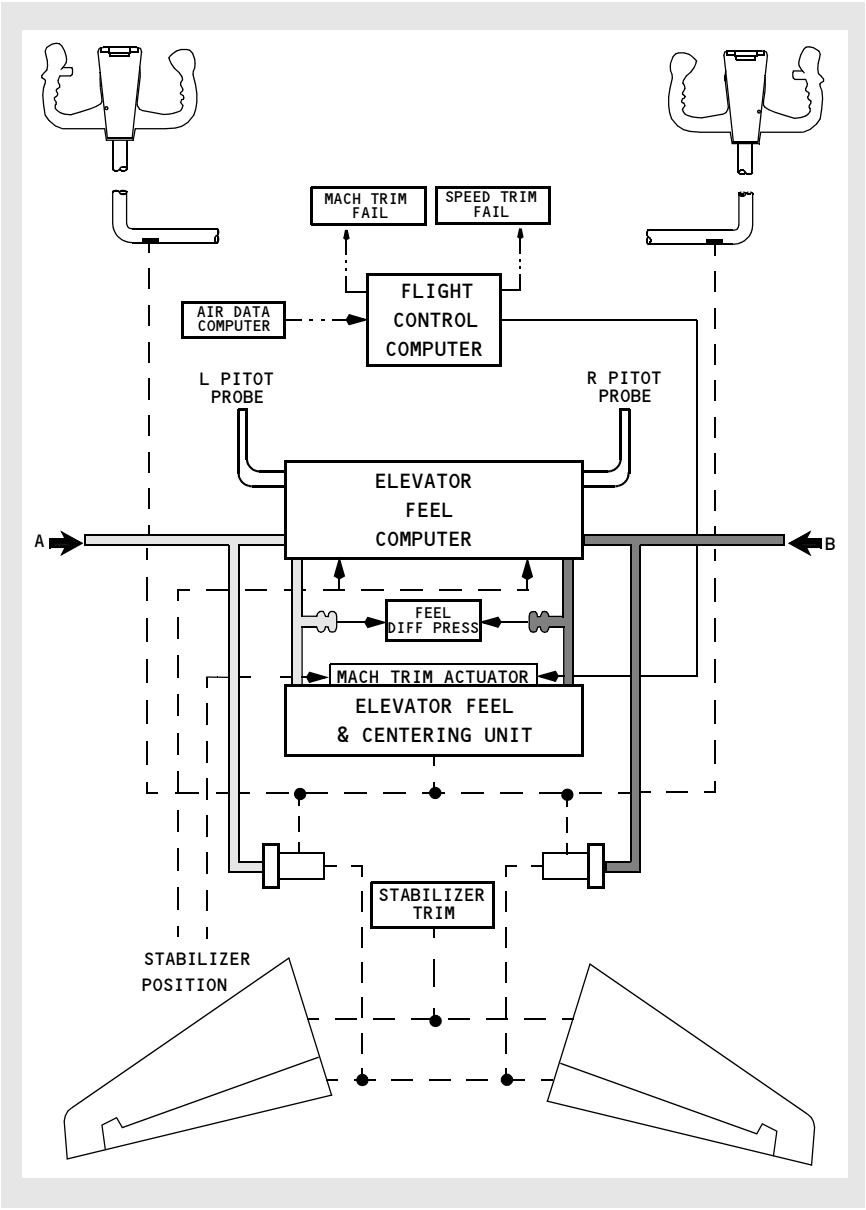
Elevator Feel System

The elevator feel computer provides simulated aerodynamic forces using airspeed (from the elevator pitot system) and stabilizer position. Feel is transmitted to the control columns by the elevator feel and centering unit. To operate the feel system the elevator feel computer uses either hydraulic system A or B pressure, whichever is higher. When either hydraulic system or elevator feel pitot system fail, excessive differential hydraulic pressure is sensed in the elevator feel computer and the FEEL DIFF PRESS light illuminates.

Mach Trim System

A Mach trim system provides speed stability at the higher Mach numbers. Mach trim is automatically accomplished above Mach .615 by adjusting the elevators with respect to the stabilizer as speed increases. The flight control computers use Mach information from the flight data computer to compute a Mach trim actuator position. The Mach trim actuator repositions the elevator feel and centering unit which adjusts the control column neutral position.

Pitch Control Schematic



Stabilizer

The horizontal stabilizer is positioned by the main electric trim motor controlled through either the stabilizer trim switches on the control wheel or by the autopilot trim servo motor. The stabilizer may also be positioned by manually rotating the stabilizer trim wheel.

Stabilizer Trim

Stabilizer trim switches on each control wheel actuate the electric trim motor through the main electric stabilizer trim circuit when the airplane is flown manually. With the autopilot engaged, stabilizer trim is accomplished through the autopilot stabilizer trim circuit. The main electric and autopilot stabilizer trim have two speed modes: high speed with flaps extended, and low speed with flaps retracted. If the autopilot is engaged, actuating either pair of stabilizer trim switches automatically disengages the autopilot. The stabilizer trim wheels rotate whenever electric stabilizer trim is actuated.

The STAB TRIM MAIN ELEC cutout switch and the STAB TRIM AUTOPILOT cutout switch, located on the control stand, are provided to allow the autopilot or main electric trim inputs to be disconnected from the stabilizer trim motor.

Control column actuated stabilizer trim cutout switches stop operation of the main electric and autopilot trim when the control column movement opposes trim direction. When the STAB TRIM override switch is positioned to OVERRIDE, electric trim can be used regardless of control column position.

Manual stabilizer control is accomplished through cables which allow the pilot to position the stabilizer by rotating the stabilizer trim wheels. The stabilizer is held in position by two independent brake systems. Manual rotation of the trim wheels can be used to override autopilot or main electric trim. The effort required to manually rotate the stabilizer trim wheels may be higher under certain flight conditions. Grasping the stabilizer trim wheel will stop stabilizer motion.

Stabilizer Trim Operation with forward or AFT CG

In the event the stabilizer is trimmed to the end of the electrical trim limits, additional trim is available through the use of the manual trim wheels. If manual trim is used to position the stabilizer beyond the electrical trim limits, the stabilizer trim switches may be used to return the stabilizer to electrical trim limits.

Stabilizer Position Indication and Green Band

Stabilizer position is displayed in units on two STAB TRIM indicators located inboard of each stabilizer trim wheel. The STAB TRIM indicators also display the TAKEOFF green band indication.

The trim authority for each mode of trim is limited to:

- Main Electric Trim
  Flaps retracted 2.5 to 12.5 units (–300)
  Flaps retracted 2.8 to 12.5 units (–400/500)
  Flaps extended 0.25 to 12.5 units
- Autopilot Trim 0.25 to 14.0 units
- Manual Trim 0 to 17.0 units

The green band range of the STAB TRIM indicator shows the takeoff trim range. An intermittent horn sounds if takeoff is attempted with the stabilizer trim outside the takeoff trim range.

Speed Trim System

The speed trim system is designed to improve flight characteristics during operations with a low gross weight, aft center of gravity, high thrust. It monitors inputs of stabilizer position, thrust lever position, airspeed, and vertical speed and then trims the stabilizer using the autopilot stabilizer trim. It operates most frequently during takeoffs and go–arounds. Conditions for speed trim operation are listed below:

- Flaps not up (737–300)
- Flaps up or down (737–400/500)
- Airspeed 100 – 300 KIAS
- 10 seconds after takeoff
- 5 seconds following release of trim switches
- N1 above 60%
- Autopilot not engaged
- Sensing of trim requirement

Yaw Control (before Rudder System Enhancement Program (RSEP) modification)

Yaw control is accomplished by a hydraulically powered rudder and a yaw damper system. The rudder is controlled by displacing the rudder pedals. The yaw damping functions are controlled by the yaw damper rate gyro.

Rudder

The rudders provide yaw control around the airplane's vertical axis. The A and B FLT CONTROL switches control hydraulic shutoff valves for the rudder and the standby rudder.

Each set of rudder pedals is connected by cables to the main and standby rudder PCUs through the rudder feel and centering unit. The main rudder PCU is powered by hydraulic system A and B while the standby rudder PCU is powered by the standby hydraulic system. The standby hydraulic system is provided as a backup if system A and/or B pressure is lost. It can be activated manually through the FLT CONTROL switches or automatically. (Refer to Chapter 13, Hydraulics, Standby Hydraulic System)

A rudder pressure reducer is connected to the A system hydraulic line upstream of the main rudder PCU. Hydraulic pressure to the rudder is reduced when the airplane climbs above 1000 feet AGL. Hydraulic pressure returns to normal when the airplane descends through 700 feet AGL, or if B hydraulic system depressurizes, or whenever the N1 difference between the left and right engines exceeds 45%.

Rudder Trim

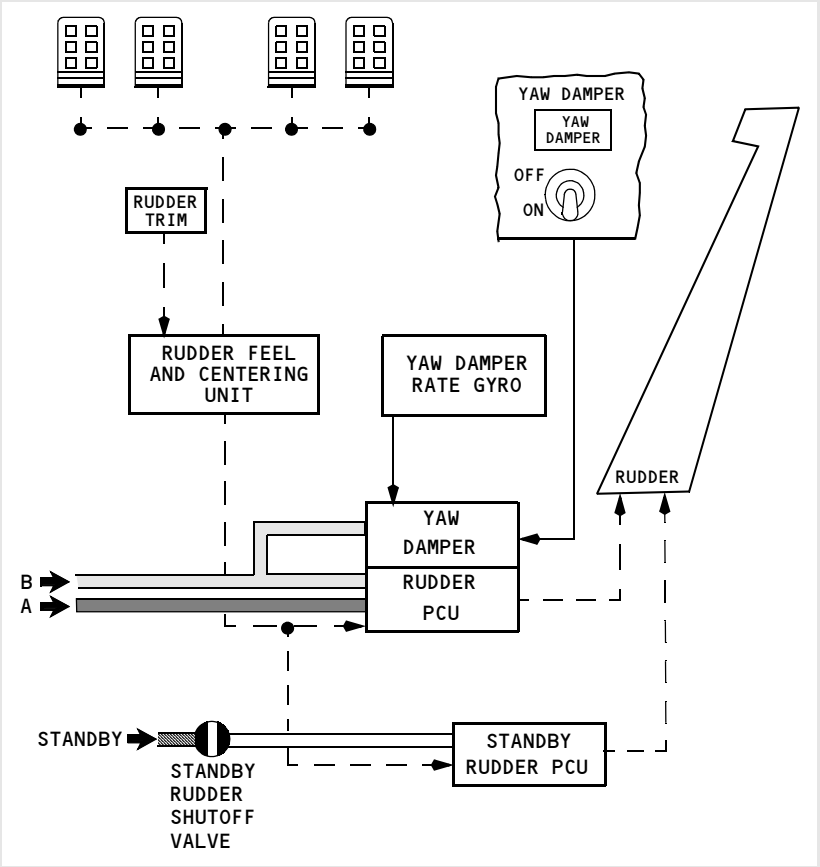
The RUDDER trim control, located on the aft electronic panel, electrically repositions the rudder feel and centering unit which adjusts the rudder neutral position. The rudder pedals are displaced proportionately. The rudder trim indicator displays the rudder trim position in units.

Yaw Damper

The yaw damper system prevents unwanted (Dutch) roll and provides turn coordination. The yaw damper coupler receives inputs from the yaw rate gyro and the air data computer. It then provides inputs to the rudder through the main rudder PCU. At higher airspeeds the amount of yaw damper rudder deflection decreases. No rudder pedal movement results from yaw damper operation.

The yaw damper uses hydraulic system B pressure only. If hydraulic system B pressure is lost the yaw damper system is inoperative but the YAW DAMPER switch remains in the ON position until the B FLT CONTROL switch is positioned to OFF or STBY RUD. Then the YAW DAMPER switch disengages and the amber YAW DAMPER light illuminates and the YAW DAMPER cannot be reengaged.

Yaw Control Schematic (before RSEP modification)



Yaw Control (after Rudder System Enhancement Program (RSEP) modification)

Yaw control is accomplished by a hydraulically powered rudder and a yaw damper system. The rudder is controlled by displacing the rudder pedals. The yaw damping functions are controlled by the yaw damper coupler (YDC).

Rudder

The rudder provides yaw control about the airplane's vertical axis. The A and B FLT CONTROL switches control hydraulic shutoff valves for the rudder and the standby rudder.

Each set of rudder pedals is mechanically connected by cables to the input levers of the main and standby rudder PCUs. The main PCU consists of two independent input rods, two individual control valves, and two separate actuators; one for Hydraulic system A and one for Hydraulic system B. The standby rudder PCU is controlled by a separate input rod and control valve and is powered by the standby hydraulic system. All three input rods have individual jam override mechanisms that allow input commands to continue to be transferred to the remaining free input rods if an input rod or downstream hardware is hindered or jammed.

A rudder pressure reducer (RPR) is connected to the Hydraulic system A line upstream of the main rudder PCU. A rudder pressure limiter (RPL) is incorporated in the Hydraulic system B part of the main rudder PCU. Both the RPR and RPL limit hydraulic pressure to the rudder when full rudder authority is not required. Hydraulic pressure to the rudder is limited when the airplane climbs above 1000 feet AGL. Hydraulic pressure is returned to normal when the airplane descends through 700 feet AGL, or if B hydraulic system depressurizes, or whenever the N1 difference between the left and right engines exceeds 45%. This function limits full rudder authority in flight after takeoff and before landing. The Yaw Damper Coupler (YDC) controls both the RPR and the RPL respectively, for Hydraulic system A and Hydraulic system B of the main rudder PCU.

The main rudder PCU contains a Force Fight Monitor (FFM) that detects opposing pressure (force fight) between A and B actuators. This may occur if either system A or B input is jammed or disconnected. The FFM output is used to automatically turn on the Standby Hydraulic pump, open the standby rudder shutoff valve pressurizing the standby rudder PCU, and illuminate the STBY RUD ON, Master Caution, and Flight Control (FLT CONT) lights.

The standby rudder PCU is powered by the standby hydraulic system. The standby hydraulic system is provided as a backup if system A and/or B pressure is lost. With the standby PCU powered the pilot retains adequate rudder control capability. It can be operated manually through the FLT CONTROL switches or automatically. (Refer to Chapter 13, Hydraulics, Standby Hydraulic System)

An amber STBY RUD ON light illuminates when the standby rudder hydraulic system is commanded on. The standby rudder system can be pressurized with either Flight Control switch, automatically during takeoff or landing (Refer to Chapter 13, Hydraulics, Standby Hydraulic System) or automatically by the Force Fight Monitor. The STBY RUD ON light illumination actives Master Caution and Flight Control warning lights on the Systems Annunciation Panel.

Rudder Trim

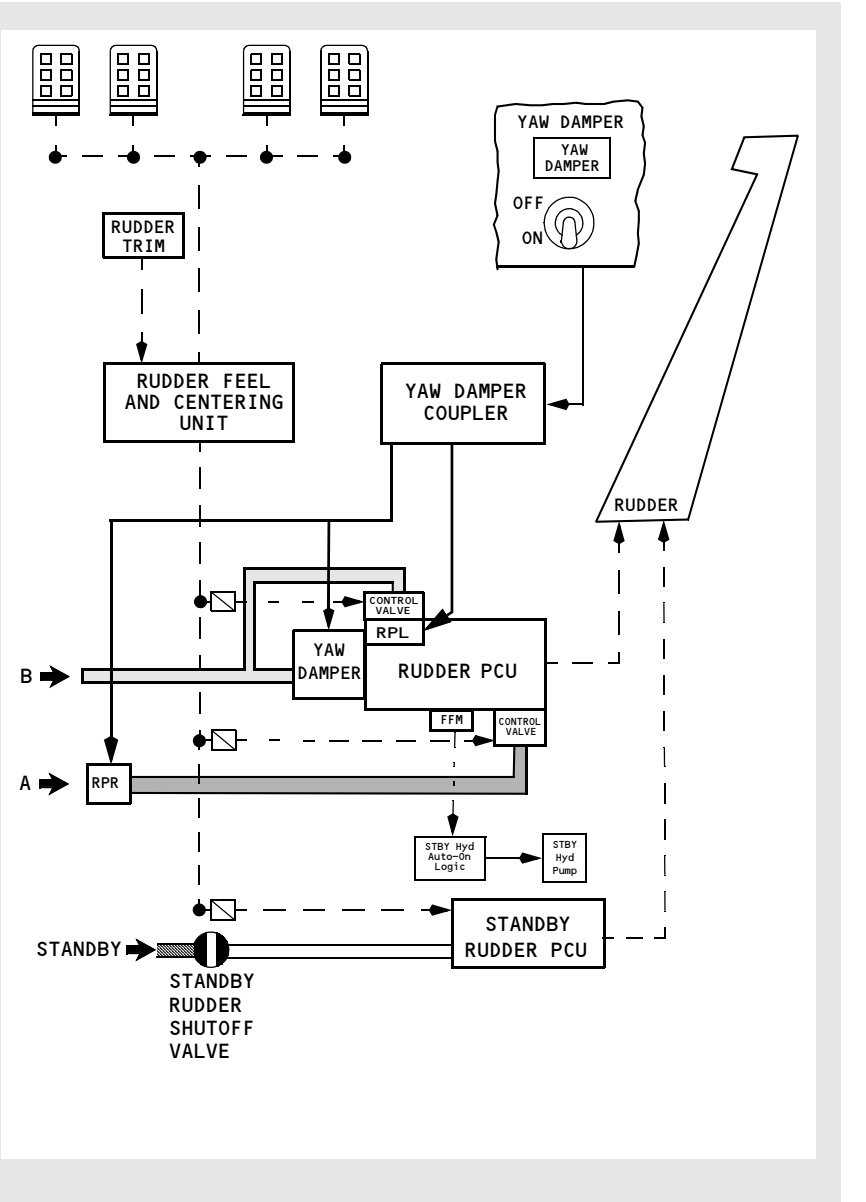
The RUDDER trim control, located on the aft electronic panel, electrically repositions the rudder feel and centering unit which adjusts the rudder neutral position. The rudder pedals are displaced proportionately. The rudder trim indicator displays the rudder trim position in units.

Yaw Damper

The yaw damper system prevents unwanted (Dutch) roll and provides turn coordination. The yaw damper coupler receives inputs from the yaw rate gyro and the air data computer. It then provides inputs to the rudder through the main rudder PCU. At higher airspeeds the amount of yaw damper rudder deflection decreases. No rudder pedal movement results from yaw damper operation.

The yaw damper uses hydraulic system B pressure only. If hydraulic system B pressure is lost the yaw damper system is inoperative but the YAW DAMPER switch remains in the ON position until the B FLT CONTROL switch is positioned to OFF or STBY RUD. Then the YAW DAMPER switch disengages and the amber YAW DAMPER light illuminates and the YAW DAMPER cannot be reengaged.

Yaw Control Schematic (after RSEP modification)



Speed Brakes

The speed brakes consist of flight spoilers and ground spoilers. Hydraulic system A powers all six ground spoilers, three on the upper surface of each wing. The SPEED BRAKE lever controls the spoilers. When the SPEED BRAKE lever is actuated all the spoilers extend when the airplane is on the ground, and only the flight spoilers extend when the airplane is in the air.

In Flight Operation

Operating the SPEED BRAKE lever in flight causes all flight spoiler panels to rise symmetrically to act as speed brakes. Caution should be exercised when deploying flight spoilers during a turn, as they greatly increase roll rate. When the speed brakes are in an intermediate position roll rates increase significantly. Moving the SPEED BRAKE lever past the FLIGHT detent causes buffeting and is not recommended in flight.

Ground Operation

During landing, the auto speed brake system operates when these conditions occur:

- SPEED BRAKE lever is in the ARMED position
- SPEED BRAKE ARMED light is illuminated
- both thrust levers are retarded to IDLE
- main landing gear wheels spin–up (more than 60 kts) – SPEED BRAKE lever automatically moves to the UP position, and the flight spoilers deploy
- right main landing gear strut compresses on touchdown, causing the mechanical linkage to open the ground spoiler bypass valve, and the ground spoilers deploy

If a wheel spin–up signal is not detected, when the air/ground system senses ground mode, the SPEED BRAKE lever moves to the UP position, and all spoiler panels deploy automatically.

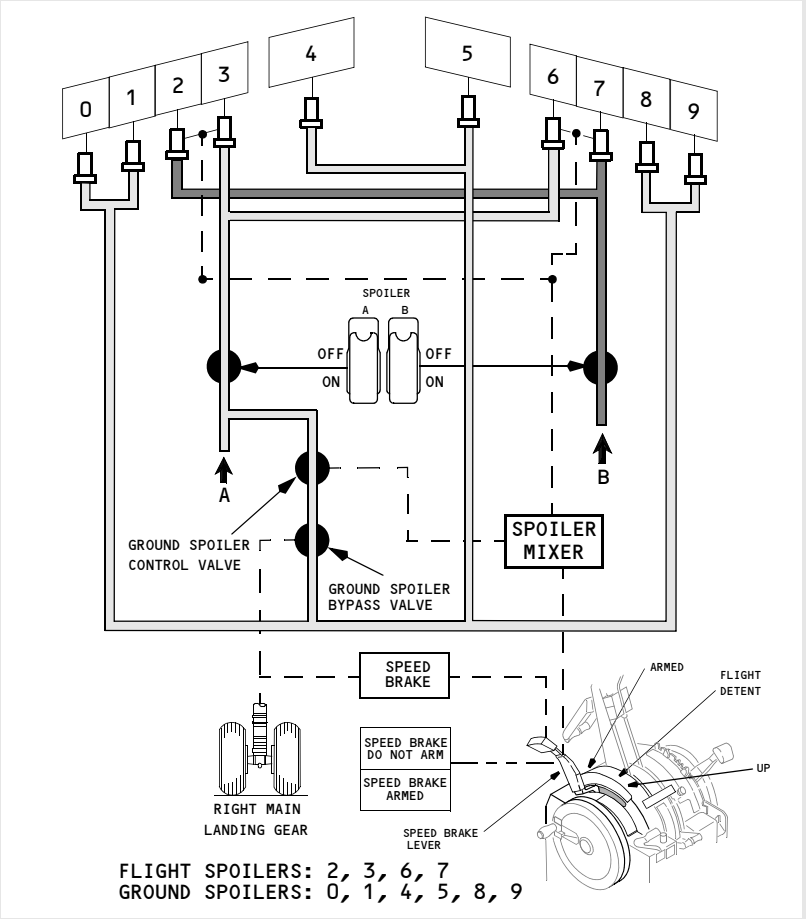
During a rejected takeoff (RTO), the auto speed brake system operates when these conditions occur:

- main landing gear wheels spin–up (more than 60 kts)
- takeoff is rejected, both thrust levers are retarded to IDLE and the reverse thrust levers are positioned for reverse thrust – SPEED BRAKE lever automatically moves to the UP position and all spoilers deploy.

After a RTO or landing, if either thrust lever is advanced, the SPEED BRAKE lever automatically moves to the DOWN detent and all spoiler panels retract. The spoiler panels may also be retracted by manually moving the SPEED BRAKE lever to the DOWN detent.

The SPEED BRAKE caution light flashes continuously if the Speed Brake Lever is aft of the ARMED position, the air/ground sensor is in the air position, and the flaps are extended beyond position 10.

Speed Brakes Schematic



Flaps and Slats

The flaps and slats are high lift devices that increase wing lift and decrease stall speed during takeoff, low speed maneuvering and landing.

LE devices consist of four flaps and six slats: two flaps inboard and three slats outboard of each engine. Slats extend to form a sealed or slotted leading edge depending on the TE flap setting. The TE devices consist of triple slotted flaps inboard and outboard of each engine.

TE flap positions 1–15 provide increased lift; positions 15–40 provide increased lift and drag. Flap positions 15, 30 and 40 are normal landing flap positions. Flaps 15 is normally limited to airports where approach climb performance is a factor. Runway length and condition must be taken into account when selecting a landing flap position.

To prevent excessive structural loads from increased Mach at higher altitude, flap extension above 20,000 feet should not be attempted.

Flap and Slat Sequencing

LE devices and TE flaps are normally extended and retracted by hydraulic power from system B. When the FLAP lever is in the UP detent, all flaps and LE devices are commanded to the retracted or up position. Moving the FLAP lever aft allows selection of flap detent positions 1, 2, 5, 10, 15, 25, 30 or 40. The LE devices deployment is sequenced as a function of TE flaps deployment.

When the FLAP lever is moved from the UP position to the 1, 2, or 5 position, the TE flaps extend to the commanded position and the LE:

- flaps extend to the extended position, and
- slats extend to the extended (intermediate) position.

When the FLAP lever is moved beyond the 5 position the TE flaps extend to the commanded position and the LE:

- flaps remain at the extended position, and
- slats extend to the full extended position.

The LE devices sequence is reversed upon retraction.

Mechanical gates hinder inadvertent FLAP lever movement beyond flaps 1 for one engine inoperative go–around, and flaps 15 for normal go–around.

Indicator lights on the center instrument panel provide overall LE devices position status. The LE DEVICES annunciator on the aft overhead panel indicates the positions of the individual flaps and slats.

Flap Load Relief

A flap load limiter provides a TE flap load relief function which protects the flaps from excessive air loads. This function is operative at the flaps 40 position only. The FLAP lever does not move, but the flap position indicator displays flap retraction and re–extension and the FLAP LOAD RELIEF light illuminates.

When the flaps are set at 40 the TE flaps:

- retract to 30 if airspeed exceeds 158 knots (-300/500)
- re–extend when airspeed is reduced to 153 knots.
- retract to 30 if airspeed exceeds 162 knots (-400)
- re–extend when airspeed is reduced to 157 knots.

Autoslats

At flap positions 1, 2 and 5 an autoslat function is available that moves the LE slats to FULL EXTEND if the airplane approaches a stall condition.

The autoslat system is designed to enhance airplane stall characteristics at high angles of attack during takeoff or approach to landing. When TE flaps 1 through 5 are selected, the LE slats are in the extend position. As the airplane approaches the stall angle, the slats automatically drive to the full extended position, prior to stick shaker activation. The slats return to the extend position when the pitch angle is sufficiently reduced below the stall critical attitude.

Autoslat operation is normally powered by hydraulic system B. An alternate source of power is provided by system A through a power transfer unit (PTU) if a loss of pressure is sensed from the higher volume system B engine driven pump. The PTU uses system A pressure to power a hydraulic motorized pump, pressurizing system B fluid to provide power for the autoslat operation. (Refer to Chapter 13, Hydraulics, Power Transfer Unit)

Alternate Extension

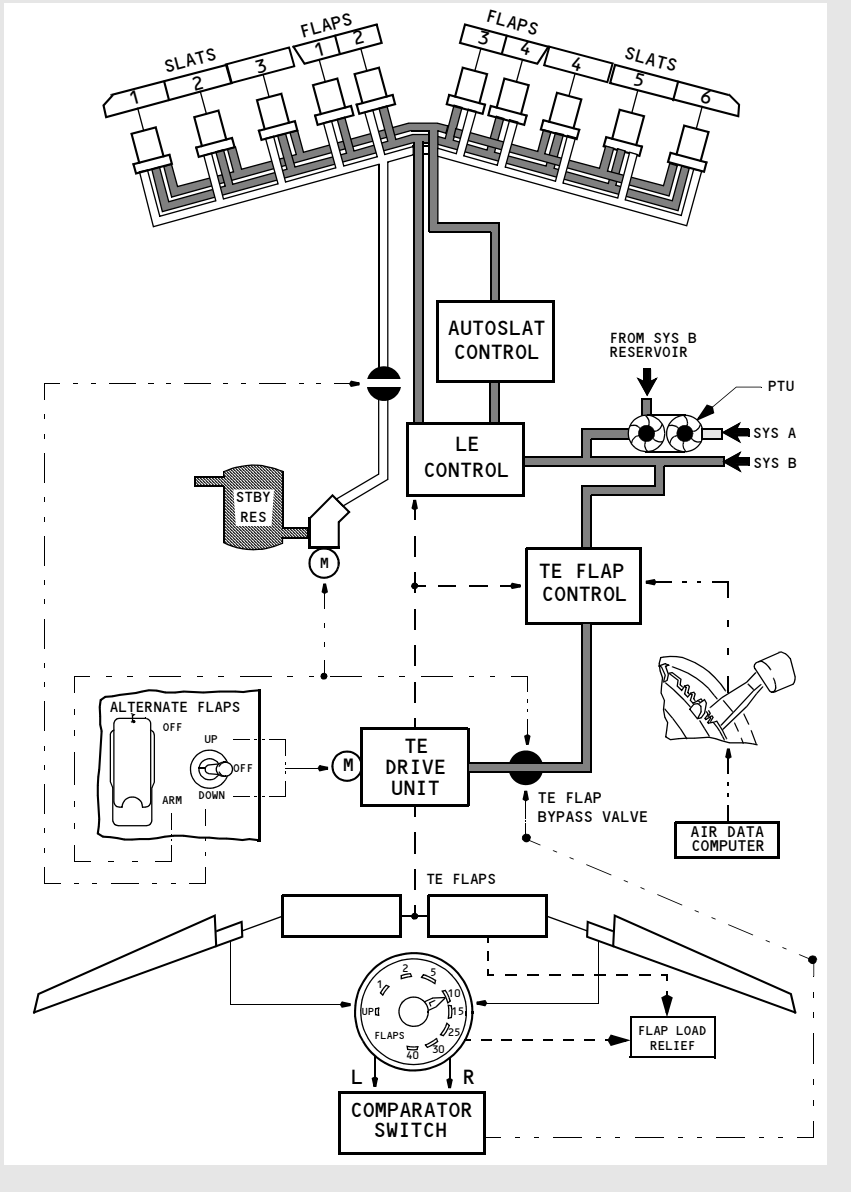
In the event that hydraulic system B fails, an alternate method of extending the LE devices, and extending and retracting the TE flaps is provided.

The TE flaps can be operated electrically through the use of two alternate flap switches. The guarded ALTERNATE FLAPS master switch closes a flap bypass valve to prevent hydraulic lock of the flap drive unit and arms the ALTERNATE FLAPS position switch. The ALTERNATE FLAPS position switch controls an electric motor that extends or retracts the TE flaps. The switch must be held in the DOWN position until the flaps reach the desired position. No asymmetry protection is provided through the alternate (electrical) flap drive system.

Note: The LE devices cannot be retracted by the standby hydraulic system.

When using alternate flap extension the LE flaps and slats are driven to the full extended position using power from the standby hydraulic system. In this case the ALTERNATE FLAPS master switch energizes the standby pump, and the ALTERNATE FLAPS position switch, held in the down position momentarily, fully extends the LE devices.

Leading Edge Devices and Trailing Edge Flaps Schematic



High Lift Device Protection and Indication

Trailing Edge Flap Asymmetry

When a trailing edge asymmetry develops, a comparator switch closes the TE flap bypass valve, removing hydraulic power from the flap drive unit. The flap position will be displayed as a needle split on the flap position indicator.

Leading Edge Device Improper Position

When a leading edge device is in an improper position the LE FLAPS TRANSIT light remains illuminated and one of the following indications is displayed on the LE Devices Annunciator Panel:

- amber TRANSIT light illuminated
- incorrect green EXT or FULL EXT light illuminated
- no light illuminated.