CHAPTER

32

Landing Gear

CHAPTER 32
LANDING GEAR

Subject/Page	Date	COC
32-EFFECTIVE PAGES		
1 thru 11	Sep 05/2018	
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32-CONTENTS		
1	May 05/2015	
2	Jul 25/2018	
3	Jul 25/2018	
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8	Jul 25/2018	
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A = Added, R = Revised, D = Deleted, O = Overflow, C = Customer Originated Change

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LANDING GEAR

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LANDING GEAR

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34	May 05/2015				

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Subject/Page	Date	COC
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A = Added, R = Revised, D = Deleted, O = Overflow, C = Customer Originated Change

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Subject/Page	Date	COC	Subject/Page	Date	COC
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16	May 05/2015	

A = Added, R = Revised, D = Deleted, O = Overflow, C = Customer Originated Change

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A = Added, R = Revised, D = Deleted, O = Overflow, C = Customer Originated Change

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LANDING GEAR - INTRODUCTION

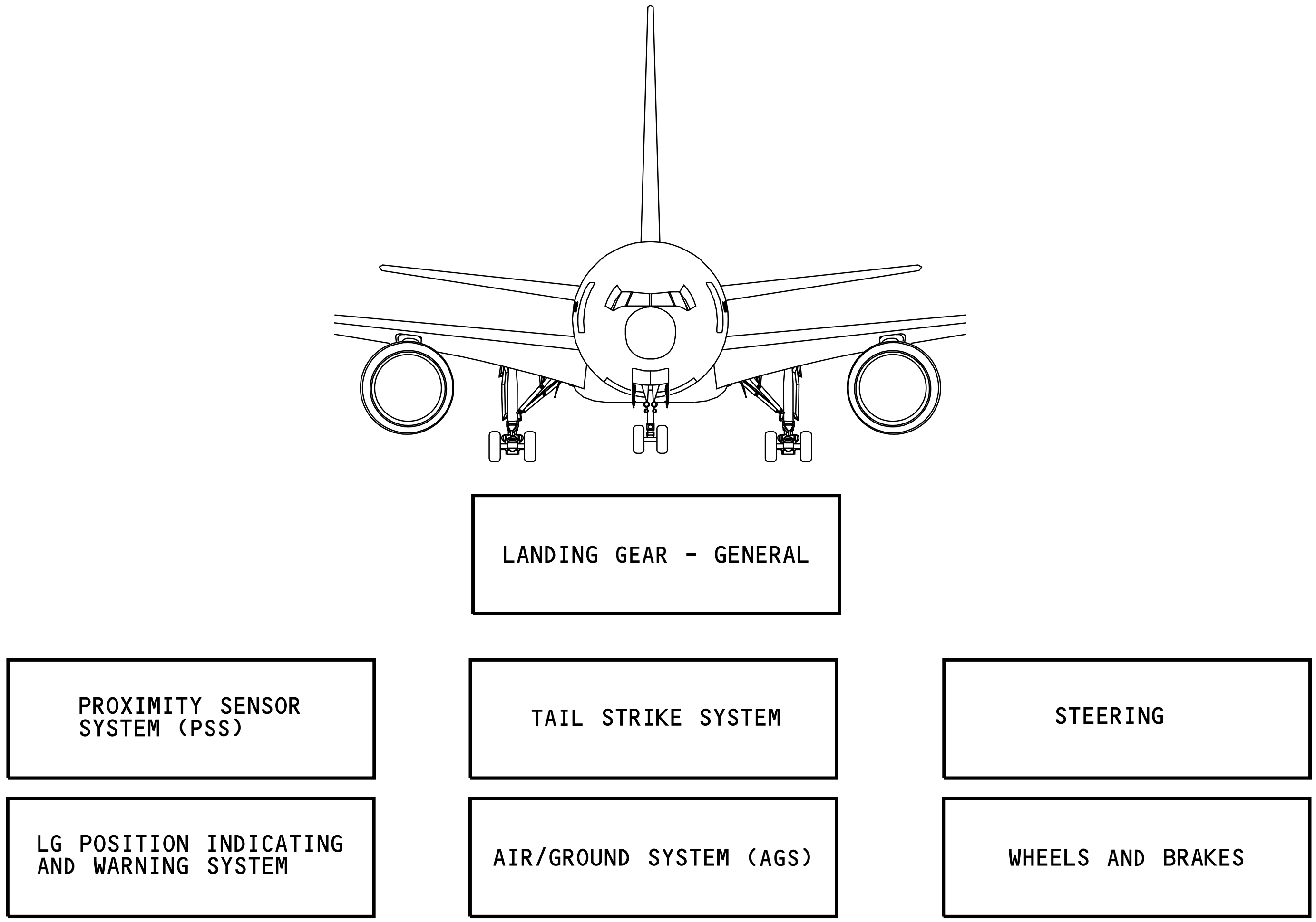
General

These are the landing gear systems (ATA chapter 32):

- Landing Gear - General (32-00, 32-10, 32-20), (32-30)
- Proximity Sensor System (PSS) (32-08)
- Landing Gear (LG) Position Indication and Warning System (32-61)
- Tail Strike System (TSS) (32-71)
- Air/Ground System (AGS) (32-09)
- Steering (32-50)
- Wheels and Brakes (32-40).

Abbreviations and Acronyms

- actr - actuator
- AGS - air/ground system
- altn - alternate
- APU - auxiliary power unit
- ARINC - Aeronautical Radio, Inc.
- ATA - air transport association
- bat - battery
- ctr - center
- ctrl - control
- ELMS - electrical load management system
- ext - extension
- fwd - forward
- gnd - ground
- gr - gear
- hyd - hydraulic
- HYDIM - hydraulic interface module
- ind - indicator
- L - left
- LDG - landing
- LG - landing gear
- lk - lock
- lts - lights
- MFD - multi-function display
- mod - module
- mot - motor
- NG - nose gear
- MLG - main landing gear
- NLG - nose landing gear
- opr - operated
- press - pressure
- PSEU - proximity sensor electronics unit
- PSI - pounds per square inch
- PSS - proximity sensor system
- PTT - press-to-test
- R - right
- ref - reference
- ret - retraction
- seq - sequence
- sol - solenoid
- stby - standby
- sw - switch
- sys - system
- TSS - tail strike system
- vlv - valve



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LANDING GEAR - INTRODUCTION

LANDING GEAR - GENERAL - INTRODUCTION

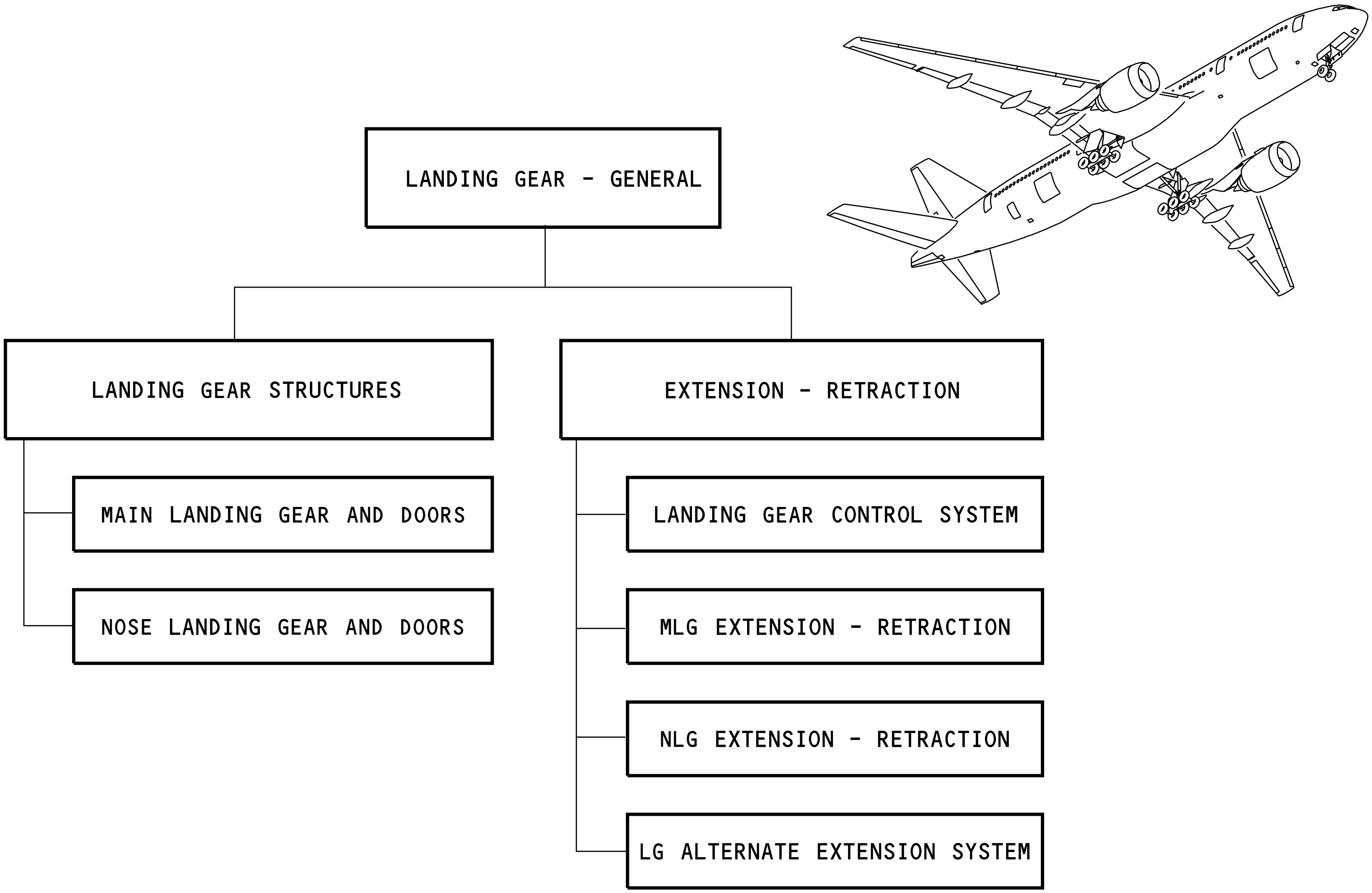
Purpose

Landing gear structural components hold the weight of the airplane while the airplane is on the ground. These are the landing gear structural systems:

- The main landing gear (MLG) and doors (SECTION 32-10)
- The nose landing gear (NLG) and doors (SECTION 32-20).

Landing gear extension-retraction systems extends and retracts the landing gear to reduce airplane drag in flight. These are the landing gear extension-retraction systems:

- The landing gear control system (SECTION 32-31)
- The main landing gear extension and retraction (SECTION 32-32)
- The nose landing gear extension and retraction (SECTION 32-34)
- The landing gear alternate extension system (SECTION 32-35).



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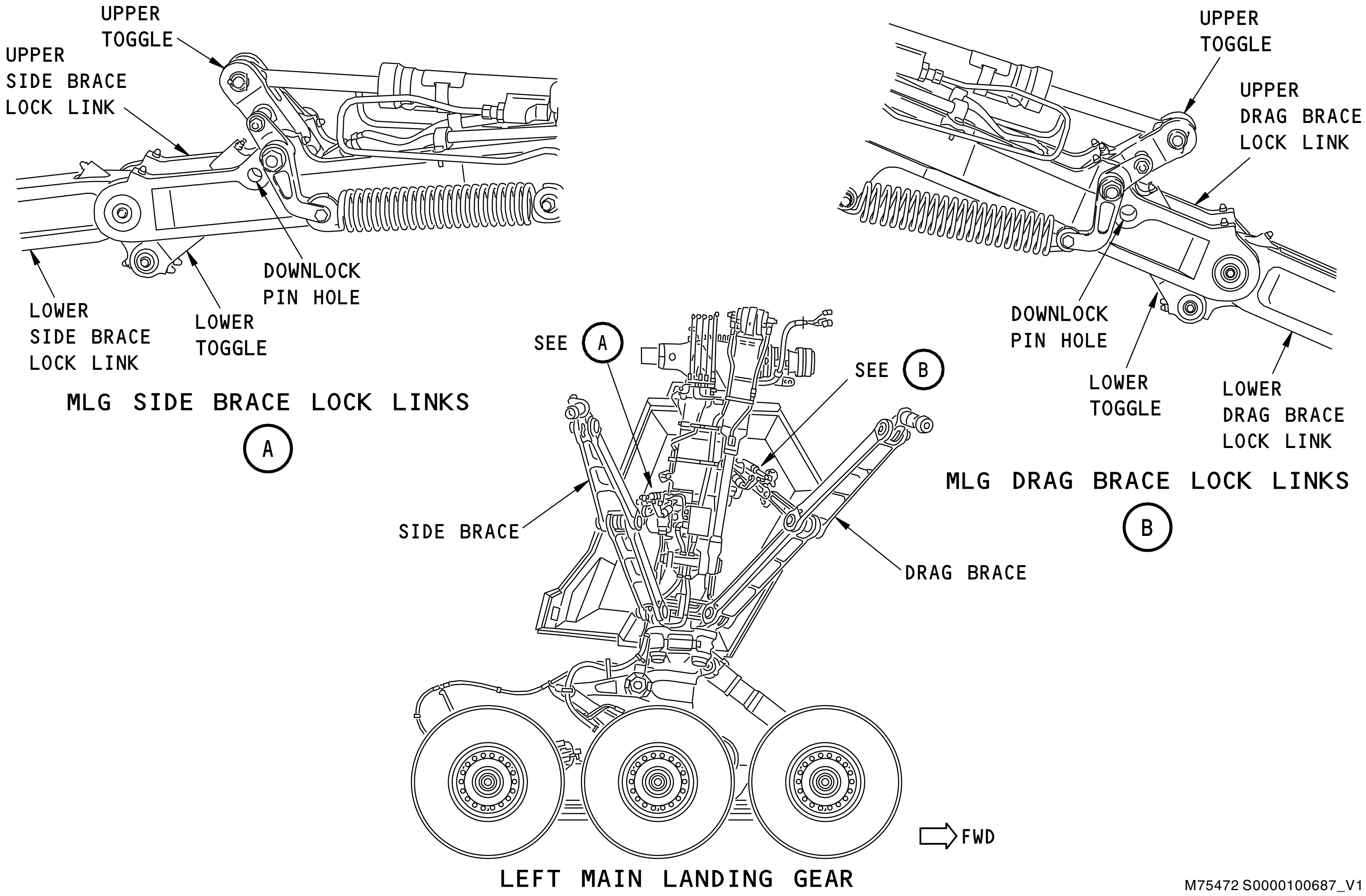
LANDING GEAR - GENERAL - INTRODUCTION

LANDING GEAR - DOWNLOCK PINS - MAIN LANDING GEAR

General

There are two main landing gear downlock pins for each main landing gear.

The pins install in the MLG drag brace lock link and the MLG side brace lock link. You install the downlock pins to prevent MLG retraction.



LANDING GEAR - DOWNLOCK PINS - MAIN LANDING GEAR

LANDING GEAR - DOOR LOCKS - MAIN LANDING GEAR

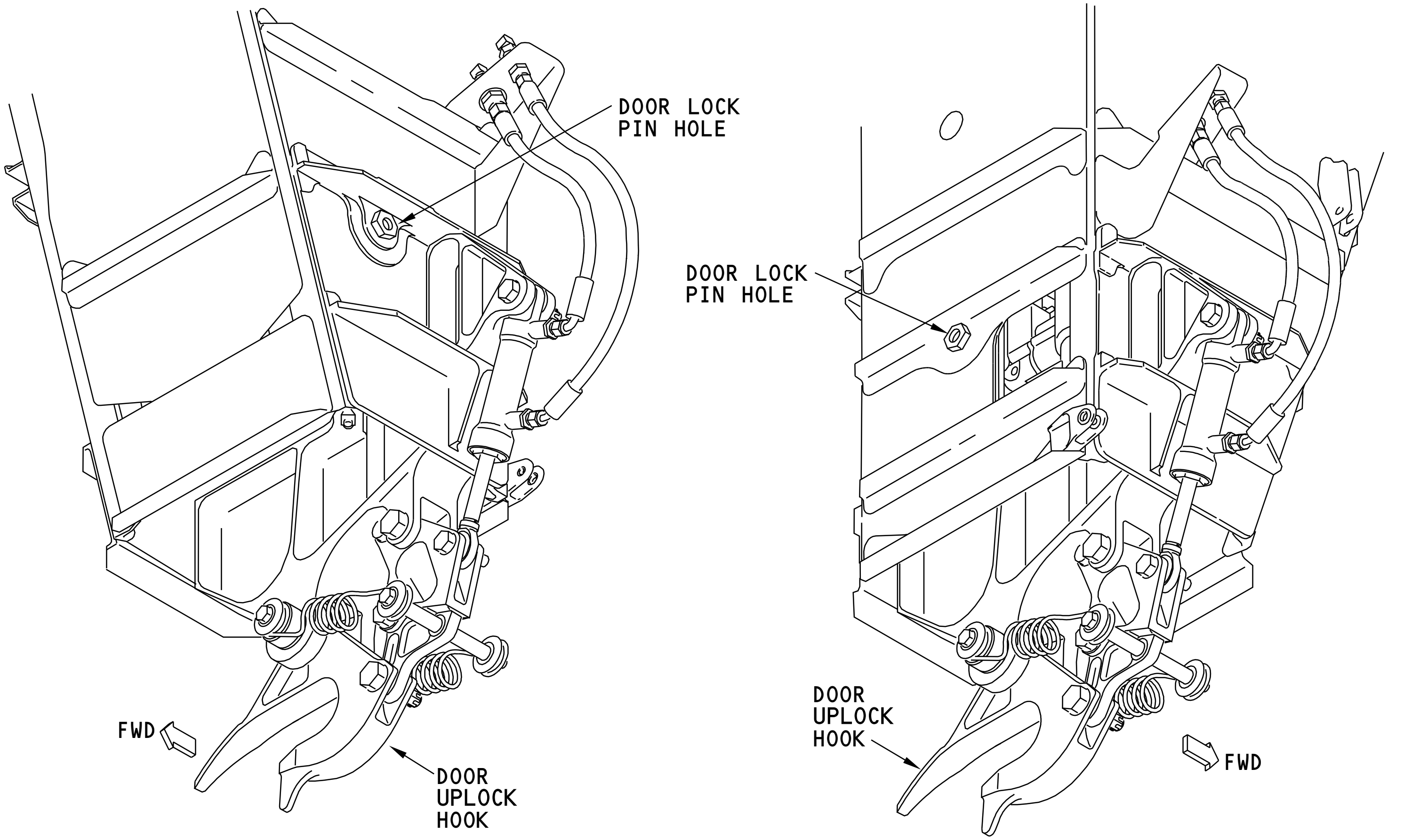
General

Door lock pins prevent the MLG doors from being closed.

The pins go in the MLG door release/safety valve module in each main landing gear wheel well. When installed, the pins prevent the safety valve from moving to the unsafe position.

The door lock pin hole for the left MLG door is on the outboard side of the support structure for the left MLG door uplock hook.

The door lock pin hole for the right main gear door is on the aft side of the support structure for the right MLG door uplock hook.



MLG DOOR UPLOCK HOOK SUPPORT STRUCTURE - LEFT MLG

MLG DOOR UPLOCK HOOK SUPPORT STRUCTURE - RIGHT MLG

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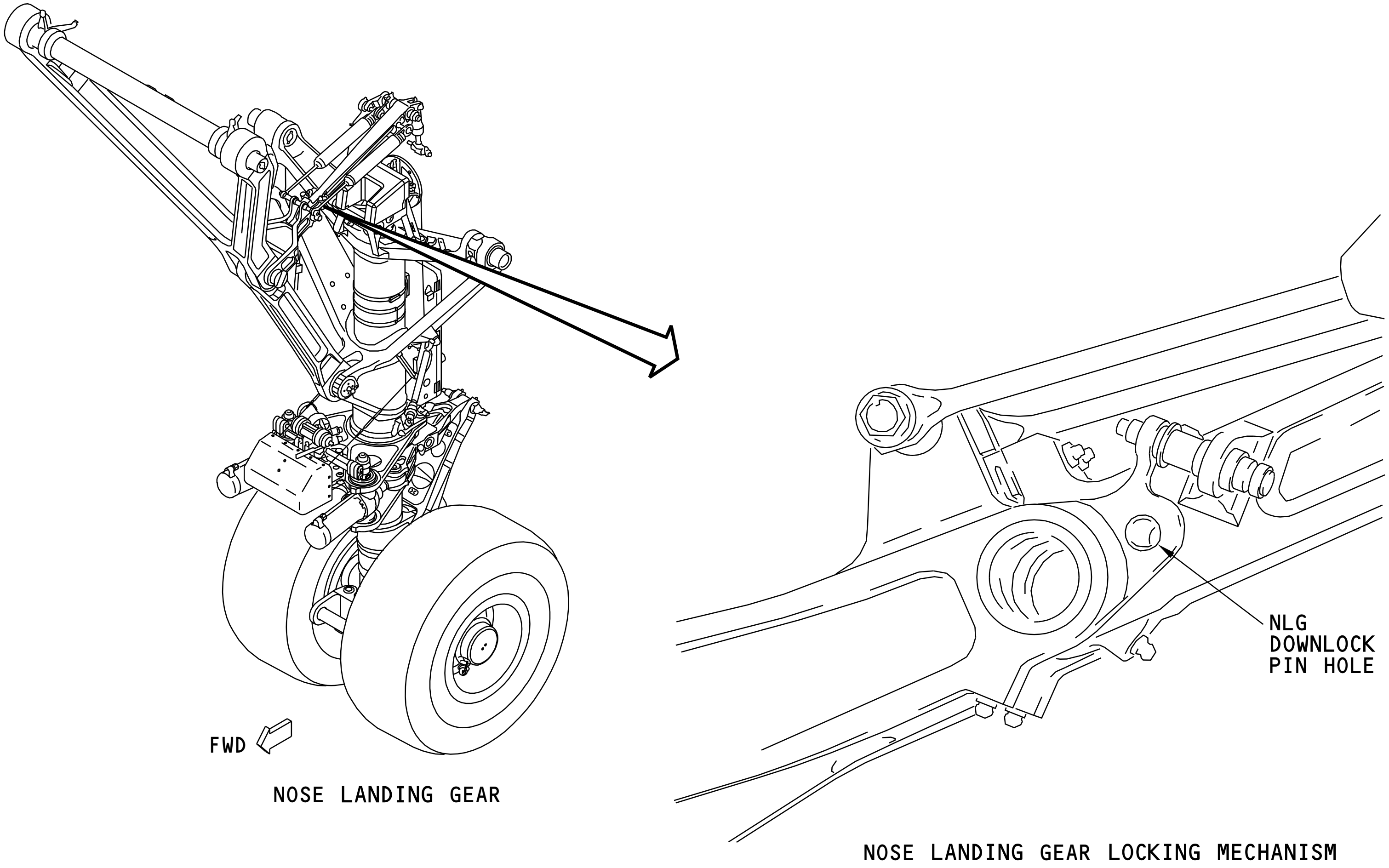
LANDING GEAR - DOOR LOCKS - MAIN LANDING GEAR

LANDING GEAR - DOWNLOCK PIN - NOSE LANDING GEAR

General

The nose landing gear downlock pin installs in the NLG lock link.



NOSE LANDING GEAR

NOSE LANDING GEAR LOCKING MECHANISM

M42236 S000618577_V1

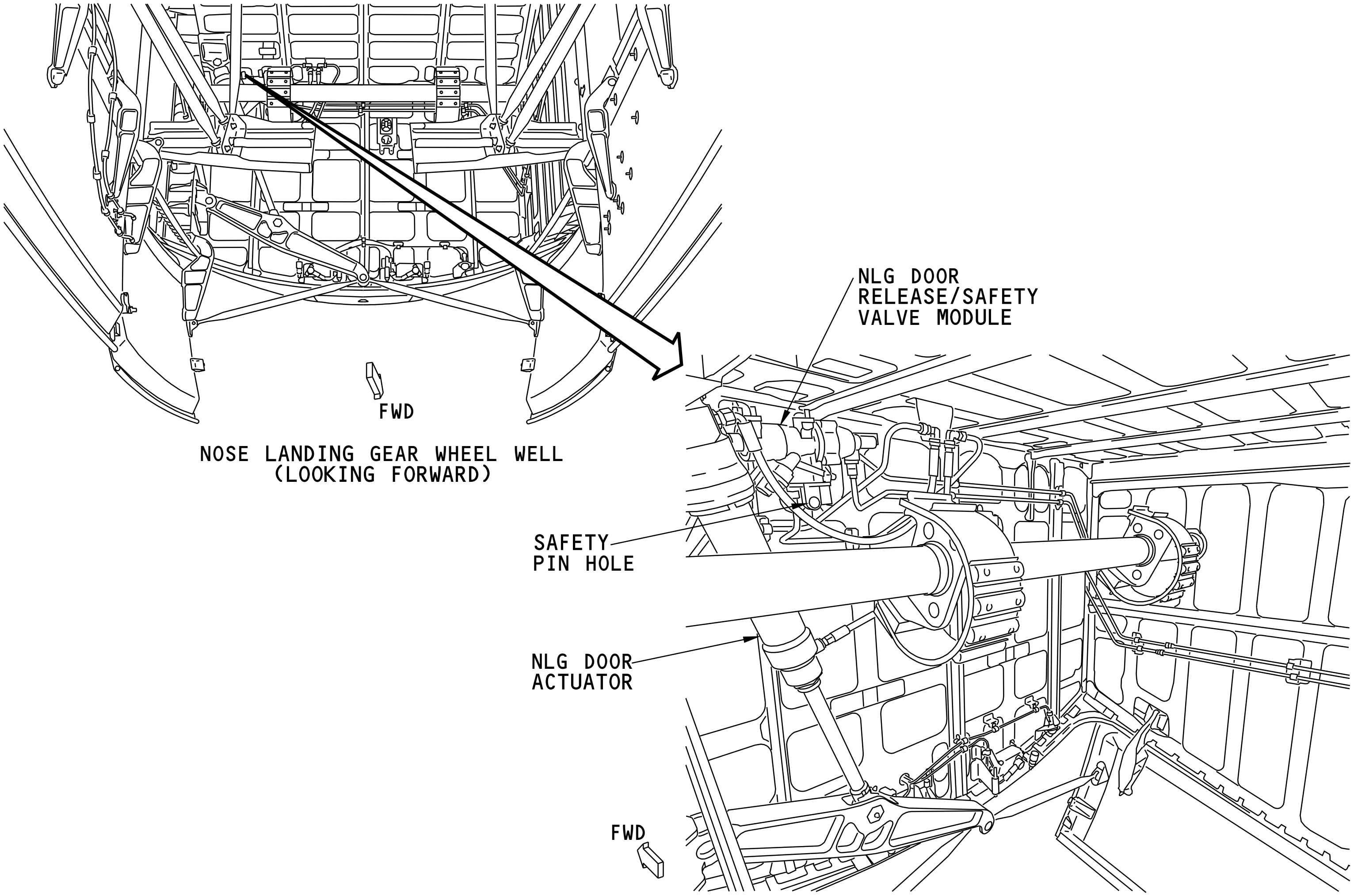
LANDING GEAR - DOWNLOCK PIN - NOSE LANDING GEAR

LANDING GEAR - DOOR LOCK - NOSE LANDING GEAR

General

The NLG door lock pin prevents the nose landing gear doors from being closed.

The pin goes in the NLG door release/safety valve module on the forward bulkhead of the NLG wheel well. When installed, the pin prevents the movement of the safety valve to the unsafe position.



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LANDING GEAR - DOOR LOCK - NOSE LANDING GEAR

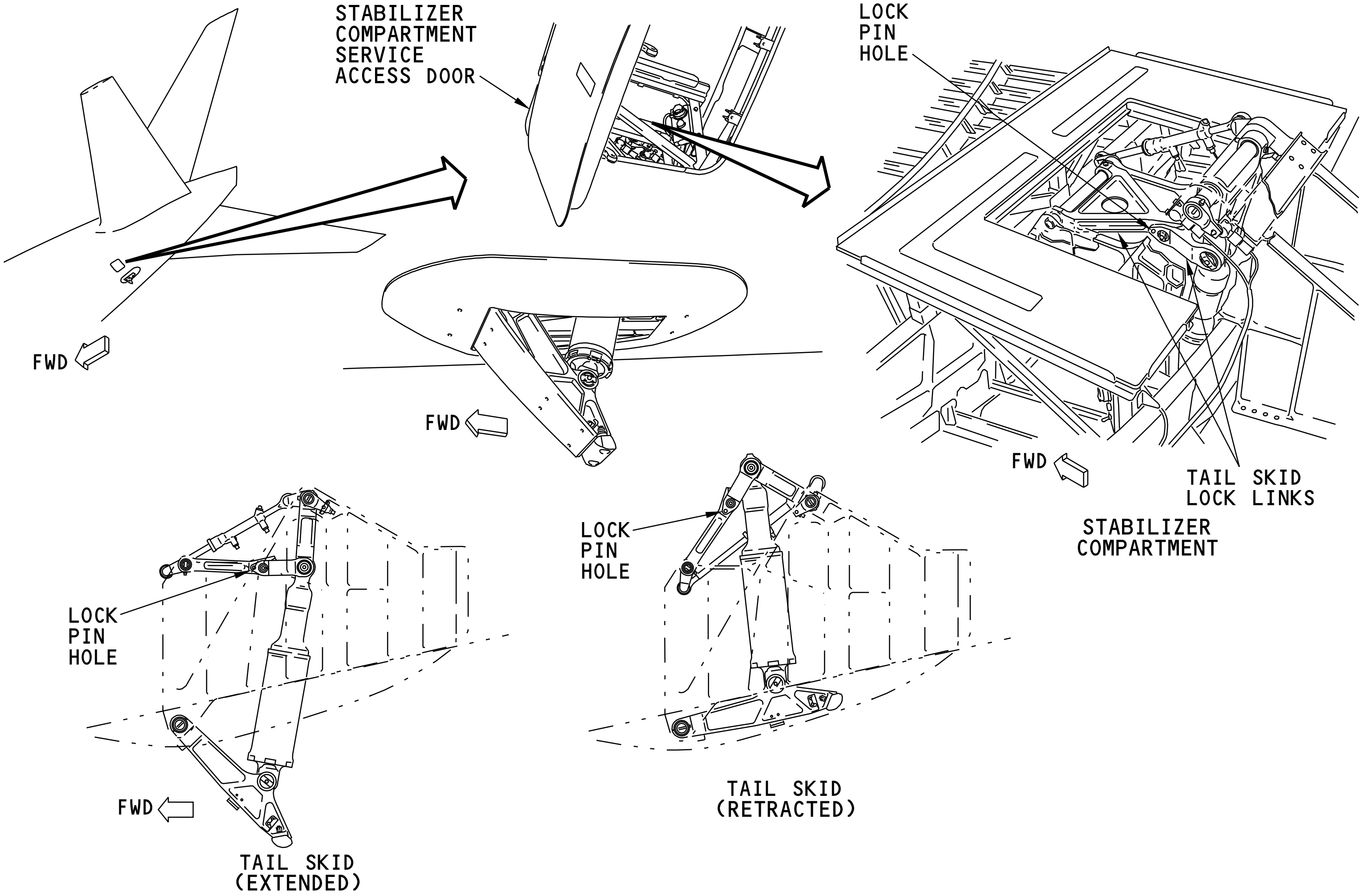
LANDING GEAR - LOCK PIN - TAIL SKID

General

The tail skid lock pin prevents tail skid actuation.

The pin goes in the tail skid lock links. You get access to the lock links through the stabilizer compartment forward access door. When installed, the pin prevents the movement of the tail skid system.

The pin locks the tail skid in the retracted or the extended position.



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LANDING GEAR - LOCK PIN - TAIL SKID

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PROXIMITY SENSOR SYSTEM - INTRODUCTION

Purpose

The proximity sensor system (PSS) is primarily used to monitor the position of mechanical components. The PSS also provides position indication and control for some critical systems. PSS uses two proximity sensor electronics units (PSEUs) to provide position data for these systems:

- Landing gear
- Passenger entry doors
- Cargo doors and access doors
- Equipment center access doors
- Thrust reversers

ARO 001-004

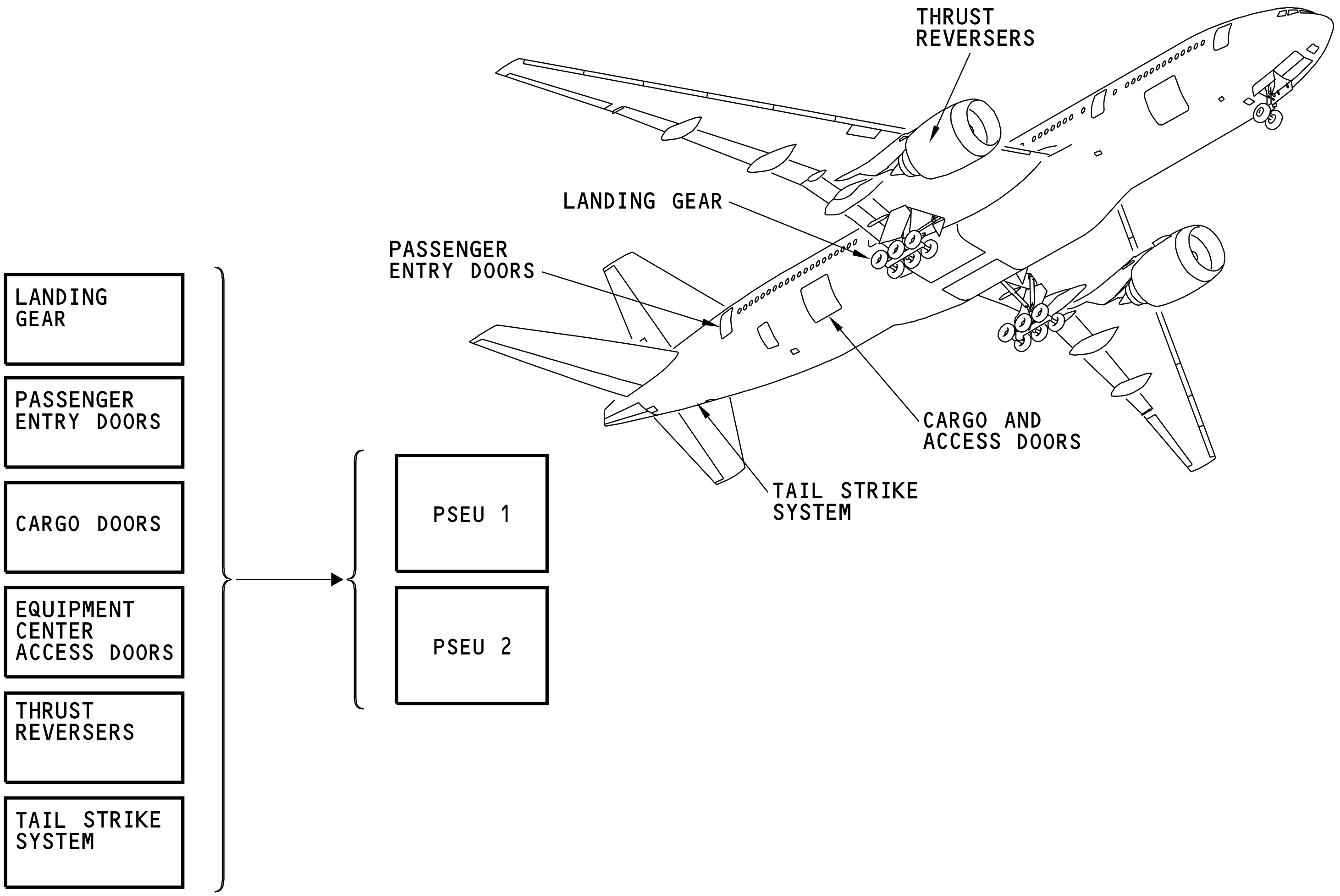
- Tail skid system

ARO ALL

- Tail strike system.

Abbreviations and Acronyms

- AFDC - autopilot flight director computer
- AIMS - airplane information management system
- altn - alternate
- AMU - audio management unit
- ARINC - Aeronautical Radio, Inc.
- bat - battery
- BITE - built-in test equipment
- BSCU - brake system control unit
- CSDS - cargo smoke detection system
- CSMU - cabin system management unit
- dn - down
- ECC - equipment cooling controller
- EEC - electronic engine control
- ELMS - electrical load management system
- EICAS - engine indication and crew alerting system
- fwd - forward
- gnd - ground
- hdlg - handling
- lvr - lever
- HYDIM - hydraulic interface module
- MLG - main landing gear
- NLG - nose landing gear
- pri - primary
- PSEU - proximity sensor electronic unit
- PSS - proximity sensor system
- ref - reference
- SLG - Semi-levered gear
- TCAS - traffic alert and collision avoidance system
- TSA - tail strike assembly
- WEU - warning electronic unit
- WOW - weight-on-wheels



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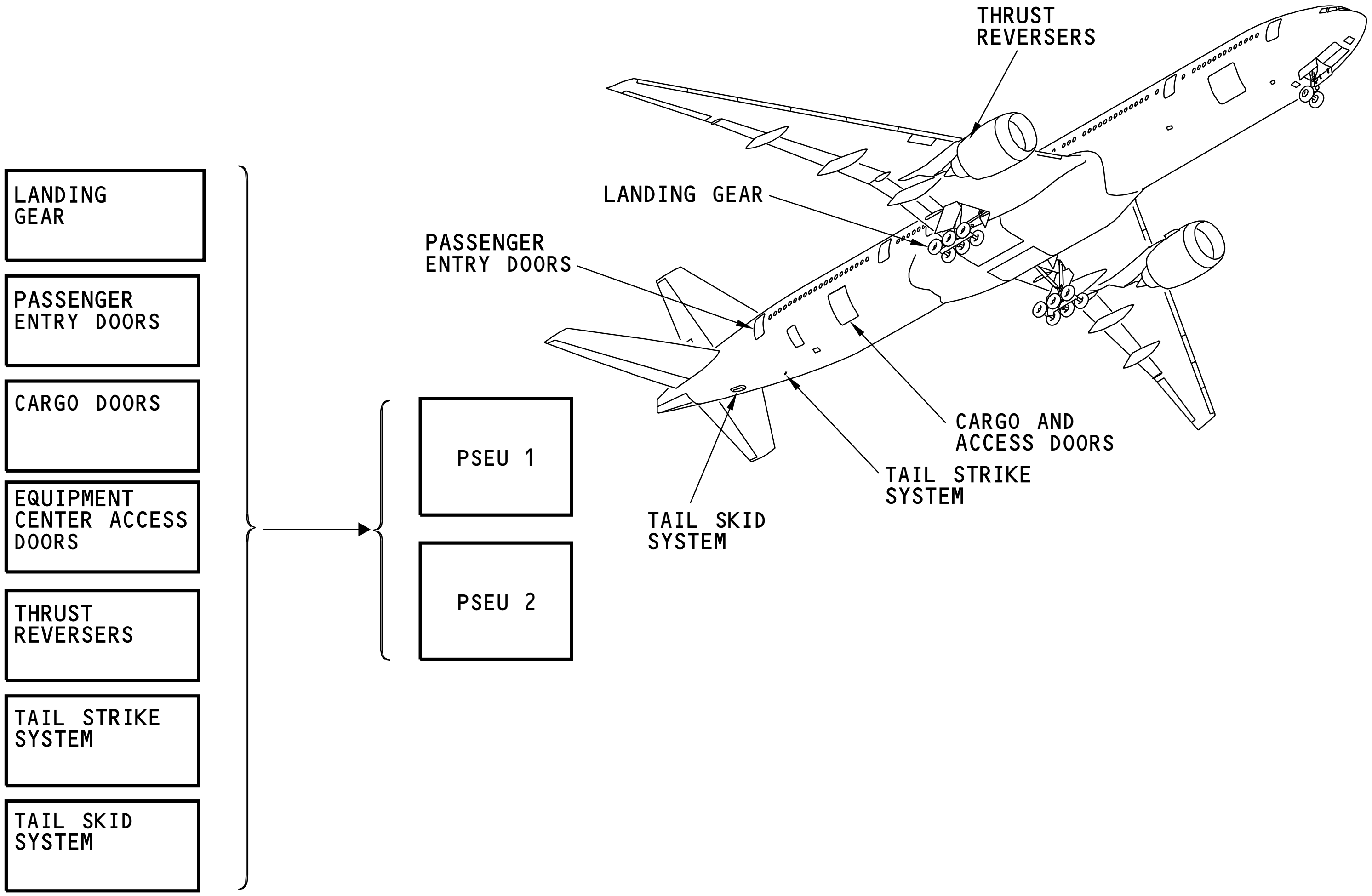
PROXIMITY SENSOR SYSTEM - INTRODUCTION



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PROXIMITY SENSOR SYSTEM - INTRODUCTION

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PROXIMITY SENSOR SYSTEM - GENERAL DESCRIPTION

General

The PSS gets position data for some airplane components and supplies this data to other airplane systems for indication and control functions.

The proximity sensor system components include:

- Two proximity sensor electronics units (PSEUs)
- Proximity sensors.

Inputs

The PSEUs get position data from proximity sensors on these systems/components:

- Landing gear
- Passenger entry doors
- Cargo doors and access doors
- Thrust reversers

ARO 001-004

- Tail skid.

ARO ALL

The PSS also gets some discrete hardwire inputs from the tail strike system and other airplane components.

Outputs

The PSEUs supply position data through the systems ARINC 629 buses to these airplane systems:

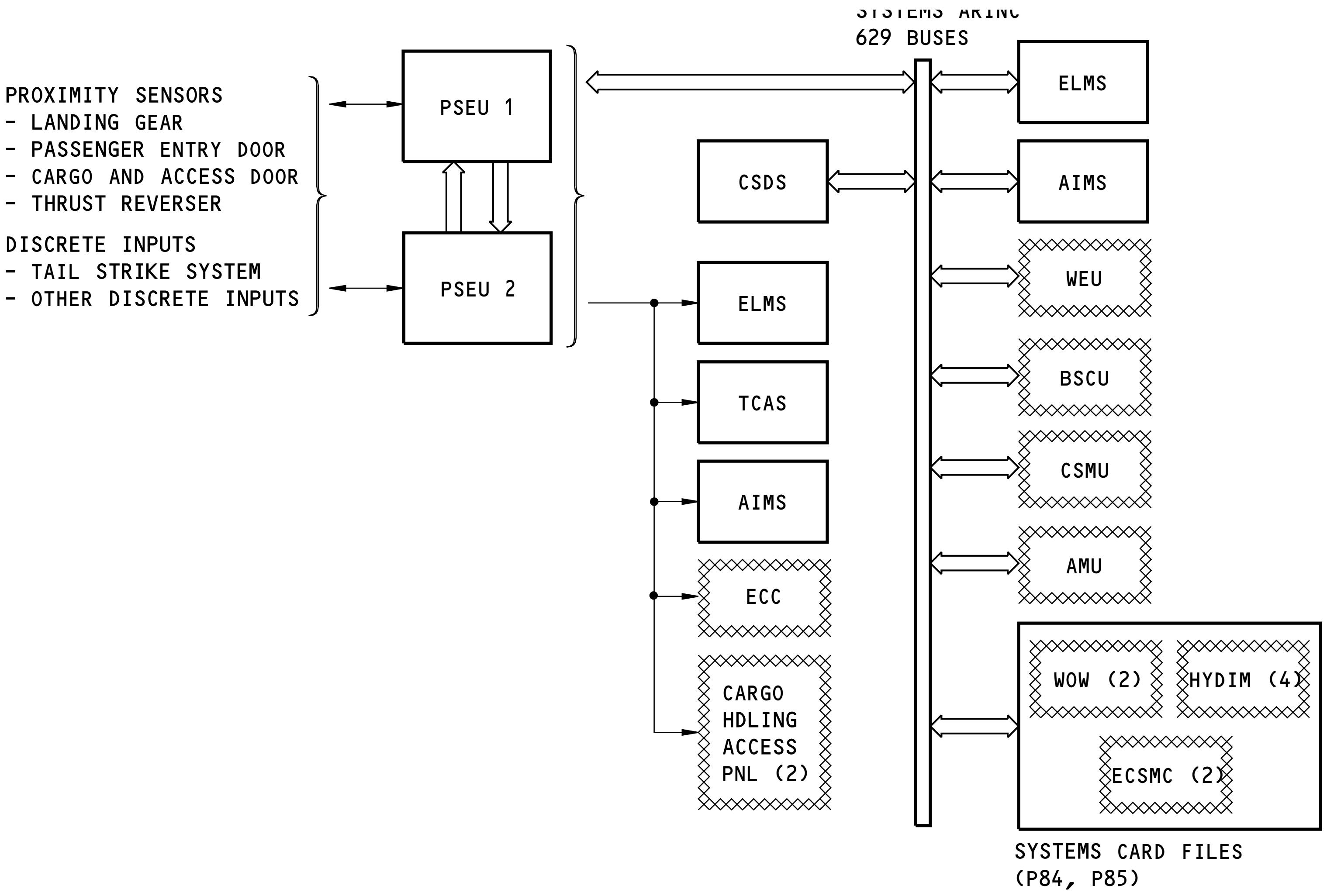
- Airplane information management system (AIMS)
- Electrical load management system (ELMS)
- Brake system control unit (BSCU)
- Warning electronic unit (WEU)
- Cabin system management unit (CSMU)
- Audio management unit (AMU)
- Cargo smoke detection system (CSDS).

These components in the left and right system card files get PSEU data through the ARINC signal gateway (ASG) cards:

- Weight on wheels (WOW) cards
- Hydraulic interface module (HYDIM) cards
- Environmental control system miscellaneous cards (ECSMC).

The PSEUs supply data through hardwire discretes to these systems:

- ELMS
- Traffic alert and collision avoidance system (TCAS)
- AIMS
- ECC (equipment cooling controller)
- Cargo handling access panels.



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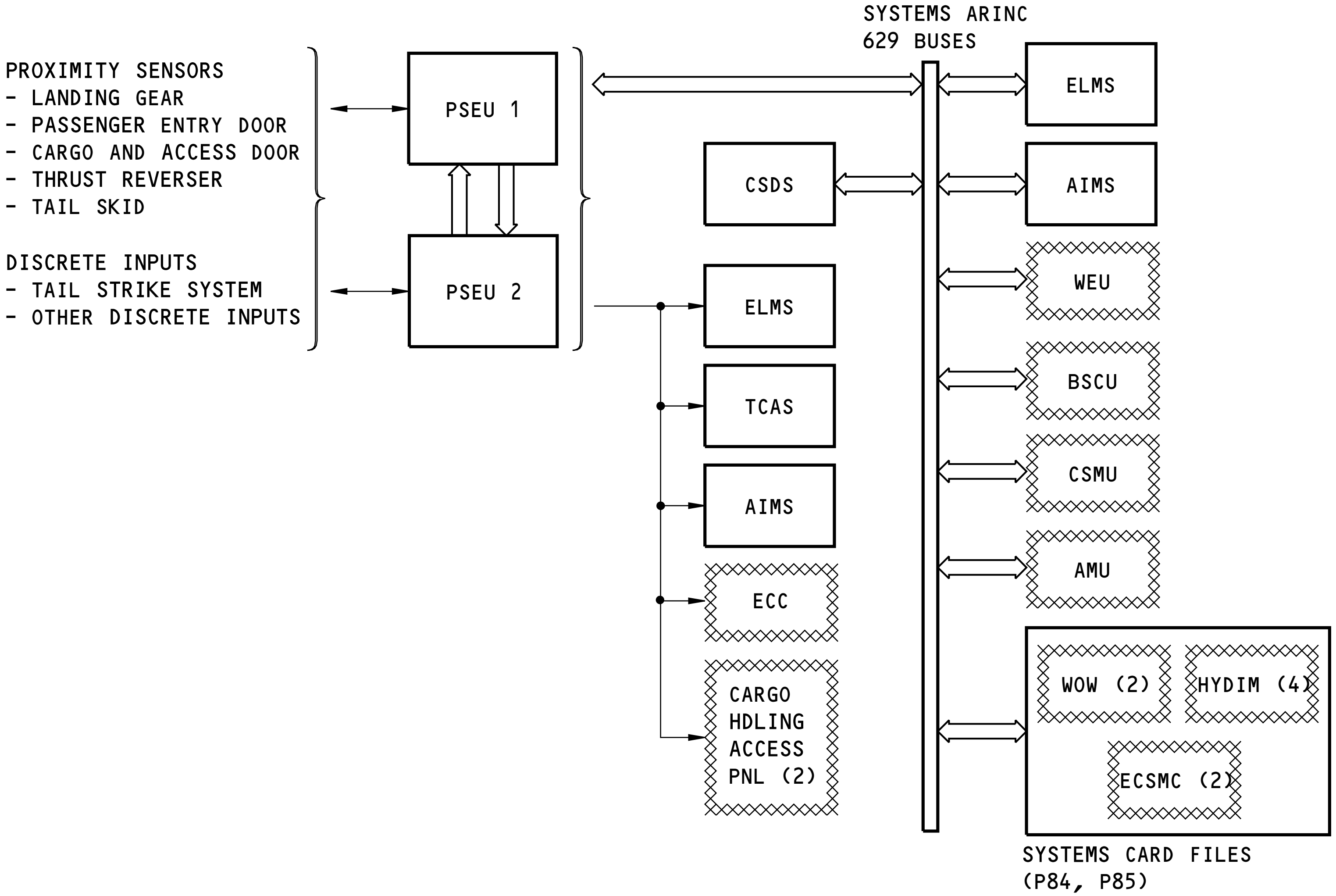
PROXIMITY SENSOR SYSTEM - GENERAL DESCRIPTION



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PROXIMITY SENSOR SYSTEM - GENERAL DESCRIPTION

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PROXIMITY SENSOR SYSTEM - PROXIMITY SENSORS

Purpose

The proximity sensors get position input of airplane components. They supply this position data to the PSEUs.

Physical Description

There are two types of sensors:

- Flange mount
- Thread mount.

Both types of sensors are inductance-type sensors.

There are approximately 100 sensors on the airplane.

Functional Description

The PSEU sends a signal to energize the magnetic core in the sensor. The inductance of the sensor changes when a steel target gets near the sensor.

The flange mount sensors send a near signal when the target is 0.24 inches (6.1 mm) from the sensor (head-on). They send a far signal when the target is 0.3 inches (7.6 mm) from the sensor (head-on).

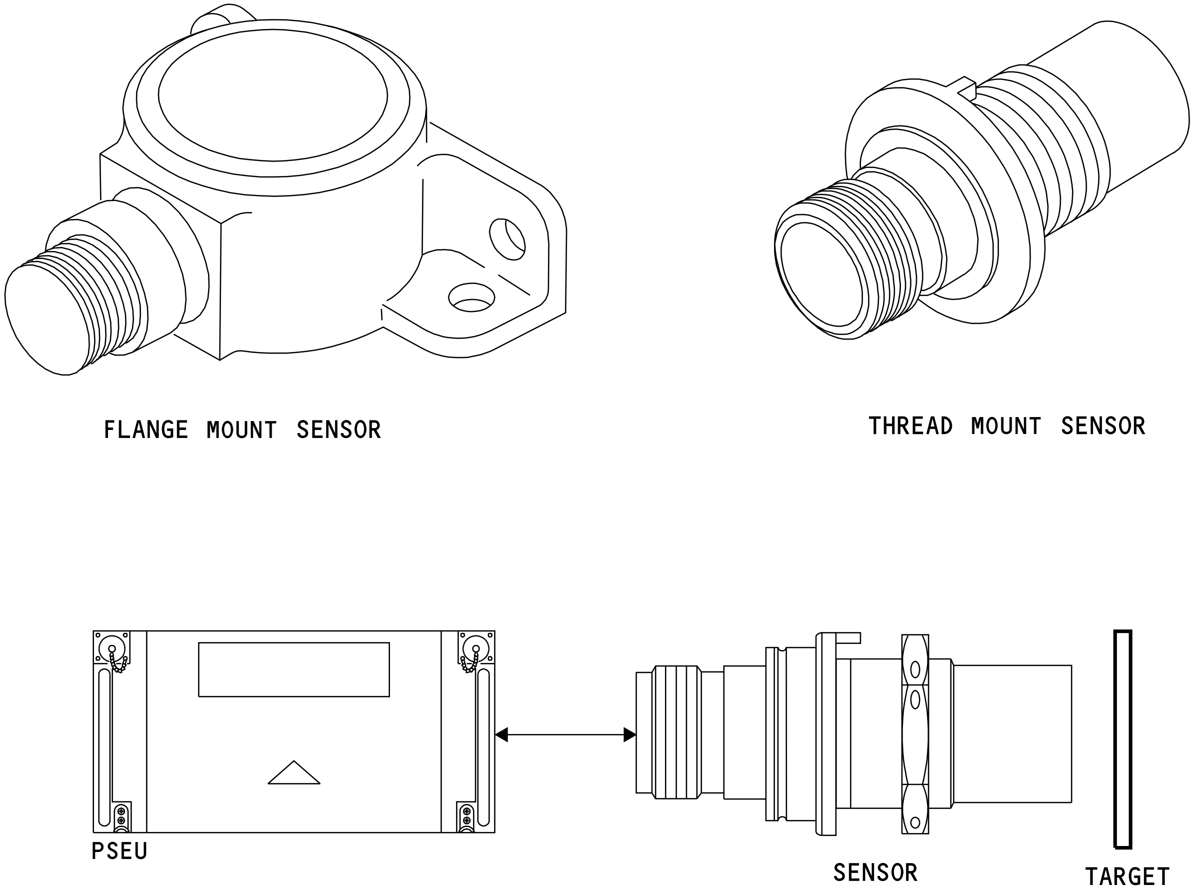
The thread mount sensors send a near signal when the target is 0.085 inches (2.2 mm) from the sensor (head-on). They send a far signal when the target is 0.12 inches (3.1 mm) from the sensor (head-on).

Training Information Point

The targets are made of corrosion-resistant steel. Standard target sizes are 0.05 inches (1.3 mm) thick and either 1.25 inches (31.7 mm) or 0.75 inches (19 mm) in diameter.

Some proximity sensors use non-standard targets. For example, sensors for the cargo doors and passenger entry doors use door structure for the targets.

Correct sensor-target gap is important for correct PSS operation.



M42243 S000618584_V1

PROXIMITY SENSOR SYSTEM - PROXIMITY SENSORS

PROXIMITY SENSOR SYSTEM - PSEU - COMPONENT LOCATION

Purpose

The PSEUs are the central components of the proximity sensor system. They get proximity sensor input and other discrete signals. The PSEUs process this data and send control and indication signals to other airplane systems.

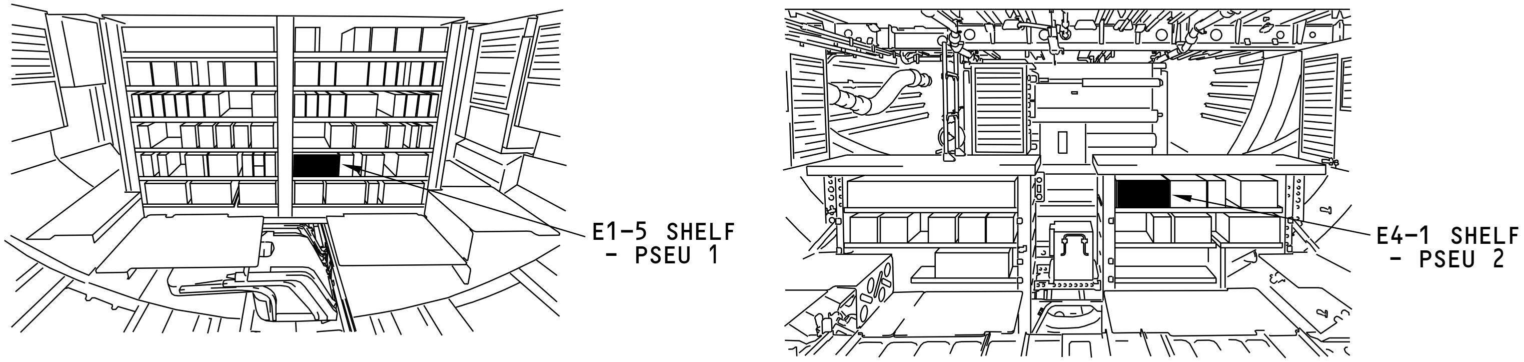
Location

The PSEUs are in the main equipment center. PSEU 1 is on the E1-5 shelf. PSEU 2 is on the E4-1 shelf.

Training Information Point

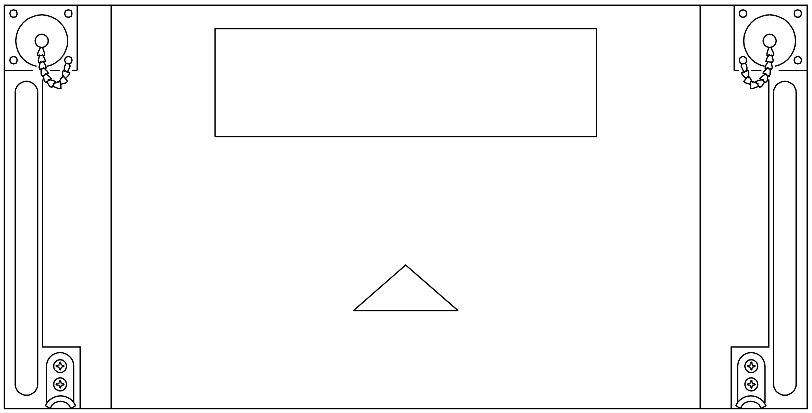
The PSEUs are electrostatic discharge sensitive devices.

⚠ **CAUTION** DO NOT TOUCH THE PSEU BEFORE YOU DO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE. ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE PSEU.



MAIN EQUIPMENT CENTER (LOOKING AFT)

MAIN EQUIPMENT CENTER (LOOKING FORWARD)



PSEU (TYPICAL)

M42244 S000618585_V1

PROXIMITY SENSOR SYSTEM - PSEU - COMPONENT LOCATION

PROXIMITY SENSOR SYSTEM - PSEU - CIRCUIT CARDS

General

PSEU 1 and PSEU 2 each contain 8 circuit cards.

These are the 4 different types of circuit cards:

- Comm/processor card
- Proximity driver card
- Aux/driver card
- Power supply card

Comm/Processor Card

There are two comm/processor cards in each PSEU. Each card is redundant and independent of the other card. The PSEU needs only one card to operate. Each card contains an ARINC 629 terminal and a ARINC 429 interface to communicate with airplane systems and with the other PSEU. These cards control the operation of the PSEU and supply BITE and monitoring functions.

The comm/processor cards are interchangeable.

Proximity Driver Card

Proximity driver cards control power to proximity sensors and calculates the target near or far condition. Proximity driver cards also processes discrete inputs and use discrete outputs to drive relays, lamps and logic. PSEU 1 has 3 proximity driver cards and PSEU 2 has 4 proximity driver cards.

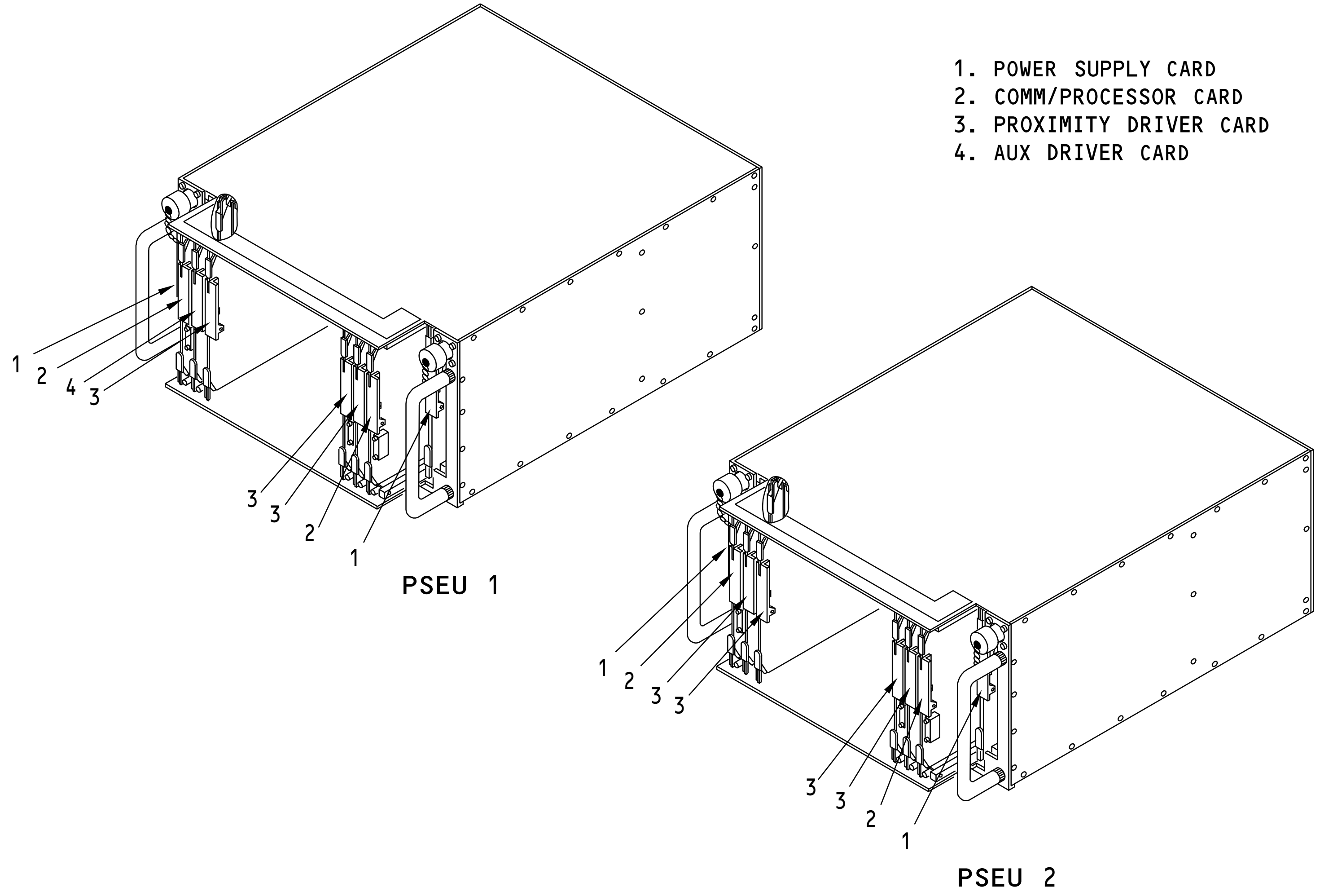
The proximity cards are interchangeable.

Aux/Driver Card

The Aux Driver Card in PSEU 1 contains the cargo door control power supply which gets power from the Gnd HDLG Bus. A separate partition of the card contains the passenger entry door flight lock drivers which are powered by the PSEU 1 main power supply cards.

Power Supply Cards

There are two redundant and independent power supply cards in each PSEU. Each Comm/Processor card uses only one power supply. All PSEU subsystems except the Cargo Door Control, use both power supplies for redundancy. The power supply cards change 28v dc power to other voltages for PSEU operation. These modules are interchangeable.



PROXIMITY SENSOR SYSTEM - PSEU - CIRCUIT CARDS

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PROXIMITY SENSOR SYSTEM - PSEU 1 - FUNCTIONAL DESCRIPTION

General

PSEU 1 processes signals from proximity sensors and other discrete inputs. The signals are processed and sent out on the ARINC 629 busses to interact with the other systems. PSEU 1 signals are used for these subsystems:

- Cargo door control
- Landing gear indication
- Left semi-lever gear control & monitoring
- Tail strike indication
- Left engine thrust reverser indication
- Left escape slide compartment door monitoring
- Passenger entry door flight lock control

Shared Resources

The functions that are common to all subsystems are separated from the subsystems and combined into two redundant sets of shared resources. Each set of shared resources has an independent power supply card and comm/processor card.

The shared resource cards supply electrical power (except for cargo door control) and processing functions to all of the proximity sensors, discrete and digital outputs. One set of shared resources supplies primary power (except for cargo door control), provides processing functions, and communicates on the left ARINC 629 system bus. The other set of shared resources supplies alternate power (except cargo door control), provides redundant processing functions, and communicates on the right ARINC 629 system bus.

Power Supply

The 28v dc left main bus is the primary power source to PSEU 1. The battery bus is the alternate power source to the PSEU.

The ground handling bus supplies a separate source of power to the Aux Driver card for cargo door control during ground operations.

Outputs

Each comm/processor card supplies position data to other airplane systems through either the left or the right ARINC 629 systems buses.

The driver cards supply discrete outputs directly to other airplane systems.

The PSEUs communicate between each other over ARINC 429 busses.

Cargo Door Control

The cargo door control function uses these cards:

- A proximity driver card
- An Aux driver card.

The cargo door control function gets inputs from proximity sensors on the forward and aft cargo doors through the proximity driver card. Discrete outputs from the proximity driver card control the operation of the cargo doors. The ground handling bus supplies power to cargo door control on the Aux driver card only on the ground. There is no power to cargo door control drivers from any other bus.

Landing Gear/Tail Strike

The landing gear/tail strike function uses a proximity driver card and gets input from proximity sensors on the nose landing gear, main landing gears and the landing gear doors. This function also gets discrete inputs from the landing gear control lever module and the alternate extend switch.

Discrete signals through the tail strike assembly go to this function to determine the tail strike status.

Left Semi-lever Gear Control & Indication

The left semi-lever gear hydraulic strut has a built-in sensor for control and monitoring. This function takes input from the proximity sensor and the lock command from AIMS. The sensor provides indication to the flight crew to verify that the SLG is in proper configuration for takeoff. Faults will cause EICAS and maintenance messages.

PROXIMITY SENSOR SYSTEM - PSEU 1 - FUNCTIONAL DESCRIPTION

Thrust Reverser

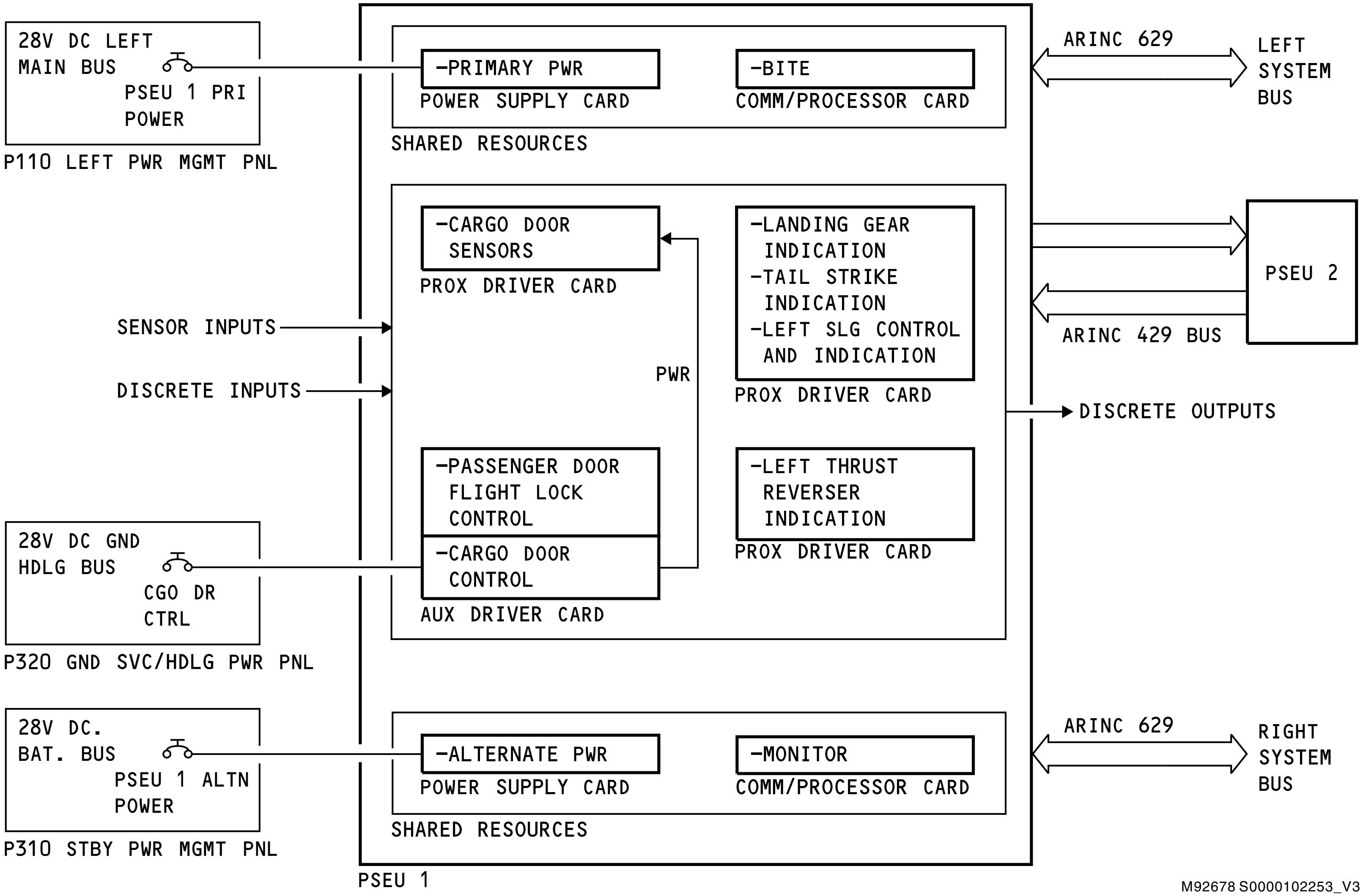
The thrust reverser function uses a proximity driver card to monitor sensors located on the left engine thrust reverser.

The same proximity driver card also determines the target position and discrete input state for the left escape slide compartment door.

The sensor position and health signals are relayed through the comm/processor card to other airplane systems.

Flight Lock

Both Comm/processor cards control the flight lock drivers on the Aux driver card. The passenger entry doors lock when the computed airspeed is more than 80 knots.



PROXIMITY SENSOR SYSTEM - PSEU 1 - FUNCTIONAL DESCRIPTION

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PROXIMITY SENSOR SYSTEM - PSEU 2 - FUNCTIONAL DESCRIPTION

General

PSEU 2 processes signals from proximity sensors and other discrete inputs. The signals are processed and sent out on the ARINC 629 busses to interact with the other systems. PSEU 2 signals are used for these subsystems:

- Door indication
- Landing gear indication
- Right semi-lever gear control & indication
- Tail strike indication

ARO 001-004

- Tail skid indication

ARO ALL

- Right engine thrust reverser control and indication.
- Right escape slide compartment door monitoring.

Shared Resources

The shared resource cards supply electrical power and processing functions to all of the proximity driver cards in PSEU 2. One set of shared resources supplies the primary power, provides processing functions and communicates on the right ARINC 629 system bus. The other set of shared resources supplies the alternate power, provides redundant processing functions and communicates on the left ARINC 629 system bus.

Power Supply

The 28v dc right main bus is the primary power source to PSEU 2. The battery bus is the alternate power source to the PSEU.

Outputs

Each comm/processor card supplies position data to other airplane systems through either the left or the right ARINC 629 systems buses.

The driver cards supply discrete outputs directly to other airplane systems.

The PSEUs communicate between each other over ARINC 429 busses.

Door Indication

The door indication function uses two proximity driver cards and get input from sensors on these doors:

- The passenger entry doors
- The forward cargo door
- The aft cargo door
- The bulk cargo door
- The forward equipment center access door
- The main equipment center access door.

ARO 005-999

Landing Gear/Tail Strike

The landing gear / tail strike proximity driver card processes sensor inputs from the nose gear and main landing gear sensors. It also gets discrete inputs from the landing gear control lever module, alternate extend switch, and tail strike assembly.

The landing gear/tail strike function in PSEU 1 is identical to the landing gear/tail strike function in PSEU 2.

ARO 001-004

Landing Gear/Tail Strike/Tail Skid

The landing gear / tail strike / tail skid proximity driver card processes sensor inputs from the nose gear, main landing gear, and tail skid. It also gets discrete inputs from the landing gear control lever module, alternate extend switch, and tail strike assembly.

The landing gear/tail strike function in PSEU 1 is identical to the landing gear/tail strike function in PSEU 2.

PROXIMITY SENSOR SYSTEM - PSEU 2 - FUNCTIONAL DESCRIPTION

ARO ALL

Right Semi-lever Gear Control & Indication

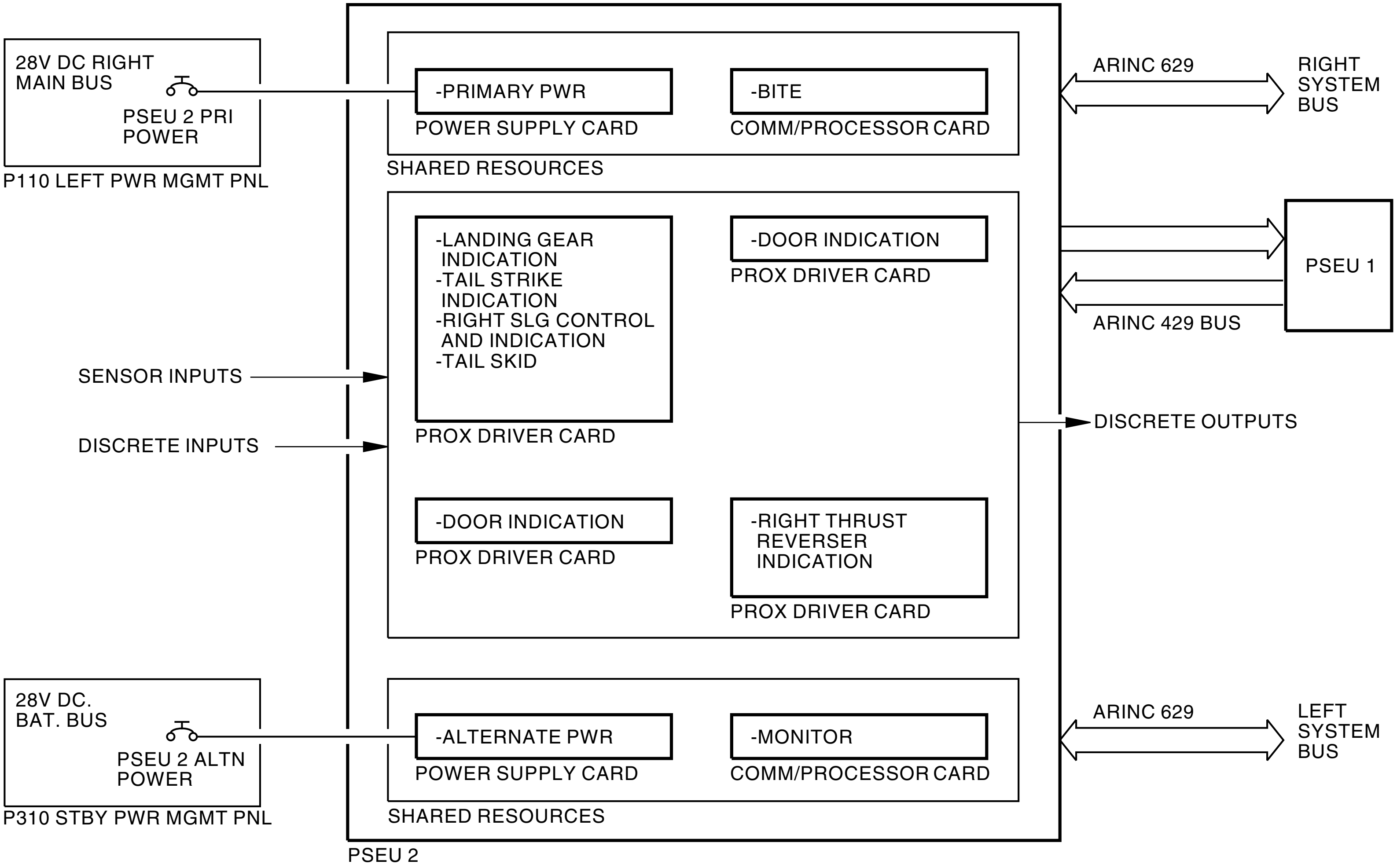
The right semi-lever gear hydraulic strut has a built-in sensor for control and monitoring. This function takes input from the proximity sensor and the lock command from AIMS. The sensor provides indication to the flight crew to verify that the SLG is in proper configuration for takeoff. Faults will cause EICAS and maintenance messages.

Thrust Reverser

The thrust reverser function uses a proximity driver card to monitor sensors located on the right engine.

The same proximity driver card also determines the target position and discrete input state for the right escape slide compartment door.

The sensor position and health signals are relayed through the comm/processor card to other airplane systems.



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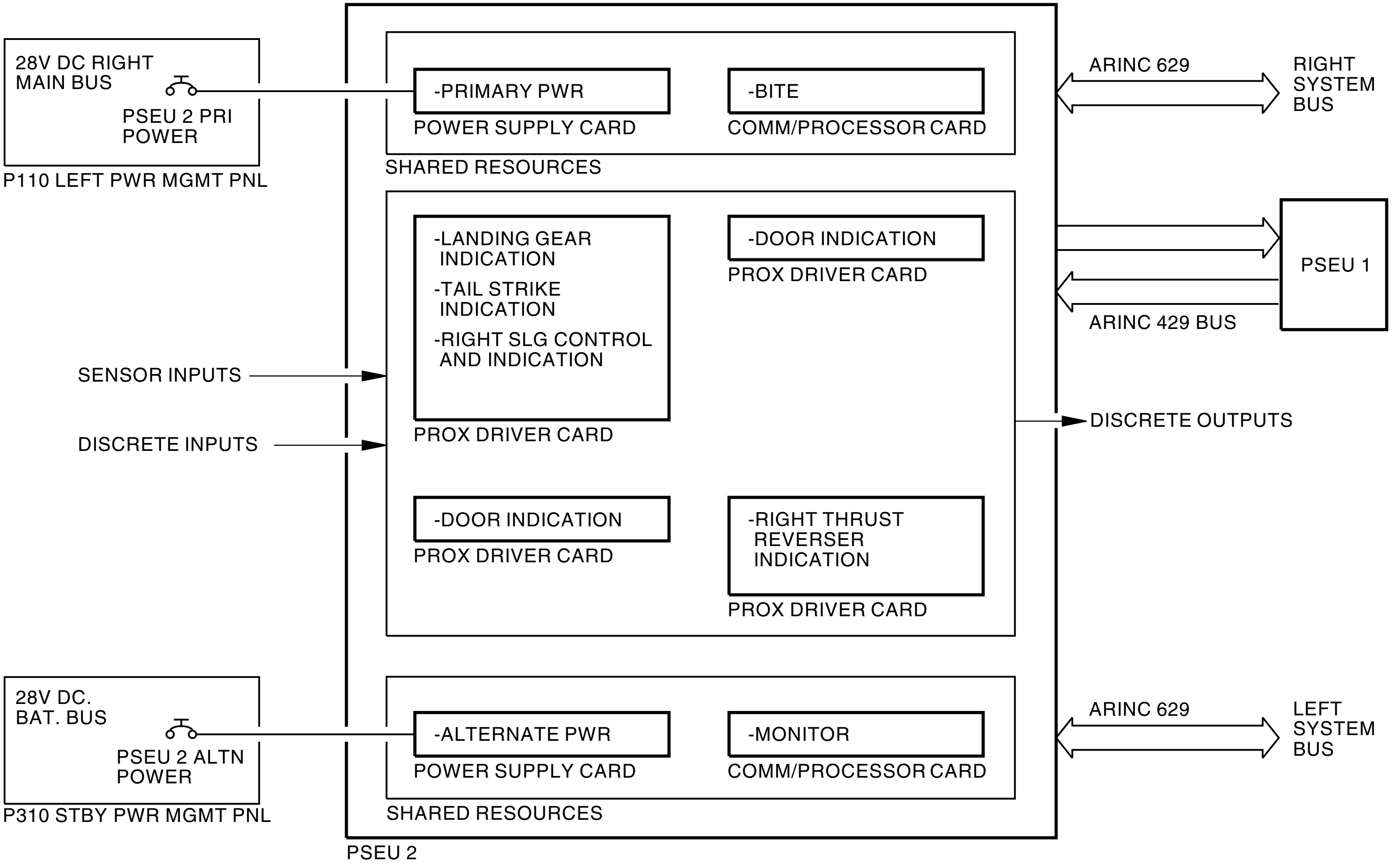
PROXIMITY SENSOR SYSTEM - PSEU 2 - FUNCTIONAL DESCRIPTION



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PROXIMITY SENSOR SYSTEM - PSEU 2 - FUNCTIONAL DESCRIPTION

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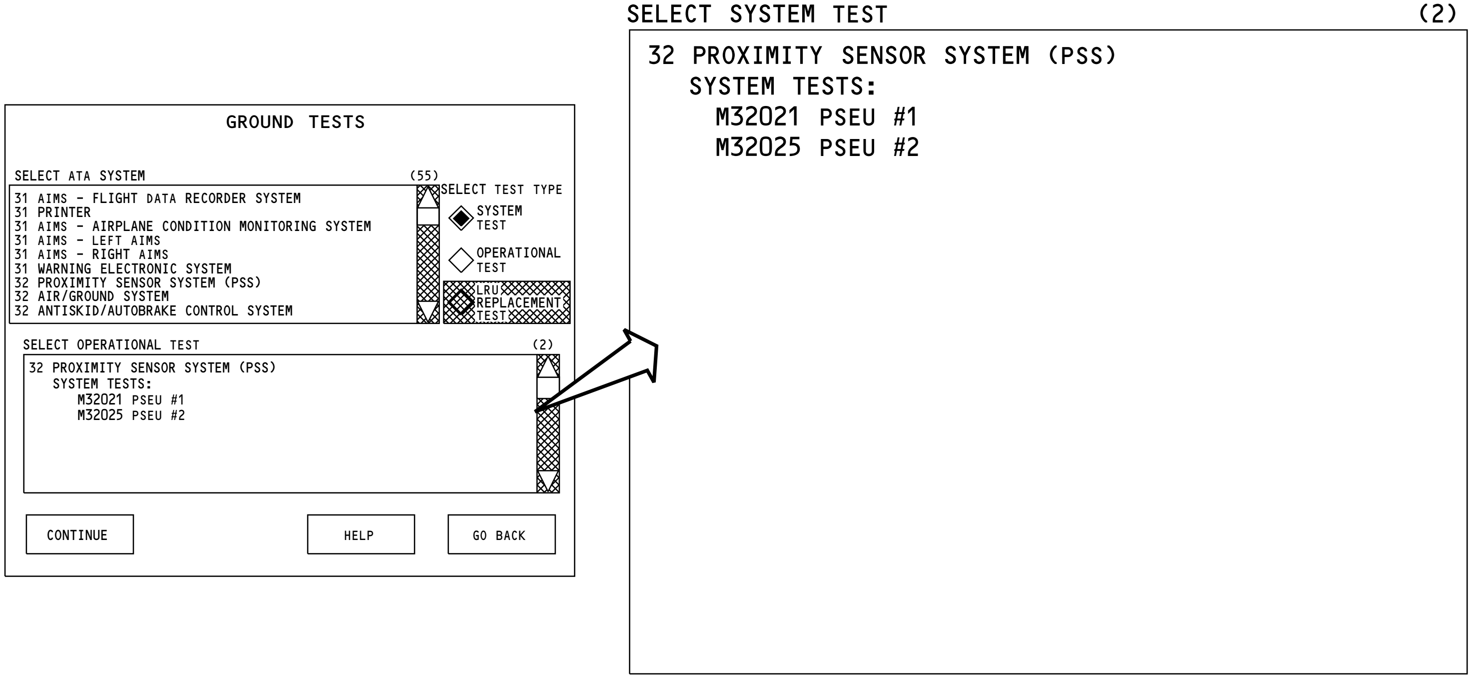
PROXIMITY SENSOR SYSTEM - SYSTEM TESTS

General

These are the system tests for the proximity sensor system:

- M32021 PSEU #1
- M32025 PSEU #2.

The system tests do a test for the correct operation and installation of the PSEUs.



GROUND TESTS

SELECT ATA SYSTEM (55)

31 AIMS - FLIGHT DATA RECORDER SYSTEM
31 PRINTER
31 AIMS - AIRPLANE CONDITION MONITORING SYSTEM
31 AIMS - LEFT AIMS
31 AIMS - RIGHT AIMS
31 WARNING ELECTRONIC SYSTEM
32 PROXIMITY SENSOR SYSTEM (PSS)
32 AIR/GROUND SYSTEM
32 ANTISKID/AUTOBRAKE CONTROL SYSTEM

SELECT TEST TYPE
● SYSTEM TEST
○ OPERATIONAL TEST
○ LRU REPLACEMENT TEST

SELECT OPERATIONAL TEST (2)

32 PROXIMITY SENSOR SYSTEM (PSS)
SYSTEM TESTS:
M32021 PSEU #1
M32025 PSEU #2

SELECT SYSTEM TEST (2)

32 PROXIMITY SENSOR SYSTEM (PSS)
SYSTEM TESTS:
M32021 PSEU #1
M32025 PSEU #2

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PROXIMITY SENSOR SYSTEM - SYSTEM TESTS

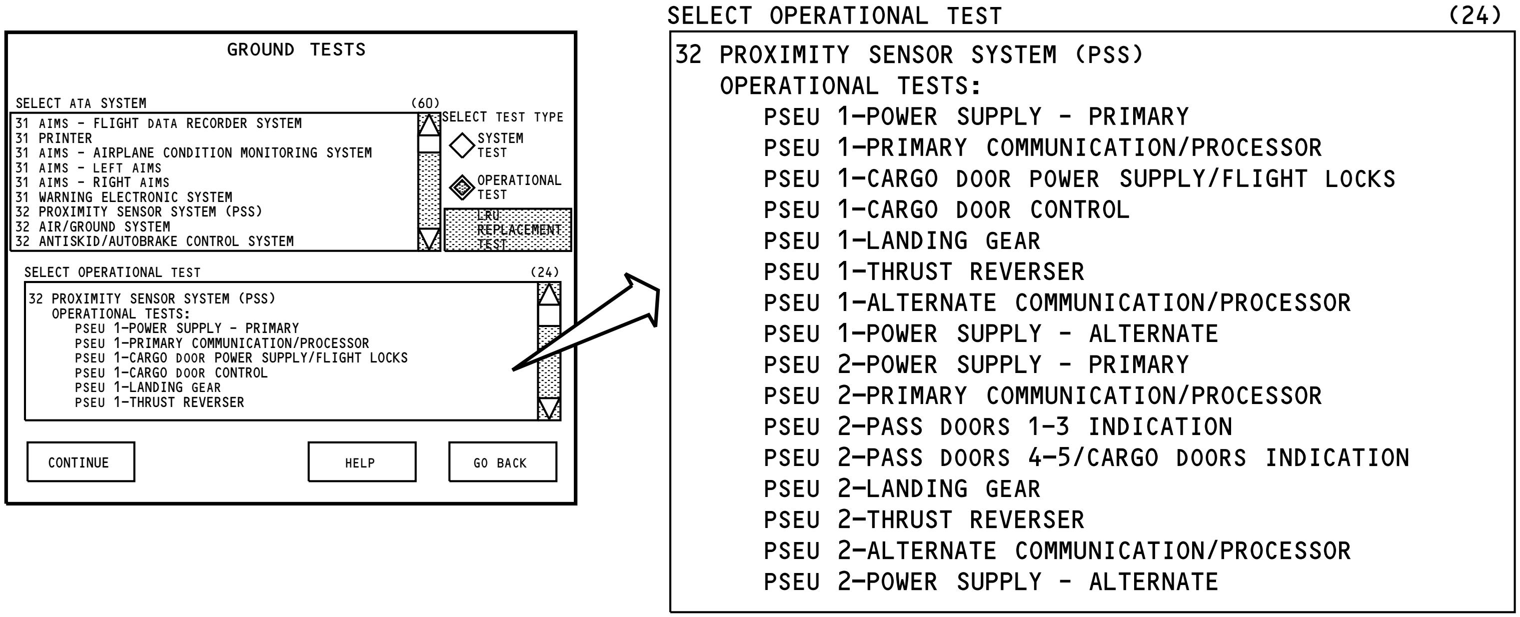
PROXIMITY SENSOR SYSTEM - OPERATIONAL TESTS

General

These are the operational tests for the proximity sensor system:

- PSEU 1 Power Supply - Primary
- PSEU 1 Primary Communication / Processor
- PSEU 1 Cargo Door Power Supply / Flight Locks
- PSEU 1 Cargo Door Control
- PSEU 1 Landing Gear
- PSEU 1 Thrust Reverser
- PSEU 1 Alternate Communication / Processor
- PSEU 1 Power Supply - Alternate
- PSEU 2 Power Supply - Primary
- PSEU 2 Primary Communication / Processor
- PSEU 2 Pass Doors 1-3 Indication
- PSEU 2 Pass Doors 4-5 / Cargo Doors Indication
- PSEU 2 Landing Gear
- PSEU 2 Thrust Reverser
- PSEU 2 Alternate Communication / Processor
- PSEU 2 Power Supply - Alternate

The operational tests do a test of the operation and installation of the PSEU circuit cards.



SELECT OPERATIONAL TEST (24)

32 PROXIMITY SENSOR SYSTEM (PSS)
- OPERATIONAL TESTS:
  - PSEU 1-POWER SUPPLY - PRIMARY
  - PSEU 1-PRIMARY COMMUNICATION/PROCESSOR
  - PSEU 1-CARGO DOOR POWER SUPPLY/FLIGHT LOCKS
  - PSEU 1-CARGO DOOR CONTROL
  - PSEU 1-LANDING GEAR
  - PSEU 1-THRUST REVERSER
  - PSEU 1-ALTERNATE COMMUNICATION/PROCESSOR
  - PSEU 1-POWER SUPPLY - ALTERNATE
  - PSEU 2-POWER SUPPLY - PRIMARY
  - PSEU 2-PRIMARY COMMUNICATION/PROCESSOR
  - PSEU 2-PASS DOORS 1-3 INDICATION
  - PSEU 2-PASS DOORS 4-5/CARGO DOORS INDICATION
  - PSEU 2-LANDING GEAR
  - PSEU 2-THRUST REVERSER
  - PSEU 2-ALTERNATE COMMUNICATION/PROCESSOR
  - PSEU 2-POWER SUPPLY - ALTERNATE

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PROXIMITY SENSOR SYSTEM - OPERATIONAL TESTS

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AIR/GROUND SYSTEM - INTRODUCTION

Purpose

The air/ground system (AGS) supplies air mode and ground mode signals to airplane systems.

Components

These are the AGS components:

- Air/Ground load sensors (4)
- Weight-on-wheels (WOW) logic cards (2)
- Air/ground relays.

General Description

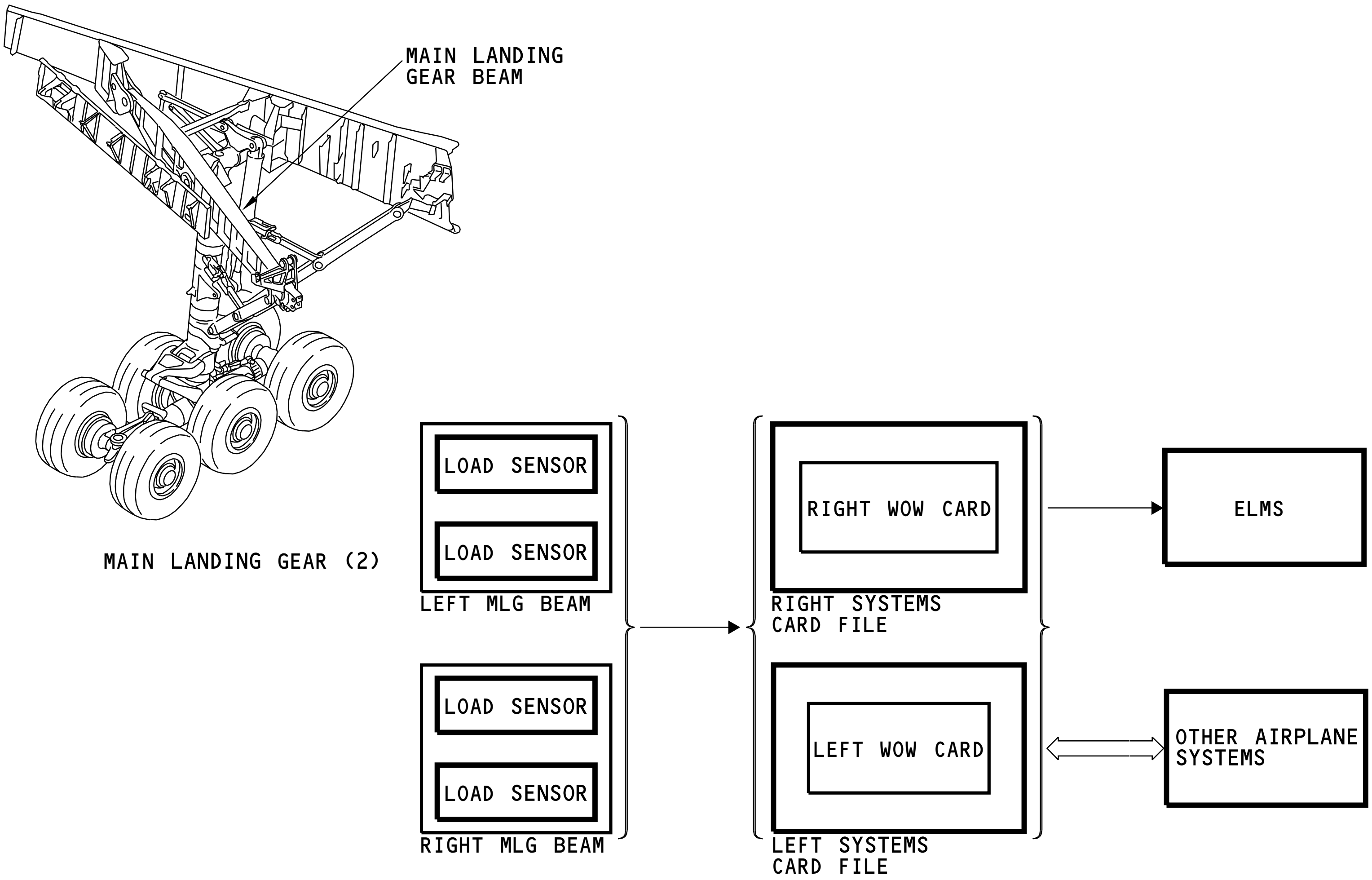
Two load sensors on each main landing gear beam send landing gear load data to the two WOW cards.

The WOW cards control air/ground relays in the ELMS. These relays supply air/ground signals to other airplane systems.

The WOW cards also send digital air/ground data through the systems ARINC 629 buses to airplane systems.

Abbreviations and Acronyms

- ADF - automatic direction finder
- ADIRU - air data inertial reference unit
- A/G - air/ground
- AGS - air/ground system
- AIMS - airplane information management system
- APU - auxiliary power unit
- ASCPC - air supply and cabin pressure controller
- ASG - ARINC signal gateway
- ARINC - Aeronautical Radio, Inc.
- ATC - air traffic control
- EEC - electronic engine control
- ELMS - electrical load management system
- gnd - ground
- HF - high frequency
- HYDIM - hydraulic interface module
- ILS - instrument landing system
- MAT - maintenance access terminal
- MLG - main landing gear
- PA/CI - passenger address/cabin interphone
- PSEU - proximity sensor electronic unit
- TCAS - traffic alert and collision avoidance system
- VOR/MB - VOR/marker beacon
- WHCU - window heat control unit
- WOW - weight-on-wheels
- WX - weather



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AIR/GROUND SYSTEM - INTRODUCTION

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AIR/GROUND SYSTEM - INTERFACES

General

Two WOW cards supply air/ground signals to other airplane systems through:

- Left and right systems ARINC 629 buses
- ARINC 429 buses
- Air/ground relays in the ELMS.

The WOW cards get inputs from airplane systems through:

- Left and right systems ARINC 629 buses
- ARINC 429 buses
- Hard-wire.

ARINC 629 Interfaces

These systems and components get air/ground signals through the systems ARINC 629 buses:

- Airplane information management system (AIMS)
- Airborne vibration monitor signal conditioner unit (AVMSCU) (2)
- Autopilot flight director computer (AFDC) (3)
- Audio management unit (AMU)
- APU controller (APUC)
- Air supply cabin pressure controller (ASCPC) (2)
- Backup generator converter
- Bus power control unit (BPCU)
- Cabin system management unit (CSMU)
- Cabin temperature controllers (CTC) (2)
- Control display unit (CDU) (3)
- Engine data interface unit (EDIU) (2)
- Electrical load management system (ELMS)
- Fuel quantity indication system (FQIS) processor
- Flap slat electronic unit (FSEU) (2)
- Generator control unit (GCU) (3)
- Overhead panel bus controller (OPBC)
- Passenger address/cabin interphone (PA/CI) controller
- Proximity sensor electronics unit (PSEU) (2)
- Warning electronic unit (WEU) (2).

The AIMS uses the air/ground signals for these functions:

- Central maintenance computing
- Data communications management
- Data conversion gateway
- Flight management computing
- Navigation display
- Primary flight display
- Software data loader
- Thrust management computing function.

These systems get air/ground data through the data conversion gateway function in the AIMS:

- Cabin telecommunications unit (CTU)
- Flight data recorder (FDR)
- Global positioning system (GPS)
- Ground proximity warning system (GPWS)
- Primary flight computer (PFC) (3).

The ELMS supplies air/ground signals for these functions:

- APU controls
- Cargo fire extinguishing
- DC standby system
- Ground crew call horn
- Fuel jettison
- Fuel management

AIR/GROUND SYSTEM - INTERFACES

- Hydraulic pump control
- Passenger oxygen system.

Internal Card File Systems

These cards in the left and right systems card files get air/ground signals through ARINC 429 which go through the ASG cards:

- Airfoil and cowl ice protection system (ACIPS) card (2)
- Cargo smoke detection system (CSDS) card (2)
- Environmental control system miscellaneous card (ECSMC) (2)
- Hydraulics interface modules (HYDIM) card (4).

The duct leak overheat detection system (DLODS) also gets air/ground inputs through the systems card files.

Air/Ground Relay Interfaces

The WOW cards control air/ground relays in the ELMS. The left WOW card controls air/ground relays in the P110 power management panel. The right WOW card controls air/ground relays in the P210 and P310 power management panels.

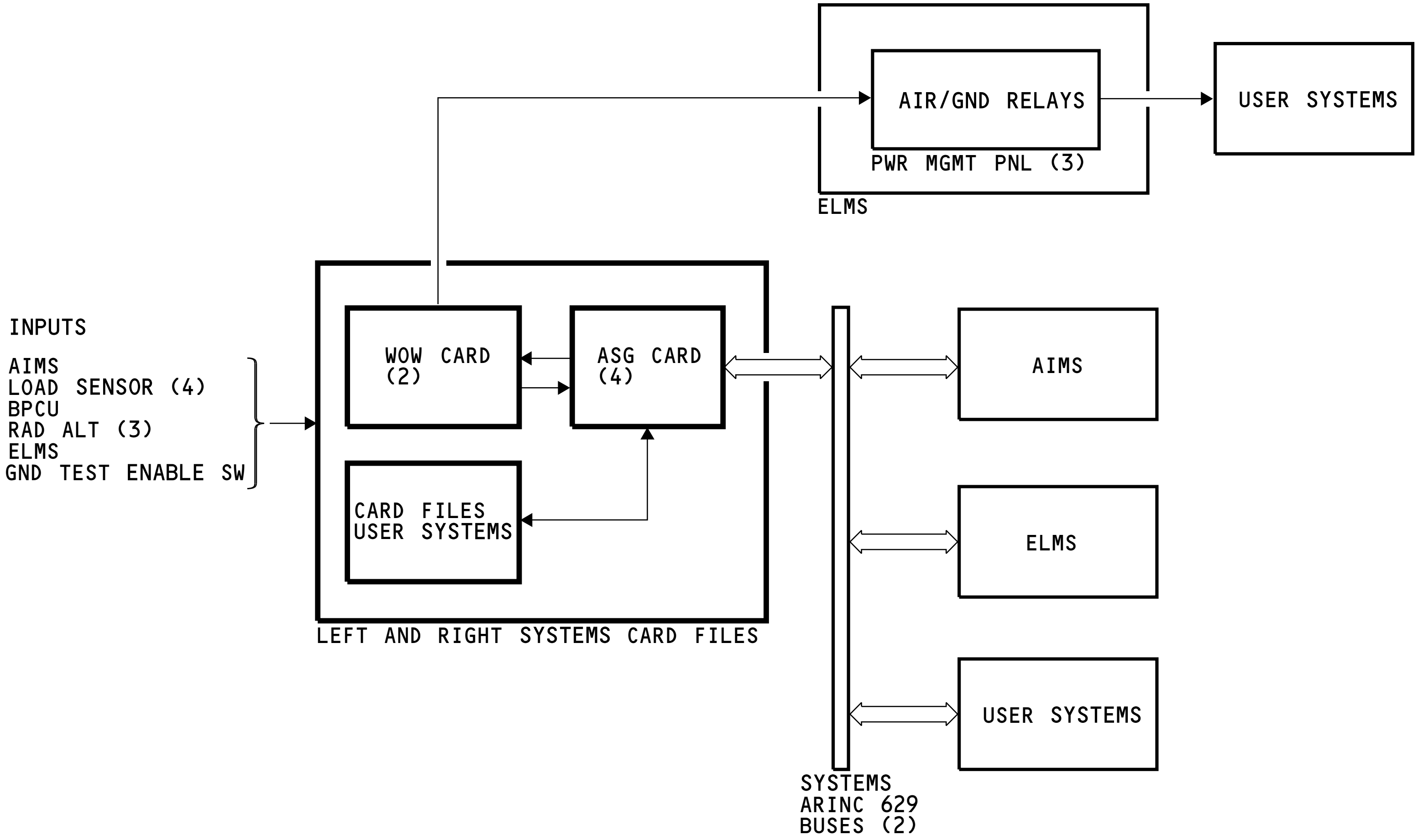
These systems, components, and functions get air/ground signals through the air/ground relays:

- AIMS
- Air data inertial reference unit (ADIRU) on battery relay
- APU external shutdown
- ATC control panel
- Automatic direction finder (ADF) receiver(2)
- Brake status lights
- Brouter
- Center system tail and wing flight control shutoff valves
- Cockpit voice recorder control panel
- Distance measuring equipment (DME) interrogator (2)
- Drain line valve (2)
- Drain mast heater (2)
- HF communication (HF) transceiver (2)
- Multi-mode receiver (MMR) (3)
- Jettison nozzle valve (2)
- Landing gear lever lock
- Maintenance access terminal (MAT)
- Radio altitude (RA) transceiver (3)
- Traffic alert and collision avoidance system (TCAS) computer
- VOR/MB receiver (2)
- Water drain line hose heater thermostat
- Wing root landing light heating
- Window heat control unit (WHCU) (2)
- Weather radar (WXR) transceiver (2).

WOW Card Inputs

The WOW cards get inputs from:

- AIMS (time and date, flight phase/leg, airplane registration number, ICAO code)
- Bus power control unit (external power available)
- ELMS (air/ground relay status)
- Ground test enable switch
- Load sensors
- Radio altitude (RA) transceiver (3).



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AIR/GROUND SYSTEM - INTERFACES

AIR/GROUND SYSTEM - WOW LOAD SENSOR

Purpose

The load sensors measure the load on the main landing gear beams to find when the airplane has weight on wheels.

Location

Two load sensors are on each main landing gear (MLG) beam. The load sensors attach to mounting brackets. Covers supply protection to the sensors. These covers attach to the MLG beam.

Functional Description

The load sensor is a variable reluctance strain measurement device.

The sensor has two pieces which attach by mounting brackets to the MLG beam structure in two places. The two pieces move independently as the MLG beam bends.

One piece has a target and the other piece has two coils. The target and coils do not touch each other.

These two pieces connect by a flexible bellows.

In the air mode, the MLG beam is in an unloaded condition and the sensor target is in the in-air position.

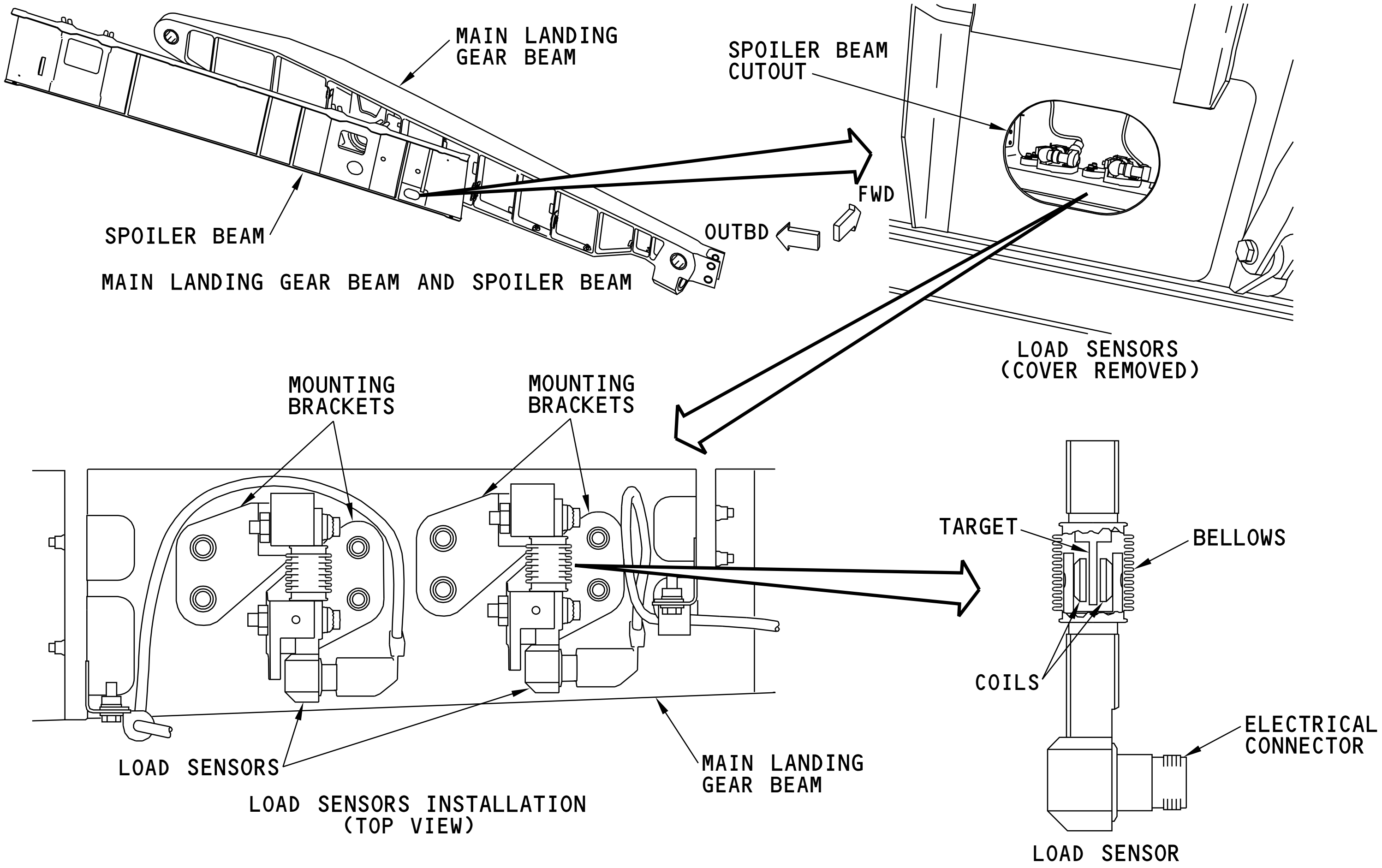
In the ground mode, airplane weight causes the MLG beam to bend. This changes the distance between the target and the coils and causes the target to be in the on-ground position.

The load sensor sends an analog signal to the WOW cards.

Training Information Point

You remove a panel from the bottom of the wing to get access to the load sensors. The panel attaches to the MLG beam and the spoiler beam.

A cutout in the spoiler beam lets you see the load sensors.



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AIR/GROUND SYSTEM - WOW LOAD SENSOR

AIR/GROUND SYSTEM - WOW CARDS AND AIR/GROUND RELAYS

Purpose

Two WOW cards get the weight-on-wheels signals from the WOW sensors. The WOW cards then send air/ground data to other airplane systems. The WOW cards also control master air/ground relays in ELMS.

Air/ground relays get the signals from the WOW cards and supply air/ground analog signals to other aircraft systems.

Location

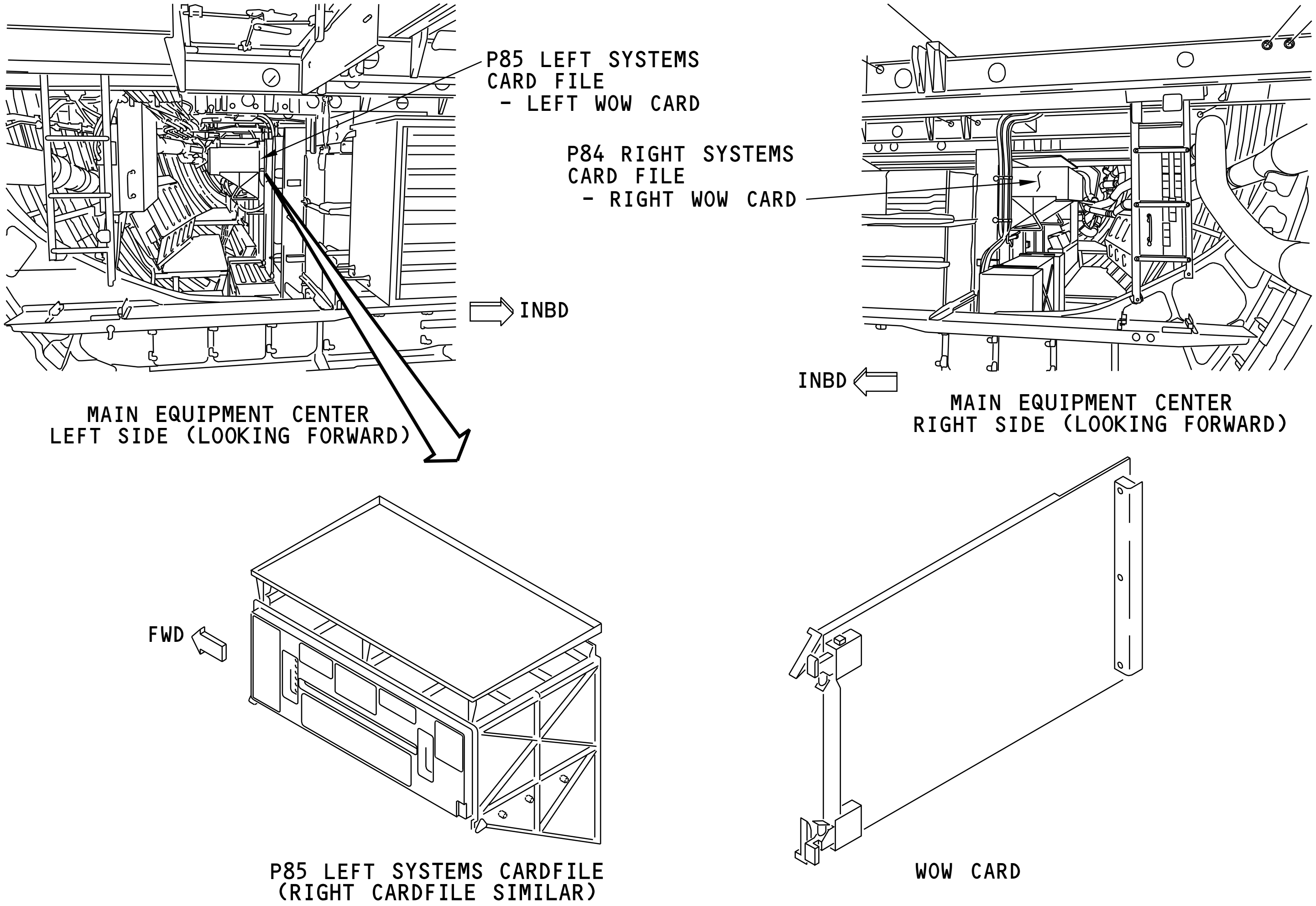
The right WOW card is in the P84 systems card file in the main equipment center. The left WOW card is in the P85 systems card file in the main equipment center.

The air/ground relays are in the ELMS P110, P210, and P310 power management panels (not shown) in the main equipment center.

Training Information Point

The WOW cards are electrostatic sensitive.

The WOW cards are software loadable. See chapter 45-10-00 for more information.



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AIR/GROUND SYSTEM - WOW CARDS AND AIR/GROUND RELAYS

AIR/GROUND SYSTEM - FUNCTIONAL DESCRIPTION

Power Supply

The systems cardfiles supply 28v dc electrical power to the WOW cards. The left WOW card gets power from battery bus section 2 and the hot battery bus. The right WOW card gets power from the right main bus and the hot battery bus.

The left, right, or battery buses supply 28V dc electrical power to the air/ground relays in the ELMS.

Load Sensors

The weight of the airplane on the ground causes the main landing gear beams to bend. Two load sensors on each main landing gear beam measure this bending and send analog signals to the WOW cards.

WOW Cards

Each WOW card supplies power to and gets input from a load sensor on each of the main landing gear beams.

The WOW cards send air/ground data to airplane systems through the ASG cards and the systems ARINC 629 buses.

The WOW cards also control the air/ground relays in the ELMS.

Air/Ground Relays

The right WOW card controls master air mode and ground mode relays in the P210 and P310 power management panels.

The left WOW card controls master air mode and ground mode relays in the P110 power management panel.

The WOW cards supply the ground to energize the master relays.

The master relays supply the ground to the slave relays. The slave relays supply the air/ground output to the airplane systems.

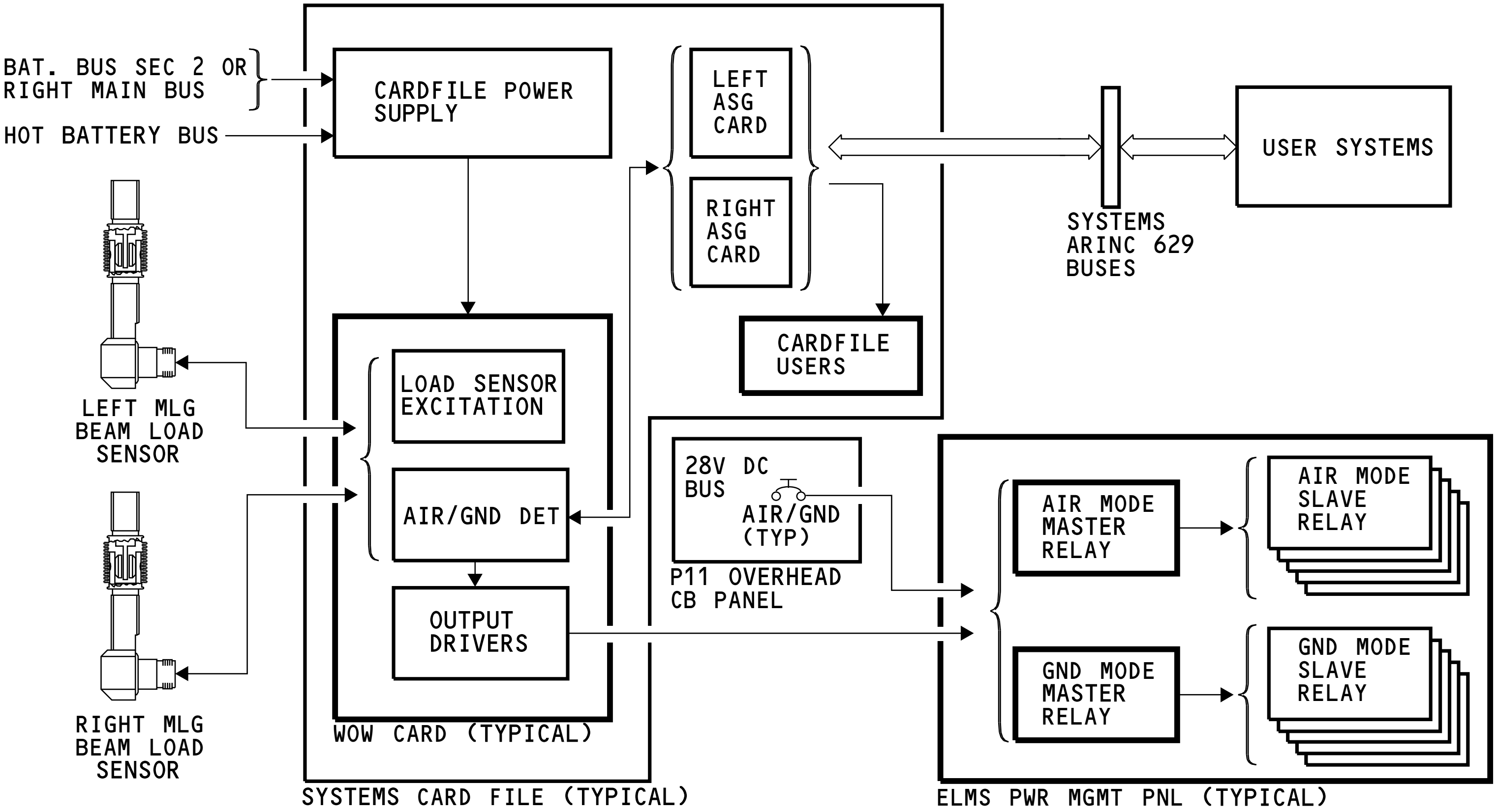
Training Information Point

The WOW cards energize the air mode relays in the air and energize the ground mode relays on the ground.

When a relay fails, it almost always fails to the de-energized position.

The de-energized position for the air mode relays is the ground state. The air mode relays are also called fail-to-ground relays.

The de-energized position for the ground mode relays is the air state. The ground mode relays are also called fail-to-air relays.



M42254 S000618598_V1

AIR/GROUND SYSTEM - FUNCTIONAL DESCRIPTION

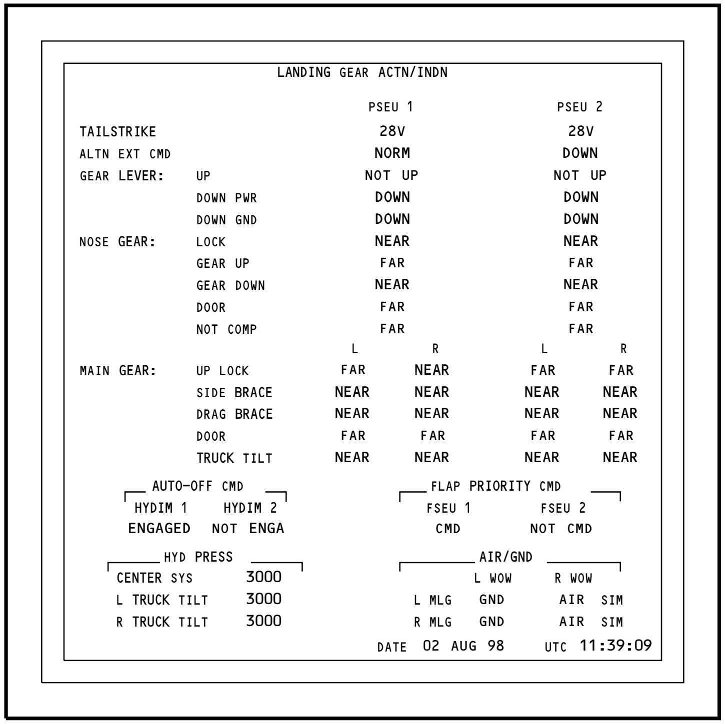
AIR/GROUND SYSTEM - INDICATION

Maintenance Page

The air or ground output from each of the load sensors shows on the landing gear actuation/indication maintenance page. This page shows simulated air or ground conditions with the word SIM next to the AIR or GND indication.

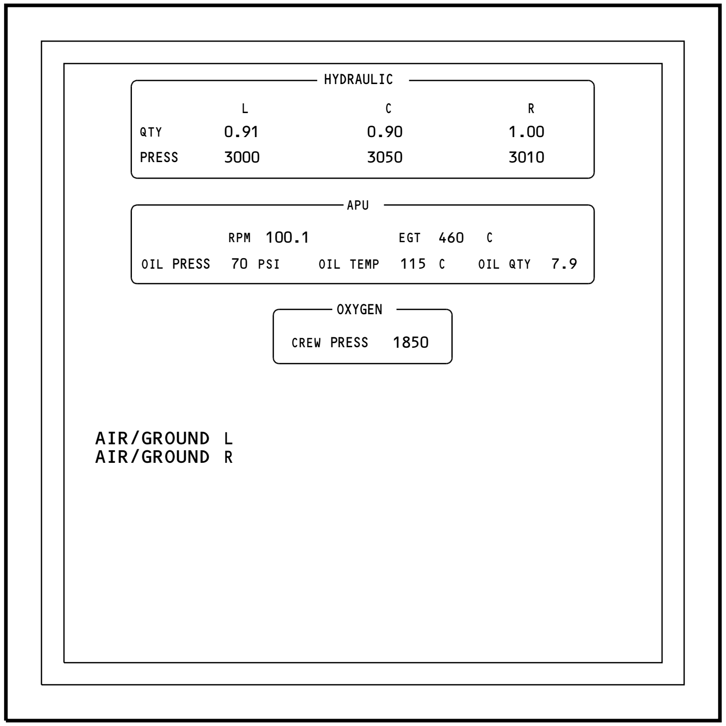
Status Display

Status messages show if there is a fault in either the left or the right air/ground system.



```
                        LANDING GEAR ACTN/INDN

                                  PSEU 1          PSEU 2
TAILSTRIKE                         28V             28V
ALTN EXT CMD                       NORM            DOWN
GEAR LEVER:  UP                   NOT UP          NOT UP
             DOWN PWR              DOWN            DOWN
             DOWN GND              DOWN            DOWN
NOSE GEAR:   LOCK                  NEAR            NEAR
             GEAR UP               FAR             FAR
             GEAR DOWN             NEAR            NEAR
             DOOR                  FAR             FAR
             NOT COMP              FAR             FAR
                                L       R       L       R
MAIN GEAR:   UP LOCK           FAR     NEAR    FAR     FAR
             SIDE BRACE        NEAR    NEAR    NEAR    NEAR
             DRAG BRACE        NEAR    NEAR    NEAR    NEAR
             DOOR              FAR     FAR     FAR     FAR
             TRUCK TILT        NEAR    NEAR    NEAR    NEAR

     AUTO-OFF CMD                     FLAP PRIORITY CMD
   HYDIM 1    HYDIM 2                 FSEU 1       FSEU 2
   ENGAGED    NOT ENGA                 CMD        NOT CMD

        HYD PRESS                         AIR/GND
   CENTER SYS      3000                    L WOW     R WOW
   L TRUCK TILT    3000           L MLG    GND      AIR SIM
   R TRUCK TILT    3000           R MLG    GND      AIR SIM
                              DATE 02 AUG 98     UTC 11:39:09
```

LANDING GEAR ACTUATION/INDICATION
MAINTENANCE PAGE

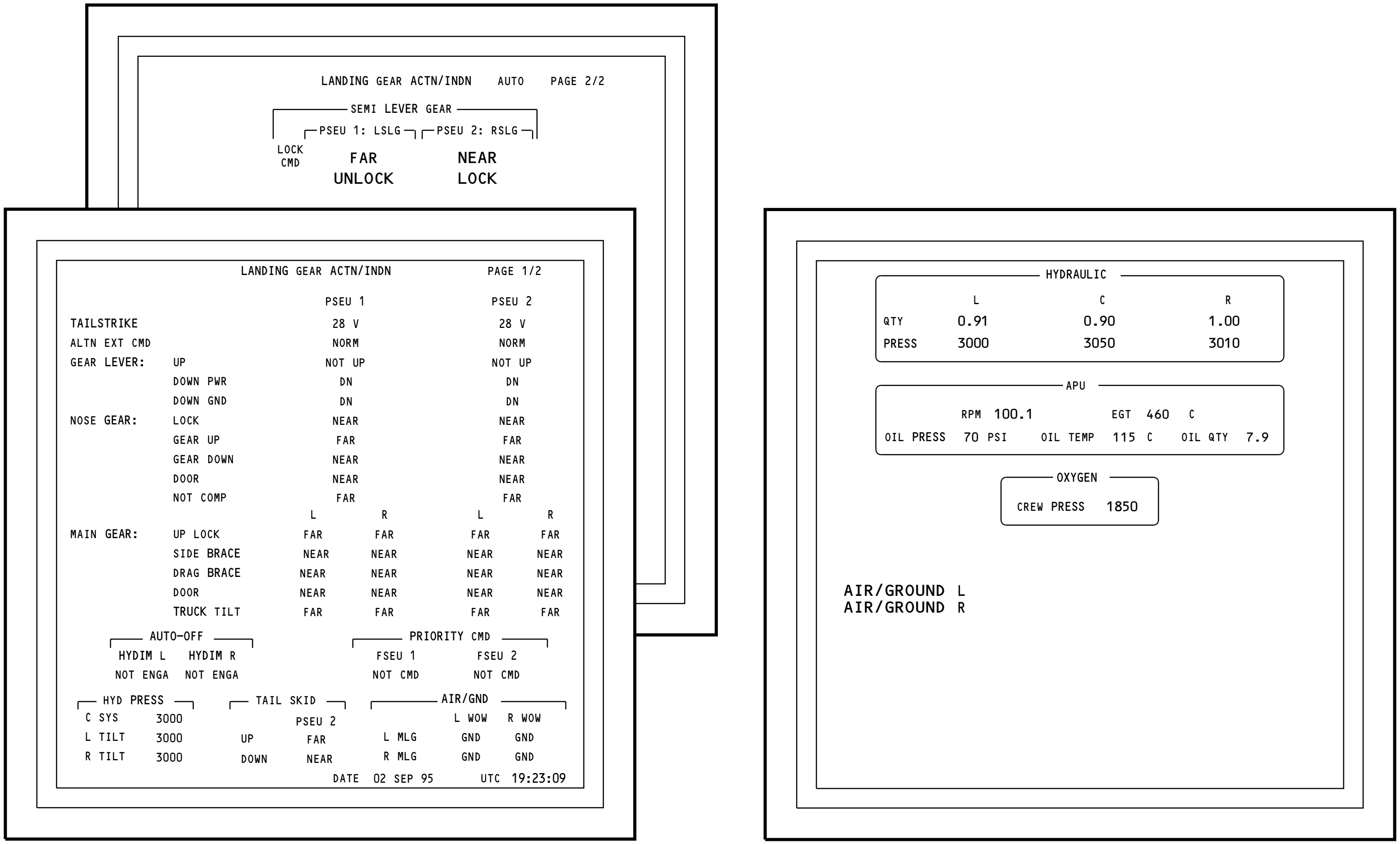


```
                        HYDRAULIC
               L                  C                  R
QTY          0.91               0.90               1.00
PRESS        3000               3050               3010

                           APU
          RPM  100.1            EGT  460  C
OIL PRESS  70 PSI     OIL TEMP  115 C     OIL QTY  7.9

                         OXYGEN
                  CREW PRESS   1850


AIR/GROUND L
AIR/GROUND R
```

STATUS DISPLAY

M42255 S000618599_V1

AIR/GROUND SYSTEM - INDICATION



```
LANDING GEAR ACTN/INDN    AUTO    PAGE 2/2

            SEMI LEVER GEAR
      PSEU 1: LSLG     PSEU 2: RSLG
LOCK
CMD      FAR             NEAR
       UNLOCK            LOCK
```

```
                          LANDING GEAR ACTN/INDN              PAGE 1/2

                                         PSEU 1                  PSEU 2
TAILSTRIKE                               28 V                    28 V
ALTN EXT CMD                             NORM                    NORM
GEAR LEVER:     UP                       NOT UP                  NOT UP
                DOWN PWR                 DN                      DN
                DOWN GND                 DN                      DN
NOSE GEAR:      LOCK                     NEAR                    NEAR
                GEAR UP                  FAR                     FAR
                GEAR DOWN                NEAR                    NEAR
                DOOR                     NEAR                    NEAR
                NOT COMP                 FAR                     FAR
                                     L          R            L          R
MAIN GEAR:      UP LOCK              FAR        FAR          FAR        FAR
                SIDE BRACE           NEAR       NEAR         NEAR       NEAR
                DRAG BRACE           NEAR       NEAR         NEAR       NEAR
                DOOR                 NEAR       NEAR         NEAR       NEAR
                TRUCK TILT           FAR        FAR          FAR        FAR

       AUTO-OFF                              PRIORITY CMD
   HYDIM L   HYDIM R                    FSEU 1          FSEU 2
   NOT ENGA  NOT ENGA                   NOT CMD         NOT CMD

  HYD PRESS         TAIL SKID                     AIR/GND
 C SYS     3000                 PSEU 2                    L WOW   R WOW
 L TILT    3000        UP       FAR           L MLG       GND     GND
 R TILT    3000        DOWN     NEAR          R MLG       GND     GND
                                      DATE  02 SEP 95       UTC  19:23:09
```

LANDING GEAR ACTUATION/INDICATION
MAINTENANCE PAGE

```
                          HYDRAULIC
                L                 C                 R
QTY            0.91              0.90              1.00
PRESS          3000              3050              3010

                             APU
             RPM  100.1              EGT  460   C
OIL PRESS   70 PSI     OIL TEMP   115  C     OIL QTY   7.9

                     OXYGEN
               CREW PRESS   1850


AIR/GROUND L
AIR/GROUND R
```

STATUS DISPLAY

M99546 S0000102498_V1

AIR/GROUND SYSTEM - INDICATION

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AIR/GROUND SYSTEM - SYSTEM TESTS

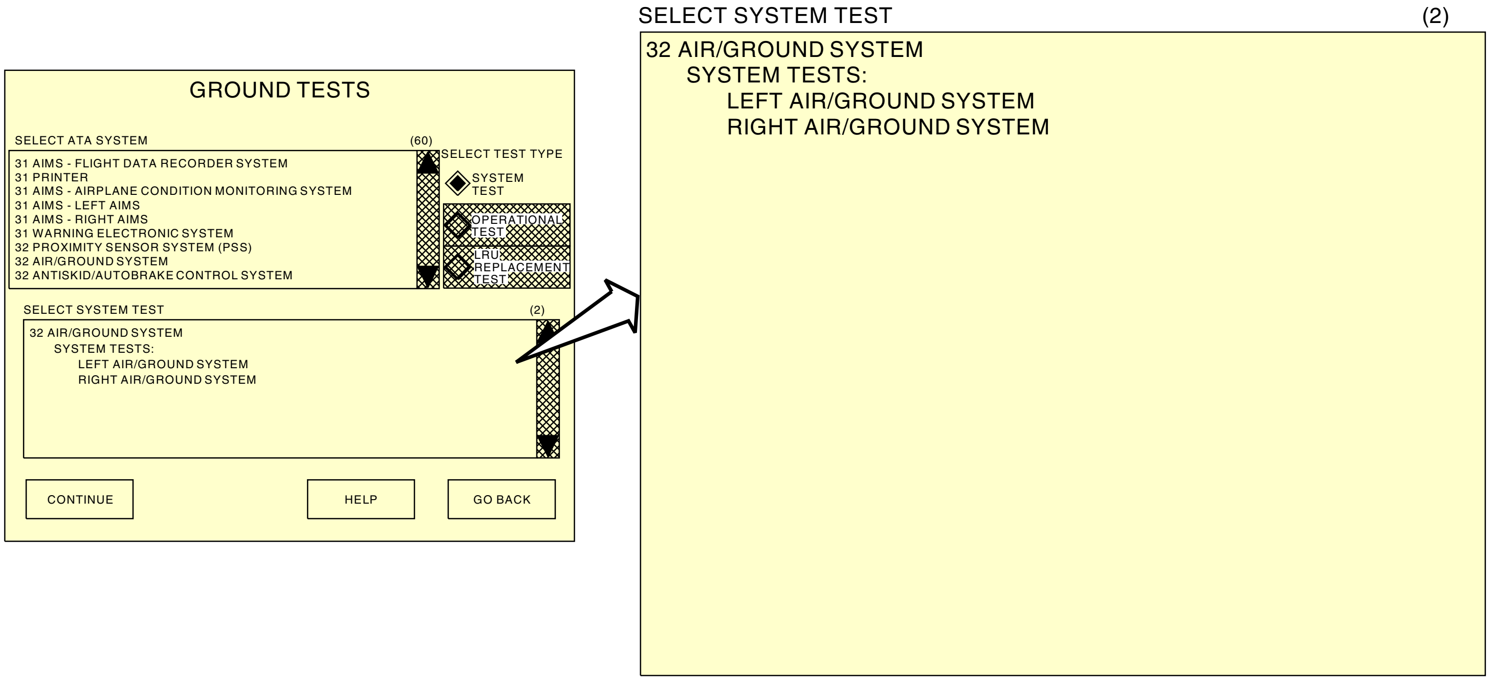
General

These are the air/ground system tests:

- LEFT AIR/GROUND SYSTEM
- RIGHT AIR/GROUND SYSTEM.

Air/Ground System Tests

There is an air/ground test for each of the air/ground systems. These tests do a check of the functions of the air/ground system components.



GROUND TESTS

SELECT ATA SYSTEM (60)

31 AIMS - FLIGHT DATA RECORDER SYSTEM
31 PRINTER
31 AIMS - AIRPLANE CONDITION MONITORING SYSTEM
31 AIMS - LEFT AIMS
31 AIMS - RIGHT AIMS
31 WARNING ELECTRONIC SYSTEM
32 PROXIMITY SENSOR SYSTEM (PSS)
32 AIR/GROUND SYSTEM
32 ANTISKID/AUTOBRAKE CONTROL SYSTEM

SELECT TEST TYPE

◆ SYSTEM TEST
◇ OPERATIONAL TEST
◇ LRU REPLACEMENT TEST

SELECT SYSTEM TEST (2)

32 AIR/GROUND SYSTEM
  SYSTEM TESTS:
    LEFT AIR/GROUND SYSTEM
    RIGHT AIR/GROUND SYSTEM

SELECT SYSTEM TEST (2)

32 AIR/GROUND SYSTEM
  SYSTEM TESTS:
    LEFT AIR/GROUND SYSTEM
    RIGHT AIR/GROUND SYSTEM

M42465 S000618601_V2

AIR/GROUND SYSTEM - SYSTEM TESTS

AIR/GROUND SYSTEM - SPECIAL FUNCTIONS

General

You can control air mode and ground mode simulation through these six special functions on the MAT:

- Left air simulation
- left ground simulation
- Left stop simulation
- Right air simulation
- Right ground simulation
- Right stop simulation.

The simulation functions make the outputs of the selected WOW cards (left or right) go to the simulated condition.

To simulate air mode when the airplane is on the ground, you use the air simulation function.

To simulate the ground mode if the airplane is on jacks, you use the ground simulation function.

You use the stop simulation function to stop the air or ground simulation.

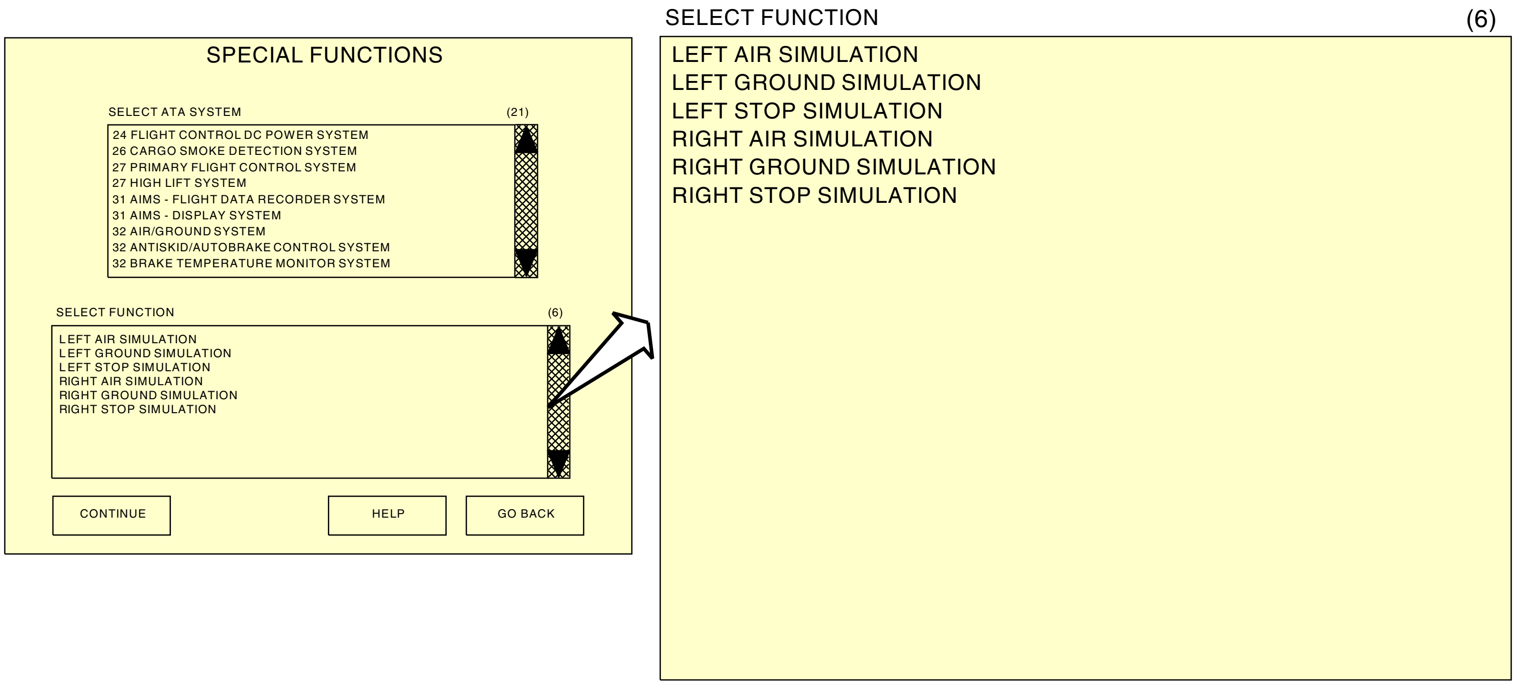
Training Information Point

To do a simulation, you must use the ground test enable switch (P61). Also, one of these two conditions must be true:

- Primary or secondary external electrical power is available
- Radio altitude is less than 2 feet (from any of the three radio altimeters).

To simulate air mode or ground mode to all the airplane systems, you must do the simulation function for the left and the right WOW cards.

WARNING PREPARE THE SAFETY SENSITIVE SYSTEMS FOR THE AIR MODE BEFORE YOU OPEN THE AIR/GROUND CIRCUIT BREAKERS. IN THE AIR MODE, MANY OF THE AIRPLANE SYSTEMS CAN OPERATE AND CAUSE INJURIES TO PERSONNEL AND/OR DAMAGE TO EQUIPMENT.



SPECIAL FUNCTIONS

SELECT ATA SYSTEM (21)

24 FLIGHT CONTROL DC POWER SYSTEM
26 CARGO SMOKE DETECTION SYSTEM
27 PRIMARY FLIGHT CONTROL SYSTEM
27 HIGH LIFT SYSTEM
31 AIMS - FLIGHT DATA RECORDER SYSTEM
31 AIMS - DISPLAY SYSTEM
32 AIR/GROUND SYSTEM
32 ANTISKID/AUTOBRAKE CONTROL SYSTEM
32 BRAKE TEMPERATURE MONITOR SYSTEM

SELECT FUNCTION (6)

LEFT AIR SIMULATION
LEFT GROUND SIMULATION
LEFT STOP SIMULATION
RIGHT AIR SIMULATION
RIGHT GROUND SIMULATION
RIGHT STOP SIMULATION

SELECT FUNCTION (6)

LEFT AIR SIMULATION
LEFT GROUND SIMULATION
LEFT STOP SIMULATION
RIGHT AIR SIMULATION
RIGHT GROUND SIMULATION
RIGHT STOP SIMULATION

M42467 S000618603_V2

AIR/GROUND SYSTEM - SPECIAL FUNCTIONS

AIR/GROUND SYSTEM - AIR/GROUND RIGGING/CALIBRATION

General

After you replace a load sensor, the new sensor must be calibrated to the airplane. You calibrate all four load sensors if you replace the two WOW cards.

You can calibrate each WOW load sensor with the air/ground rigging/calibration function on the MAT. This function is in the PSEU and Air/Ground Rigging function in the Other Functions menu. There is a calibration function for each of the four load sensors.

Calibration

The screen for this function shows a rigging status ruler. The ruler shows the output of the selected load sensor in counts. The count is a measurement of the bending of the main landing gear beam.

This screen also shows the acceptable count ranges for air and ground calibrations and the limits for air and ground rigging. The calibration ranges are wider than the rigging limits.

The sensor reading must be within the rigging limits when you install a new load sensor. You use the calibration range when you replace the WOW cards or if you want to do a check of the sensors. If the sensor is not within the applicable limits, you must adjust the sensor mounting brackets before you calibrate.

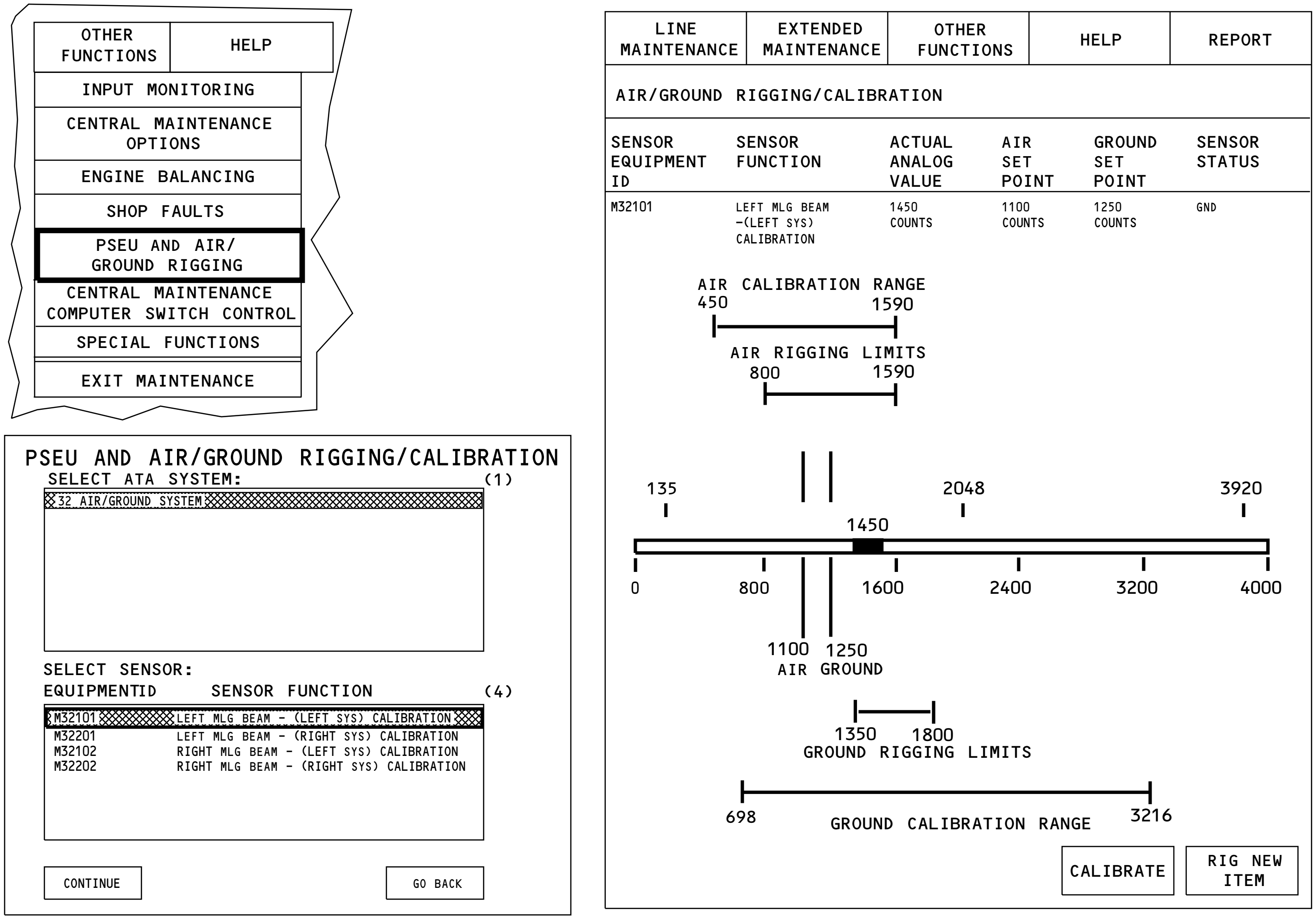
When you select calibrate at the bottom of the screen, ground calibration and air calibration buttons show.

If the airplane weight is on the landing gear, do the ground calibration.

If the airplane is on jacks, do the air calibration.

Training Information Point

The ground test enable switch must be in the ENABLE position to do this function.



EQUIPMENTID	SENSOR FUNCTION (4)
M32101	LEFT MLG BEAM - (LEFT SYS) CALIBRATION
M32201	LEFT MLG BEAM - (RIGHT SYS) CALIBRATION
M32102	RIGHT MLG BEAM - (LEFT SYS) CALIBRATION
M32202	RIGHT MLG BEAM - (RIGHT SYS) CALIBRATION

SENSOR EQUIPMENT ID	SENSOR FUNCTION	ACTUAL ANALOG VALUE	AIR SET POINT	GROUND SET POINT	SENSOR STATUS
M32101	LEFT MLG BEAM -(LEFT SYS) CALIBRATION	1450 COUNTS	1100 COUNTS	1250 COUNTS	GND

M42468 S000618604_V1

AIR/GROUND SYSTEM - AIR/GROUND RIGGING/CALIBRATION

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MAIN LANDING GEAR AND DOORS - INTRODUCTION

General

The two main landing gear absorb landing forces and hold most of the airplane weight when the airplane is on the ground.

The main landing gear doors open to permit MLG operation. The doors close to aerodynamically seal the MLG wheel wells.

Main Landing Gear

Each main landing gear has a six-wheel truck. A hydraulic strut tilts the truck up and down during takeoff and when the plane is in the air. A drag brace and a side brace hold each gear in the extended position. Lock links hold the drag brace and side brace in the extended position. Over-center toggles, on the lock links, lock the gear in the extended position.

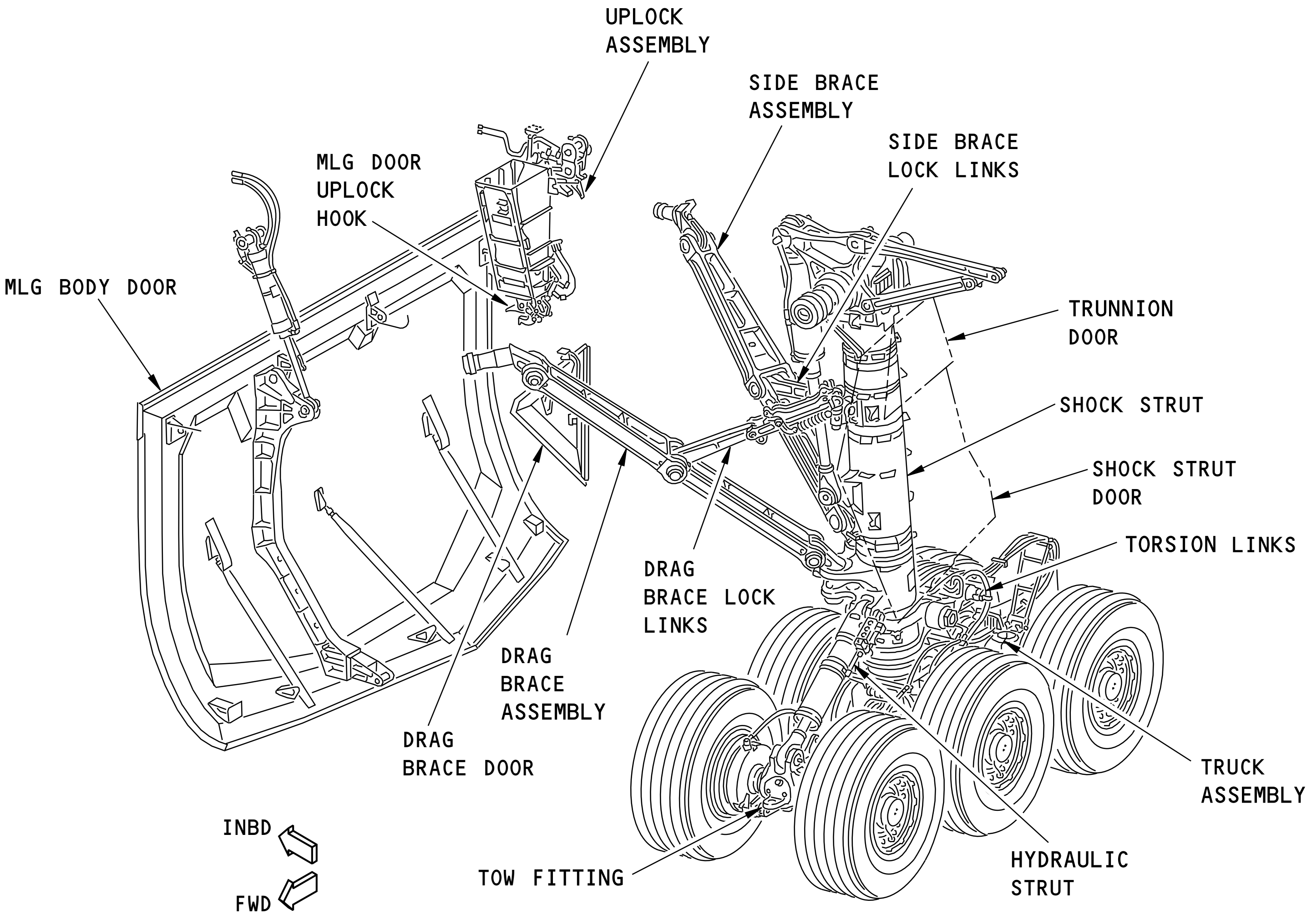
Each main landing gear has these components:

- MLG drag brace assembly
- MLG side brace assembly
- MLG side brace lock links
- MLG drag brace lock links
- MLG torsion links
- MLG truck assembly
- MLG hydraulic strut
- MLG shock strut.

Main Landing Gear Doors

These are the four doors for each main landing gear:

- MLG body door
- MLG drag brace door
- MLG shock strut door
- MLG trunnion door.



LEFT MAIN LANDING GEAR AND DOORS

M91581 S0000100296_V2

MAIN LANDING GEAR AND DOORS - INTRODUCTION

MAIN LANDING GEAR AND DOORS - SIDE BRACE ASSEMBLY, DRAG BRACE ASSEMBLY, AND LOCK LINKS

General

The MLG side brace assembly and the MLG drag brace assembly hold the main landing gear in the extended position. They also supply lateral support to the main landing gear.

The lock links hold the braces in their extended position.

MLG Drag Brace Assembly

The MLG drag brace assembly is on the forward side of each main landing gear. The upper and lower drag braces connect by a hinge.

A spindle on the upper drag brace pivots around a fitting in the forward part of the main gear wheel well.

A spindle on the lower drag brace pivots around a fitting on the main gear shock strut.

MLG Drag Brace Lock Links

The MLG drag brace lock links hold the MLG drag brace when the gear is in the extended position. Upper and lower toggles connect to the upper and lower lock links. These toggles move to an over-center locked position when the gear is down. Two springs hold the toggles in the over-center locked position.

MLG Side Brace Assembly

The MLG side brace assembly is on the aft side of the main landing gear. Upper and lower side braces connect by a hinge.

A spindle on the upper side brace pivots around a fitting in the inboard end of the main landing gear beam.

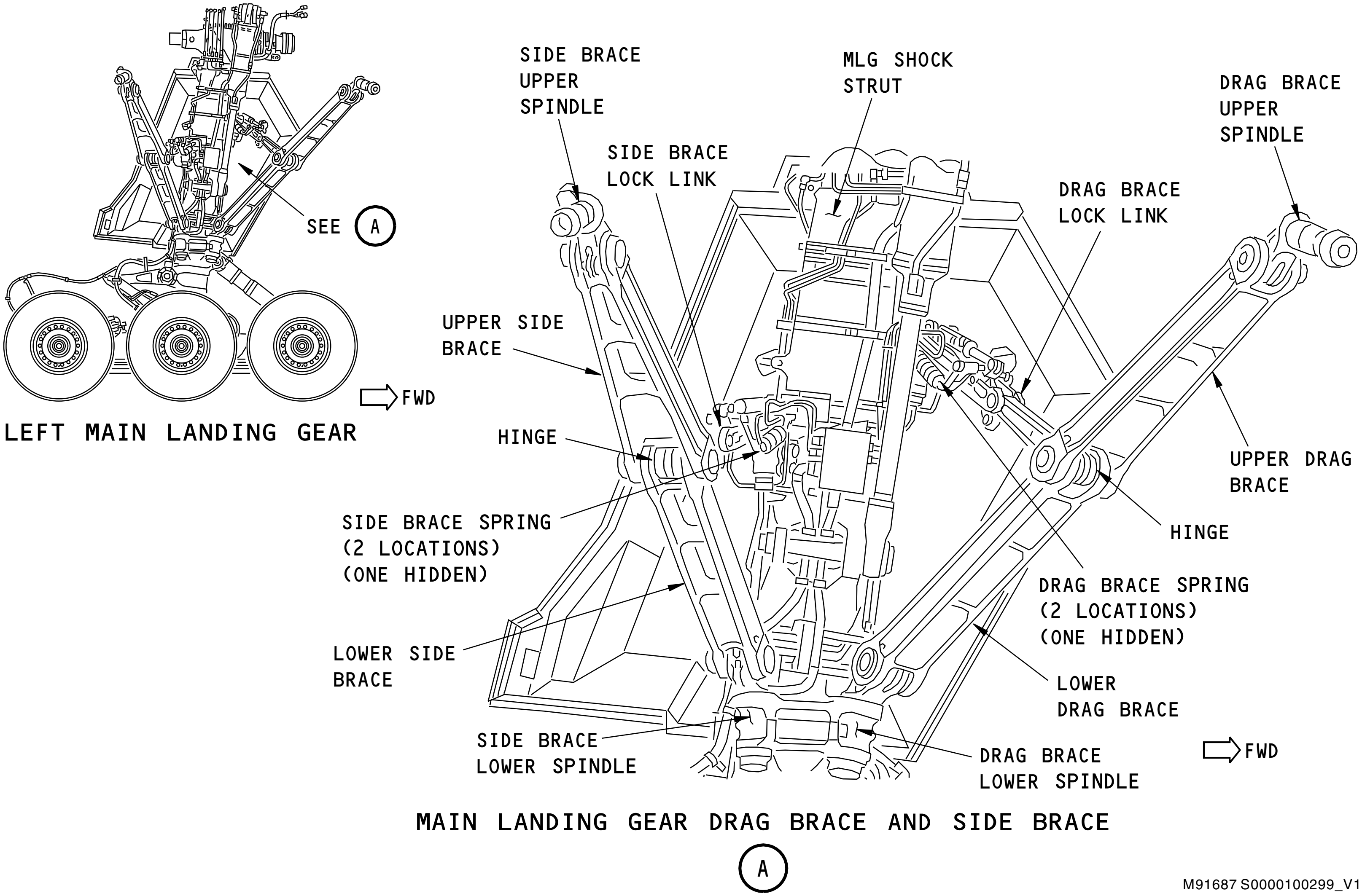
A spindle on the lower side brace pivots around a fitting on the main gear shock strut.

MLG Side Brace Lock Links

The MLG side brace lock links hold the MLG side brace when the gear is in the extended position. Upper and lower toggles connect to the upper and lower lock links. These toggles move to an over-center locked position when the gear is down. Two springs hold the toggles in the over-center locked position.

Training Information Point

You install downlock pins in the upper side brace lock link and the upper drag brace lock link. Each pin holds the upper toggle and the upper lock link together. The pins prevent MLG retraction.



LEFT MAIN LANDING GEAR

MAIN LANDING GEAR DRAG BRACE AND SIDE BRACE

A

MAIN LANDING GEAR AND DOORS - DRAG BRACE, SIDE BRACE, AND LOCK LINK ASSEMBLIES

MAIN LANDING GEAR AND DOORS - TRUCK ASSEMBLY

General

Each main landing gear truck has these components:

- Axles
- Tow fittings
- Brake rods
- Wheels and tires
- Brakes
- Hydraulic strut
- Main gear steering components.

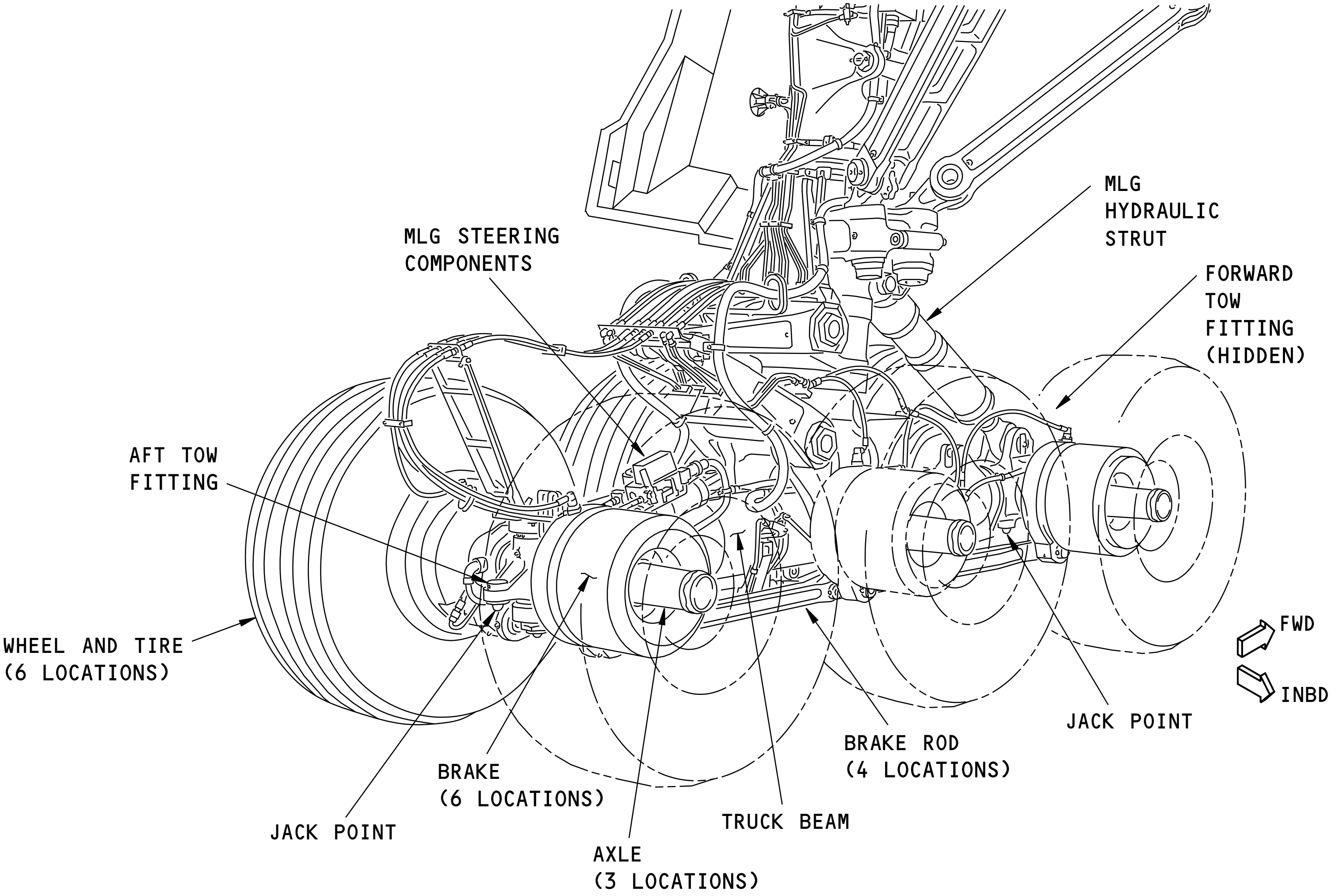
There are three axles on each MLG truck. A jacking point is under the center of the forward and aft axles.

A tow fitting is on the forward part of the MLG truck. There is also a tow fitting/jackpoint on the aft part of the MLG truck.

Brake rods attach the brakes to the MLG shock strut to prevent rotation.

The hydraulic strut tilts the MLG truck up and down during takeoff and when the airplane is in the air. See the MLG extension-retraction section for more information on the hydraulic strut (SECTION 32-32).

The main landing gear steering components steer the aft axle 6.5 degrees left or right. See the main gear steering section for more information (SECTION 32-53).



MAIN LANDING GEAR AND DOORS - TRUCK ASSEMBLY

MAIN LANDING GEAR AND DOORS - SHOCK STRUT

Purpose

The main landing gear shock struts absorb landing forces and transmit vertical loads to the airplane structure.

Physical Description

The shock struts are standard forged steel air-oil shock absorbers. They have an inner cylinder which moves inside an outer cylinder.

Compressed dry nitrogen is in the upper part of the shock strut and hydraulic fluid is in the lower part of the shock strut.

Torsion links on the aft part of the shock strut connect the inner and outer cylinders.

Shock Strut Seals

A static seal and a dynamic seal keep the nitrogen and the hydraulic fluid in the shock strut. The static seal is between the lower bearing and the outer cylinder. The dynamic seal is between the lower bearing and the inner cylinder.

There are two spare static seals in the shock strut. There are also two spare dynamic seals and dynamic seal backup rings in the shock strut.

The spare seals permit the change of faulty seals without the removal of the inner cylinder.

Training Information Point

The dynamic seal is not the same as the spare dynamic seals. The spare dynamic seals are more flexible. This permits installation of the spare dynamic seals on to the larger diameter of the spare seal carrier.

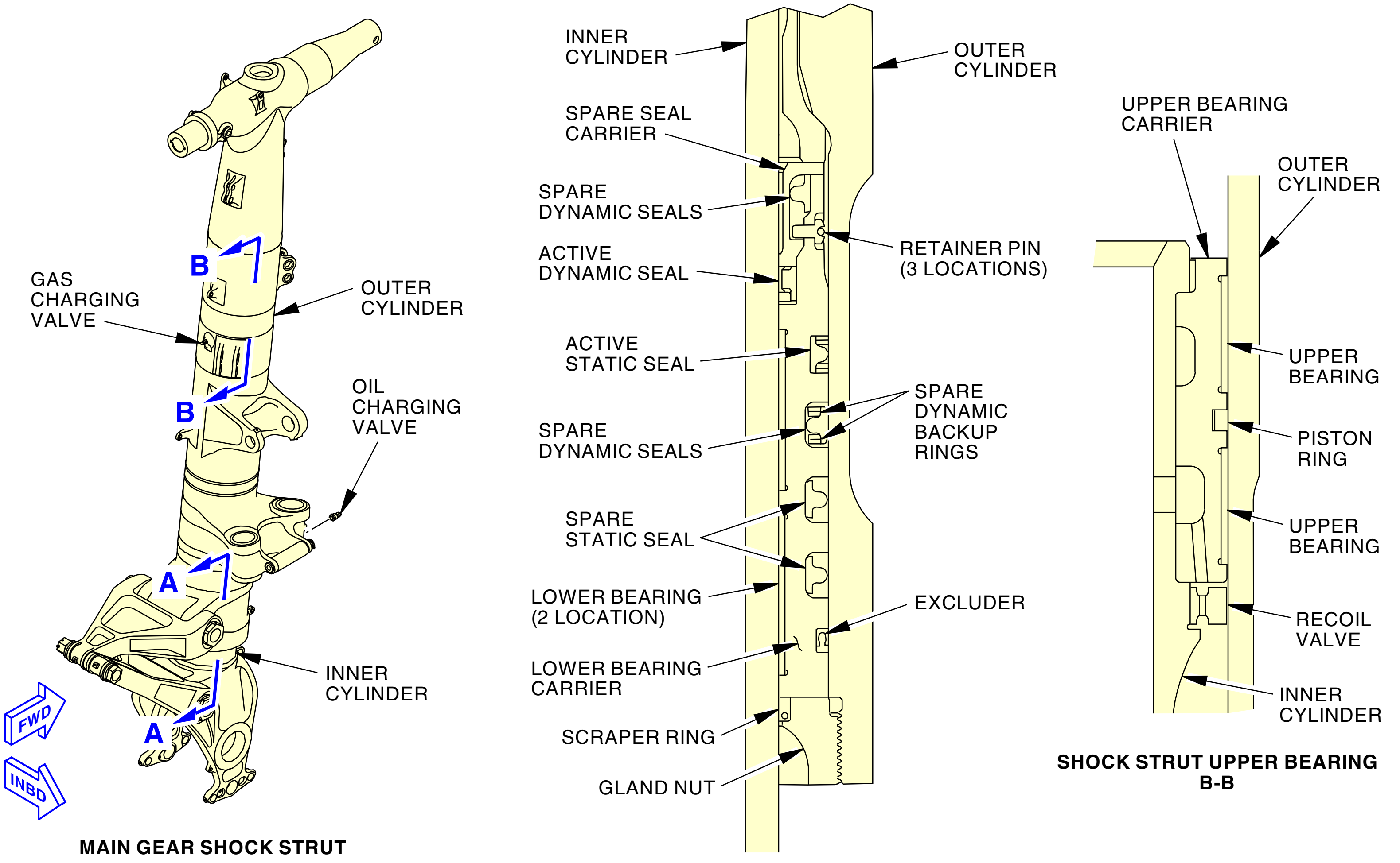
A gas charging valve (not shown) is on the aft side of the MLG shock strut near the side brace lock links.

The oil charging valve is on the front of the shock strut forward of the upper torsion link.

A servicing chart (not shown) is on the main landing gear shock strut door.

⚠ **WARNING** DO NOT REMOVE THE VALVE BODY UNTIL YOU DEFLATE THE SHOCK STRUT FULLY. THE AIR PRESSURE CAN BLOW THE VALVE BODY OUT AND CAUSE INJURIES TO PERSONNEL.

⚠ **CAUTION** USE ONLY THE TYPE OF HYDRAULIC FLUID SHOWN ON THE SHOCK STRUT NAMEPLATE. DIFFERENT TYPES OF FLUID WILL CAUSE DAMAGE TO SEALS.



MAIN GEAR SHOCK STRUT

SHOCK STRUT LOWER BEARING
A-A

SHOCK STRUT UPPER BEARING
B-B

M91863 S0000100301_V3

MAIN LANDING GEAR AND DOORS - SHOCK STRUT

MAIN LANDING GEAR AND DOORS - MLG DOORS

General

These are the four main landing gear doors:

- MLG body door
- MLG drag brace door
- MLG shock strut door
- MLG trunnion door.

MLG Body Door

The body door closes over the MLG wheel well. Hinges attach the door to the MLG wheel well near the keel beam.

A hydraulic actuator opens and closes the body door during extension and retraction. See the MLG extension-retraction section for more information on the MLG door actuator (SECTION 32-32).

An uplock roller on the door slides into an uplock hook assembly to keep the main landing gear door closed. See the MLG extension-retraction section for more information on the MLG door uplock hook and MLG door lock actuator (SECTION 32-32).

You use the landing gear alternate extension system to operate the body door on the ground. See the landing gear alternate extension system section for more information on the ground door operation (SECTION 32-35).

Skid bars on the MLG body door prevent damage to the door from the main landing gear. The MLG may touch the MLG body door during alternate landing gear extension or if the truck does not tilt down during MLG retraction.

MLG Drag Brace Door

The MLG drag brace door attaches to the drag brace and to the wing structure.

MLG Shock Strut Door

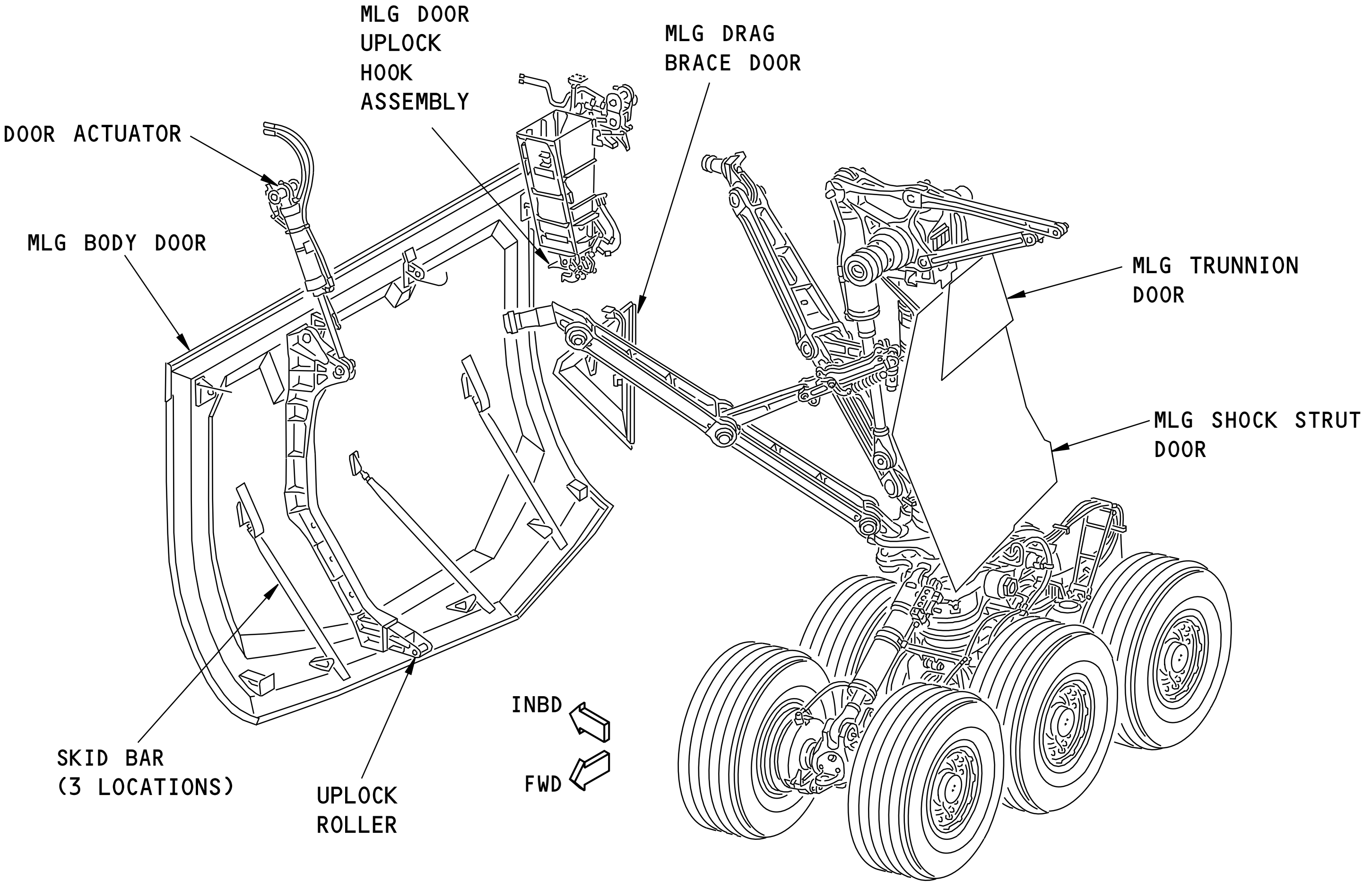
The MLG shock strut door attaches directly to the shock strut.

MLG Trunnion Door

The trunnion door is hinged to the wing.

Training Information Point

The main landing gear doors are made of composite materials.



LEFT MAIN LANDING GEAR AND DOORS

M91702 S0000100302_V1

MAIN LANDING GEAR AND DOORS - MLG DOORS

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NOSE LANDING GEAR AND DOORS - INTRODUCTION

General

The nose landing gear absorbs landing forces and holds the forward part of the airplane weight when the airplane is on the ground. The nose gear also steers the airplane on the ground.

The nose landing gear doors open to permit gear operation and close to aerodynamically seal the NLG wheel well.

Nose Landing Gear

The nose landing gear is a conventional two wheel gear. A drag strut assembly holds the nose gear in the extended or retracted position. A lock link assembly moves to the over-center position to lock the drag strut in either position.

These are the nose landing gear components:

- NLG drag strut assembly
- NLG lock link assembly
- NLG torsion links
- NLG shock strut.

Nose Landing Gear Doors

Two forward and two aft doors aerodynamically seal the nose gear wheel well to reduce drag.

The forward doors attach to the outer edge of the NLG wheel well. A hydraulic actuator opens and closes the forward doors.

The aft doors attach to the outer edge of the wheel well. They connect to the shock strut and move mechanically with the gear during extension and retraction.

Training Information Point

There is a tow fitting forward of the shock strut between the nose landing gear tires.

There is also a tow fitting aft of the shock strut between the nose landing gear tires (not shown).

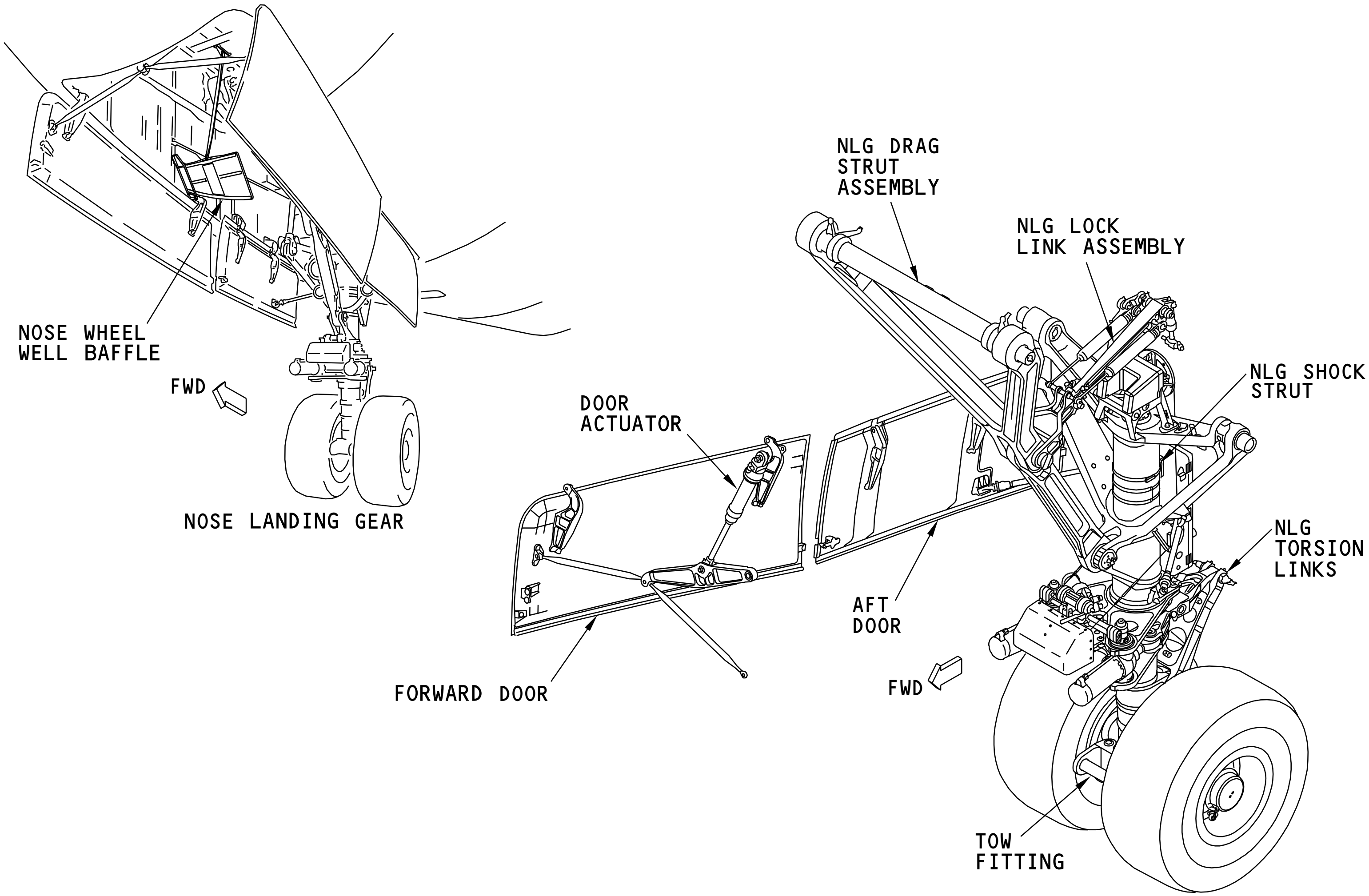
You can disconnect the torsion links to permit the nose landing gear to move greater than the normal steering limits (70 degrees).

The nose landing gear doors are made of composite materials.

You use the alternate extension system to operate the forward NLG doors on the ground.

See the alternate extension system section for more information on the NLG door operation (SECTION 32-35).

Nose wheel well baffles on the left and right sides of the wheel well decreases landing gear door vibrations during gear operation.



M42266 S000618614_V1

NOSE LANDING GEAR AND DOORS - INTRODUCTION

NOSE LANDING GEAR AND DOORS - SHOCK STRUT

Purpose

The nose landing gear shock strut absorbs airplane landing forces and transmits vertical loads to the airplane structure.

Physical Description

The nose landing gear shock strut is a dual air chamber forged steel air-oil shock strut. It has an inner and an outer cylinder.

Compressed dry nitrogen is in the upper chamber of the outer cylinder and the lower chamber of the inner cylinder. Hydraulic fluid is in the shock strut between the upper and lower air chambers.

Torsion links on the aft part of the shock strut connect the inner and outer cylinders.

Centering cams inside the shock strut center the nose wheels when the shock strut extends.

Shock Strut Seals

A static seal and a dynamic seal keep the nitrogen and the hydraulic fluid in the shock strut. The static seal is between the lower bearing and the outer cylinder. The dynamic seal is between the lower bearing and the inner cylinder.

There are two spare static seals, two spare dynamic seals, and backup rings for the spare dynamic seals in the shock strut. The spare seals permit change of faulty seals without removal of the inner cylinder.

Training Information Point

The dynamic seal is not the same as the spare dynamic seal. The spare dynamic seal is more flexible. This permits installation of the spare dynamic seal on to the larger diameter of the spare seal carrier.

The upper air chamber charging valve is on the front of the shock strut outer cylinder. An in-line pressure gage indicates the operational status of the pressure in the upper air chamber. The lower air chamber charging valve is behind the forward tow fitting below the shock strut inner cylinder.

The oil charging valve is on the left side of the shock strut outer cylinder. There is also an oil relief valve on the top of the shock strut outer cylinder.

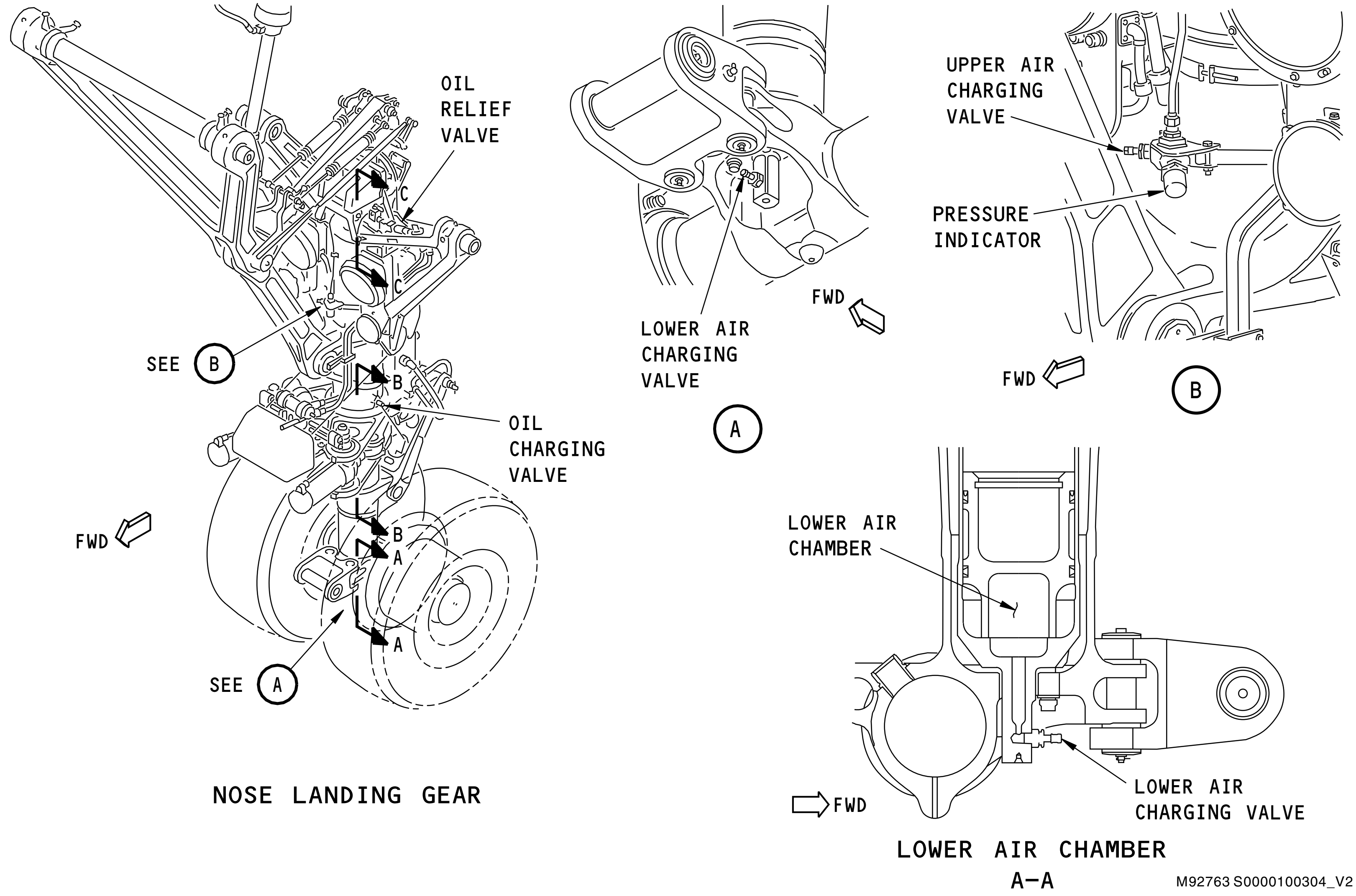
A servicing chart (not shown) is on the right aft nose landing gear door.

⚠ **WARNING**

DO NOT REMOVE THE AIR VALVE BODY UNTIL THE SHOCK STRUT HAS BEEN DEFLATED. INTERNAL PRESSURE CAN BLOW THE VALVE OUT, CAUSING INJURY TO PERSONNEL.

⚠ **CAUTION**

WHEN SERVICING THE SHOCK STRUT WITH FLUID, USE ONLY THE FLUID SPECIFIED ON THE NAMEPLATE. FLUIDS WHICH ARE NOT COMPATIBLE OR OF THE WRONG TYPE WILL CAUSE THE SEALS TO DETERIORATE AND RESULT IN LEAKS.



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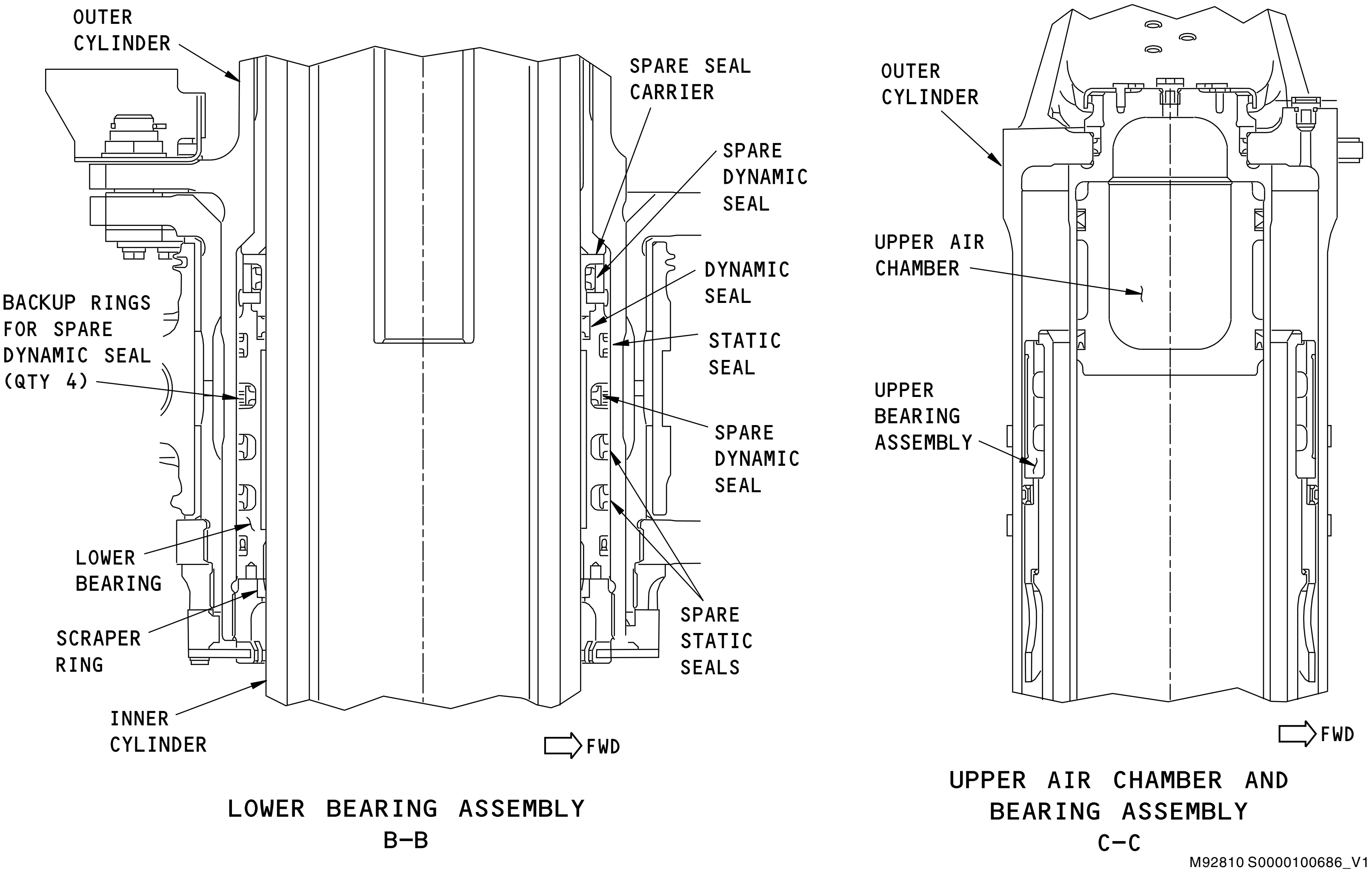
NOSE LANDING GEAR AND DOORS - SHOCK STRUT



LOWER BEARING ASSEMBLY
B-B

UPPER AIR CHAMBER AND BEARING ASSEMBLY
C-C

M92810 S0000100686_V1

NOSE LANDING GEAR AND DOORS - SHOCK STRUT

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NOSE LANDING GEAR AND DOORS - DRAG STRUT AND LOCK LINK ASSEMBLIES

General

Drag strut and lock link assemblies hold the nose landing gear in the extended and retracted positions.

Drag Strut Assembly

The drag strut assembly has upper and lower struts which attach by a hinge in the center.

The upper drag strut is trunnion-mounted to the side walls in the nose wheel well.

The lower drag strut attaches to a hinge on the shock strut.

Lock Link Assembly

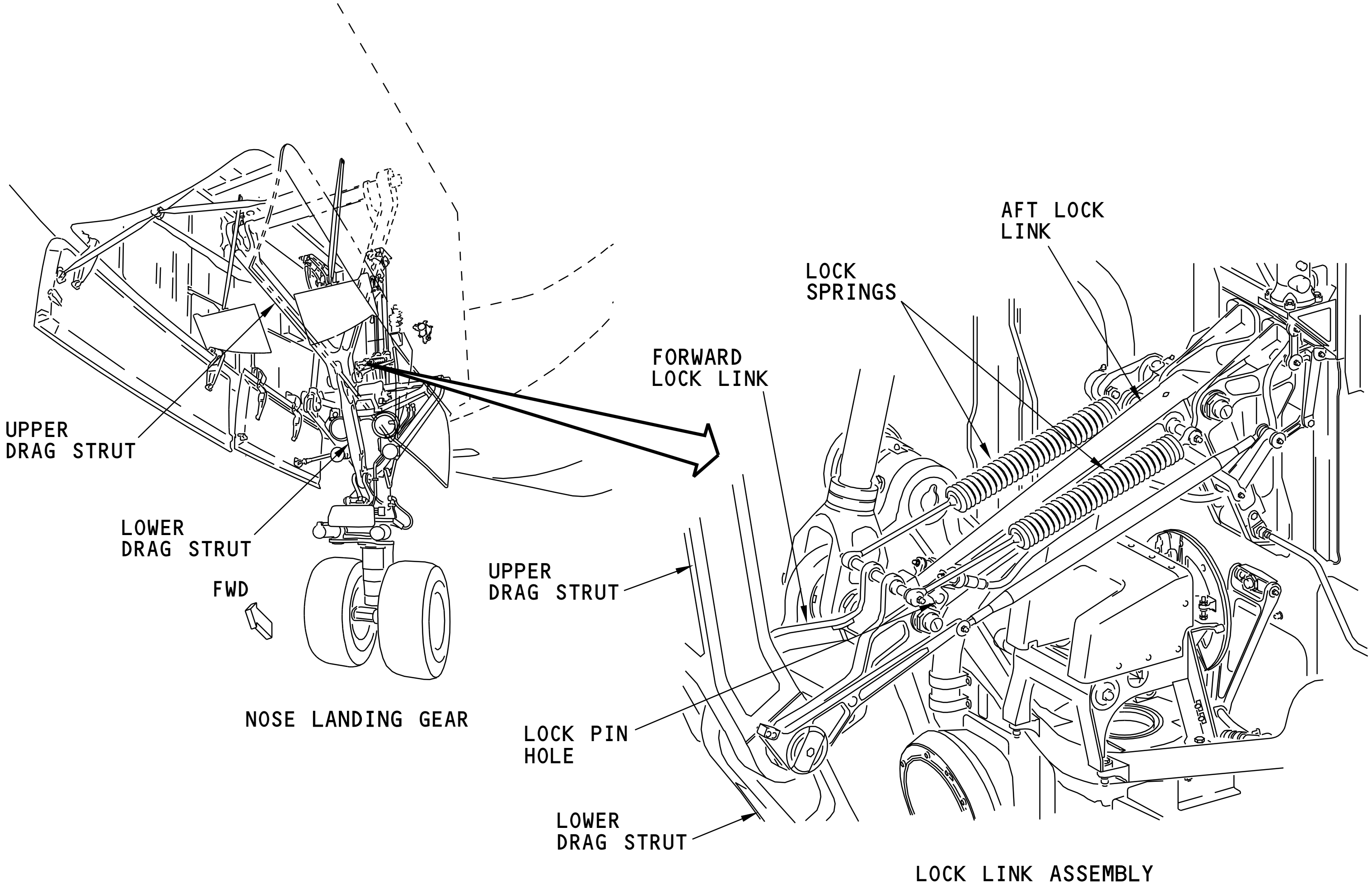
The lock link assembly has forward and aft lock links and two lock springs.

The forward and aft lock links attach by a hinge.

The lock springs help keep the lock link in the locked position.

Training Information Point

A lock pin hole in the lock link assembly permits you to install a down lock pin. Use this pin to keep the nose gear in the down and locked position.



NOSE LANDING GEAR

LOCK LINK ASSEMBLY

M42268 S000618616_V1

NOSE LANDING GEAR AND DOORS - DRAG STRUT AND LOCK LINK ASSEMBLIES

NOSE LANDING GEAR AND DOORS - NLG DOORS

Nose Landing Gear Doors

Two forward and two aft NLG doors aerodynamically seal the nose gear wheel well to reduce drag.

Forward Doors

The forward doors attach to the outboard edges of the NLG wheel well. A hydraulic actuator opens and closes the forward doors. Each forward door attaches to the NLG wheel well with two hinges.

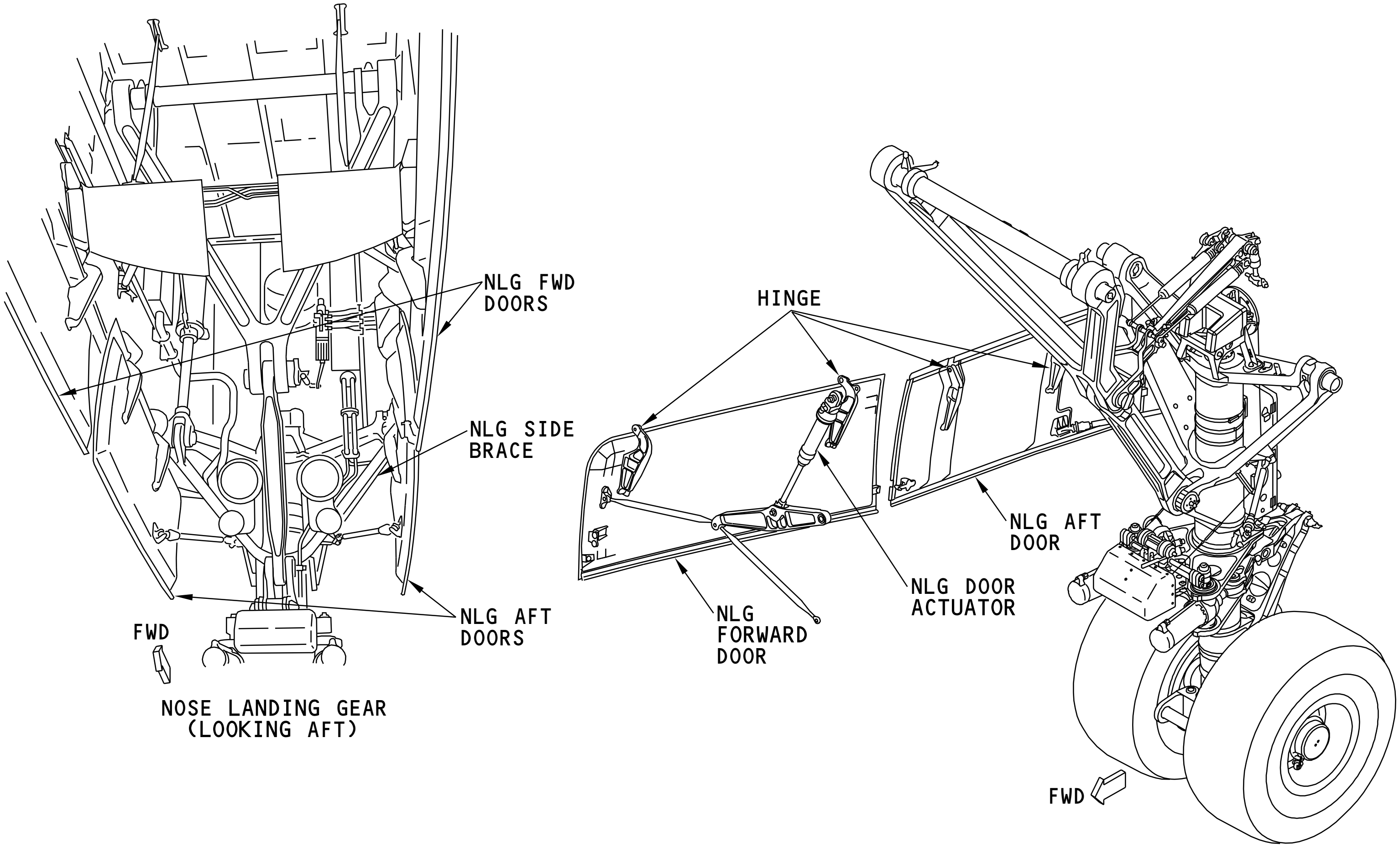
Aft Doors

The aft doors attach to the outboard edges of the NLG wheel well. They connect to the side braces and operate mechanically with the gear during extension and retraction. Each aft door attaches to the NLG wheel well with two hinges.

The nose landing gear doors are made of composite materials.

Training Information Point

You use the alternate extension system to open the forward doors on the ground. See the landing gear alternate extension system section for more information on the ground door operation (SECTION 32-35).



NOSE LANDING GEAR (LOOKING AFT)

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NOSE LANDING GEAR AND DOORS - NLG DOORS

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EXTENSION-RETRACTION - INTRODUCTION

General

ARO 005-999

Extension and retraction lowers and raises the landing gear.

ARO 001-004

Extension and retraction lowers and raises the landing gear and the tail skid.

ARO ALL

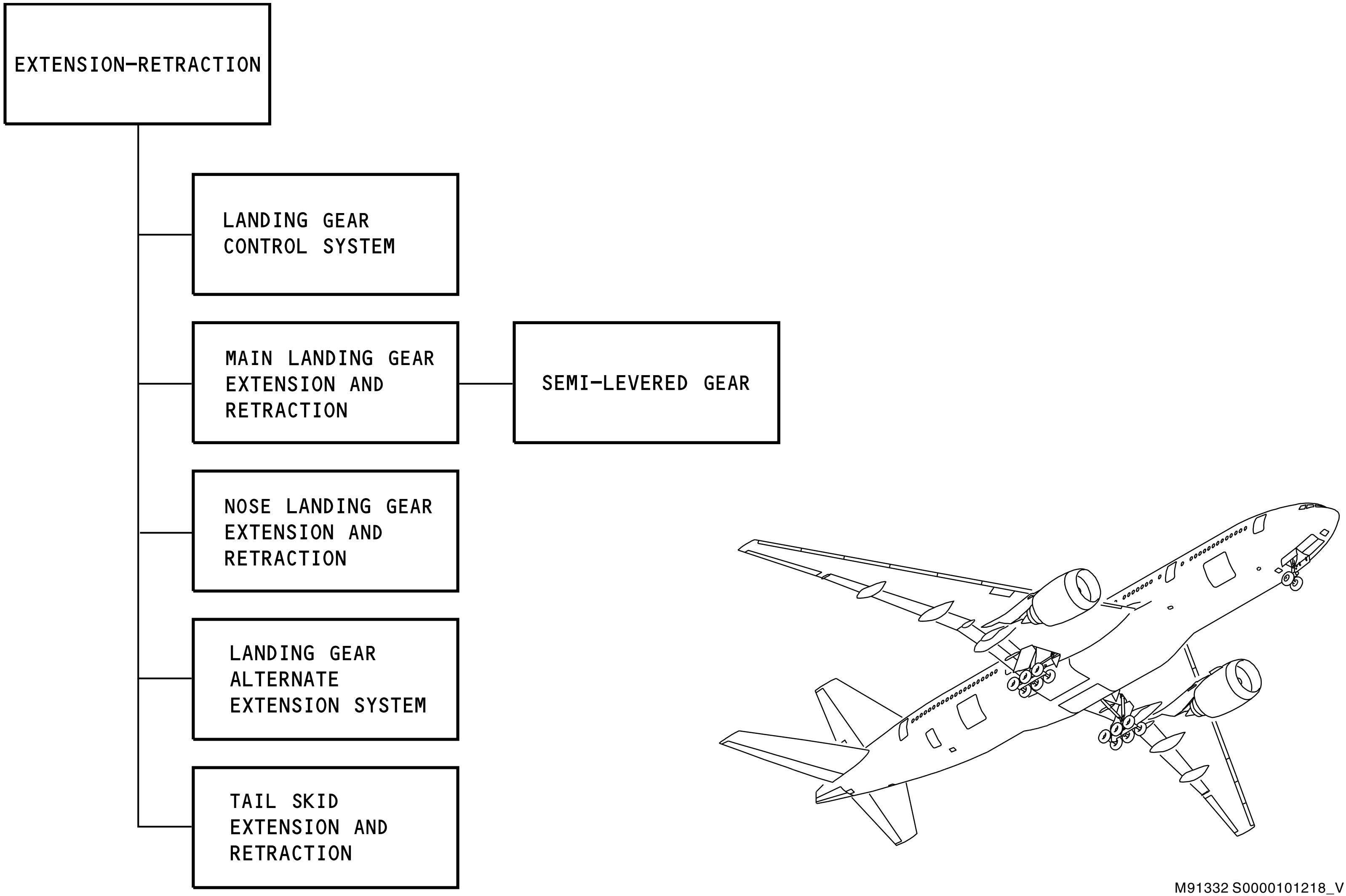
These are part of extension and retraction:

- The landing gear control system (SECTION 32-31)
- The main landing gear extension and retraction (SECTION 32-32)
- The nose landing gear extension and retraction (SECTION 32-34)
- The landing gear alternate extension system (SECTION 32-35).

ARO 001-004

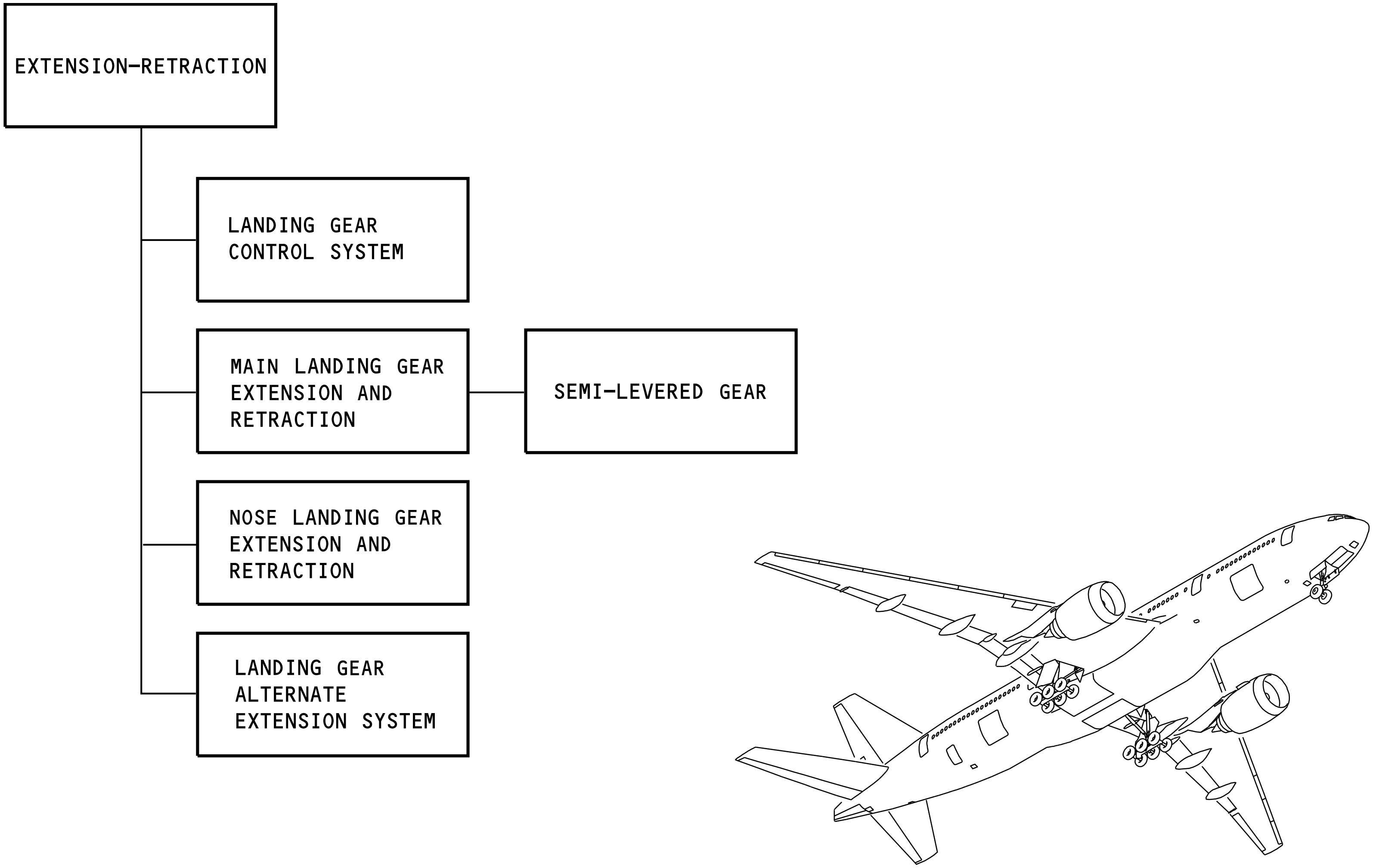
- The tail skid extension and retraction system (SECTION 32-72).

ARO ALL



M91332 S0000101218_V1

EXTENSION-RETRACTION - INTRODUCTION



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EXTENSION-RETRACTION - INTRODUCTION

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LANDING GEAR CONTROL SYSTEM - INTRODUCTION

Purpose

ARO 005-999

The landing gear control system controls the extension and retraction of the main and nose landing gears.

ARO 001-004

The landing gear control system controls the extension and retraction of the main and nose landing gears, and the tailskid.

ARO ALL

The landing gear control system also includes control for the semi-levered gear hydraulic strut on each of the main landing gear.

Components

Landing gear control system components are:

- The landing gear control lever module
- The NLG selector/bypass valve
- The MLG selector/bypass valve.

Location

The landing gear control lever is on the P2 center instrument panel.

The NLG selector/bypass valve is in the NLG wheel well.

The MLG selector/bypass valve is the right MLG wheel well.

General Description

Landing gear control is electrical. A two-position (UP and DOWN) landing gear control lever controls the extension and retraction.

When the airplane is on the ground, a landing gear lever lock solenoid locks the landing gear lever in the DOWN position. The solenoid releases the lock when the airplane is in the air.

Auto-off relays in ELMS remove the gear-up signal ten seconds after the landing gear retracts. This removes the pressure from the landing gear components.

The semi-levered gear control provides for electrical control of the hydraulically actuated hydraulic strut on each main landing gear. A relay in ELMS supplies power to the solenoid on the hydraulic strut to lock the strut during rotation on takeoff.

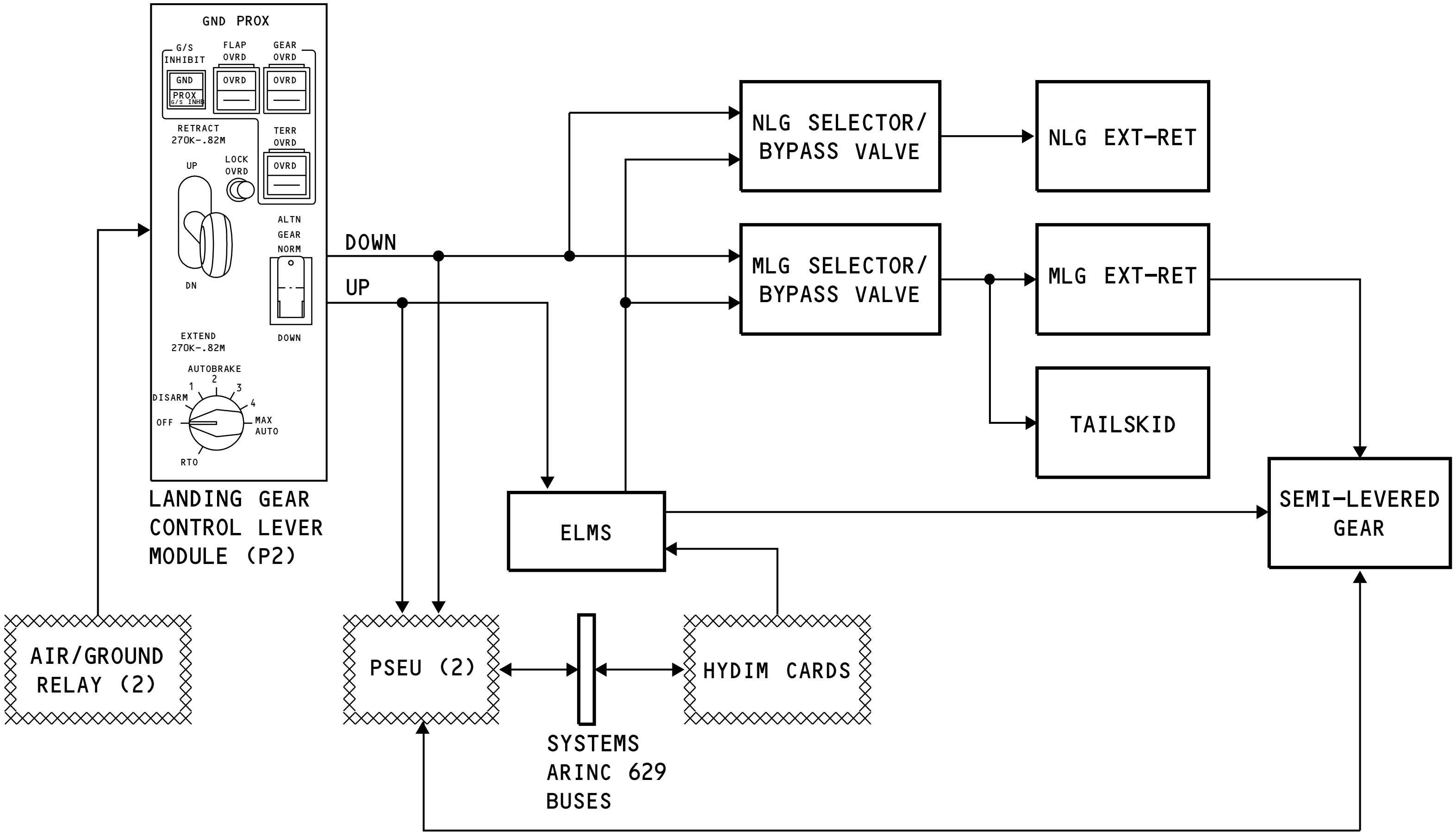
Interfaces

The proximity sensor electronics unit (PSEUs) get landing gear lever position. The PSEUs also supply landing gear position data to the HYDIM cards.

The PSEUs supply a ground for electrical power to the semi-levered gear relays when conditions to lock the semi-levered gear occur during takeoff rotation or through an operator initiated test.

The HYDIM cards control the auto-off relays in ELMS.

Air/ground relays control the landing gear lever lock solenoid.



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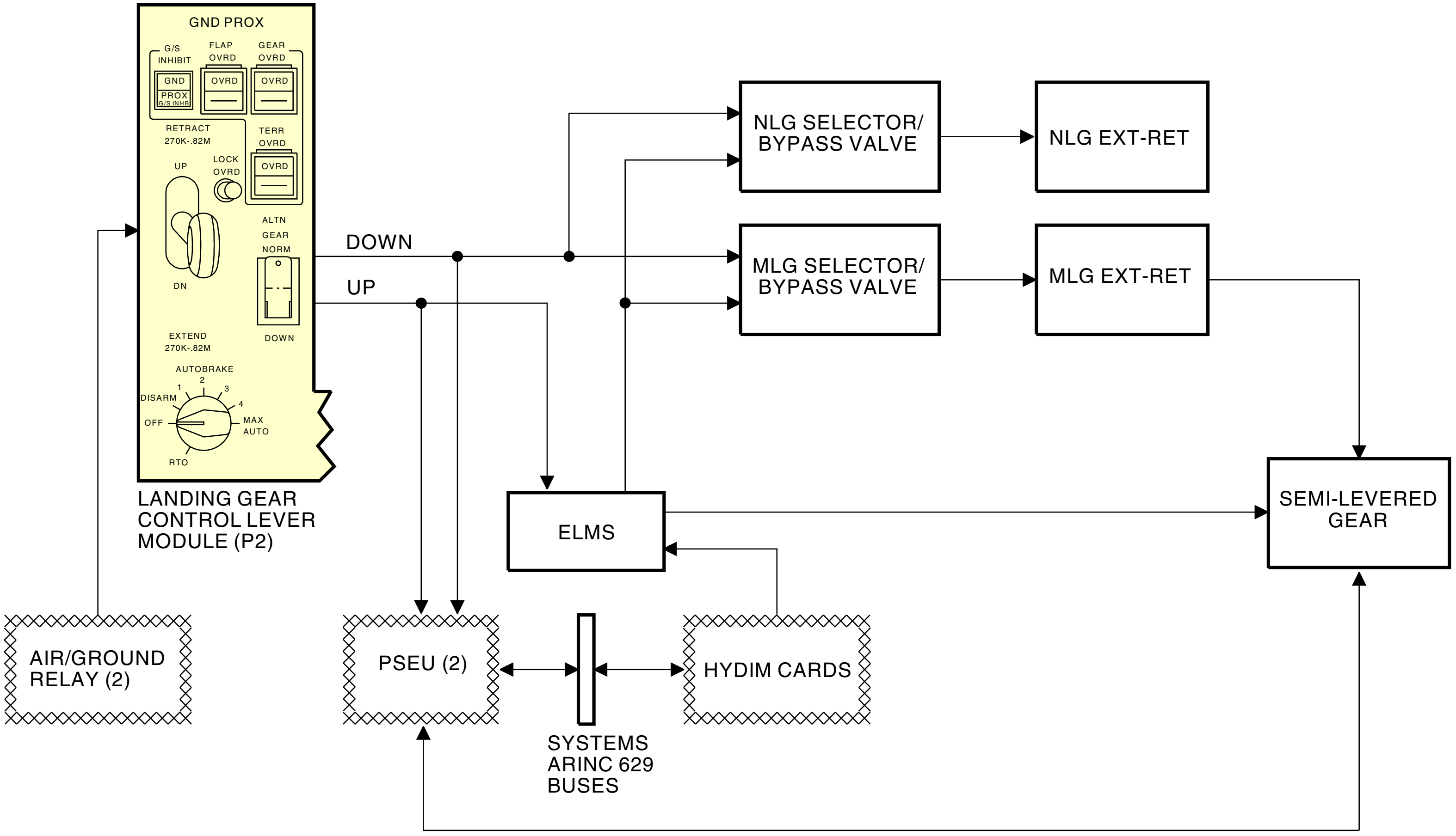
LANDING GEAR CONTROL SYSTEM - INTRODUCTION



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LANDING GEAR CONTROL SYSTEM - INTRODUCTION

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LANDING GEAR CONTROL SYSTEM - LANDING GEAR CONTROL LEVER MODULE

Purpose

The landing gear control lever module sends signals to the landing gear selector/bypass valves to extend and retract the landing gear and the tail skid (if applicable).

Physical Description

The module has these components:

- Lever
- Switches
- Lock mechanism.

Location

The landing gear lever is on the P2 center forward panel.

Functional Description

The lever has two positions with detents: UP and DN. You must first pull the lever out before you can raise or lower the lever.

ARO 014-016

The lever has seven internal switches. Four of these switches control power and ground to the down solenoids in the NLG and MLG selector/bypass valves. Two switches go to the ELMS to control power to the up solenoids in the NLG and MLG selector/bypass valves. One switch resets the gear door release/safety valve modules after an alternate gear extension or ground door operation.

ARO 001-013, 017-999

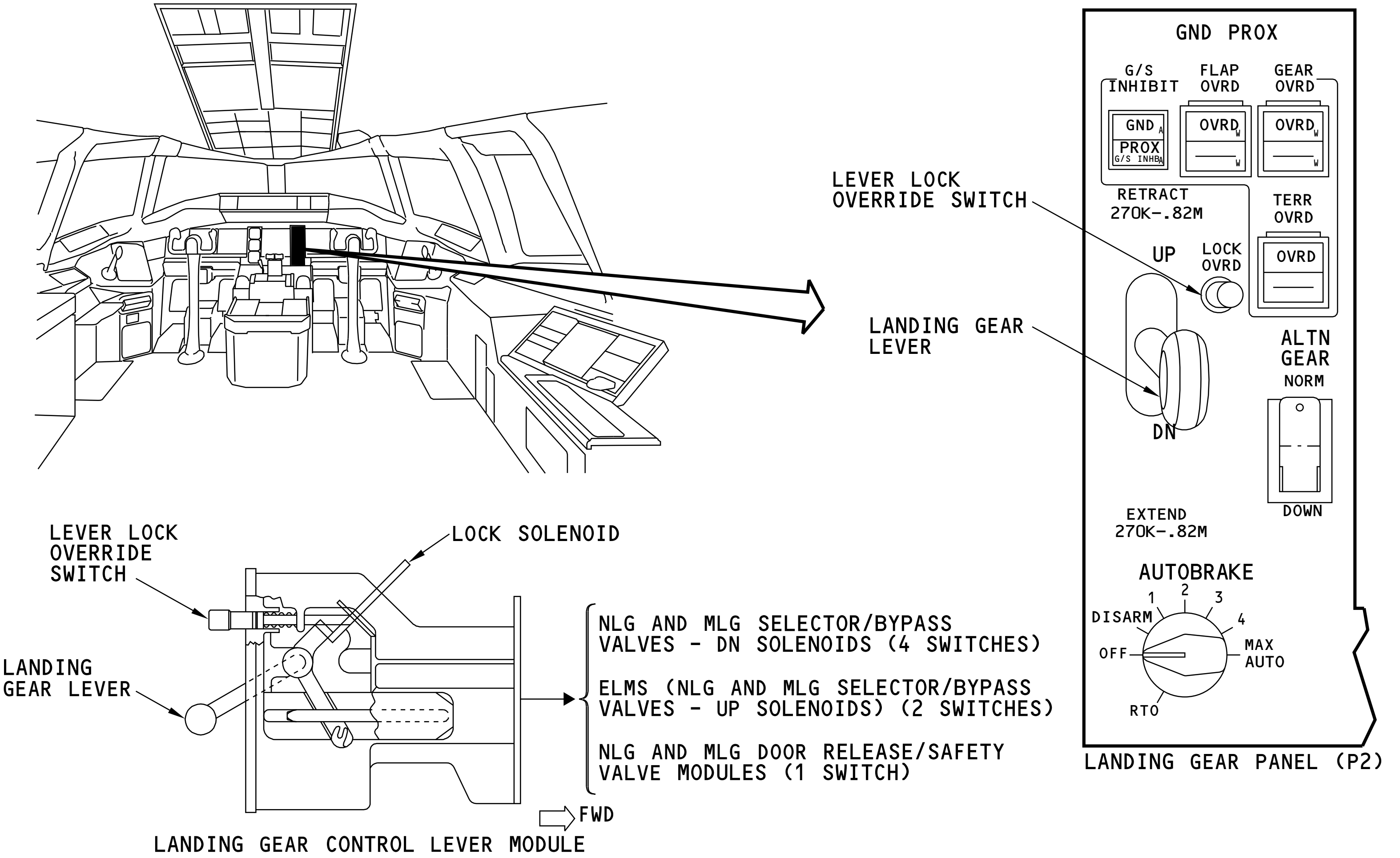
The lever has eight internal switches. Four of these switches control power and ground to the down solenoids in the NLG and MLG selector/bypass valves. Two switches go to the ELMS to control power to the up solenoids in the NLG and MLG selector/bypass valves. One switch resets the gear door release/safety valve modules after an alternate gear extension or ground door operation. One switch provides a signal to the weather radar system. See the weather radar system section for more information (SECTION 34-43).

ARO ALL

The module also has a solenoid controlled lever lock mechanism. The lever lock prevents accidental movement of the control lever from DN to UP when the airplane is on the ground. When the aircraft takes off, the solenoid gets electrical power and releases the lever lock.

Training Information Point

You can mechanically release the landing gear lever lock with the lever lock override switch.



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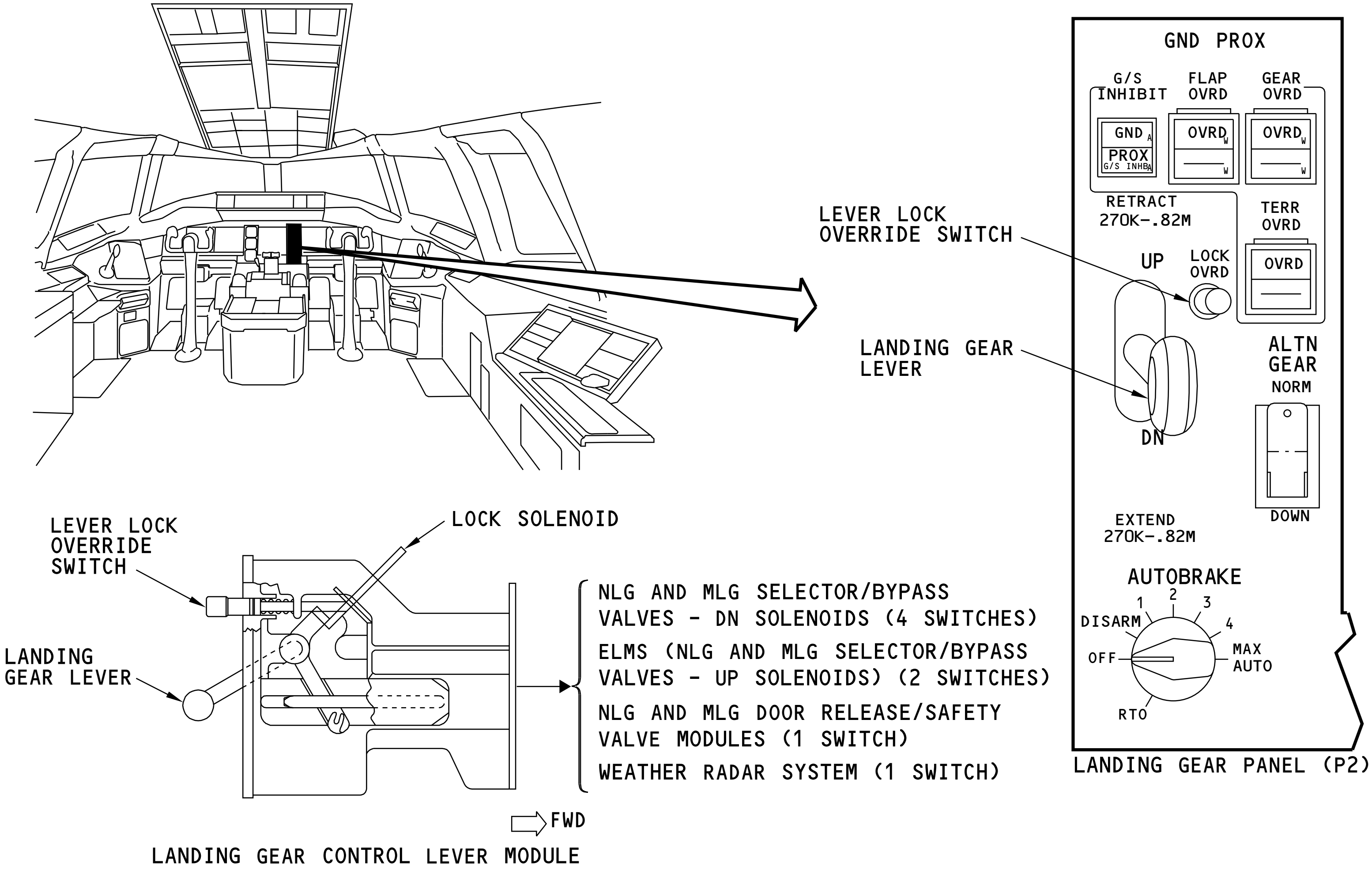
LANDING GEAR CONTROL SYSTEM - LANDING GEAR CONTROL LEVER MODULE



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LANDING GEAR CONTROL SYSTEM - LANDING GEAR CONTROL LEVER MODULE

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LANDING GEAR CONTROL SYSTEM - LANDING GEAR SELECTOR/BYPASS VALVES - INTRODUCTION

Purpose

The NLG selector/bypass valve controls extend and retract pressure to NLG extension and retraction components.

The MLG selector/bypass valve controls extend and retract pressure to the left and the right MLG extension and retraction components.

The NLG and MLG selector/bypass valves operate the same way. The MLG selector/bypass valve is larger to permit higher hydraulic flow.

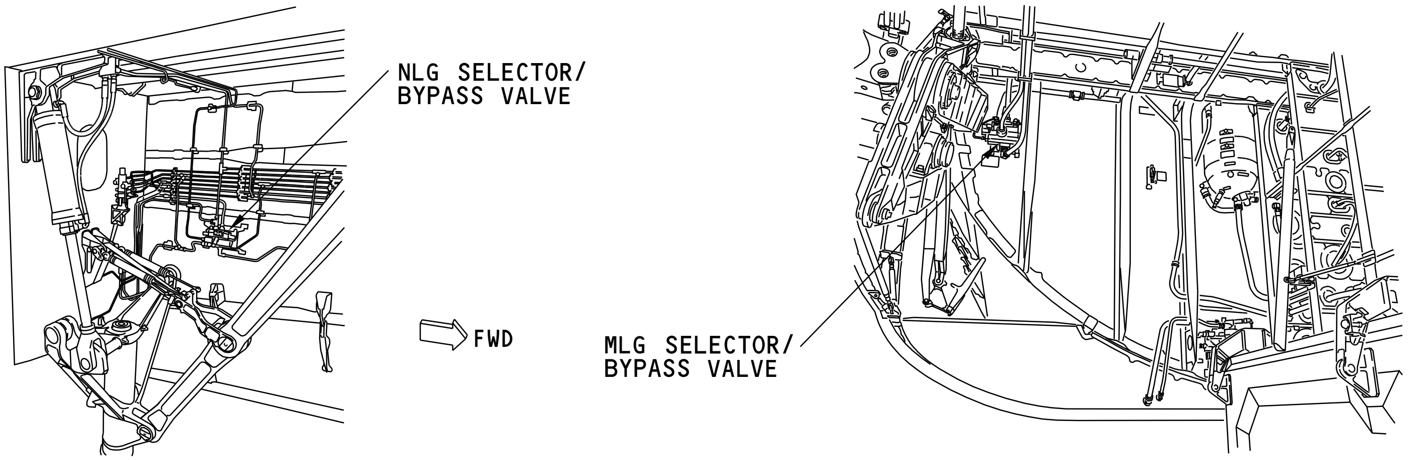
Location

The NLG selector/bypass valve is on the left bulkhead in the NLG wheel well.

The MLG selector/bypass valve is on the aft bulkhead in the right MLG wheel well.

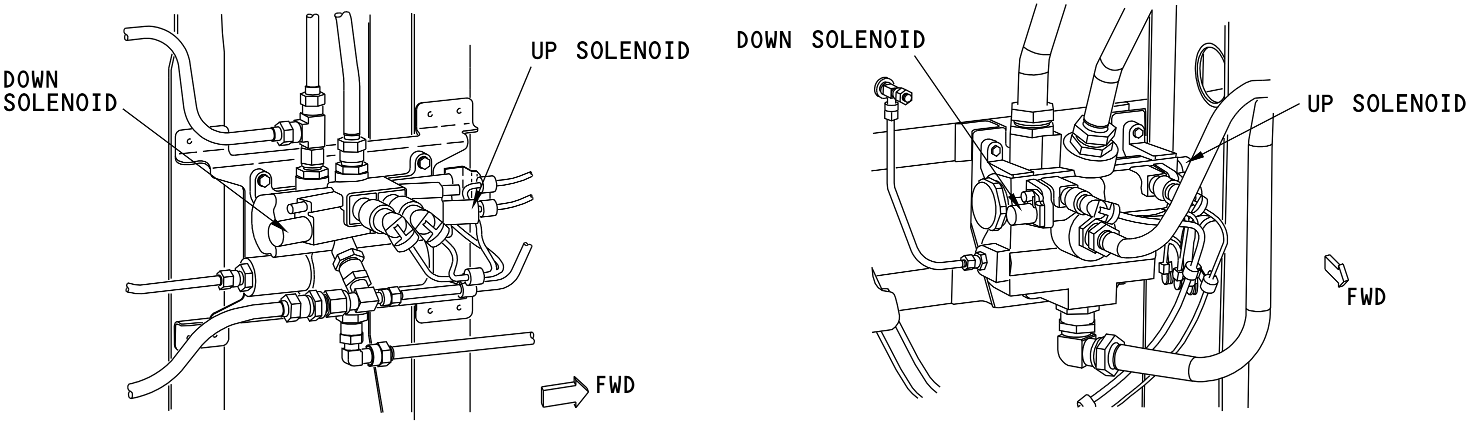
Training Information Point

The solenoids on the selector/bypass valves are LRUs.



NLG WHEEL WELL

RIGHT MLG WHEEL WELL - AFT BULKHEAD



NLG SELECTOR/BYPASS VALVE

MLG SELECTOR/BYPASS VALVE

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LANDING GEAR CONTROL SYSTEM - LANDING GEAR SELECTOR/BYPASS VALVES - INTRODUCTION

LANDING GEAR CONTROL SYSTEM - LANDING GEAR SELECTOR/BYPASS VALVES - FUNCTIONAL DESCRIPTION

General

The landing gear selector bypass valves are solenoid- operated, three-position valves. These are the positions:

- Retract
- Off
- Extend.

The landing gear selector/bypass valves have these components:

- Dual coil UP solenoids
- Dual coil DOWN solenoids
- Solenoid-operated valve (2)
- Selector valve
- Bypass valve.

The dual coil solenoids get input from the switches in the landing gear control lever module and from the ELMS to control the solenoid-operated valves.

Off Position

In the OFF position, center system hydraulic pressure goes to both solenoid-operated valves and to both sides of the landing gear selector valve. This keeps the selector valve in the OFF position.

In this position, the landing gear is not pressurized.

Extension

For a gear extension, the down solenoids get power and ground through the down switches in the landing gear control lever module. This moves the down solenoid-operated valve which releases pressure from one side of the selector valve. Hydraulic pressure and spring force move the selector valve to the DOWN position.

This permits hydraulic pressure to go to the landing gear down lines.

Retraction

For a gear retraction, the up solenoids get power through the up switches in the landing gear control lever module. This power also goes through the ELMS. This moves the up solenoid-operated valve which releases pressure from one side of the selector valve. Hydraulic pressure and spring force move the selector valve to the UP position.

This permits hydraulic pressure to go to the landing gear up lines.

Bypass Valve

The pressure operated bypass valve has a NORMAL and a BYPASS position.

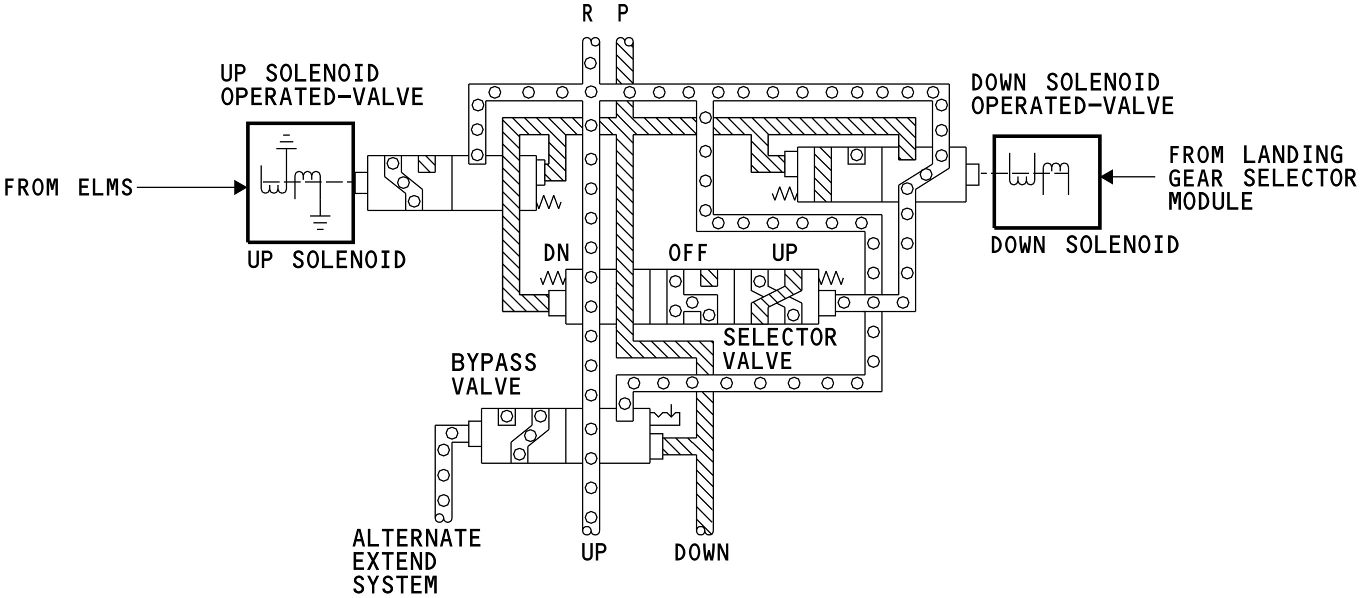
During normal landing gear operation, the bypass valve is in the NORMAL position.

If the selector valve is in the UP or OFF positions, or if there is no pressure in the center hydraulic system, alternate extend pressure moves the bypass valve to BYPASS.

This makes sure the gear retraction lines connect to return to permit the alternate extension system to extend the gear.

This prevents a selector valve stuck in the UP position from keeping the landing gear retracted.

Normal system gear extend pressure resets the bypass valves to NORMAL.



LANDING GEAR SELECTOR/BYPASS VALVE
(SHOWN WITH GEAR SELECTED DOWN)

▨ PRESSURE

○ ○ ○ RETURN

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LANDING GEAR CONTROL SYSTEM - LANDING GEAR SELECTOR/BYPASS VALVES - FUNCTIONAL DESCRIPTION

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LANDING GEAR CONTROL SYSTEM - FUNCTIONAL DESCRIPTION

General

The landing gear control system controls extension and retraction of the landing gear and the tail skid (if applicable).

The landing gear control system also includes lock and unlock of the hydraulic strut for the semi-levered main landing gear.

Lever Lock

When the airplane is in the air, two air/ground relays in the ELMS supply a ground to energize the lever lock solenoid. This releases the lock on the landing gear control lever and permits you to move the control lever UP.

Retraction

When you put the landing gear control lever UP, two switches in the landing gear control lever module supply power to auto-off relays in ELMS. The auto-off relays supply the power to UP solenoid in each of the landing gear selector/bypass valves.

Hydraulic pressure then goes through the selector/bypass valves to the UP lines for retraction of the landing gear and the tail skid (if applicable).

Another switch in the landing gear control lever module resets the alternate extension system MLG and NLG door release/safety valve modules.

Auto-Off

After gear retraction, the PSEUs send signals to the HYDIM cards L and R. After a ten second delay, the HYDIM cards energize the auto-off relays in the ELMS.

This removes electrical power from the UP solenoid and the selector valve moves to OFF to remove pressure from the landing gear.

NOTE: Auto-of f remains engaged until gear extension is commanded, or a failure is detected in the landing gear control circuits, or a gear indicates that it is no longer up and locked, or a door indicates that it is no longer closed. Once a fault is detected and the gear retracted, the gear remains pressurized for the remainder of the flight. This function is controlled by HYDIM.

Extension

When you put the landing gear lever DOWN, four switches in the landing gear lever module supply the electrical power and the ground to the DOWN solenoid in each of the landing gear selector valves.

Hydraulic pressure then goes through the landing gear selector/bypass valves to the DOWN lines for extension of the landing gear and the tail skid (if applicable).

Down pressure stays on as long as the landing gear lever is DOWN and the center hydraulic system is pressurized.

ARO 001-013, 017-999

Another switch in the landing gear control lever module supplies a signal the weather radar system. See the weather radar system section for more information. (SECTION 34-43)

ARO ALL

Semi-Lever Gear

The semi-levered gear hydraulic strut on each main landing gear is electrically controlled and hydraulically actuated to lock mid-stroke to facilitate the semi-levered gear function during takeoff rotation. The hydraulic strut is commanded to unlock for landing and for stow during extension and retraction. During touchdown the hydraulic strut is unlocked and acts as a damper.

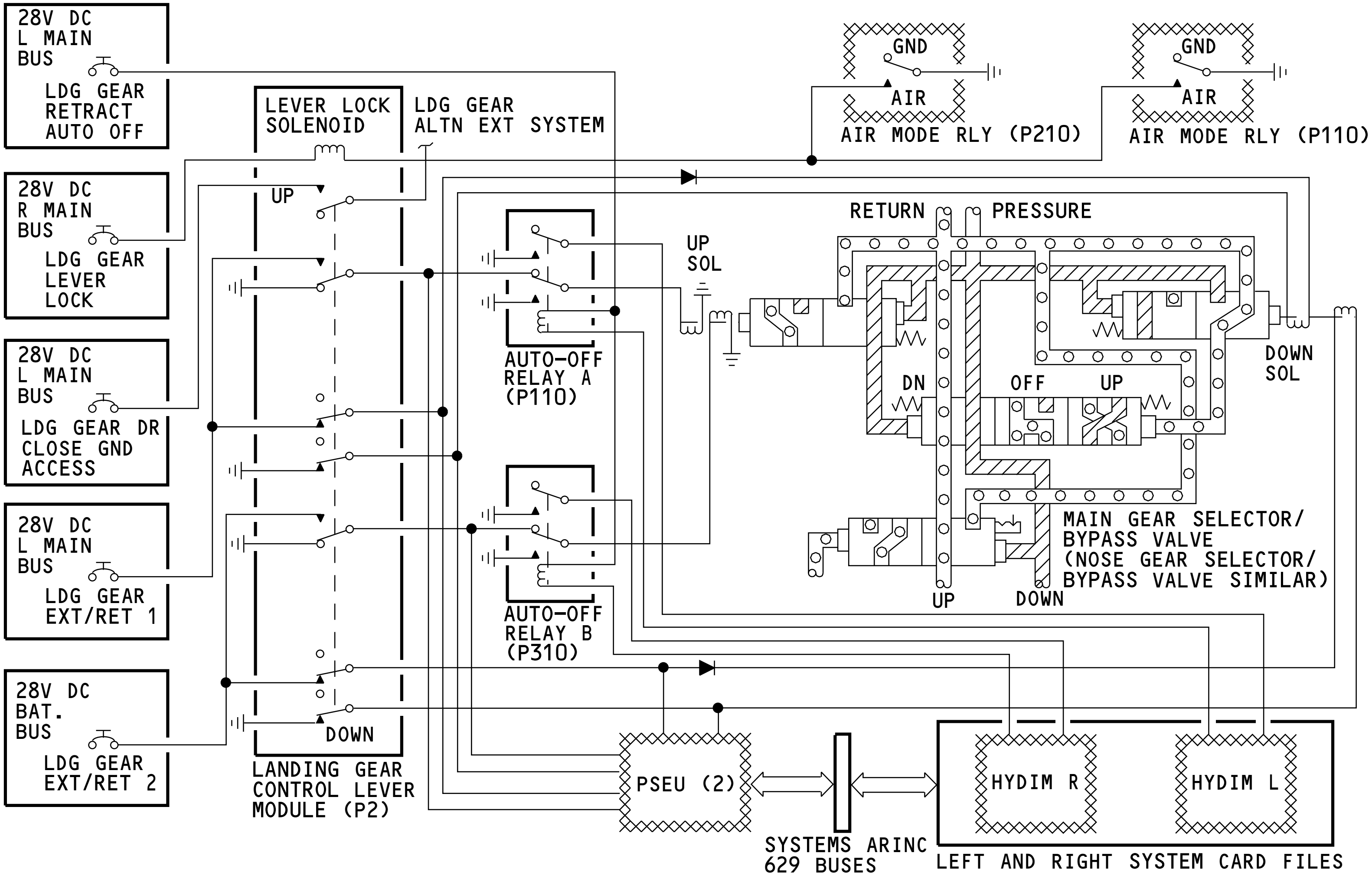
The semi-levered gear hydraulic strut is commanded to lock when the PSEU senses that all of these conditions have occurred:

- The left and right engines are running
- The flaps are in the Takeoff position
- The airplane is on the ground
- Either throttle is at or above 40 degrees.

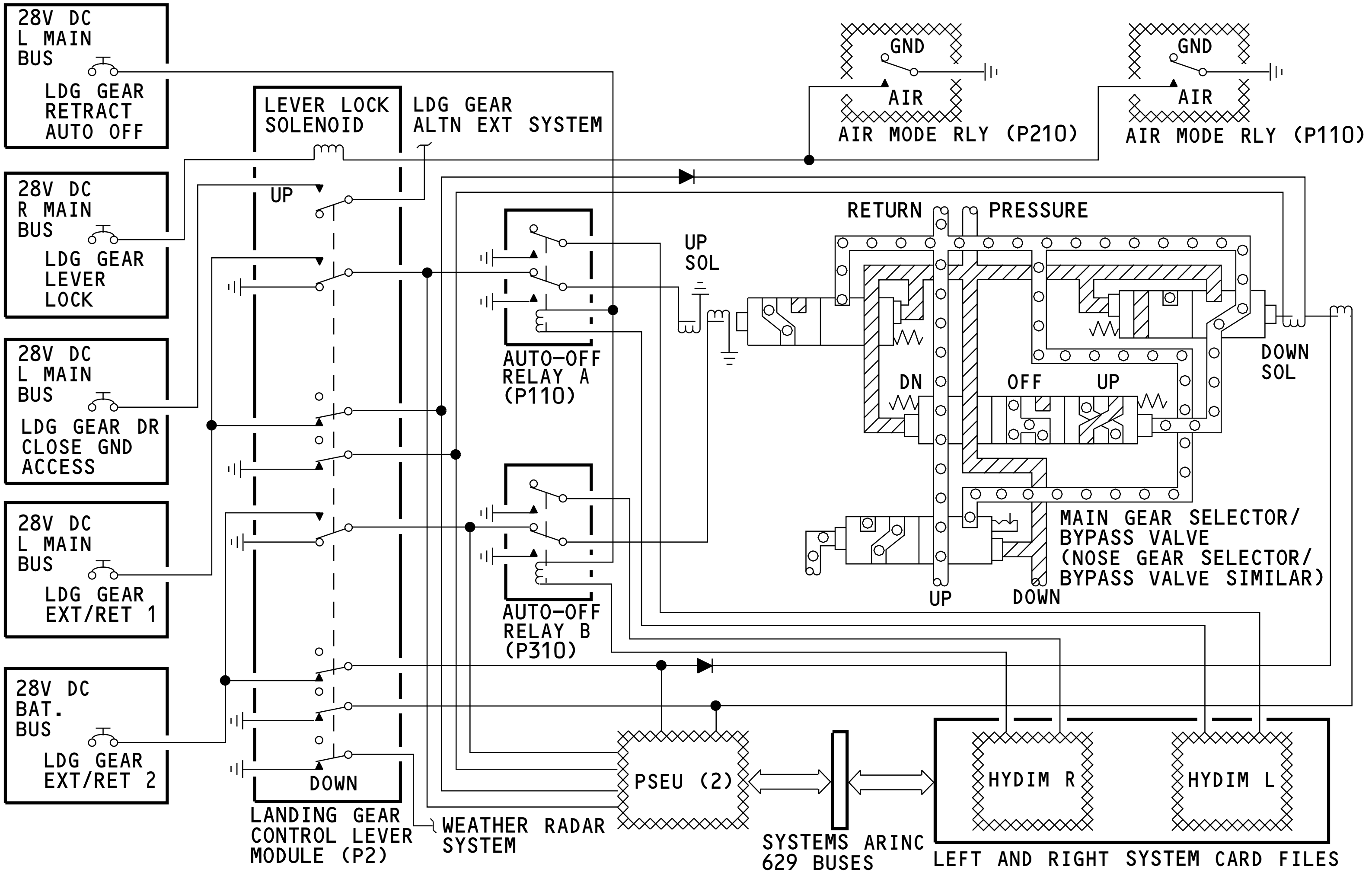
LANDING GEAR CONTROL SYSTEM - FUNCTIONAL DESCRIPTION

The semi-levered gear hydraulic strut is commanded to unlock when the PSEU senses any one of these conditions have occurred:

- The airplane is in the air, or
- Both throttles are less than 40 degrees and the airspeed is greater than 60 knots, or
- Either engine is not running and the airspeed is less than 60 knots, or
- Both engines are not running, or
- The flaps are not in the Takeoff position.



LANDING GEAR CONTROL SYSTEM - FUNCTIONAL DESCRIPTION



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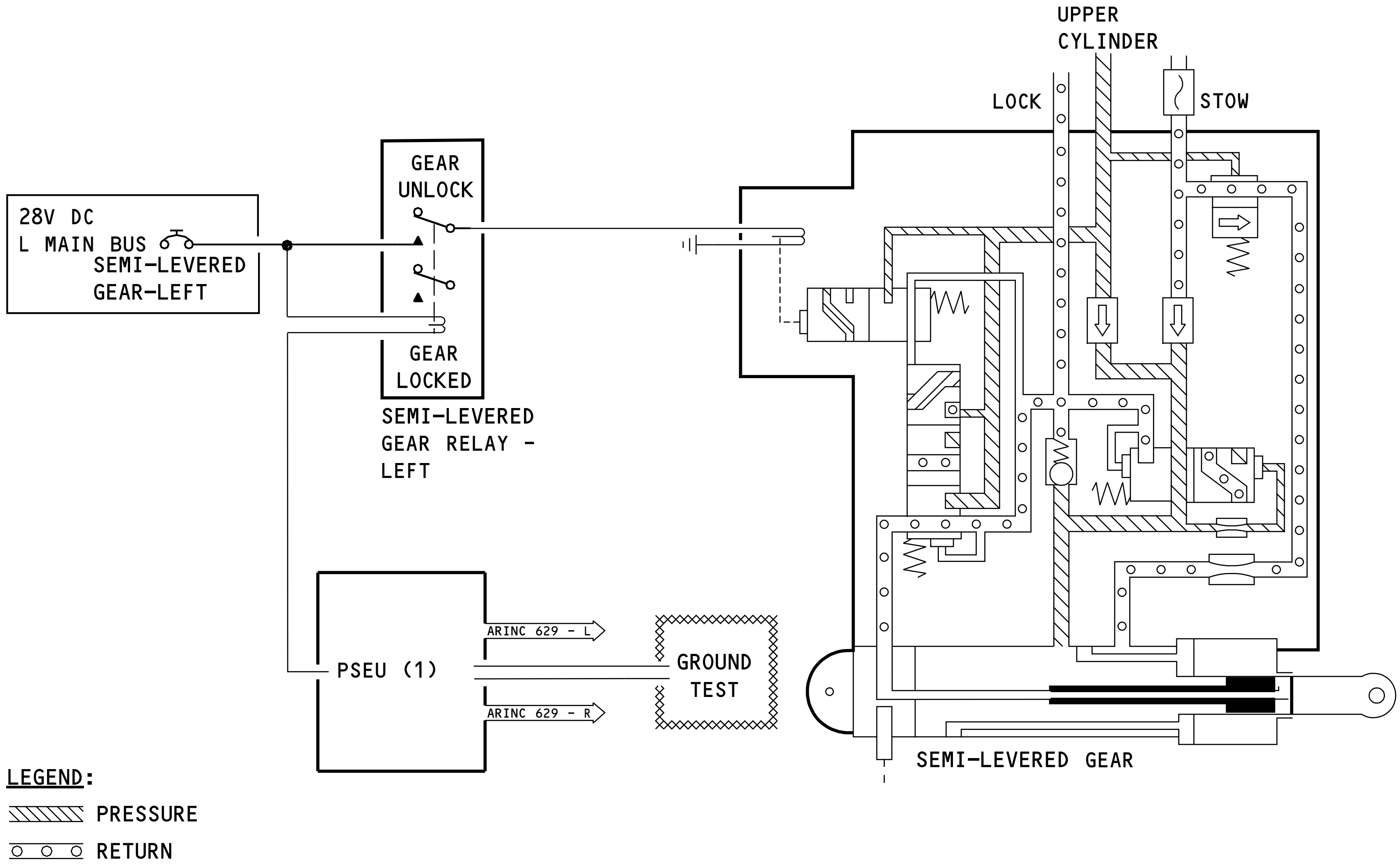
LANDING GEAR CONTROL SYSTEM - FUNCTIONAL DESCRIPTION



LEFT MAIN GEAR
(RIGHT MAIN GEAR IS EQUIVALENT)

M96225 S0000101254_V2

LANDING GEAR CONTROL SYSTEM - SEMI-LEVER GEAR - FUNCTIONAL DESCRIPTION

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MLG EXTENSION-RETRACTION - INTRODUCTION

Purpose

The MLG extension and retraction system extends and retracts the main landing gear and opens and closes the main landing gear doors.

The extension and retraction system also tilts the MLG truck forward wheels up when the gear is in the extended position in flight. It tilts the MLG truck forward wheels down during gear retraction.

A semi-levered main landing gear uses an electrically controlled and hydraulically actuated hydraulic strut, in place of the truck positioner actuator, to increase the length of the main landing gear during takeoff. This provides an increased angle of attack on takeoff rotation for better takoff performance and also does the tilt function of the MLG truck.

Components

Each MLG has these extension and retraction components:

- MLG door-operated sequence valve
- MLG uplock assembly and actuator
- MLG retract actuator
- MLG drag brace-operated sequence valve
- MLG uplock-operated sequence valve
- MLG door priority/relief valve
- MLG door actuator
- MLG door uplock hook and door lock actuator
- MLG side brace downlock actuator
- MLG drag brace downlock actuator.
- MLG hydraulic strut fuses
- MLG semi-levered gear hydraulic strut

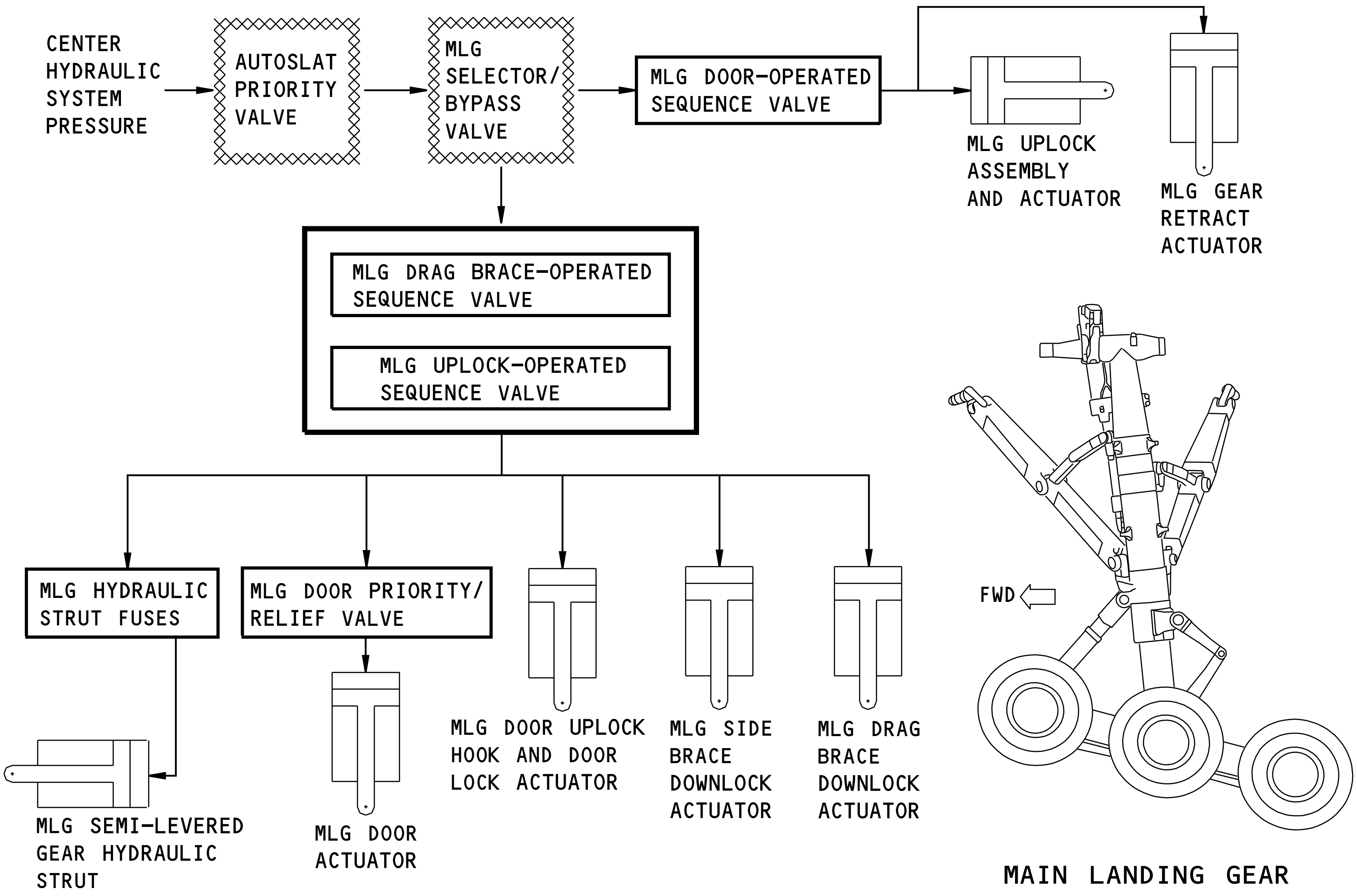
General Description

The center hydraulic system supplies pressure through the autoslat priority valve and the MLG selector/bypass valve to operate the main landing gear. See the leading edge slats section for more information about the autoslat priority valve (SECTION 27-81).

The door-operated sequence valve controls hydraulic pressure to the MLG uplock actuator and the MLG retract actuator.

The MLG drag brace-operated sequence valve and the MLG uplock-operated sequence valve together control hydraulic pressure to these actuators:

- MLG door actuator
- MLG door lock actuator
- MLG side brace downlock actuator
- MLG drag brace downlock actuator.
- MLG semi-levered gear hydraulic strut



M91419 S0000101178_V1

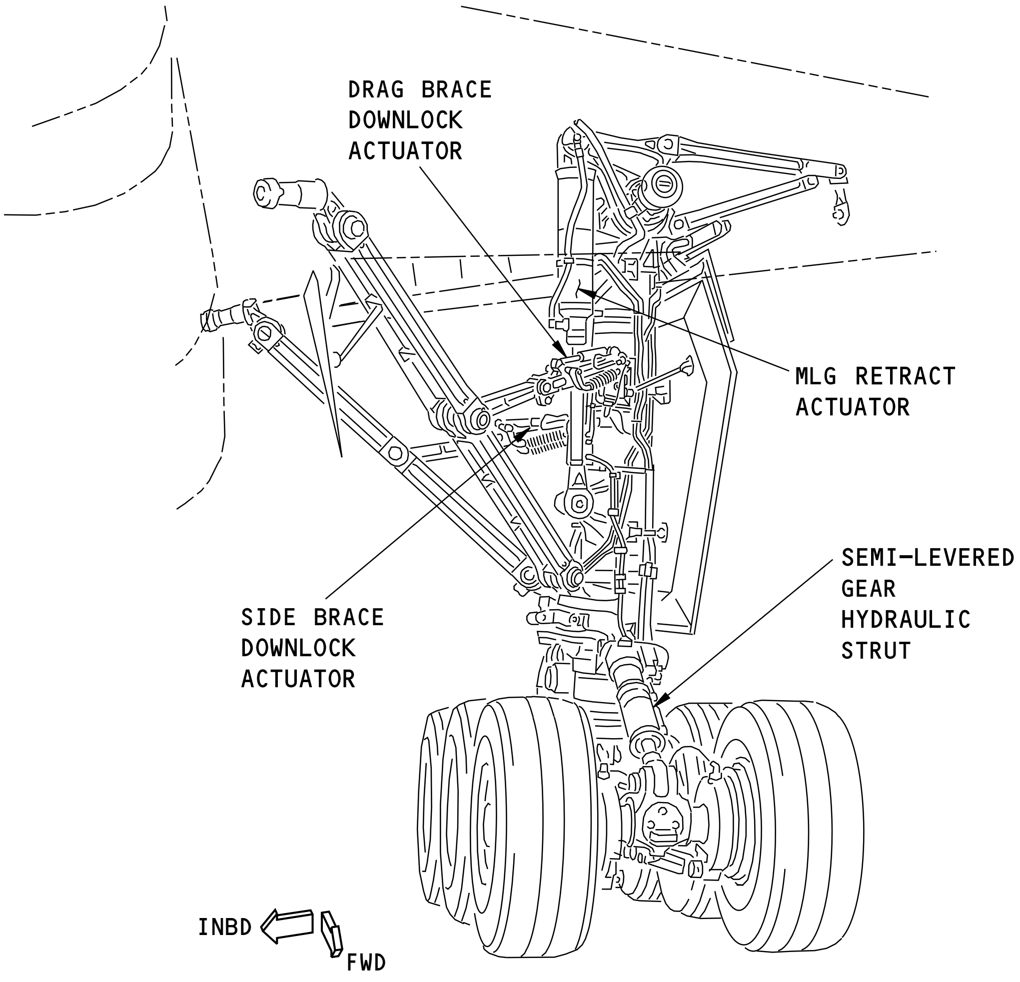
MLG EXTENSION-RETRACTION - INTRODUCTION

MLG EXTENSION-RETRACTION - GEAR COMPONENT LOCATIONS

General

These extension and retraction components are on each MLG:

- Side brace downlock actuator
- Retract actuator
- Drag brace downlock actuator
- Semi-levered gear hydraulic strut.



LEFT MAIN LANDING GEAR

M95283 S0000101281_V1

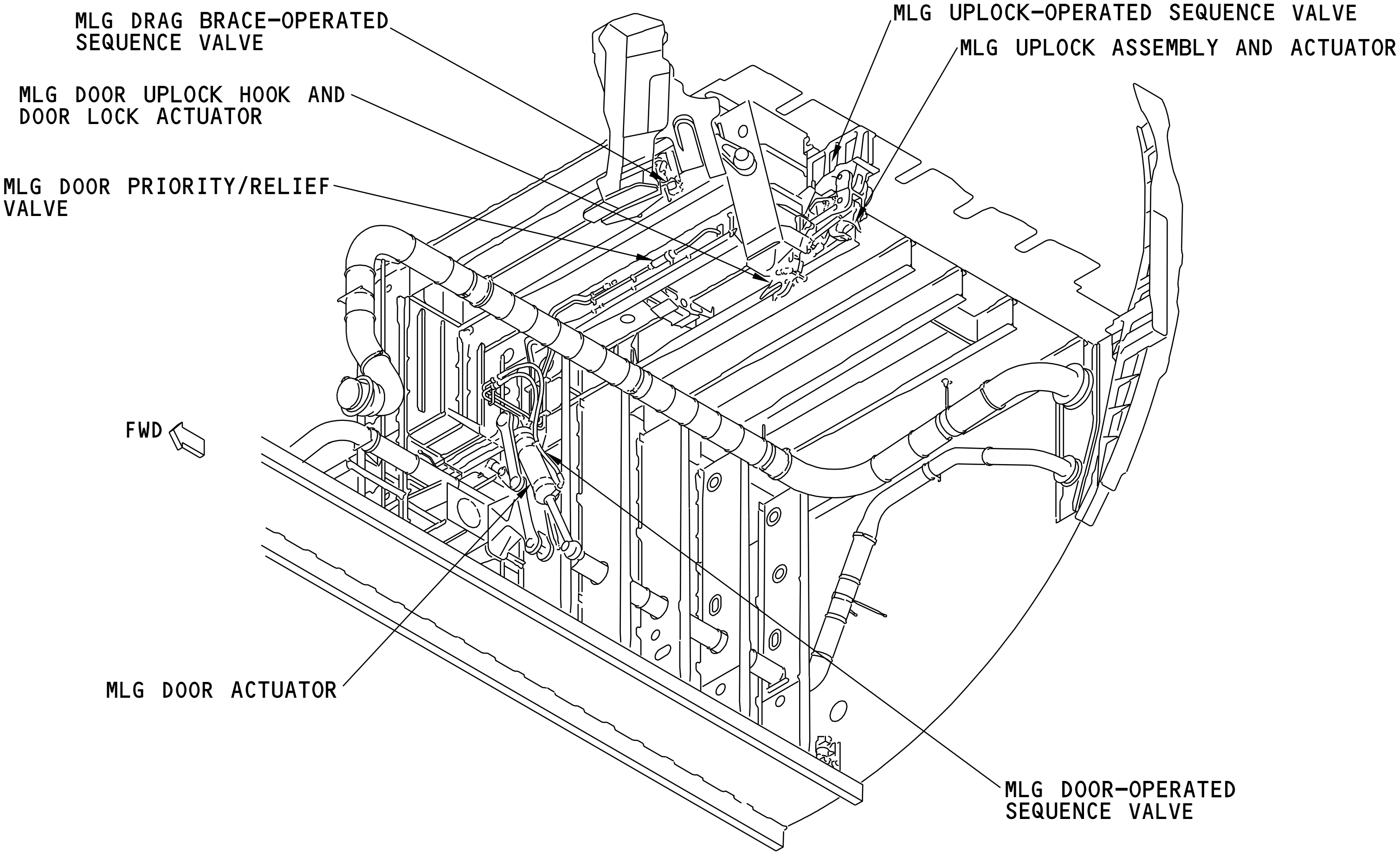
MLG EXTENSION-RETRACTION - GEAR COMPONENT LOCATIONS

MLG EXTENSION-RETRACTION - WHEEL WELL COMPONENT LOCATIONS

General

These components are in each main gear wheel well:

- MLG door priority/relief valve
- MLG door uplock hook and door lock actuator
- MLG drag brace-operated sequence valve
- MLG uplock-operated sequence valve
- MLG uplock assembly and actuator
- MLG door-operated sequence valve
- MLG door actuator.



LEFT MLG WHEEL WELL

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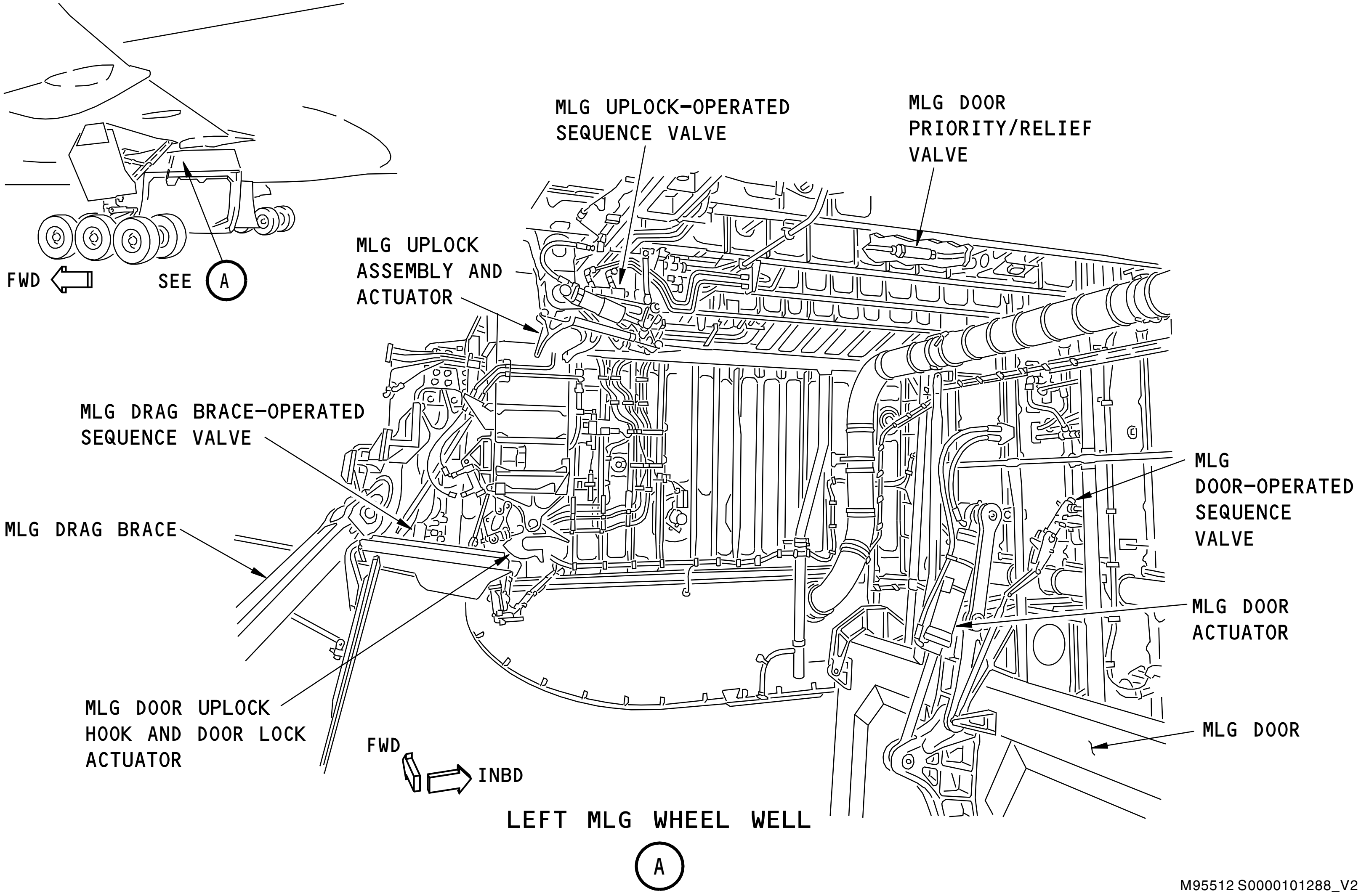
MLG EXTENSION-RETRACTION - WHEEL WELL COMPONENT LOCATIONS



MLG EXTENSION-RETRACTION - WHEEL WELL COMPONENT LOCATIONS

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MLG EXTENSION-RETRACTION - MLG RETRACT ACTUATOR

Purpose

The MLG retract actuator supplies the force to retract the main landing gear.

Physical Description

The retract actuator is a hydraulic piston-type actuator. The actuator retracts to raise the gear and extends when the gear extends. The actuator is not pressurized during gear extension.

A flow restrictor in the retract port union controls the gear extension rate.

Snubbers on the rod end and the head end of the actuator control actuator speed at the ends of the actuator stroke.

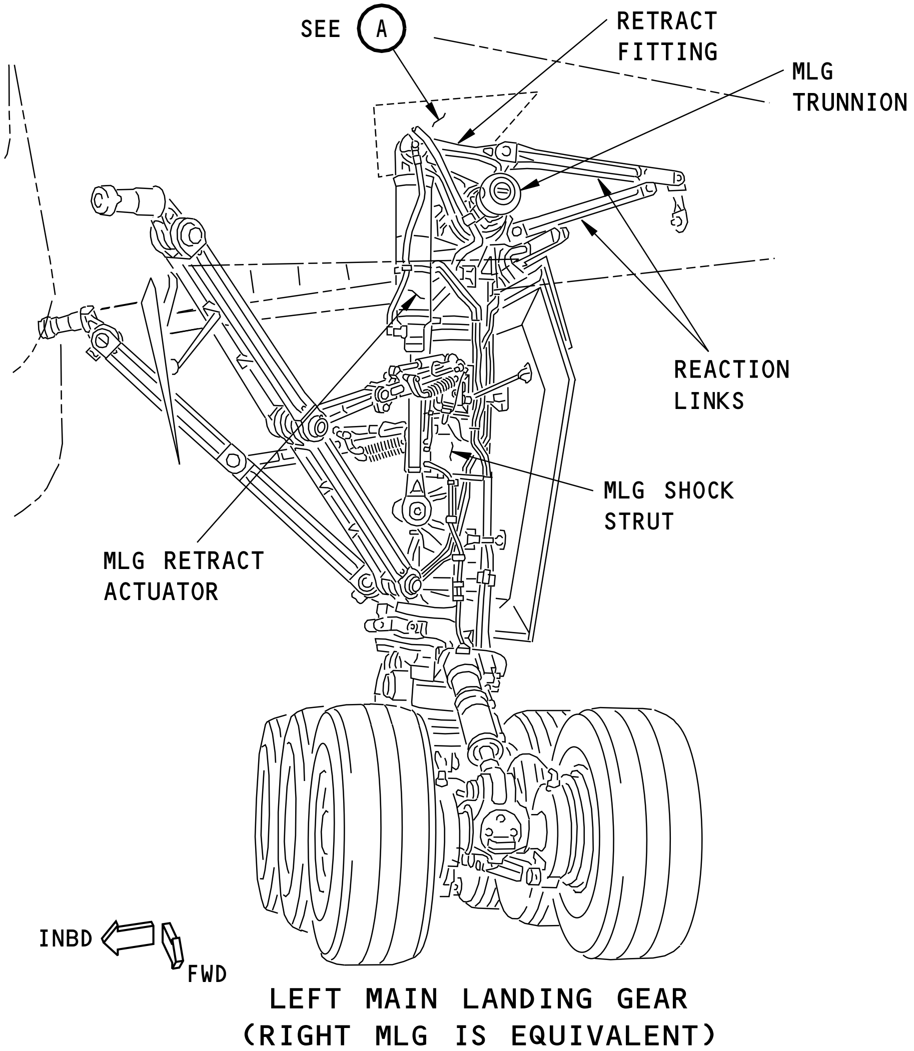
The dry weight of the retract actuator is approximately 240 pounds (109 kilograms).

Location

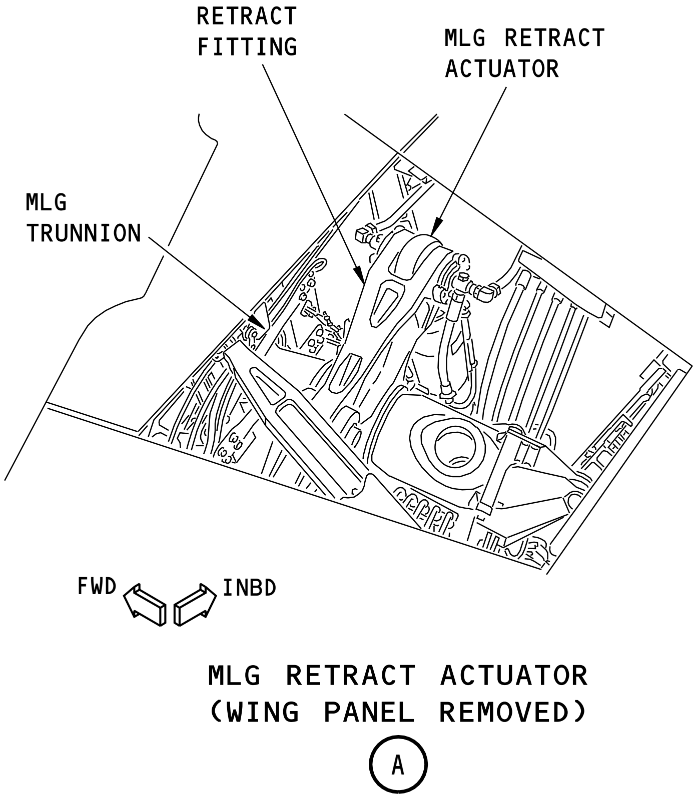
The retract actuator is inboard of the main landing gear shock strut. The rod end attaches to the inboard side of the shock strut. The head end attaches to the retract fitting mounted on the trunnion. Two reaction links connect the retract fitting to the wing rear spar.

Training Information Point

A removable wing panel permits access to the head end of the actuator from above.



LEFT MAIN LANDING GEAR
(RIGHT MLG IS EQUIVALENT)



MLG RETRACT ACTUATOR
(WING PANEL REMOVED)
A

M95210 S0000101295_V1

MLG EXTENSION-RETRACTION - MLG RETRACT ACTUATOR

MLG EXTENSION-RETRACTION - MLG SIDE BRACE AND DRAG BRACE DOWNLOCK ACTUATORS

Purpose

The side brace downlock actuator locks and unlocks the over-center toggles between the side brace lock links during extension and retraction.

The drag brace downlock actuator locks and unlocks the over-center toggles between the drag brace lock links during extension and retraction.

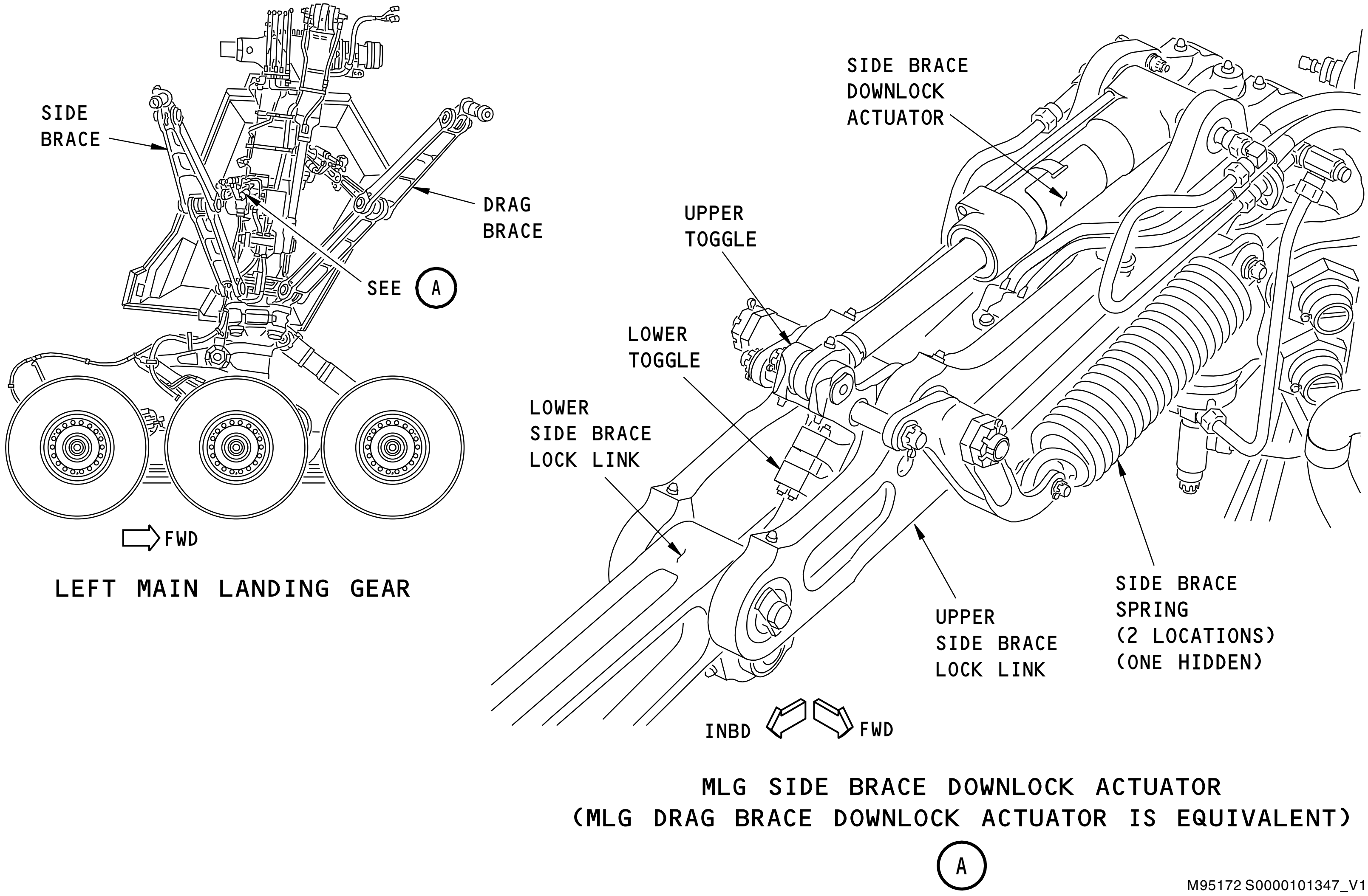
The MLG side brace downlock actuator and the MLG drag brace downlock actuator are identical and interchangeable.

Physical Description

The actuators are hydraulic cylinders. They extend to lock the toggles during gear extension. They retract to unlock the toggles during gear retraction.

Location

The head ends of the actuators attach to the upper lock links. The rod ends attach to the upper toggles.



LEFT MAIN LANDING GEAR

MLG SIDE BRACE DOWNLOCK ACTUATOR
(MLG DRAG BRACE DOWNLOCK ACTUATOR IS EQUIVALENT)

MLG EXTENSION-RETRACTION - MLG SIDE BRACE AND DRAG BRACE DOWNLOCK ACTUATORS

MLG EXTENSION-RETRACTION - MLG DOOR ACTUATOR AND MLG DOOR-OPERATED SEQUENCE VALVE

Purpose

The MLG door actuator opens and closes the main gear door during gear extension and retraction.

The MLG door-operated sequence valve controls hydraulic flow to the main gear uplock actuator and to the MLG retract actuator.

Physical Description

The MLG door actuator is a hydraulic piston-type actuator. The actuator extends to open the main gear door and retracts to close the MLG door. Flow restrictors in the extend and retract port unions control the rate of door operation. Snubbers in the rod end and head end of the actuator control actuator speed at the ends of the actuator travel. The dry weight of the MLG door actuator is approximately 72 pounds (32.7 kg).

The MLG door-operated sequence valve is a two-position valve - DOOR OPEN and DOOR NOT OPEN. A mechanical linkage from the main landing gear door operates the sequence valve. The mechanical linkage includes these components:

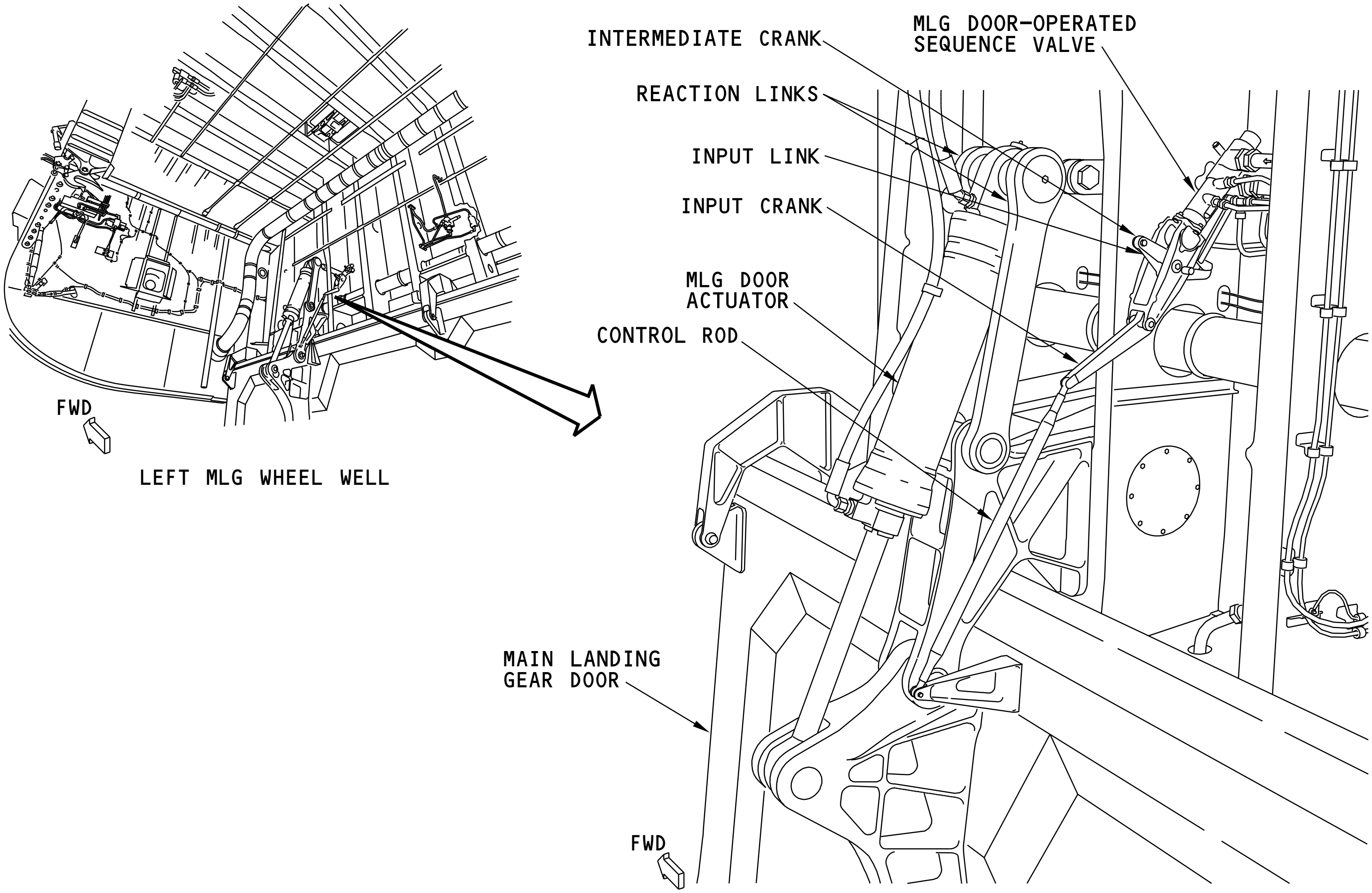
- Control rod
- Input crank
- Input link
- Intermediate crank
- Valve link (not shown).

The MLG door-operated sequence valve weighs 4.6 pounds (2.1 kg).

Location

The head end of the MLG door actuator attaches to reaction links which attach to the keel beam. The rod end attaches to the landing gear door.

The MLG door-operated sequence valve is on the keel beam aft of the MLG door actuator.



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MLG EXTENSION-RETRACTION - MLG DOOR ACTUATOR AND MLG DOOR-OPERATED SEQUENCE VALVE

MLG EXTENSION - MLG DOOR UPLOCK HOOK AND MLG DOOR LOCK ACTUATOR

Purpose

The MLG door uplock hook and MLG door lock actuator are part of the door uplock assembly.

The door uplock hook holds the main gear door closed.

The door lock actuator locks and unlocks the door uplock hook during landing gear door operation.

Physical Description

The uplock hook uses over-center locking to hold the door closed. Two springs keep the hook in this position.

The door lock actuator is a piston-type actuator. It retracts to unlock the uplock hook and extends to lock the uplock hook.

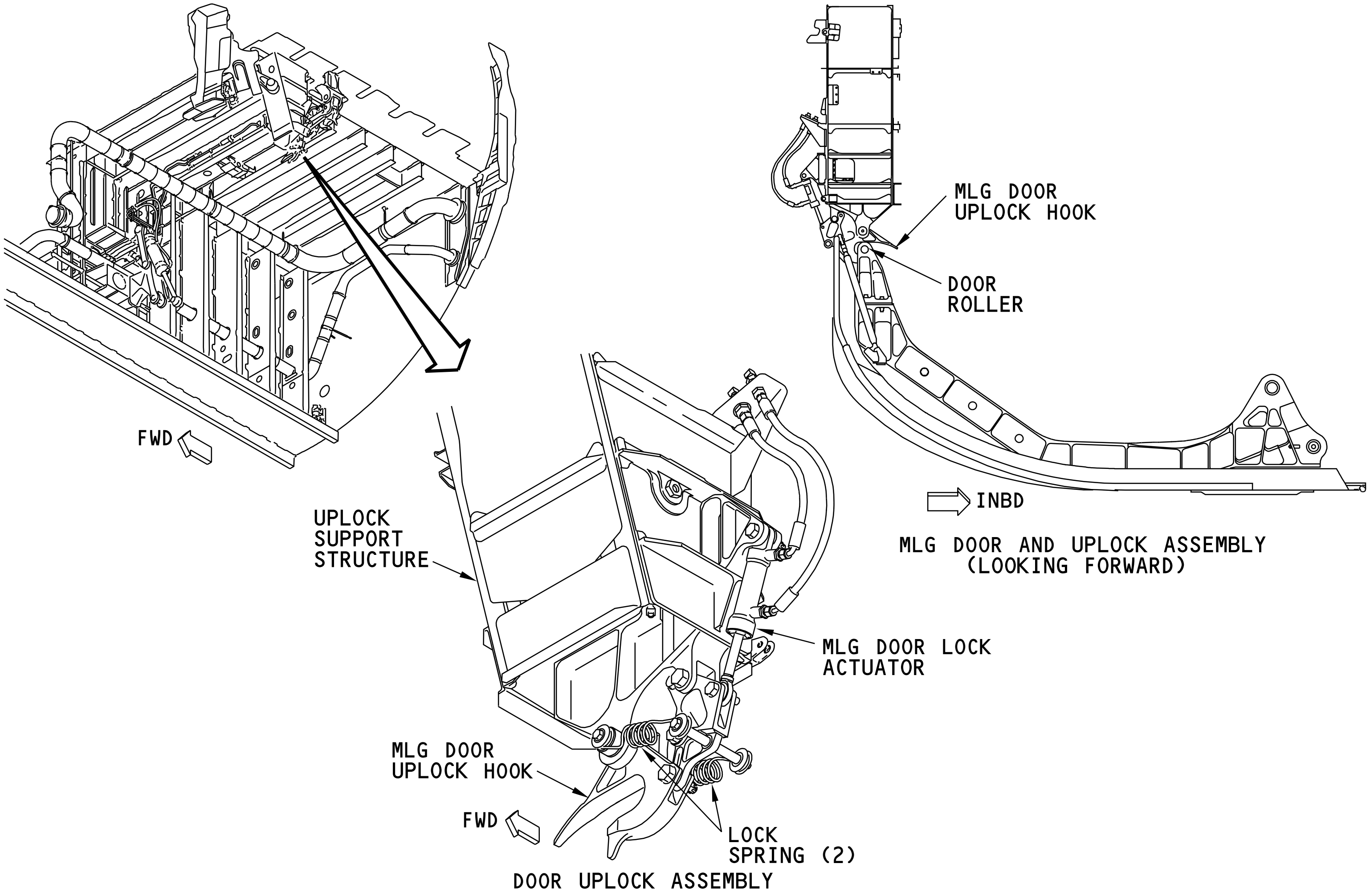
Location

The door uplock assembly is on the uplock support structure. This structure is on the outboard side of the wheel well and attaches to the wheel well ceiling.

Functional Description

To open the MLG door, the door lock actuator moves the door uplock hook to the unlocked position. This permits the roller on the door to move out of the hook and the door to open.

When the door closes, the roller on the door engages the uplock hook. The motion of the door and pressure in the door lock actuator drive the uplock hook to the overcenter locked position.



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MLG EXTENSION - MLG DOOR UPLOCK HOOK AND MLG DOOR LOCK ACTUATOR

MLG EXTENSION-RETRACTION - MLG UPLOCK ASSY, UPLOCK ACTUATOR, AND UPLOCK-OPERATED SEQUENCE VALVE

Purpose

The MLG uplock assembly holds the main landing gear in the UP position.

The MLG uplock actuator unlocks the main gear uplock assembly during gear extension.

The MLG uplock-operated sequence valve controls main landing gear door close operation.

Physical Description

The MLG uplock assembly uses over-center locking to keep the main landing gear up and locked. Two springs hold the uplock hook in this position.

The MLG uplock actuator is a two-position piston-type actuator. It retracts to unlock the gear and extends during gear uplock operation.

The MLG uplock-operated sequence valve is a two-position sequence valve (LOCKED AND UNLOCKED). A mechanical linkage from the uplock mechanism moves the sequence valve.

Location

The MLG uplock assembly is on the ceiling on the outboard edge of each wheel well. The uplock assembly is aft of the door uplock assembly.

The MLG uplock actuator attaches horizontally above the MLG uplock mechanism.

The MLG uplock-operated sequence valve attaches vertically above the MLG uplock mechanism.

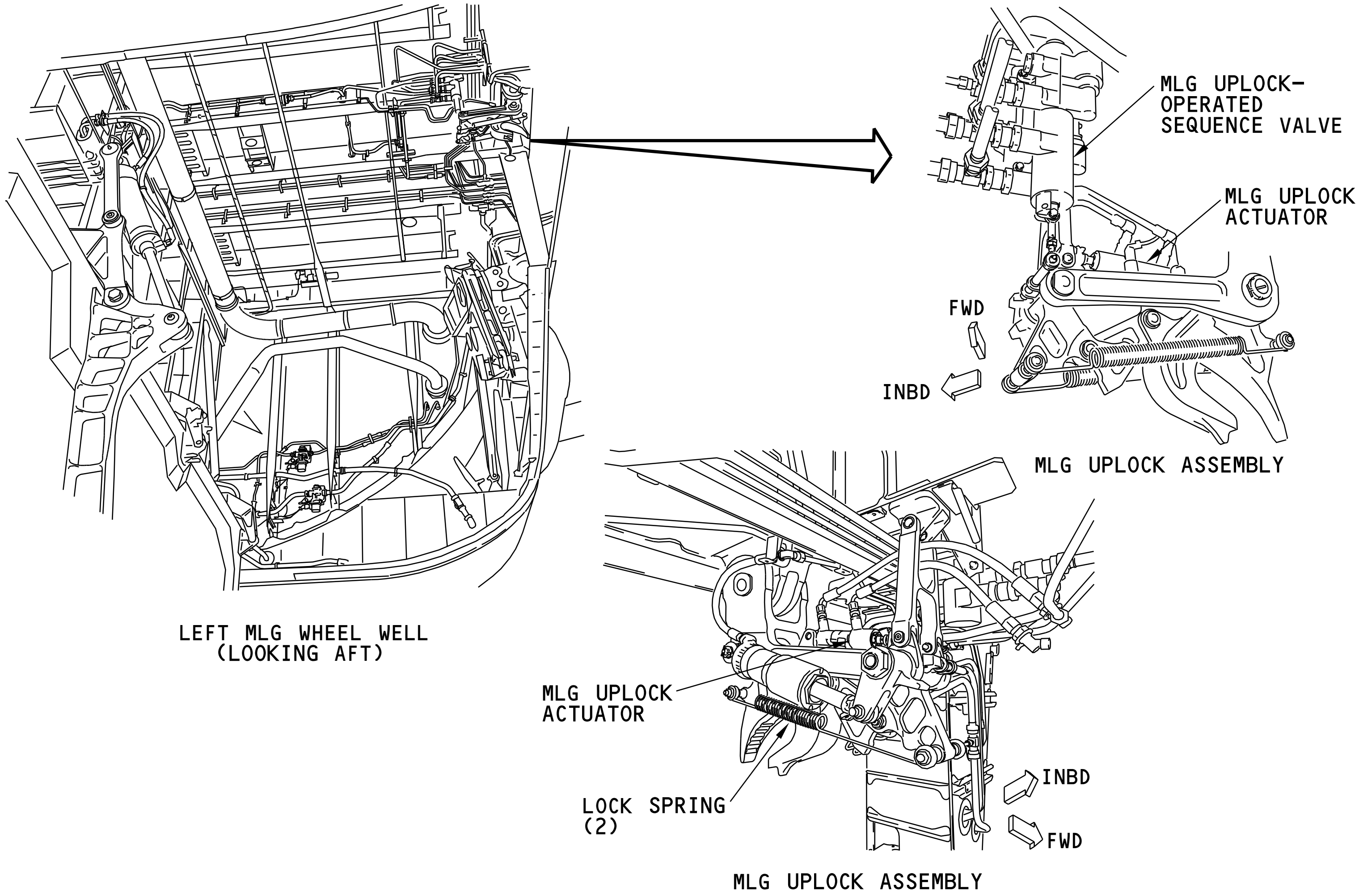
Functional Description

During gear retraction, the roller on the MLG shock strut engages the hook in the uplock assembly. The motion of the gear starts to move the uplock mechanism to the over-center locked position. This also moves the MLG uplock-operated sequence valve to the lock position.

The MLG uplock-operated sequence valve then supplies pressure to the extend side of the MLG uplock actuator. This makes sure the uplock mechanism moves to the over-center locked position.

Lock springs hold the mechanism in this position.

During gear extension, the MLG uplock actuator moves the uplock mechanism to the unlocked position. This releases the gear from the up and locked position.



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MLG EXTENSION-RETRACTION - MLG UPLOCK ASSY, UPLOCK ACTUATOR, AND UPLOCK-OPERATED SEQUENCE VALVE

MLG EXTENSION-RETRACTION - MLG DRAG BRACE-OPERATED SEQUENCE VALVE

Purpose

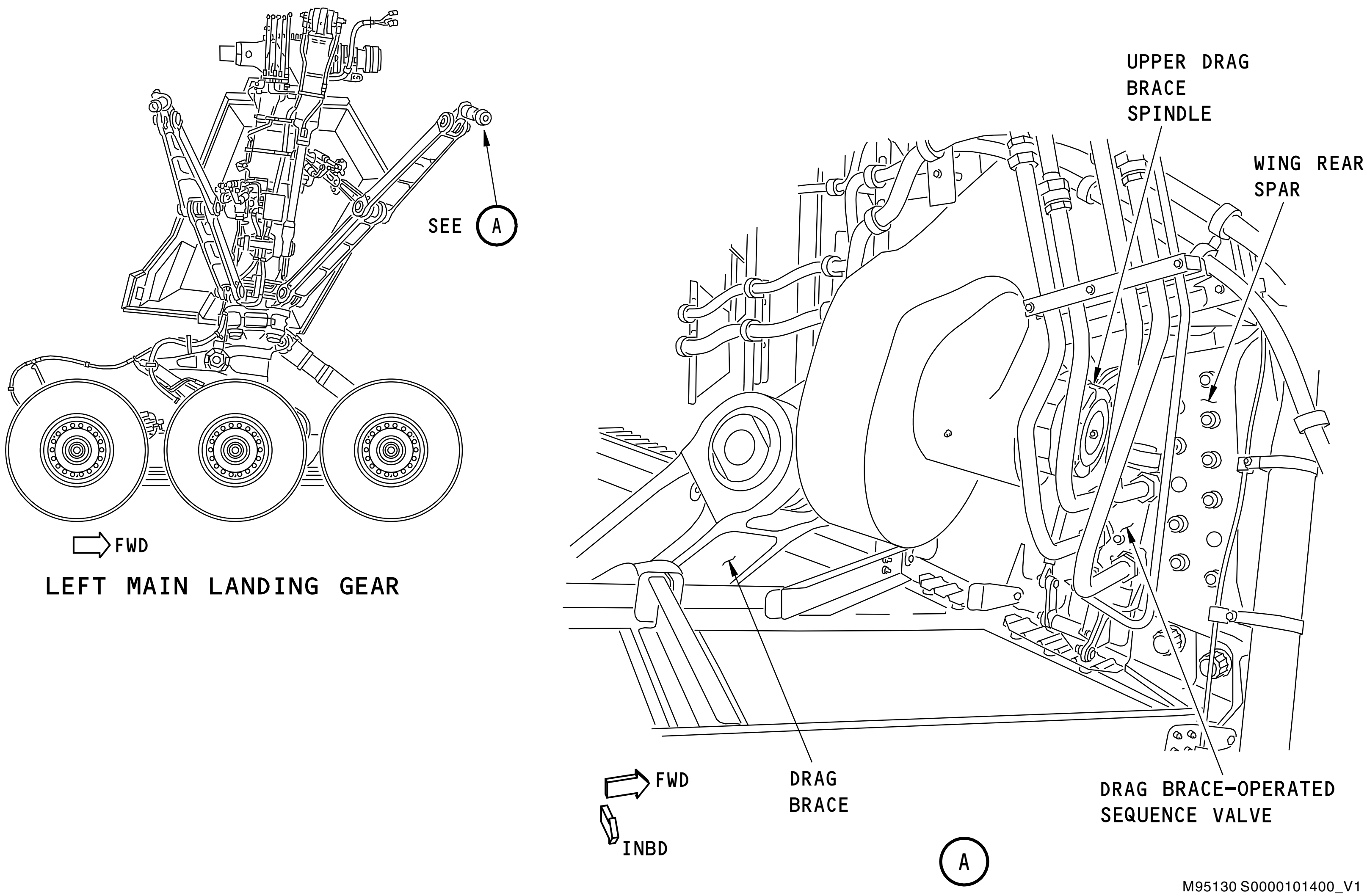
The MLG drag brace-operated sequence valve controls MLG door close operation during landing gear extension.

Physical Description

The MLG drag brace-operated sequence valve has two positions: GEAR DOWN and GEAR NOT DOWN. Linkage from the upper drag brace spindle moves the valve.

Location

The MLG drag brace-operated sequence valve is in the MLG wheel well on the wing rear spar.



MLG EXTENSION-RETRACTION - MLG DRAG BRACE-OPERATED SEQUENCE VALVE

MLG EXTENSION-RETRACTION - SLG HYDRAULIC STRUT FUSES

Purpose

The SLG hydraulic strut fuses prevent loss of center hydraulic system fluid if there is a leak in the hydraulic lines to the SLG hydraulic strut.

There are fuses in the tilt and stow hydraulic pressure lines to the SLG hydraulic strut.

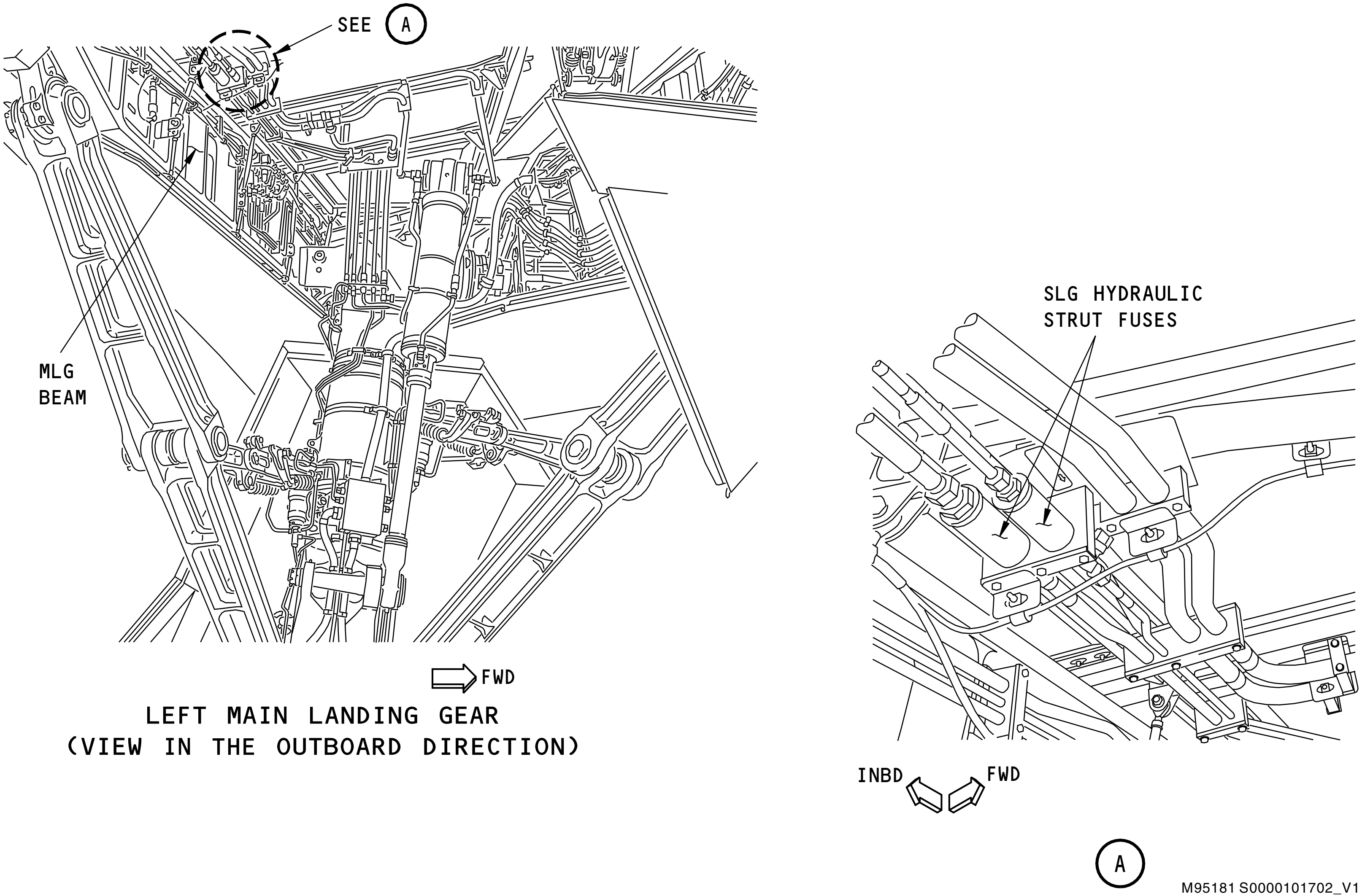
Location

The hydraulic strut fuses are above the MLG truck near the main landing gear beam.

Training Information Point

The MLG Tilt fuse was changed from a volumetric fuse (777-200/300) to a flow rate fuse (777-300ER). During ground operations the Semi-Lever Gear Hydraulic Strut (777-300ER) can draw up to 6 gpm continuously.

The MLG Stow fuse volumetric fusing requirements were also changed due to an increase in the Tilt to Stow exchange volume for the Semi-Lever Gear Hydraulic Strut as opposed to the truck positioner actuator used for other 777 models.



LEFT MAIN LANDING GEAR
(VIEW IN THE OUTBOARD DIRECTION)

A

MLG EXTENSION-RETRACTION - SLG HYDRAULIC STRUT FUSES

MLG EXTENSION-RETRACTION - SLG HYDRAULIC STRUT

Purpose

The semi-levered gear (SLG) hydraulic strut moves the main landing gear truck forward wheels up and locks in this position to effectively lengthen the main landing gear and provide an increased angle of attack during takeoff rotation.

The hydraulic strut operates as a truck positioner actuator to move the main landing gear truck to approximately 11 degrees forward wheels up (TILT) when the airplane is in the air and the landing gear is down and locked. The strut provides damping during touchdown.

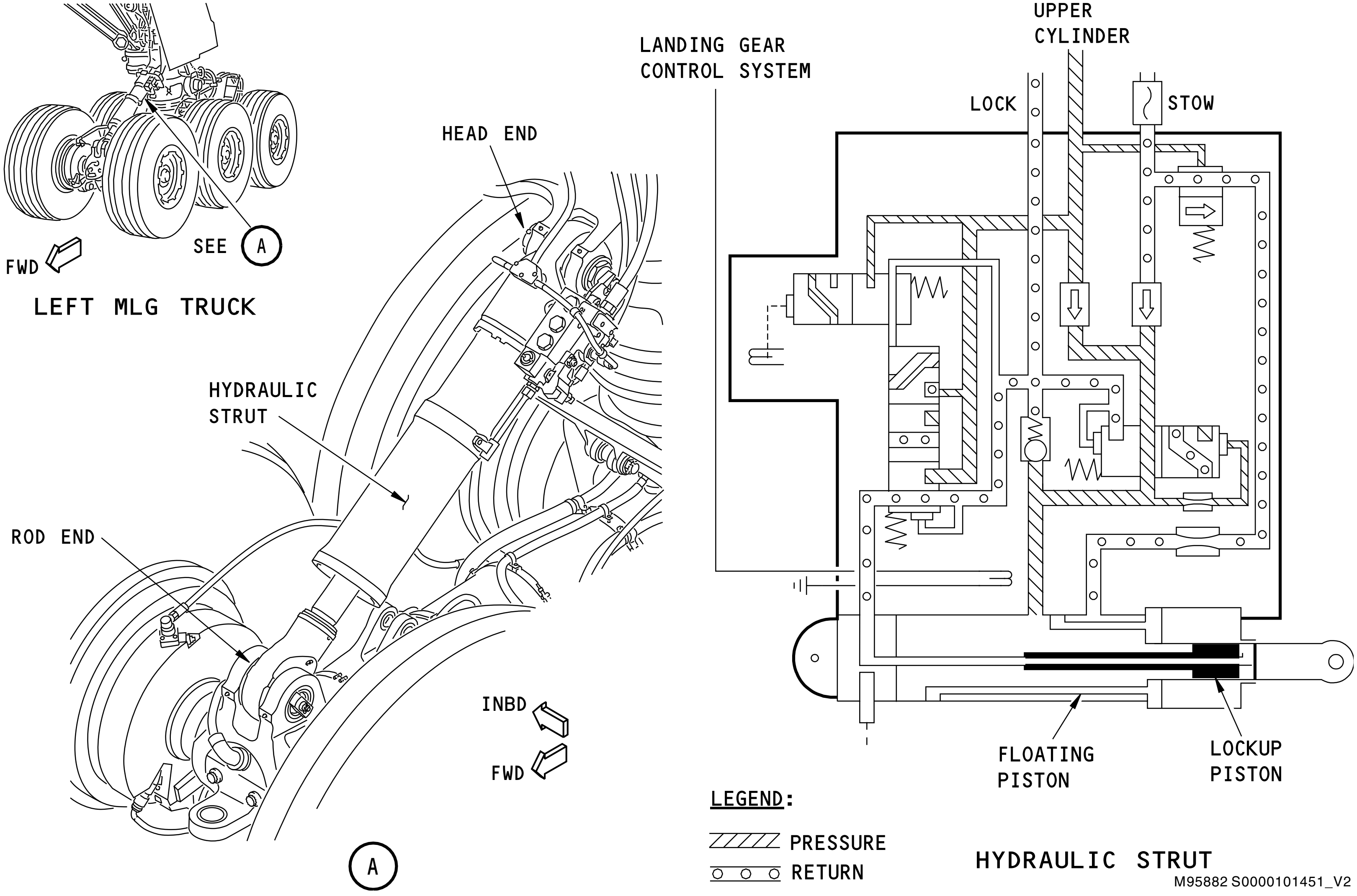
The hydraulic strut also moves the truck to approximately 5 degrees forward wheels down (STOW) during gear retraction. The gear stays in this position during flight.

Physical Description

The SLG hydraulic strut has a lockup piston, a piston rod, and a floating piston. The floating piston can move between stops in the barrel of the strut. The lockup piston provides a hydraulic lock for the semi-levered gear tilt position during takeoff rotation to prevent strut extension past the tilt length.

Location

The SLG hydraulic strut is on the forward end of the MLG truck. The head end attaches to the main gear shock strut. The rod end attaches to a bracket on the forward end of the MLG truck beam.



MLG EXTENSION-RETRACTION - SLG HYDRAULIC STRUT

MLG EXTENSION-RETRACTION - SLG HYDRAULIC STRUT - FUNCTIONAL DESCRIPTION

General

The semi-levered gear (SLG) hydraulic strut retracts to move the MLG truck to the TILT position and extends to move the MLG truck to the STOW position. In the LOCKED position a hydraulic lock holds the strut in the TILT position during takeoff rotation to extend the length of the main landing gear. When the landing gear is commanded up, the hydraulic lock is removed, and the hydraulic strut extends to the STOW position.

Tilt Position

When landing gear down is commanded and the airplane is in the air, regulated hydraulic pressure goes to the two sides of the floating piston. When the landing gear is approximately 20 degrees from down, the MLG drag brace operated sequence valve removes Stow pressure and applies Tilt pressure to the hydraulic strut. This retracts the hydraulic strut which moves the truck to approximately 11 degrees forward wheels up (airplane in the air).

A relief valve opens to release hydraulic strut pressure increases caused by thermal expansion and touch down loads.

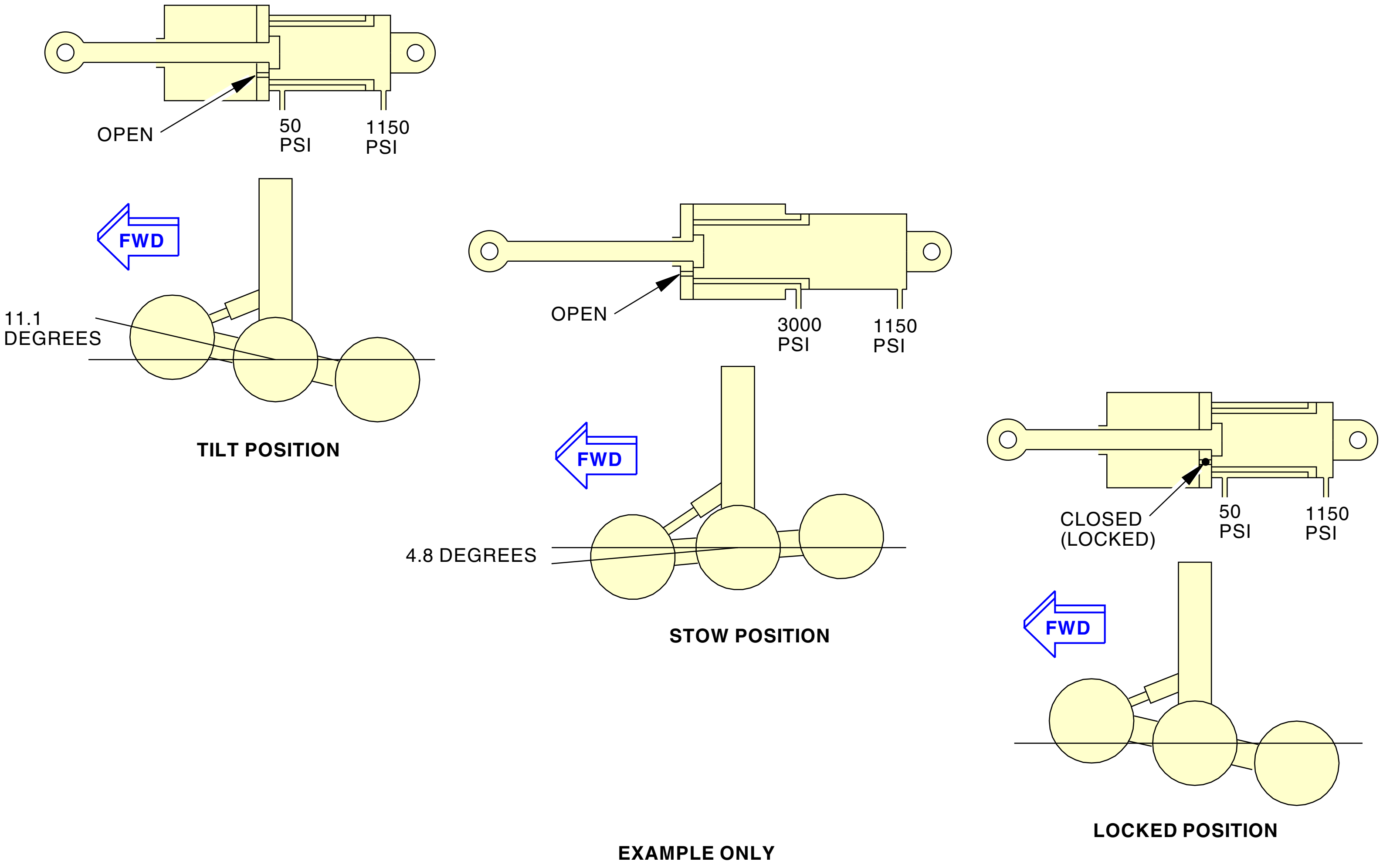
Locked Position

When the hydraulic strut is commanded to lock the solenoid on the strut is energized to hydraulically lock the lockup piston, piston rod, and the floating piston. This will allow the hydraulic strut to compress freely but it cannot extend past the tilt stroke length.

Stow Position

During gear retraction, hydraulic pressure is removed from the Tilt line and is applied to the Stow line by the door operated sequence valve. The pressure goes between the floating piston and the head side of the piston rod. This makes the floating piston, piston rod, and lockup piston move to touch the stops on the cylinder rod end. This moves the truck to approximately 5 degrees forward wheels down position. Regardless of the electrical lockup command, the Semi-Lever Gear will unlock when Tilt pressure is removed. This prevents any delay in gear retraction if the Hydraulic struts have not been commanded to unlock when gear up is commanded.

After the landing gear is up and locked, pressure is removed from the Stow line when the uplock operated sequence valve moves to the locked position. The fluid is then trapped in the hydraulic strut which keeps the gear in the STOW position.



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MLG EXTENSION-RETRACTION - SLG HYDRAULIC STRUT - FUNCTIONAL DESCRIPTIO

MLG EXTENSION - RETRACTION - MLG DOOR PRIORITY/RELIEF VALVE

Purpose

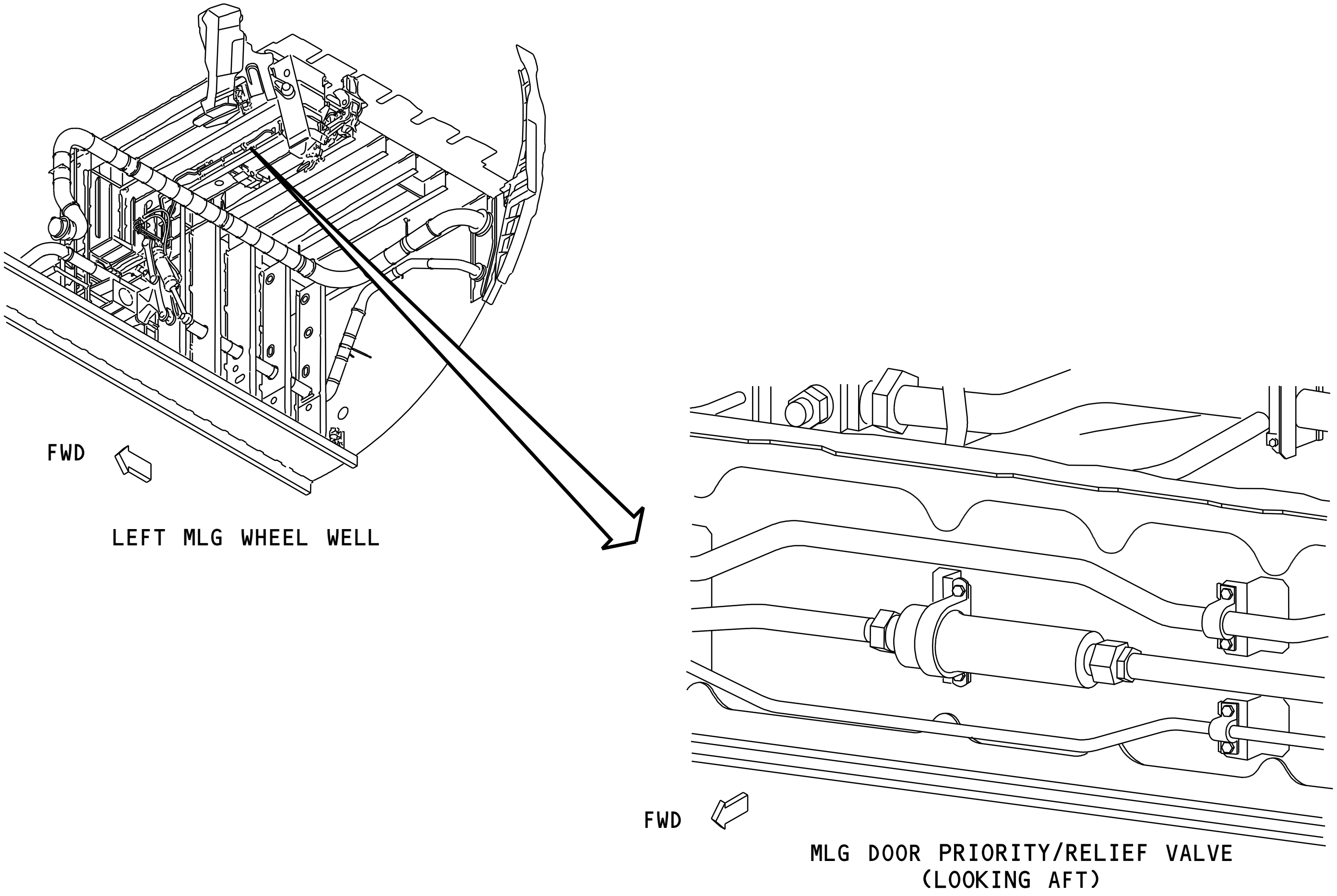
The MLG door priority/relief valve puts a limit on the quantity of pressure to the MLG door actuator during gear retraction. The MLG door priority/relief valve makes sure that sufficient pressure goes to the truck positioner actuator to move the truck to the STOW position before the gear goes into the wheel well. The MLG door priority/relief valve makes sure that sufficient pressure goes to the door uplock actuator to move the uplock hook to the STOW position.

Location

A MLG door priority relief valve is on the ceiling of each MLG wheel well.

Functional Description

The MLG door priority/relief valve operates by pressure. When pressure upstream of the valve goes below 2000 psi, the valve limits door open pressure to the MLG door actuator.



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MLG EXTENSION - RETRACTION - MLG DOOR PRIORITY/RELIEF VALVE

MLG EXTENSION-RETRACTION - RETRACTION SEQUENCE

General

MLG retraction is the same for both left and right main gears.

These are the start positions:

- MLG - DOWN and LOCKED
- MLG door - CLOSED and LOCKED
- SLG hydraulic strut - TILT
- MLG drag brace-operated sequence valve - DOWN
- MLG uplock-operated sequence valve - UNLOCKED
- MLG door-operated sequence valve - NOT OPEN.

Control

When you move the landing gear lever to the UP position, the MLG selector/bypass valve moves to the UP position. Hydraulic pressure then goes to the retract lines.

Gear Unlock - Truck Tilt

The pressure goes to the MLG drag brace and MLG side brace downlock actuators. These actuators start to retract to unlock the gear downlocks.

Pressure also goes through the MLG drag brace-operated sequence valve and the MLG uplock-operated sequence valve. This pressure extends the SLG hydraulic strut to the STOW position.

Door Opens

Pressure through the sequence valves also retracts the MLG door lock actuator to unlock the main gear door. The MLG door actuator gets extend pressure through the MLG door priority/relief valve. The MLG door starts to open.

Gear Retracts

When the MLG door is almost all the way open, the MLG door-operated sequence valve moves to OPEN. Pressure then goes to the MLG retract actuator to retract the gear.

When the gear starts to retract, the MLG drag brace-operated sequence valve moves to the NOT DOWN position.

As the MLG goes into the wheel well, a roller on the landing gear strut moves the MLG uplock mechanism to the LOCKED position. This moves MLG uplock-operated sequence valve to the locked position.

This removes pressure from the SLG hydraulic strut. Pressure trapped in the SLG hydraulic strut keeps the MLG truck in the STOW position.

Pressure then goes to the MLG uplock actuator to make sure the MLG uplock mechanism locks.

Pressure through the MLG door-operated sequence valve also goes to brake system components for the gear retract braking function. See the wheels and brakes section for more information (SECTION 32-40).

Door Closes

Pressure also goes to the close side of the MLG door actuator and the lock side of the MLG door lock actuator. The door starts to close.

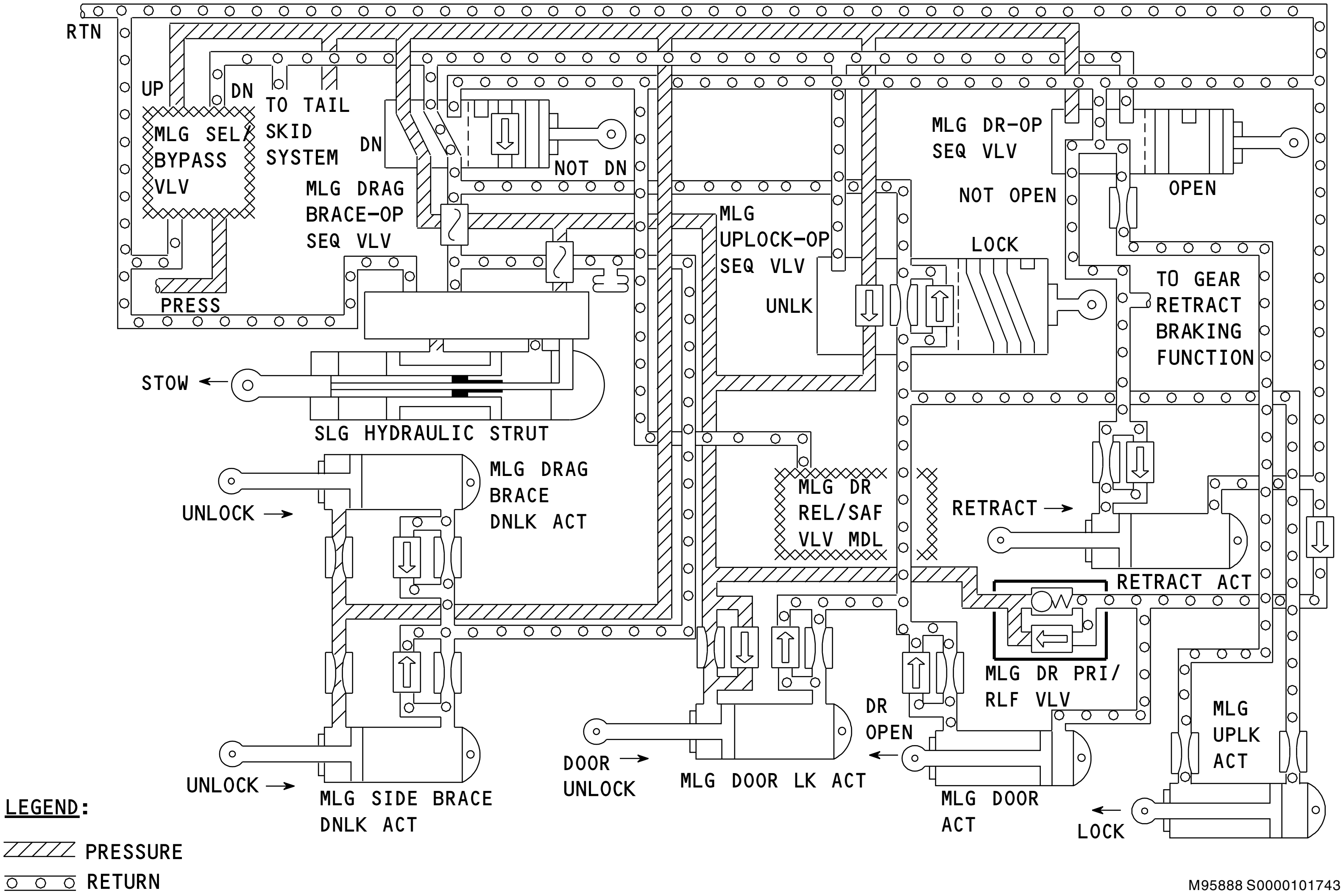
When the door is almost closed, a roller on the door starts to move the MLG door uplock mechanism to the locked position. Pressure in the MLG door lock actuator moves the uplock mechanism over-center to the locked position.

Final Position

Final main gear conditions are:

- MLG - UP and LOCKED
- MLG door - CLOSED and LOCKED
- SLG hydraulic strut - STOW
- MLG drag brace-operated sequence valve - NOT DOWN
- MLG uplock-operated sequence valve - LOCKED
- MLG door-operated sequence valve - NOT OPEN.

Pressure stays in the retract lines until the auto-off function moves the MLG selector/bypass valve to OFF.



MLG EXTENSION-RETRACTION - RETRACTION SEQUENCE

MLG EXTENSION-RETRACTION - EXTENSION SEQUENCE

General

Main gear extension is the same for both left and right main gear.

These are the start conditions:

- MLG - UP and LOCKED
- MLG door - CLOSED and LOCKED
- SLG hydraulic strut - STOW
- MLG Drag brace-operated sequence valve - NOT DOWN
- MLG uplock-operated sequence valve - LOCKED
- MLG door-operated sequence valve - NOT OPEN.

Control

When you select DOWN with the landing gear lever, the MLG selector/bypass valve moves to the down position. This permits hydraulic pressure to go to the extend lines.

Door Opens

Pressure goes through the MLG drag brace-operated sequence valve and the MLG uplock-operated sequence valve. This pressure goes to the SLG hydraulic strut to hold the MLG truck in the STOW position.

This pressure also goes to the MLG door lock actuator to unlock the MLG door. The MLG door actuator then gets extend pressure through the MLG door priority/relief valve. The MLG door starts to open.

Gear Extends - Truck Tilts

When the MLG door is almost all the way open, the MLG door-operated sequence valve moves to OPEN. Pressure then goes to the MLG uplock actuator to unlock the MLG uplock.

The MLG extends by its own weight and by airloads. It is not pressurized during extension.

When the main landing gear is 20 degrees from fully extended, the MLG drag brace-operated sequence valve moves to DOWN.

Hydraulic pressure then retracts the SLG hydraulic strut which moves the MLG truck to the TILT position.

Hydraulic pressure also goes to the MLG drag brace and MLG side brace downlock actuators to lock the gear down.

Door Closes

Pressure from the MLG drag brace-operated sequence valve goes through the MLG uplock-operated sequence valve and the MLG door release/safety valve module. This pressure goes to the MLG door actuator and the MLG door lock actuator. The MLG main gear door closes.

When the door is almost closed, a roller on the door starts to move the MLG door uplock mechanism to the locked position. Pressure in the MLG door lock actuator moves the uplock mechanism over-center to the locked position.

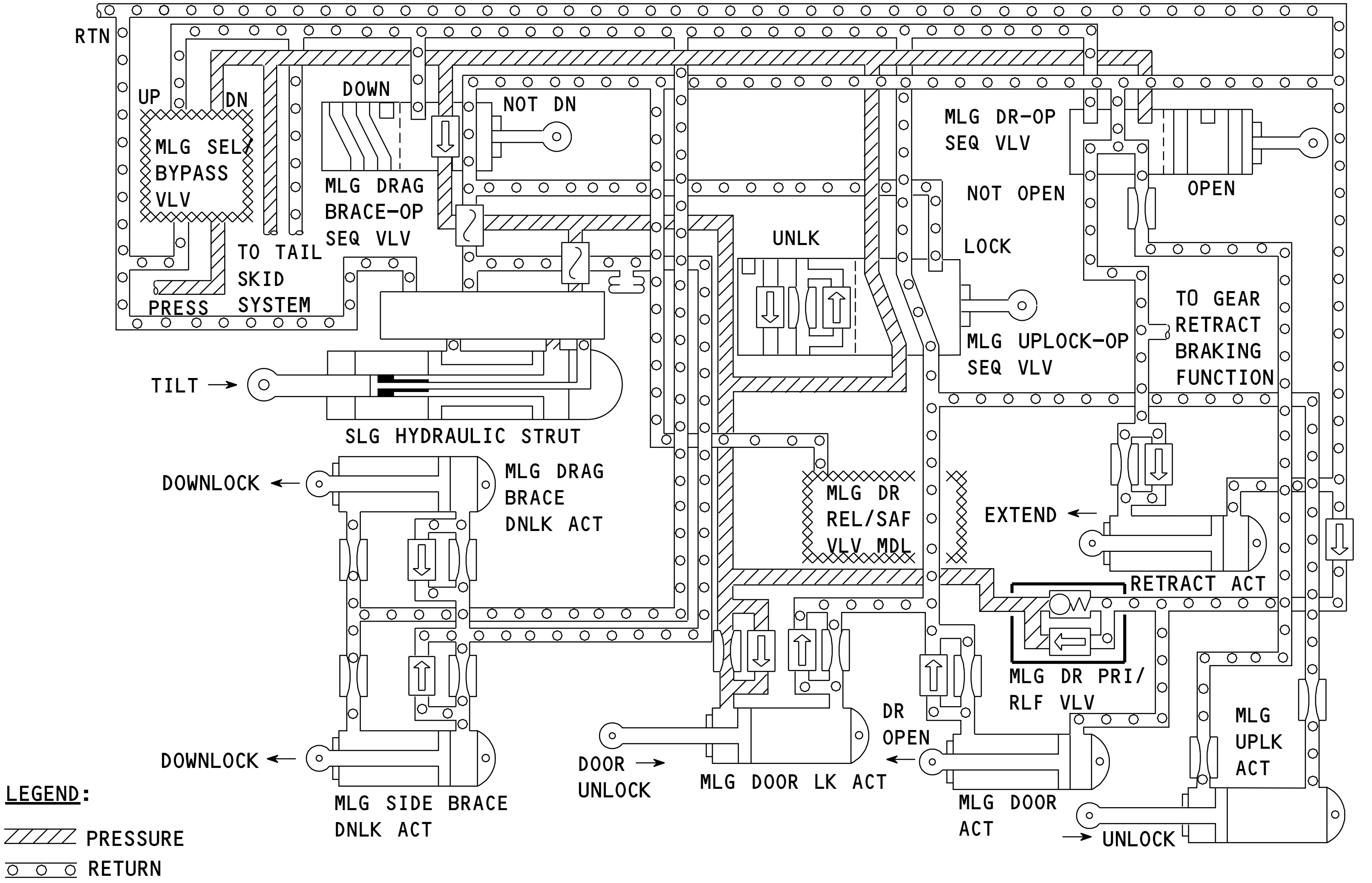
Final Condition

These are the final conditions of the MLG:

- MLG - DOWN and LOCKED
- MLG door - CLOSED and LOCKED
- SLG hydraulic strut - TILT
- MLG drag brace-operated sequence valve - DOWN
- MLG uplock-operated sequence valve - UNLOCKED
- MLG door-operated sequence valve - NOT OPEN.

These actuators stay pressurized when the MLG is down and the center hydraulic system is pressurized:

- MLG door actuator
- MLG door lock actuator
- SLG hydraulic strut
- MLG side brace actuator
- MLG drag brace actuator
- MLG uplock actuator.



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MLG EXTENSION-RETRACTION - EXTENSION SEQUENCE

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NLG EXTENSION-RETRACTION - INTRODUCTION

Purpose

The NLG extension-retraction system extends and retracts the nose landing gear and opens and closes the NLG doors.

Components

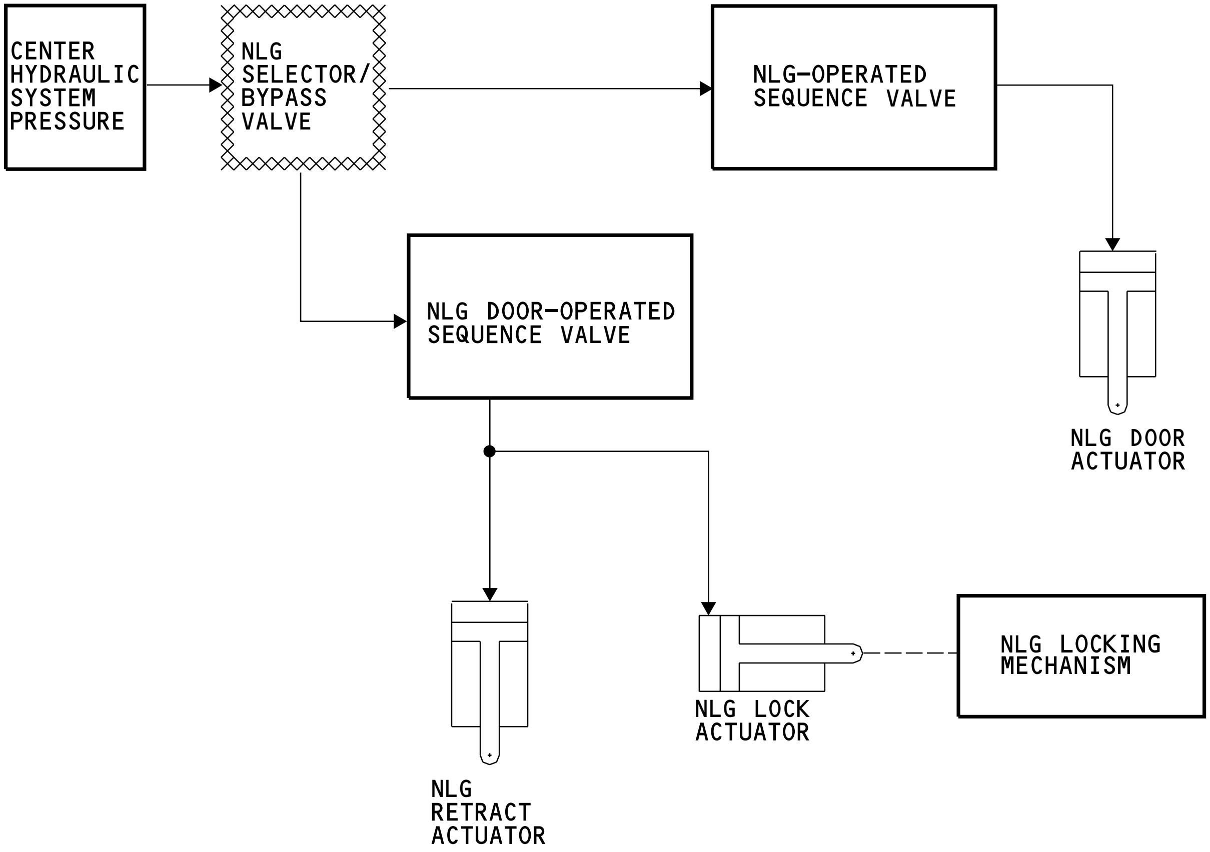
These are the NLG extension-retraction components:

- NLG-operated sequence valve
- NLG door actuator
- NLG door-operated sequence valve
- NLG retract actuator
- NLG lock actuator
- NLG locking mechanism.

General Description

The center hydraulic system supplies pressure to operate the nose landing gear. The pressure goes through the NLG selector/bypass valve. The NLG door-operated sequence valve controls hydraulic pressure to the NLG retract actuator and the NLG lock actuator.

The NLG-operated sequence valve controls hydraulic pressure to the NLG door actuator.



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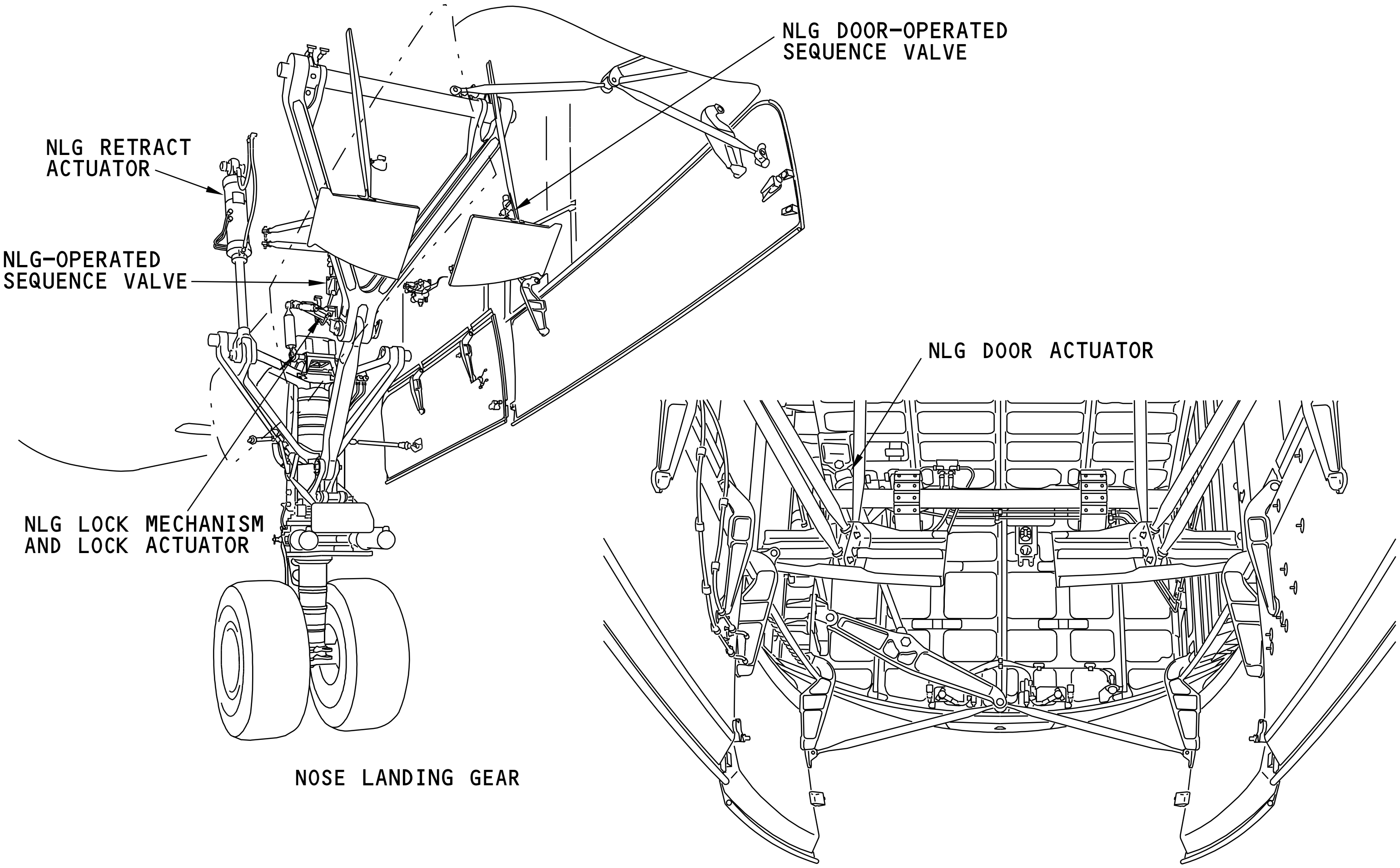
NLG EXTENSION-RETRACTION - INTRODUCTION

NLG EXTENSION-RETRACTION - COMPONENT LOCATIONS

General

These are the components in the NLG wheel well:

- NLG retract actuator
- NLG-operated sequence valve
- NLG lock actuator
- NLG lock mechanism
- NLG door-operated sequence valve
- NLG door actuator.



NOSE LANDING GEAR

NLG WHEEL WELL - (LOOKING FORWARD)

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NLG EXTENSION-RETRACTION - COMPONENT LOCATIONS

NLG EXTENSION-RETRACTION - NLG RETRACT ACTUATOR

Purpose

The NLG retract actuator supplies the force to retract the nose landing gear.

Physical Description

The NLG gear retract actuator is a two-position piston-type actuator. The actuator retracts to raise the NLG and extends to lower the NLG.

A flow restrictor controls the gear extension rate.

Snubbers at both ends of the actuator control speed at the ends of the actuator stroke.

The NLG retract actuator is unpressurized during gear extension.

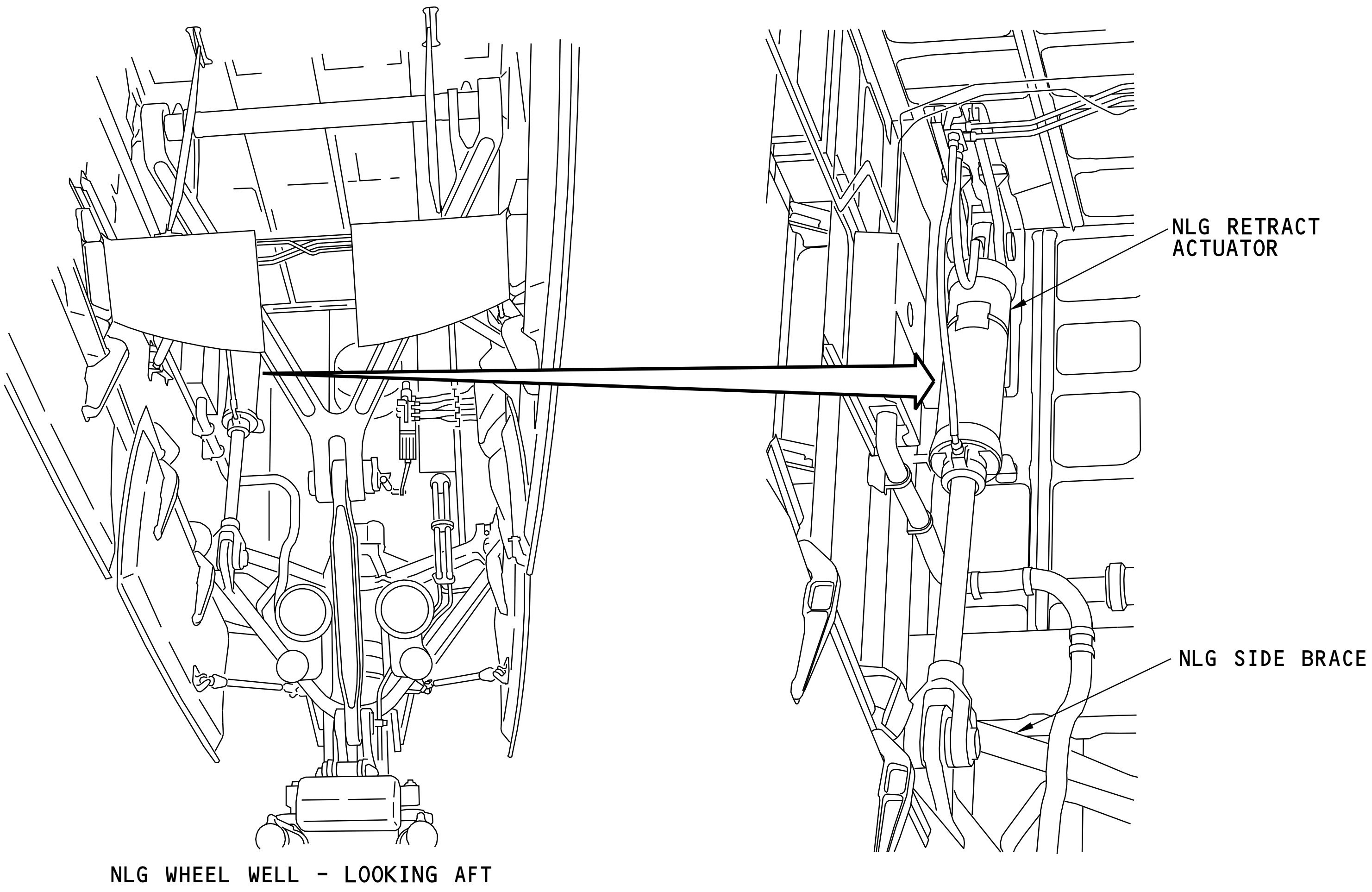
The dry weight of the actuator is approximately 95 pounds (43 kilograms).

Location

The NLG retract actuator is in the right top corner of the aft bulkhead in the NLG wheel well.

The head end of the actuator attaches to a bracket in the top, aft, right outboard corner of the wheel well.

The rod end attaches to the right side brace for the NLG.



NLG EXTENSION-RETRACTION - NLG RETRACT ACTUATOR

NLG EXTENSION-RETRACTION - NLG LOCKING MECHANISM AND NLG LOCK ACTUATOR

Purpose

The NLG locking mechanism holds the NLG in the extended or the retracted position.

The NLG lock actuator unlocks the NLG locking mechanism at the start of an extension or retraction. It also locks the mechanism when the NLG is fully extended or fully retracted.

Physical Description

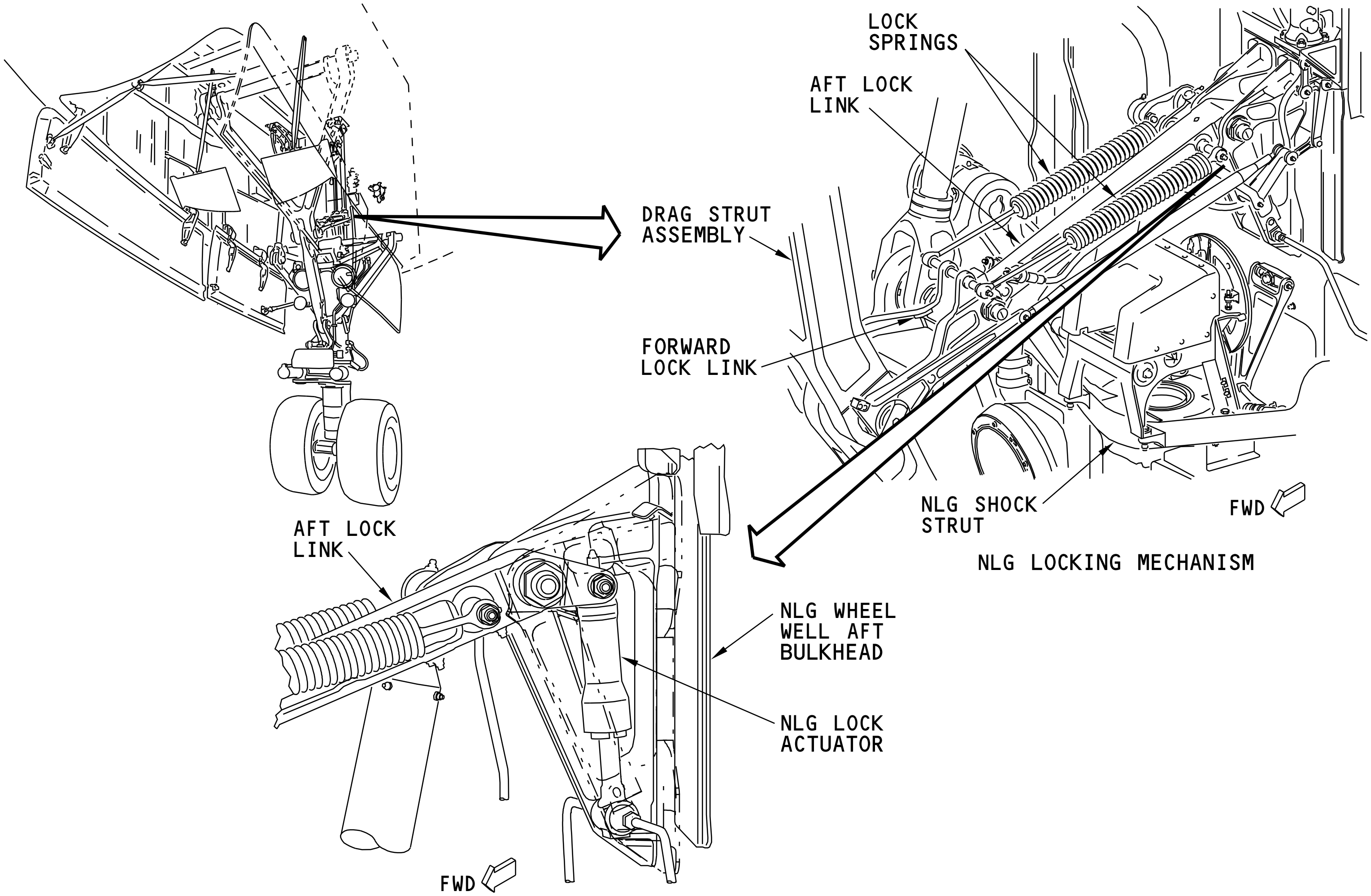
The NLG locking mechanism uses over-center locking to lock the NLG in either the extended or retracted position. The locking mechanism has a forward and an aft lock link which connect by a hinge. Two lock springs keep the lock links in position.

The NLG lock actuator is a hydraulic piston-type actuator. Flow restrictors control the hydraulic flow rate in both directions of actuator motion.

Location

The nose gear locking mechanism is directly above the nose gear shock strut. The forward lock link attaches to the drag strut hinge. The aft lock link attaches to the NLG wheel well aft bulkhead.

The NLG lock actuator is at the aft end of the NLG locking mechanism. The rod end of the actuator attaches to the NLG wheel well aft bulkhead. The head end attaches to the aft part of the locking mechanism.



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NLG EXTENSION-RETRACTION - NLG LOCKING MECHANISM AND NLG LOCK ACTUATOR

NLG EXTENSION-RETRACTION - NLG LOCKING MECHANISM AND NLG LOCK ACTUATOR - FUNCTIONAL DESCRIPTION

Retraction

Before gear retraction, the NLG lock actuator retracts. This unlocks the NLG locking mechanism and permits the NLG to retract.

The hydraulic pressure stays on the retract side of the NLG lock actuator while the gear is in transit.

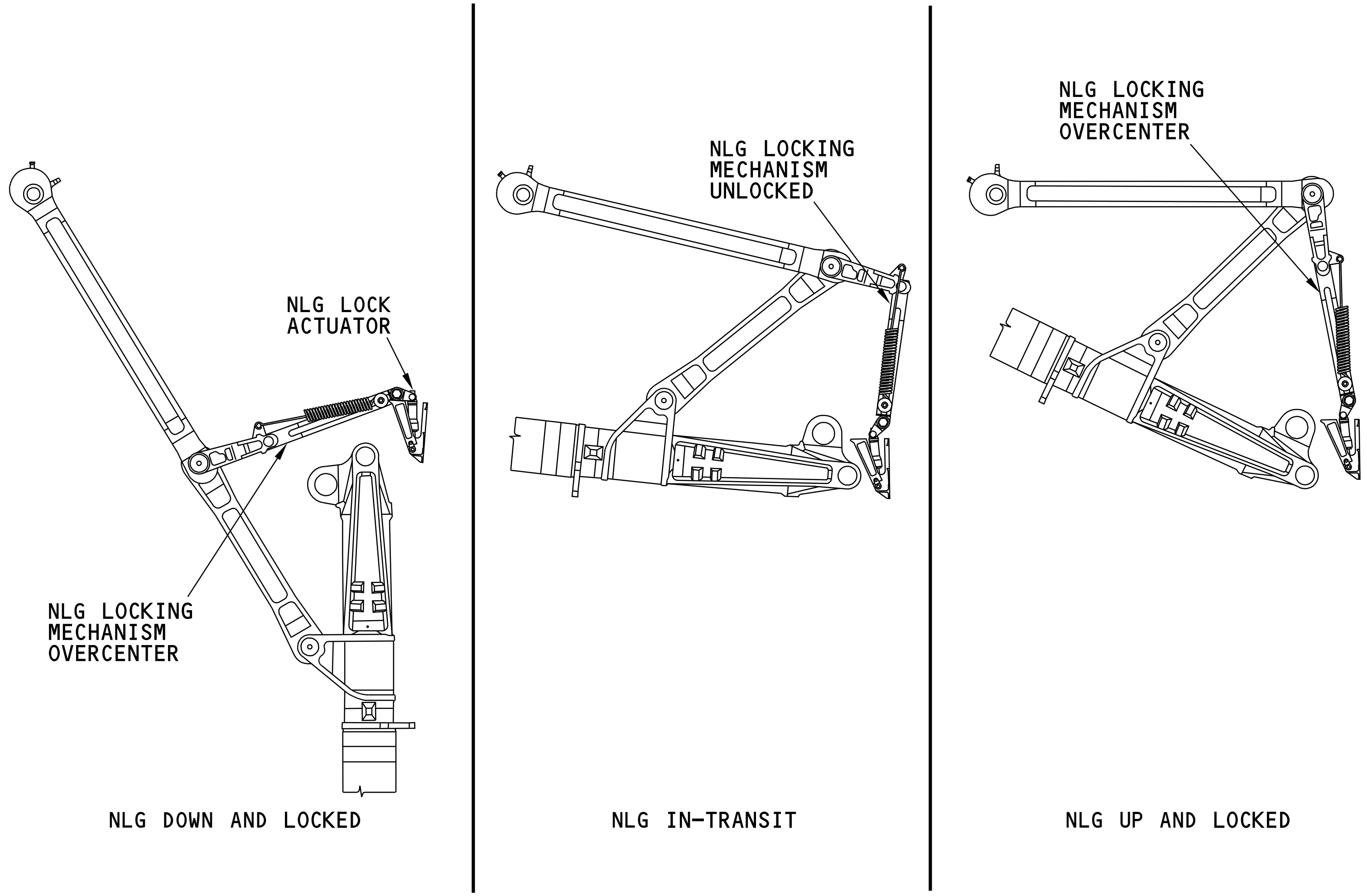
The NLG lock actuator moves the NLG locking mechanism to the lock position when the NLG is in the retracted position.

Extension

Before gear extension, the NLG lock actuator extends. This unlocks the NLG locking mechanism and permits the NLG to extend.

Hydraulic pressure stays on the extend side of the NLG lock actuator while the gear is in transit.

The NLG lock actuator moves the NLG locking mechanism to the lock position when the NLG is in the extended position.



NLG DOWN AND LOCKED

NLG IN-TRANSIT

NLG UP AND LOCKED

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NLG EXTENSION-RETRACTION - NLG LOCKING MECHANISM AND NLG LOCK ACTUATOR - FUNCTIONAL DESCRIPTION

NLG EXTENSION-RETRACTION - NLG-OPERATED SEQUENCE VALVE

Purpose

The NLG-operated sequence valve makes sure that the doors move only if the NLG is in the retracted or the extended position. It makes sure that the doors do not move if the NLG is in-transit.

Physical Description

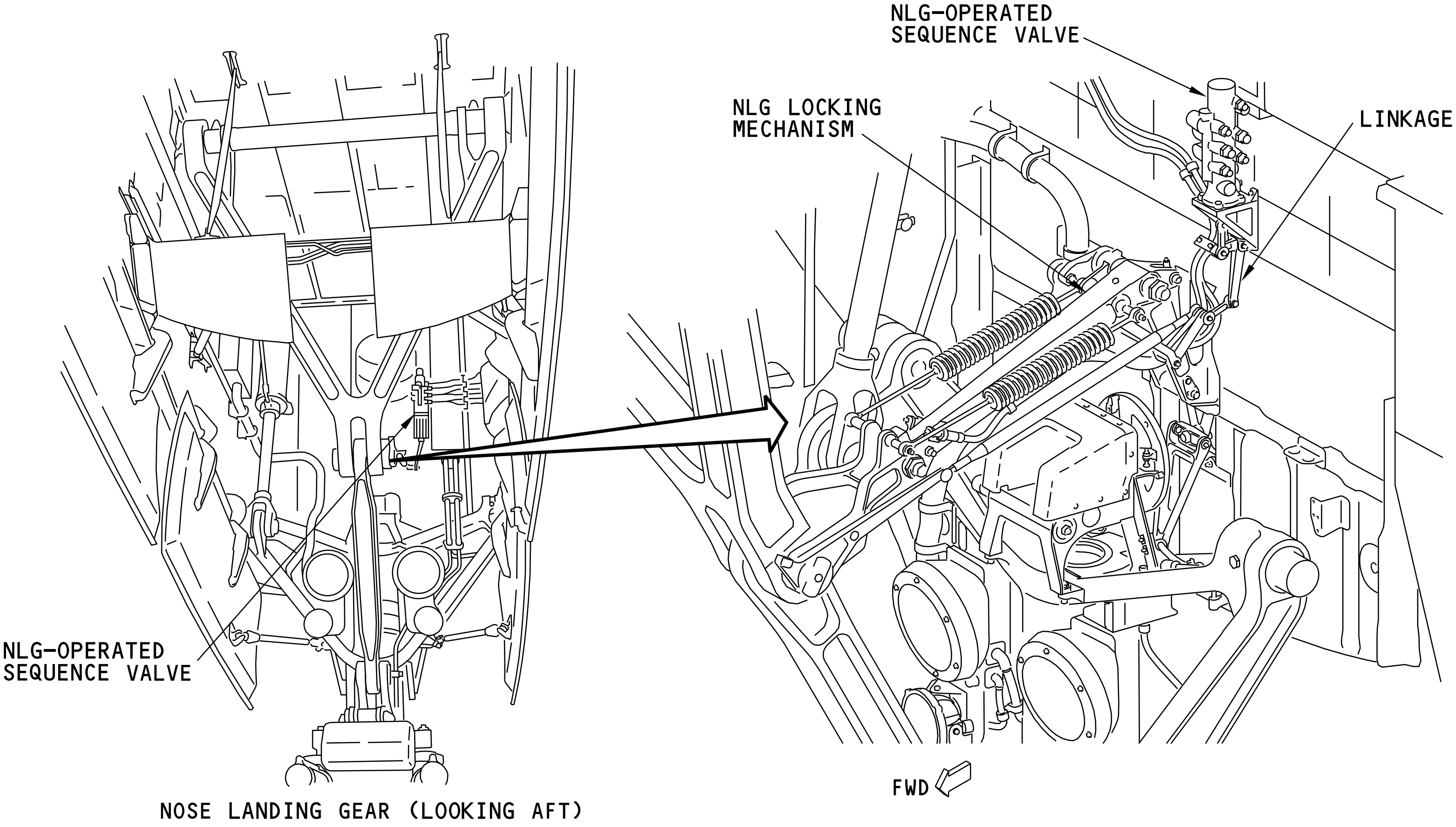
The NLG-operated sequence valve is a three position valve. The positions are:

- Gear up
- Gear in transit
- Gear down.

A linkage from the nose landing gear locking mechanism moves the sequence valve.

Location

The NLG-operated sequence valve is on the aft bulkhead in the nose wheel well.



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NLG EXTENSION-RETRACTION - NLG-OPERATED SEQUENCE VALVE

NLG EXTENSION-RETRACTION - NLG DOOR ACTUATOR AND NLG DOOR-OPERATED SEQUENCE VALVE

Purpose

The NLG door actuator opens and closes the NLG forward doors. A lock in the actuator holds the doors closed.

The NLG door-operated sequence valve controls the hydraulic flow to the NLG lock and retract actuators. This makes sure the NLG extends or retracts only when the NLG doors are open.

Physical Description

The NLG door actuator is a two-position hydraulic actuator. The actuator extends to open the doors and retracts to close the doors.

Flow restrictors at the head and rod ends of the actuator control actuator speed.

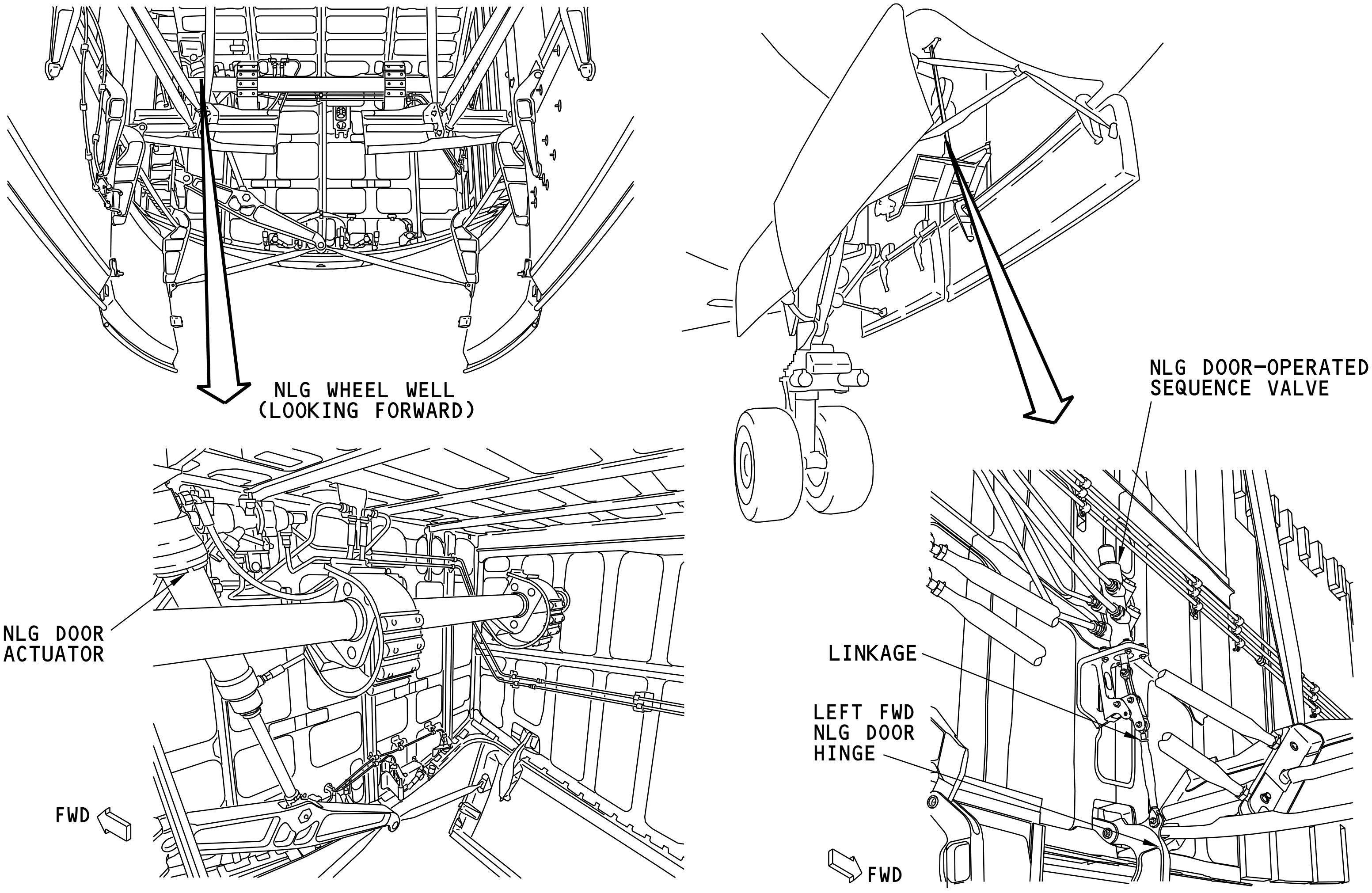
An internal lock engages when the NLG doors close. During normal operation, hydraulic pressure to open the NLG doors unlocks this lock.

The NLG door-operated sequence valve is a two position valve - OPEN and CLOSED. The sequence valve moves to the OPEN position when the doors are four degrees from the fully open position. A linkage from a hinge on the left forward NLG door operates the sequence valve.

Location

The NLG door actuator is in the forward, left side of the nose wheel well. The head end of the actuator attaches to a bracket on the wheel well ceiling. The rod end attaches to a crank. The crank moves both forward doors through rods.

The NLG door-operated sequence valve is on the left NLG wheel well wall.



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NLG EXTENSION-RETRACTION - NLG DOOR ACTUATOR AND NLG DOOR-OPERATED SEQUENCE VALVE

NLG EXTENSION-RETRACTION - RETRACTION SEQUENCE

Initial Position

These are the initial positions for NLG components:

- NLG - DOWN AND LOCKED
- NLG doors - CLOSED
- NLG-operated sequence valve - GEAR DOWN
- NLG door-operated sequence valve - CLOSED.

Control

When you select UP with the landing gear control lever, the NLG selector/bypass valve moves to the up position. Hydraulic pressure then goes to the retract lines.

Gear Unlocks - Doors Open

Hydraulic pressure goes to the NLG lock actuator. The actuator starts to retract to unlock the downlock.

Pressure also goes through the NLG-operated sequence valve to the NLG door actuator. The actuator extends and opens the forward doors.

Gear Retracts

When the doors are almost fully open, the NLG door-operated sequence valve moves to OPEN. Pressure then goes to the NLG retract actuator and the NLG starts to retract.

After the NLG starts to retract, the NLG-operated sequence valve moves to the GEAR IN TRANSIT position. This keeps pressure on the open side of the door actuator.

Doors Close - Gear Locks

When the NLG is almost all the way up, the NLG-operated sequence valve moves to the UP position. Pressure now goes to the retract side of the NLG door actuator and the NLG doors start to close.

Pressure through the NLG-operated sequence valve also goes to the NLG retract actuator. This keeps the NLG up after the nose gear doors close.

The NLG lock actuator continues to retract and locks the NLG when the gear is fully up.

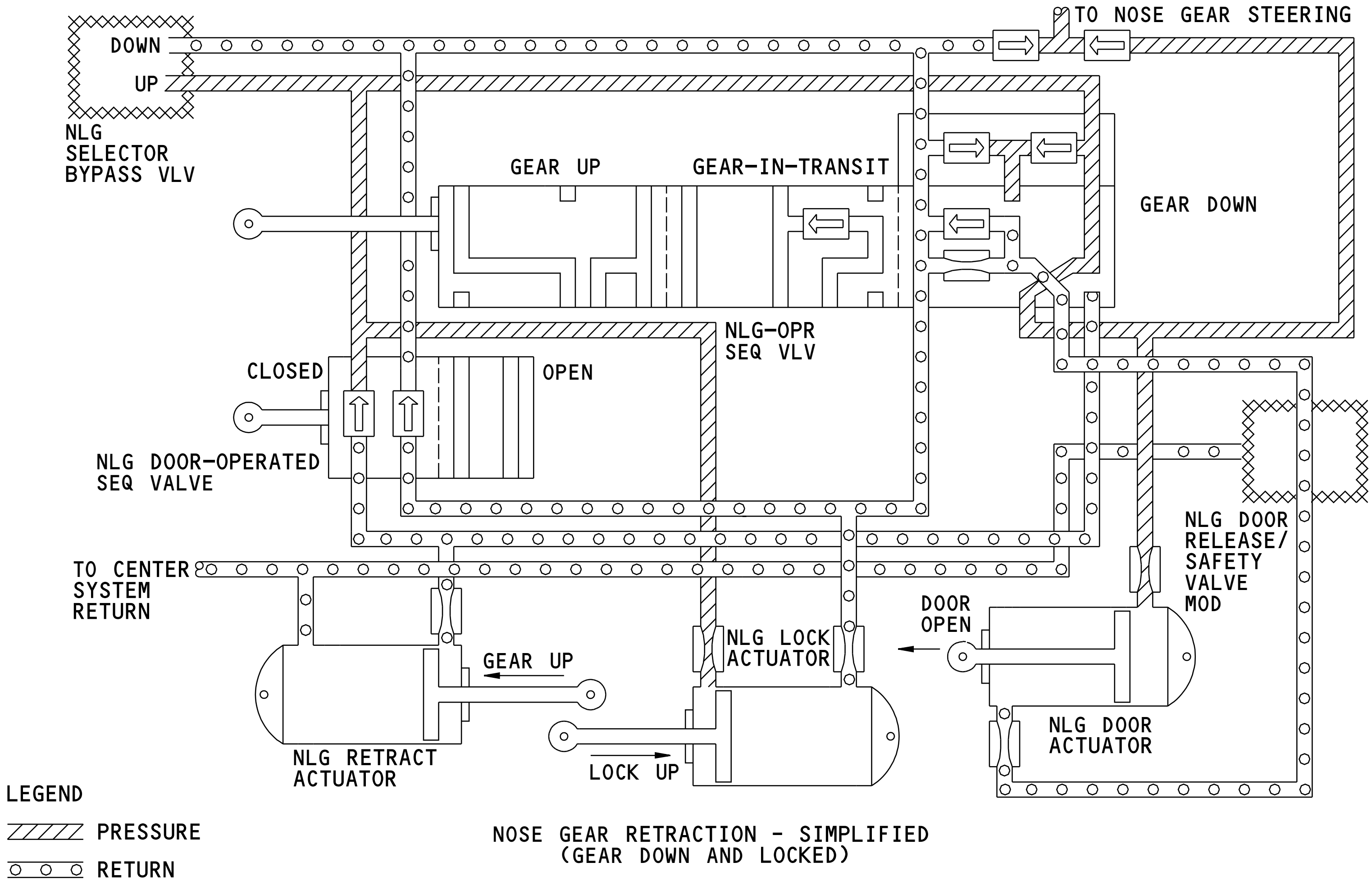
The lock inside the NLG door actuator locks the NLG doors when the doors are in the CLOSED position.

Final Positions

These are the final positions for nose gear components:

- NLG - UP AND LOCKED
- NLG doors - CLOSED
- NLG gear-operated sequence valve - GEAR UP
- NLG door-operated sequence valve - CLOSED.

The NLG selector/bypass valve automatically removes pressure from the NLG retract lines approximately ten seconds after the gear is up and locked.



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NLG EXTENSION-RETRACTION - RETRACTION SEQUENCE

NLG EXTENSION-RETRACTION - EXTENSION SEQUENCE

Initial Positions

These are the initial positions for the nose gear components:

- NLG - UP AND LOCKED
- NLG doors - CLOSED
- NLG-operated sequence valve - GEAR UP
- NLG door-operated sequence valve - CLOSED.

Control

When you select DOWN with the landing gear control lever, the nose landing gear selector/bypass valve moves to the DOWN position. Hydraulic pressure then goes to the extend lines.

Doors Open

Hydraulic pressure goes through the NLG-operated sequence valve to the NLG door actuator. The pressure unlocks the actuator and opens the forward nose landing gear doors.

Gear Unlocks - Gear Extends

When the nose landing gear doors are almost at the full open position, the NLG door-operated sequence valve moves to OPEN.

Pressure then goes to the extend side of the NLG lock actuator to unlock the uplock.

The NLG extends by the force of its own weight and by airloads. As the NLG starts to extend, the NLG-operated sequence valve moves to the GEAR-IN-TRANSIT position.

Doors Close

When the NLG is almost down, the NLG-operated sequence valve moves to the DOWN position. Pressure now goes to the retract side of the NLG door actuator and the doors start to close.

The NLG lock actuator continues to extend and locks the NLG when the gear is fully down.

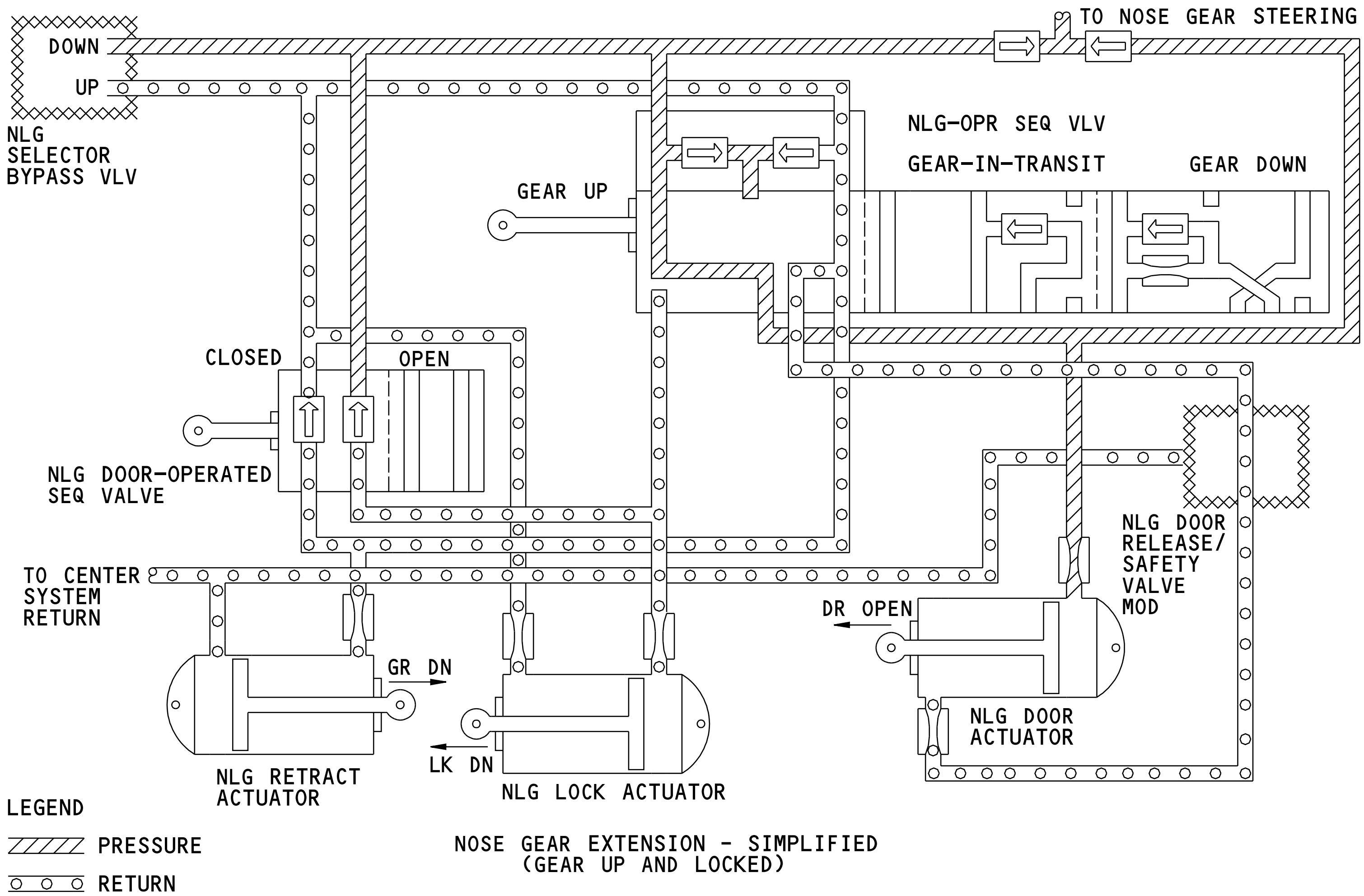
The lock inside the NLG door actuator locks when the doors are in the CLOSED position.

Final Positions

The final positions for NLG components are:

- NLG - DOWN AND LOCKED
- NLG doors - CLOSED
- NLG-operated sequence valve - GEAR DOWN
- NLG door-operated sequence valve - CLOSED.

Pressure stays in the NLG lock actuator and the NLG door actuator when the gear is down and the center hydraulic system is pressurized.



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NLG EXTENSION-RETRACTION - EXTENSION SEQUENCE

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LANDING GEAR ALTERNATE EXTENSION SYSTEM - INTRODUCTION

Purpose

The alternate extension system permits you to extend the landing gear when there is no center hydraulic system pressure or if normal extension fails.

You also use the alternate extension system to open the landing gear doors on the ground.

Components

The alternate extension system components include:

- The alternate extend power pack
- The main landing gear door release/safety valve modules
- The nose landing gear door release/safety valve module
- The main landing gear alternate uplock release actuators
- The nose landing gear alternate uplock release actuator
- The alternate extend hydraulic pressure switch.

General Description

The alternate extension system operates independently of the normal extension and retraction system.

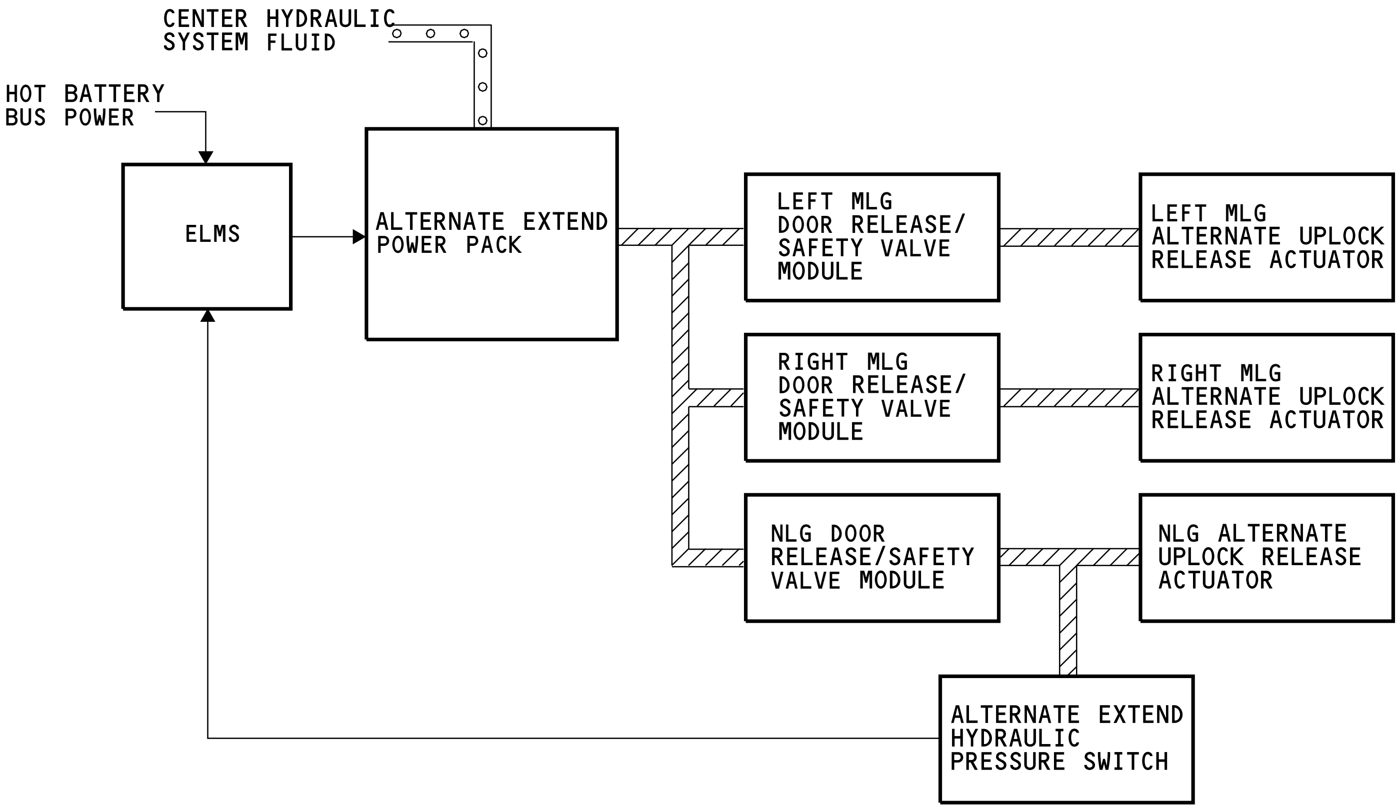
The hot battery bus supplies power to control and operate the alternate extension system. The ELMS contains relays that control the power to the alternate extend power pack.

The alternate extend power pack has a hydraulic pump operated by an electric motor. The alternate extend power pack pressurizes fluid from the center hydraulic system. This fluid then goes to door release/safety valve modules for each landing gear and unlocks the landing gear doors.

Fluid then goes to alternate uplock release actuators for each landing gear and unlocks the uplocks for the landing gear.

The landing gear doors open and the landing gear extend by airloads and their own weight. The landing gear tires may contact the landing gear doors during an alternate extension.

The alternate extend pressure switch stops operation of the power pack after the extend cycle is complete.



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LANDING GEAR ALTERNATE EXTENSION SYSTEM - INTRODUCTION

LANDING GEAR ALTERNATE EXTENSION SYSTEM - COMPONENT LOCATIONS

Main Landing Gear Wheel Well

These components are in each main landing gear wheel well:

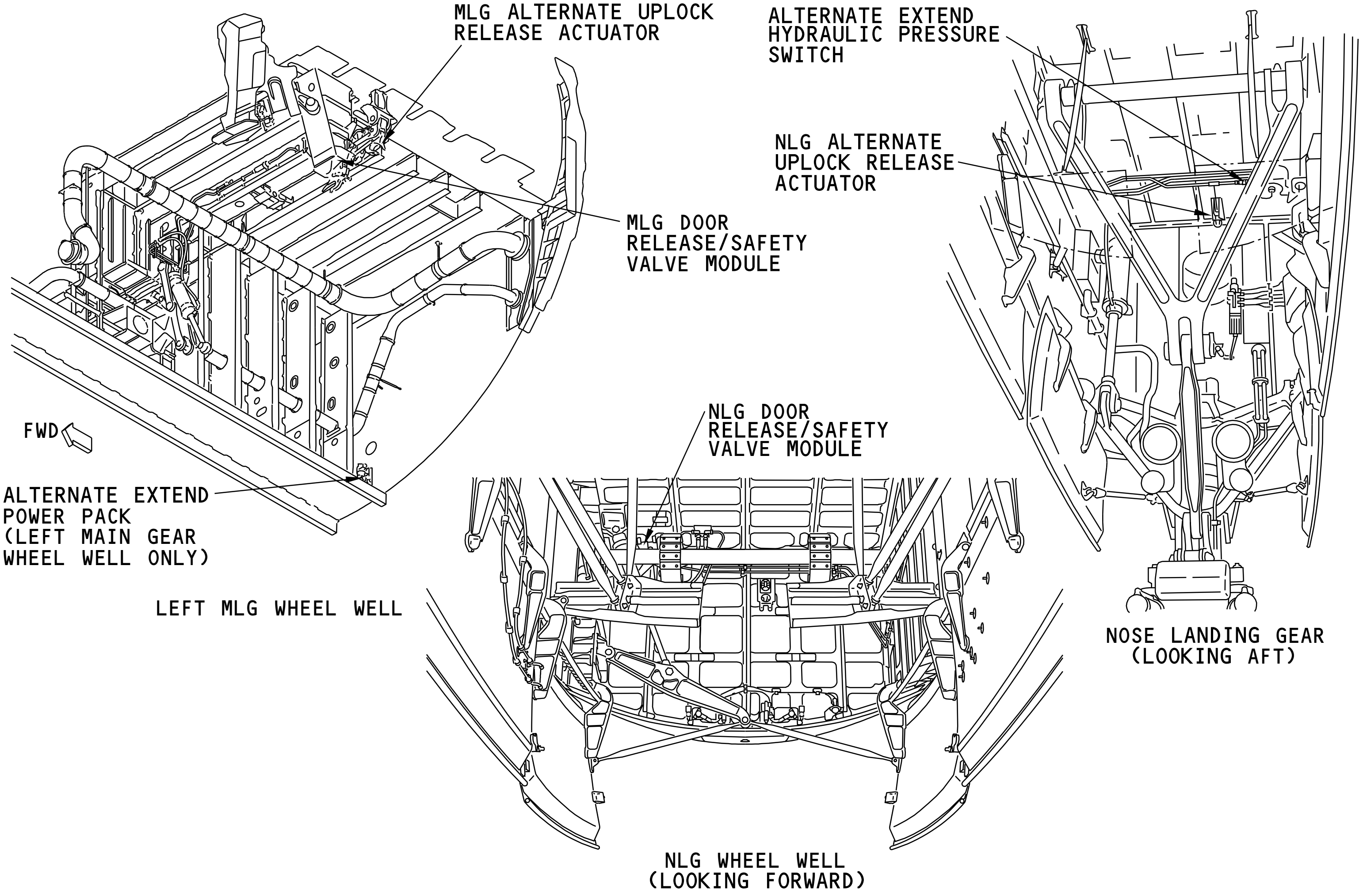
- Main landing gear door release/safety valve module
- Main landing gear alternate uplock release actuator.

The alternate extend power pack is in the left main landing gear wheel well.

Nose landing Gear Wheel Well

These components are in the nose landing gear wheel well:

- Nose landing gear door release/safety valve module
- Nose landing gear alternate uplock release actuator
- Alternate extend hydraulic pressure switch.



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LANDING GEAR ALTERNATE EXTENSION SYSTEM - COMPONENT LOCATIONS

LANDING GEAR ALTERNATE EXTENSION SYSTEM - ALTERNATE GEAR SWITCH

General

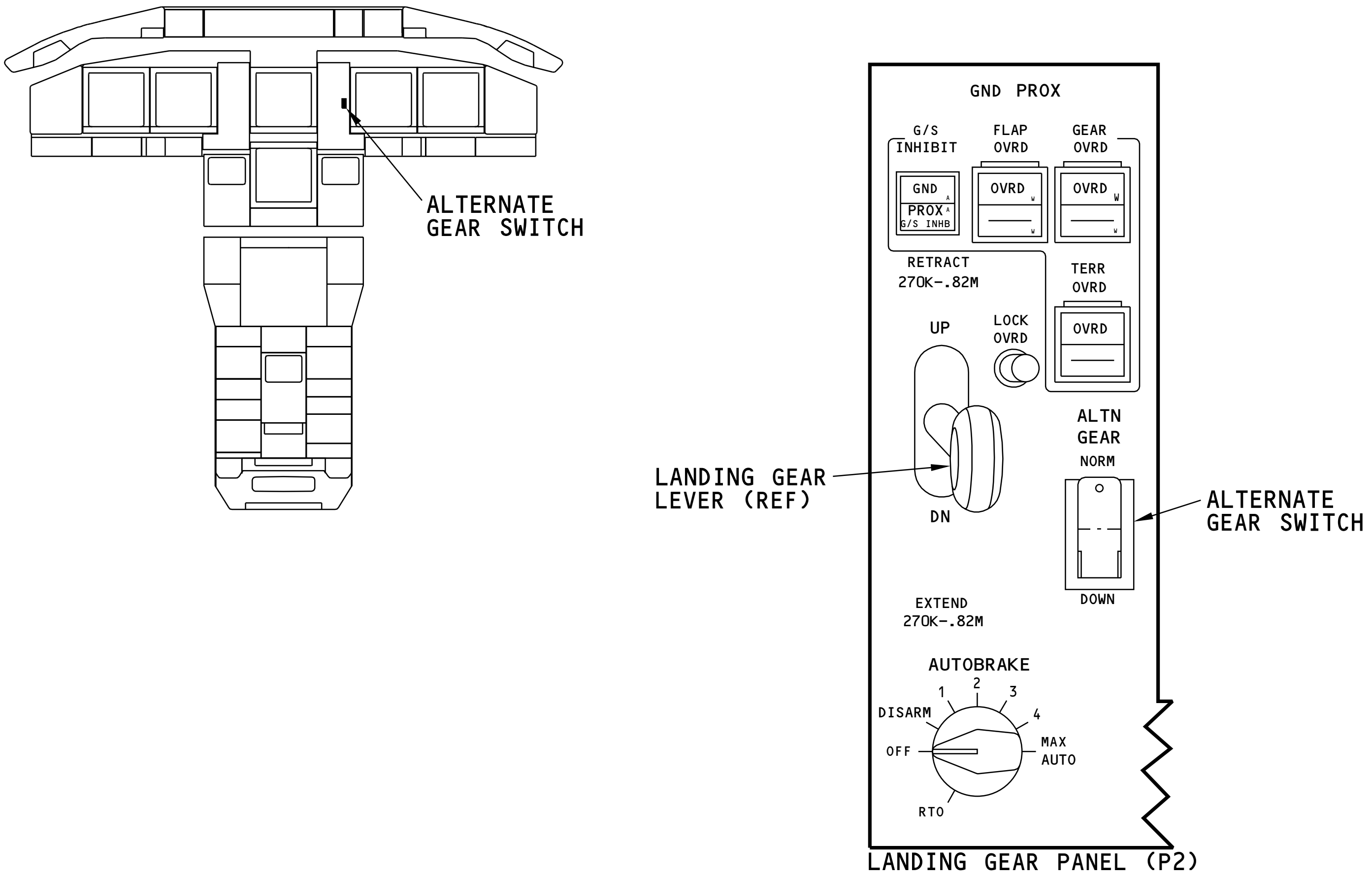
The alternate gear switch is on the landing gear panel on the P2 center forward panel.

This switch is a guarded, two-position toggle switch. The positions of the switch are NORM and DOWN. The switch is spring-loaded to the NORM position.

You hold the alternate gear switch momentarily in the DOWN position to start the alternate gear extension.

Training Information Point

You can operate the alternate gear switch with the landing gear lever in the UP or DN position.



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LANDING GEAR ALTERNATE EXTENSION SYSTEM - ALTERNATE GEAR SWITCH

LANDING GEAR ALTERNATE EXTENSION SYSTEM - GROUND DOOR OPERATION CONTROLS

Purpose

Ground door switches permit you to open and close the landing gear doors on the ground.

Location

These switches are on these two panels:

- P56 wheel well electrical service panel
- P40 service and APU shutdown panel.

Wheel Well Electrical Service Panel Switches

The wheel well electrical service panel is on the bottom of the airplane behind the main landing gear wheel wells.

These two switches on the wheel well electrical service panel control the landing gear doors:

- Arm doors switch
- All doors open/MLG doors close switch.

The arm doors switch is a two-position toggle switch. The two positions are OFF and ARM. The all doors open/MLG doors close switch is a three position switch. The positions are MLG DOOR CLOSE, OFF, and ALL DOORS OPEN. To operate the switches, you must pull them out from the OFF detent. Both switches are spring-loaded to OFF.

You must operate both switches at the same time. You move the arm doors switch to the ARM DOORS position. You move the all doors open/MLG doors close switch to the ALL DOORS OPEN position to open all landing gear doors (MLG and NLG). This operates the LG alternate extension system.

You move the arm doors switch to the ARM DOORS position and the all doors open/MLG doors close switch to the MLG DOORS CLOSE position to close the MLG doors. The doors close with center hydraulic system pressure.

Two control switches make sure that a single electrical failure does not accidentally operate the landing gear doors.

Service and APU Shutdown Panel Switches

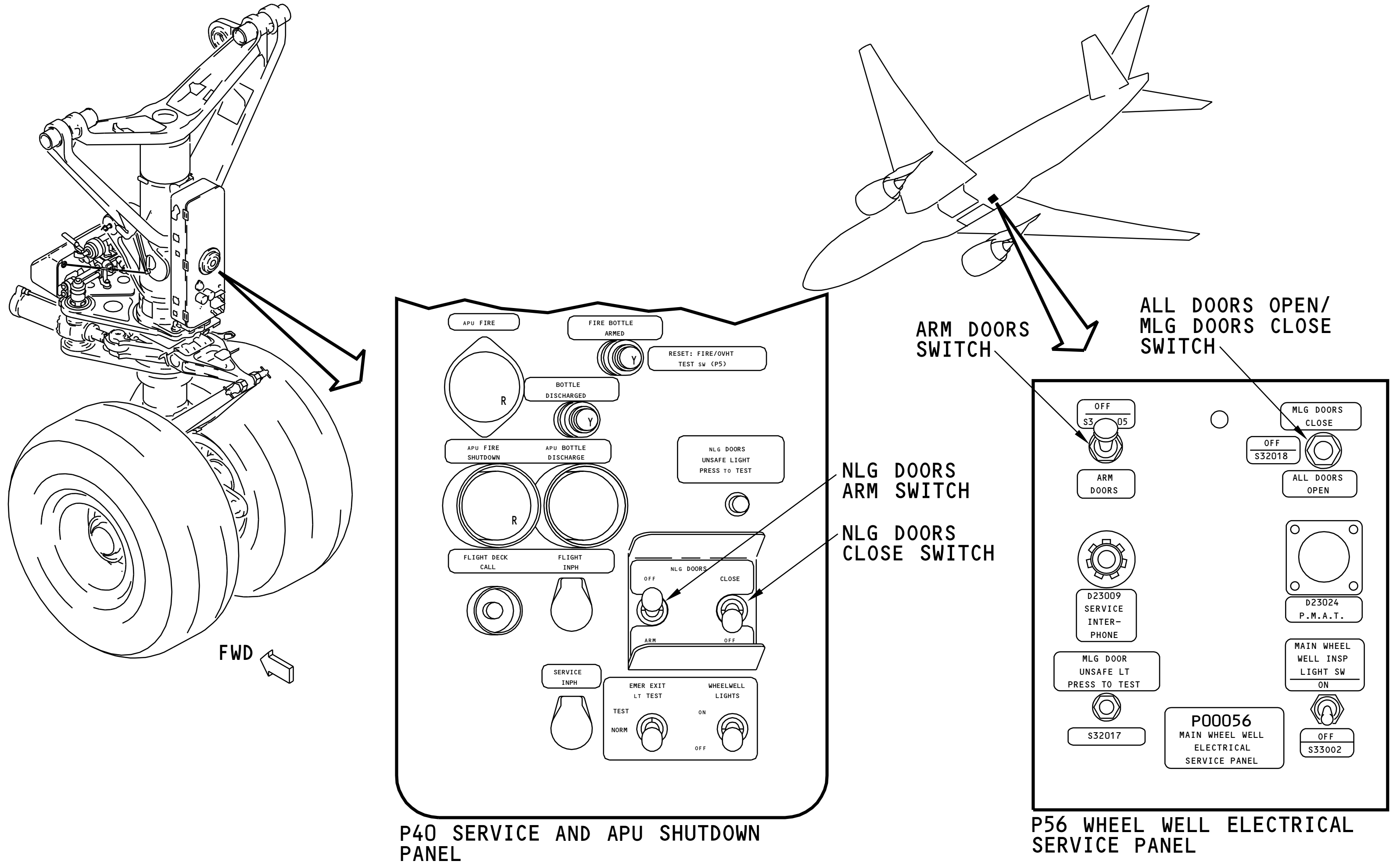
The service and APU shutdown panel is on the aft side of the nose landing gear shock strut.

Two switches on the service and APU shutdown panel operate the nose landing gear doors:

- NLG doors arm switch
- NLG doors close switch.

These switches are two-position toggle switches. To operate the switches, you must pull them out from the OFF detent. Both switches are spring-loaded to OFF.

You must operate both switches at the same time. You move the switches to the ARM and CLOSE positions to close the NLG doors. The doors close with center hydraulic system pressure.



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LANDING GEAR ALTERNATE EXTENSION SYSTEM - GROUND DOOR OPERATION CONTROLS

LANDING GEAR ALTERNATE EXTENSION SYSTEM - ALTERNATE EXTEND POWER PACK

Purpose

The alternate extend power pack supplies hydraulic pressure to the alternate extension system.

Physical Description

The power pack is an electric motor hydraulic pump. The 28v dc hot battery bus supplies power to the motor.

An oversize tube from the center hydraulic system reservoir supplies hydraulic fluid to the hydraulic pump in the power pack.

The power pack has internal hydraulic routing to let hydraulic fluid flow back into the oversize supply tube when the power pack is off.

Location

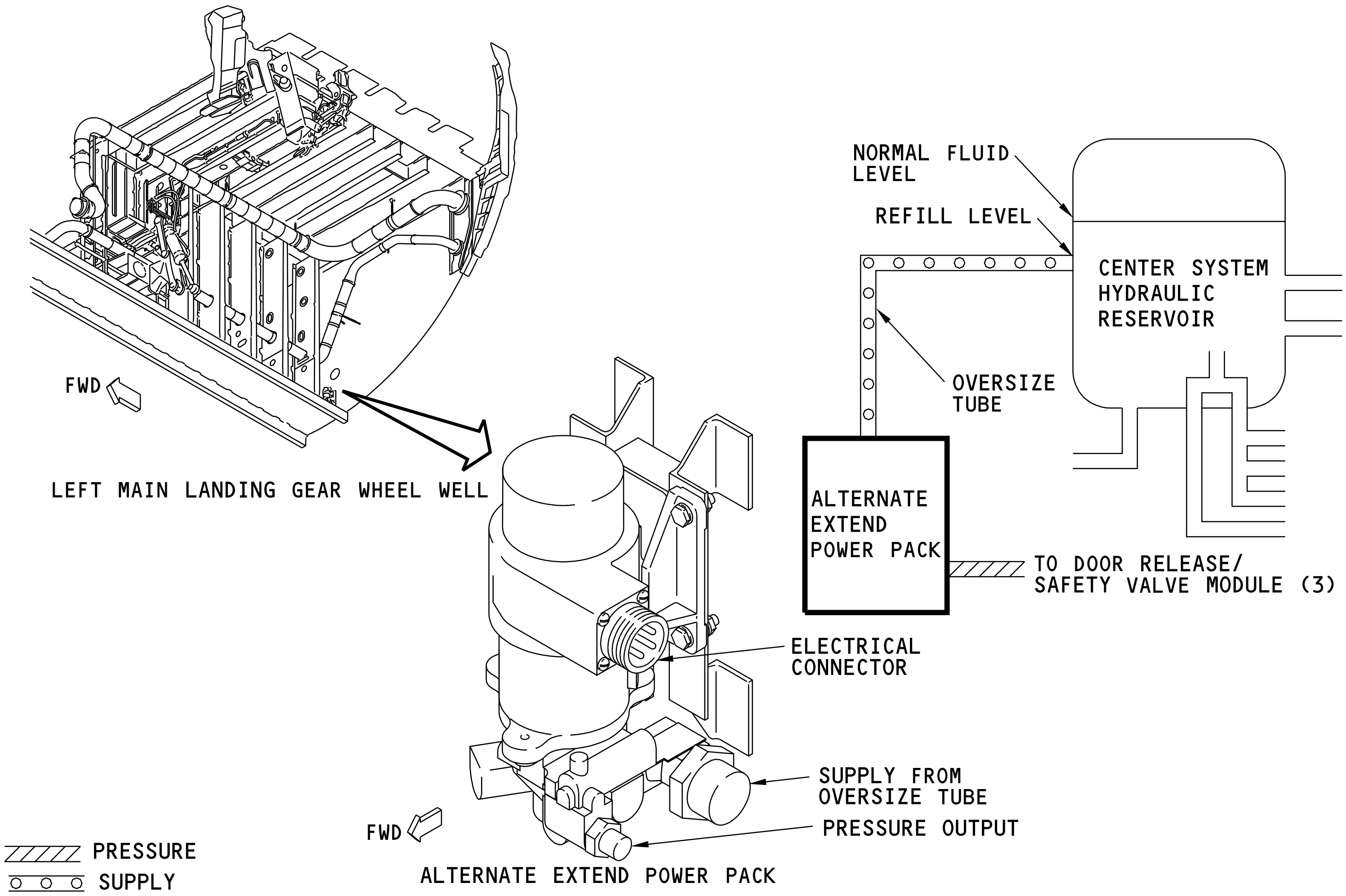
The alternate extend power pack is in the aft-inboard corner of the left main landing gear wheel well.

Training Information Point

The supply tube connects to the side of the reservoir. The connection is slightly below the reservoir refill level (0.75 reservoir fluid level). This makes sure that a hydraulic fluid leak in the alternate extension system is detected by reservoir refill indications. This also makes sure that the supply tube is filled when the reservoir is correctly serviced.

A leak in the alternate extension system does not drain all the fluid from the center hydraulic system reservoir.

The supply tube from the reservoir contains enough hydraulic fluid to do an alternate extension. The alternate extension system does function with an empty center hydraulic system reservoir.



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LANDING GEAR ALTERNATE EXTENSION SYSTEM - ALTERNATE EXTEND POWER PACK

LANDING GEAR ALTN EXTENSION SYSTEM - DOOR RELEASE/SAFETY VALVE MODULES - GENERAL DESCRIPTION

Purpose

There is one main landing gear door release/safety valve module for each main landing gear. There is one nose landing gear door release/safety valve module.

When the alternate extension system operates, the door release/safety valve modules do these functions:

- Stop the normal hydraulic system pressure to the close side of each landing gear door actuator
- Connect the close side of each door actuator to return, so the doors can open
- Extend a rod to release the landing gear door locks
- Send pressure to the alternate uplock release actuators to release the landing gear uplocks.

Each MLG door release/safety valve module extends a rod to push the gear door uplock mechanism to release the over-center lock. This permits the MLG doors to open. The NLG door release/safety valve module extends a rod to push a crank on the NLG door actuator. This crank turns to release the lock inside the NLG door actuator. This permits the NLG doors to open.

The door release/safety valve modules also have a reset function to close the doors. You use switches on the P40 and P56 panels to reset the modules. Center hydraulic system pressure closes the landing gear doors.

Location

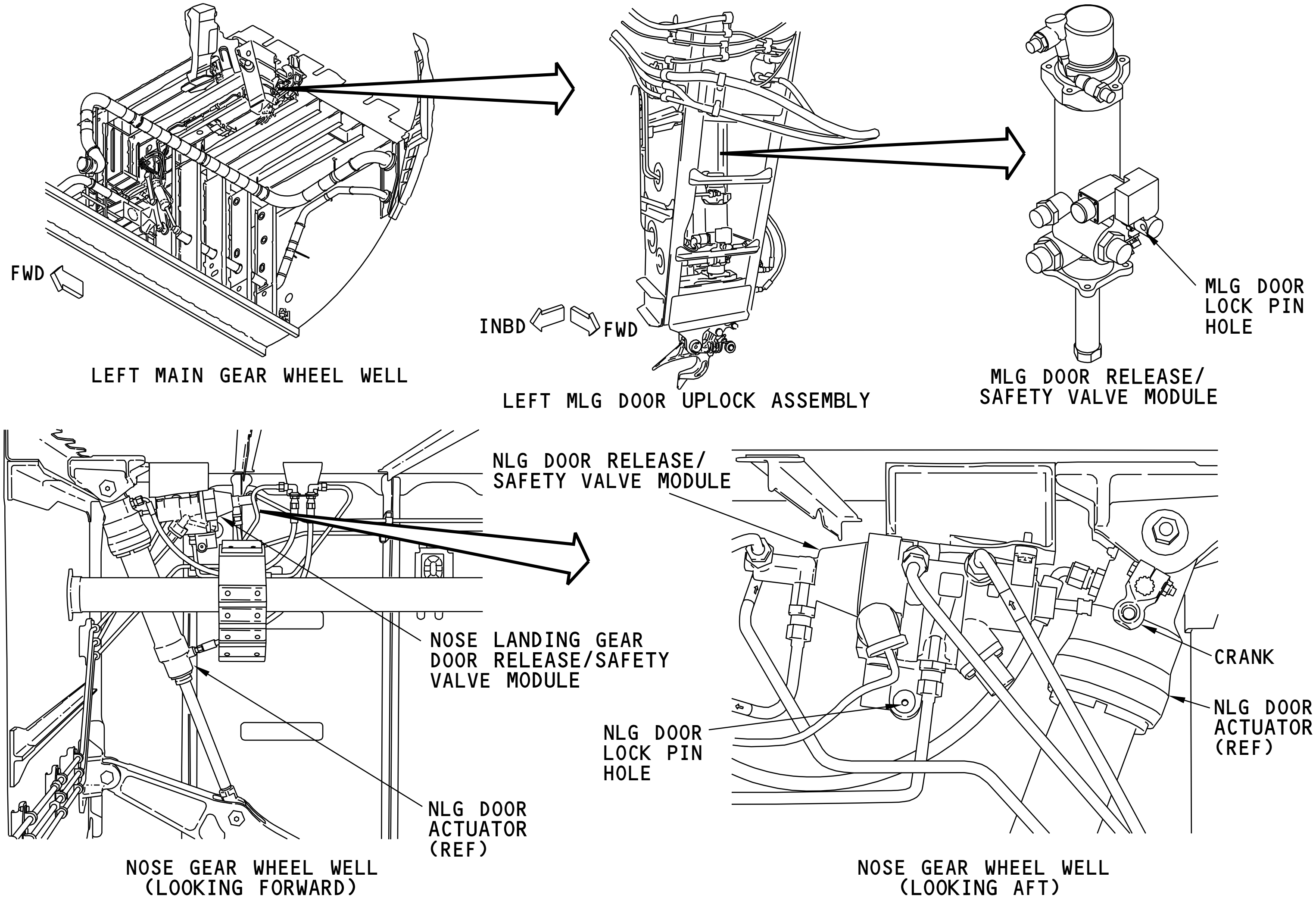
The main landing gear door release/safety valve modules are inside the door uplock assembly. A removable panel permits access to the module.

The nose landing gear door release/safety valve module is on the ceiling in the nose wheel well near the nose landing gear door actuator.

Training Information Point

The nose landing gear door release/safety valve module is not interchangeable with the main landing gear door release/safety valve modules.

You install door lock pins in the door release/safety valve modules for safety. With the pins installed, you cannot reset the modules and the doors cannot close.



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LANDING GEAR ALTN EXTENSION SYSTEM - DOOR RELEASE/SAFETY VALVE MODULES - GENERAL DESCRIPTION

LANDING GEAR ALTN EXTENSION SYSTEM - DOOR RELEASE/SAFETY VALVE MODS - FUNCTIONAL DESCRIPTION

General

Each door release/safety valve module contains these components:

- Door release actuator
- Door safety valve
- Safety valve latch
- Safety valve latch position sensing switch
- Solenoid-operated valve.

The door release/safety valve modules are part of the alternate extension system. They are also connected to the normal landing gear extension-retraction system. The hydraulic fluid to close the landing gear doors flows through the door release/safety valve modules.

Door Release Actuator

The door release actuator extends when it gets hydraulic pressure from the alternate extend power pack.

Each MLG door release actuator releases the gear door uplock mechanism. The NLG door release actuator releases the lock inside the NLG door actuator. This permits the doors to open.

After it extends, each door release actuator permits hydraulic pressure to go to the gear alternate uplock release actuator.

An internal spring returns the door release actuator to its retracted position after the power pack stops operation.

Door Safety Valve

The safety valve is a two-position valve: SAFE and NORMAL.

During normal operation of the landing gear extension-retraction system, the valve is in the NORMAL position. In the NORMAL position, door close hydraulic pressure can go to the door actuator to close the door.

The door release actuator moves the safety valve to the SAFE position as it extends. In the SAFE position, the door close pressure cannot go to the door actuator.

A latch keeps the safety valve in the SAFE position. A position sensing switch controls the gear door unsafe light.

Solenoid-Operated Valve

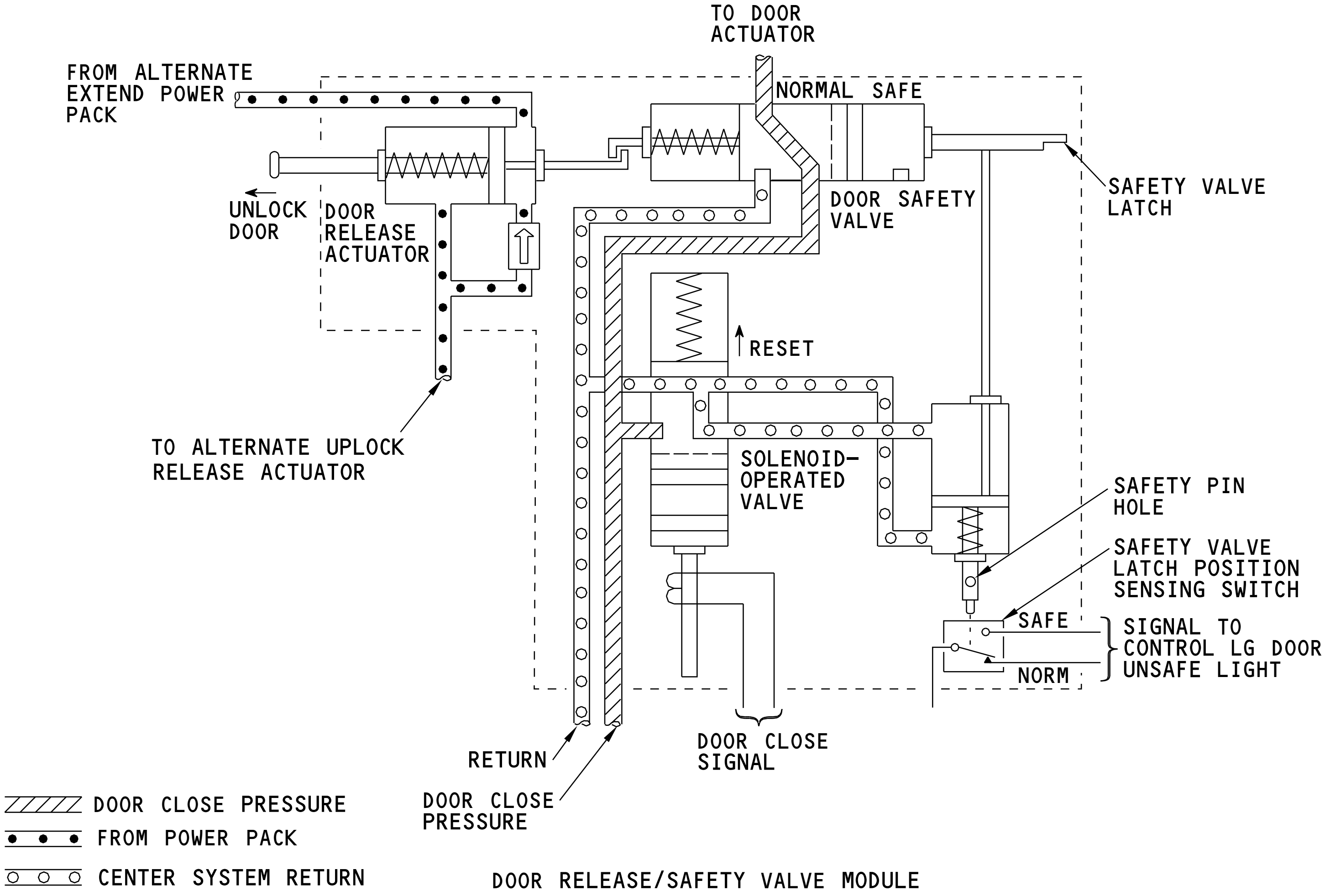
The solenoid-operated valve is a two-position valve.

A signal to close the landing gear door energizes the solenoid. This moves the valve and permits hydraulic pressure to unlatch the safety valve. To close the door, you must have door close hydraulic pressure and the door-close signal at the same time.

After hydraulic pressure releases the latch, a spring moves the safety valve to the NORMAL position. The hydraulic pressure then goes to the door actuator and the door closes.

Training Information Point

A door safety pin hole is on each module. The safety pin keeps the safety valve in the SAFE position. You cannot close the door with the safety pin installed in the door release/safety valve module.



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LANDING GEAR ALTN EXTENSION SYSTEM - DOOR RELEASE/SAFETY VALVE MODS - FUNCTIONAL DESCRIPTION

LANDING GEAR ALTERNATE EXTENSION SYSTEM - MLG ALTERNATE UPLOCK RELEASE ACTUATOR

General

The MLG alternate uplock release actuators supply the force to unlock the MLG uplocks. This permits the MLG to extend by gravity and airloads.

There is one MLG alternate uplock release actuator for each main landing gear.

Physical Description

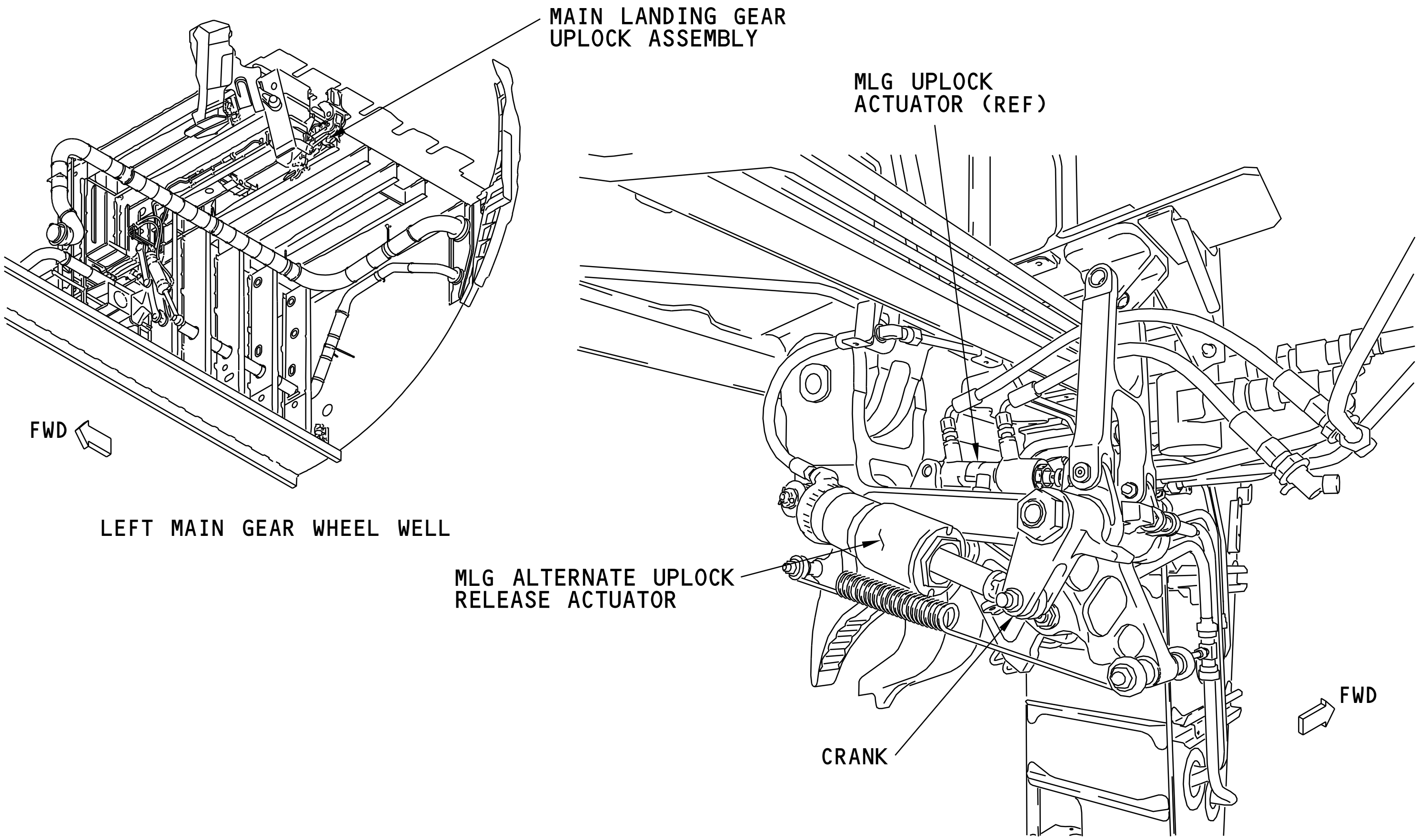
The actuators extend when they get alternate extend pressure.

The MLG alternate uplock release actuators turn cranks which touch the gear uplock mechanisms to release the overcenter locks of the gear uplock mechanisms.

Springs inside the actuators return the actuators to the retracted position when there is low alternate extension hydraulic pressure.

Location

The MLG alternate uplock release actuators are in each wheel well on the MLG uplock assembly.



LANDING GEAR ALTERNATE EXTENSION SYSTEM - MLG ALTERNATE UPLOCK RELEASE ACTUATOR

LANDING GEAR ALTERNATE EXTENSION SYSTEM - NLG ALTERNATE UPLOCK RELEASE ACTUATOR

Purpose

The nose landing gear alternate uplock release actuator supplies the force to unlock the nose landing gear lock link mechanism. This permits the nose landing gear to extend by gravity and airloads.

Location

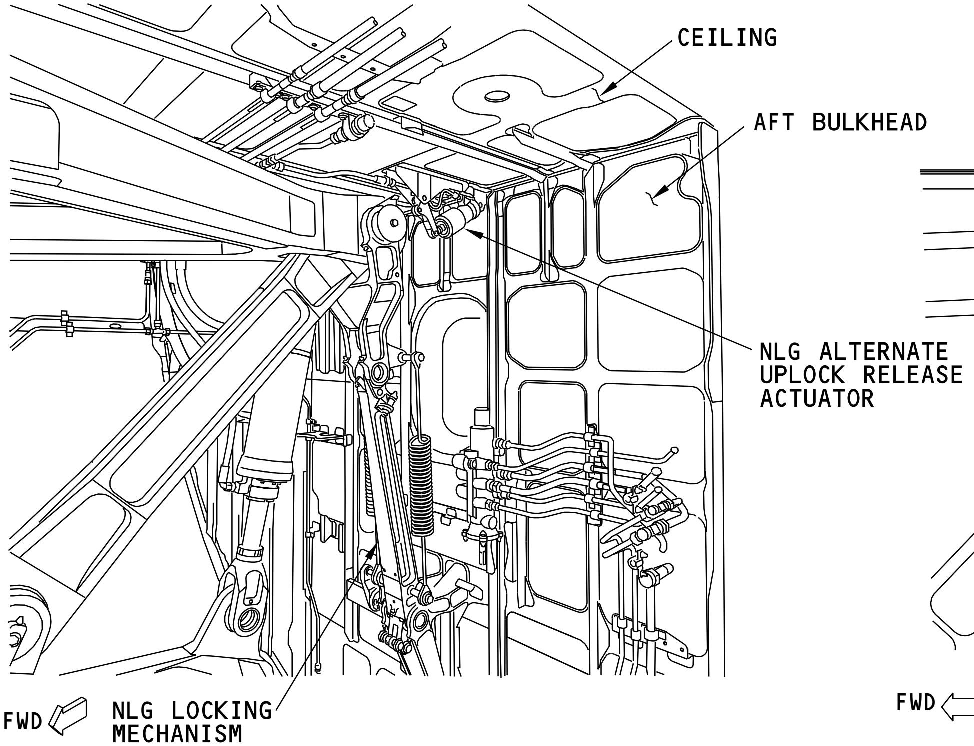
The nose landing gear alternate uplock release actuator is in the aft-top corner of the nose wheel well.

Functional Description

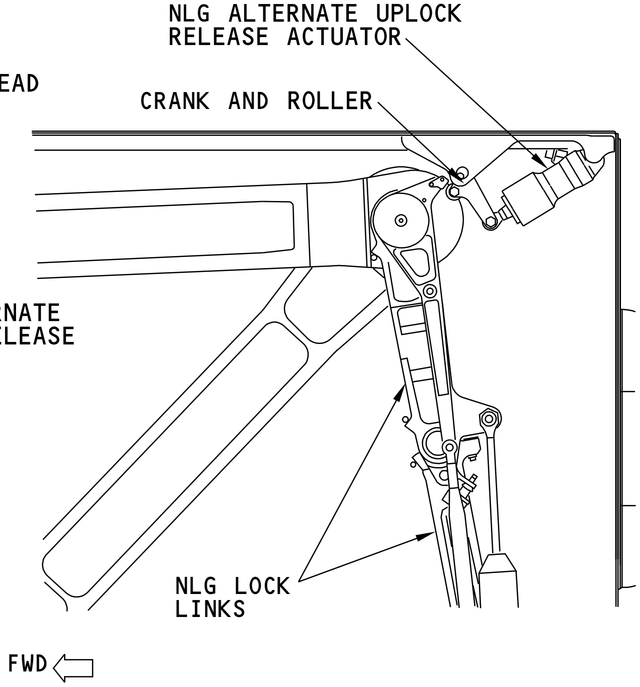
The actuator extends when it gets alternate extend pressure.

The nose gear alternate uplock release actuator moves a crank. A roller on the crank moves and unlocks the nose landing gear lock links.

A spring inside the actuator returns the actuator to the retracted position after an alternate extension.



NLG WHEEL WELL (AFT)
(NLG RETRACTED)



NLG ALTERNATE UPLOCK RELEASE
(SIDE VIEW)

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LANDING GEAR ALTERNATE EXTENSION SYSTEM - NLG ALTERNATE UPLOCK RELEASE ACTUATOR

LANDING GEAR ALTERNATE EXTENSION SYSTEM - ALTERNATE EXTEND HYDRAULIC PRESSURE SWITCH

Purpose

The alternate extend hydraulic pressure switch stops the alternate extend power pack when the extend cycle is complete.

Location

The alternate extend hydraulic pressure switch is on the ceiling in the NLG wheel well. It is near the NLG alternate uplock release actuator.

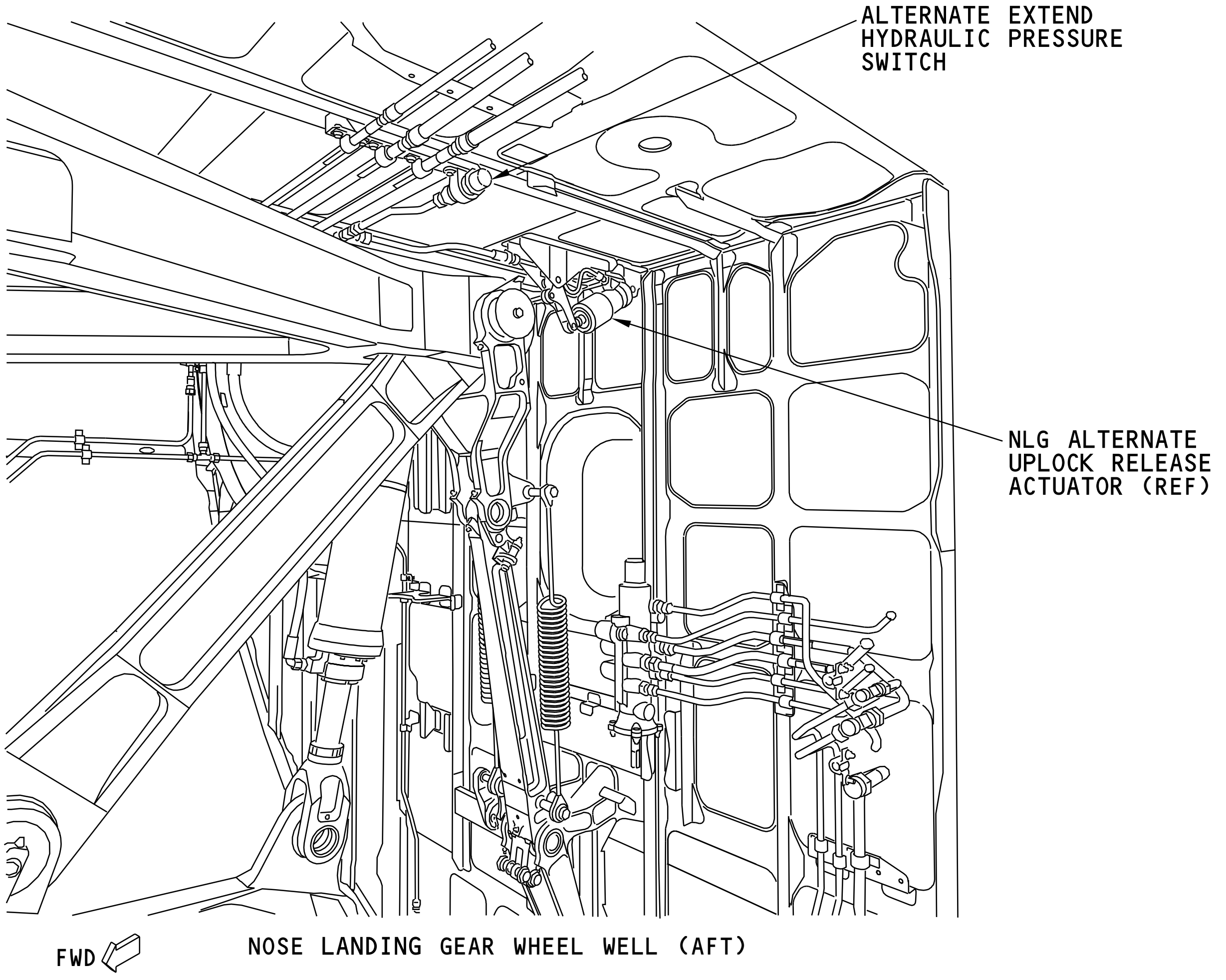
Functional Description

The pressure switch is in the hydraulic line between the NLG door release/safety valve module and the NLG alternate uplock release actuator.

The NLG alternate uplock release actuator is the farthest point in the alternate extension system from the power pack. It is the last component to get hydraulic pressure.

The switch opens when there is 2100 psi in the pressure line. This removes electrical power from the alternate extend power pack and it stops.

When the alternate extend pressure decreases below 1700 psi, the pressure switch closes to reset the alternate extension system.



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LANDING GEAR ALTERNATE EXTENSION SYSTEM - ALTERNATE EXTEND HYDRAULIC PRESSURE SWITCH

LANDING GEAR ALTERNATE EXTENSION SYSTEM - LANDING GEAR DOOR UNSAFE LIGHTS

Purpose

A red landing gear door unsafe light is in each wheel well. Each light turns on when the door is open and the wheel well is not safe to enter. The position of the safety valve in the landing gear door release/safety valve module controls the light.

Location

A main landing gear door unsafe light is on the lower part of the keel beam in each wheel well.

The nose landing gear door unsafe light is on the nose landing gear wheel well forward bulkhead above the right nose landing gear forward door.

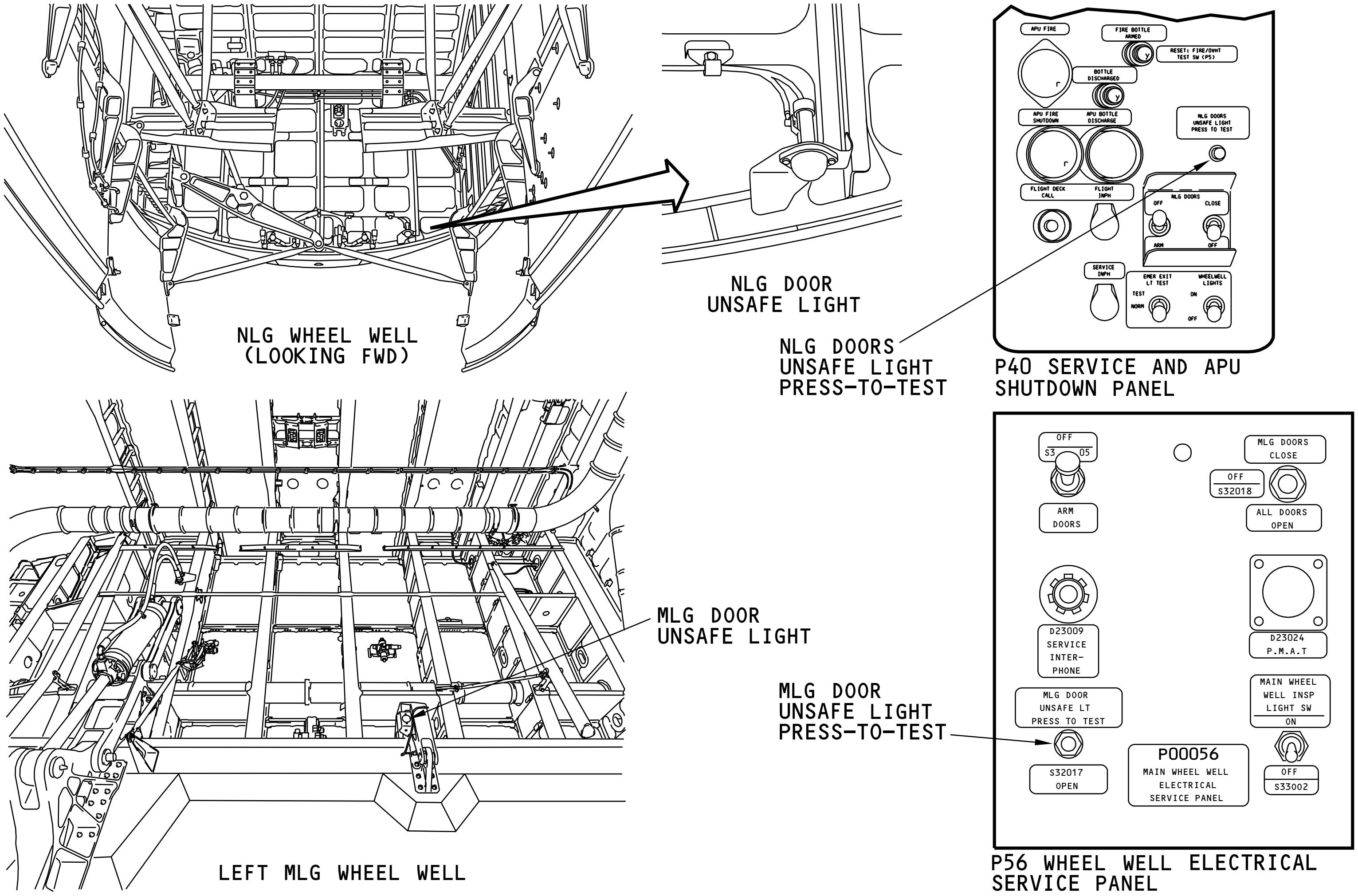
Training Information Point

A press-to-test switch on the main wheel well electrical service panel tests the operation of both main landing gear door unsafe lights.

A press-to-test switch on the service and APU shutdown panel tests the operation of the nose landing gear door unsafe light.

WARNING MAKE SURE THE DOOR UNSAFE LIGHT IN EACH WHEEL WELL FOR THE MAIN LANDING GEAR IS OFF. IF A DOOR UNSAFE LIGHT IS ON, DO NOT GO INTO THE RELATED WHEEL WELL. WHEN A DOOR UNSAFE LIGHT IS ON, THE DOOR FOR THE RELATED MAIN LANDING GEAR IS IN A NOT SAFE CONDITION AND CAN ACCIDENTALLY CLOSE. THE DOORS CLOSE QUICKLY AND CAN CAUSE INJURIES TO PERSONS OR DAMAGE TO EQUIPMENT.

WARNING MAKE SURE THE DOOR UNSAFE LIGHT IN THE WHEEL WELL FOR THE NOSE LANDING GEAR IS OFF. IF THE DOOR UNSAFE LIGHT IS ON, DO NOT GO INTO THE WHEEL WELL. WHEN THE DOOR UNSAFE LIGHT IS ON, THE DOORS FOR THE NOSE LANDING GEAR ARE IN A NOT SAFE CONDITION AND CAN ACCIDENTALLY CLOSE. THE DOORS CLOSE QUICKLY AND CAN CAUSE INJURIES TO PERSONS OR DAMAGE TO EQUIPMENT.



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LANDING GEAR ALTERNATE EXTENSION SYSTEM - LANDING GEAR DOOR UNSAFE LIGHTS

LANDING GEAR ALTERNATE EXTENSION SYSTEM - LANDING GEAR DOOR CLOSED SWITCHES

Purpose

The landing gear door closed switches supply landing gear door position input to control landing gear door unsafe light operation.

Each main landing gear door has a MLG door closed switch. The nose landing gear forward doors have a single NLG door closed switch.

Physical Description

The switches are mechanical plunger-type switches. They operate by direct contact with the landing gear door.

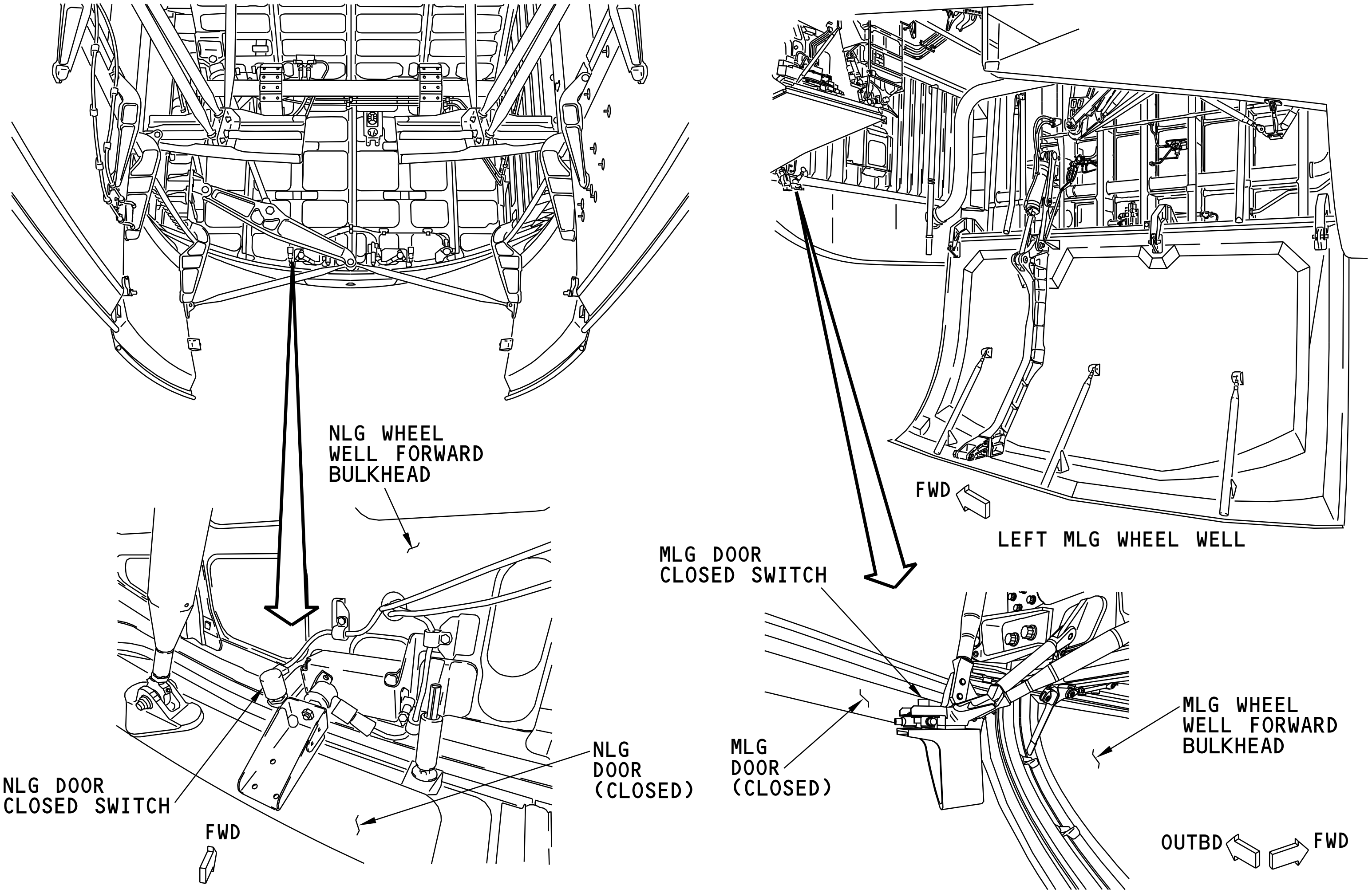
The switches open when the landing gear doors are closed. The door unsafe lights are always off when the LG doors are closed.

The switches close when the LG doors are open.

Location

The NLG door closed switch is on the forward bulkhead of the nose landing gear wheel well.

A MLG door closed switch is in the outboard forward corner of each main landing gear wheel well on the forward door stop.



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LANDING GEAR ALTERNATE EXTENSION SYSTEM - LANDING GEAR DOOR CLOSED SWITCHES

LANDING GEAR ALTERNATE EXTENSION SYSTEM - LG DOOR UNSAFE LIGHTS - FUNCTIONAL DESCRIPTION

General

The landing gear door unsafe lights come on when a landing gear door is open and the safety valve in the landing gear door release/safety valve module is in the NORMAL position.

Inputs

The 28v dc hot battery bus supplies power for operation of the landing gear door unsafe lights.

The safety latch position sensing switch in the door release/safety valve modules supply safety valve position inputs.

The door closed switches supply landing gear door position inputs.

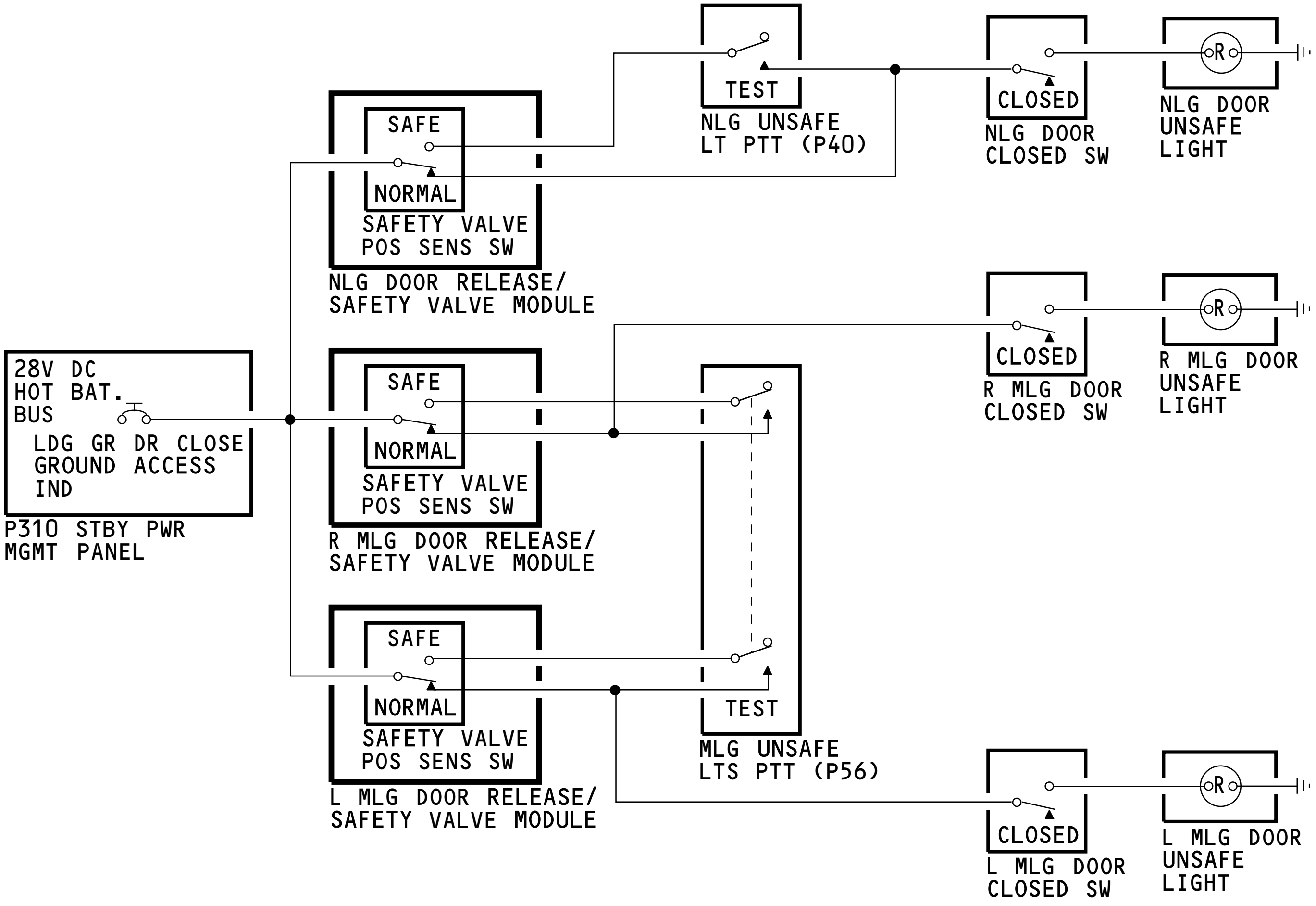
Press-To-Test

The nose landing gear press-to-test switch lets you do a test of the nose landing gear unsafe light when the nose gear door is open and the safety valve is SAFE.

The main landing gear press-to-test switch lets you do a test of both main landing gear unsafe lights when the main landing gear doors are open and the safety valves are SAFE.

Training Information Point

During normal operation of the landing gear extension-retraction system, the safety valves in the door release/safety valve modules are in the NORMAL positions. The LG door unsafe lights turn on while the LG doors are open during normal landing gear extension and retraction.



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LANDING GEAR ALTERNATE EXTENSION SYSTEM - LG DOOR UNSAFE LIGHTS - FUNCTIONAL DESCRIPTION

LANDING GEAR ALTERNATE EXTENSION SYSTEM - FUNCTIONAL DESCRIPTION - ELECTRICAL

General

A switch on the P2 center instrument panel or switches on the wheel well electrical service panel (P56) start alternate extend power pack operation.

Alternate Extension System Operation

The alternate gear switch is a two position (NORM and DOWN) guarded toggle switch. It is a momentary switch and is spring-loaded to NORM.

When you push the alternate gear switch, the alternate extend control relays in ELMS energize. These relays have a latching circuit which keep them energized after you release the alternate gear switch.

The relays permit power from the hot battery bus to go to the alternate extend power pack.

The alternate extend power pack comes on and supplies hydraulic pressure for alternate extend operation.

After all doors and gear are unlocked, the alternate extend hydraulic pressure increases. At 2100 psi, the alternate extend hydraulic pressure switch opens and removes electrical power in the latching circuits for both alternate extend control relays. This removes electrical power from the alternate extend power pack.

Ground Door Operation

Ground door operation is almost the same as operation with the alternate gear switch.

The only difference is that you use the switches on the P56 panel to power the alternate extend control relays.

Indications

The PSEUs monitor the alternate extend control relays.

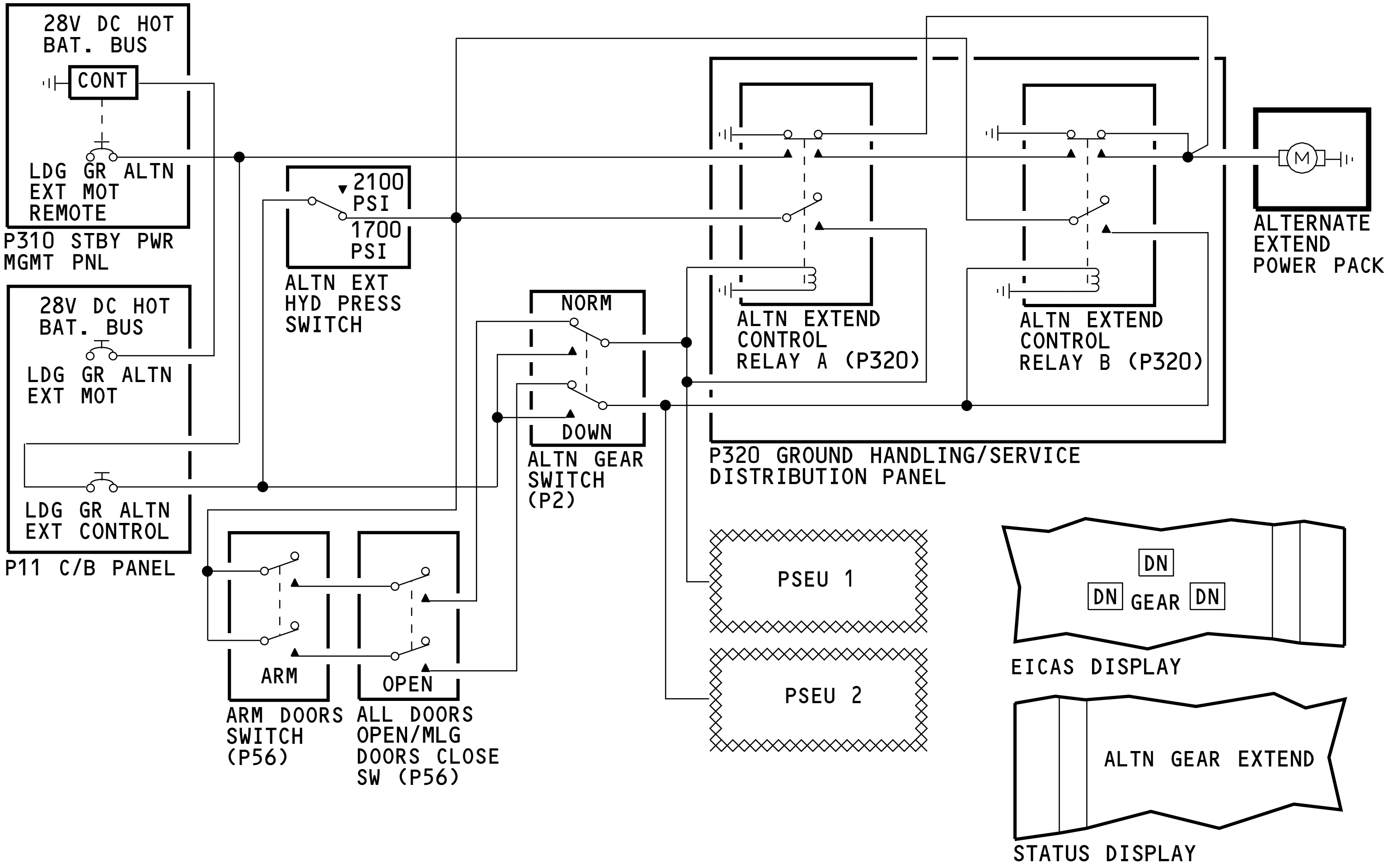
When you operate the alternate extend switch or the ground door release switches, the gear display on the EICAS expands to the multi-symbol display. The multi-symbol display shows the position of each gear. The display remains expanded until all landing gear doors are closed.

The position of each door shows on the landing gear synoptic display. The GEAR DOOR advisory message shows on the EICAS when the alternate extension system is energized. The GEAR DOOR advisory message stays displayed until all of the doors close.

If either or both relays are energized for more than 60 seconds, the ALTN GEAR EXTEND message shows on the status display. Since the normal alternate extension cycle is less than 60 seconds, this indicates a system fault.

Training Information Point

To manually remove power from the alternate extension system, you pull the LDG GR ALTN EXT MOT circuit breaker on the P11 panel. This circuit breaker controls the LDG GR ALTN EXT MOT REMOTE circuit breaker on the P310 standby power management panel.



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LANDING GEAR ALTERNATE EXTENSION SYSTEM - FUNCTIONAL DESCRIPTION - ELECTRICAL

LANDING GEAR ALTERNATE EXTENSION SYSTEM - FUNCTIONAL DESCRIPTION - HYDRAULIC

General

The alternate extend power pack pressurizes hydraulic fluid from the center hydraulic system.

Pressure goes to the MLG and the NLG selector/bypass valves. If the selector valve is in the UP or OFF position, the bypass valve moves to the BYPASS position to let the gear extend. See the landing gear control section for more information about the landing gear selector/bypass valves (SECTION 32-31).

The MLG and NLG alternate extend components operate the same. Each MLG and the NLG have these components:

- Landing gear door release/safety valve module
- Landing gear alternate uplock release actuator.

There is one alternate extend hydraulic pressure switch located in the NLG wheel well.

Landing Gear Door Release/Safety Valve Module

Alternate extend pressure extends the door release actuator. This actuator releases the landing gear door which then opens by gravity and airloads.

As the door release actuator extends, the safety valve moves to the SAFE position. The safety valve is latched in the SAFE position.

After it extends, the door release actuator sends pressure to the landing gear alternate uplock release actuator.

Landing Gear Alternate Uplock Release Actuator

The landing gear alternate uplock release actuator extends to unlock the landing gear uplock. This permits gravity and airloads to extend the gear. The tires may contact the door during alternate extension.

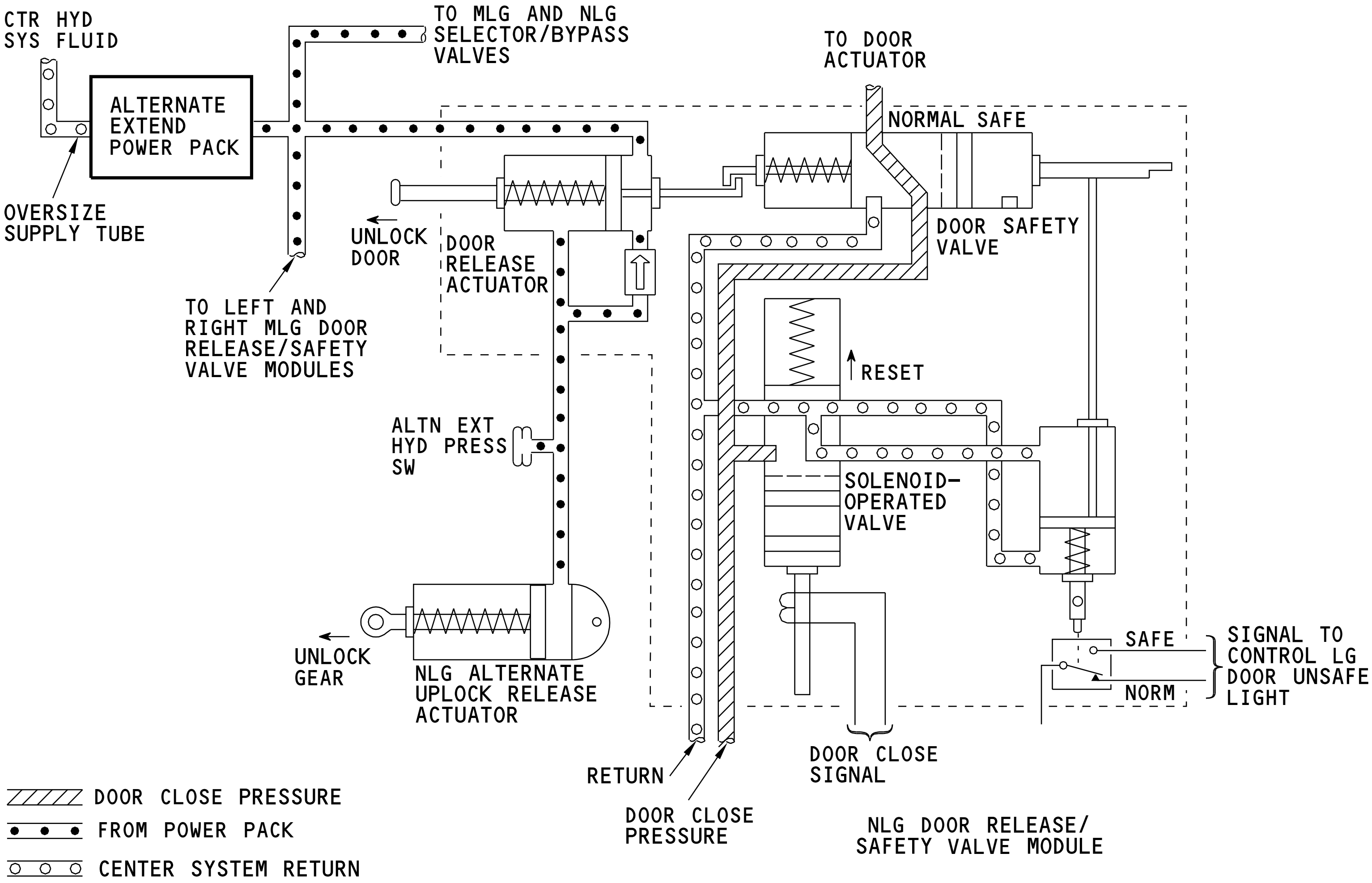
Alternate Extend Hydraulic Pressure Switch

After all doors and gear are unlocked, hydraulic pressure in the alternate extension system increases. When the pressure gets to 2100 psi, the alternate extend hydraulic pressure switch opens. This removes electrical power from the alternate extend control relays. The relays de-energize and remove electrical power from the alternate extend power pack.

Reset

When the alternate extend power pack stops, the alternate uplock release actuator and the door release actuator in the door release/safety valve reset. The springs in the actuators push the hydraulic fluid through the alternate extend power pack and into the oversize supply tube.

The door safety valve in the door release/safety valve module remains in the SAFE position until it is reset. This prevents the door from closing. The door safety valve is reset by an electric signal to the solenoid operated valve. Switches on the P40 and P56 panels, or a switch within the landing gear control lever module provide the reset signal. When the solenoid energizes, the valve permits hydraulic pressure to release the safety valve latch. The reset signal must be made while door close hydraulic pressure is available. When the valve moves to the NORMAL position, the door closes.



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LANDING GEAR ALTERNATE EXTENSION SYSTEM - FUNCTIONAL DESCRIPTION - HYDRAULIC

LANDING GEAR ALTERNATE EXTENSION SYSTEM - LANDING GEAR DOOR CLOSE OPERATION

General

You can close the landing gear doors with the door close switches or with the landing gear lever. The center hydraulic system supplies the pressure to close the landing gear doors.

MLG and NLG gear door close operation is almost the same.

Door Close Operation

You close the two main landing gear doors at the same time with switches on the P56 wheel well electrical service panel.

You close the nose landing gear doors with switches on the P40 service and APU shutdown panel.

The landing gear lever closes all the landing gear doors only after the gear have retracted. The landing gear door close signal from the landing gear lever goes through a five second time delay relay in the P320 ground handling/service distribution panel. When you move the landing gear lever to the UP position, the solenoids in the door release/safety valve modules get power five seconds later. This delay gives the selector valves time to move to the UP position. This prevents the safety valve from accidental movement to the NORMAL position before the selector valve has time to move. The delay makes sure the door release/safety valve modules are reset by the lever only after the gear retract.

For any door close signal, power from the 28v dc left main bus goes to the solenoid valves in the landing gear door release/safety valve modules.

To close the doors, the door close signal must be made at the same time door close hydraulic pressure is available.

Training Information Point

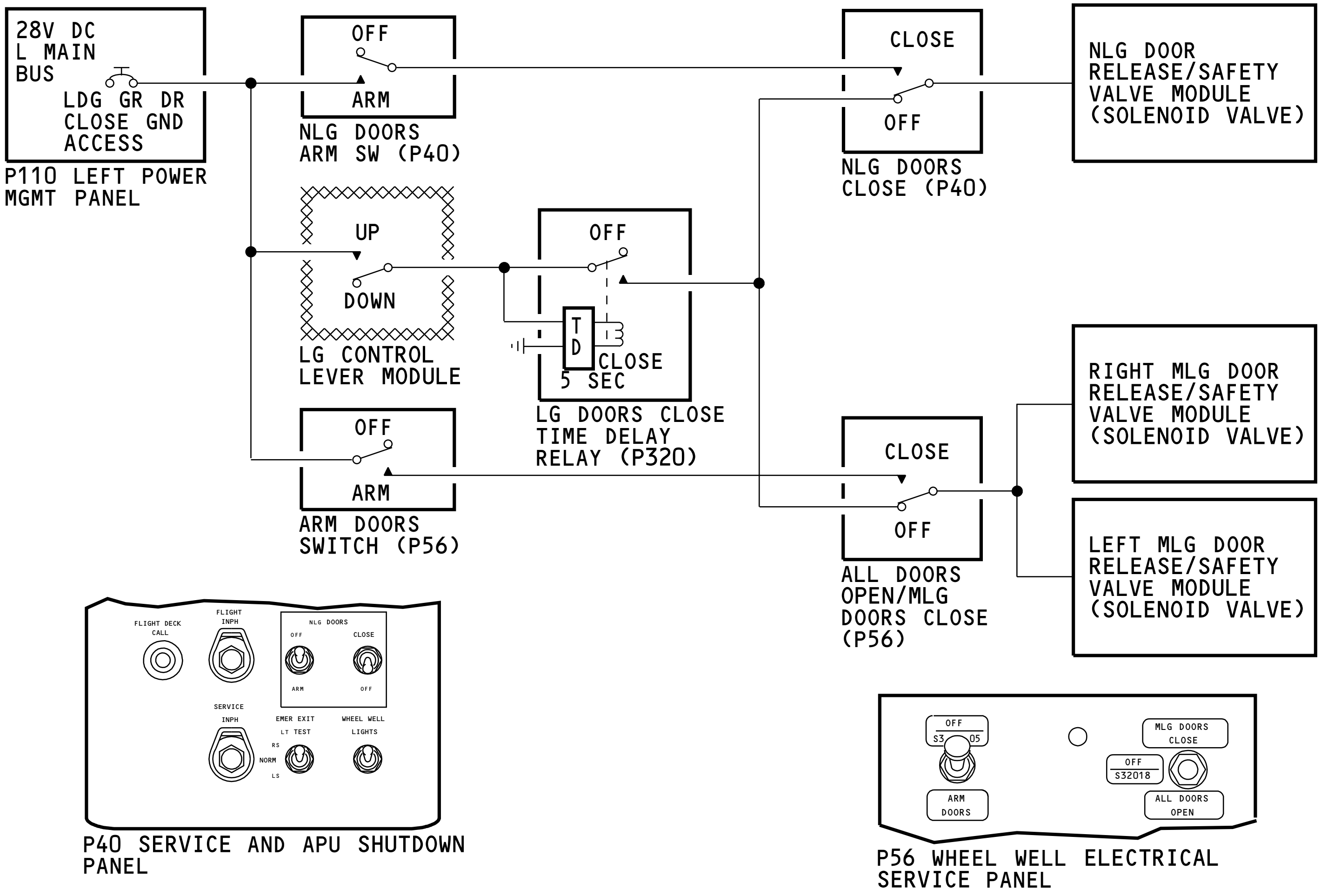
When you use the switches on the P56 panel, the main landing gear doors close in approximately 10 seconds.

⚠ **WARNING** MAKE SURE THE AREA AROUND THE DOORS FOR THE MAIN LANDING GEAR IS CLEAR OF PERSONS AND EQUIPMENT. THE DOORS CLOSE QUICKLY AND CAN CAUSE INJURY TO PERSONS OR DAMAGE TO EQUIPMENT.

When you use the switches on the P40 panel, the nose landing gear doors close in approximately 5 seconds.

⚠ **WARNING** MAKE SURE THE AREA AROUND THE DOORS FOR THE NOSE LANDING GEAR IS CLEAR OF PERSONS AND EQUIPMENT. THE DOORS CLOSE QUICKLY AND CAN CAUSE INJURY TO PERSONS OR DAMAGE TO EQUIPMENT.

Once the door close operation starts, you can not stop the operation with the switches on the remote panels.



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LANDING GEAR ALTERNATE EXTENSION SYSTEM - LANDING GEAR DOOR CLOSE OPERATION

LANDING GEAR ALTERNATE EXTENSION SYSTEM - BLEED VALVES

General

Four bleed valves let you bleed air from the alternate extension system. You need to bleed the alternate extension system when you replace some of the alternate extension system components.

Location

The bleed valves are near these components:

- The NLG selector/bypass valve (NLG wheel well)
- The NLG alternate uplock release actuator (NLG wheel well)
- The left and right MLG alternate uplock release actuators (left and right MLG wheel wells).

Training Information Point

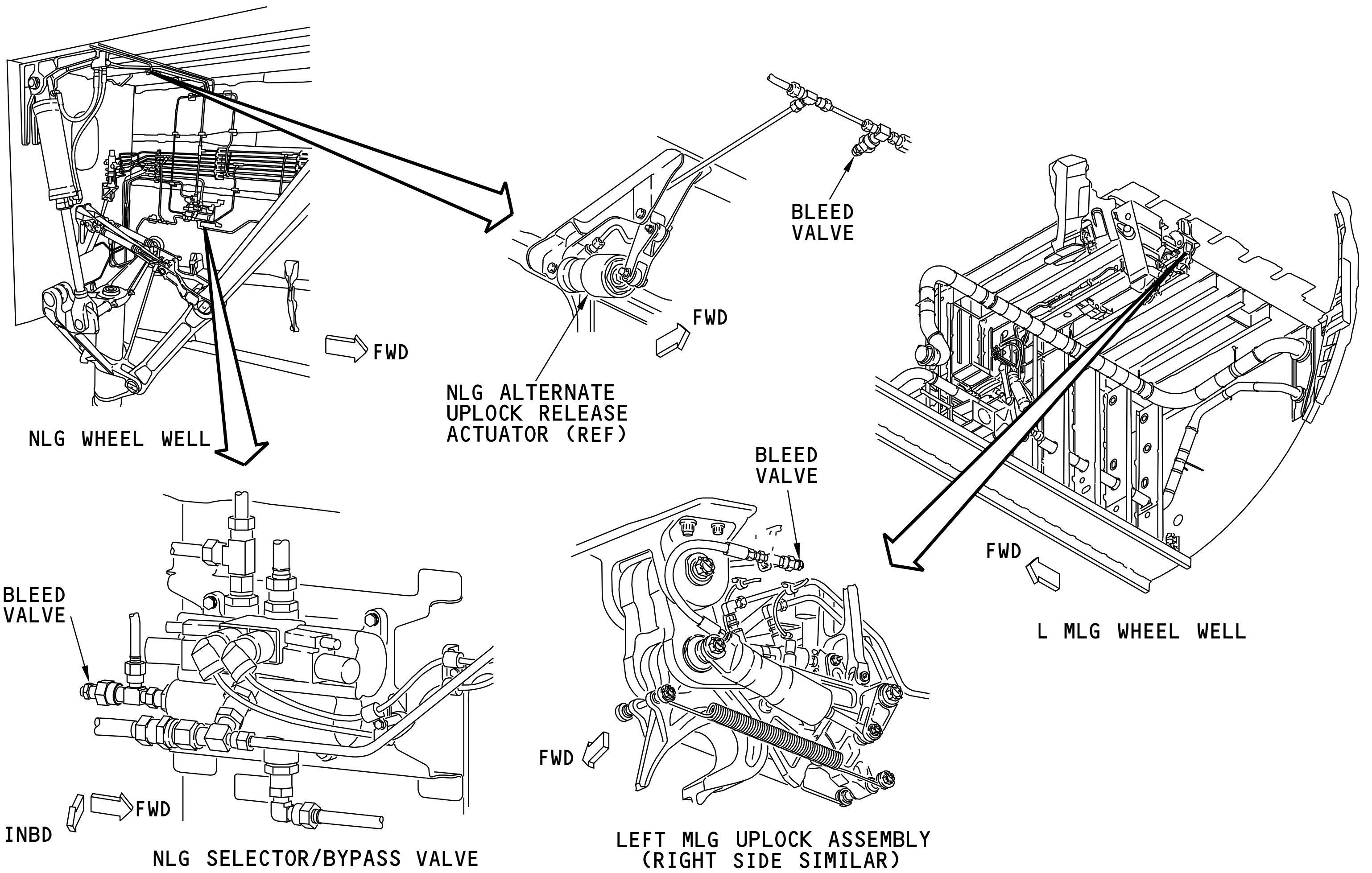
You operate the alternate extend power pack when you bleed the alternate extension system.

NOTE: The alternate extend power pack operates when you command the landing gear doors open with the ground door release system.

NOTE: The EICAS displays indicate non-normal sequencing during this test.

NOTE: The power pack remains ON until the LDG GR ALTN EXT CONTROL circuit breaker is opened. (The pressure switch that usually stops the power pack does not work since you are bleeding the system.)

⚠ CAUTION MAKE SURE YOU DO NOT RUN THE ALTERNATE EXTEND POWER PACK FOR MORE THAN FIVE MINUTES. IF YOU RUN THE POWER PACK FOR MORE THAN FIVE MINUTES, THE POWER PACK CAN GET TOO HOT. THIS CAN CAUSE DAMAGE TO THE EQUIPMENT.



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LANDING GEAR ALTERNATE EXTENSION SYSTEM - BLEED VALVES

WHEELS AND BRAKES - INTRODUCTION

General

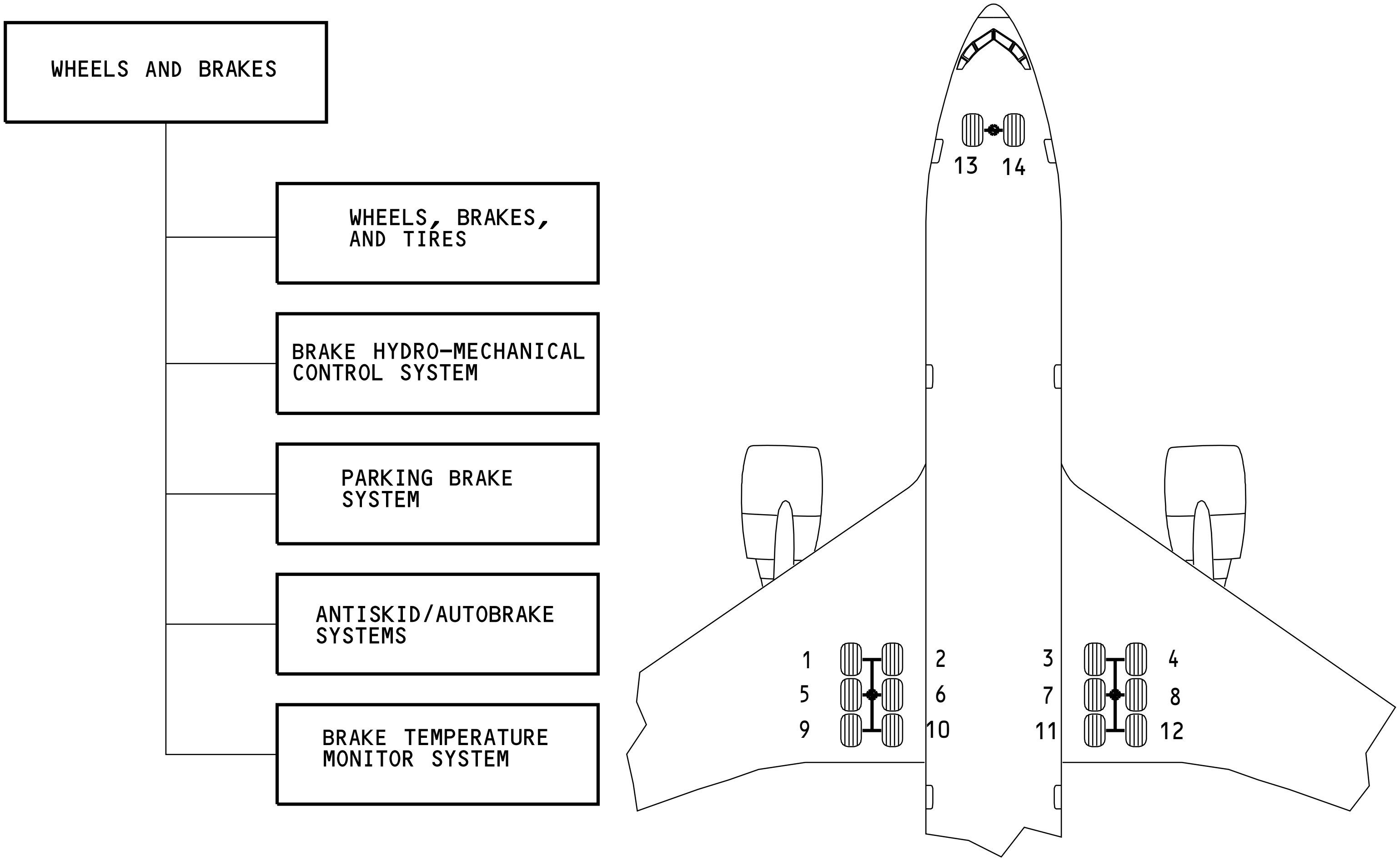
The wheels and brakes system includes:

- Wheels, brakes, and tires (SECTION 32-45)
- Brake hydro-mechanical control system (SECTION 32-41)
- Parking brake system (SECTION 32-44)
- Antiskid/autobrake systems (SECTION 32-42)
- Brake temperature monitor system (BTMS) (SECTION 32-46).

Abbreviations and Acronyms

- A/B - autobrake
- ACMP - alternating current motor pump
- ADIRU - air data inertial reference unit
- AIMS - airplane information management system
- AIV - accumulator isolation valve
- altn - alternate
- ARINC - aeronautical radio, inc
- ASSV - alternate source selection valve
- A/S - antiskid
- bat - battery
- BITE - built-in test equipment
- brk - brake
- BSCU - brake system control unit
- BTMS - brake temperature monitor system
- BTMU - brake temperature monitor unit
- capt - captain
- ctr - center
- ctrl - control
- DC - direct current
- decel - deceleration
- ft - feet
- fwd - forward
- gnd - ground
- gr - gear
- hyd - hydraulic
- ind - indication
- kts - knots
- ldg - landing
- LG - landing gear
- LRU - line replaceable unit
- lt - left
- mdl - module
- MD&T - master dim and test
- MFD - multi-function display
- MLG - main landing gear
- mtrd - metered
- NLG - nose landing gear
- press - pressure
- PSEU - proximity sensor electronic unit
- psi - pounds per square inch
- psig - pounds per square inch gage
- pwr - power
- ref - reference
- rel - release
- rqst - request
- rt - right
- RTO - rejected takeoff
- sec - second
- sel - selector
- sig - signal

- sol - solenoid
- spd - speed
- stby - standby
- strg - steering
- sw - switch
- sys - system
- temp - temperature
- vlv - valve
- whl - wheel
- WIU - wheel interface unit
- xdcr - transducer.



WHEELS, TIRES, AND BRAKES NUMBERING SYSTEM

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WHEELS AND BRAKES - INTRODUCTION

WHEELS AND BRAKES - SUMMARY

General

The airplane rests on 14 wheels and tires.

Control for the brake system pressure comes from the hydro-mechanical, parking brake, and autobrake systems.

The antiskid system supplies protection to the tires from skid conditions.

The brake temperature monitor system shows brake temperature data on the flight deck.

Wheels, Brakes, and Tires

There are two nose gear wheel and tire assemblies and six assemblies on each main gear truck.

The main wheel and tire assemblies use multiple-disc carbon brakes. The nose wheel and tire assemblies do not have hydraulic brakes.

Brake Hydro-Mechanical Control System

The hydro-mechanical control system controls hydraulic pressure to the brakes.

The brake system has separate normal and alternate systems.

Brake pedal movement controls hydraulic pressure to the main landing gear brakes.

The brakes apply during landing gear retraction through the alternate brake metering valves.

Parking Brake System

The parking brake system latches the brake pedals in the brakes applied position.

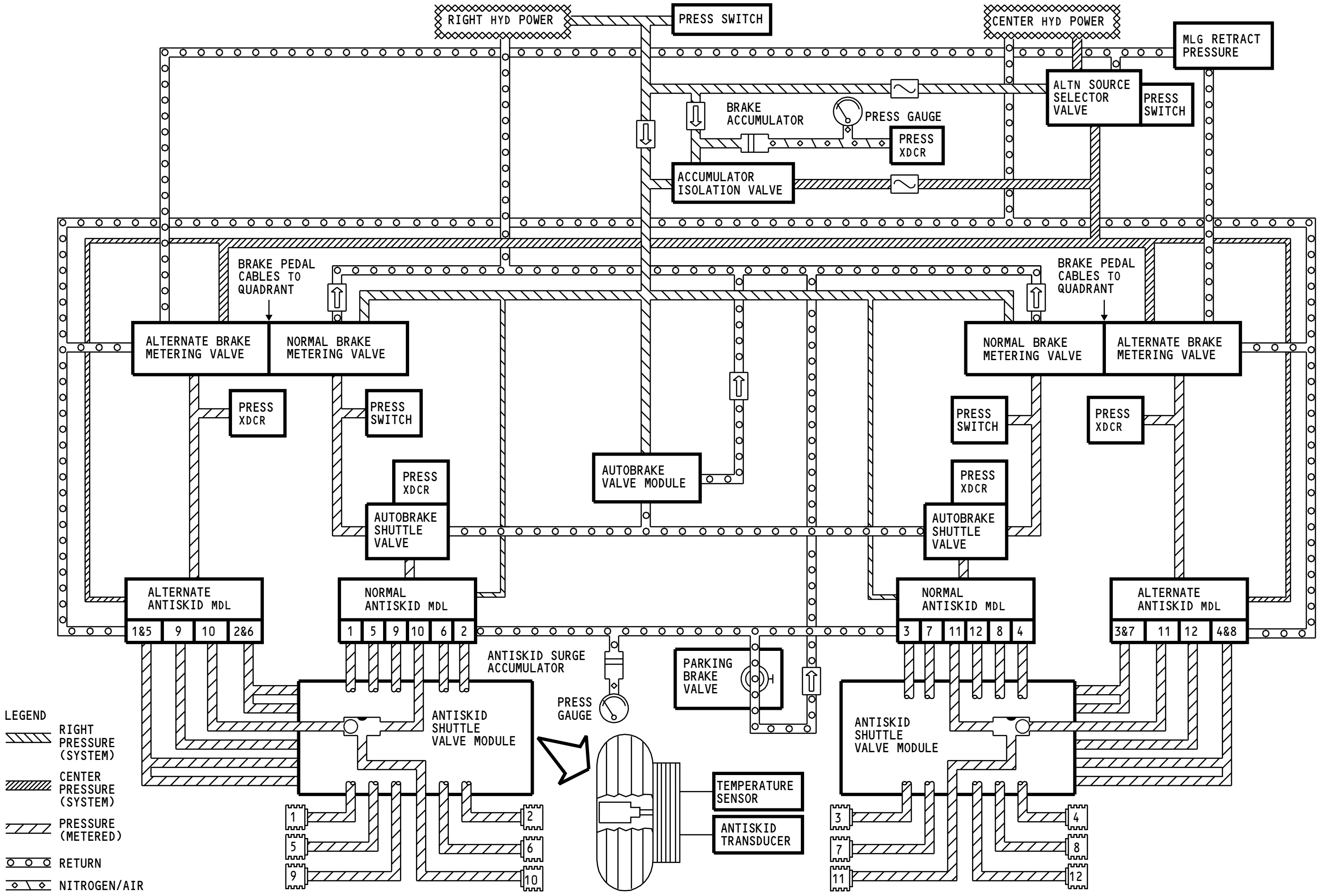
Antiskid/Autobrake Systems

The antiskid system automatically decreases brake pressure to prevent tire skid conditions.

The autobrake system automatically applies hydraulic pressure to the brakes during landing or a rejected takeoff.

Brake Temperature Monitoring System (BTMS)

The BTMS monitors brake temperatures and shows brake temperature data on the landing gear synoptic display and the brake and steering maintenance page.



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WHEELS AND BRAKES - SUMMARY

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BRAKE HYDRO-MECHANICAL CONTROL - INTRODUCTION

Purpose

The brake hydro-mechanical system supplies manual control of the main landing gear brakes.

Brake hydraulic source selection uses two valves to automatically control different pressure sources to supply these brake functions:

- Normal brakes
- Alternate brakes
- Reserve brakes
- Accumulator brakes
- Gear retract braking.

The brake pedals control the normal and the alternate brake systems.

Normal Brakes

When all the pressure sources are available, the normal brake system uses right hydraulic system pressure to operate the brakes.

Alternate Brakes

The alternate brake system uses center hydraulic system pressure to operate the brakes when right hydraulic system pressure is low.

Reserve Brakes

Reserve brakes use isolated center system pressure to pressurize the alternate brake system.

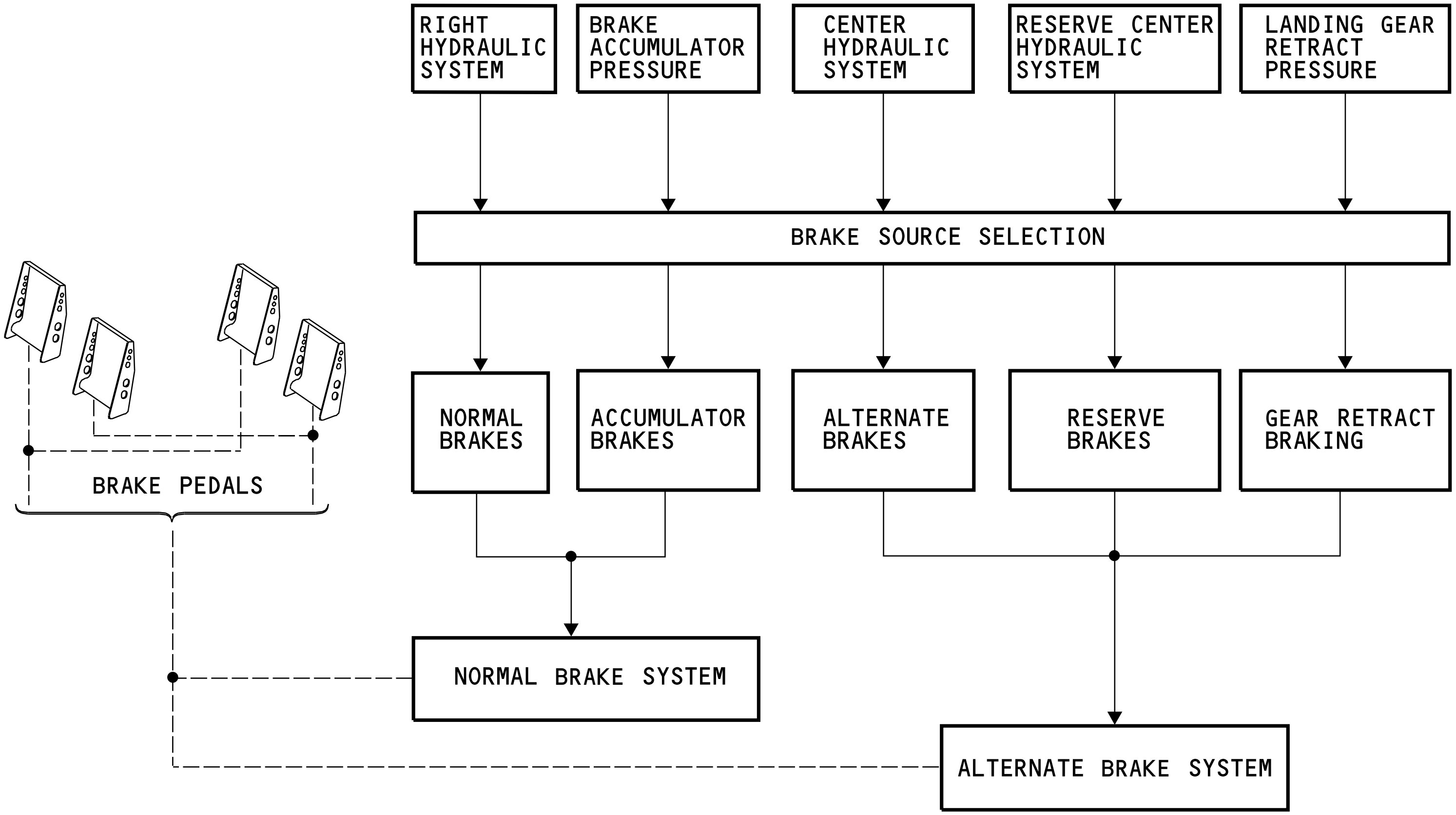
When the center hydraulic system reservoir is low, hydraulic system control isolates the output of the C1 ACMP for reserve brakes and nose wheel steering. This pump uses reserve fluid in the reservoir and pressurizes the alternate brake system.

Accumulator Brakes

When the normal, alternate, and reserve brake pressures are low, the accumulator pressurizes the normal brake system. The parking brake uses accumulator pressure when no other pressure sources are available.

Gear Retract Braking

The alternate brake system uses landing gear retract pressure to stop main gear wheel rotation during gear retraction.



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BRAKE HYDRO-MECHANICAL CONTROL - INTRODUCTION

BRAKE HYDRO-MECHANICAL CONTROL - FLIGHT DECK COMPONENTS

Flight Deck Components

The hydro-mechanical control system includes these components on or near the flight deck:

- Brake pedal bus mechanism
- Brake cables
- Brake accumulator pressure gage
- Brake source light.

Brake Pedal Bus Mechanism

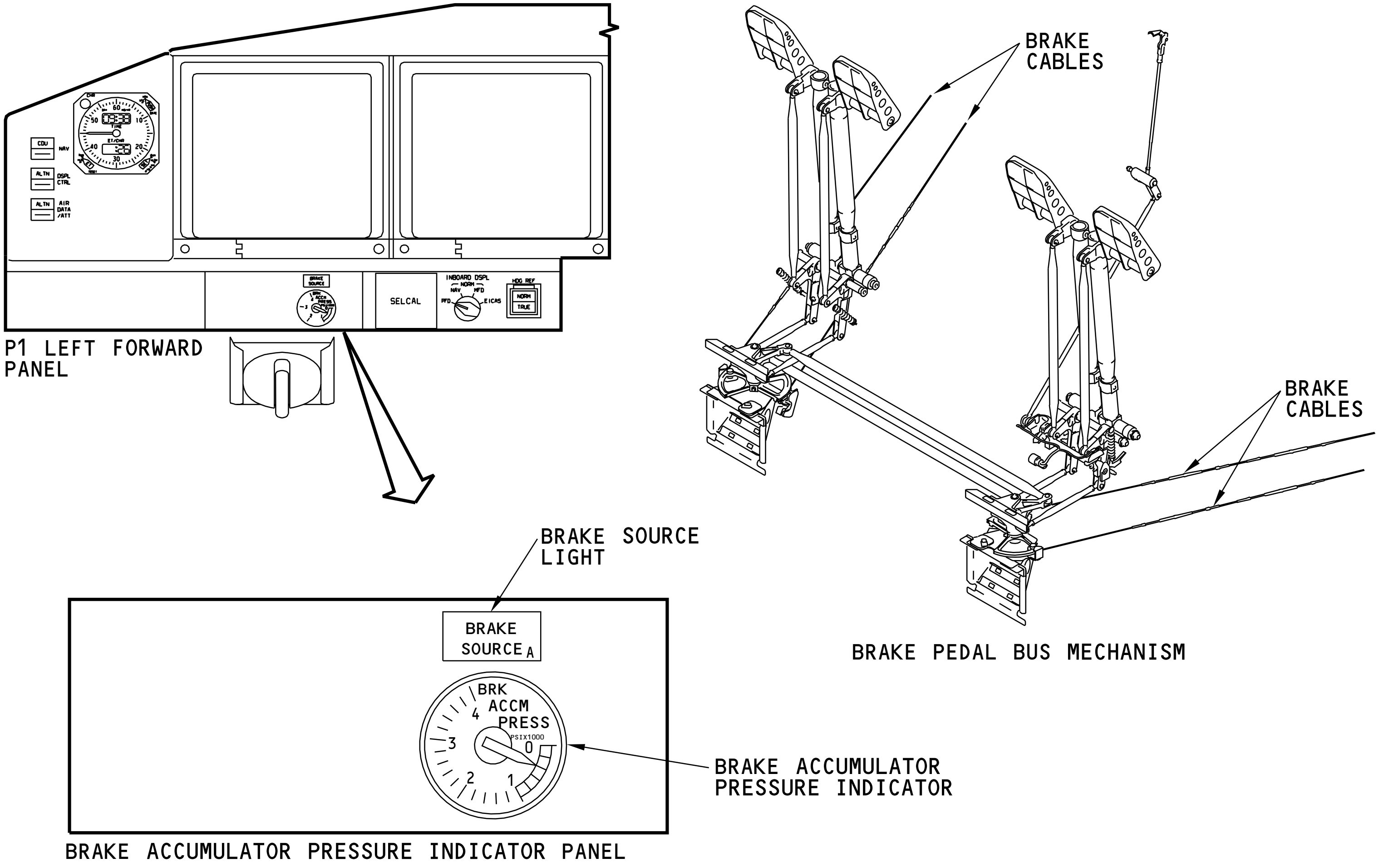
Most of the brake pedal bus mechanism components are below the flight deck floor. You get access to these components through the forward equipment center.

Brake Cables

Brake cables connect the brake pedal bus mechanism to the brake metering valves in the main landing gear wheel wells.

Brake Accumulator Pressure Gage and Brake Source Light

The brake accumulator pressure indicator and brake source light are on the P1 left forward panel.



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BRAKE HYDRO-MECHANICAL CONTROL - FLIGHT DECK COMPONENTS

BRAKE HYDRO-MECHANICAL CONTROL - MAIN LANDING GEAR WHEEL WELL COMPONENTS

Main Landing Gear Wheel Well Components

The hydro-mechanical control system includes these components in or near the left and right main landing gear wheel wells:

- Brake metering valves (2)
- Brake alternate source selector valve (ASSV)
- Brake accumulator isolation valve (AIV)
- Brake accumulator
- Brake accumulator servicing components
- Brake source pressure switch (2)
- Antiskid surge accumulator
- Antiskid surge accumulator servicing components.

Brake Metering Valves

The left and right brake metering valves are in the forward section of the main landing gear wheel wells.

Brake Alternate Source Selector Valve

The alternate source selector valve is in the left main landing gear wheel well inboard on the keel beam.

Brake Accumulator Isolation Valve

The accumulator isolation valve is in the right main landing gear wheel well inboard on the keel beam below the brake accumulator.

Brake Accumulator

The brake accumulator is on the keel beam in the right main landing gear wheel well.

Brake Accumulator Servicing Components

Brake accumulator servicing components are on the keel beam below and forward of the brake accumulator in the right main landing gear wheel well.

Brake Source Pressure Switch

There are two brake source pressure switches.

The normal brake hydraulic system pressure switch is in the right main landing gear wheel well on the keel beam inboard of the brake accumulator.

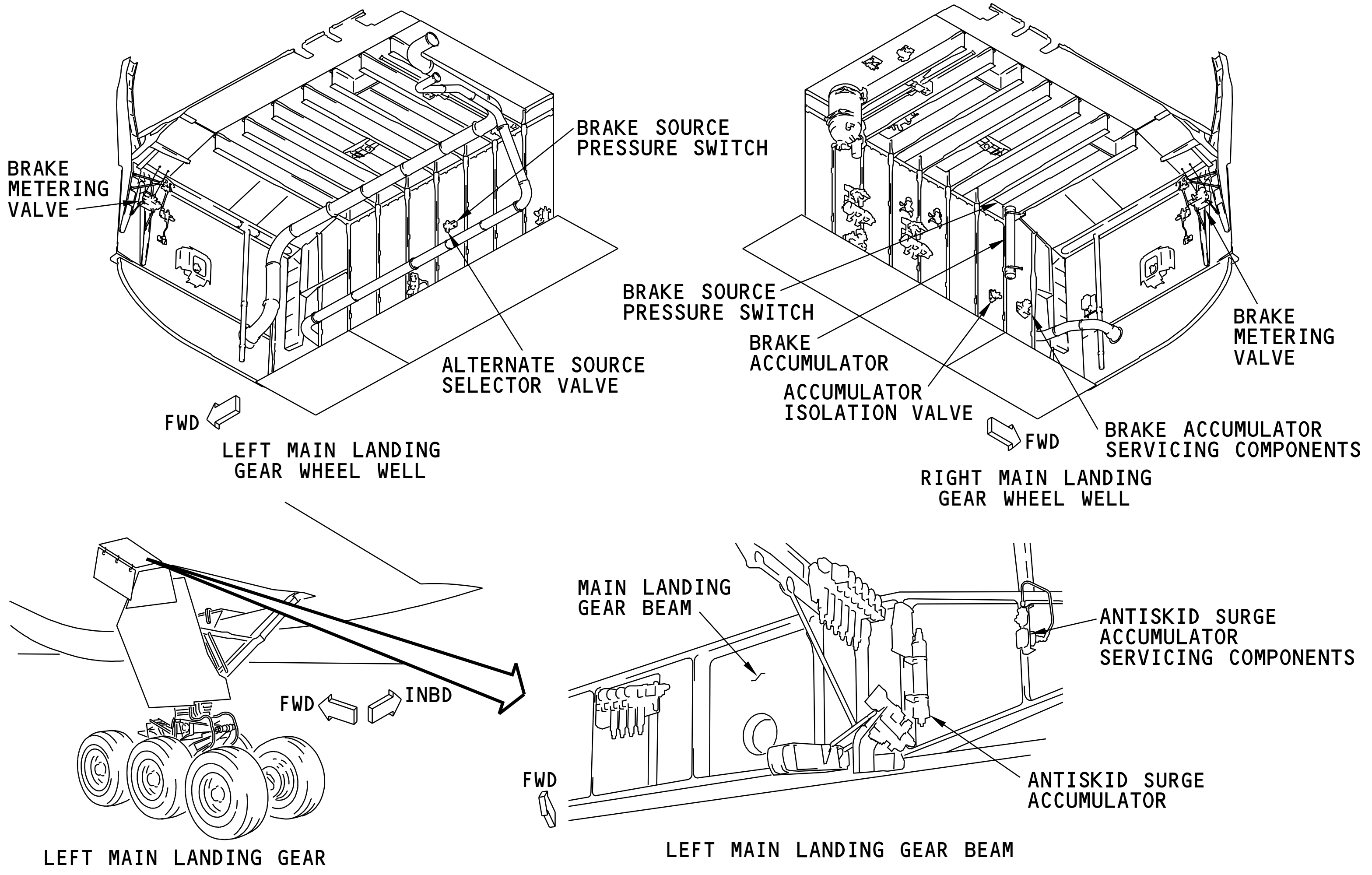
The alternate brake hydraulic system pressure switch is in the left main landing gear wheel well on the alternate source selector valve.

Antiskid Surge Accumulator

The antiskid surge accumulator is on the left main landing gear beam outboard of the landing gear trunnion.

Antiskid Surge Accumulator Servicing Components

Antiskid surge accumulator servicing components are on the left main landing gear beam outboard of the antiskid surge accumulator.



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BRAKE HYDRO-MECHANICAL CONTROL - MAIN LANDING GEAR WHEEL WELL COMPONENTS

BRAKE HYDRO-MECHANICAL CONTROL - BRAKE PEDAL BUS MECHANISM

Purpose

The brake pedal bus mechanism sends brake pedal inputs to manually control brake system pressure.

Components

These are the brake pedal bus mechanism components:

- Captain's and first officer's rudder pedals
- Vertical control rods (4)
- Lower bellcranks (4)
- Fore-aft control rods (4)
- Brake pedal bus crank assemblies (2)
- Cable quadrants (2)
- Transverse control rods (2)
- Brake cables (4).

Location

The rudder pedals are above the flight deck floor. The vertical control rods extend through the floor into the forward equipment center.

The brake cables attach to the brake pedal bus mechanism cable quadrants with a routing through the fuselage sides to the main landing gear wheel wells.

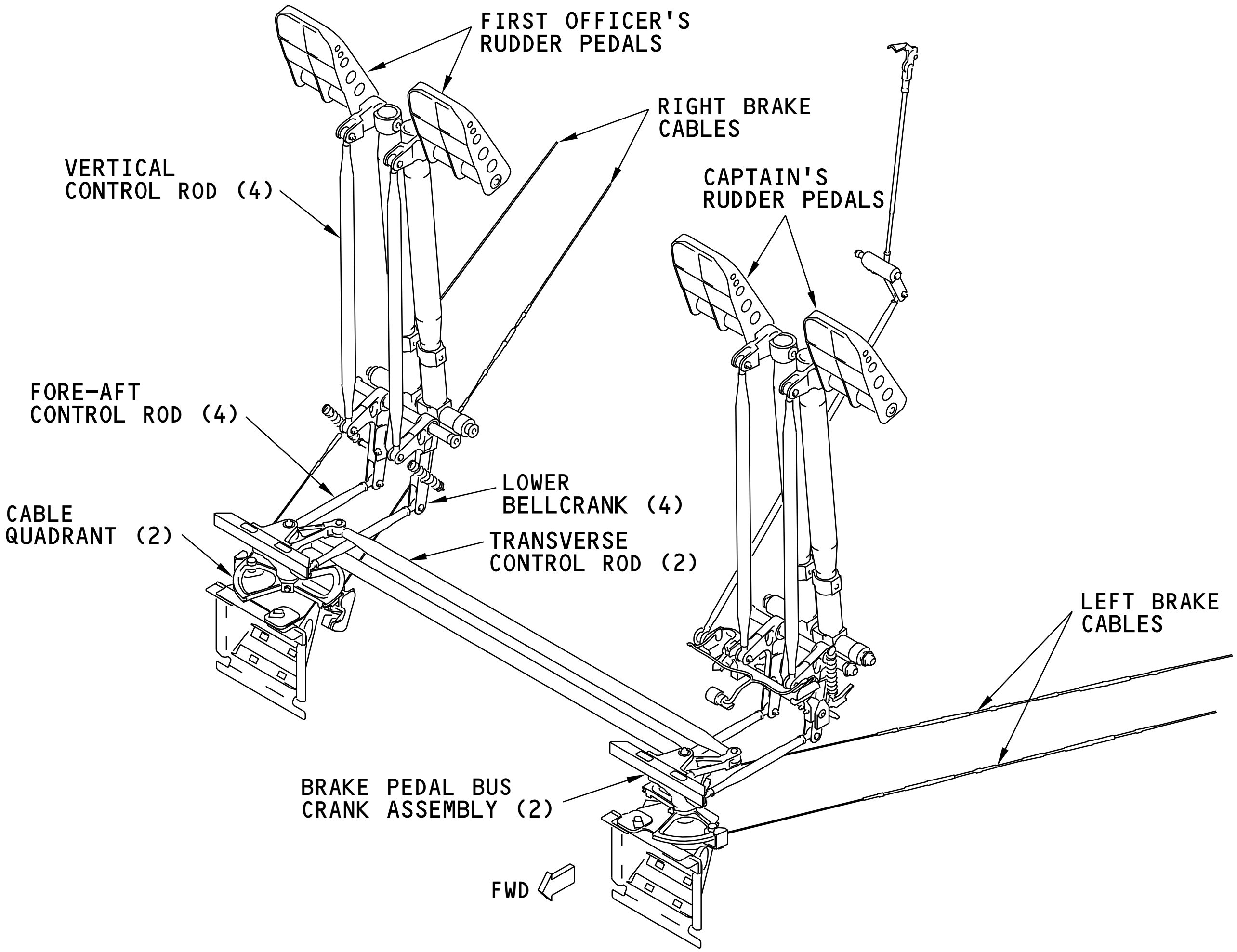
Functional Description

Two sets of brake pedals operate the brake pedal bus mechanism.

Pedal operation goes through vertical control rods to the lower bellcranks. These bellcranks connect to brake pedal bus crank assemblies and cable quadrants with fore-aft control rods.

Input to the left cable quadrant controls the left brakes with brake cables on the left side of the airplane. The right cable quadrant and cables are on the right side of the airplane and operate the same way as the left.

Transverse control rods connect the left and right brake pedal bus crank assemblies. This permits control of the left and right brakes with the captain's or the first officer's pedals.



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BRAKE HYDRO-MECHANICAL CONTROL - BRAKE PEDAL BUS MECHANISM

BRAKE HYDRO-MECHANICAL CONTROL - BRAKE METERING VALVE ASSEMBLY - GENERAL DESCRIPTION

Purpose

The brake metering valve assemblies get brake pedal input and control brake pressure.

Components

Each brake metering valve assembly includes these components:

- Brake metering valve actuation/support assembly
- Normal brake metering valve
- Alternate brake metering valve.

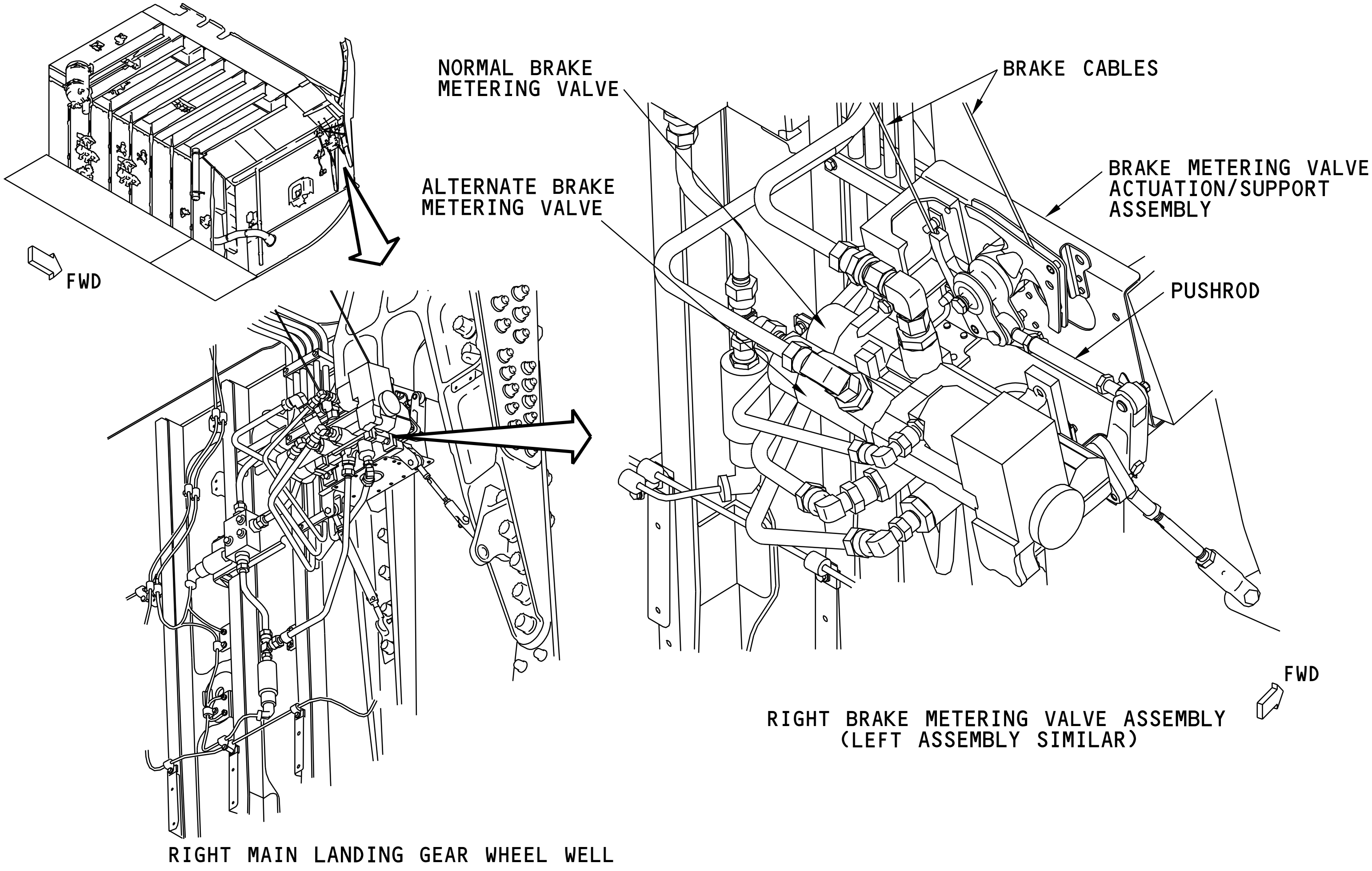
Location

Normal and alternate brake metering valves attach to each other to make the brake metering valve assembly. There is a brake metering valve in each main landing gear wheel well. Each attaches to a brake metering valve actuation/support assembly.

These brake metering valve assemblies attach to the wing rear spar side of body fitting in the forward section of each wheel well.

Training Information Point

You can replace the brake metering valve as a unit with no change in brake cable rigging. To do this, remove the brake metering valve from the actuation/support assembly. After installation of the new valve, you can make small adjustments with the pushrod in the actuation/support assembly.



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BRAKE HYDRO-MECHANICAL CONTROL - BRAKE METERING VALVE ASSEMBLY - GENERAL DESCRIPTION

BRAKE HYDRO-MECHANICAL CONTROL - BRAKE METERING VALVE ASSEMBLY - FUNCTIONAL DESCRIPTION

General

On the brake metering valve assembly, the normal and alternate brake metering valves are almost the same. They bolt together and use the same input shaft.

Only one valve at a time gets pressure except during gear retract braking. The alternate source selector valve and the accumulator isolation valve control which metering valve gets pressure.

The normal brake metering valve uses right hydraulic system and accumulator pressure for the normal brake system.

The alternate brake metering valve uses center/reserve hydraulic system pressure for the alternate brake system when the right hydraulic system has low pressure. It also uses pressure from the landing gear retract line to stop the main gear wheel rotation during retraction.

Normal and Alternate Brake Application

The brake pedal command goes to the metering valves through cables and linkage. This moves the metering valve input shaft.

When the input shaft turns, it moves the metering valve spools in both valves at the same time.

The metering valve spools are spring-loaded to the brakes OFF position.

Metering valve spool movement sends pressure to the brakes and to the feedback chamber. This pressure applies the brakes and causes the feedback chamber to move the metering spool back to the brake pressure maintained position.

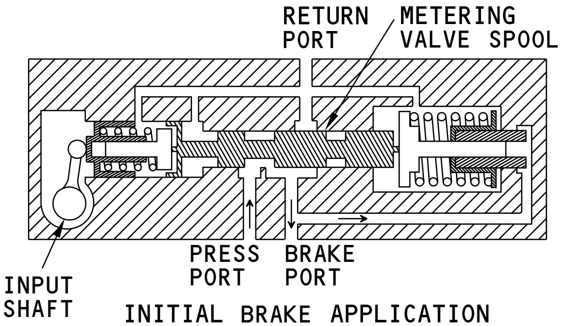
Brake pedal release permits the springs to return the metering spools in both valves to the brakes OFF position. This sends brake pressure to return and releases the brakes.

Gear Retract Wheel Braking

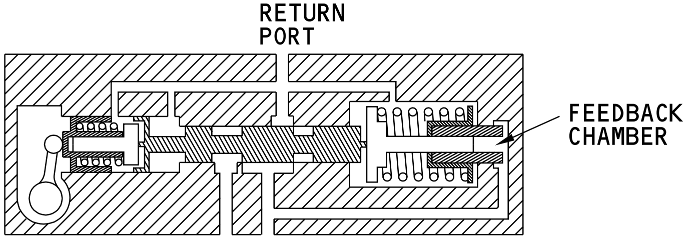
During landing gear retraction, landing gear retract pressure pressurizes the gear retract braking actuator.

The gear retract braking actuator moves a forked actuator lever to operate the alternate brake metering valve spool. This operation does not move the input shaft and does not back-drive the brake pedals.

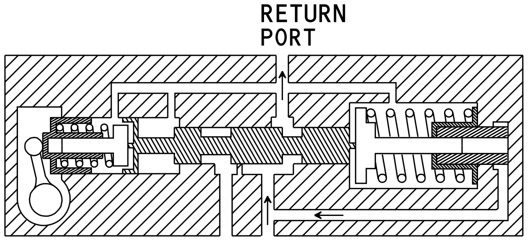
The movement of the alternate metering valve spool sends approximately 550 psi of pressure to the brakes.



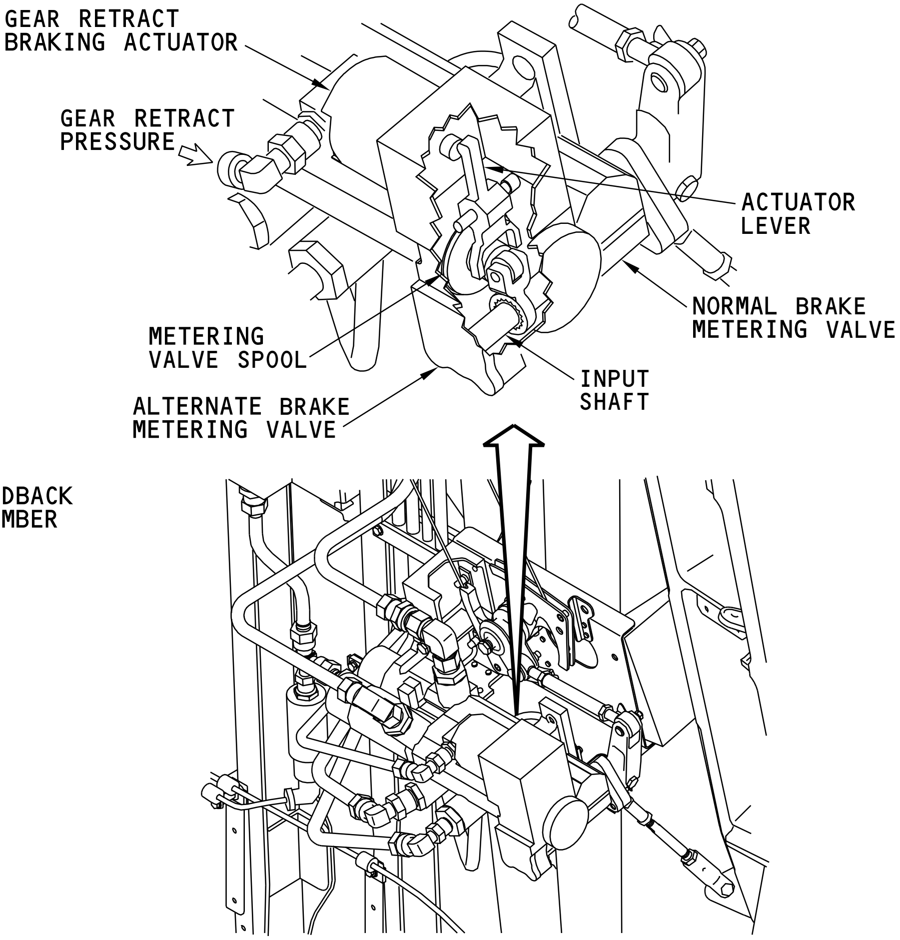
INITIAL BRAKE APPLICATION



BRAKE PRESSURE MAINTAINED



BRAKE RELEASED



BRAKE METERING VALVE ASSEMBLY

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BRAKE HYDRO-MECHANICAL CONTROL - BRAKE METERING VALVE ASSEMBLY - FUNCTIONAL DESCRIPTION

BRAKE HYDRO-MECHANICAL CONTROL - BRAKE ACCUMULATOR AND SERVICING COMPONENTS

General

The brake accumulator supplies brake pressure to the normal brake hydraulic system when the center and right hydraulic systems are off. It supplies enough pressure for six full brake applications or to keep the parking brake pressurized for eight hours.

Components

These are the brake accumulator and servicing components:

- Brake accumulator
- Charging valve
- Pressure transducer
- Pressure indicator (flight deck)
- Pressure indicator (wheel well).

Location

The brake accumulator and servicing components are on the keel beam in the right main wheel well.

The brake accumulator pressure indicator is on the brake accumulator pressure indicator panel on the P1 left forward panel below the brake source light.

Physical Description

The accumulator is a gas charged unit with a floating piston that separates the gas and the fluid sides. It has a precharge of 1000 psi and a volume of 600 cubic inches. The right hydraulic system pressurizes the accumulator.

The brake accumulator pressure transducer sends the pressure signal to the pressure indicator on the flight deck.

The pressure indicator in the main landing gear wheel well is used for inspection and servicing.

Charging instructions are on a placard by the charging valve and transducer.

Training Information Point

This is a summary of things you do to do a check of the accumulator precharge pressure:

- Make sure the right and center hydraulic systems are off
- Use the brake pedals to bleed hydraulic system pressure from the accumulator
- Compare the accumulator indicator pressure to the pressure on the charging instructions graph.

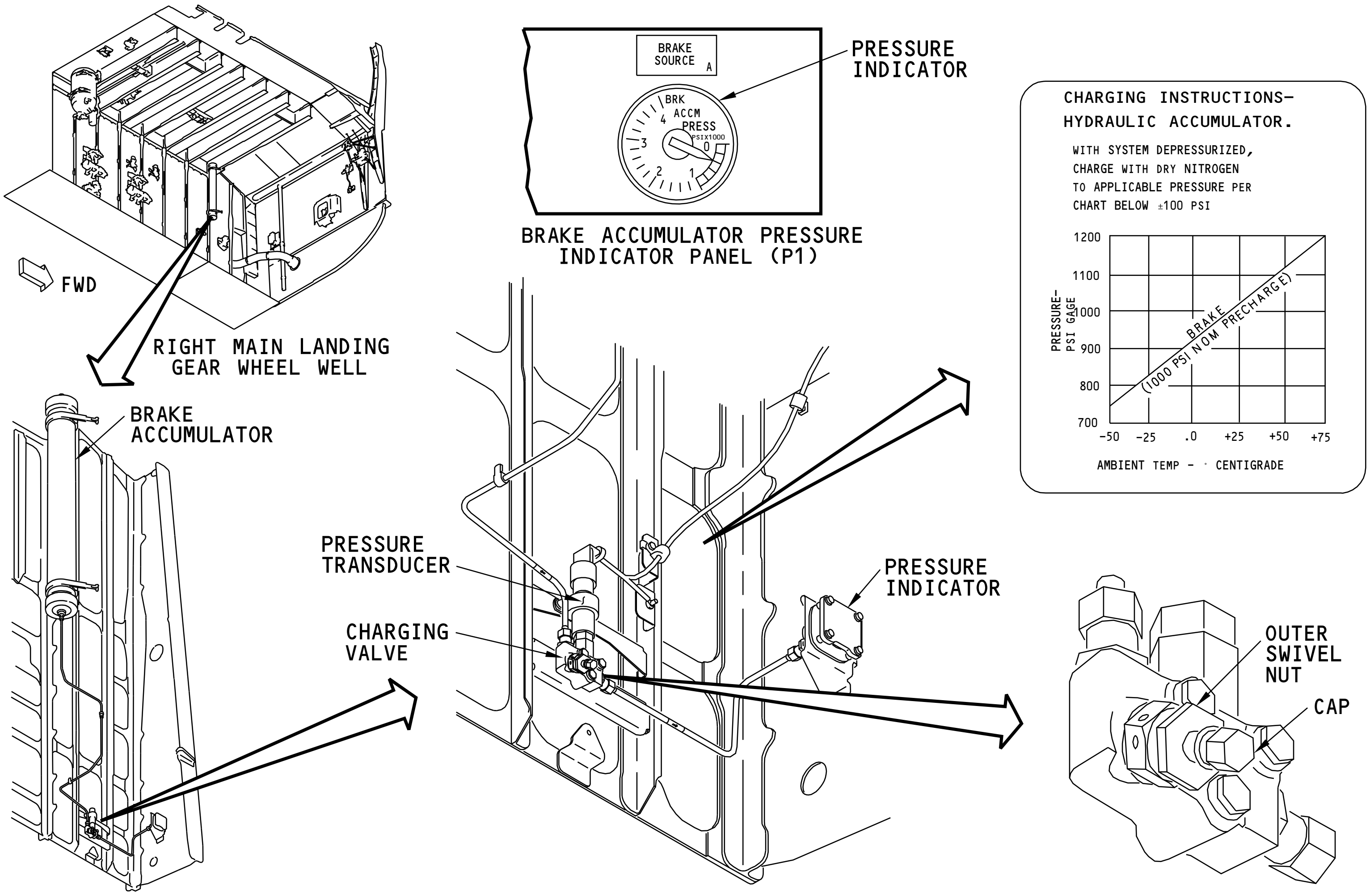
Service the accumulator if necessary.

This warning has a relation to servicing the accumulator.

⚠ **WARNING** DO NOT LOOSEN THE BODY OF THE BRAKE ACCUMULATOR CHARGING VALVE. THE PRESSURE IN THE BRAKE ACCUMULATOR CAN QUICKLY PUSH THE CHARGING VALVE OFF THE MANIFOLD. THIS CAN CAUSE INJURY TO PERSONS OR DAMAGE TO EQUIPMENT.

This is a summary of the servicing procedure:

- Connect the valve a pressure regulated source of dry nitrogen
- Turn the outer swivel nut to open the valve
- Pressurize the accumulator to the appropriate pressure shown on the graph
- If a large pressure change was made, let the gas stabilize for five minutes and then measure the pressure again.



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BRAKE HYDRO-MECHANICAL CONTROL - BRAKE ACCUMULATOR AND SERVICING COMPONENTS

BRAKE HYDRO-MECHANICAL CONTROL - ANTISKID SURGE ACCUMULATOR AND SERVICING COMPONENTS

Purpose

The anti-skid surge accumulator absorbs brake release surges from the left normal anti-skid valve module.

Components

The anti-skid surge accumulator and servicing components include:

- Antiskid surge accumulator
- Charging valve
- Pressure gage assembly.

Location

The antiskid surge accumulator and servicing components are on the left main landing beam. They are outboard and aft of the left normal antiskid valve module.

You open an access panel outboard of the left MLG to access the antiskid surge accumulator.

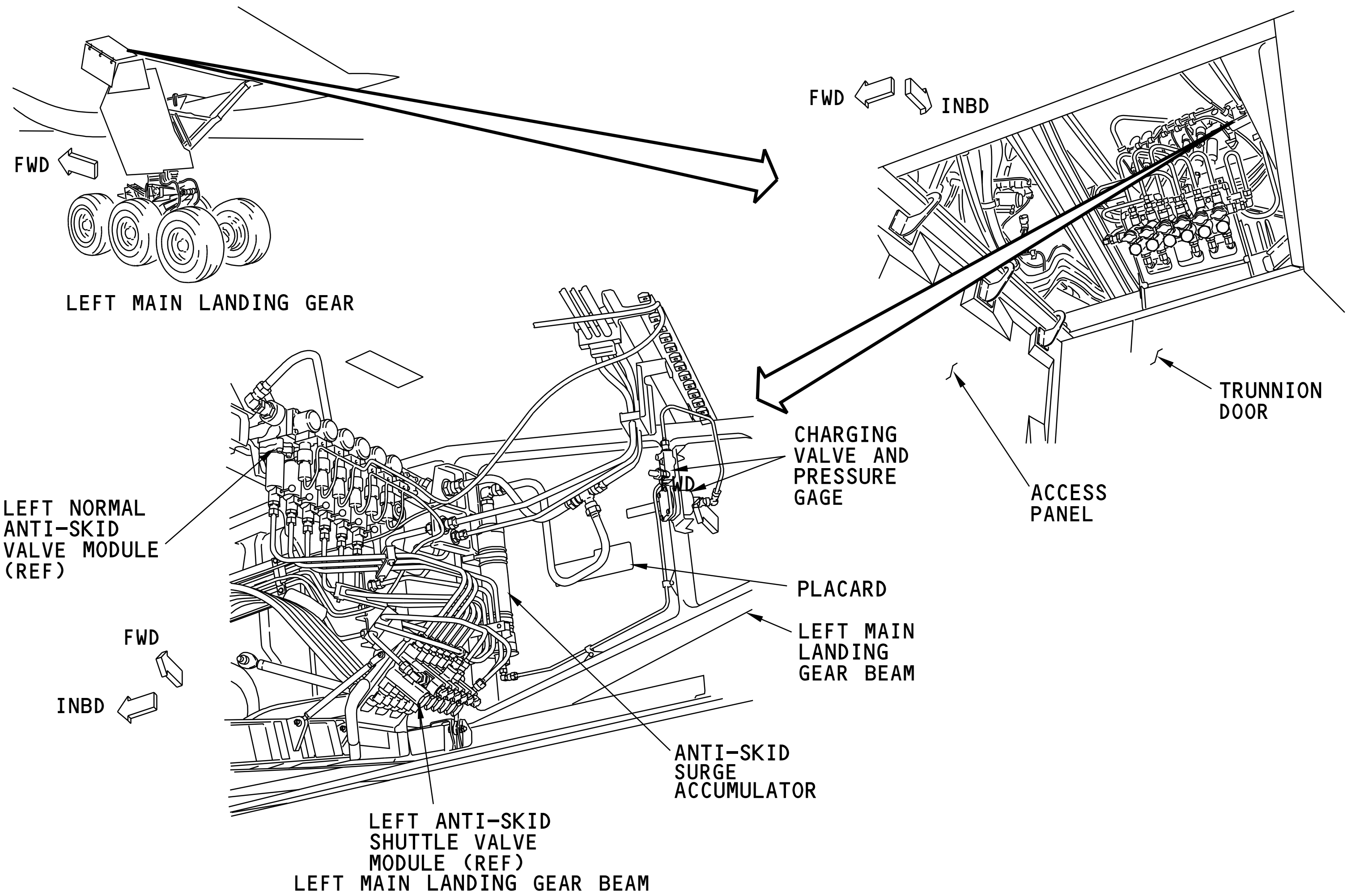
Physical Description

The accumulator is a gas charged unit with a floating piston that separates the gas and the fluid sides. It has a precharge of 150 psi and a volume of 25 cubic inches.

Charging instructions are on a placard by the charging valve and gage.

Training Information Point

The right normal antiskid valve module does not need an antiskid surge accumulator because the right hydraulic system reservoir is very near to the right normal antiskid valve module.



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BRAKE HYDRO-MECHANICAL CONTROL - ANTISKID SURGE ACCUMULATOR AND SERVICING COMPONENTS

BRAKE HYDRO-MECHANICAL CONTROL - ALTERNATE SOURCE SELECTOR AND ACCUMULATOR ISOLATION VALVES

Purpose

These two hydro-mechanical valves select and send pressure to the normal or the alternate brake hydraulic systems:

- Brake alternate source selector valve (ASSV)
- Brake accumulator isolation valve (AIV).

Location

The ASSV is on the keel beam in the left main landing gear wheel well.

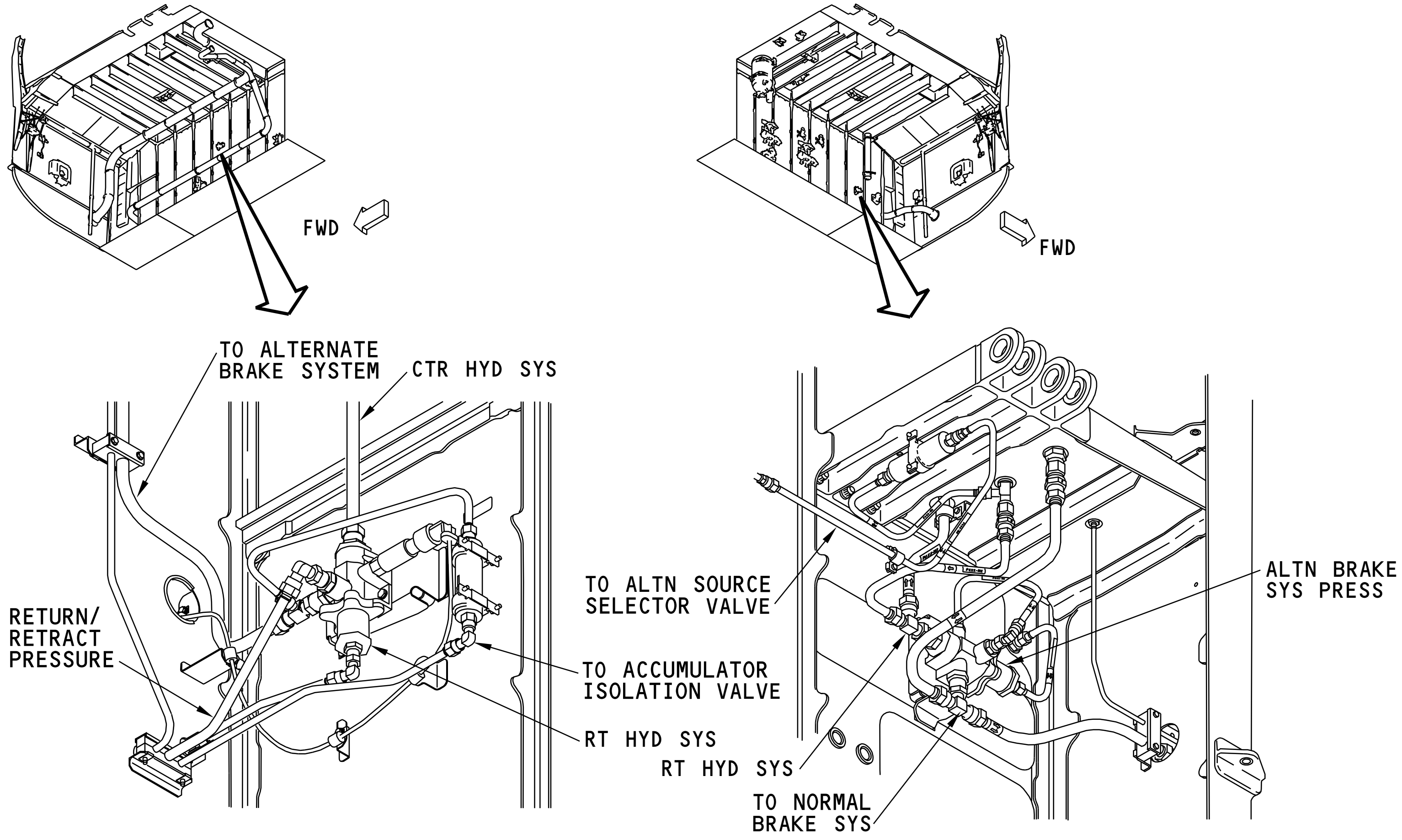
The AIV is on the keel beam below the brake accumulator in the right main landing gear wheel well.

Physical Description

Both valves are the same and are interchangeable.

Each valve gets pressure from two sources. The pressures push on pistons in the valves that have different areas. This moves the valves to select the brake source.

The alternate source selector valve has the alternate brake hydraulic system pressure switch on the valve.



BRAKE ALTERNATE SOURCE SELECTOR VALVE
(LEFT MAIN WHEEL WELL, KEEL BEAM)

BRAKE ACCUMULATOR ISOLATION VALVE
(RIGHT MAIN WHEEL WELL, KEEL BEAM)

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BRAKE HYDRO-MECHANICAL CONTROL - ALTERNATE SOURCE SELECTOR AND ACCUMULATOR ISOLATION VALVES

BRAKE HYDRO-MECHANICAL CONTROL - BRAKE SOURCE SELECTOR VALVES - FUNCTIONAL DESCRIPTION

General

The alternate source selector valve and the accumulator isolation valve operate together to control pressure to the normal and alternate brake systems.

Valve Operation

These valves are slide-and-sleeve type valves. Control pressure on the control piston closes the valve to stop the pressure source from going through the valve.

When the control pressure decreases to 48 percent of the pressure source, the valve opens and permits the hydraulic fluid to go through the valve.

Brake Alternate Source Selector Valve (ASSV)

The right hydraulic system pressure is the control pressure for the ASSV.

When the right and center/reserve hydraulic system pressures are equal, the ASSV closes to depressurize the alternate brake system. In this position, the ASSV allows landing gear retract pressure to pressurize the alternate brake system during gear retraction.

When right hydraulic system pressure is low, the ASSV opens and permits center/reserve hydraulic system pressure to pressurize the alternate brake system.

Brake Accumulator Isolation Valve (AIV)

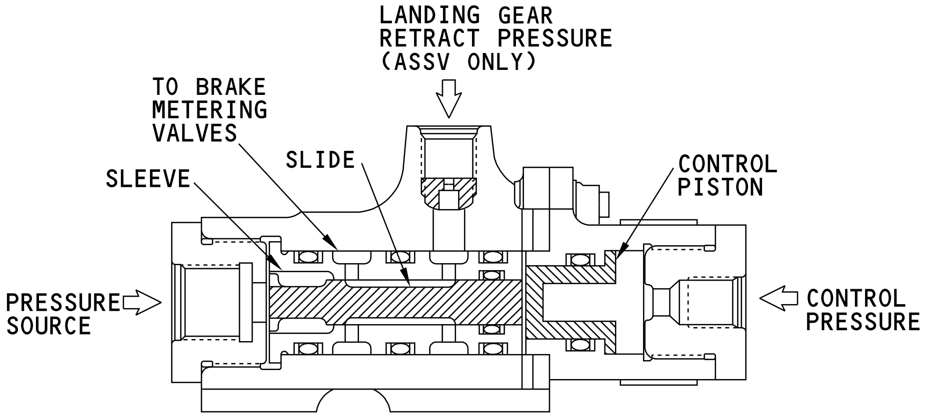
Center hydraulic system pressure downstream of the ASSV is the control pressure for the AIV.

When right hydraulic system pressure is low, center hydraulic system pressure through the ASSV closes the AIV to isolate brake accumulator pressure from the normal brake system.

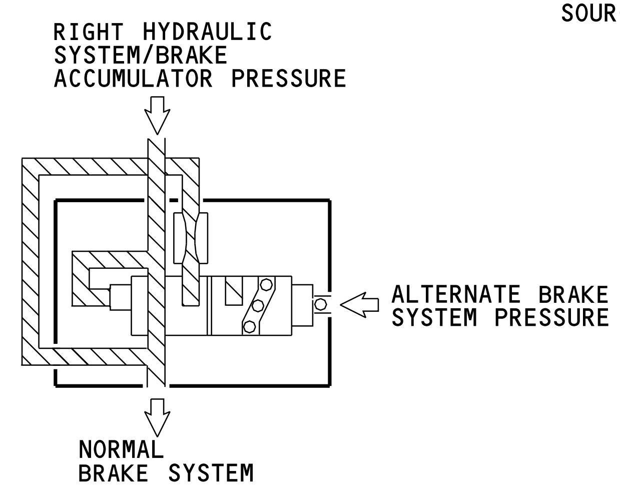
When right hydraulic system and center hydraulic system pressures are low, brake accumulator pressure opens the AIV to pressurize the normal brake system with accumulator pressure.

Training Information Point

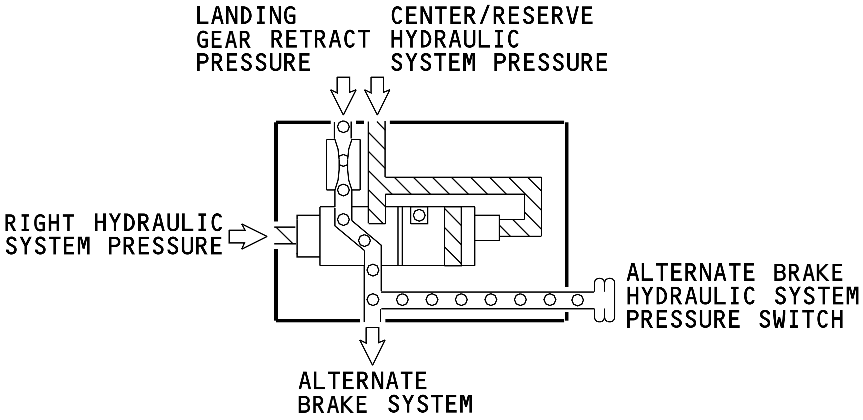
A pressure switch on the ASSV sends pressure signals to control the brake source light on the flight deck.



SOURCE SELECTOR VALVE (TYPICAL)



BRAKE ACCUMULATOR ISOLATION VALVE



BRAKE ALTERNATE SOURCE SELECTOR VALVE

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BRAKE HYDRO-MECHANICAL CONTROL - BRAKE SOURCE SELECTOR VALVES - FUNCTIONAL DESCRIPTION

BRAKE HYDRO-MECHANICAL CONTROL - BRAKE SOURCE PRESSURE SWITCHES

Purpose

These two brake source pressure switches control the brake source light and send pressure signals to the BSCU and AIMS for brake control and indication:

- The normal brake hydraulic system pressure switch
- The alternate brake hydraulic system pressure switch.

The brake source light comes on when there is low right hydraulic system pressure and there is low alternate brake system pressure.

Location

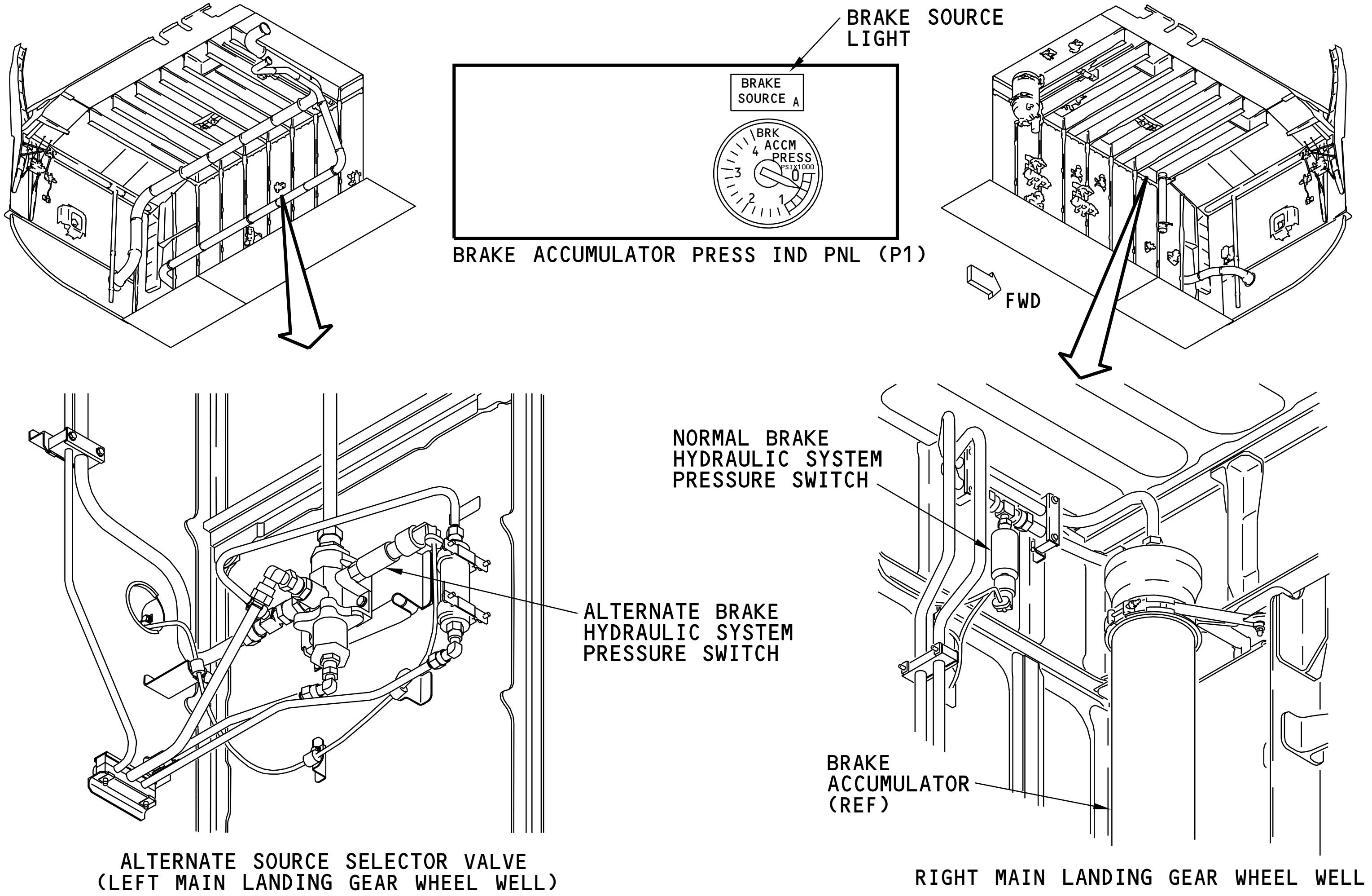
The brake source light is on the P1 left forward panel above the brake accumulator pressure gage on the flight deck.

The normal brake hydraulic system pressure switch is on the keel beam in the right main landing gear wheel well inboard and aft of the brake accumulator.

The alternate brake hydraulic system pressure switch is on the alternate source selector valve in the left main landing gear wheel well.

Physical Description

These switches are interchangeable pressure-operated switches that open at 1700 psi and close at 1200 psi.



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BRAKE HYDRO-MECHANICAL CONTROL - BRAKE SOURCE PRESSURE SWITCHES

BRAKE HYDRO-MECHANICAL CONTROL - FUNCTIONAL DESCRIPTION

General

The source selection operation supplies pressure for:

- Normal brakes
- Alternate brakes
- Reserve brakes
- Accumulator brakes
- Gear retract braking.

When the pressure in one hydraulic brake source decreases, the ASSV and AIV valves automatically change position to select the next available source and send the pressure to the brake metering valves.

Brake pedal input transmits through the brake pedal bus mechanism and cables to the left and right brake metering valves. These metering valves use this mechanical input to control the selected pressure source and pressurize the brakes.

Normal Brakes

When the right hydraulic system pressurizes, the ASSV operates to depressurize the alternate brake system. The brakes can then get metered right system hydraulic pressure from the normal brake metering valves.

The right hydraulic system pressure also charges the brake accumulator and operates the AIV.

Alternate Brakes

When right hydraulic system pressure is low, center hydraulic system pressure operates the ASSV. The ASSV sends center hydraulic system pressure to the alternate brake system. The brakes can then get metered center system hydraulic pressure from the alternate brake metering valves.

Pressure in the alternate brake system operates the AIV to isolate accumulator pressure.

Reserve Brakes

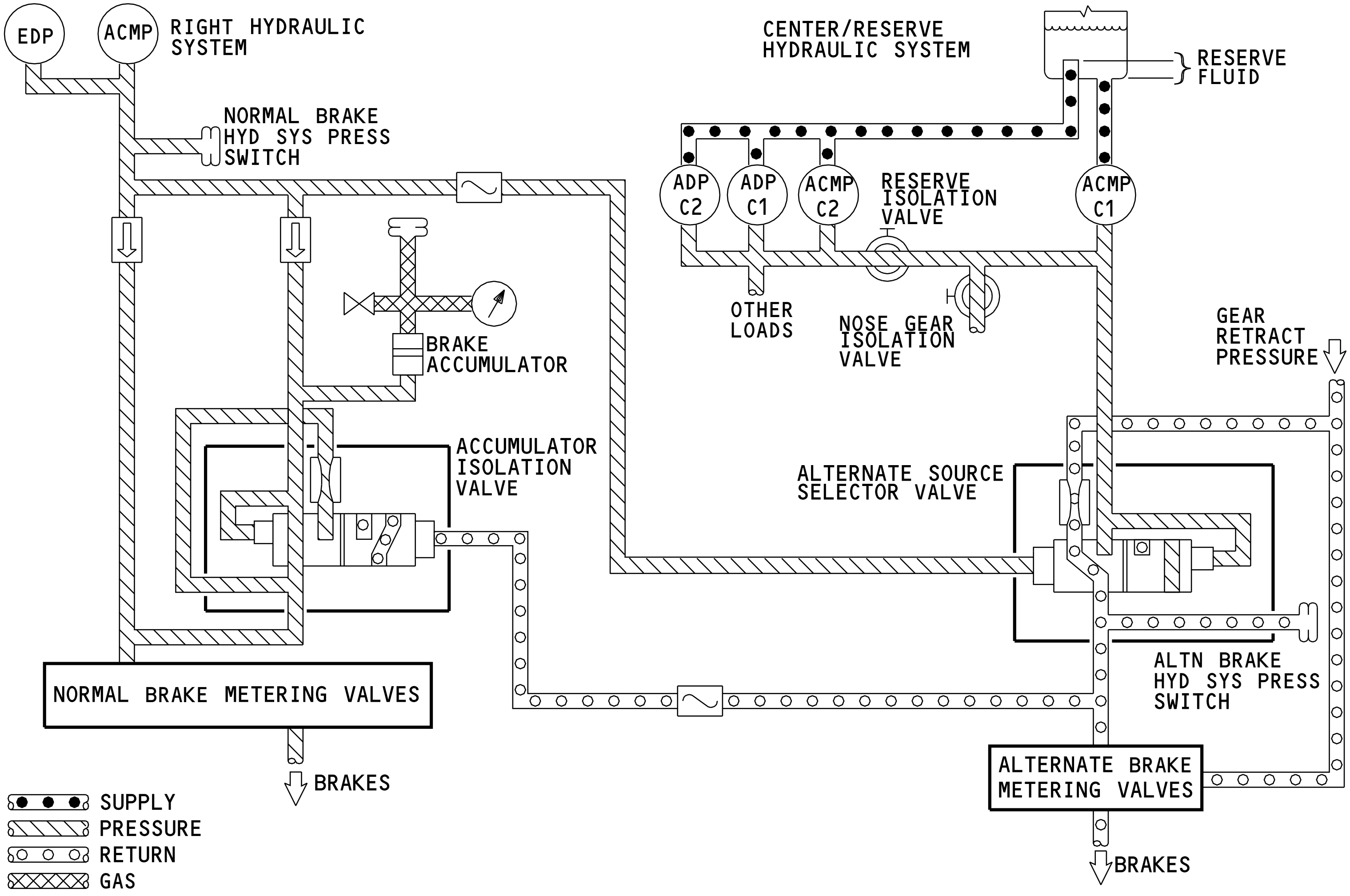
The ASSV and AIV positions and operation are the same as for alternate brakes. The only difference is that the center hydraulic system uses reserve fluid and the C1 ACMP for alternate brake system pressure.

Accumulator Brakes

When both the right and center hydraulic system pressures are low, accumulator pressure opens the AIV. The brakes then get brake accumulator pressure from the normal brake metering valves.

Gear Retract Braking

During landing gear retraction when the normal brake system has pressure, the ASSV sends main landing gear retract pressure to the alternate brake system. The gear retract pressure also operates the gear retract braking actuators on the alternate brake metering valves to pressurize the brakes.



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BRAKE HYDRO-MECHANICAL CONTROL - FUNCTIONAL DESCRIPTION

BRAKE HYDRO-MECHANICAL CONTROL - INDICATION

General

The brake source light and advisory message show when the normal and the alternate brake system pressures are low. These two switches control these indications:

- The normal brake hydraulic system pressure switch
- The alternate brake hydraulic pressure switch.

The brake accumulator pressure indicator shows brake accumulator pressure.

Functional Description

There is no flight deck effect when normal brake system pressure is low and the alternate brake system has pressure. The BSCU uses the normal system low pressure input for control of the antiskid and autobrake systems.

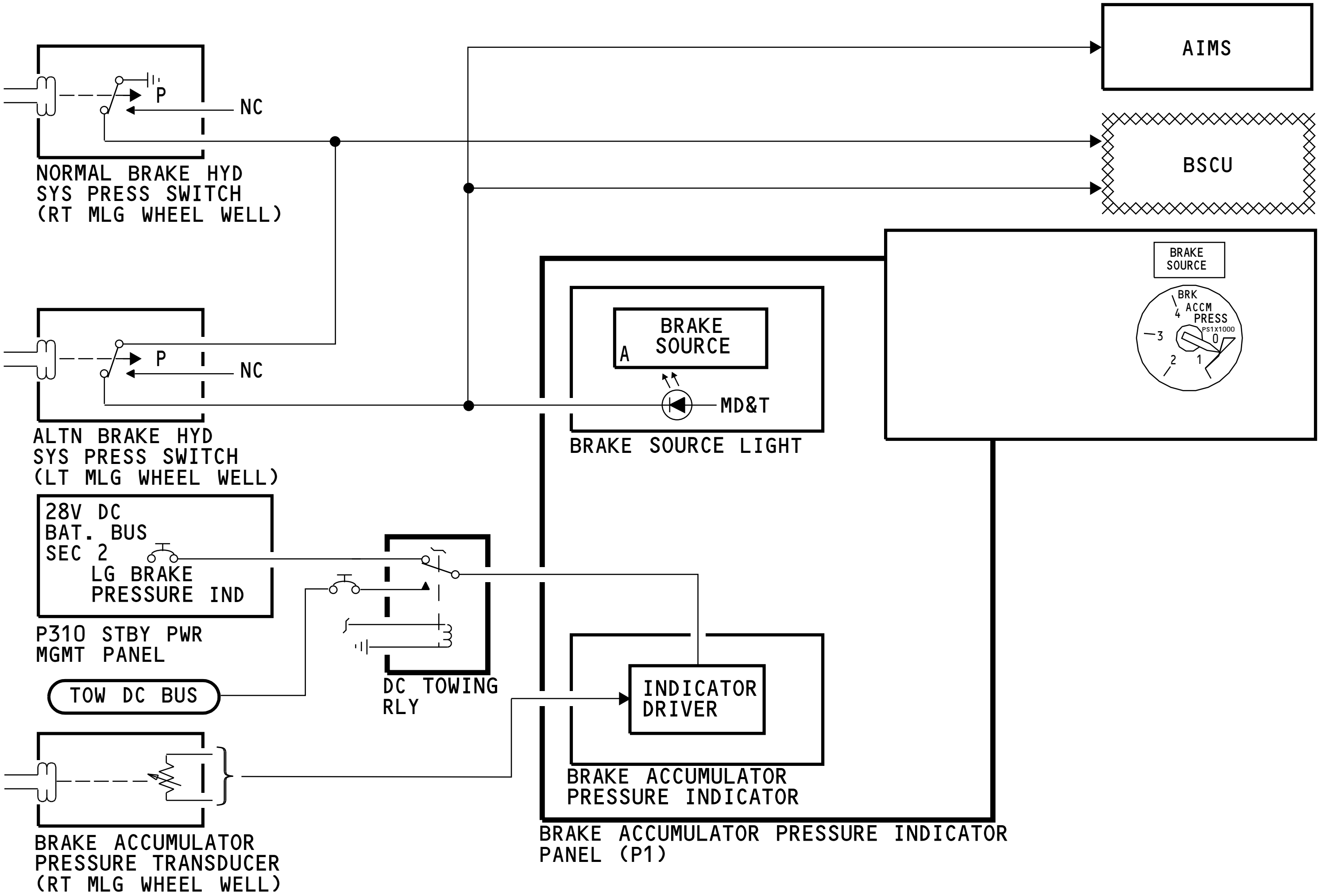
When normal and alternate brake system pressures are low, the brake source light comes on and AIMS shows the BRAKE SOURCE advisory message. The BSCU also uses these inputs for control of the antiskid and autobrake systems.

Brake accumulator pressure is the only pressure source when the brake source light is on.

The indicator driver for the brake accumulator pressure indicator uses accumulator pressure transducer input to show pressure.

Training Information Point

The towing power system can supply power to the brake accumulator pressure indicator and the brake source light. See the electrical power chapter for more information about the towing power system (CHAPTER 24).



M42353 S000618701_V1

BRAKE HYDRO-MECHANICAL CONTROL - INDICATION

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ANTISKID/AUTOBRAKE SYSTEM - INTRODUCTION

Purpose

The antiskid/autobrake system automatically controls brake metered pressure.

Antiskid System

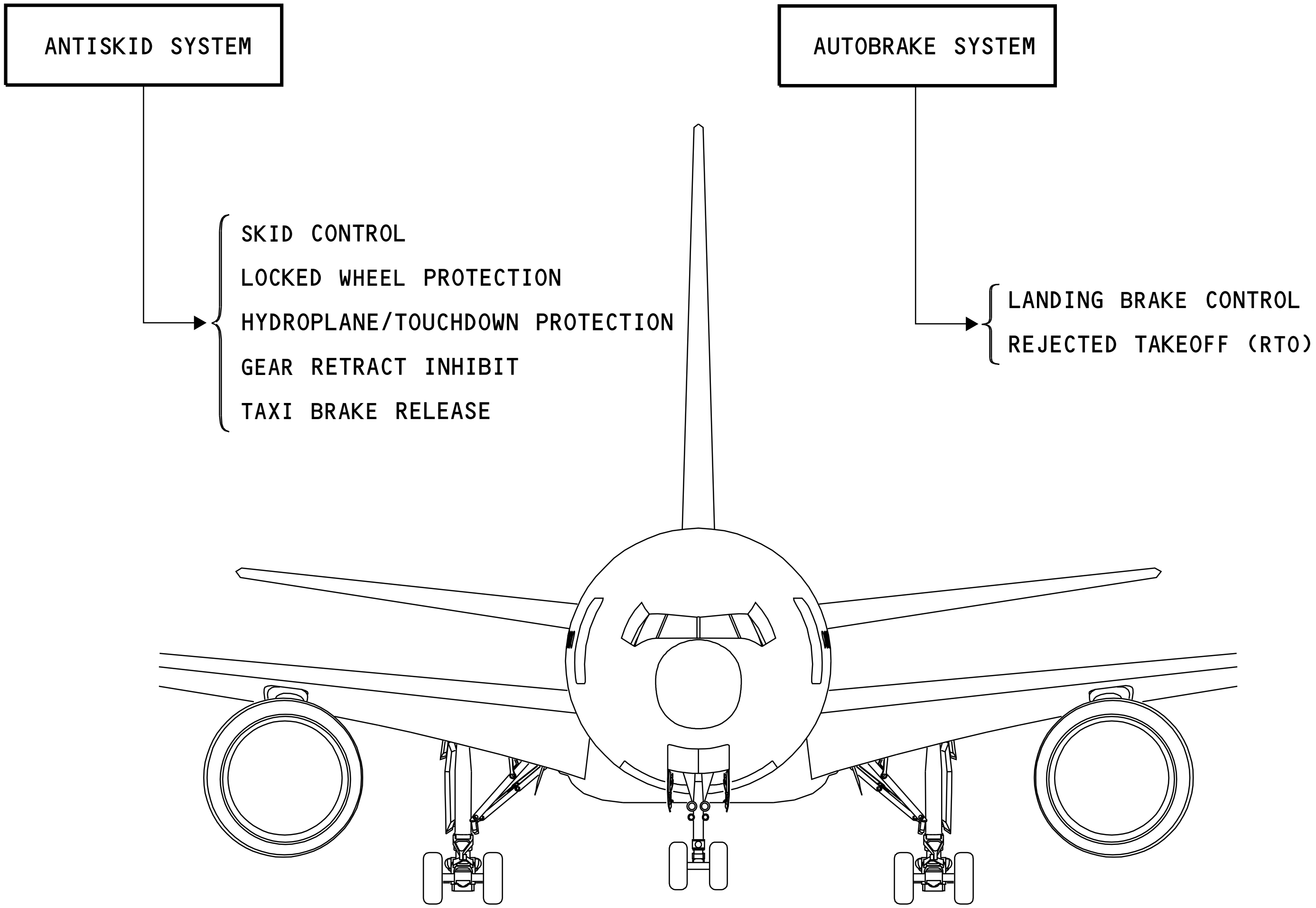
The antiskid system monitors wheel speed deceleration and controls brake pressure to prevent skid conditions. It also releases one third of the brakes during taxi to extend the brake service life.

Antiskid functions include:

- Skid control
- Locked wheel protection
- Hydroplane/touchdown protection
- Gear retract inhibit
- Taxi brake release.

Autobrake System

The autobrake system automatically supplies metered brake pressure to stop the airplane during landing or during a rejected takeoff (RTO).



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ANTISKID/AUTOBRAKE SYSTEM - INTRODUCTION

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ANTISKID/AUTOBRAKE SYSTEM - GENERAL DESCRIPTION

General

The antiskid system limits metered brake pressure from the hydro-mechanical or the autobrake systems to prevent wheel skid. This permits maximum braking effectiveness with any runway condition.

Antiskid components for each MLG include:

- Antiskid transducer (6)
- Antiskid shuttle valve module (1)
- Normal antiskid valve module (1)
- Alternate antiskid valve module (1).

The autobrake system automatically applies the brakes to stop the airplane during landing or a rejected takeoff.

Autobrake components for the airplane include:

- Autobrake selector (1)
- Normal brake metered pressure transducer (2)
- Alternate brake metered pressure transducer (2)
- Autobrake valve module (1)
- Autobrake shuttle valve (2).

The brake system control unit (BSCU) controls antiskid and autobrake operation. There are two BSCU part numbers. The base part number S294W201 is referred to as BSCU I and the base part number S294W401 is referred to as BSCU II. Unless specified, BSCU refers to both BSCU I and BSCU II.

Inputs

The BSCU uses these inputs to control antiskid and autobrake operation:

- Truck tilt (PSEUs)
- Landing gear lever position (PSEUs)
- Air and inertial data (ADIRU)
- Speedbrake lever position (PFCs)
- Thrust lever position
- Parking brake valve position
- Parking brake lever position
- Right hydraulic system pressure
- Alternate brake system pressure
- Normal and alternate metered brake pressure
- Wheel speed
- Autobrake selector position.

Normal Antiskid Operation

The normal brake metering valves send metered pressure from the right hydraulic system or the accumulator through the autobrake shuttle valves to the normal antiskid valve modules. The BSCU sends signals to the normal antiskid valve modules to control the metered pressure to each brake. The metered pressure goes through the antiskid shuttle valve modules to the brakes.

An antiskid surge accumulator absorbs pressure surges in the return lines from the left normal antiskid valve module. The pressure surges can occur during antiskid operation. It is not necessary for the right normal antiskid valve to have a surge accumulator since it is near the right system reservoir.

Alternate Antiskid Operation

The alternate brake metering valves send metered pressure from the center hydraulic system to the alternate antiskid valve modules. The BSCU sends signals to the alternate antiskid valve modules to control the metered pressure to each aft brake and to forward-middle brake pairs. The metered pressure goes through the antiskid shuttle valve modules to the brakes.

Autobrake Operation

The BSCU sends signals to the autobrake valve module to control autobrake pressure to the normal brake system.

The autobrake valve module meters right hydraulic system pressure to the brakes. The autobrake pressure goes through the autobrake shuttle valves, the normal antiskid valves, and the antiskid shuttle valves.

ANTISKID/AUTOBRAKE SYSTEM - GENERAL DESCRIPTION

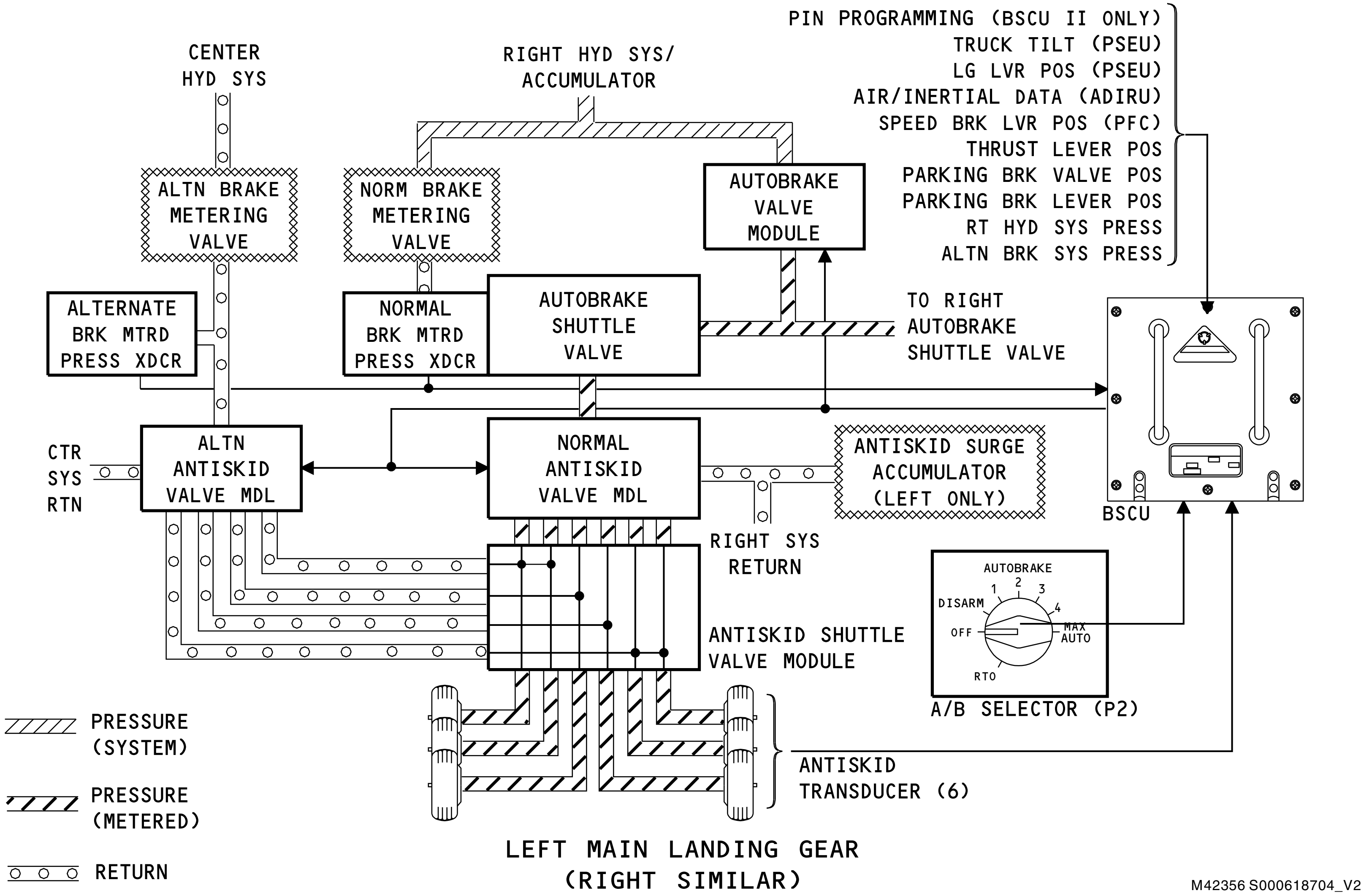
The normal antiskid operates during autobrake operation.

Software

BSCU I has embedded software and is not data loadable. BSCU II has software that is data loadable.

Pin Programming

BSCU II can be configured for operation on different 777 airplane types via program pins input, hardwired on the airplane side, for proper Antiskid/Autobrake operation.



ANTISKID/AUTOBRAKE SYSTEM - GENERAL DESCRIPTION

ANTISKID/AUTOBRAKE SYSTEM - COMPONENT LOCATIONS

General

These are the antiskid/autobrake system components:

- Autobrake selector
- Antiskid transducer (12)
- Brake system control unit (BSCU)
- Normal brake metered pressure transducer (2)
- Autobrake shuttle valve (2)
- Autobrake valve module
- Antiskid shuttle valve module (2)
- Normal antiskid module (2)
- Alternate antiskid module (2)
- Alternate brake metered pressure transducer (2).

Autobrake Selector

The autobrake selector is on the P2 center forward panel below the landing gear control lever.

Antiskid Transducer

There is an antiskid transducer for each main landing gear wheel in the each axle.

Brake System Control Unit (BSCU)

The BSCU is on the E6 rack in the aft cargo compartment.

Normal Brake Metered Pressure Transducer

The normal brake metered pressure transducers are on the autobrake shuttle valves in the left and right main wheel wells.

Autobrake Shuttle Valve

Autobrake shuttle valves are in the left and the right main gear wheel wells on the forward walls inboard of the brake metering valves.

Autobrake Valve Module

The autobrake valve module is on the keel beam in the forward section of the right main wheel well.

Antiskid Shuttle Valve Module

Antiskid shuttle valve modules are outboard of the main landing gear trunnions. They are below the normal antiskid modules.

Normal Antiskid Module

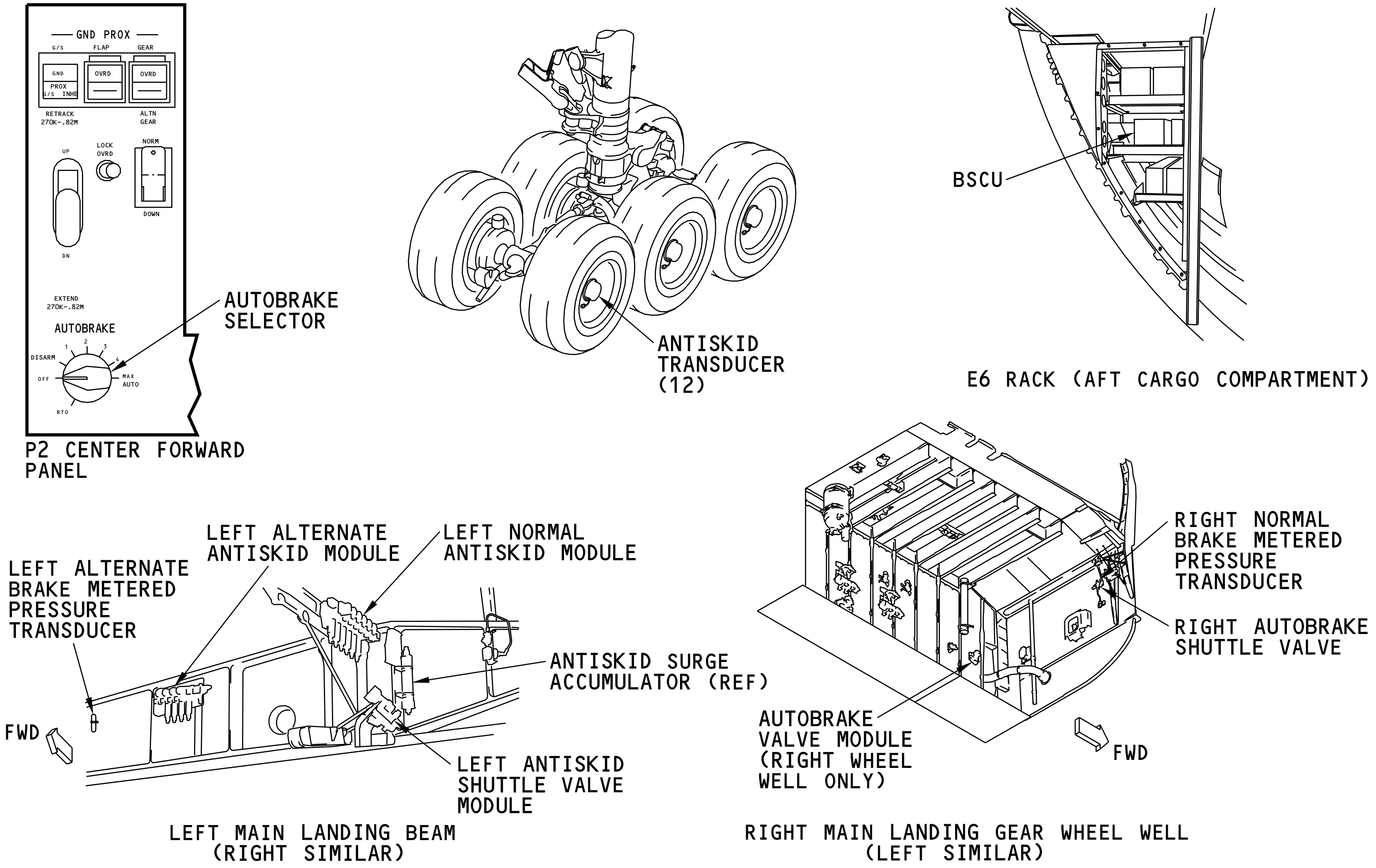
Normal antiskid modules are forward of the left and the right main landing gear beams outboard of the main landing gear trunnions.

Alternate Antiskid Module

Alternate antiskid modules are on the main landing gear beams inboard of the main landing gear trunnions.

Alternate Brake Metered Pressure Transducer

The alternate brake metered pressure transducers are on the landing gear beams inboard of the alternate antiskid valves.



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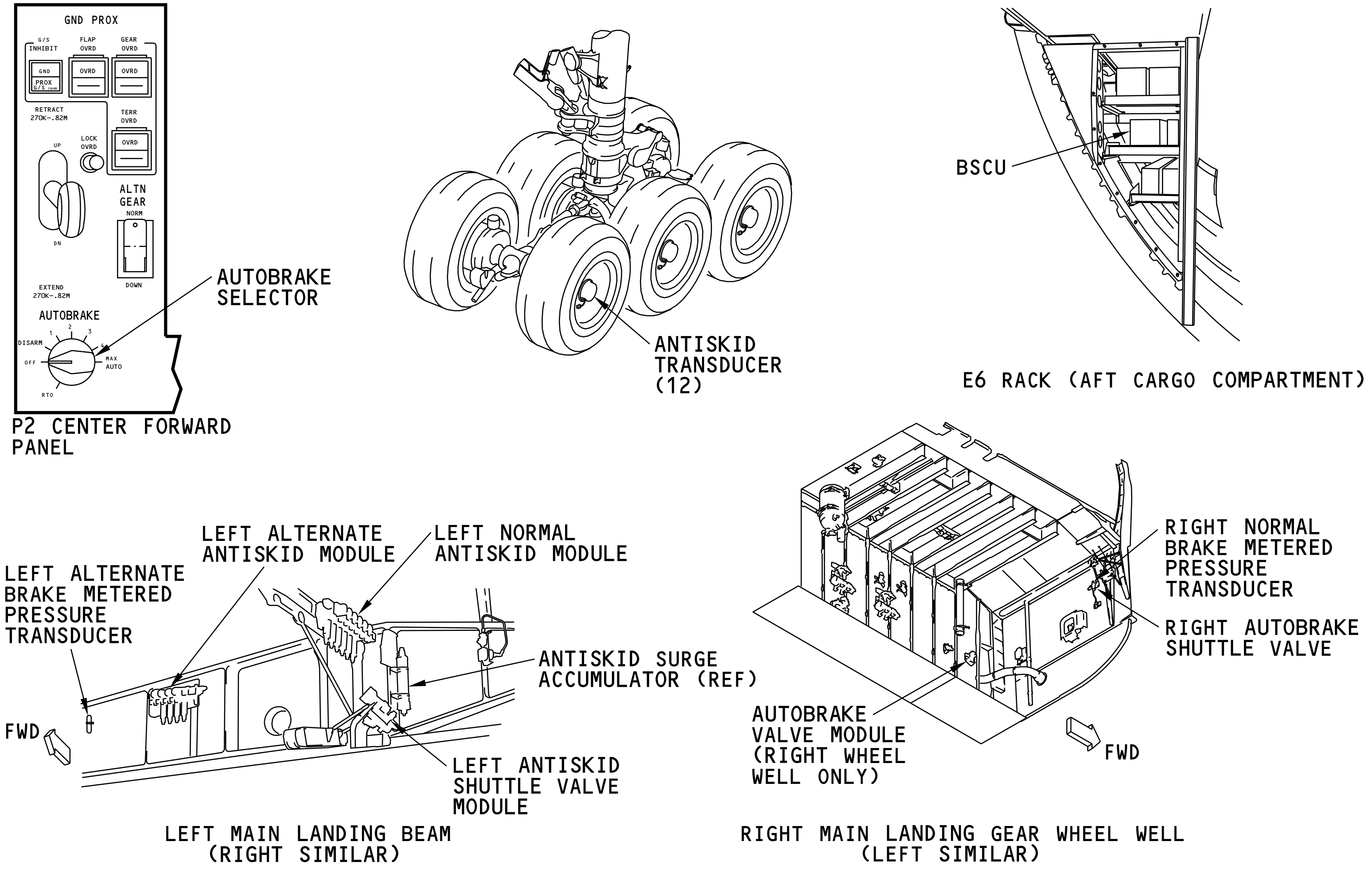
ANTISKID/AUTOBRAKE SYSTEM - COMPONENT LOCATIONS



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ANTISKID/AUTOBRAKE SYSTEM - COMPONENT LOCATIONS

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ANTISKID/AUTOBRAKE SYSTEM - AUTOBRAKE SELECTOR

Purpose

The autobrake selector permits selection of a landing autobrake deceleration rate or the rejected takeoff function.

Location

The autobrake selector is on the P2 center forward panel below the landing gear handle.

Functional Description

The autobrake selector is an eight-position selector. A latch solenoid holds the selector in all positions except OFF and DISARM. The BSCU controls the latch solenoid.

There is a detent between the OFF and DISARM positions. You must push the selector as you move it from OFF to DISARM or from DISARM to OFF. There is no detent between the OFF and RTO positions of the autobrake selector.

Positions 1 through MAX AUTO set the rate of deceleration for autobrake operation after landing. For each level of deceleration, the BSCU controls the autobrake pressure to a maximum limit. The BSCU uses a 0.1 second time delay for autobrake application after landing.

If the MAX AUTO is selected, deceleration is limited to the AUROBRAKE 4 level until the pitch angle is less than 1 degree, then deceleration is increased to the MAX AUTO level.

If a disarm condition occurs when the selector is in 1 through MAX AUTO, the latch solenoid releases the selector to DISARM.

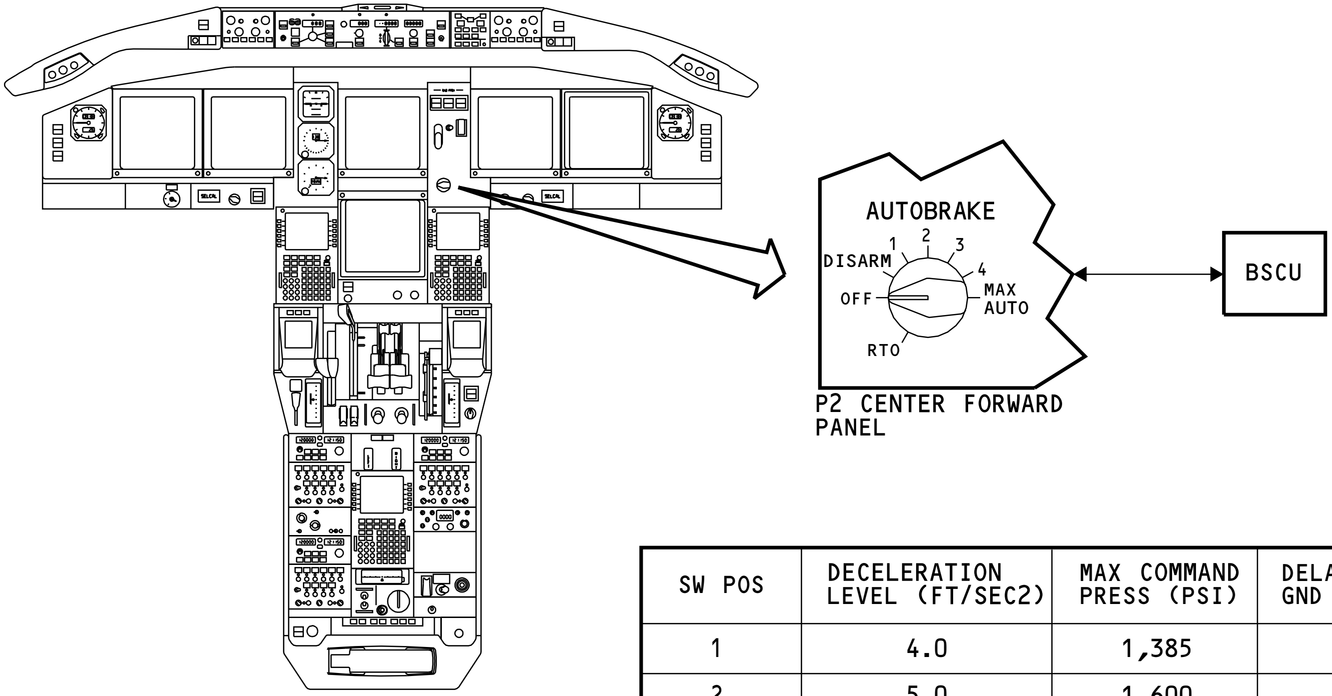
The RTO position commands maximum brake pressure for a rejected takeoff. There is no time delay before RTO autobrake application.

The latch solenoid releases the selector from the RTO position to the OFF position when the airplane goes in the air.

Training Information Point

One of these memo messages shows when the autobrake selector is in a landing autobrake position or in the RTO position:

- AUTOBRAKE 1
- AUTOBRAKE 2
- AUTOBRAKE 3
- AUTOBRAKE 4
- AUTOBRAKE MAX
- AUTOBRAKE RTO.



SW POS	DECELERATION LEVEL (FT/SEC2)	MAX COMMAND PRESS (PSI)	DELAY AFTER GND SIG (SEC)
1	4.0	1,385	0.1
2	5.0	1,600	0.1
3	6.0	1,850	0.1
4	7.5	2,150	0.1
MAX AUTO	11.0	3,100	0.1
RTO	MAX	3,100	--

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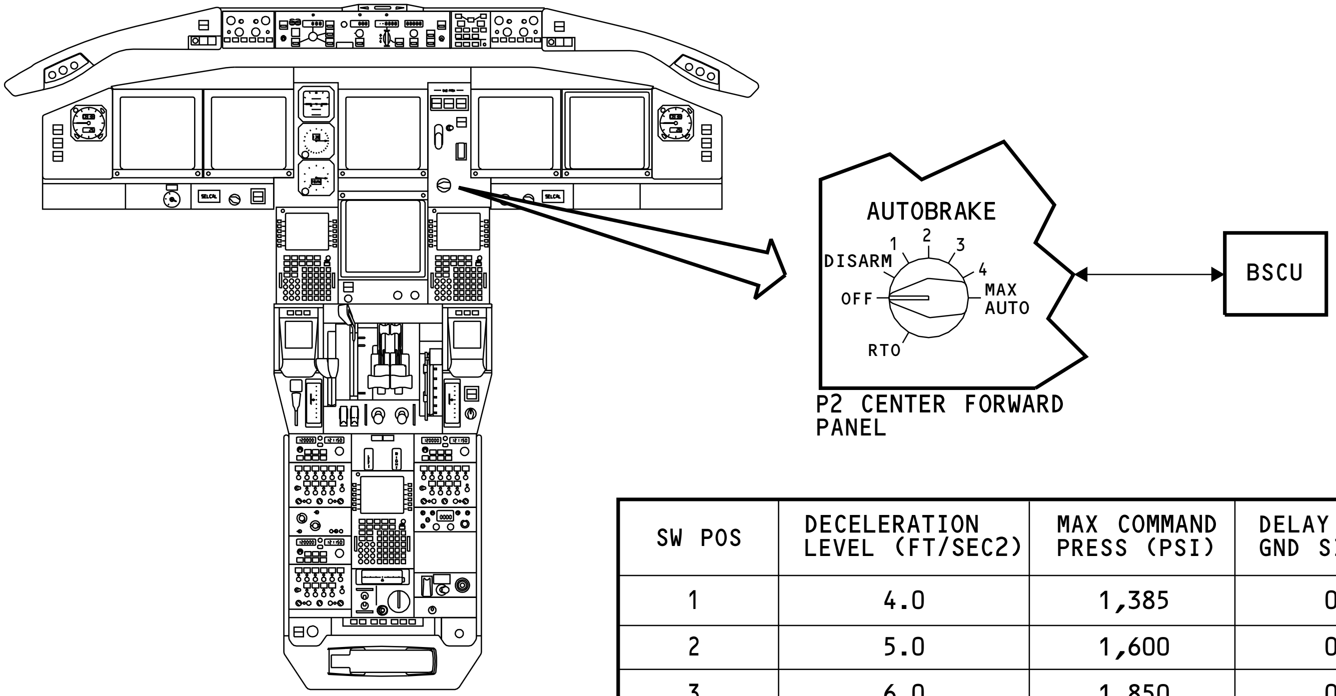
ANTISKID/AUTOBRAKE SYSTEM - AUTOBRAKE SELECTOR



SW POS	DECELERATION LEVEL (FT/SEC2)	MAX COMMAND PRESS (PSI)	DELAY AFTER GND SIG (SEC)
1	4.0	1,385	0.1
2	5.0	1,600	0.1
3	6.0	1,850	0.1
4	7.5	2,150	0.1
MAX AUTO	11.0	3,100	0.1
RTO	MAX	3,100	--

M42360 S000618709_V1

ANTISKID/AUTOBRAKE SYSTEM - AUTOBRAKE SELECTOR

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ANTISKID/AUTOBRAKE SYSTEM - ANTISKID TRANSDUCER

Purpose

Antiskid transducers supply wheel speed data to the BSCU to get wheel deceleration input. These data also goes to the BSCU for autobrake operation.

Location

There are twelve antiskid transducers. The antiskid transducer is in a support in each main landing gear axle.

Functional Description

Antiskid transducers are permanent magnetic devices with an internal rotor and stator.

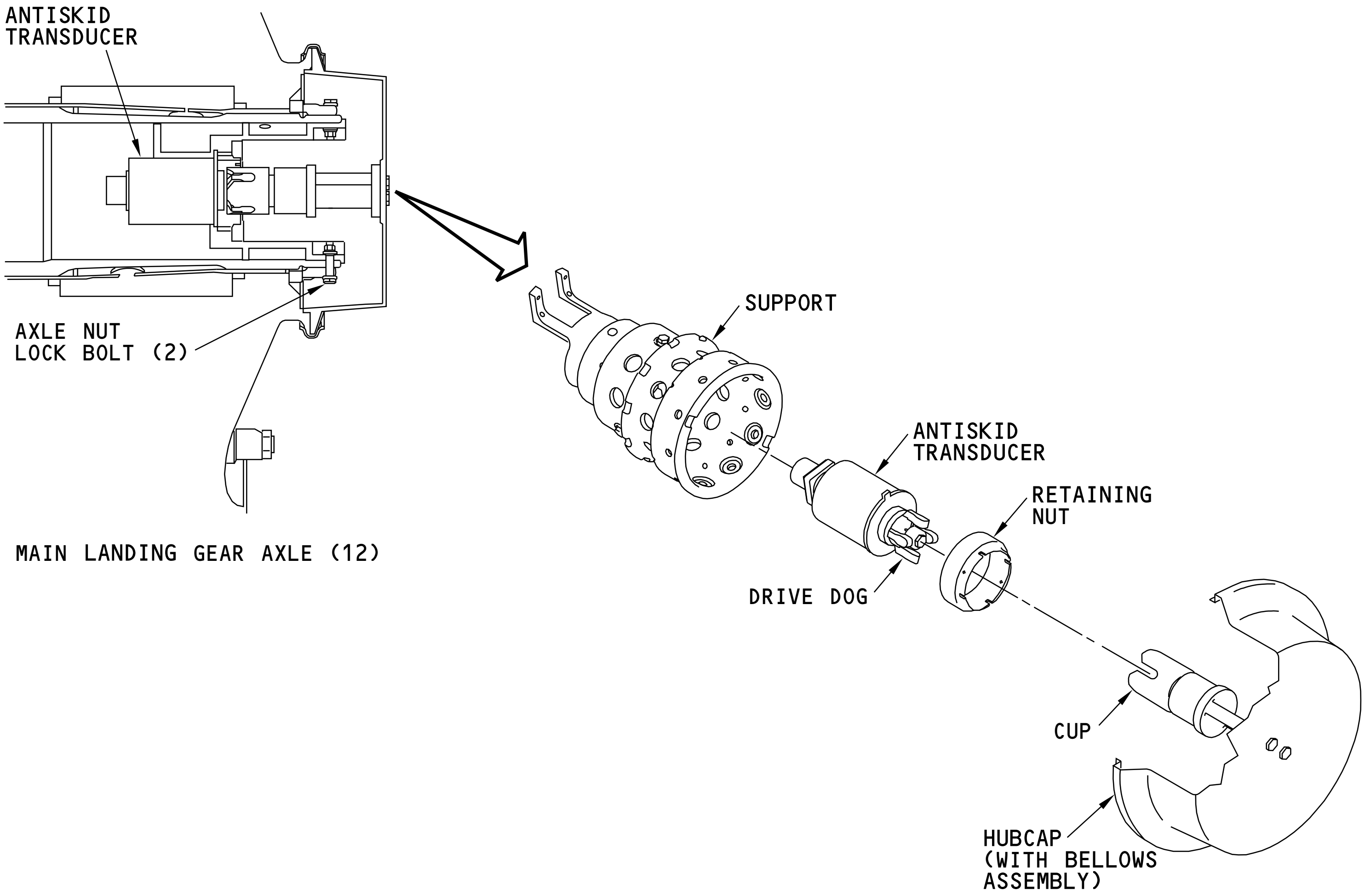
An antiskid transducer cup attaches to the hubcap through a flexible bellows assembly. This bellows assembly makes installation adjustment allowances when it compresses. The hubcap turns with the MLG wheel. The cup connects to the antiskid transducer drive dog which turns the rotor in the antiskid transducer.

Training Information Point

The transducer is an LRU.

When you remove the hubcap and the two axle nut lock bolts, you can remove the support from the axle. You do not have to remove the retaining nut.

The system can operate with one unserviceable transducer on each six wheel truck if no other brake on that truck is deactivated.



M42363 S000618712_V1

ANTISKID/AUTOBRAKE SYSTEM - ANTISKID TRANSDUCER

ANTISKID/AUTOBRAKE SYSTEM - BRAKE SYSTEM CONTROL UNIT (BSCU) - INTRODUCTION

Purpose

The brake system control unit (BSCU) contains circuit cards for the antiskid and autobrake systems, and related BITE functions.

It sends brake release inputs to the antiskid valve modules and brake application inputs to the autobrake valve module.

The BSCU also:

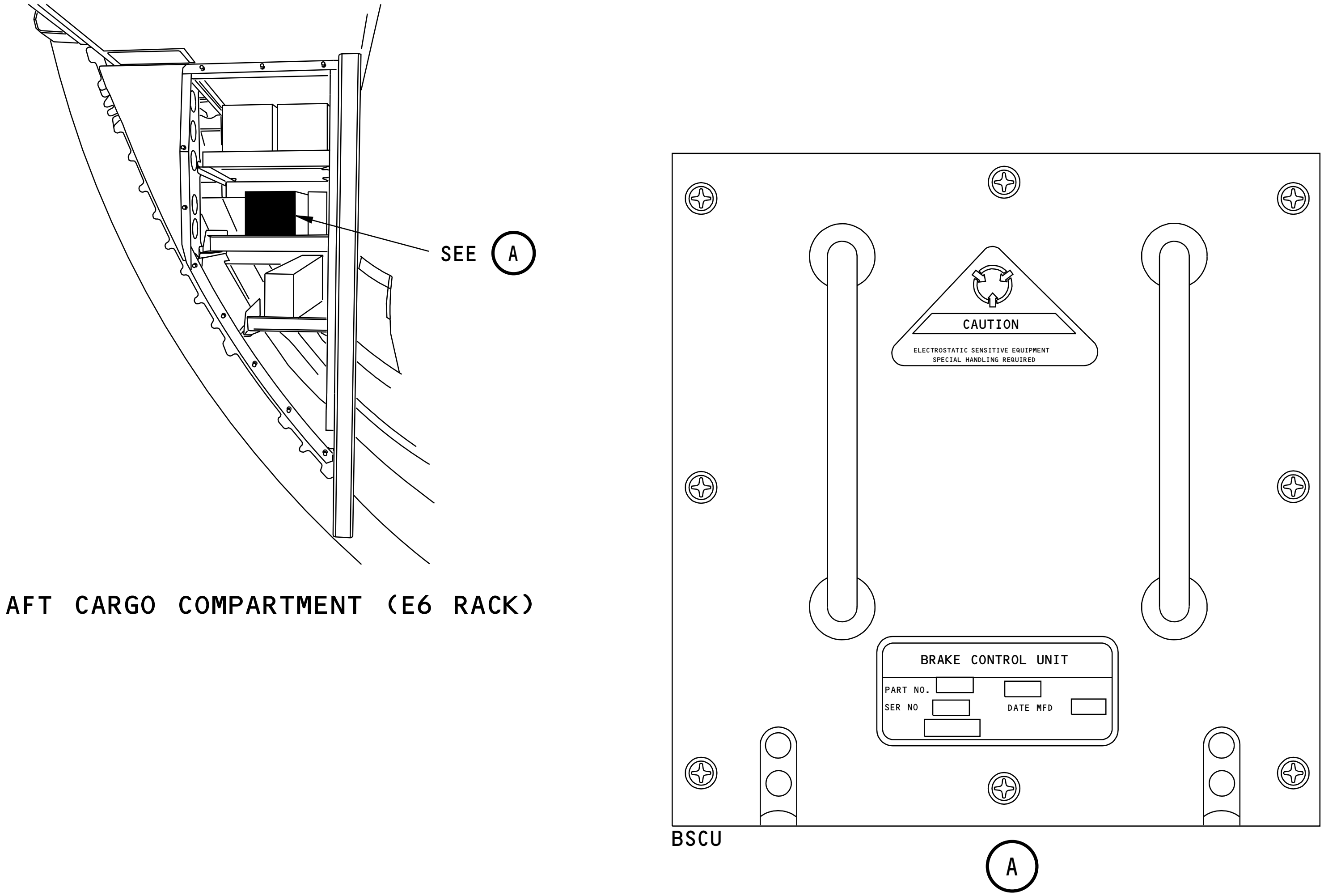
- Monitors the antiskid and autobrake systems for faults
- Communicates with other airplane systems
- Does the built-in-test functions.

The BSCU II connects with the airplane information management system (AIMS) over the ARINC 629 system buses for loading and updating software configuration. See chapter 45-10-00 for more information

The BSCU II is pin programmable so that a common unit can be installed on any minor model 777 airplane. The configuration of program pins on the airplane side enables the proper aniskid/autobrake configuration (two sets of four program pins inputs are hardwired on the airplane).

Location

The BSCU is on the E6-2 shelf in the aft cargo compartment.



M42364 S000618713_V2

ANTISKID/AUTOBRAKE SYSTEM - BRAKE SYSTEM CONTROL UNIT (BSCU) - INTRODUCTION

ANTISKID/AUTOBRAKE SYSTEM - BSCU - PHYSICAL DESCRIPTION

General

The BSCU contains two different types of circuit cards:

- Antiskid card (4)
- Autobrake/BITE/Comm card (2).

Antiskid Card

The four antiskid cards each control antiskid valves to operate the antiskid functions for a set of three wheels. These cards also supply wheel speed data for the autobrake function.

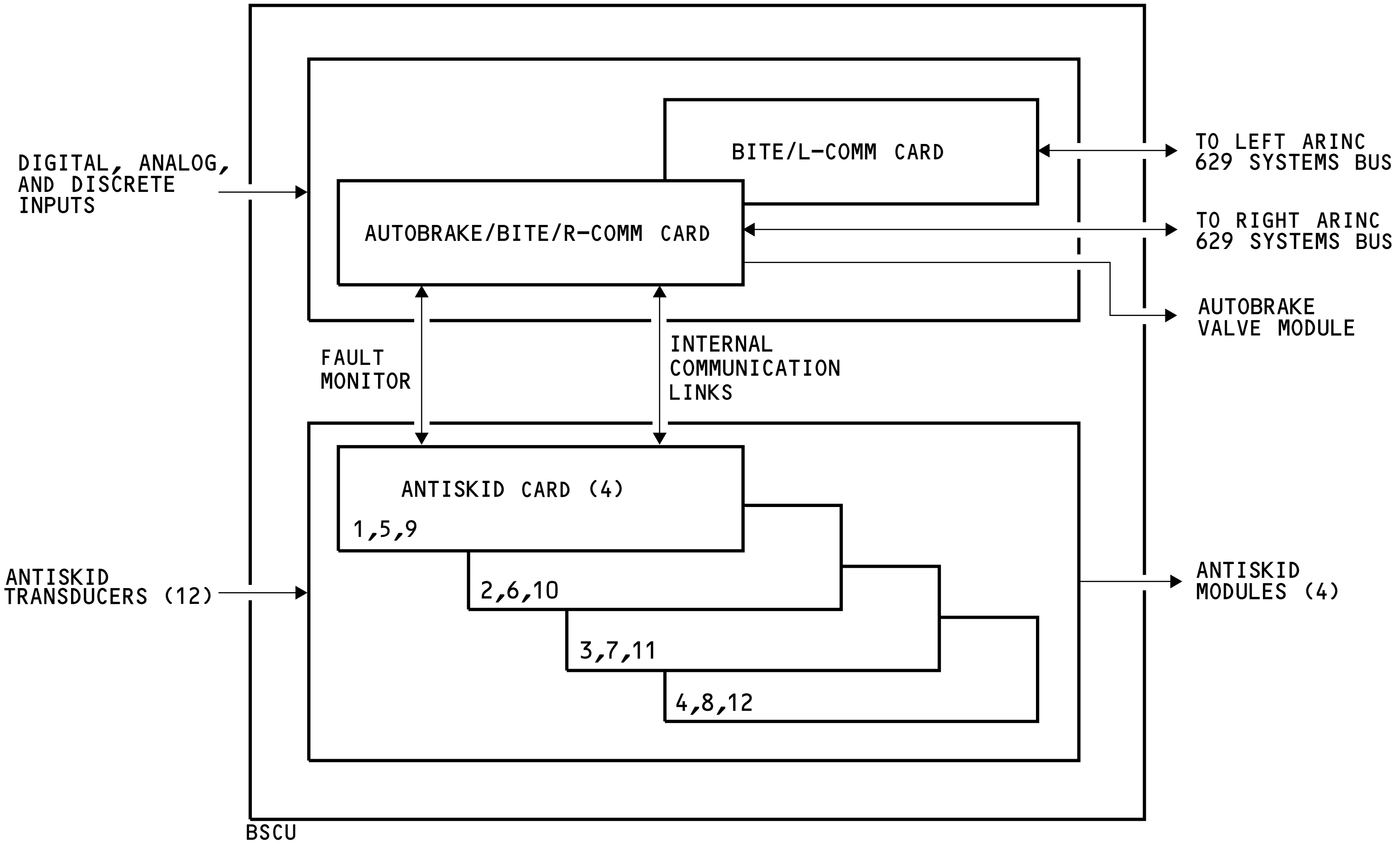
Autobrake/BITE/Comm Card

Two autobrake/BITE/Comm cards operate the autobrakes, do the built in test functions, and supply the communication links to other airplane systems.

Although the autobrake system circuitry is on each of these cards, only the card in the Autobrake/BITE/R-Comm card position controls autobrake operation.

Both of the cards do the BITE functions. Each card independently monitors the antiskid and autobrake systems for faults.

The cards communicate with other airplane systems over different ARINC 629 systems buses. Each card has different communication links to the wheel control cards. They use these links to monitor and supply the antiskid system with digital, analog, and discrete inputs.



M42366 S000618715_V1

ANTISKID/AUTOBRAKE SYSTEM - BSCU - PHYSICAL DESCRIPTION

ANTISKID/AUTOBRAKE SYSTEM - ANTISKID MODULES - INTRODUCTION

Purpose

There are two normal antiskid modules and two alternate antiskid modules in the antiskid system.

These modules release brake pressure to prevent wheel skids.

Location

The normal antiskid modules are near the main landing gear beams outboard of the main landing gear trunnions. An access panel permits you to get access to the normal antiskid valve modules.

The alternate antiskid modules are on the main landing gear beams inboard of the main landing gear trunnions.

Normal Antiskid Modules

There are two normal antiskid modules: one for each main landing gear. The modules are the same. Each module has six valves.

The modules are LRUs and each module contains these LRUs:

- Inlet filter (2)
- System pressure shutoff valve
- Antiskid valve (6)
- Hydraulic fuse (6).

Alternate Antiskid Modules

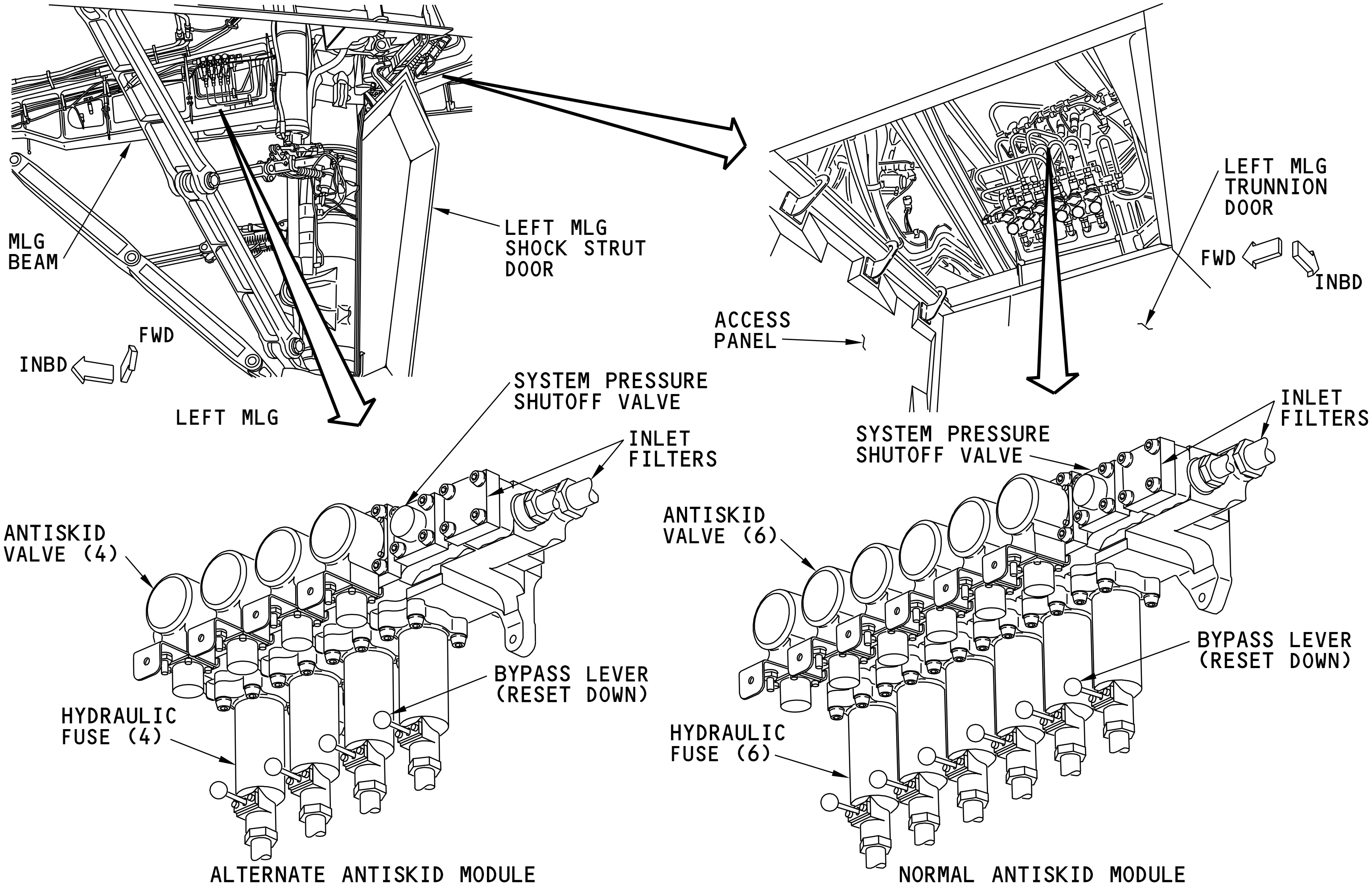
There are two alternate antiskid modules: one for each main landing gear. The modules are the same. Each module has four valves.

The modules are LRUs and each module contains these LRUs:

- Inlet filter (2)
- System pressure shutoff valve
- Antiskid valve (4)
- Hydraulic fuse (4).

Training Information Point

The system can operate with one unserviceable normal antiskid valve for each six wheel truck. You must deactivate the related brake.



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ANTISKID/AUTOBRAKE SYSTEM - ANTISKID MODULES - INTRODUCTION

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ANTISKID/AUTOBRAKE SYSTEM - ANTISKID MODULES - FUNCTIONAL DESCRIPTION

General

The operation of normal and alternate antiskid modules is the same. The number of antiskid valves and hydraulic fuses is the only difference in the two modules.

The normal antiskid module controls brake pressure for six wheels independently. The alternate antiskid module controls two wheels independently and two sets of paired wheels with the other two antiskid valves.

Inlet Filters

An in-line filter screen removes contamination from brake metered pressure fluid as it enters the antiskid module.

System pressure fluid also goes through a filter as it enters the antiskid module.

System Pressure Shutoff Valve

When brake metered pressure is above 225 psig, the system pressure shutoff valve supplies system pressure, if available, to the first stage of each antiskid valve. This provides a constant 3000 psi pressure level for pressure control.

When brake metered pressure is less than 225 psig, system pressure closes the shutoff valve. This prevents wear of first stage components by constant application of system pressure. When the shutoff valve is closed, it uses metered pressure to control the first stage.

Antiskid Valve

Each antiskid valve is a three-way, unigain control valve. The valves have two stages of control:

- The first stage controls pressure in proportion to input current from the BSCU
- The second stage keeps pressure to the brakes equal to the first stage controlled pressure.

The first stage uses a current controlled flapper between two nozzles to adjust first stage pressure. One nozzle connects to system pressure and the other connects to return.

When no current goes to the valve, the flapper moves against the return nozzle. In this position, control pressure is the same as system pressure.

When full current goes to the valve, the flapper moves against the pressure nozzle. In this position, control pressure is the same as return pressure.

For each intermediate value of input current, the flapper moves between the two nozzles to adjust the control pressure (shown).

The second stage uses a spool valve that moves with first stage control pressure and a spring on one end and metered brake pressure on the other end.

When there is no metered brake pressure, the spring holds the spool in position to send initial brake metered pressure to fill the brakes before the shutoff valve opens.

When control pressure is more than metered brake pressure, the spool moves to send metered brake pressure to the brakes.

During antiskid operation, the spool operates to control brake pressure equal to first stage control pressure. It sends excess brake pressure to system return. A flow restrictor slows spool movement.

Hydraulic Fuse

Brake line fuses prevent fluid loss caused by external leakage downstream of the antiskid modules.

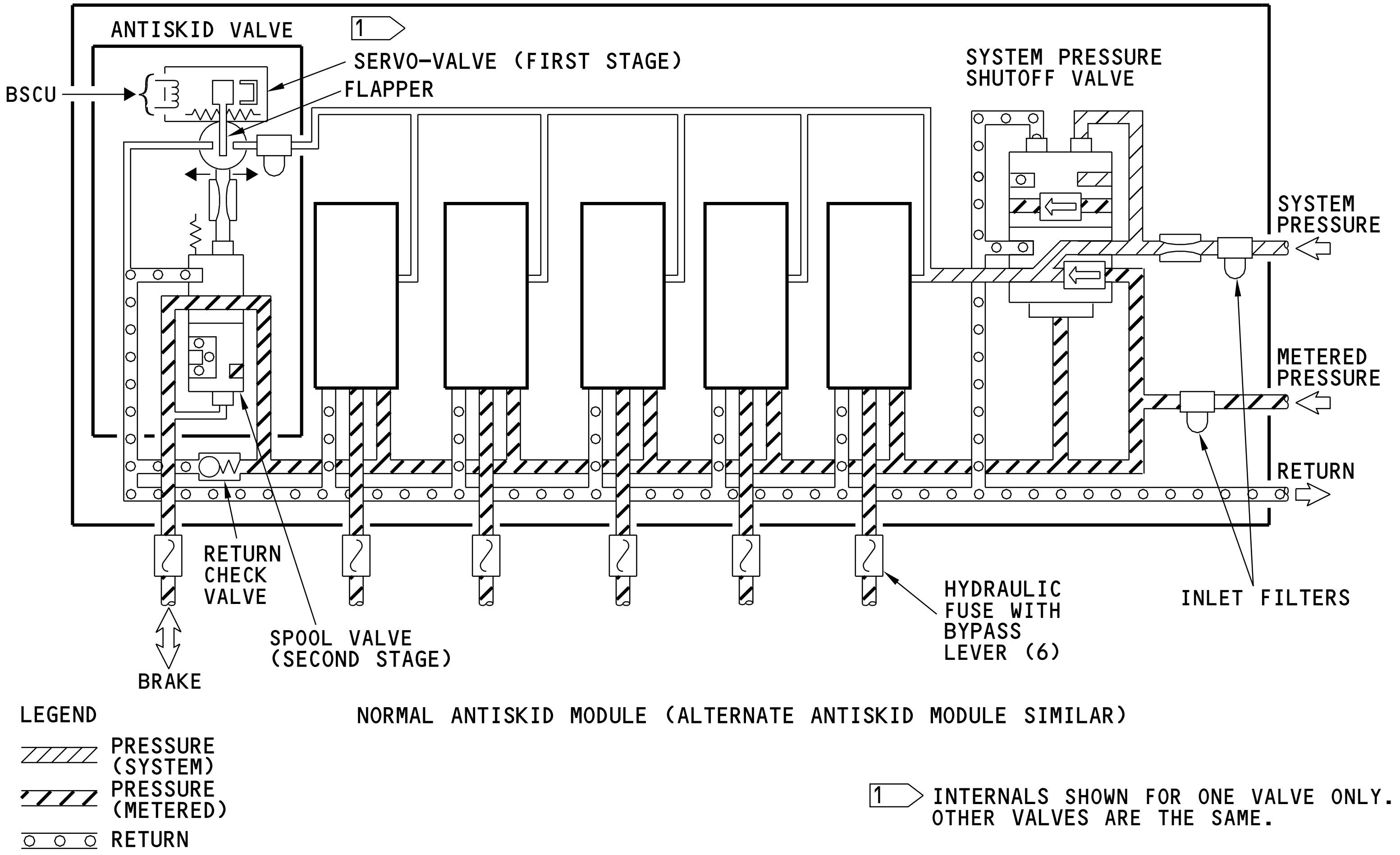
If 60 to 95 cubic inches of fluid pass through the fuse, it closes. When the pressure differential across the fuse is between 18 to 30 psi, the fuse automatically resets.

A bypass lever permits manual reset of the fuse. To reset manually, move the lever down to operate a bypass valve that equalizes pressure on each side of the fuse.

There is no indication that a fuse is set.

Return Check Valve

If the return line is blocked and metered pressure is less than return pressure, the return check valve releases brake pressure to metered pressure.



M42369 S000618718_V1

ANTISKID/AUTOBRAKE SYSTEM - ANTISKID MODULES - FUNCTIONAL DESCRIPTION

ANTISKID/AUTOBRAKE SYSTEM - ANTISKID SHUTTLE VALVE MODULE

Purpose

Two shuttle valve modules automatically select the highest metered pressure source and send it to the brakes.

Components

The shuttle valve modules are the same for the left and the right. Each module is an LRU and contains these LRUs:

- Cartridge valves (6)
- Filters (6)
- A flight dispatch disconnect.

Location

The modules are forward of the left and right main landing gear beams. They are outboard of the main landing gear below the normal antiskid modules.

You get access to the modules through an access panel outboard of each main landing gear.

Functional Description

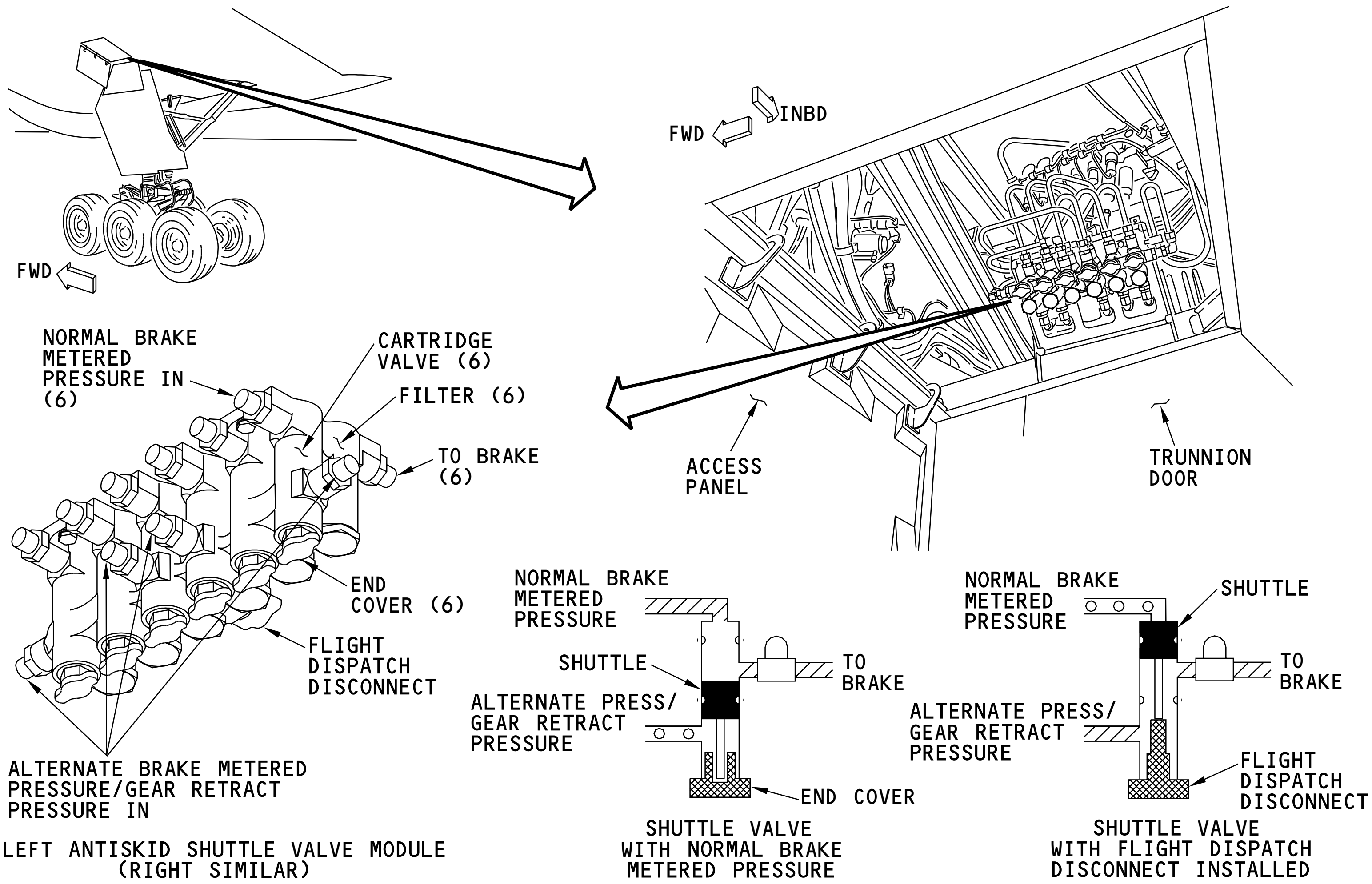
Each shuttle valve moves to a detented position to connect the input line with the higher metered pressure to the related brake line. The line with the lower pressure is blocked.

Fluid to each brake is put through a filter before it goes out of the module.

You use the shuttle valve to deactivate a brake in the normal brake system. To lock the related shuttle valve in the ALTERNATE position, you remove the end cover and install the flight dispatch disconnect. This permits gear retract pressure to the related brake with the normal brake deactivated.

Training Information Point

The system can operate with one brake on each six wheel truck deactivated.



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ANTISKID/AUTOBRAKE SYSTEM - ANTISKID SHUTTLE VALVE MODULE

ANTISKID/AUTOBRAKE SYSTEM - AUTOBRAKE VALVE MODULE

Purpose

The autobrake valve module gets BSCU electrical signals to send right hydraulic system pressure to the normal brake system during autobrake operation.

Components

The autobrake valve module is an LRU and contains these LRUs:

- Solenoid valve
- Solenoid valve pressure switch
- Control valve
- Control valve pressure transducer.

There is also a shutoff valve inside the module.

Location

The autobrake valve module is on the keel beam in the right main landing gear wheel well.

Functional Description

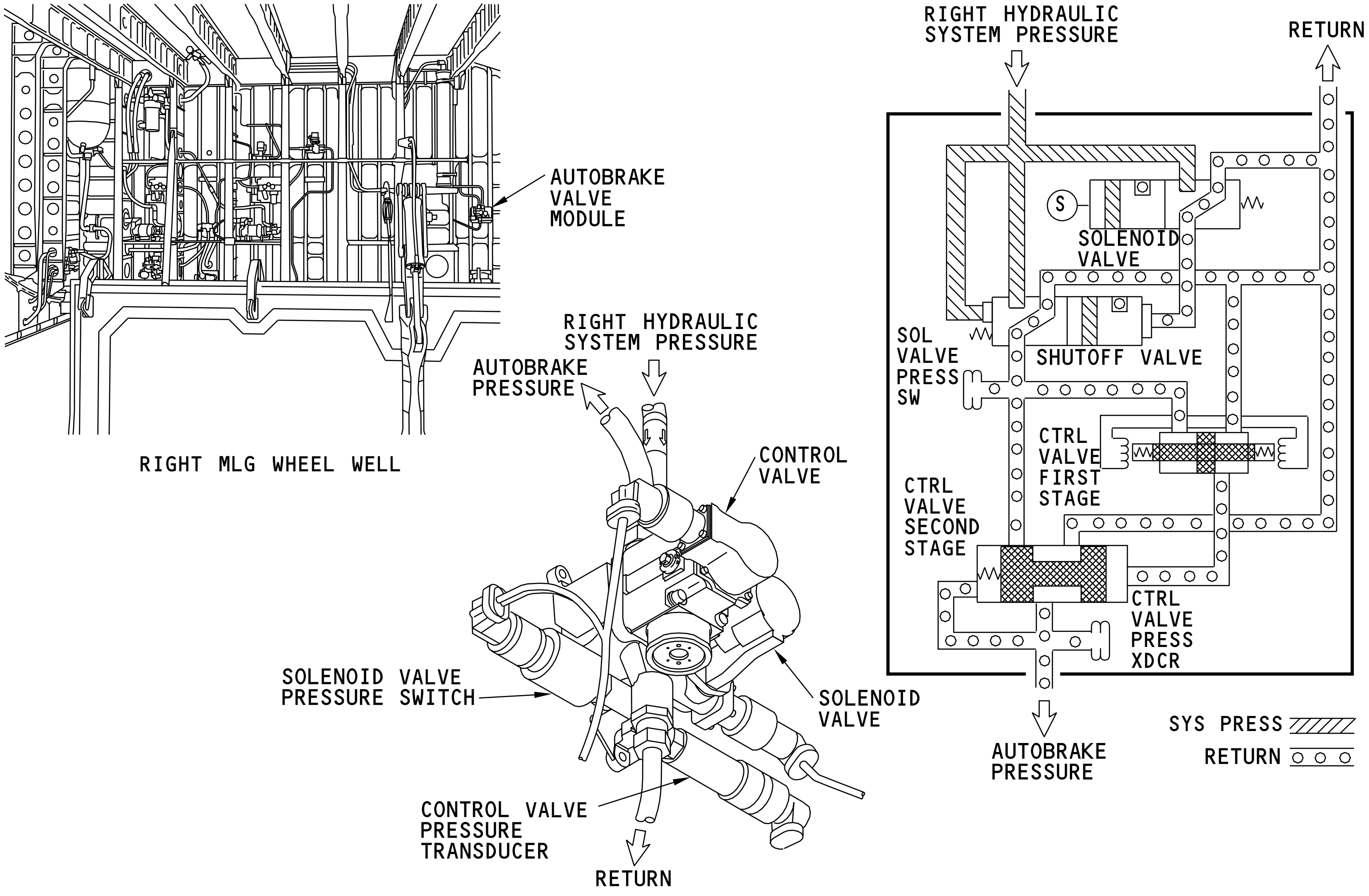
When the autobrake function does not operate, the solenoid valve is not energized. This stops hydraulic pressure downstream of the solenoid valve. During autobrake operation, the BSCU energizes the solenoid valve. This causes the solenoid valve to send right hydraulic system pressure to the shutoff valve.

This pressure causes the shutoff valve to open and permits the system pressure to go to the control valve.

The solenoid valve pressure switch sends a signal to the BSCU when the pressure downstream of the shutoff valve is more than 750 psi. The BSCU uses this signal to find solenoid valve faults.

The control valve is a two-stage servo-operated valve. The BSCU controls this valve to let the necessary hydraulic pressure to go to the brakes.

The control valve pressure transducer sends autobrake pressure output signals to the BSCU for feedback.



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ANTISKID/AUTOBRAKE SYSTEM - AUTOBRAKE VALVE MODULE

ANTISKID/AUTOBRAKE SYSTEM - AUTOBRAKE SHUTTLE VALVE

Purpose

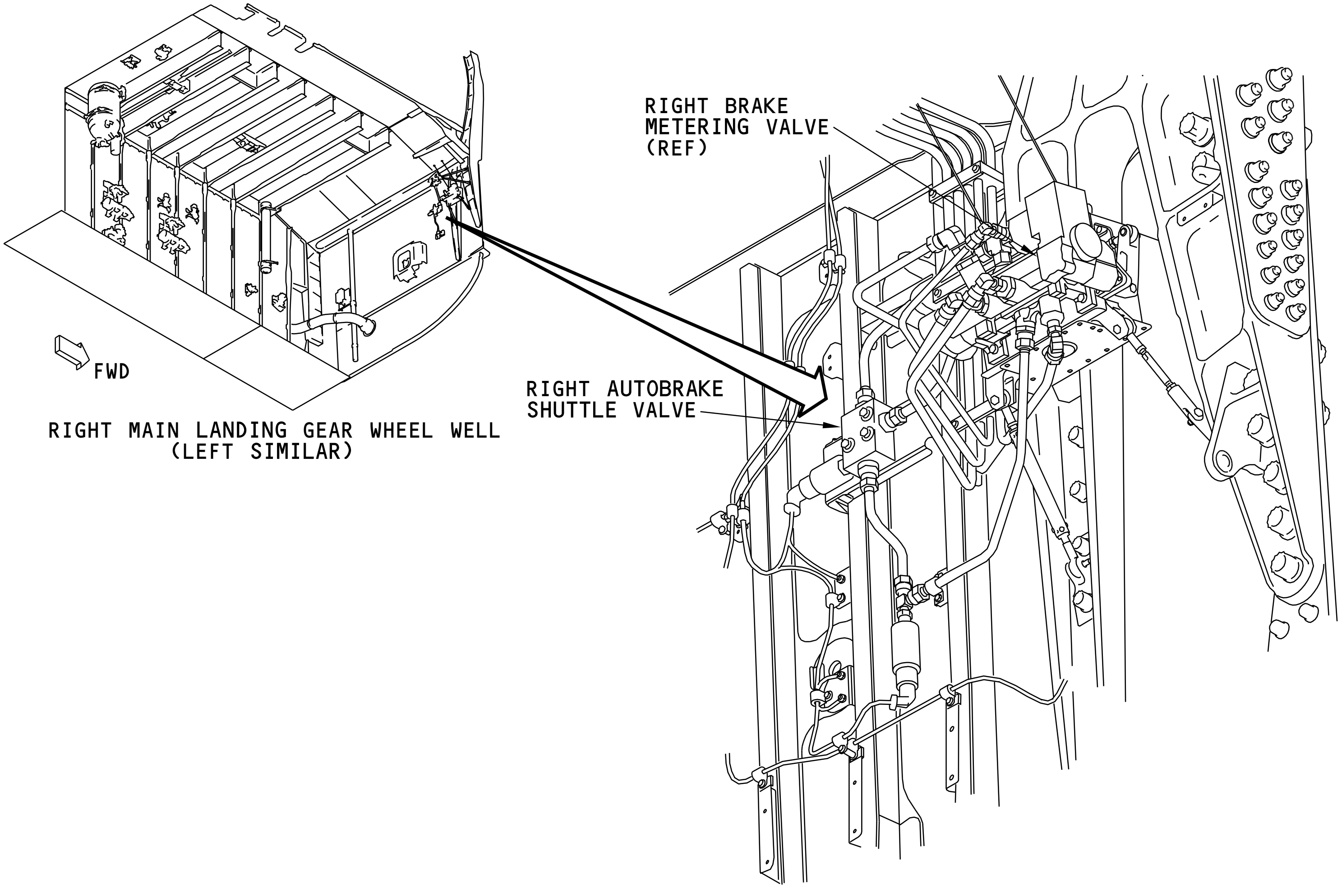
Two autobrake shuttle valves select the highest of autobrake or normal brake metered pressures and send it to the brakes.

Location

The autobrake shuttle valves are on the forward wall in the left and right main landing gear wheel wells. They are inboard of the brake metering valves.

Physical Description

The valves are un-biased shuttle valves with detents and are interchangeable.



M42370 S000618721_V1

ANTISKID/AUTOBRAKE SYSTEM - AUTOBRAKE SHUTTLE VALVE

ANTISKID/AUTOBRAKE SYSTEM - BRAKE METERED PRESSURE TRANSDUCERS

Purpose

Four brake metered pressure transducers send normal and alternate metered pressure information to the BSCU for anti-skid and autobrake control.

Location

The two normal brake metered pressure transducers are on the left and right autobrake shuttle valves in the main landing gear wheel wells.

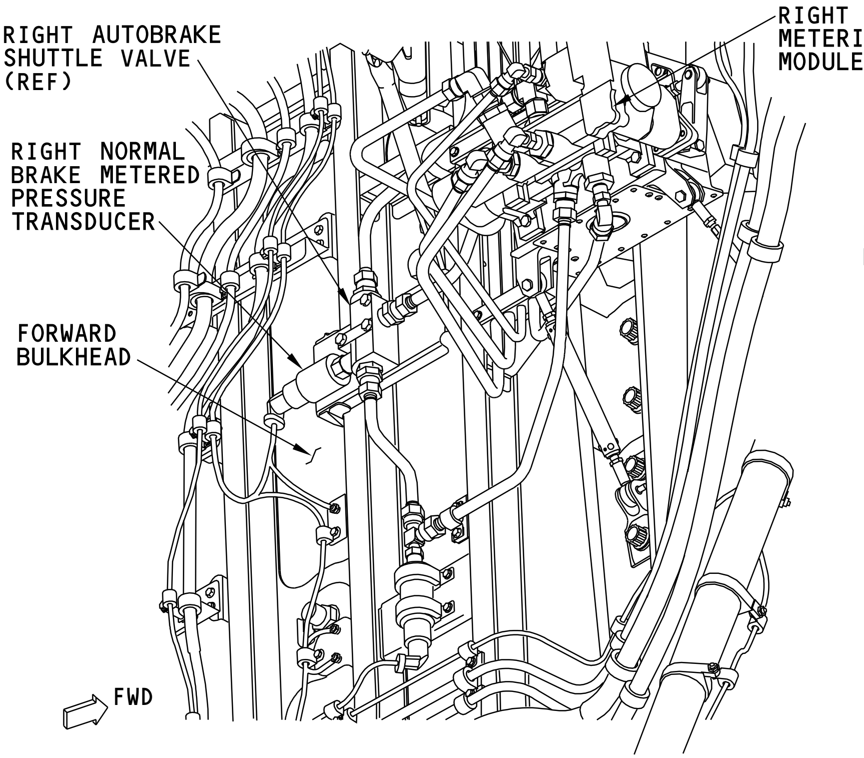
The two alternate brake metered pressure transducers are on the landing gear beams inboard of the left and right alternate antiskid modules.

Functional Description

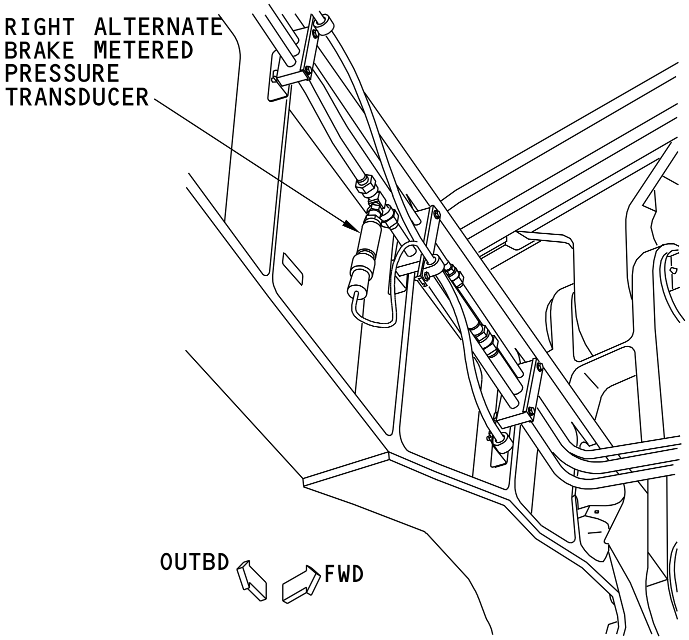
The BSCU uses inputs from the normal brake metered pressure transducers for autobrake disarm logic and for the taxi brake release function.

All four transducers supply the BSCU with metered pressure data to send to the AIMS. The data shows on the landing gear brakes/steering maintenance page.

The BSCU also sends the pressure data to the flight data recorder.



RIGHT MAIN LANDING GEAR WHEEL WELL
(LEFT SIMILAR)



RIGHT MAIN LANDING GEAR BEAM
(LEFT SIMILAR)

M42371 S000618722_V1

ANTISKID/AUTOBRAKE SYSTEM - BRAKE METERED PRESSURE TRANSDUCERS

ANTISKID/AUTOBRAKE SYSTEM - FUNCTIONAL DESCRIPTION - INTRODUCTION

General

The BSCU uses antiskid transducer signals to control the normal and alternate antiskid valve modules.

These modules receive metered pressure from the brake metering valves or the autobrake valve module and send it to the brakes through the antiskid shuttle valves.

When the BSCU gets input of a skid condition, it commands the antiskid valves to release pressure from the related brake to hydraulic system return.

When the BSCU gets input from the autobrake selector, it controls pressure to the brakes with the autobrake valve module when the airplane lands or on rejected takeoffs.

Normal Antiskid Operation

The normal brake metering valves send metered right hydraulic system or accumulator pressure through the autobrake shuttle valves to the normal antiskid modules. The normal antiskid modules use BSCU input and this metered pressure to control pressure to each brake.

The left normal antiskid module uses an antiskid surge accumulator to absorb high pressure release surges. The right normal antiskid module uses the right hydraulic system reservoir.

Alternate Antiskid Operation

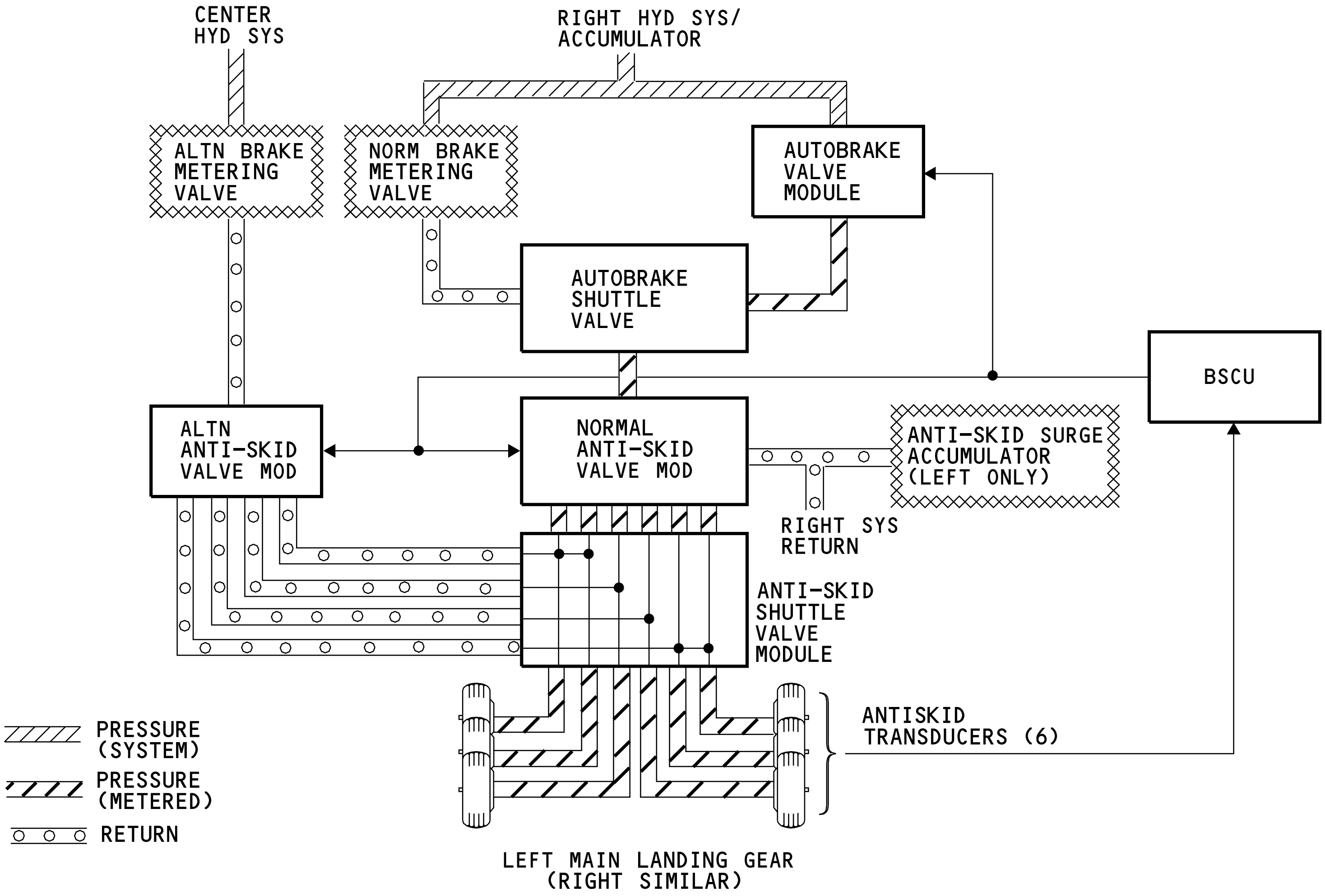
The alternate brake metering valves send metered center hydraulic system pressure to the alternate antiskid modules. The alternate antiskid modules use BSCU input and this metered pressure to control pressure to each fwd-mid group of brakes and each aft brake.

Autobrake Operation

When all conditions for autobrake operation occur, the BSCU uses the autobrake valve module to control brake pressure to the normal brake system.

The autobrake valve module sends metered right hydraulic system pressure through the autobrake shuttle valve to the normal antiskid modules.

Normal antiskid operation is the same for autobrake and normal brake application.



M42372 S000618723_V1

ANTISKID/AUTOBRAKE SYSTEM - FUNCTIONAL DESCRIPTION - INTRODUCTION

ANTISKID/AUTOBRAKE SYSTEM - ANTISKID FUNCTIONAL DESCRIPTION - ANTISKID CARDS

General - BSCU I

The four antiskid cards work together in pairs to supply primary and backup antiskid control. The 1,5,9 card works with the 3,7,11 card and the 2,6,10 card works with the 4,8,12 card.

Each antiskid card has a primary and a secondary controller. The primary controller supplies the primary control for a fore-mid-aft wheel group. The secondary controller supplies backup control functions for a different fore-mid-aft wheel group.

The primary and secondary controllers monitor wheel speed data and use drivers to control antiskid valves for normal and alternate antiskid operation.

All the drivers have two power sources.

Normal Antiskid Operation - BSCU I

During normal antiskid operation, the primary controller controls an antiskid valve driver for each of the three wheels in the three wheel group. A secondary controller on a different antiskid card also sends control signals to the antiskid valve driver.

These drivers control antiskid valves on the normal antiskid valve modules.

Alternate Antiskid Operation - BSCU I

Primary and secondary control for the alternate antiskid system is similar to the normal system.

The alternate antiskid system uses two drivers on each antiskid card for valve control. One driver controls the aft wheel. The other driver controls the forward/middle pair of wheels.

These drivers control antiskid valves on the alternate antiskid valve modules.

General - BSCU II

The BSCU II antiskid control system is divided into four wheel control groups, each consisting of three wheels: fore, mid, and aft. Each control group uses three antiskid control subsystems, one to control each wheel, located on the same antiskid circuit card. Each antiskid subsystem has its own independent regulated power supply, backup power supply, microcontroller, wheel speed transducer interface, normal and alternate valve driver, and separate communication links to the primary and secondary BITE systems.

Each antiskid card has two power sources.

Normal Antiskid Operation - BSCU II

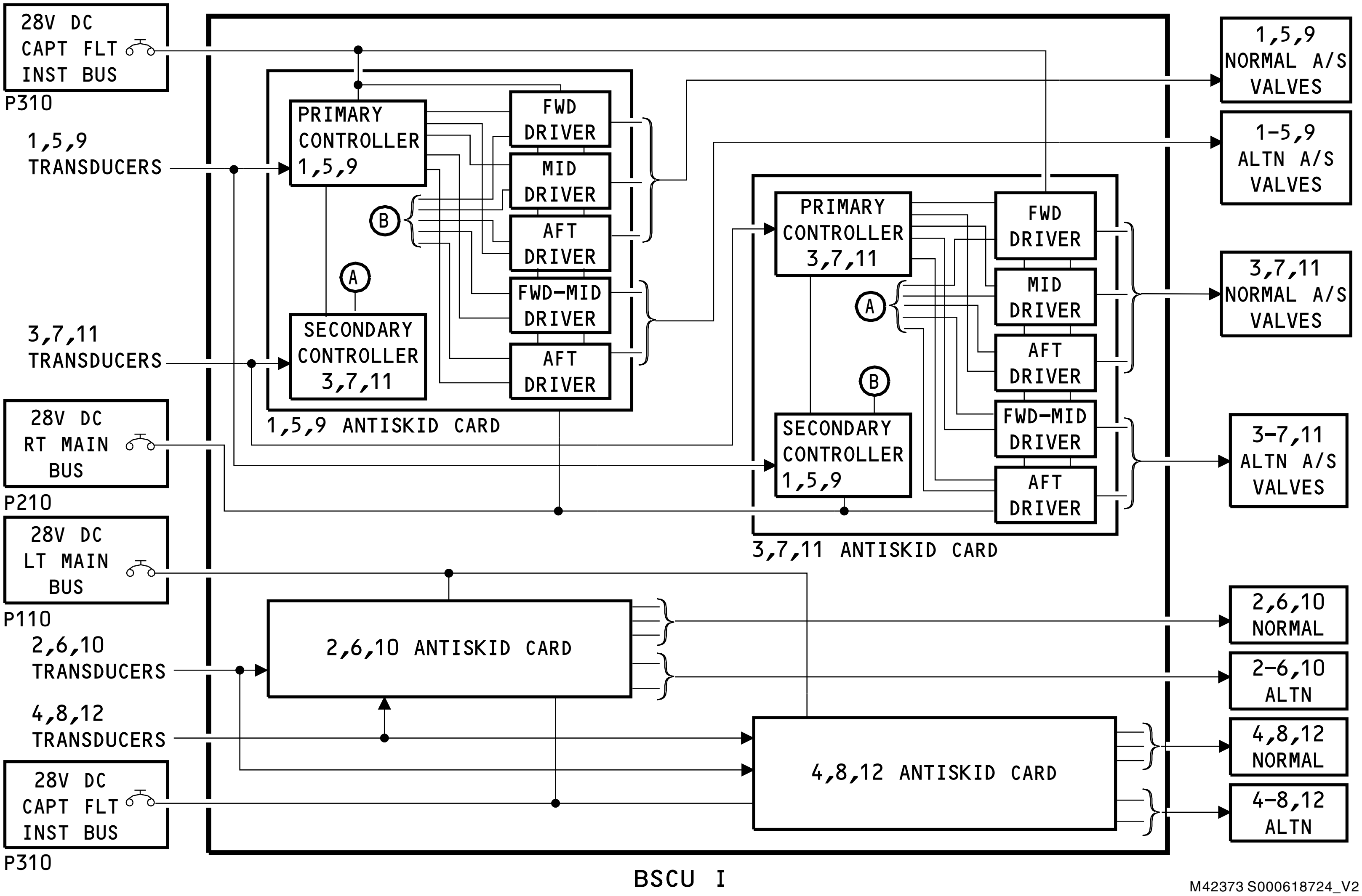
During normal antiskid operation, each antiskid control subsystem uses the normal antiskid valve driver for each of the three wheels in the three wheel group.

These drivers control antiskid valves on the normal antiskid valve modules.

Alternate Antiskid Operation - BSCU II

During alternate antiskid operation, there are alternate valve drivers that are only used by the fore and aft subsystems. The alternate antiskid system signals for the fore and mid wheels are combined together. The higher of the two signals is sent through to the alternate valve driver located on the fore subsystem.

These drivers control the antiskid valves on the alternate antiskid valve modules.



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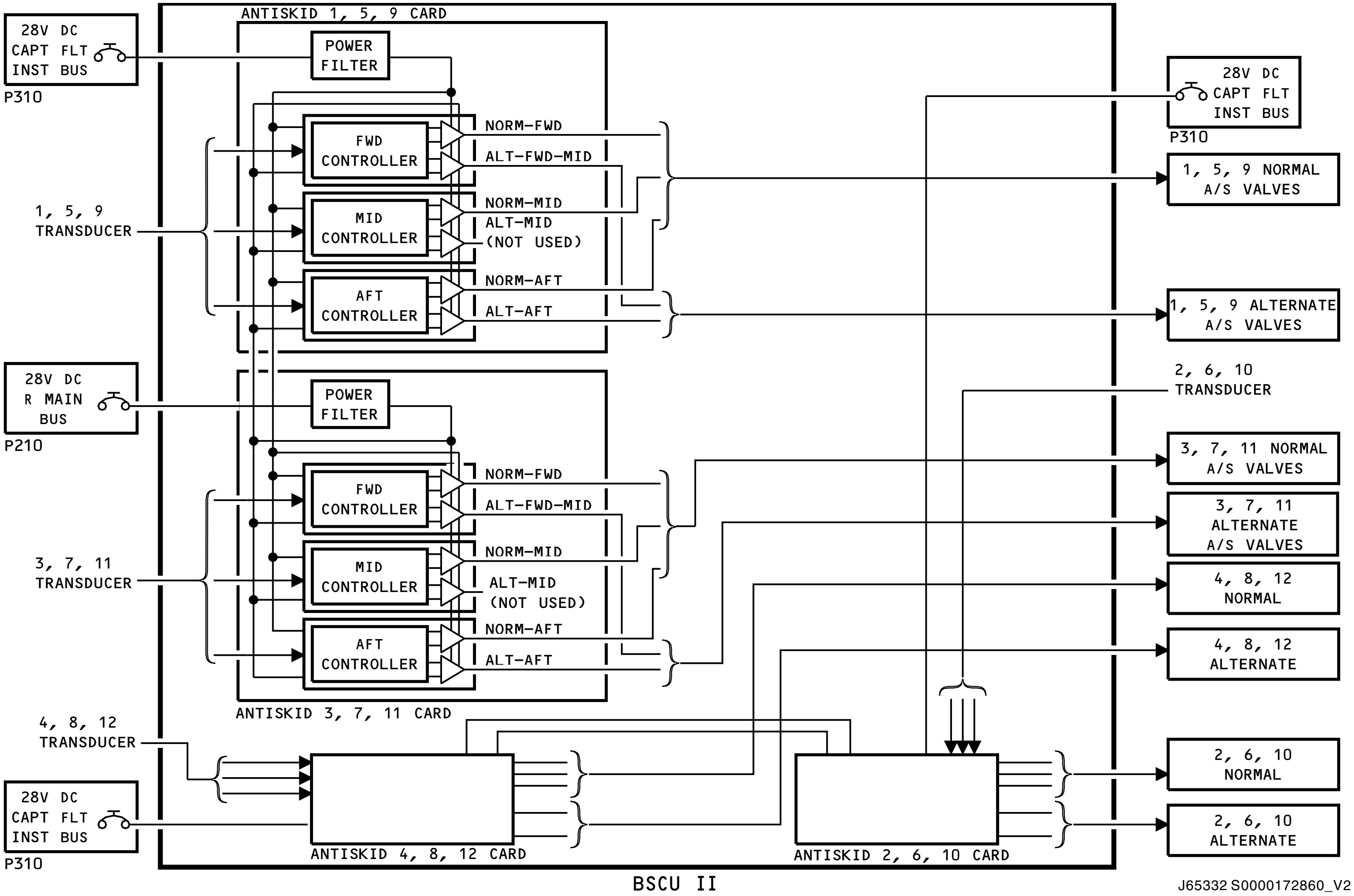
ANTISKID/AUTOBRAKE SYSTEM - ANTISKID FUNCTIONAL DESCRIPTION - ANTISKID CARDS - BSCU I



ANTISKID/AUTOBRAKE SYSTEM - ANTISKID FUNCTIONAL DESCRIPTION - ANTISKID CARDS - BSCU II

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ANTISKID/AUTOBRAKE SYSTEM - ANTISKID FUNCTIONAL DESCRIPTION - CONTROLLERS

General

The antiskid cards supply these functions:

- Skid control
- Locked wheel protection
- Hydroplane/touchdown protection
- Gear retract inhibit
- Taxi brake release.

Each controller uses these inputs for control:

- Wheel speed from a fwd-mid-aft wheel group
- Groundspeed
- Landing gear lever position
- Taxi brake release request for the BSCU I comes from the Autobrake/BITE/R-Comm. Taxi brake release request for the BSCU II comes from the Autobrake/BITE/R-Comm card for the right truck and BITE/L-Comm card for the left truck.

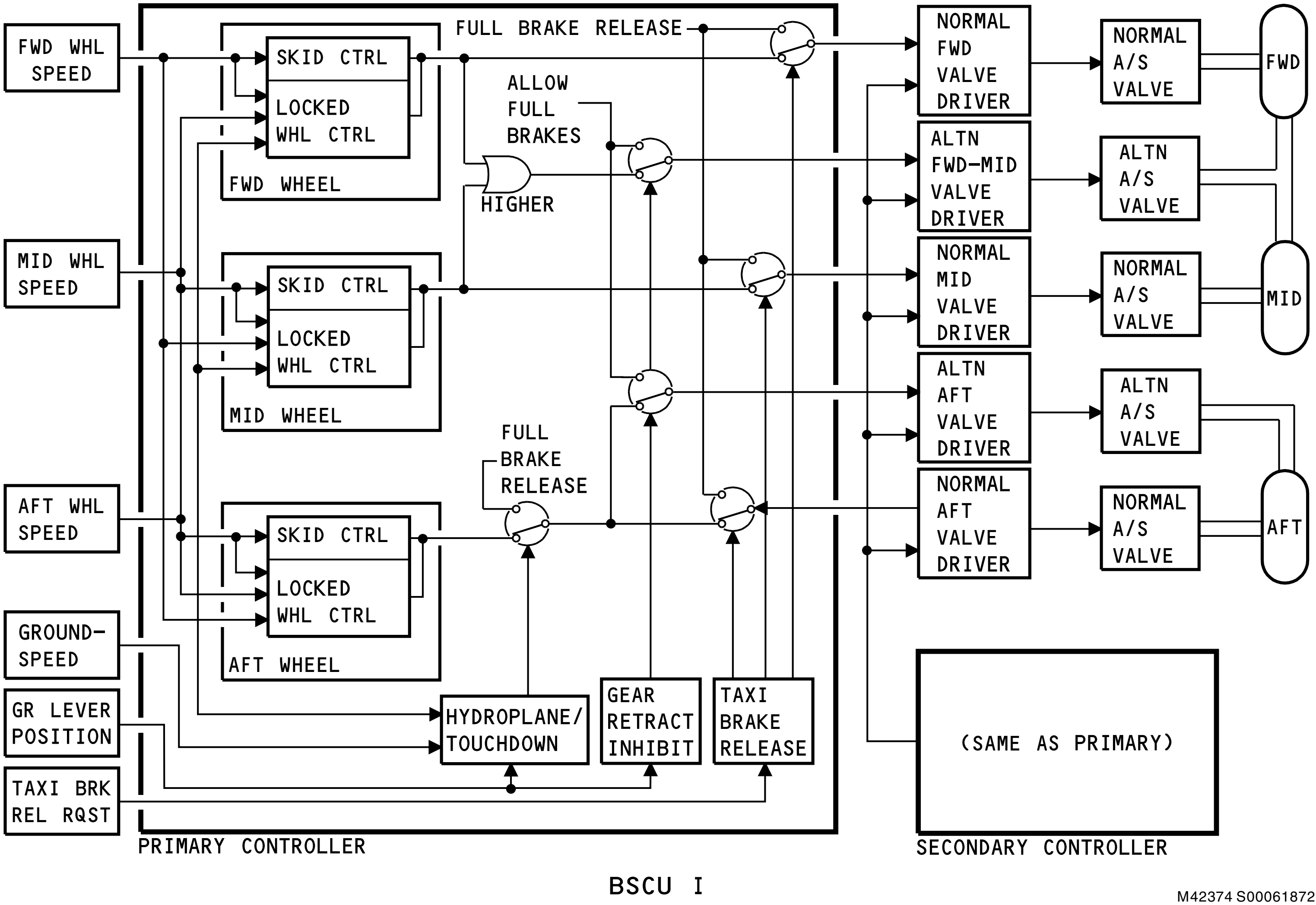
Each antiskid circuit card controls the power output to three normal and two alternate antiskid valves with 0-55 milliampere current drivers.

For the BSCU I, the primary controller on each card uses current drivers on that same card. These drivers also get inputs from the secondary controller on the paired card. For the BSCU II, the current drivers are on each of the individual controllers module. The drivers receive input from the micro-controller on the same controller module.

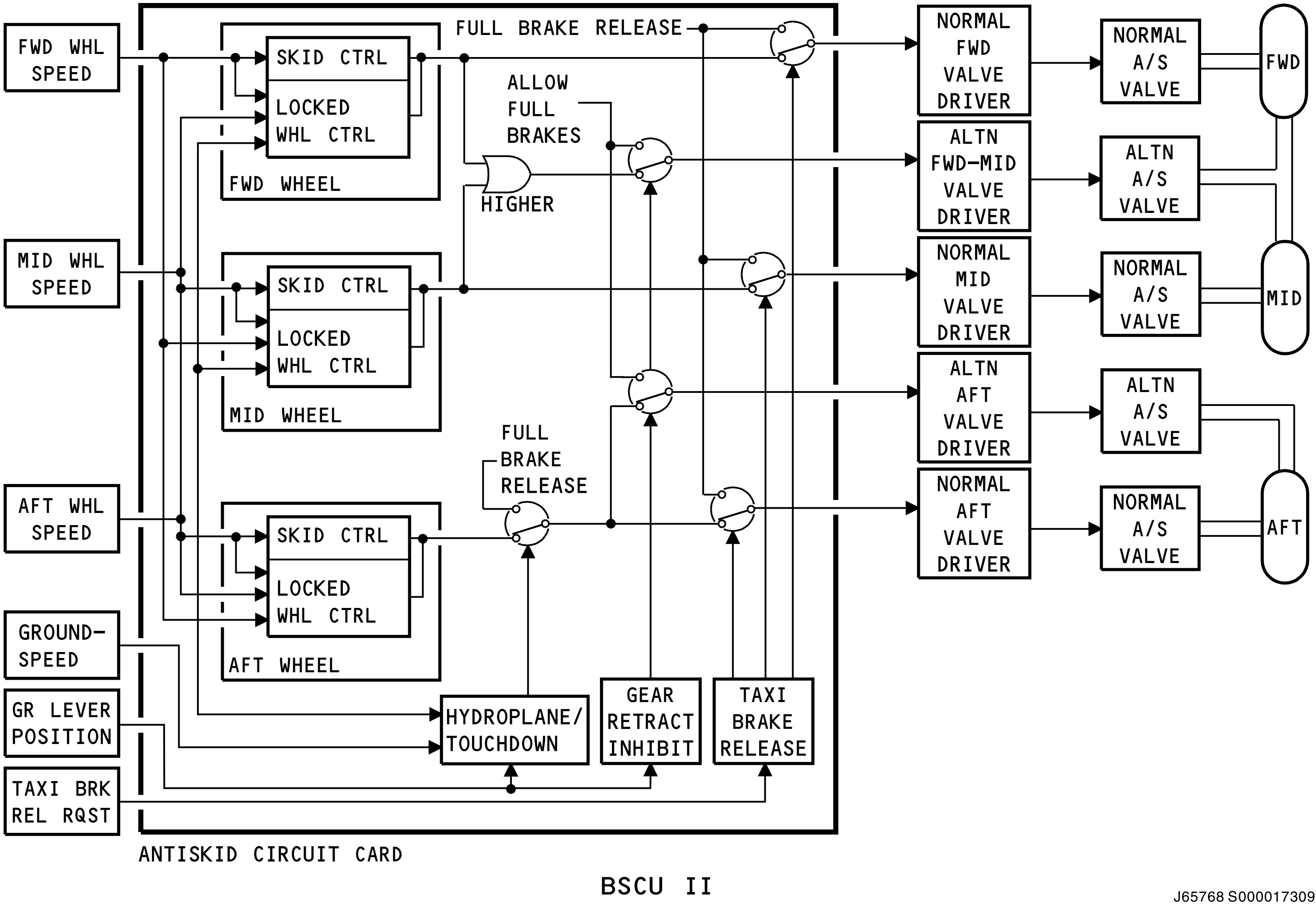
Brake Test and Fault Monitoring (not shown)

When the controllers get a brake release test request, they use the drivers to release all pressure to the requested brake.

The Autobrake/BITE/Comm cards monitor the controllers for antiskid fault data. They send this information to the AIMS for flight deck display.



ANTISKID/AUTOBRAKE SYSTEM - ANTISKID FUNCTIONAL DESCRIPTION - CONTROLLERS- BSCU I



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ANTISKID/AUTOBRAKE SYSTEM - ANTISKID FUNCTIONAL DESCRIPTION - CONTROLLERS - BSCU II

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ANTISKID/AUTOBRAKE SYSTEM - ANTISKID FUNCTIONAL DESCRIPTION - PROTECTION MODES - 1

Skid Control

Skid control compares calculated wheel speed velocity with a velocity model to control brake force. If a wheel slows down too quickly, skid control releases brake pressure until the wheel speed increases.

Skid control is available when wheel speed is greater than eight knots.

During normal antiskid operation, skid control operates for each wheel.

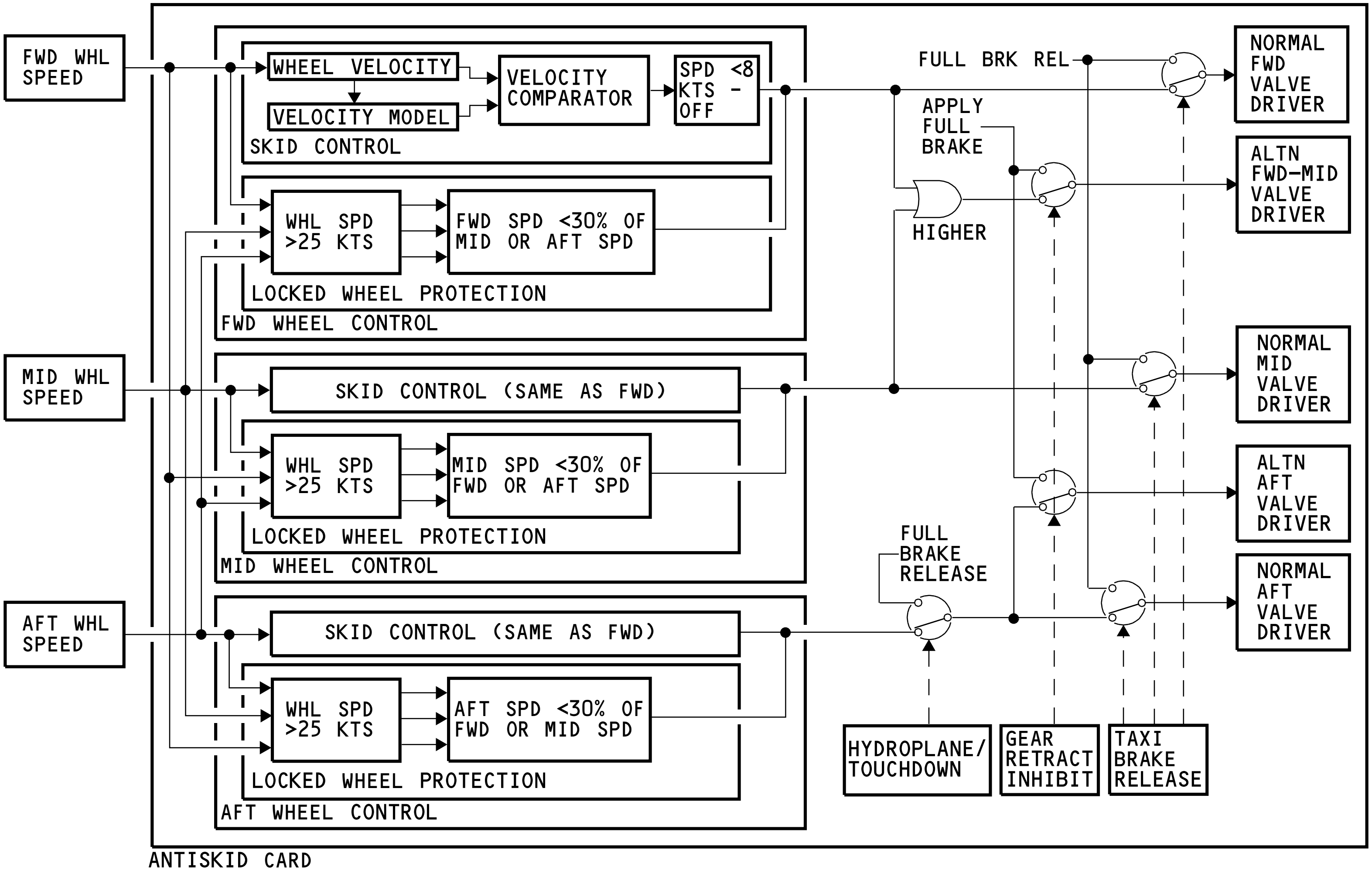
During alternate antiskid operation, skid control operates an aft wheel and a fwd-mid pair of wheels.

Locked Wheel Protection

Locked wheel protection compares the wheel speeds of a fore-mid-aft group of wheels.

If the slowest wheel speed is less than 30 percent of the fastest wheel speed, locked wheel protection releases pressure to the slowest wheel.

Locked wheel protection does not operate below 25 knots.



M42375 S000618726_V1

ANTISKID/AUTOBRAKE SYSTEM - ANTISKID FUNCTIONAL DESCRIPTION - PROTECTION MODES - 1

ANTISKID/AUTOBRAKE SYSTEM - ANTISKID FUNCTIONAL DESCRIPTION - PROTECTION MODES - 2

Hydroplane/Touchdown Protection

Hydroplane/touchdown protection operates only on the aft wheels. This mode protects against hydroplaning and also prevents locked aft wheels during touchdown.

If the gear lever is down and aft wheel speed is 50 knots less than the ground speed, hydroplane/touchdown protection releases the aft wheels.

Hydroplane/touchdown protection indirectly protects the forward and middle wheels through locked wheel protection.

Gear Retract Inhibit

To permit gear retract braking, the antiskid system stops alternate antiskid operation for 12.5 seconds after the gear lever moves out of the DOWN position.

This permits gear retract braking to stop the wheels without antiskid brake release.

Taxi Brake Release

Taxi brake release reduces brake wear. This function releases two brakes on each truck during taxi brake operation.

For the BSCU I, the Autobrake/BITE/R-Comm card supplies the taxi brake release request for both trucks. For the BSCU II, the Autobrake/BITE/R-Comm card supplies the taxi brake release request for the right truck and the BITE/L-Comm card supplies the taxi brake release request for the left truck. The requests are sent to the antiskid cards when the following occur:

- Average wheelspeed is less the 45 knots
- Normal brake metered pressure is between 250 and 1800 psi.

The antiskid cards get the taxi brake release request. If the wheel speed is between 1 and 45 knots, the antiskid cards send a full brake release signal to the normal antiskid valves for the selected wheels. These valves release normal brake pressure to the brakes on one axle of each truck. The axle that releases for the left and the right trucks may be different.

The selected axle changes for each brake application when the normal brake metered pressure falls below 150 psi.

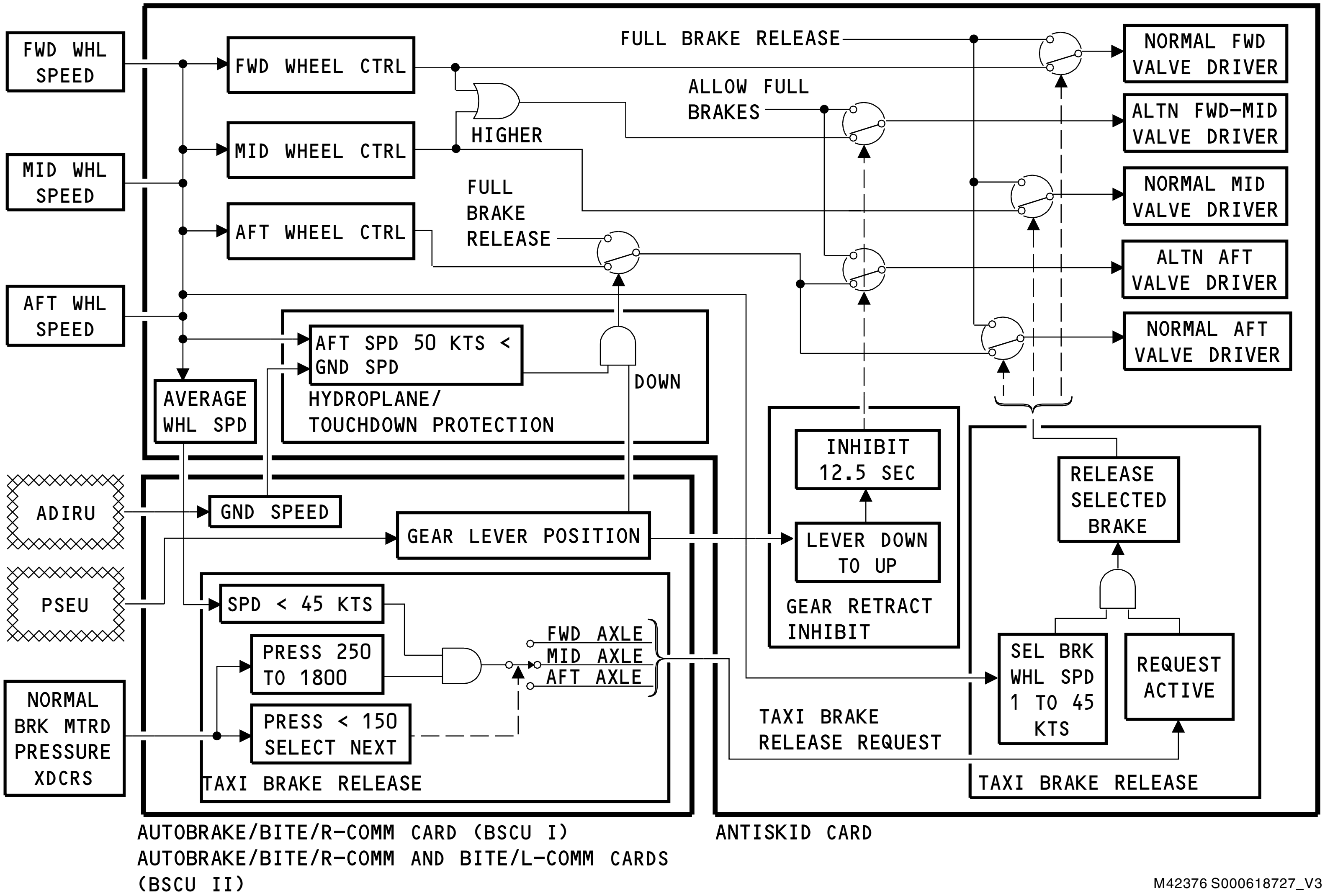
Normal brake metered pressure above 1800 psi turns off taxi brake release and permits all wheel brakes to operate.

Taxi brake release operates only in the normal antiskid system.

Brake Test and Fault Monitoring (not shown)

When the controllers get a brake release test request, they use the drivers to release all pressure to the requested brake.

The Autobrake/BITE/Comm cards monitor the controllers for antiskid fault data and send this information to AIMS for flight deck display.



ANTISKID/AUTOBRAKE SYSTEM - ANTISKID FUNCTIONAL DESCRIPTION - PROTECTION MODES - 2

ANTISKID/AUTOBRAKE SYSTEM - AUTOBRAKE CONTROL - FUNCTIONAL DESCRIPTION

General

The BSCU uses the Autobrake/BITE/R-Comm card to operate the autobrake system for landing and rejected takeoff. The BITE/L-Comm card supplies alternate BITE and secondary communication for the BSCU.

Autobrake control gets power from the left and right main dc buses. This power also goes to the autobrake selector.

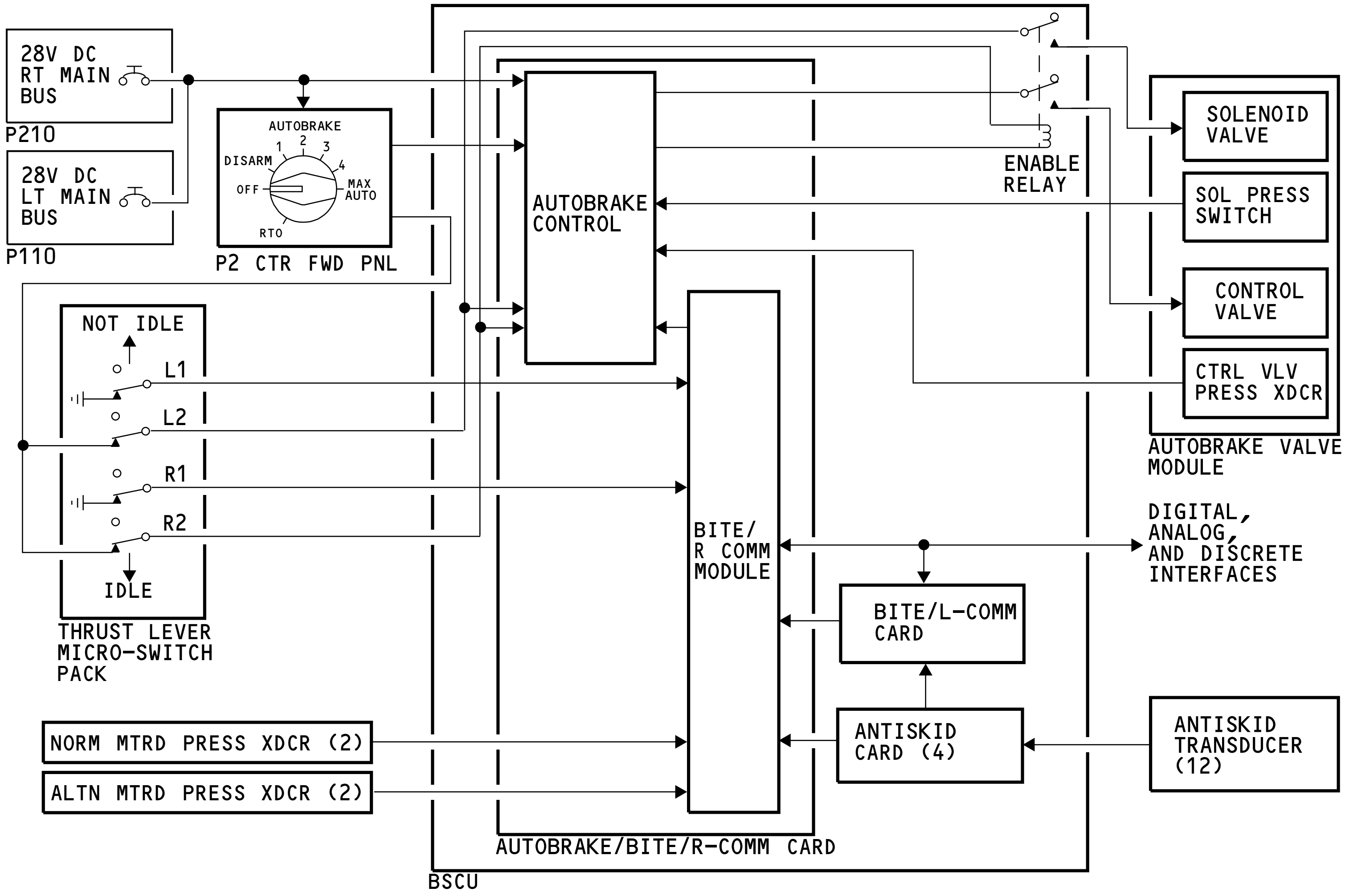
Functional Description

When all conditions occur to arm the system, the selector latches in a selected position and sends an input signal to autobrake control. It also sends electrical power to the thrust lever micro-switch pack.

The BSCU uses this power for thrust lever position input. When the thrust levers are at idle and all input conditions for landing or RTO autobrake occur, the BSCU energizes the enable relay.

The enable relay controls the solenoid valve that sends right hydraulic system pressure to the control valve.

The BSCU then uses the control valve to control pressure to the brake system to stop the airplane at the given decelerated rate.



M42377 S000618728_V1

ANTISKID/AUTOBRAKE SYSTEM - AUTOBRAKE CONTROL - FUNCTIONAL DESCRIPTION

ANTISKID/AUTOBRAKE SYSTEM - AUTOBRAKE FUNCTIONAL DESCRIPTION - LANDING ARMING LOGIC

General

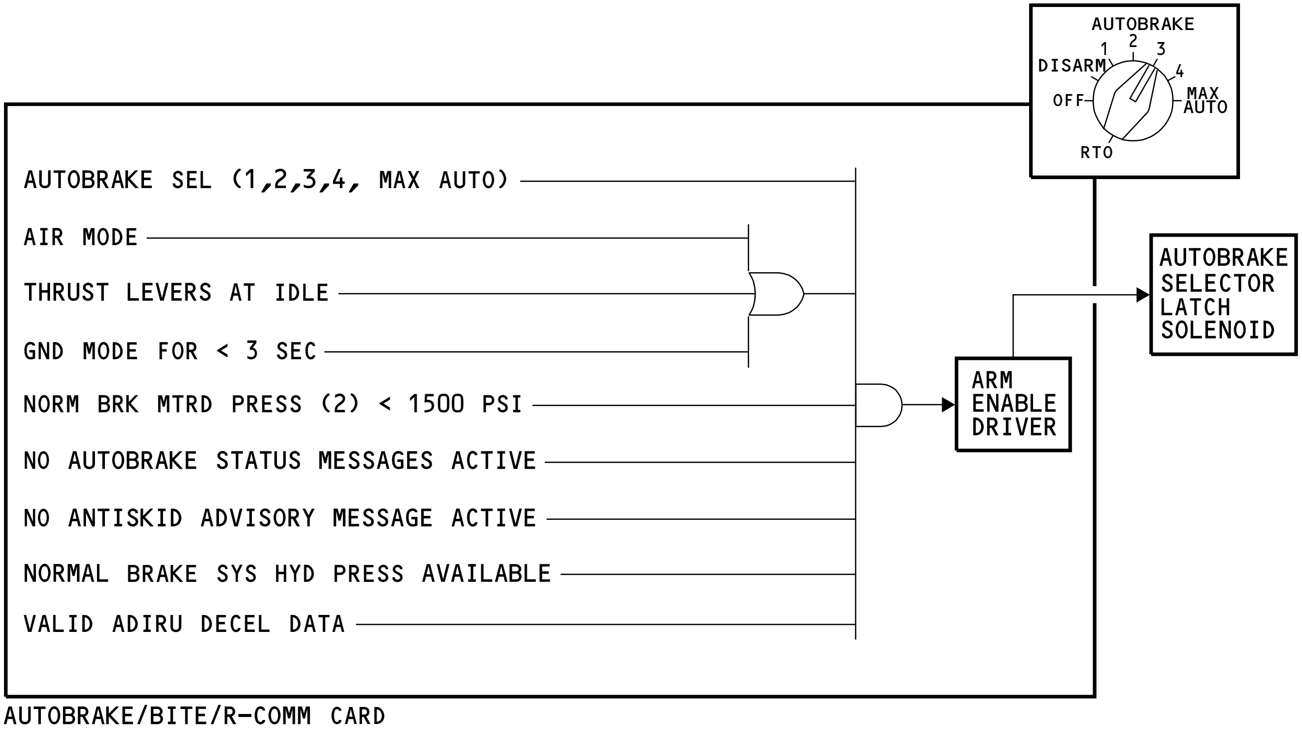
The selector latch solenoid holds the autobrake selector in the selected deceleration position when these arming conditions occur:

- You move the autobrake selector to a deceleration position (1, 2, 3, 4, MAX AUTO)
- Air mode (the two trucks TILTED or the landing gear lever UP), or the two thrust levers are at idle, or ground mode (the ADIRU ground speed - the average wheelspeed is less than 50 knots) for less than three seconds
- Left and right normal brake metered pressure is less than 1500 psi
- The AUTOBRAKE and/or AUTOBRAKE SOL VALVE status messages do not show
- The ANTISKID advisory message does not show
- Normal brake hydraulic system pressure is available (from the normal brake hydraulic pressure switch)
- ADIRU data is available.

If any of these conditions does not occur, the solenoid does not latch and the selector moves to the DISARM position. When the selector is in this position, the AUTOBRAKE advisory message shows.

If all these conditions occur, the selector stays in the selected position and one of these memo messages shows:

- AUTOBRAKE 1
- AUTOBRAKE 2
- AUTOBRAKE 3
- AUTOBRAKE 4
- AUTOBRAKE MAX.



M42378 S000618729_V1

ANTISKID/AUTOBRAKE SYSTEM - AUTOBRAKE FUNCTIONAL DESCRIPTION - LANDING ARMING LOGIC

ANTISKID/AUTOBRAKE SYSTEM - AUTOBRAKE FUNCTIONAL DESCRIPTION - LANDING APPLICATION LOGIC

General

The autobrake function applies the brakes when these conditions occur:

- Autobrake selector is in 1, 2, 3, 4, or MAX AUTO
- Thrust levers are in the idle position
- Ground mode (the two trucks are UNTILTED and the landing gear control lever is DOWN after a 0.1 second time delay)
- Wheel spin-up (average wheel speed of the 4th, 5th, 6th, and 7th fastest wheels is more than 60 knots).

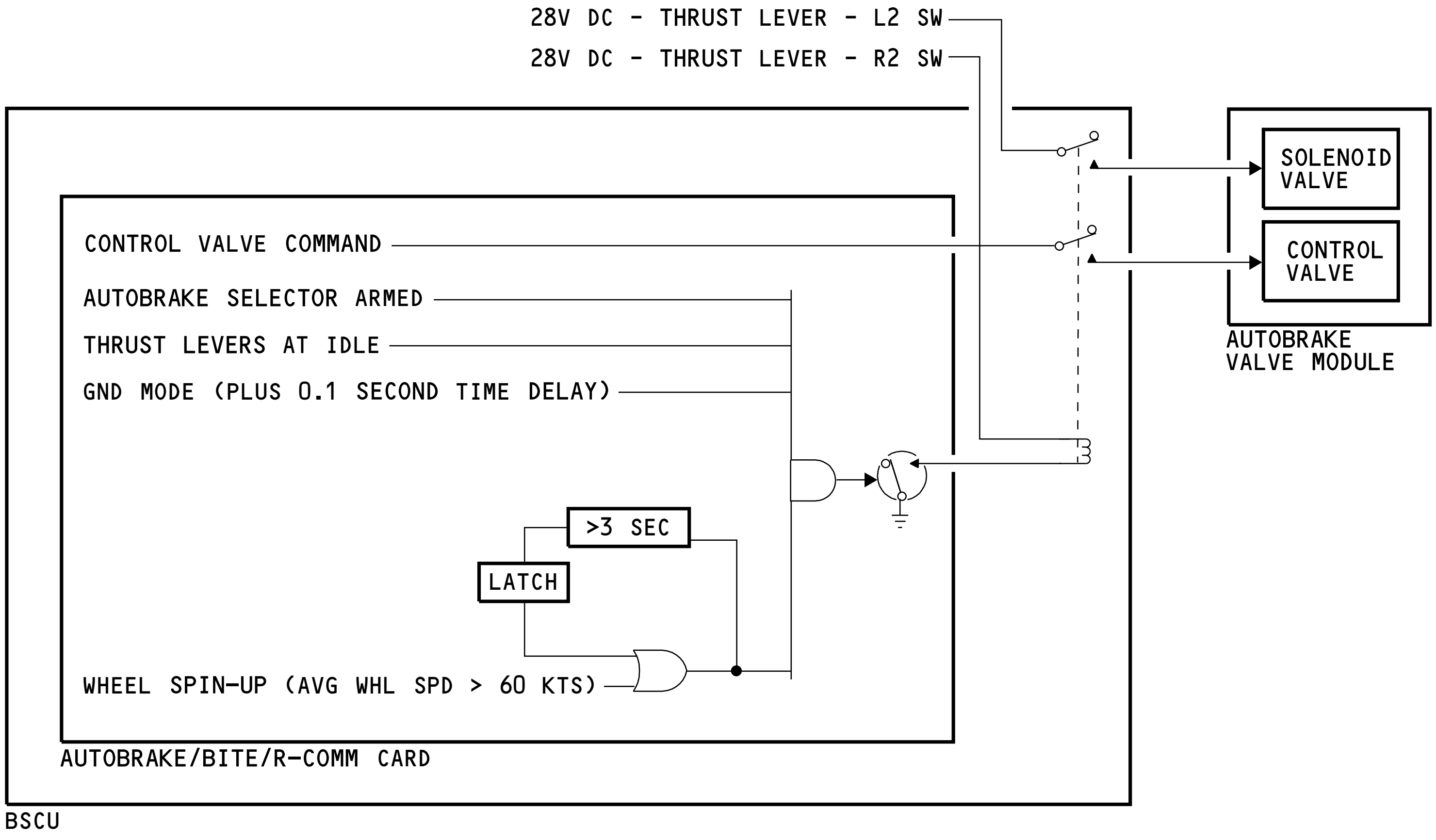
When all of the these conditions occur, the autobrake function energizes a relay in the BSCU. This supplies electrical power to the solenoid valve and connects the control valve command signal from the BSCU to the control valve.

The autobrake system then controls brake pressure to decrease the airplane speed at the specified deceleration rate.

The wheel spin-up signal latches when the average wheel speed is more than 60 knots for at least three seconds. This lets the autobrakes stay on after the speed decreases.

Training Information Point

During autobrake application, you can move the autobrake selector to change the rate of deceleration.



M42379 S000618730_V1

ANTISKID/AUTOBRAKE SYSTEM - AUTOBRAKE FUNCTIONAL DESCRIPTION - LANDING APPLICATION LOGIC

ANTISKID/AUTOBRAKE SYSTEM - AUTOBRAKE FUNCTIONAL DESCRIPTION - LANDING A/B DISARM LOGIC

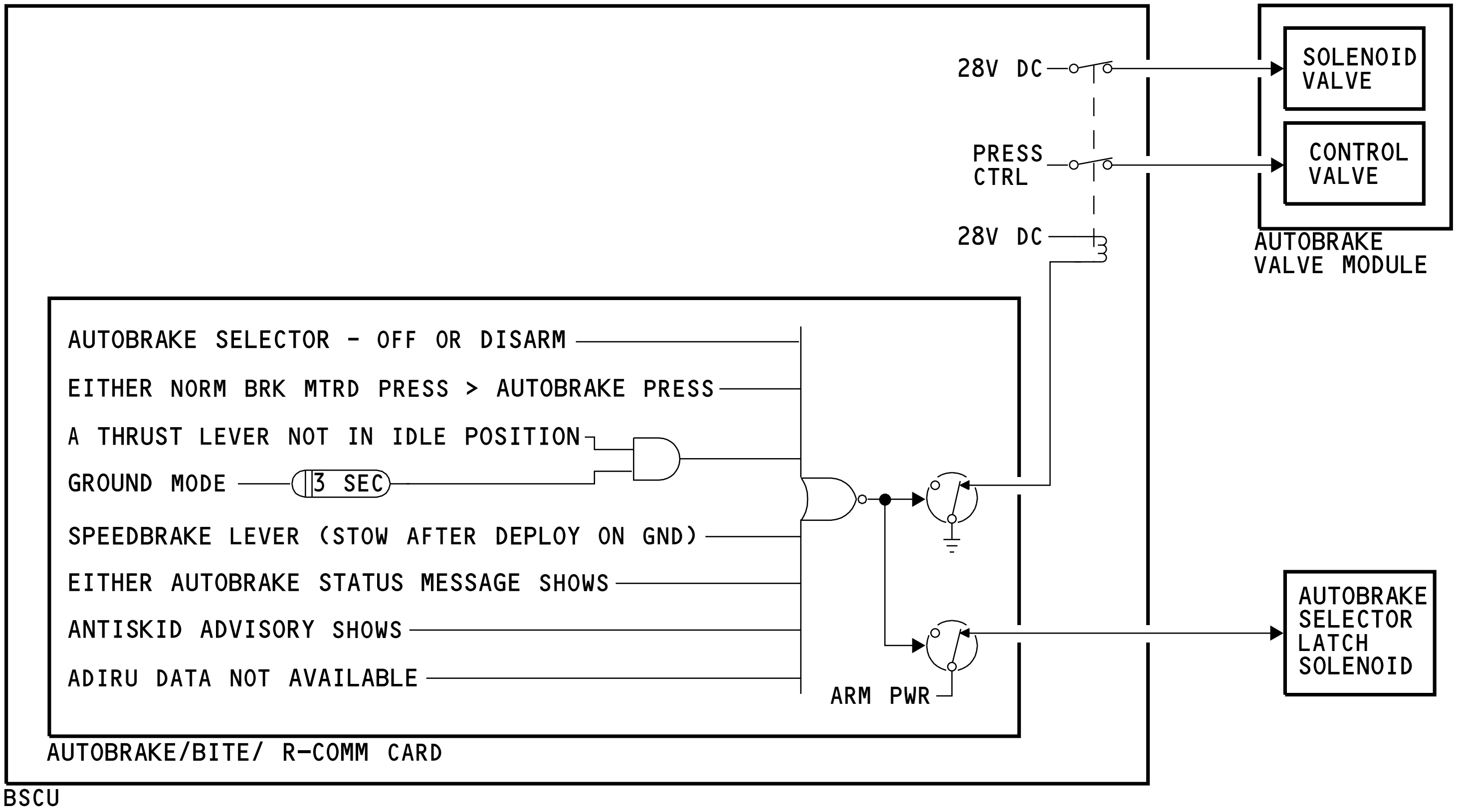
General

Any of these conditions cause the autobrakes to disarm:

- You turn the autobrake selector to the OFF or DISARM position
- Left or right normal brake metered pressure is more than autobrake pressure
- Left or right thrust lever is out of the idle position after the airplane is on the ground for more than 3 seconds (before 3 seconds causes brake release with no disarm)
- Speedbrake lever moves to the DOWN position after ground speedbrake deployment (speedbrake lever more than the ARMED position)
- Either AUTOBRAKE or AUTOBRAKE SOL VALVE status message shows
- ANTISKID advisory message shows
- ADIRU data is not available.

When disarmed, autobrake pressure stops and the autobrake selector latch solenoid releases the autobrake selector. The autobrake selector goes back to the DISARM position and the AUTOBRAKE advisory message shows.

The advisory message goes out of view when you move the autobrake selector to the OFF position.



M42380 S000618731_V1

ANTISKID/AUTOBRAKE SYSTEM - AUTOBRAKE FUNCTIONAL DESCRIPTION - LANDING A/B DISARM LOGIC

ANTISKID/AUTOBRAKE SYSTEM - AUTOBRAKE FUNCTIONAL DESCRIPTION - RTO ARM LOGIC

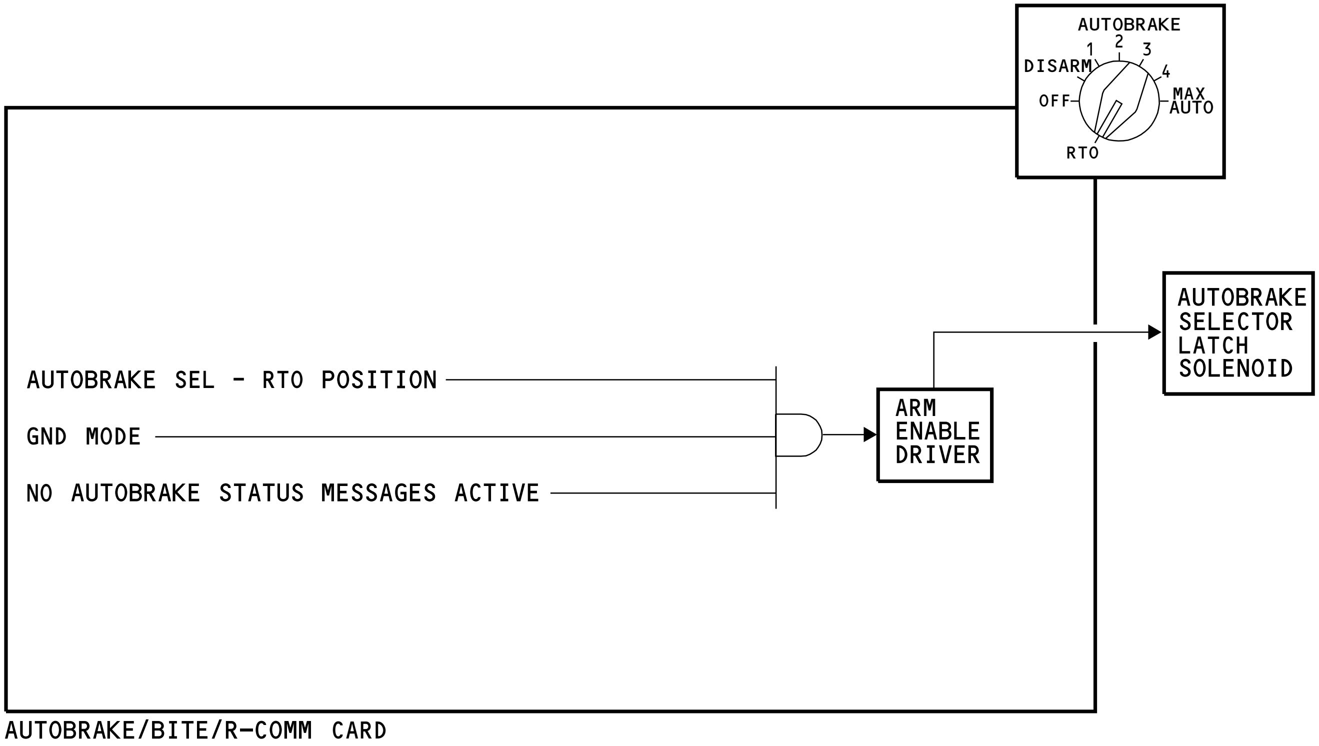
General

The autobrake selector latch solenoid holds the autobrake selector in the RTO position when the following arming conditions occur:

- You move the autobrake selector to the RTO position
- Ground mode (the two trucks are UNTILTED and the landing gear lever is DOWN)
- No AUTOBRAKE and/or AUTOBRAKE SOL VALVE status message shows.

If any of these conditions do not occur, the solenoid does not latch and the autobrake selector moves to the OFF position.

The AUTOBRAKE RTO memo message shows when the autobrake selector is in the RTO position.



M42381 S000618732_V1

ANTISKID/AUTOBRAKE SYSTEM - AUTOBRAKE FUNCTIONAL DESCRIPTION - RTO ARM LOGIC

ANTISKID/AUTOBRAKE SYSTEM - AUTOBRAKE FUNCTIONAL DESCRIPTION - RTO A/B APPLICATION LOGIC

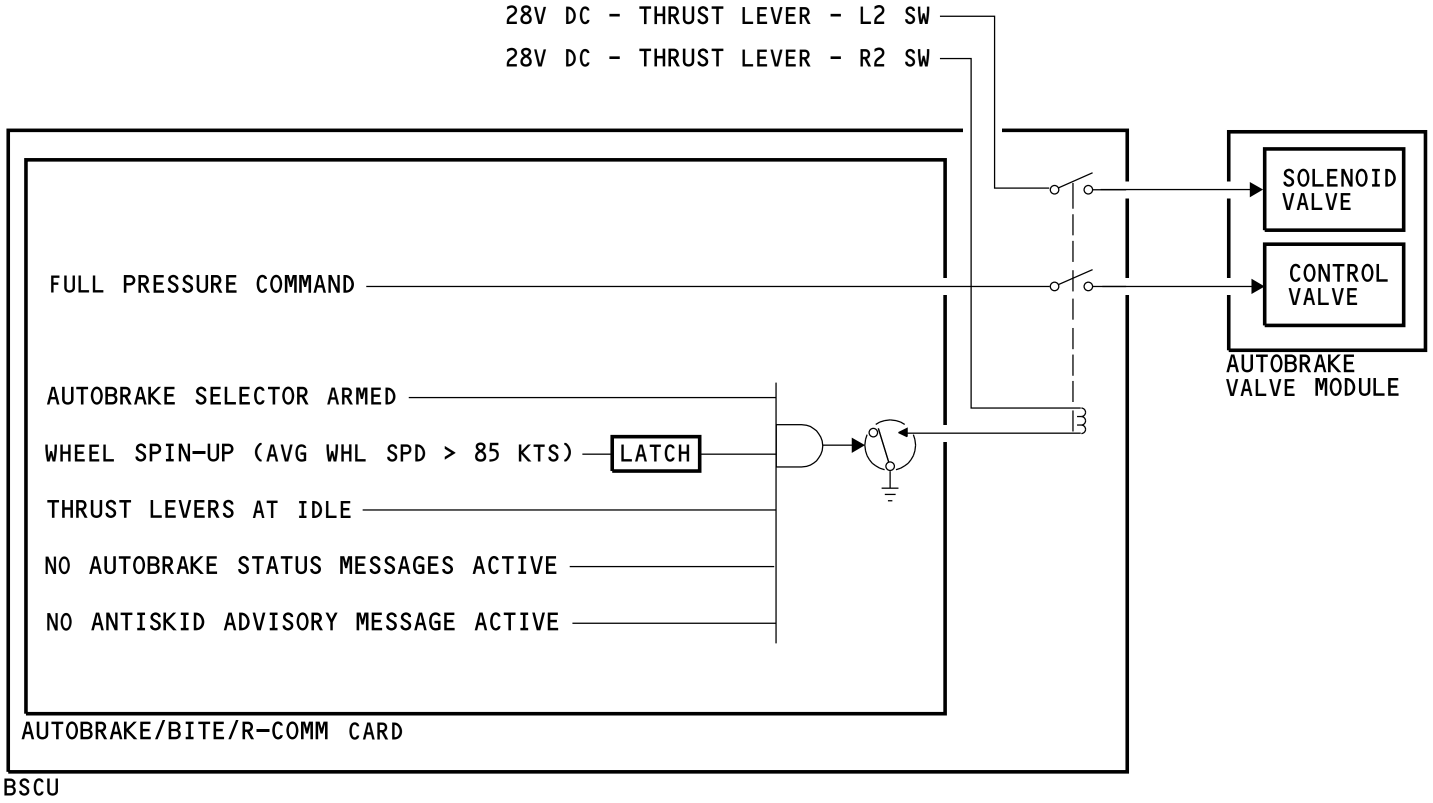
General

The RTO function applies right hydraulic system pressure to the brakes when these conditions occur:

- The autobrake selector is in the RTO position
- Wheel spin-up (average wheel speed of the 6th, 7th, 8th, and 9th fastest wheels is more than 85 knots)
- After 85 knots, all four thrust lever switches show the levers move from greater than idle to idle
- No AUTOBRAKE and/or AUTOBRAKE SOL VALVE status message shows
- No ANTISKID advisory message shows.

When all of the these conditions occur, the autobrake function energizes a relay in the BSCU. This supplies electrical power to the solenoid valve and connects the control valve command signal from the BSCU to the control valve.

The autobrake system sends a full open command to the control valve in the autobrake valve module. This supplies full hydraulic system pressure to the brakes to stop the airplane.



M42382 S000618733_V1

ANTISKID/AUTOBRAKE SYSTEM - AUTOBRAKE FUNCTIONAL DESCRIPTION - RTO A/B APPLICATION LOGIC

ANTISKID/AUTOBRAKE SYSTEM - AUTOBRAKE FUNCTIONAL DESCRIPTION - RTO A/B DISABLE LOGIC

General

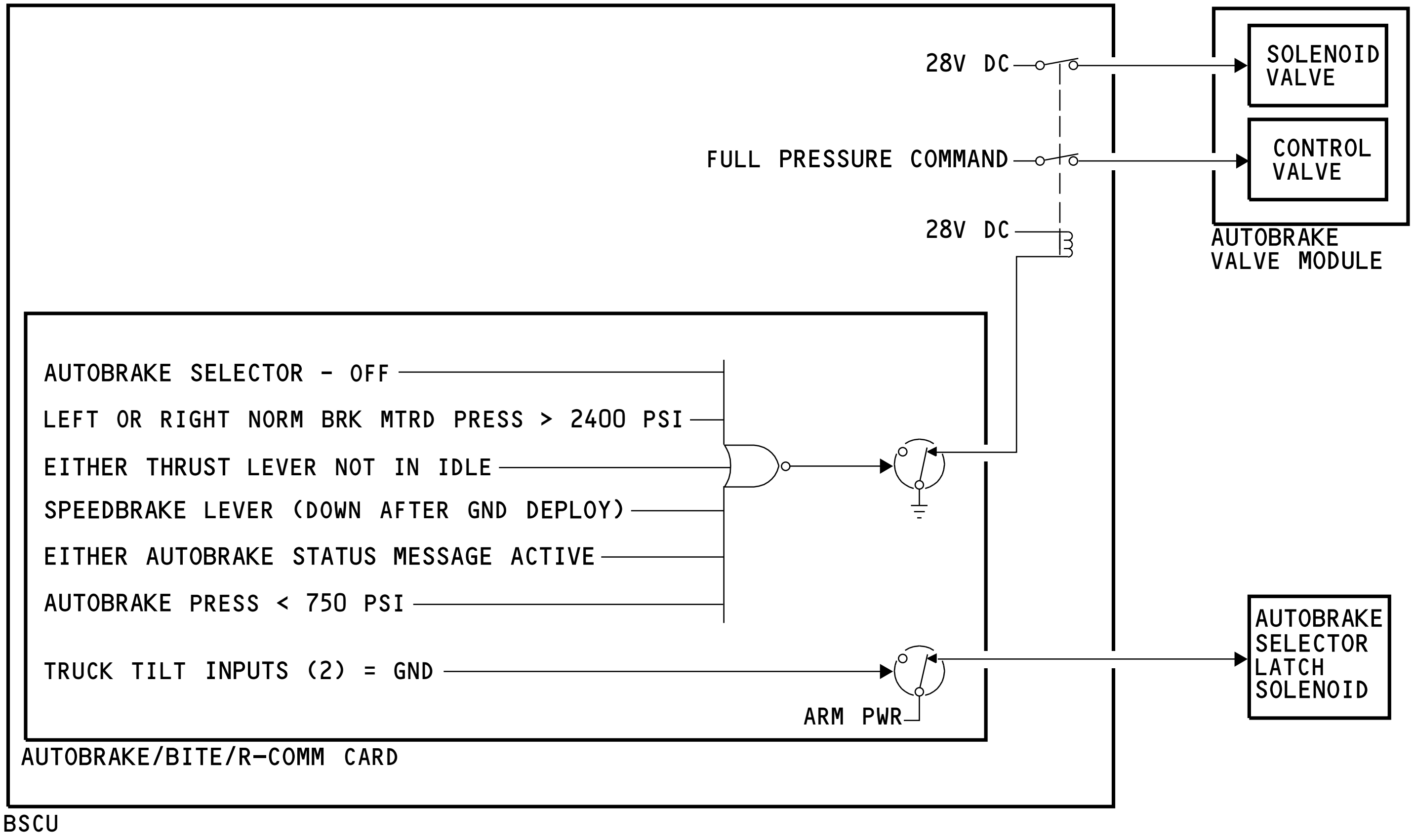
Full hydraulic system pressure stays applied to the brakes until RTO autobrake is disabled by one of these conditions:

- You move the autobrake selector to the OFF position
- Left or right normal metered brake pressure is more than 2400 psi
- You move one or both thrust levers out of the idle position
- You move the speed brake lever from the UP position to the DOWN position
- Either AUTOBRAKE or AUTOBRAKE SOL VALVE status message shows
- AUTOBRAKE pressure is less than 750 psi for one second during brake application.

The AUTOBRAKE advisory message shows when the system is disabled after an RTO brake application or if RTO application requirements were met and no brake pressure is applied.

To cancel the advisory message, you must move the selector to the OFF position.

During a normal takeoff, the autobrake selector remains in the RTO position until the airplane is in the air. The arming solenoid then releases the autobrake selector and it moves to the OFF position.



M42383 S000618734_V1

ANTISKID/AUTOBRAKE SYSTEM - AUTOBRAKE FUNCTIONAL DESCRIPTION - RTO A/B DISABLE LOGIC

ANTISKID/AUTOBRAKE SYSTEM - INDICATIONS

General

The primary and secondary bite cards in the BSCU send antiskid and autobrake fault data to AIMS for flight deck display.

There is one ANTISKID advisory message. It shows when there is a fault that causes loss of skid protection.

There is one AUTOBRAKE advisory message. It shows when the autobrake system is disarmed, inoperative, or RTO starts but the brakes do not apply. It also shows when the autobrake switch is OFF and the pressure in the autobrake valve module is not shutoff.

Autobrake memo messages show autobrake selector position.

Landing Gear Synoptic Display

The antiskid system shows fault and disabled data for each wheel on the landing gear synoptic display.

ASKID shows next to the applicable wheel when an antiskid fault is active and the ANTISKID advisory or status message shows. If the BSCU loses communication with the flight deck, the AIMS shows ASKID next to each wheel.

When you disable fault indications for a brake, BRAKE shows next to the applicable brake. This makes the ANTISKID advisory message go out of view. You can only disable one brake for each truck.

Landing Gear Brks/Strg Maintenance Page

When a fault and a CMC maintenance message for a wheel are active, one of these labels, shown in decreasing importance, will show next to the applicable wheel:

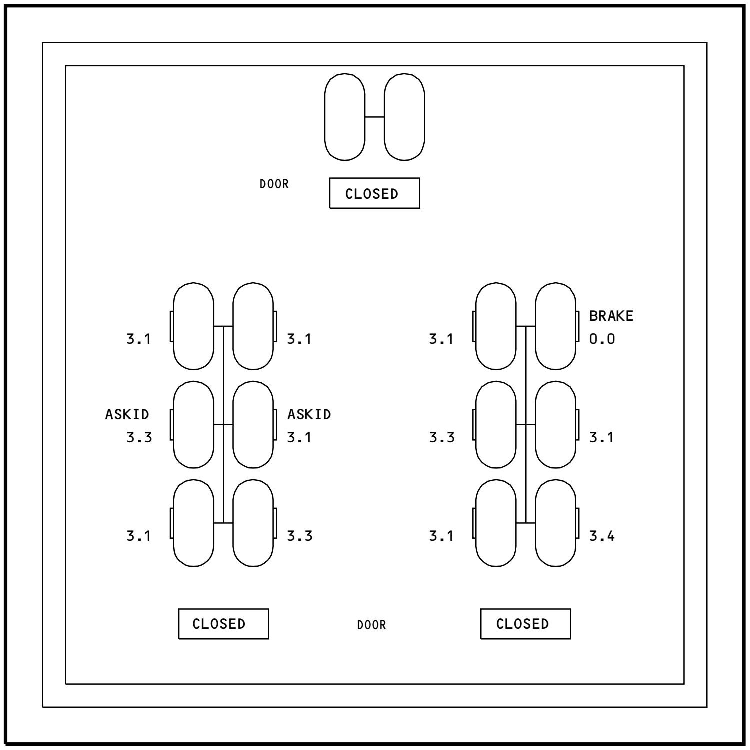
- BRAKE DEACT - brake deactivated
- ASKID PWR - power to the wheel failed
- ASKID CARD - BSCU card failed
- ASKID VALVE - normal valve and/or wiring failed
- ASKID XDCR - transducer and/or wiring failed
- ASKID ALTN - alternate valve and/or wiring failed.

Only the most important label shows for a wheel when more than one fault is active.

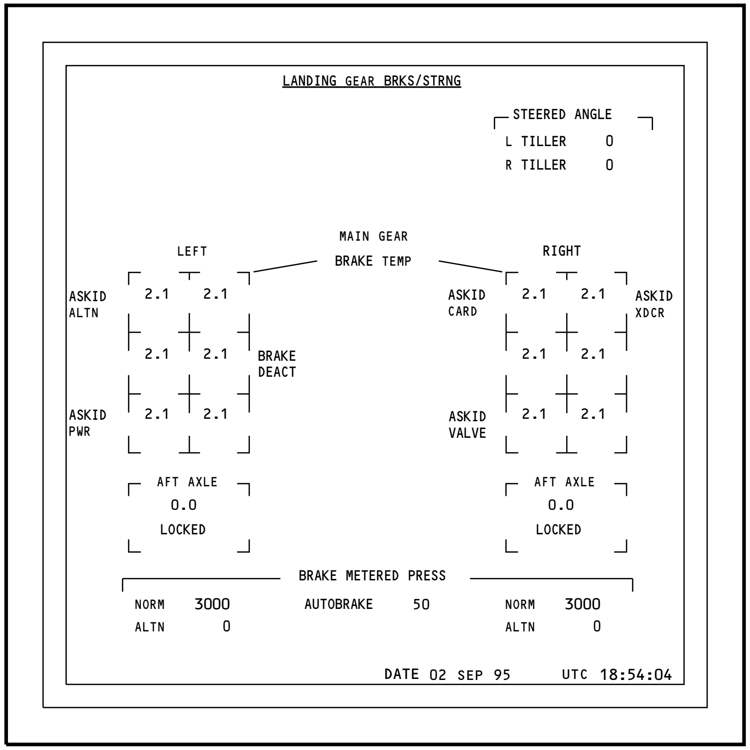
If the BSCU loses communication with the flight deck, the AIMS shows ASKID CARD next to each wheel.

Brake metered pressures for the normal and alternate brake systems show on the lower part of the page.

Autobrake pressure indication is between the brake metered pressure indications.



LANDING GEAR SYNOPTIC DISPLAY



LANDING GEAR BRKS/STRG MAINTENANCE PAGE

M42385 S000618736_V1

ANTISKID/AUTOBRAKE SYSTEM - INDICATIONS

ANTISKID/AUTOBRAKE SYSTEM - SYSTEM TESTS

General

These are the system tests for the antiskid and autobrake systems:

- System interface
- Antiskid brake release
- Autobrake application
- Wheelspeed transducer spin.

System Interface

You use the system interface test to do a test of the BSCU and of the wiring to some of the LRUs in the antiskid and autobrake systems. During the test, the brakes apply and release to check the operation of the autobrake and antiskid systems. This test also does a check of the correct operation of the sensor inputs to the BSCU.

Antiskid Brake Release

The brake release test releases the brake pressure for a selected brake through its antiskid valve. You must visually make sure the brake pressure releases. To do this, monitor the movement of the wear indicator pins.

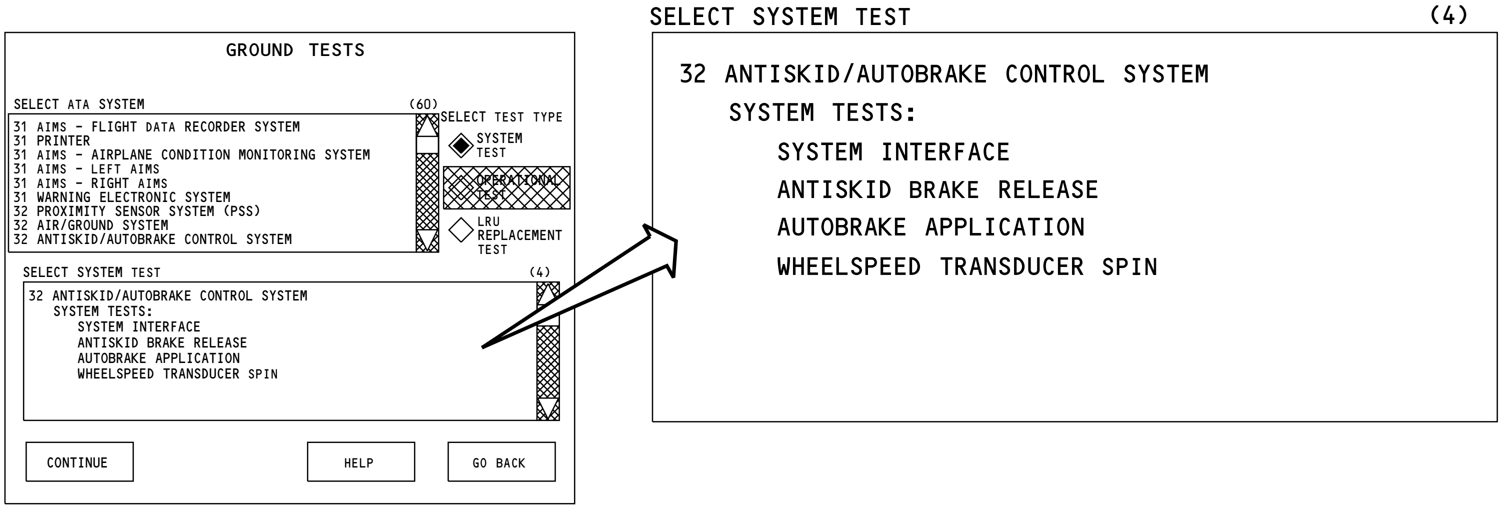
Autobrake Application

The autobrake application test does a check of the autobrake system. The test applies and releases brake pressure to all the brakes.

Wheelspeed Transducer Spin

The wheelspeed transducer spin test lets you do a test of the antiskid transducers and their wiring. You manually turn the selected antiskid transducer during this test. You must turn the transducer at 20 rpm or more during the test.

You remove the hubcap to get access to the antiskid transducer.



31 AIMS - FLIGHT DATA RECORDER SYSTEM
31 PRINTER
31 AIMS - AIRPLANE CONDITION MONITORING SYSTEM
31 AIMS - LEFT AIMS
31 AIMS - RIGHT AIMS
31 WARNING ELECTRONIC SYSTEM
32 PROXIMITY SENSOR SYSTEM (PSS)
32 AIR/GROUND SYSTEM
32 ANTISKID/AUTOBRAKE CONTROL SYSTEM

SELECT SYSTEM TEST (4)

32 ANTISKID/AUTOBRAKE CONTROL SYSTEM
  SYSTEM TESTS:
    SYSTEM INTERFACE
    ANTISKID BRAKE RELEASE
    AUTOBRAKE APPLICATION
    WHEELSPEED TRANSDUCER SPIN

M42471 S000618737_V1

ANTISKID/AUTOBRAKE SYSTEM - SYSTEM TESTS

ANTISKID/AUTOBRAKE SYSTEM - LRU REPLACEMENT TESTS

General

These are the LRU replacement tests for the antiskid and autobrake systems:

- Brake system control unit
- Antiskid valve
- Autobrake valve module
- Wheelspeed transducer.

Brake System Control Unit

The brake system control unit replacement test does a check of the BSCU and of the wiring to some of the LRUs in the antiskid and autobrake systems. During the test, the brakes apply and release to check the operation of the autobrake and antiskid systems.

This test is almost the same as the system interface test in the system test menu.

Antiskid Valve

The antiskid valve replacement test lets you do a test of a selected antiskid valve. The test releases the brake pressure for the selected brake. You must visually make sure the brake pressure releases.

This test is the same as the antiskid brake release test in the system test menu.

Autobrake Valve Module

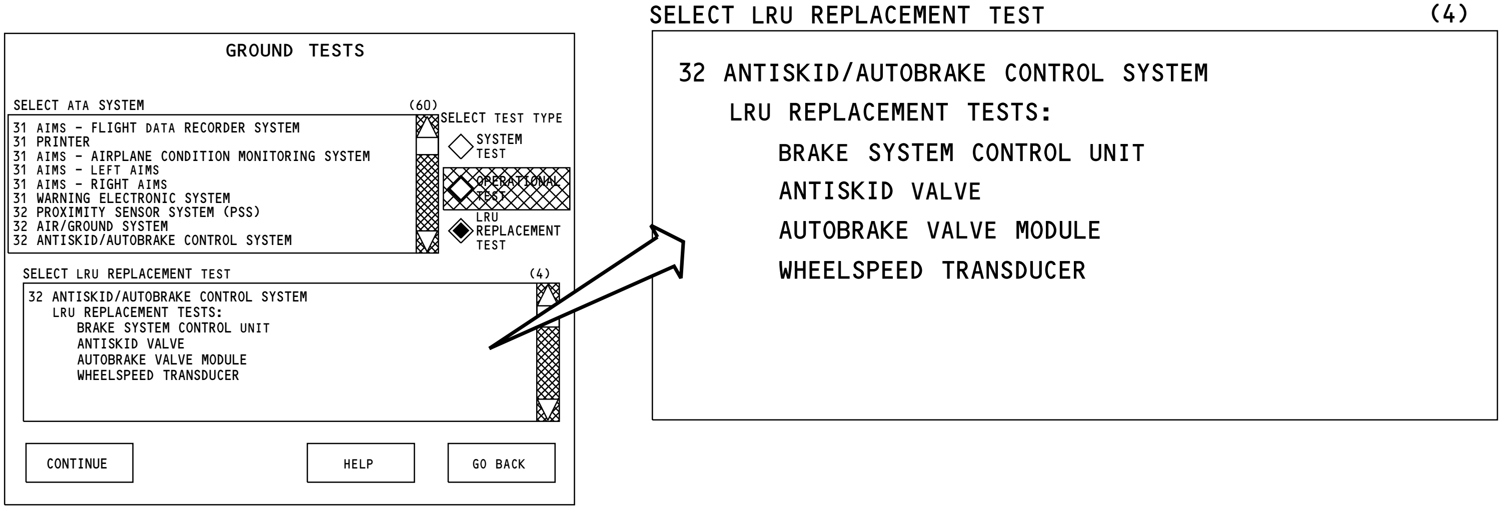
The autobrake valve module replacement test does a check of the autobrake system. The test applies and releases brake pressure to all of the brakes.

This test is the same as the autobrake application test in the system test menu.

Wheelspeed Transducer

The wheelspeed transducer replacement test lets you do a test of a selected antiskid transducer and its wiring. You manually turn the selected antiskid transducer during this test. You must turn the transducer at 20 rpm or more during the test.

This test is the same as the wheelspeed transducer spin test in the system test menu.



31 AIMS - FLIGHT DATA RECORDER SYSTEM
31 PRINTER
31 AIMS - AIRPLANE CONDITION MONITORING SYSTEM
31 AIMS - LEFT AIMS
31 AIMS - RIGHT AIMS
31 WARNING ELECTRONIC SYSTEM
32 PROXIMITY SENSOR SYSTEM (PSS)
32 AIR/GROUND SYSTEM
32 ANTISKID/AUTOBRAKE CONTROL SYSTEM

SELECT TEST TYPE: ◇ SYSTEM TEST ◇ OPERATIONAL TEST ◆ LRU REPLACEMENT TEST

SELECT LRU REPLACEMENT TEST (4)

32 ANTISKID/AUTOBRAKE CONTROL SYSTEM
    LRU REPLACEMENT TESTS:
        BRAKE SYSTEM CONTROL UNIT
        ANTISKID VALVE
        AUTOBRAKE VALVE MODULE
        WHEELSPEED TRANSDUCER

SELECT LRU REPLACEMENT TEST (4)

32 ANTISKID/AUTOBRAKE CONTROL SYSTEM
    LRU REPLACEMENT TESTS:
        BRAKE SYSTEM CONTROL UNIT
        ANTISKID VALVE
        AUTOBRAKE VALVE MODULE
        WHEELSPEED TRANSDUCER

M42472 S000618738_V1

ANTISKID/AUTOBRAKE SYSTEM - LRU REPLACEMENT TESTS

ANTISKID/AUTOBRAKE SYSTEM - SPECIAL FUNCTIONS

General

You use the antiskid indication disable function after you deactivate a brake. Brakes may be deactivated by three methods:

- Install a flight dispatch disconnect tool in the brake position on the related antiskid shuttle valve module (This deactivates normal braking only. Alternate braking is still available.)
- Disconnect the brake line
- Remove the brake.

You use the antiskid indication disable function to disable (remove) the ANTISKID advisory message for one MLG wheel on each MLG truck. This makes sure that the advisory message for antiskid failures on the selected wheel or wheels does not show.

The related ANTISKID status message can not be disabled.

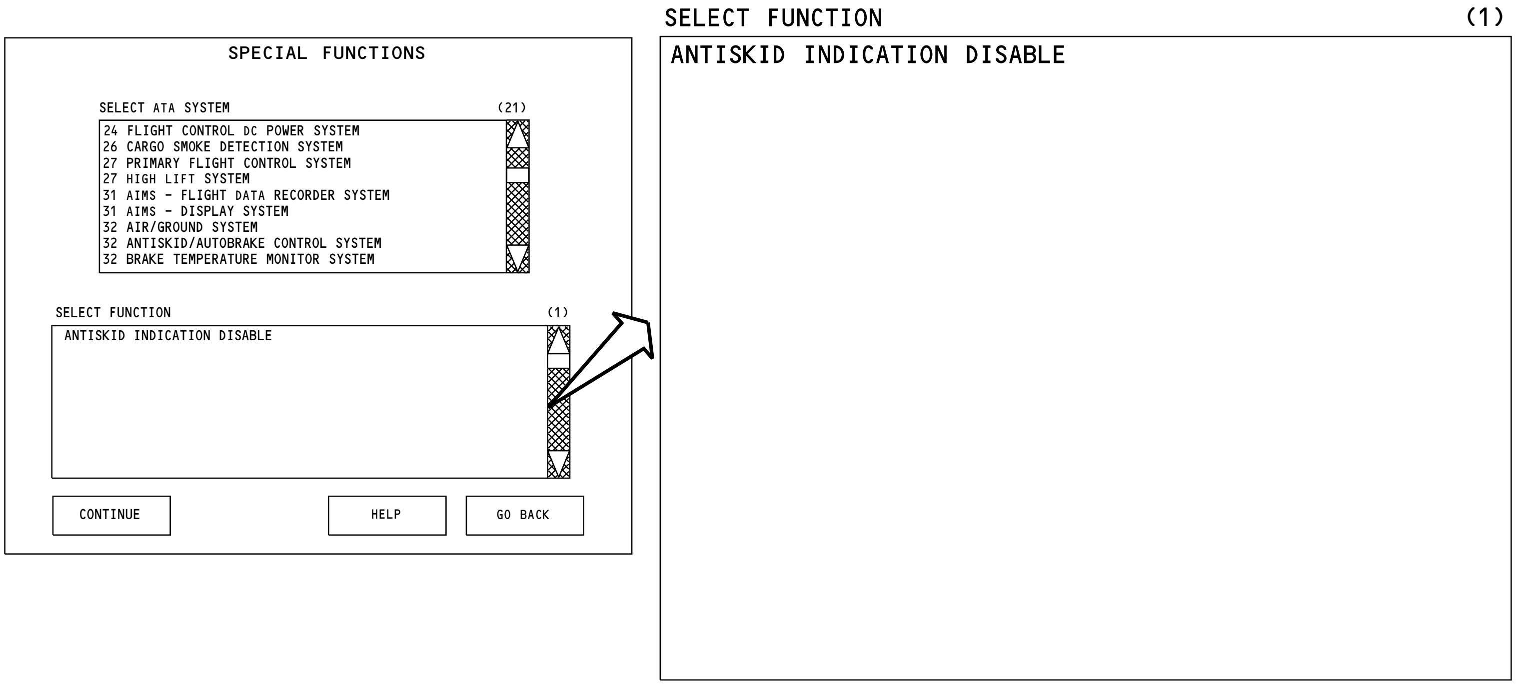
This function also lets you operate the autobrake system with an antiskid failure.

Indication

When you use the indication disable function, a BRAKE message shows on the landing gear synoptic display next to the wheel selected. A BRAKE DEACT message also shows on the brake and steering maintenance page.

Training Information Point

This special function removes the ANTISKID advisory message only for the selected brake (one per truck). If an additional brake failure occurs, the ANTISKID advisory shows again. The advisory message can not be disabled (removed) with two brakes on the same truck failed or deactivated.



SPECIAL FUNCTIONS

SELECT ATA SYSTEM (21)

24 FLIGHT CONTROL DC POWER SYSTEM
26 CARGO SMOKE DETECTION SYSTEM
27 PRIMARY FLIGHT CONTROL SYSTEM
27 HIGH LIFT SYSTEM
31 AIMS - FLIGHT DATA RECORDER SYSTEM
31 AIMS - DISPLAY SYSTEM
32 AIR/GROUND SYSTEM
32 ANTISKID/AUTOBRAKE CONTROL SYSTEM
32 BRAKE TEMPERATURE MONITOR SYSTEM

SELECT FUNCTION (1)

ANTISKID INDICATION DISABLE

SELECT FUNCTION (1)

ANTISKID INDICATION DISABLE

M42473 S000618739_V1

ANTISKID/AUTOBRAKE SYSTEM - SPECIAL FUNCTIONS

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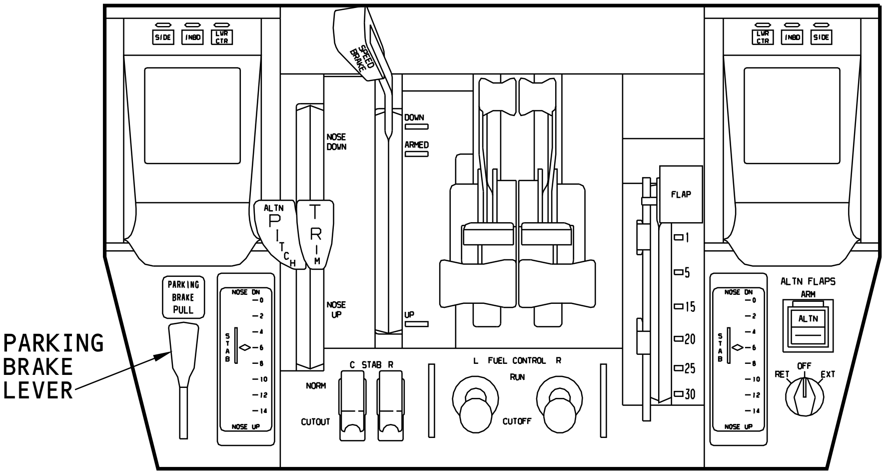
PARKING BRAKE SYSTEM - INTRODUCTION

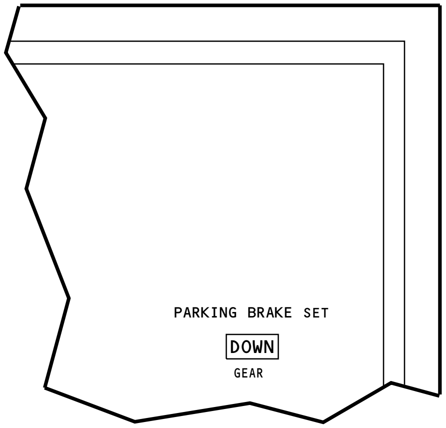
Purpose

The parking brake system uses the available brake pressure to keep the main landing gear brakes applied when the airplane is parked.

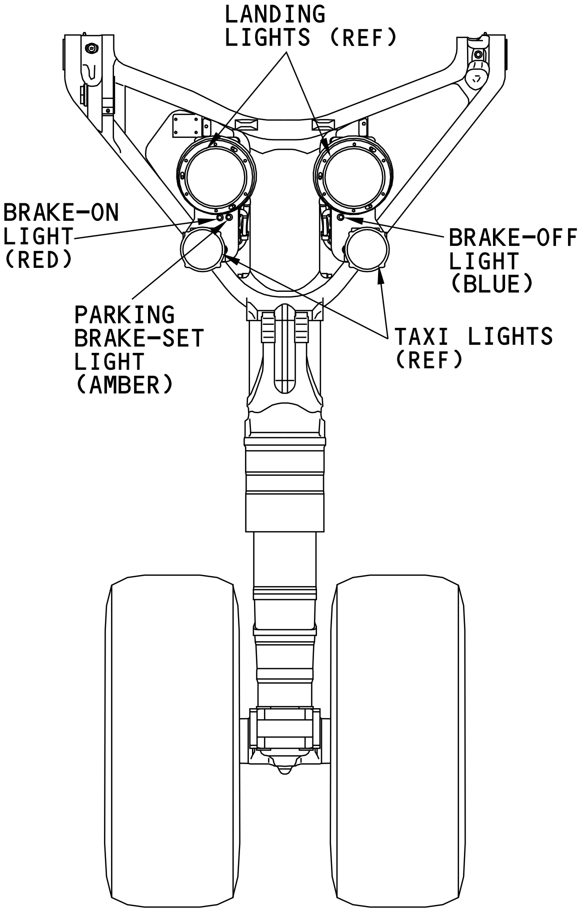
Brake status lights on the nose landing gear and the PARKING BRAKE SET memo message show the condition of the parking brake system.



P10 CONTROL STAND



EICAS DISPLAY



NOSE LANDING GEAR

M42386 S000618740_V1

PARKING BRAKE SYSTEM - INTRODUCTION

PARKING BRAKE SYSTEM - GENERAL DESCRIPTION

Components

These are the parking brake system components:

- Parking brake lever
- Parking brake latch mechanism
- Parking brake latch switch (2)
- Parking brake valve
- Pedal position switch (2)
- Brake metered pressure switch (2)
- Brake status indication light (3).

General Description

When you push the brake pedals and pull the parking brake lever, the latch mechanism latches the brake pedals in the brakes-applied position.

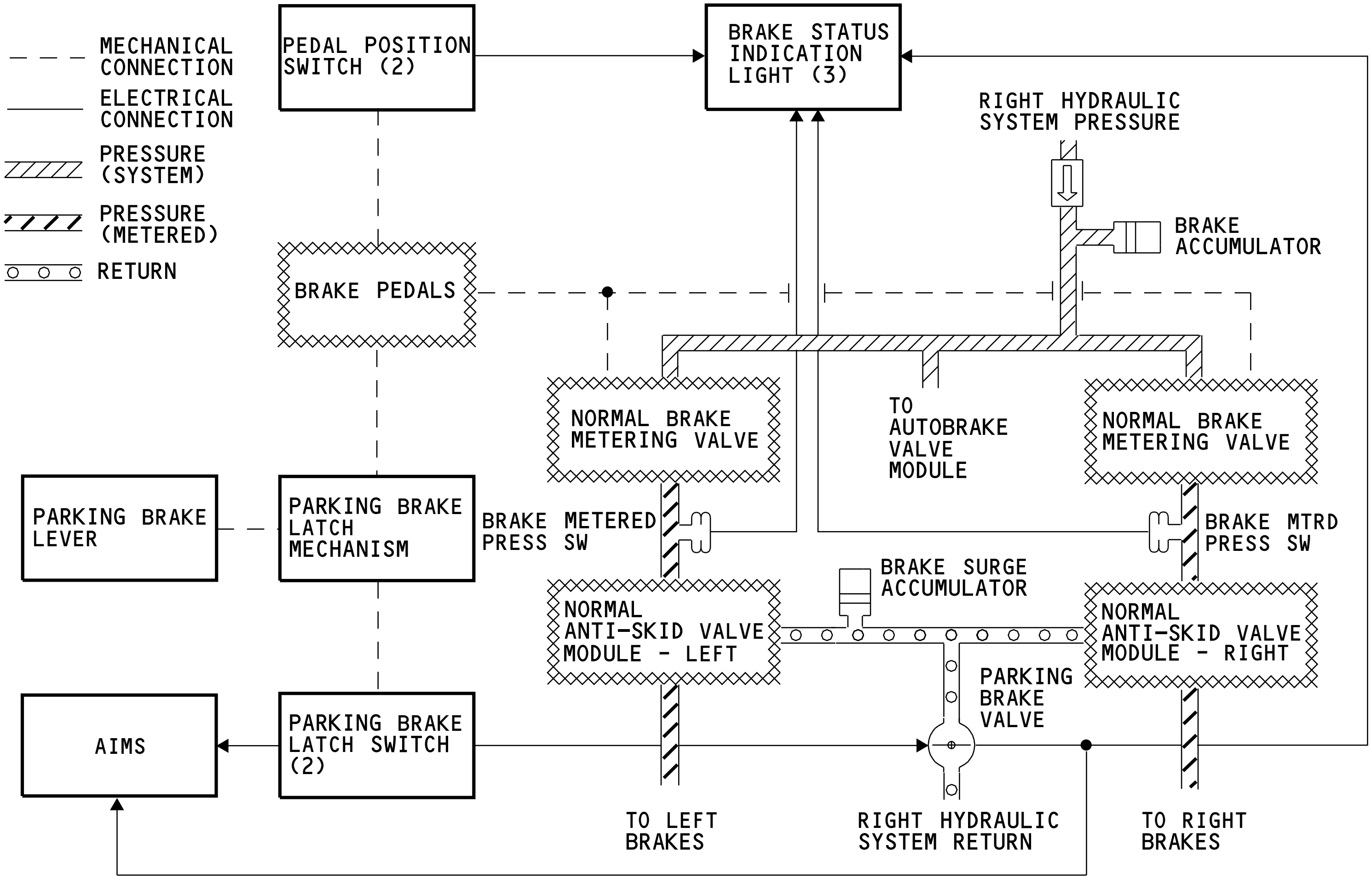
The parking brake latch switches send a signal to close the parking brake valve. They also send a signal to AIMS for flight deck indication.

The parking brake valve prevents brake pressure leakage through the normal antiskid valves.

Pedal position switches and brake metered pressure switches send signals to the brake status indication lights on the nose landing gear. These lights show people on the ground the brake system status.

Training Information Point

A fully charged (3000 psig) brake accumulator will keep the brakes pressurized at least eight hours.



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PARKING BRAKE SYSTEM - GENERAL DESCRIPTION

PARKING BRAKE SYSTEM - COMPONENT LOCATIONS

General

The parking brake lever is on the left side of the P10 control stand.

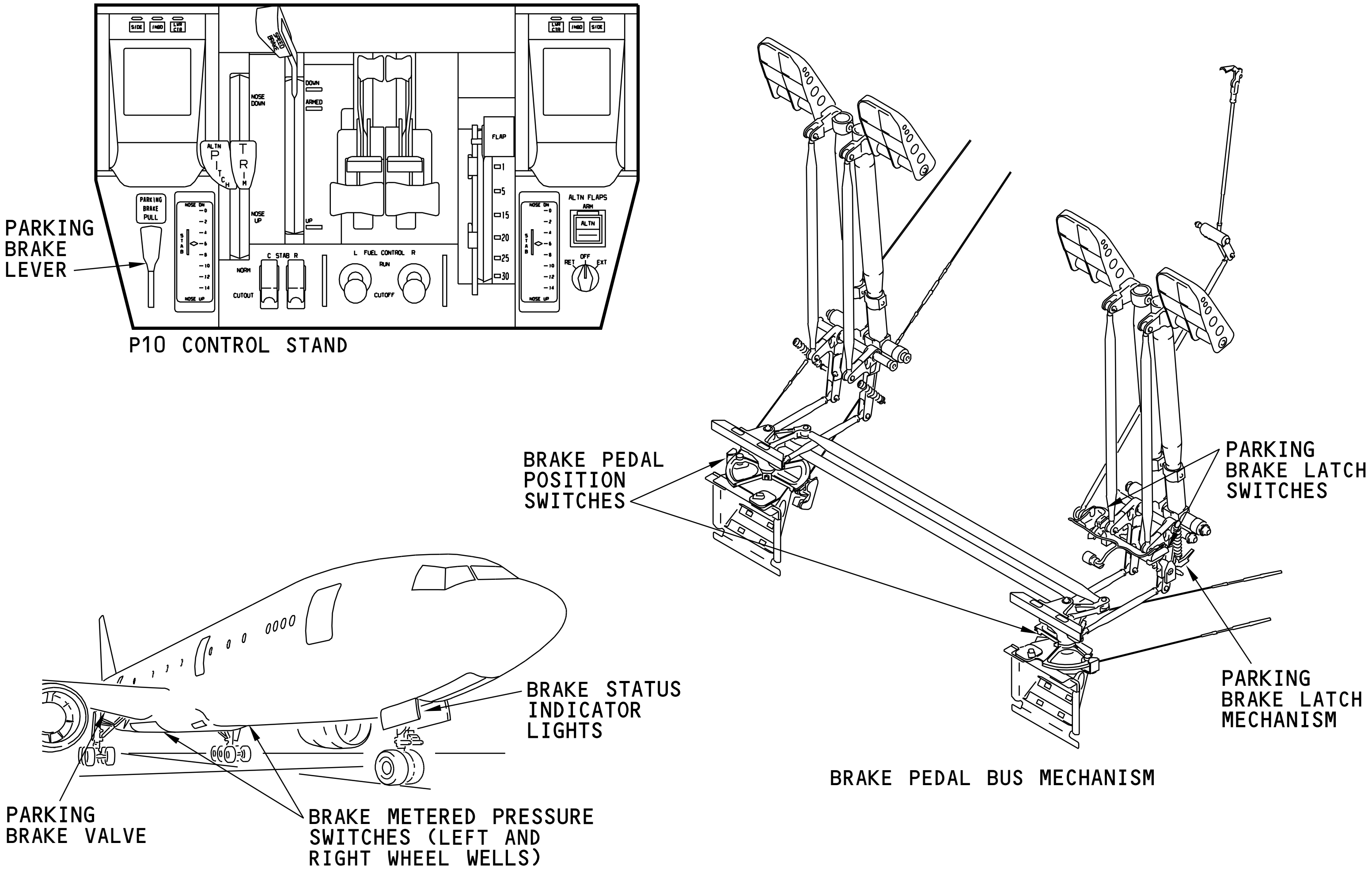
The parking brake latch mechanism is under the flight deck floor below the captain's rudder pedals. Two parking brake latch switches are on the latch mechanism.

Two brake pedal position switches are on the brake pedal quadrant assemblies.

The parking brake valve is on the main landing gear beam outboard of the right main landing gear trunnion.

The brake metered pressure switches are on forward wall in the left and right main landing gear wheel wells.

The brake status indication lights are on landing and taxi light brackets on the nose landing gear.



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PARKING BRAKE SYSTEM - COMPONENT LOCATIONS

PARKING BRAKE SYSTEM - PARKING BRAKE LEVER

Purpose

The parking brake lever mechanically moves the brake latch mechanism to lock the brakes in the applied position.

Location

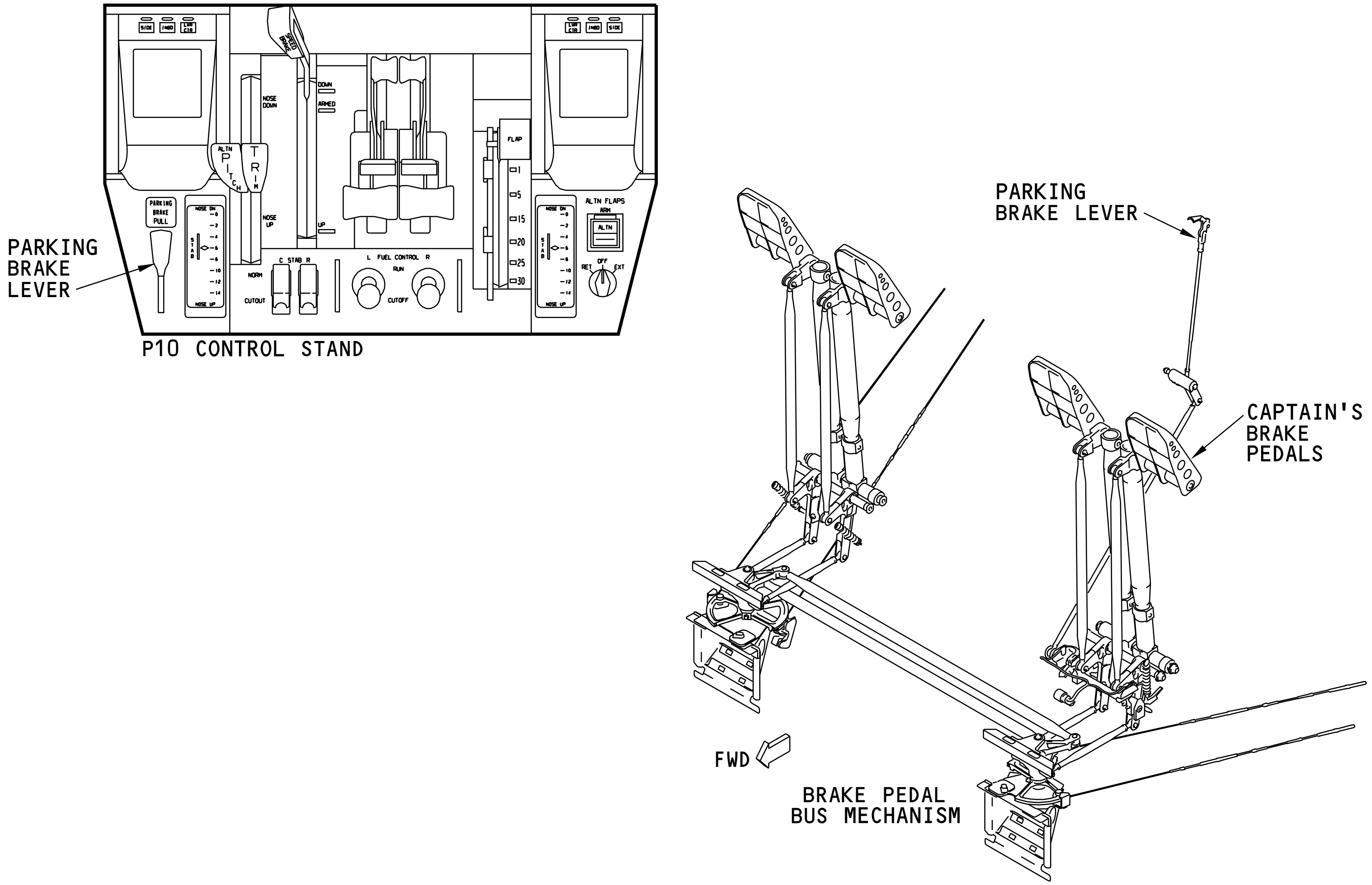
The parking brake lever is aft of the cursor control device on the left side of the P10 control stand.

Operation

To set the parking brake, push the captain's brake pedals to the fully-applied position. While holding the pedals in position, pull up and aft on the parking brake lever. Then release pedal pressure. This holds the brake pedals in the applied position.

The lever stays in the up and aft position when the parking brake is set.

To release the parking brake, push the brake pedals. The lever moves to the down position.



M42389 S000618743_V1

PARKING BRAKE SYSTEM - PARKING BRAKE LEVER

PARKING BRAKE SYSTEM - PARKING BRAKE LATCH MECHANISM AND LATCH AND PEDAL POSITION SWITCHES

Purpose

The parking brake latch mechanism mechanically locks the brake pedals in the applied position.

These are the parking brake latch mechanism components:

- Latching pawls (2)
- Pawl stops (2)
- Latch spring.

Two parking brake latch switches control the parking brake valve and parking brake indications.

Two pedal position switches control the brake-off light.

Location

The parking brake latch mechanism is in the forward equipment center below the captain's rudder pedals.

The parking brake latch switches are on both sides of the latch mechanism.

The pedal position switches are on the captain's and the first officer's brake pedal cable quadrants.

Functional Description

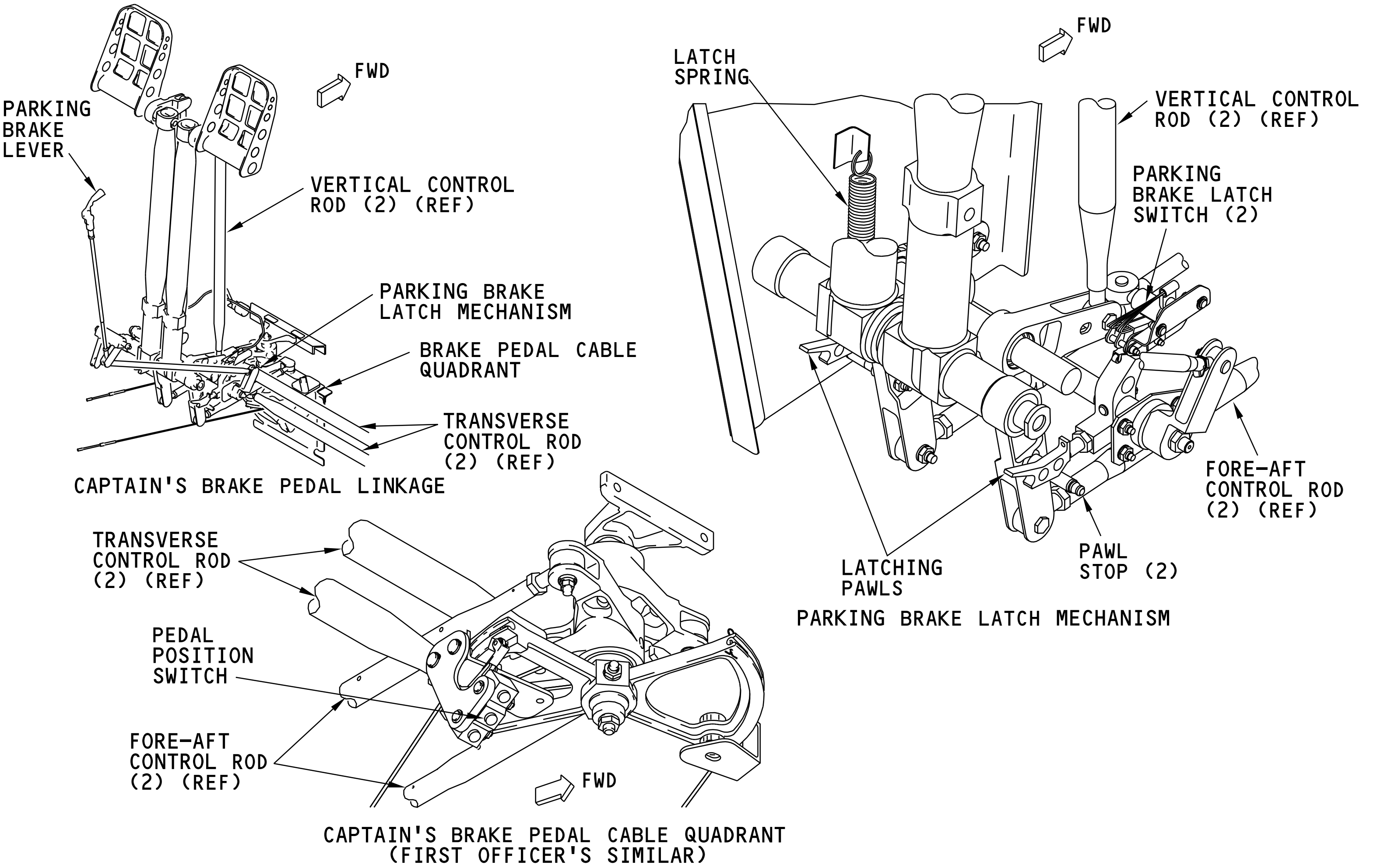
When you push on the brake pedals and pull the parking brake lever up, the latching pawls hold the brakes in the applied position. The pawls engage stops on the captain's left and right brake lower bellcranks.

The parking brake latch switches send signals to close the parking brake valve. They also send lever position data to AIMS and to the brake system control unit (BSCU) for control and indication.

The latch spring pulls the pawls up and releases the parking brake latch when you push the pedals forward.

When you release the brake pedals, the parking brake latch switches send signals to open the parking brake valve.

The pedal position switches turn on the brake-off light when both brake pedals are in the not-applied position.



CAPTAIN'S BRAKE PEDAL LINKAGE

PARKING BRAKE LATCH MECHANISM

CAPTAIN'S BRAKE PEDAL CABLE QUADRANT
(FIRST OFFICER'S SIMILAR)

M42390 S000618744_V1

PARKING BRAKE SYSTEM - PARKING BRAKE LATCH MECHANISM AND LATCH AND PEDAL POSITION SWITCHES

PARKING BRAKE SYSTEM - BRAKE METERED PRESSURE SWITCHES

Purpose

The brake metered pressure switches control the brake-on light when the airplane is on the ground.

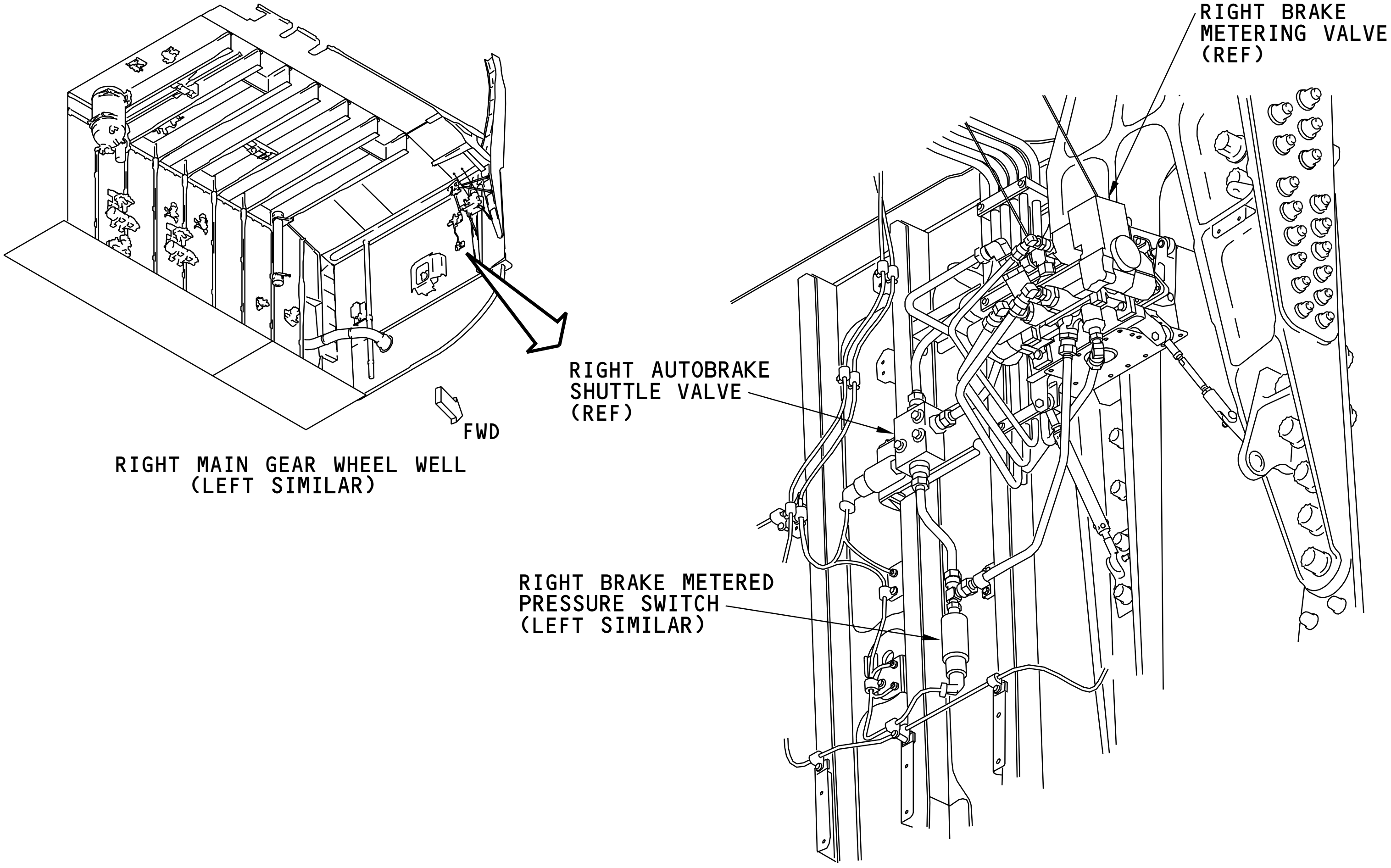
Location

The right brake metered pressure switch is on the forward wall of the right main landing gear wheel well below the right autobrake shuttle and brake metering valves.

The left brake metered pressure switch is on the forward wall of the left main landing gear wheel well similar to the right.

Functional Description

When the left and the right switches sense high metered brake pressure, they turn on the brake-on light.



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PARKING BRAKE SYSTEM - BRAKE METERED PRESSURE SWITCHES

PARKING BRAKE SYSTEM - PARKING BRAKE VALVE

Purpose

The parking brake valve closes to prevent brake accumulator pressure leakage through the normal antiskid valve modules.

Location

The parking brake valve is on the right main landing gear beam outboard of the right main gear trunnion. It is outboard and aft of the normal antiskid shuttle valve module.

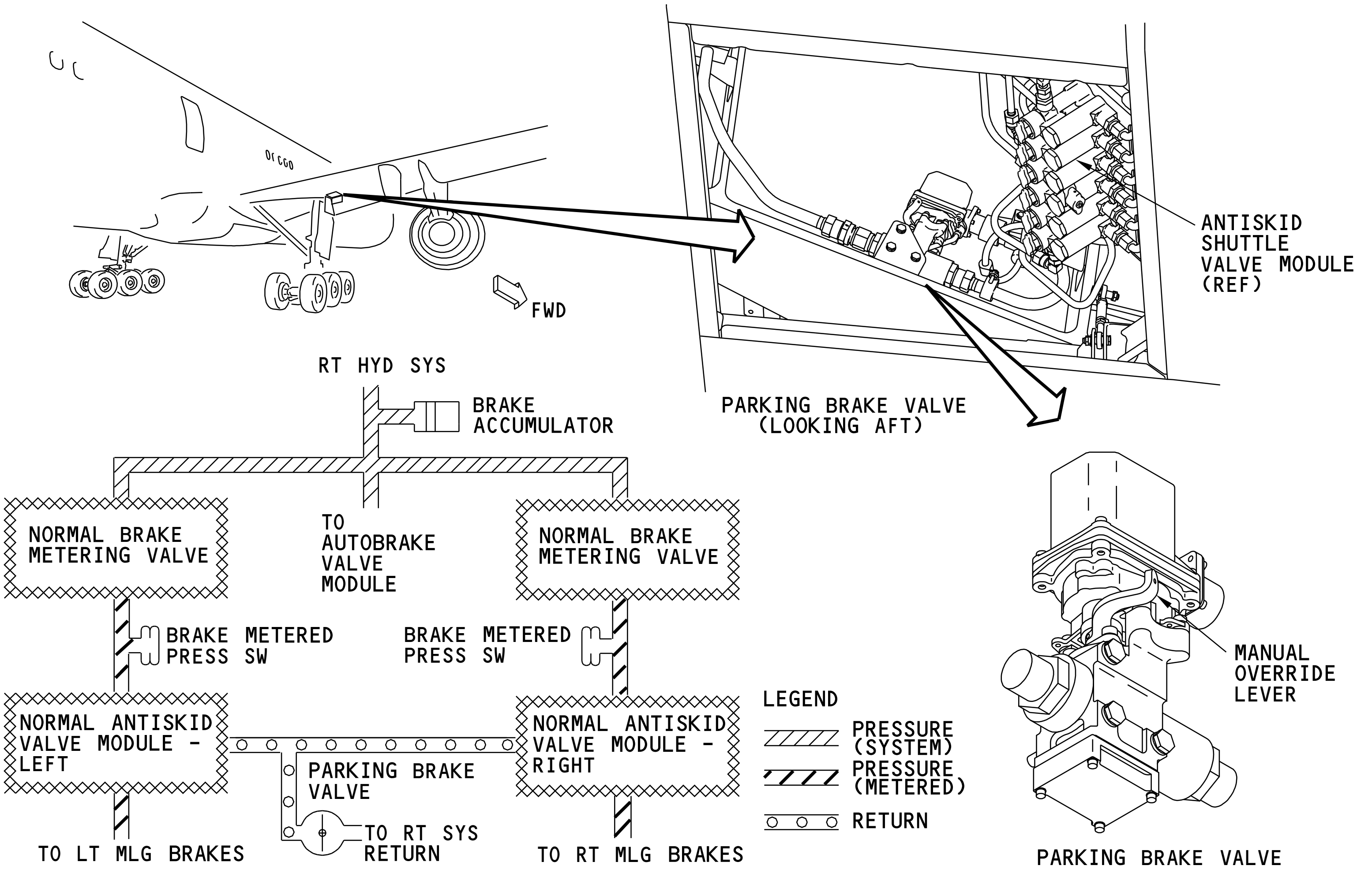
Physical Description

The valve is a brushless dc motor-operated valve. It has a manual override lever to move the valve.

Functional Description

When the parking brake valve closes, it blocks the return lines from the normal antiskid modules. This prevents brake system pressure loss caused by internal leakage in the normal antiskid valve modules.

An internal switch in the valve sends position information to the BSCU and controls the parking brake close relay.



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PARKING BRAKE SYSTEM - PARKING BRAKE VALVE

PARKING BRAKE SYSTEM - BRAKE STATUS INDICATION LIGHTS

General

Three brake status lights show people on the ground the condition of the brakes.

These are the three brake status indication lights:

- Brake-off light
- Brake-on light
- Parking brake set light.

Location

The brake status indication lights are on the nose landing gear landing and taxi light brackets.

The blue brake-off light is on the left side below the left landing light. The red brake-on light (outboard) and the amber parking brake set light (inboard) are on the right side below the right landing light.

Brake Off Light

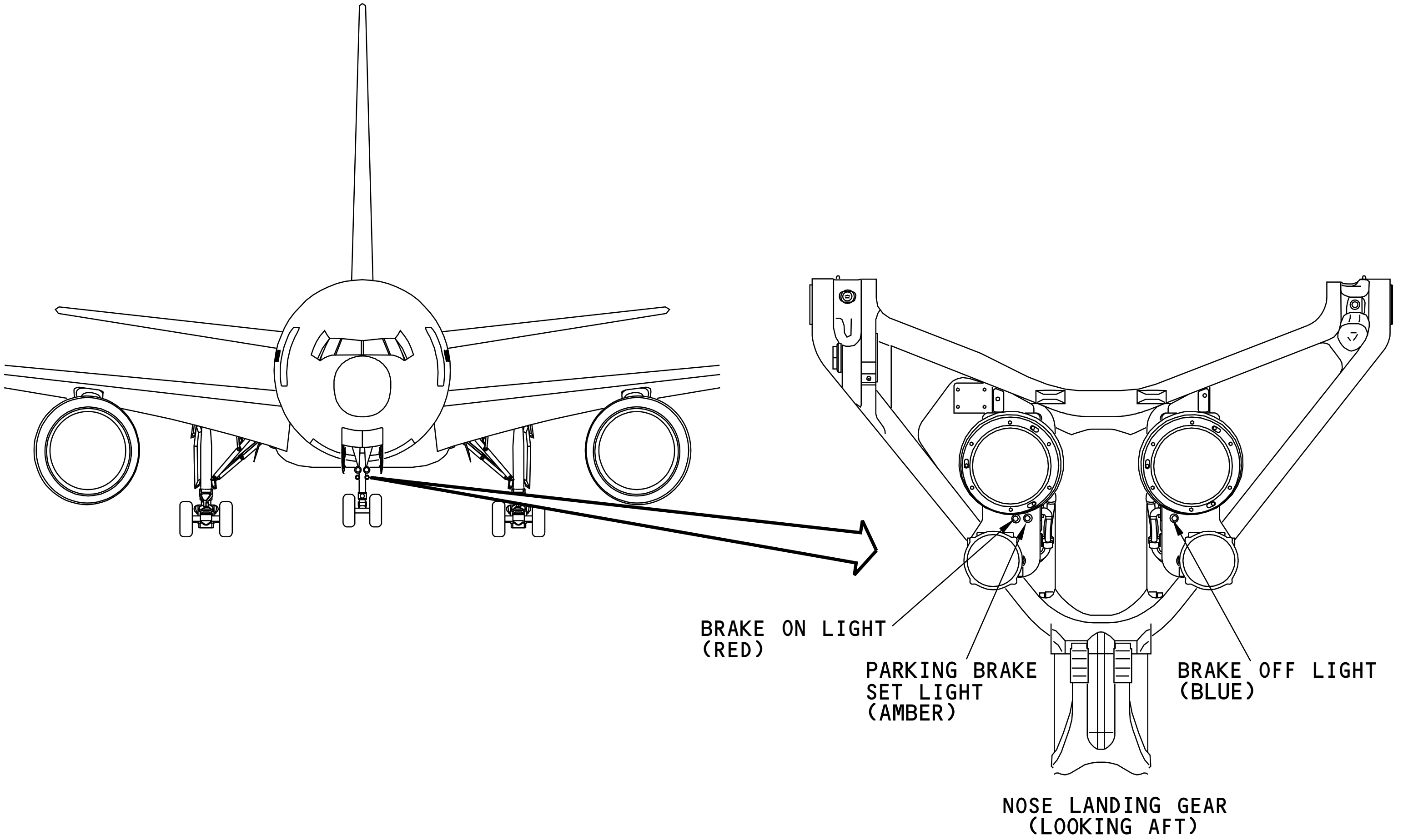
The brake-off light shows when the captain's and the first officer's brake pedals are in the not-applied position.

Brake On Light

The brake-on light shows when there is metered pressure in the left and right brake systems.

Parking Brake Set Light

The parking brake set light shows when the parking brake valve is in the closed position.



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PARKING BRAKE SYSTEM - BRAKE STATUS INDICATION LIGHTS

PARKING BRAKE - FUNCTIONAL DESCRIPTION - CONTROL AND PARKING BRAKE-SET LIGHT INDICATION

General

When the parking brake lever is set, one parking brake latch switch sends hot battery bus power to close the parking brake valve. The BSCU also monitors lever position through this switch.

Both parking brake latch switches send signals to the AIMS. The AIMS uses this data to monitor parking brake lever position for the warning electronics system and memo message display.

When the parking brake valve is fully closed, an internal switch uses hot battery bus power to energize the parking brake close relay.

Indication

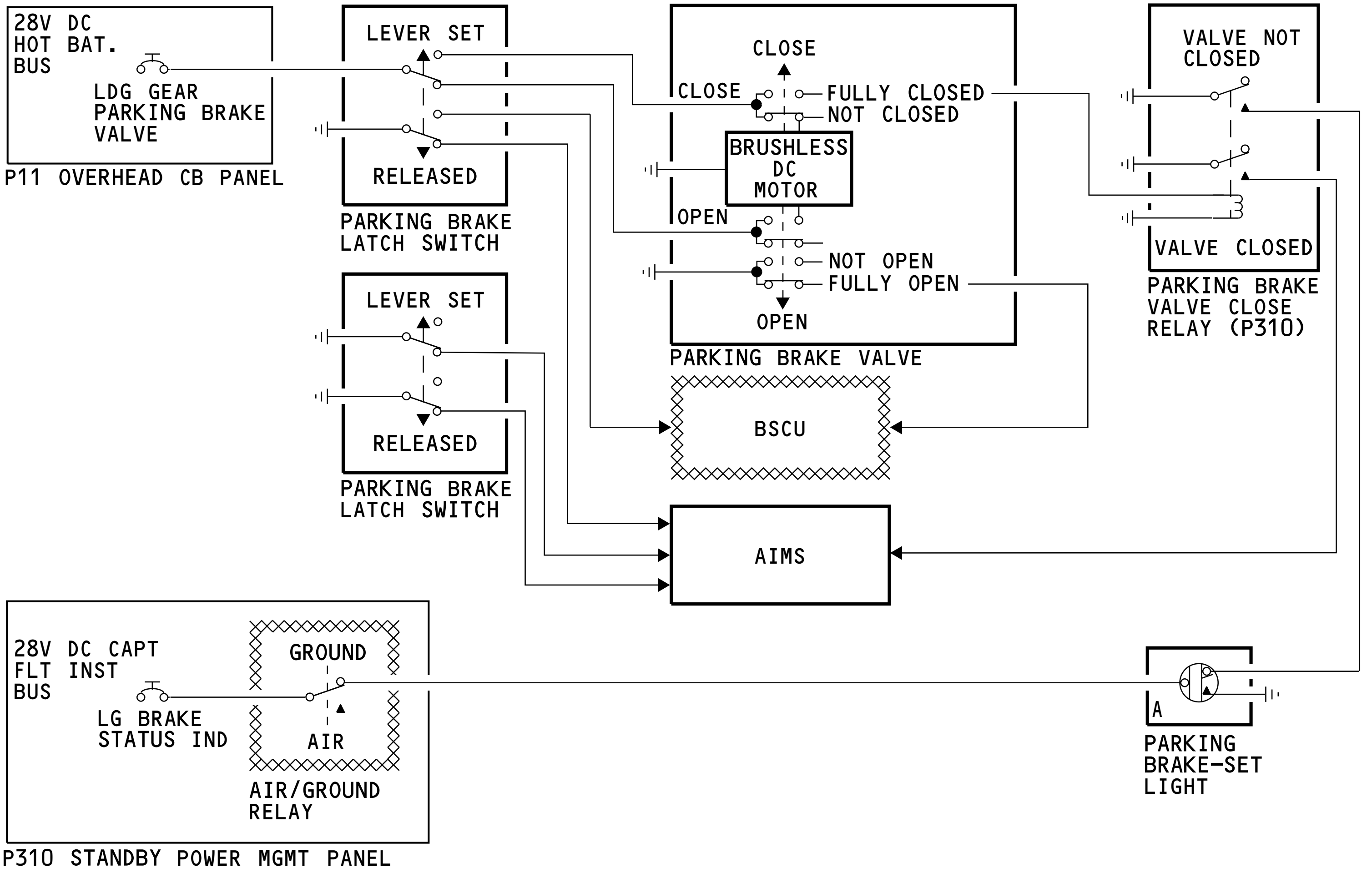
The parking brake close relay tells the AIMS to show the PARKING BRAKE SET memo message on the EICAS display. The close relay also turns on the parking brake set light on the nose gear when the airplane is on the ground.

Training Information Point

You can push-to-test the parking brake-set light.

If the parking brake valve is not fully open with the parking brake lever released, these messages will show:

- ANTISKID advisory message
- ANTISKID status message.



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PARKING BRAKE - FUNCTIONAL DESCRIPTION - CONTROL AND PARKING BRAKE-SET LIGHT INDICATION

PARKING BRAKE SYSTEM - FUNCTIONAL DESCRIPTION - BRAKE-OFF AND BRAKE-ON LIGHT INDICATION

Brake-Off light Indication

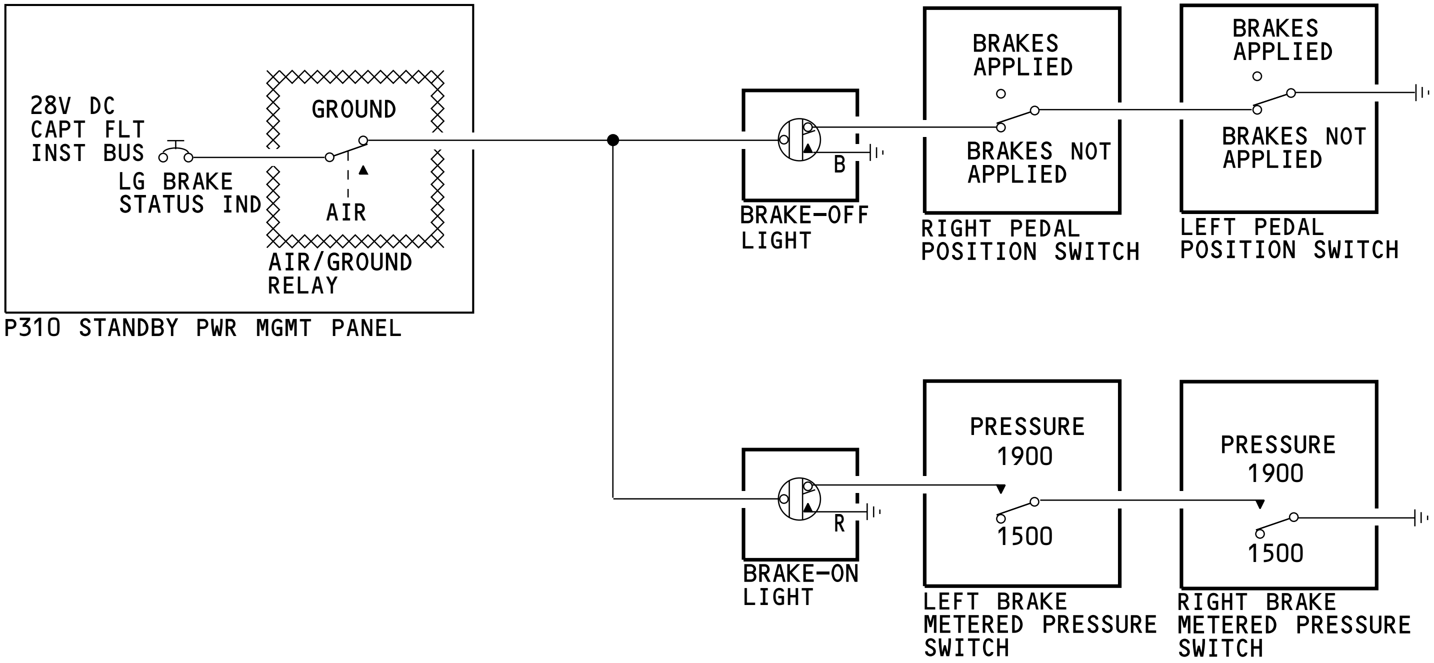
The brake-off light turns on when the airplane is on the ground and the left and right pedal position switches are in the brakes not-applied position.

Brake-On Light Indication

The brake-on light turns on when the airplane is on the ground and the left and right brake metered pressure switches get high metered brake pressure input.

Training Information Point

You can push-to-test the brake-on and the brake-off lights.



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PARKING BRAKE SYSTEM - FUNCTIONAL DESCRIPTION - BRAKE-OFF AND BRAKE-ON LIGHT INDICATION

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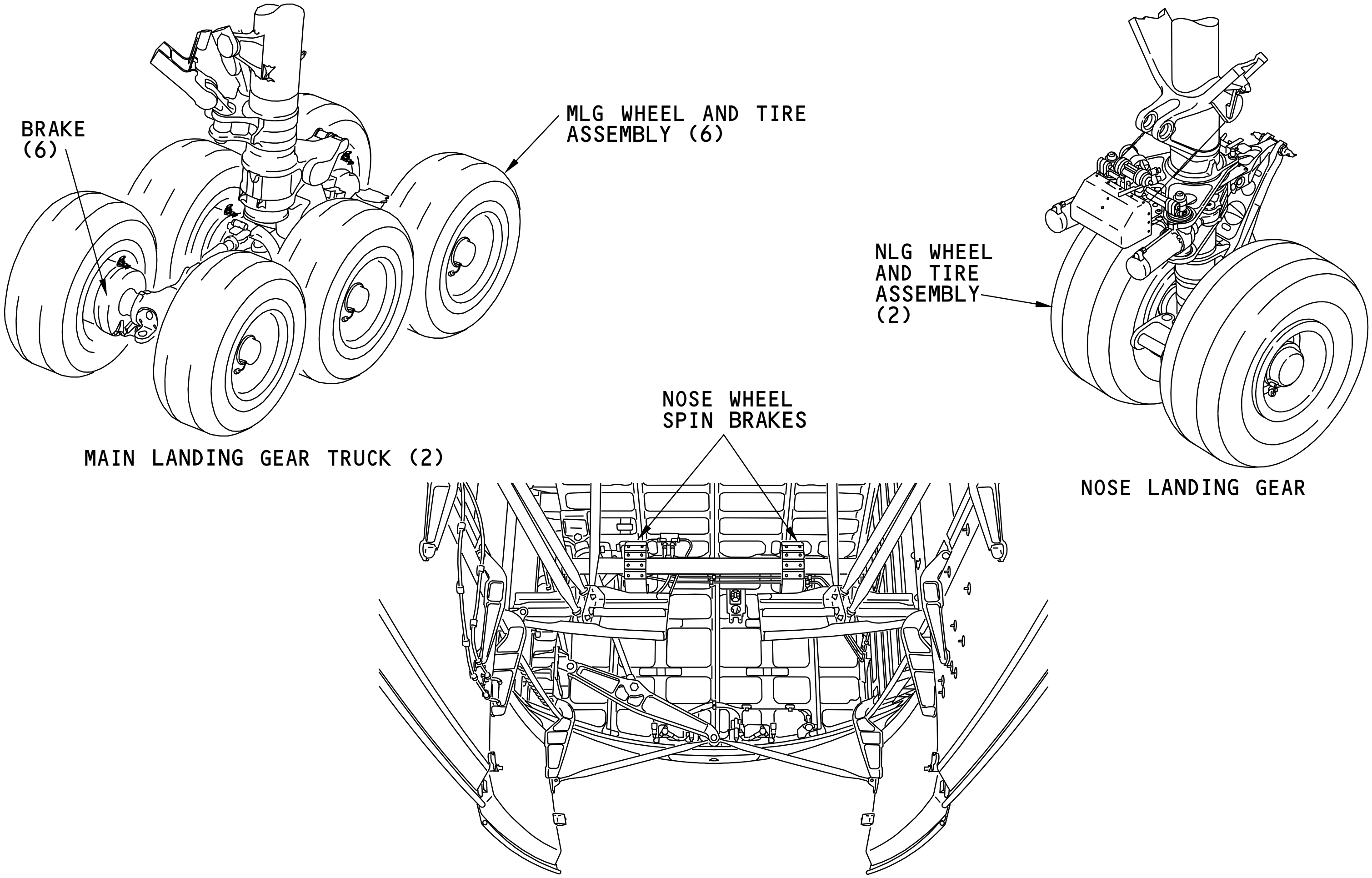
WHEELS, BRAKES, AND TIRES - INTRODUCTION

Main Landing Gear

Each main landing gear has a six wheel truck. A brake assembly is in each of the 12 main landing gear wheel and tire assemblies.

Nose Landing Gear

The nose landing gear has two wheel and tire assemblies. There are no hydraulic brakes for these wheels. Nose wheel spin brakes stop nose wheel rotation during retraction when the nose wheels enter the wheel well.



MAIN LANDING GEAR TRUCK (2)

NOSE LANDING GEAR

NOSE LANDING GEAR WHEEL WELL
(LOOKING FORWARD)

M42396 S000618750_V1

WHEELS, BRAKES, AND TIRES - INTRODUCTION

WHEELS, BRAKES AND TIRES - NOSE LANDING GEAR WHEEL AND TIRE

Nose Landing Gear Wheels

The nose wheels are radial tire wheels. They have forged inner and outer halves. Tie bolts hold the two halves together. Each wheel also has these components:

- Tire inflation valve
- Over-pressure relief valve.

Tire Inflation Valve

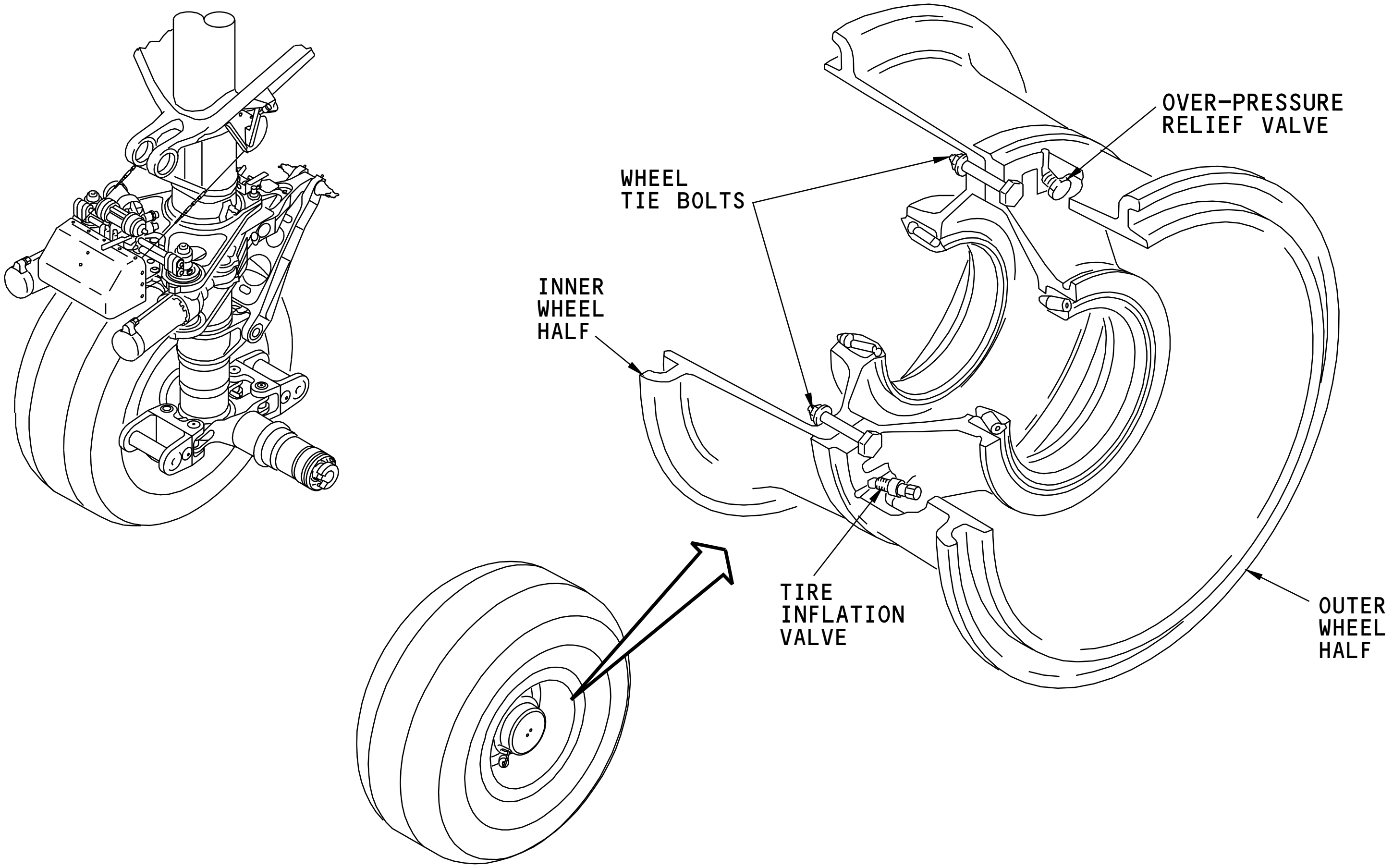
A tire inflation valve is in the outer wheel half.

Over-Pressure Relief Valve

An over-pressure relief valve is in the outer wheel half. The relief valve releases tire pressure more than 375-450 psig.

Training Information Point

The nose landing gear wheels can operate with one wheel tie bolt broken or missing.



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WHEELS, BRAKES AND TIRES - NOSE LANDING GEAR WHEEL AND TIRE

WHEELS, BRAKES, AND TIRES - NOSE WHEEL SPIN BRAKE

Purpose

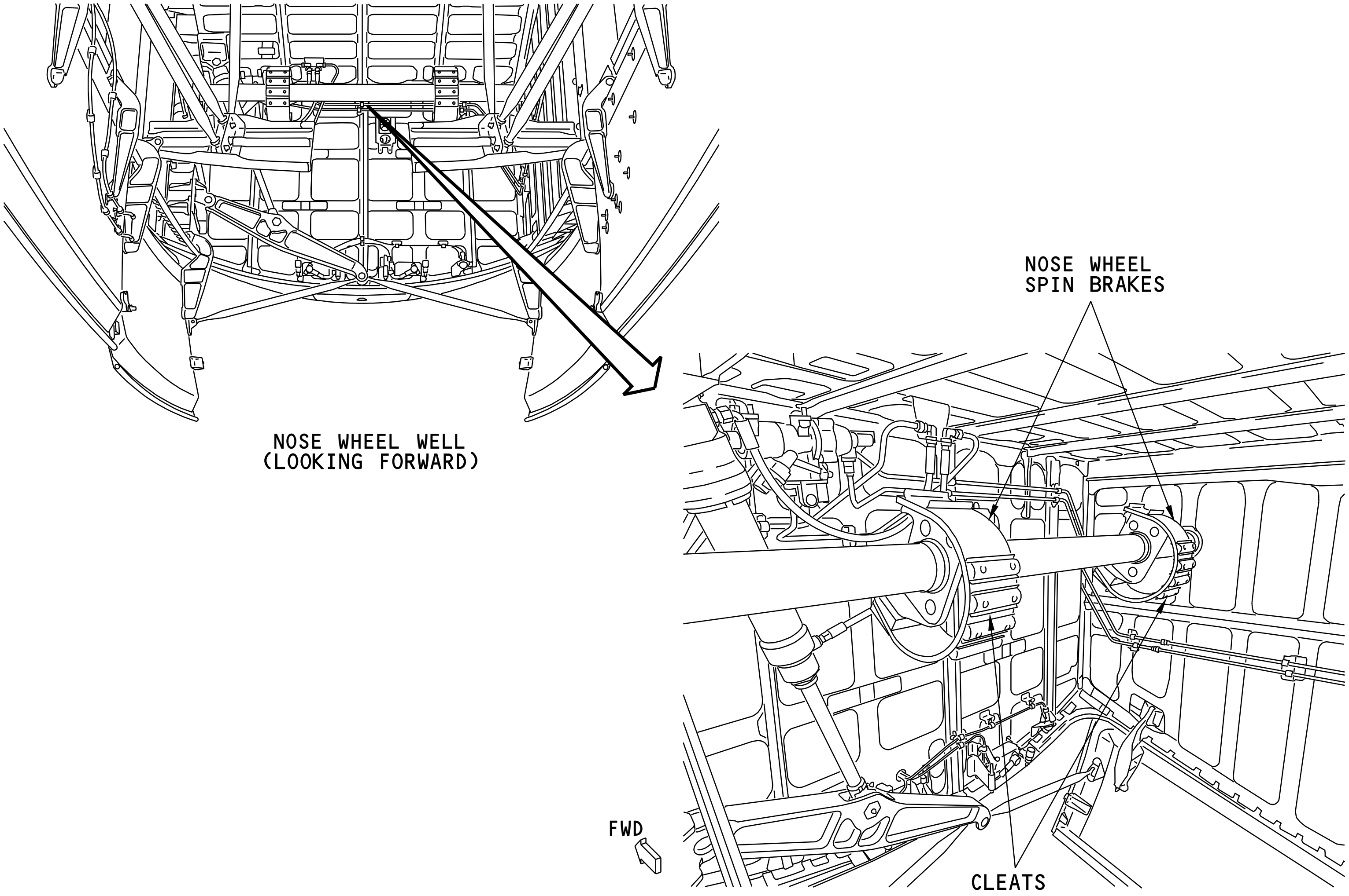
Two nose wheel spin brakes use friction with the nose gear tires to stop nose wheel rotation after the nose gear enters the wheel well.

Physical Description

The wheel spin brake assemblies are on a tube in the upper forward nose wheel well. Each wheel spin brake assembly has four stainless steel cleats.

Training Information Point

The cleats on the wheel spin brake assemblies are line replaceable units.



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WHEELS, BRAKES, AND TIRES - NOSE WHEEL SPIN BRAKE

WHEELS, BRAKES, AND TIRES - MAIN LANDING GEAR WHEEL AND TIRE

Main Landing Gear Wheels

The main wheels are radial tire wheels. They have forged inner and outer halves. Tie bolts hold the two halves together. Brake rotor drive keys and heat shields are in the inner half of each wheel.

Each wheel also has these components:

- Tire inflation valve
- Over-pressure relief valve
- Thermal fuse plug (3).

Tire Inflation Valve

A tire inflation valve is in the outer wheel half.

Over-Pressure Relief Valve

An over-pressure relief valve is in the outer wheel half. The relief valve releases tire pressure above 375-450 psig.

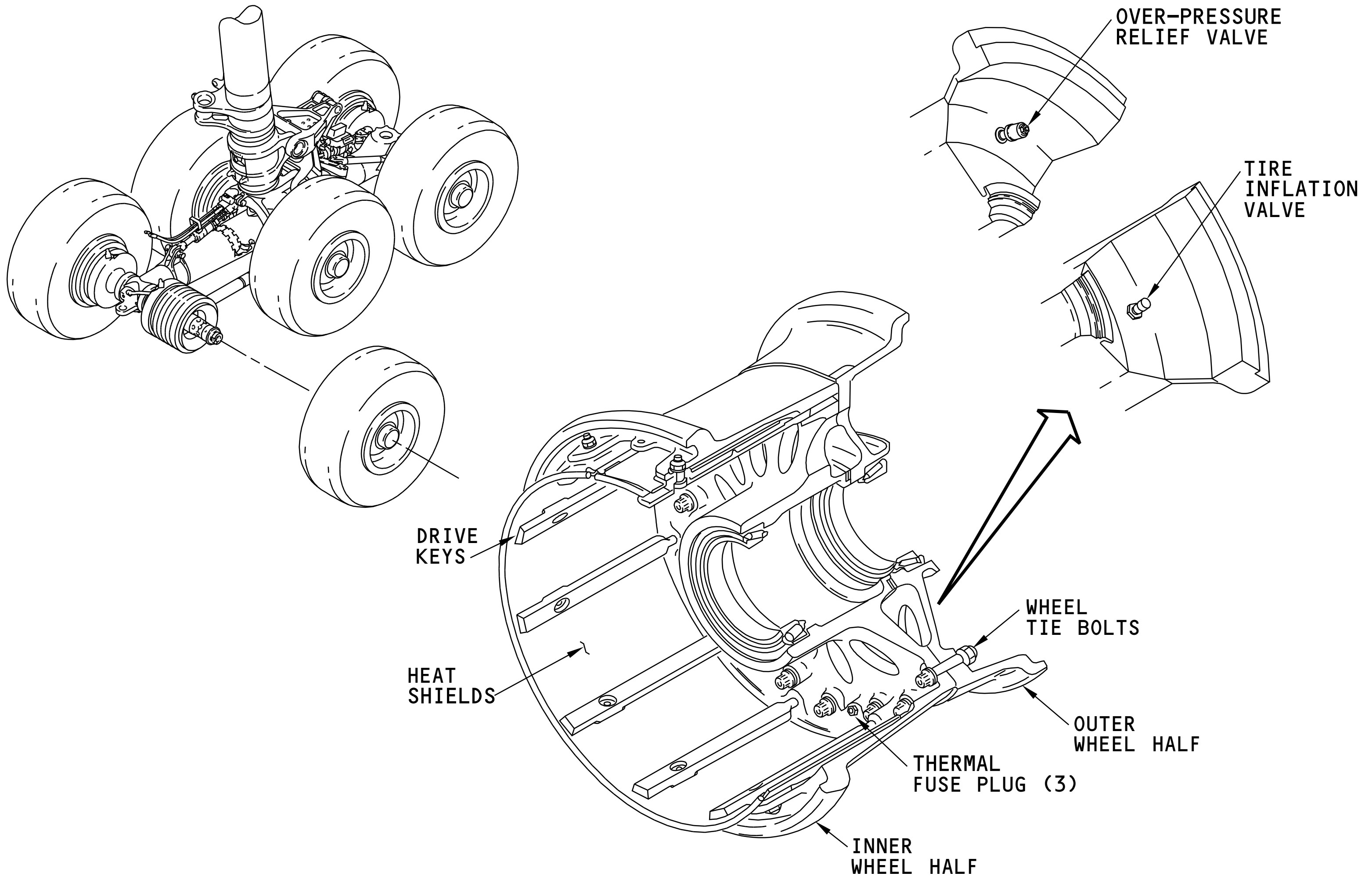
Thermal Fuse Plugs

Three thermal fuse plugs in the inner wheel half prevent tire explosion caused by hot brakes. The plugs melt to release tire pressure when their temperature is approximately 360F (182C).

Training Information Point

You must jack both ends of the main landing gear wheel truck to remove the center wheel and tire assemblies.

The main landing gear wheels can operate with one wheel tie bolt broken or missing.



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WHEELS, BRAKES, AND TIRES - MAIN LANDING GEAR WHEEL AND TIRE

WHEELS, BRAKES, AND TIRES - MAIN LANDING GEAR WHEEL BRAKES

General

The main landing gear wheel brakes use hydraulic pressure to slow or stop the airplane during landing and taxi.

Each main landing gear wheel brake components include:

- Stators and rotors
- End plate assembly
- Pressure plate
- Self-adjusting piston (7)
- Axle bushing (2)
- Wear indicator pin (2)
- Brake disconnect (not shown)
- Hydraulic bleed port (not shown).

Physical Description

The brake assembly is a rotor-stator unit that operates using hydraulic pressure. The assembly uses carbon discs as rotors and stators.

The rotors and stators are compressed between the pressure plate and the end plate assembly to slow or stop the airplane.

Self-adjusting pistons apply brake system hydraulic pressure to the pressure plate. The pistons automatically adjust for brake wear.

Two indicator pins on the inboard side of the brake housing show brake wear.

The brake units mount on bushings which ride on replaceable landing gear axle sleeves.

The center brake attachment points connect directly to the lower strut at the same place the brake rods attach. The forward and aft brake attachment points connect to the brake rods.

The brake rods transmit brake torque to the strut. They also allow brake rotation as the truck position changes.

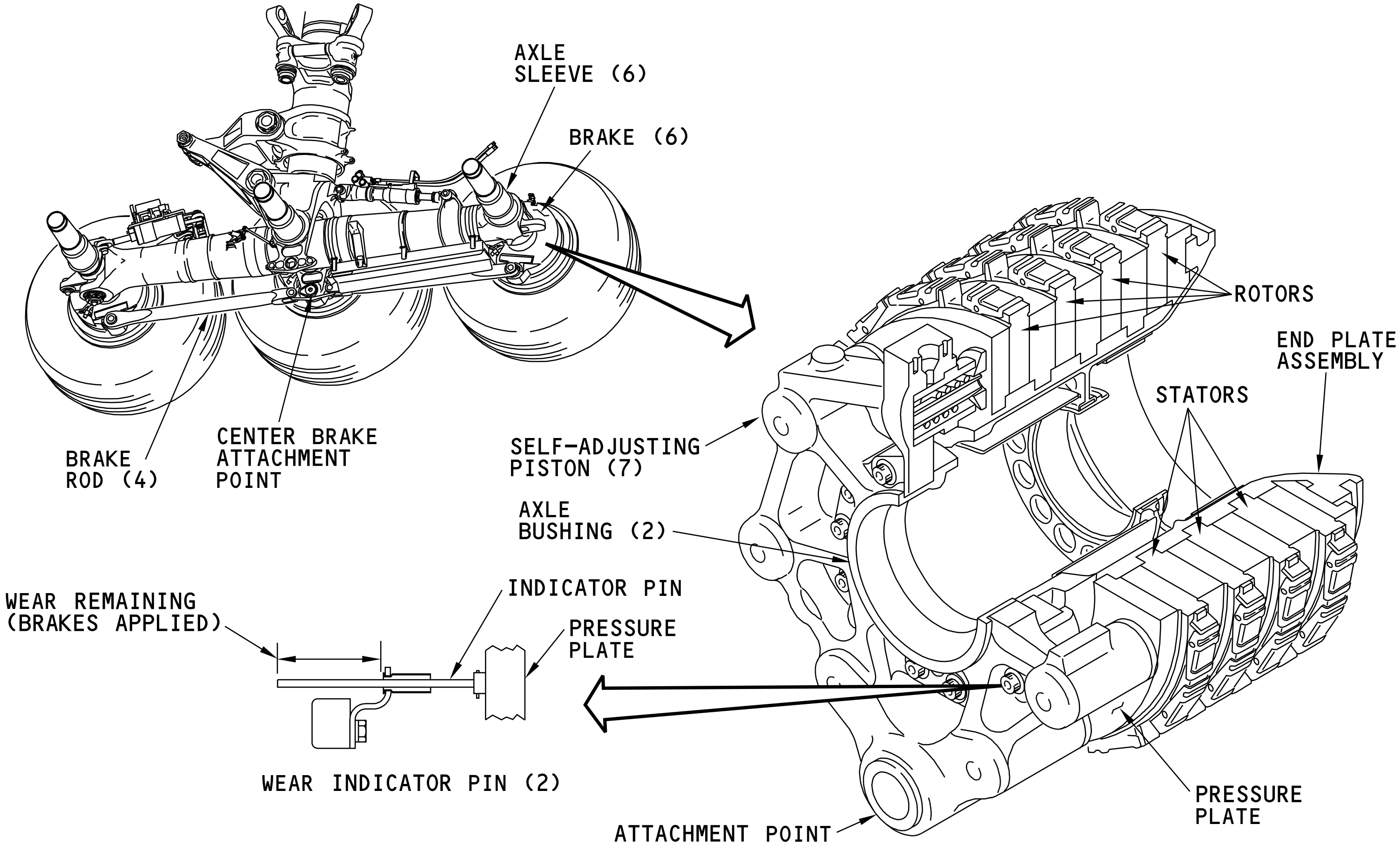
Training Information Point

You must apply the brakes to do a check of the wear indicator pins.

The brake system can operate with one brake on each six wheel truck deactivated. Brakes may be deactivated by three methods:

- Install a flight dispatch disconnect tool in the brake position on the related antiskid shuttle valve module (This deactivates normal braking only. Alternate braking is still available.)
- Disconnect the brake line
- Remove the brake.

If the brake is removed or the brake line is disconnected, the gear must remain down for two minutes before retraction.



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WHEELS, BRAKES, AND TIRES - MAIN LANDING GEAR WHEEL BRAKES

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BRAKE TEMPERATURE MONITORING SYSTEM - INTRODUCTION

Purpose

The brake temperature monitoring system (BTMS) gets brake temperature inputs from the twelve main gear brakes and supplies this data for flight deck indication.

Components

These are the tire and brake monitoring system components:

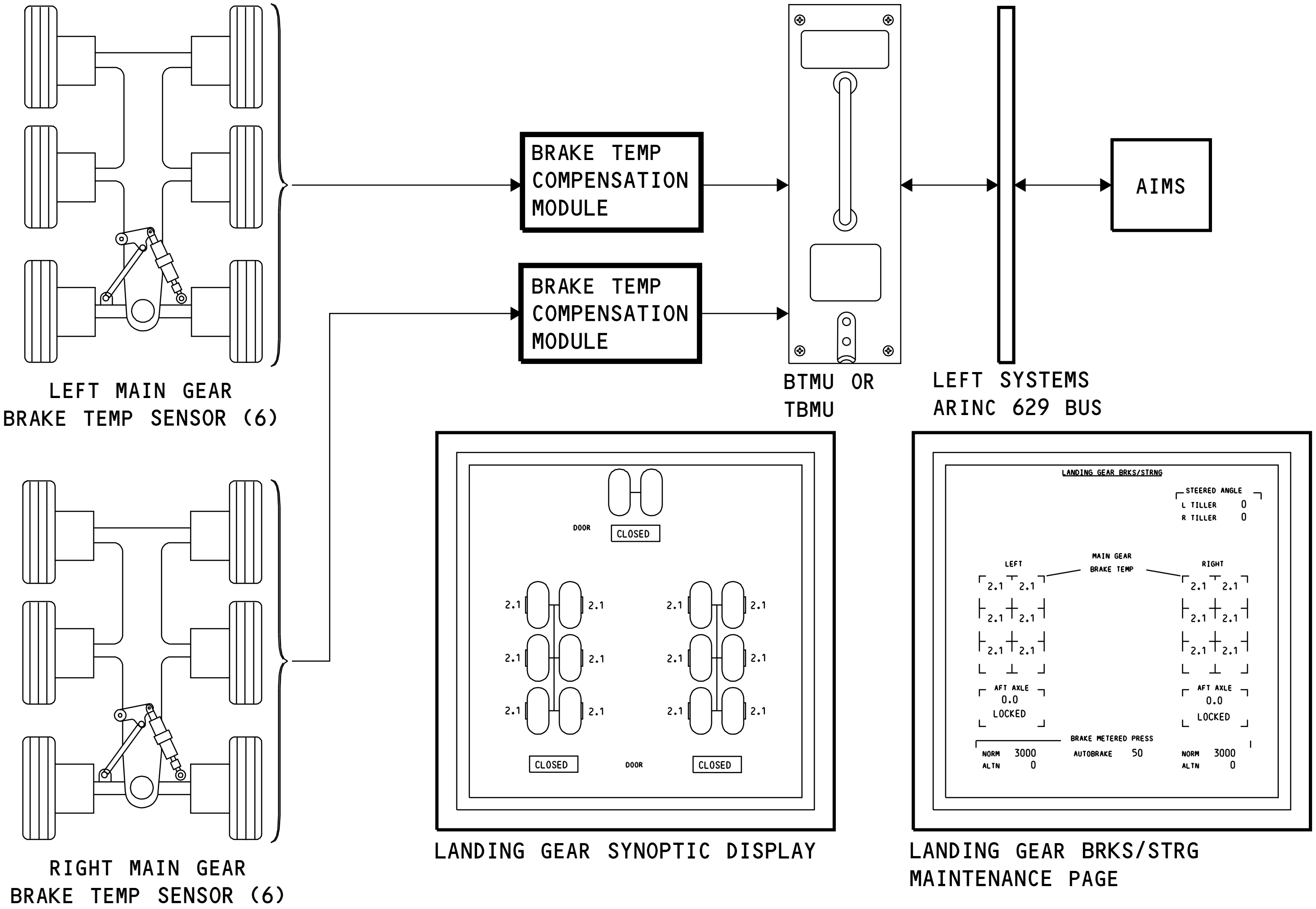
- Brake temperature sensor (12)
- Brake temperature compensation module (2)
- Tire and brake monitoring unit (TBMU)

General Description

Brake temperature sensors send brake temperature data through the brake temperature compensation modules to the TBMU. The compensation modules supply a reference ambient temperature.

The TBMU sends brake temperature data to the AIMS through the left ARINC 629 system bus.

The multi-function display (MFD) shows brake temperature data on the landing gear synoptic display and on the landing gear brakes/steering maintenance page.



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BRAKE TEMPERATURE MONITORING SYSTEM - INTRODUCTION

BRAKE TEMPERATURE MONITORING SYSTEM - SENSOR AND COMPENSATION MODULE

Brake Temperature Sensor

The brake temperature sensor is a thermocouple. It sends a brake temperature signal through the brake temperature compensation module to the tire and brake monitoring unit (TBMU).

A brake temperature sensor is near the bottom of the brake in each of the main gear brake assemblies.

Brake Temperature Compensation Module

The brake temperature compensation modules connect the thermocouple wire to the aircraft wiring.

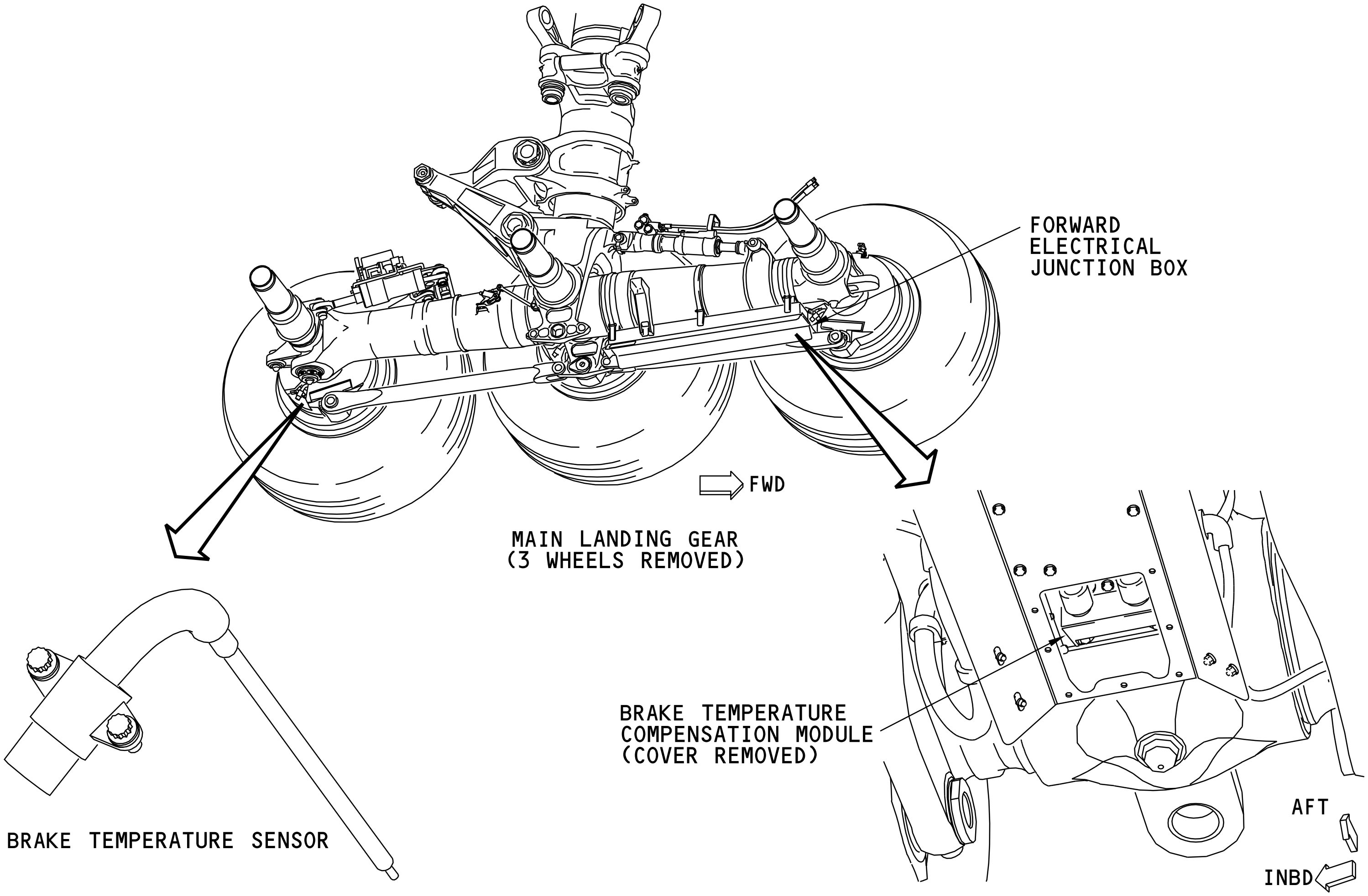
Two reference temperature sensors in each brake temperature compensation module supply reference ambient temperature signals to the TBMU. The TBMU uses this reference temperature to correct the brake temperature signals from the brake temperature sensors.

A brake temperature compensation module is in the forward electrical junction box on the bottom of each truck.

Training Information Point

The brake temperature sensors are LRUs. The brake temperature compensation modules are also LRUs.

A cover on the forward electrical junction box permits easy access to the brake temperature compensation module.



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BRAKE TEMPERATURE MONITORING SYSTEM - SENSOR AND COMPENSATION MODULE

BRAKE TEMPERATURE MONITORING SYSTEM - FUNCTIONAL DESCRIPTION

General

The left 28v dc bus supplies the electrical power for the brake temperature monitoring system.

Brake Temperature Inputs for the TBMU

The brake temperature sensors in each of the wheel brakes send temperature signals to the brake temperature compensation modules.

The compensation modules supply ambient reference temperature signals.

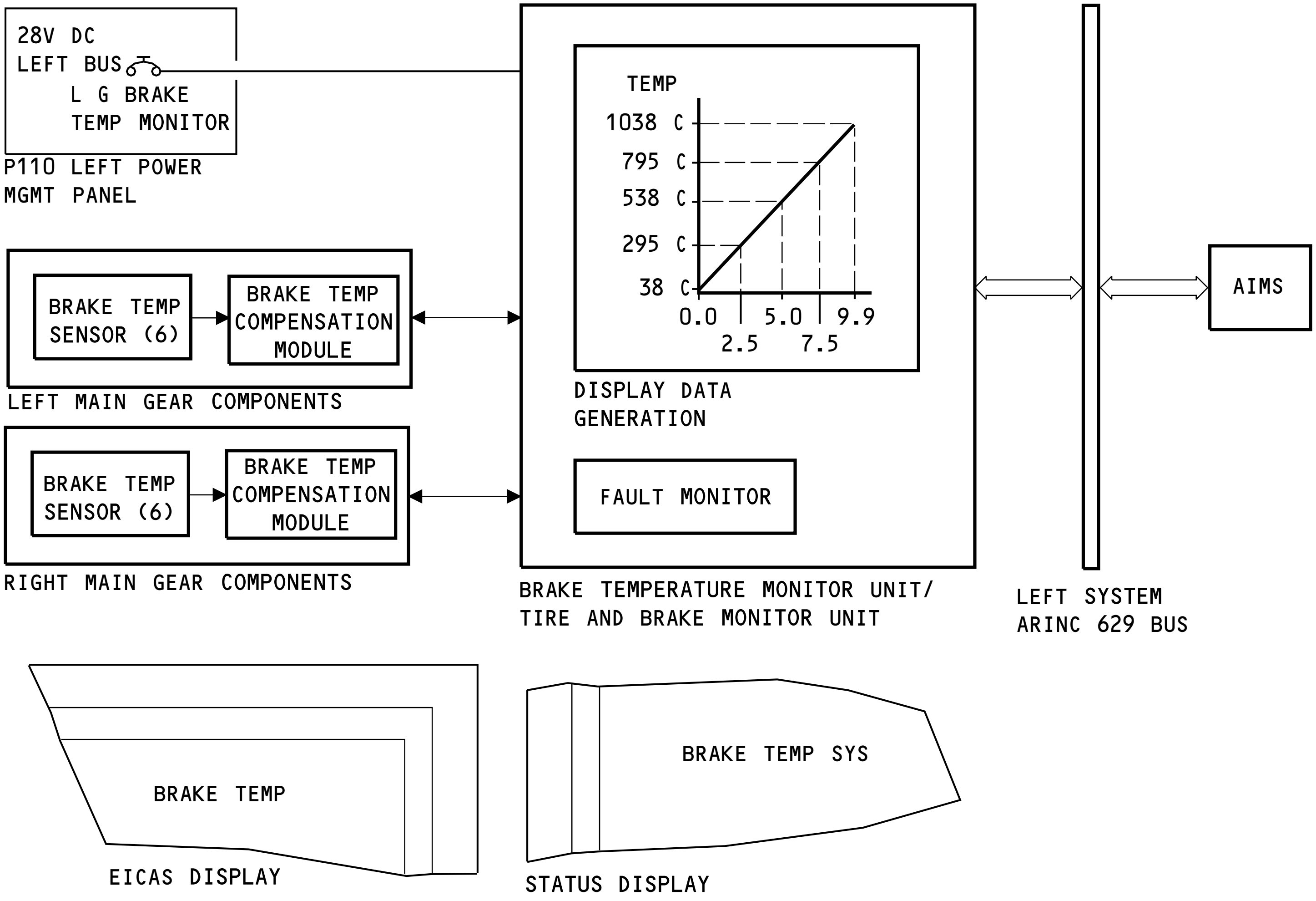
These inputs go the tire and brake monitoring unit (TBMU).

TBMU Operation

The TBMU gets the brake temperature input and changes this data to a value between 0.0 and 9.9. This value goes to AIMS for flight deck display.

The TBMU also compares the brake temperature to specific advisory condition limits. The BRAKE TEMP advisory message shows when brake temperature is more than these limits.

A fault monitor in the TBMU monitors the brake temperature monitoring system components for faults. The status message BRAKE TEMP SYS shows when there is a loss of brake temperature indication function.



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BRAKE TEMPERATURE MONITORING SYSTEM - FUNCTIONAL DESCRIPTION

BRAKE TEMPERATURE MONITORING SYSTEM - INDICATION

General

Brake temperature indication shows on the landing gear synoptic display and the brake and steering maintenance page.

Brake Temperature Indication

Brake temperature between approximately 38C (100F) and 1038C (1900F)shows as a number on a linear scale between 0.0 and 9.9.

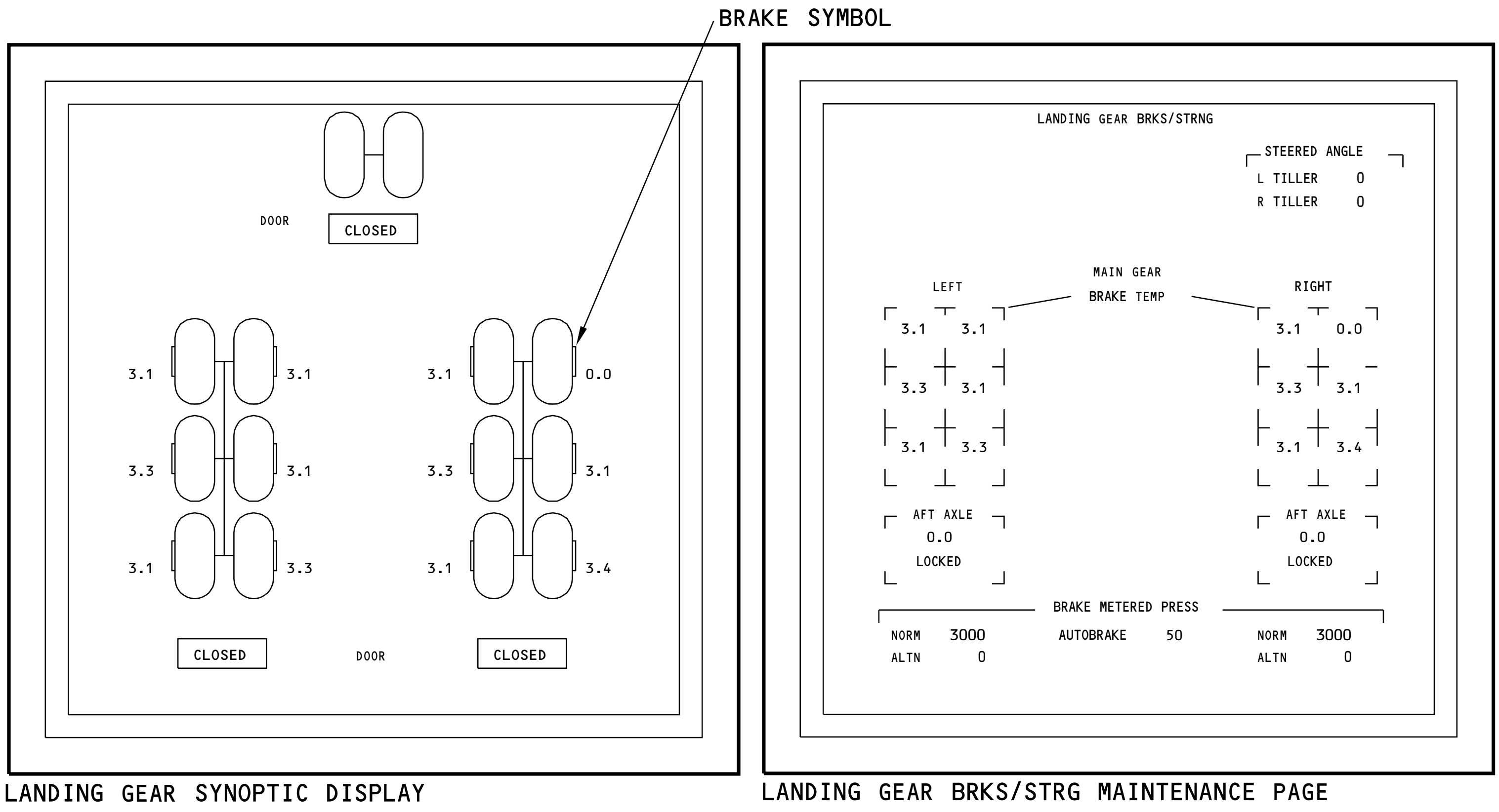
On the landing gear synoptic display, the values less than 5.0 show in white. A solid white brake symbol shows the hottest brake on each main gear truck between 3.0 and 4.9. If two brakes on one truck are the same temperature, the solid white brake symbol shows the brake that first went to that temperature.

When the brake temperature is 5.0 or more, the number changes to amber and the brake symbol changes to a solid amber. All brake temperatures above 5.0 will show this indication. The amber indication stays on until the brake temperature decreases to less than 3.5.

A BRAKE TEMP message shows on the EICAS display if there is an amber temperature indication.

Training Information Point

If the brake temperatures are more than 5.0, the wheel thermal fuse plugs may melt.



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BRAKE TEMPERATURE MONITORING SYSTEM - INDICATION

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TIRE PRESSURE INDICATION SYSTEM - INTRODUCTION

Purpose

The tire pressure indication system measures the tire pressures for the two nose gear and 12 main gear tires.

Components

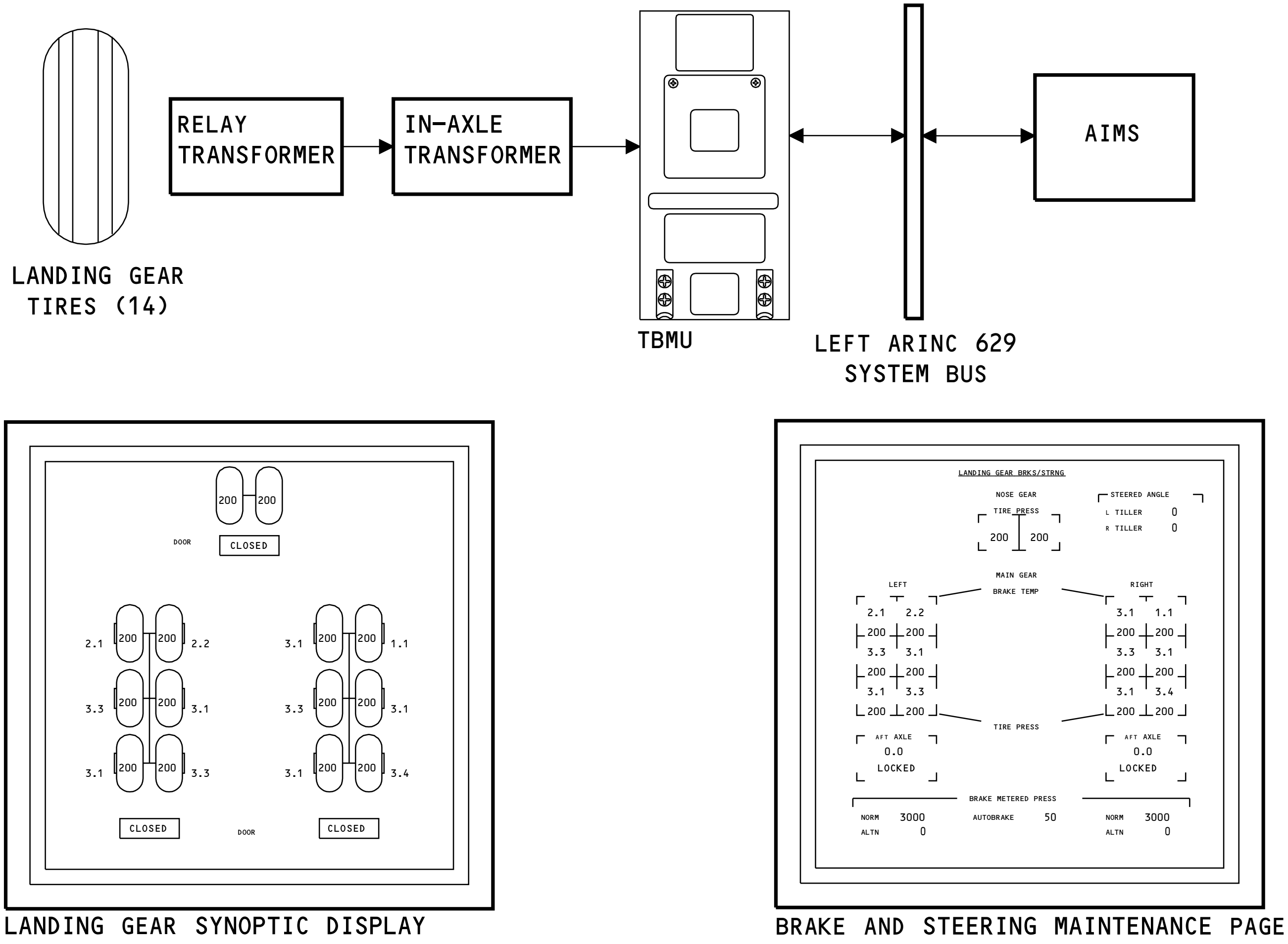
These are the tire pressure indicating system components for the tire and brake monitoring system (TBMS):

- Tire pressure sensor/fill valve (14)
- Tire and brake monitoring unit (TBMU)
- Relay transformer hubcap assembly (14)
- Main gear in-axle adapter transformer (12)
- Nose gear in-axle adapter transformer (2)

General Description

The tire and brake monitoring unit (TBMU) sends the tire pressure data to AIMS through the left ARINC 629 bus.

The MFD shows tire pressure data on the landing gear synoptic display and brake and steering maintenance page.



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TIRE PRESSURE INDICATION SYSTEM - INTRODUCTION

TIRE PRESSURE INDICATION SYSTEM - TIRE PRESSURE SENSORS AND WHEEL INTERFACE

Location

A tire pressure sensor/fill valve is installed on each of the 12 main gear wheels and two nose gear wheels. There is an in-axle transformer in each of the axles.

Tire Pressure Sensor/Fill Valve

The tire pressure sensor/fill valve is made of an air fill valve and three independent pressure sensing channels which provide accurate tire pressure.

The tire pressure sensor/fill valve is installed in the wheel.

A relay transformer hubcap assembly connects to the tire pressure sensor/fill valve.

Relay Transformer

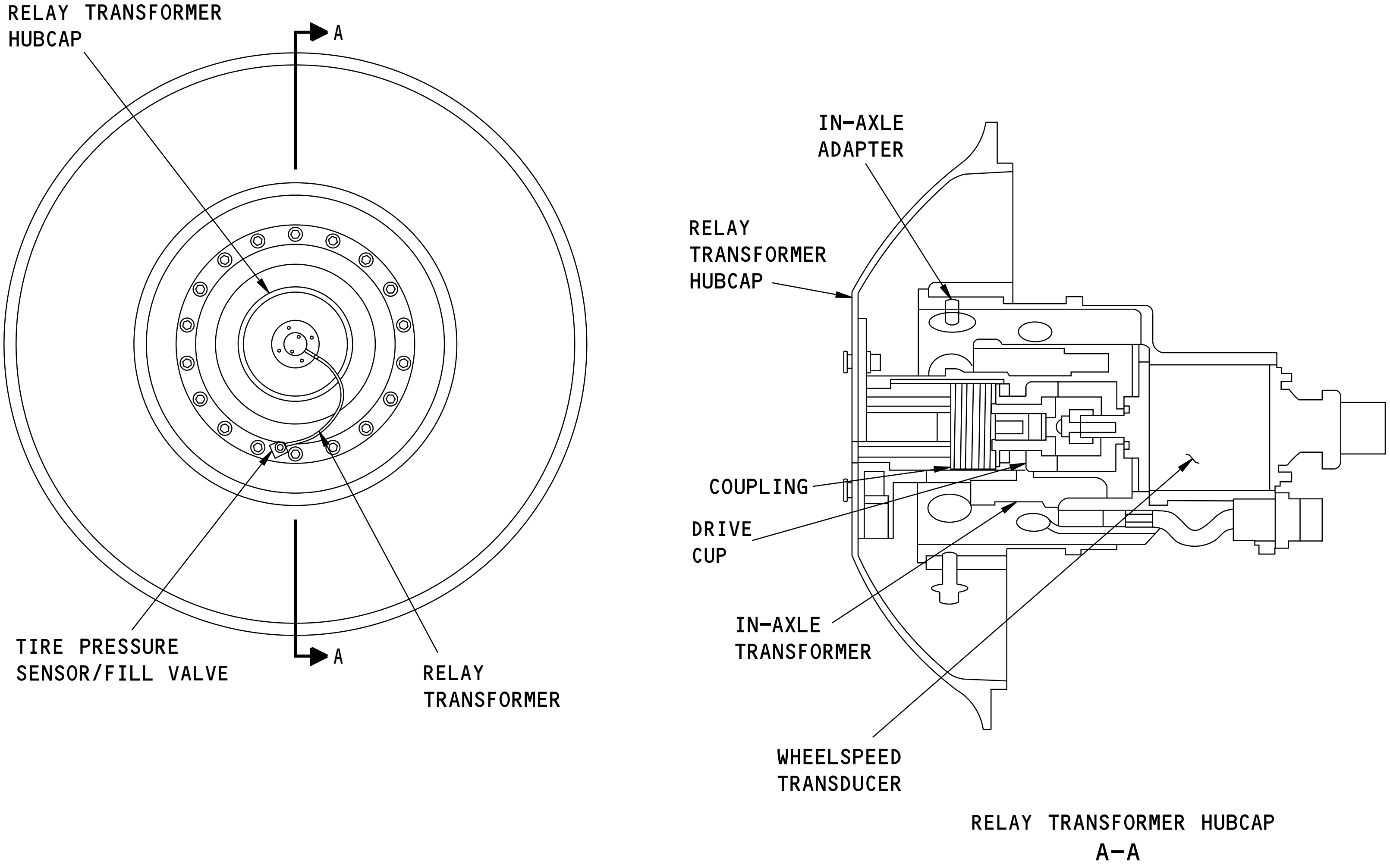
The relay transformer rotates as the wheel rotates, creating a rotational transformer with the in-axle adapter transformer assembly.

The relay transformer hubcap assembly is installed on each wheel and provides the interface between the pressure sensor/fill valve and the in-axle transformer.

Outside of the hubcap, the relay transformer is physically connected to the pressure sensor/fill valve by means of a coupling ring that fits around the outer casing of the pressure sensor/fill valve.

Training Information Point

To remove a tire pressure sensor/fill valve, you do need to deflate the tire.



1361997 S0000244066_V2

TIRE PRESSURE INDICATION SYSTEM - TIRE PRESSURE SENSOR/FILL VALVE

TIRE AND BRAKE MONITORING SYSTEM - TIRE AND BRAKE MONITORING UNIT

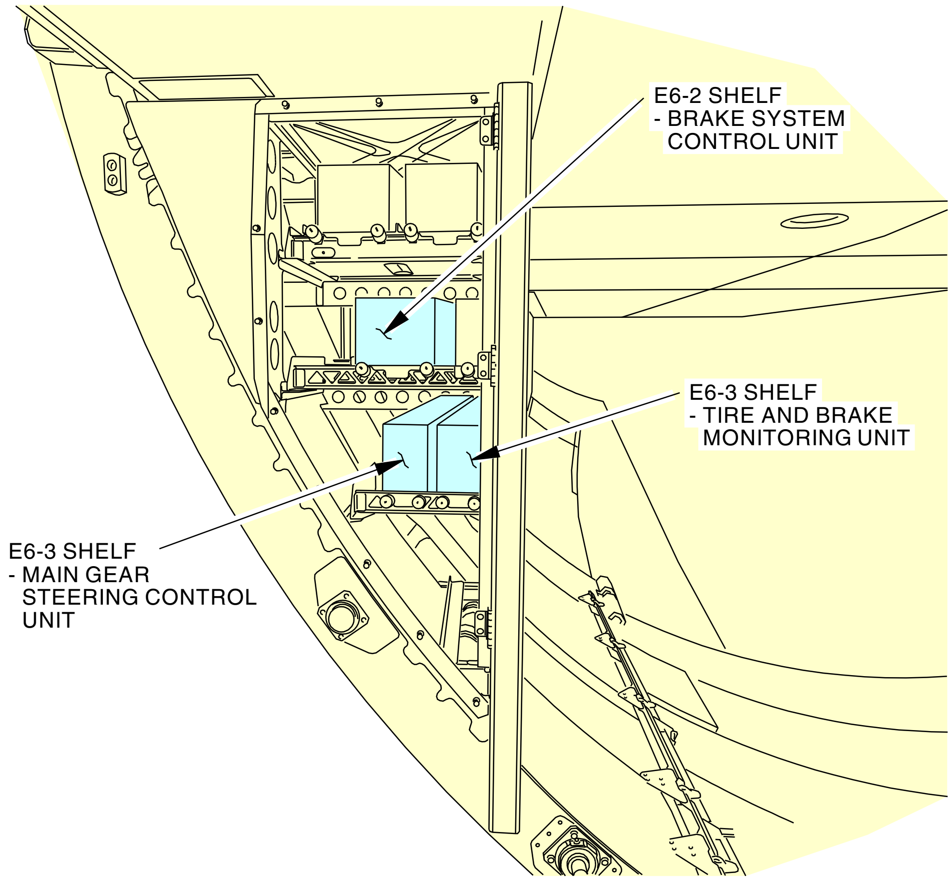
Purpose

The TBMU supplies power to the in-axle transformer and relay transformer and to the tire pressure sensor/fill valves. It gets the tire pressure inputs and sends this data to the AIMS.

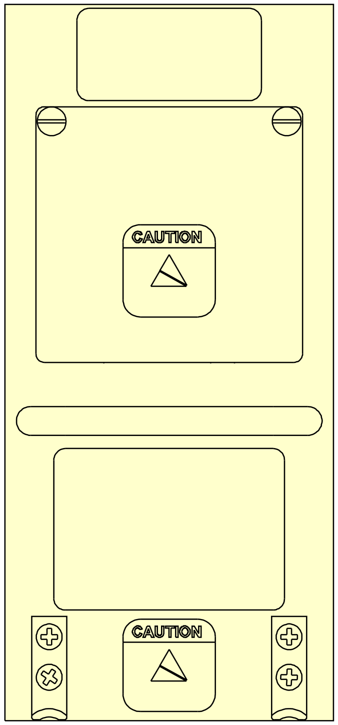
The TBMU also monitors the tire pressure indication system components.

Location

The TBMU is on the E6-3 shelf in the aft cargo compartment.



AFT CARGO COMPARTMENT
(LOOKING AFT)



TBMU

1359345 S0000244743_V2

TIRE PRESSURE INDICATION SYSTEM - TIRE AND BRAKE MONITORING UNIT

TIRE PRESSURE INDICATION SYSTEM - FUNCTIONAL DESCRIPTION

Power Supply

The left 28 v dc MAIN bus supplies the electrical power to operate the tire pressure indication system.

TBMU - Tire Pressure Sensor/Fill Valve

The TBMU supplies an excitation signal to each of the 14 wheel interface units.

The wheel interface unit sends the signal across the rotating interface of the wheel to the tire pressure sensor/fill valve.

Tire Pressure Sensor/Fill Valve - TBMU Signal

The tire pressure/sensor fill valve sends a dc voltage signal that is in proportion to the tire pressure.

The wheel interface unit transmits the signal across the rotating interface of the wheel back to the TBMU.

TBMU Operation

The TBMU gets the tire pressure signals and sends them to the AIMS for the flight deck display.

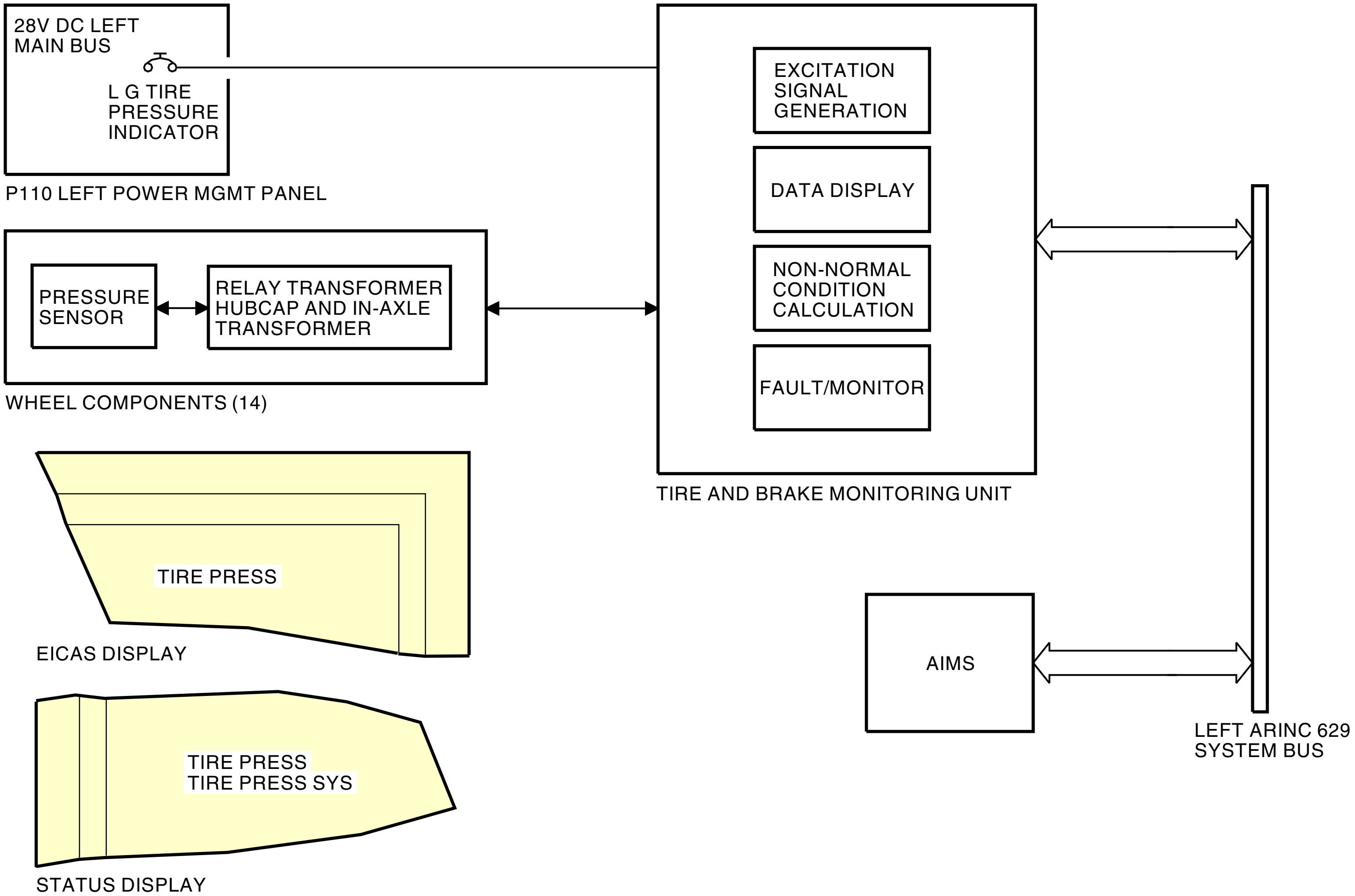
The TBMU also calculates non-normal tire pressure conditions and shows these EICAS messages:

- TIRE PRESS (Advisory) - non-normal tire pressure conditions.
- TIRE PRESS (Status) - non-normal tire pressure conditions.

Non-normal tire pressure conditions include:

- Tire pressure below 100 psi.
- Main gear tire pressure different from the average tire pressure by 18 percent or more (the TBMU calculates average tire pressure by discarding the three highest and the three lowest tire pressures and averaging the middle six tire pressures).
- More than 25 percent difference in pressure between main gear tires on the same axle.
- More than 12 percent difference between the nose gear tire pressures.

A fault monitor in the TBMU monitors tire pressure indication components and interfaces for faults. The status message TIRE PRESS SYS shows if there is a fault.



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TIRE PRESSURE INDICATION SYSTEM - FUNCTIONAL DESCRIPTION

TIRE PRESSURE INDICATION SYSTEM - INDICATIONS

General

Tire pressure indication, shows in psi on the landing gear synoptic display and the brake and steering maintenance page.

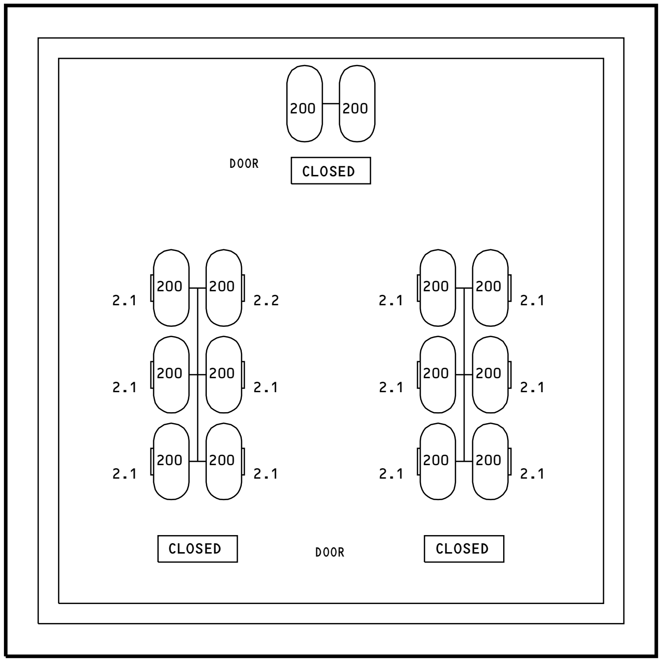
Tire Pressure Indication

The landing gear synoptic display and the brake and steering maintenance page show normal tire pressure in white.

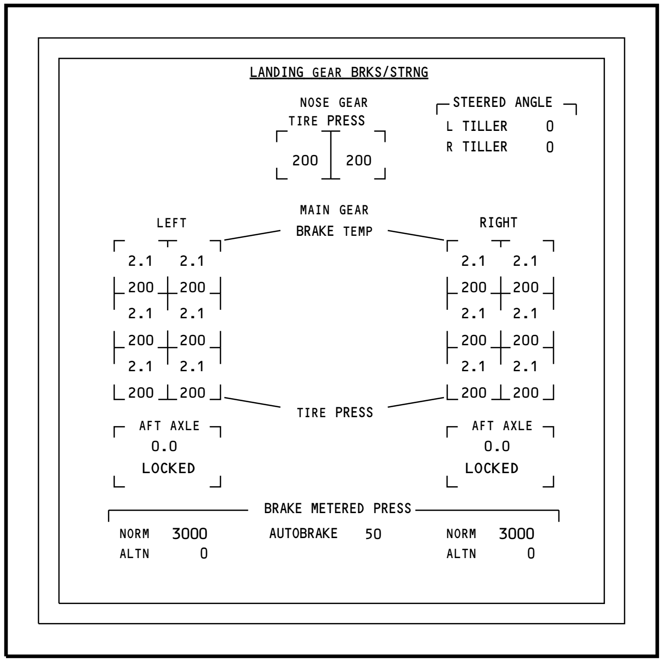
The tire pressure display changes to amber to show non-normal pressure conditions.

Non-normal conditions also cause a message to show on the EICAS display.

The tire display will go out of view if there is a Loss of pressure data or if the pressure data is invalid.



LANDING GEAR SYNOPTIC DISPLAY



BRAKE AND STEERING MAINTENANCE PAGE

M42420 S000618775_V1

TIRE PRESSURE INDICATION SYSTEM - INDICATIONS

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STEERING - INTRODUCTION

Purpose

The nose gear steering (NGS) system and the main gear steering system (MGSS) supply directional control of the airplane on the ground.

The MGSS also decreases tire scrub and the U-turn radius.

You make steering inputs through two steering tillers and the rudder pedals.

Nose Gear Steering

The nose gear steering system is a hydro-mechanical system that moves the nose landing gear up to 70 degrees left or right.

Main Gear Steering

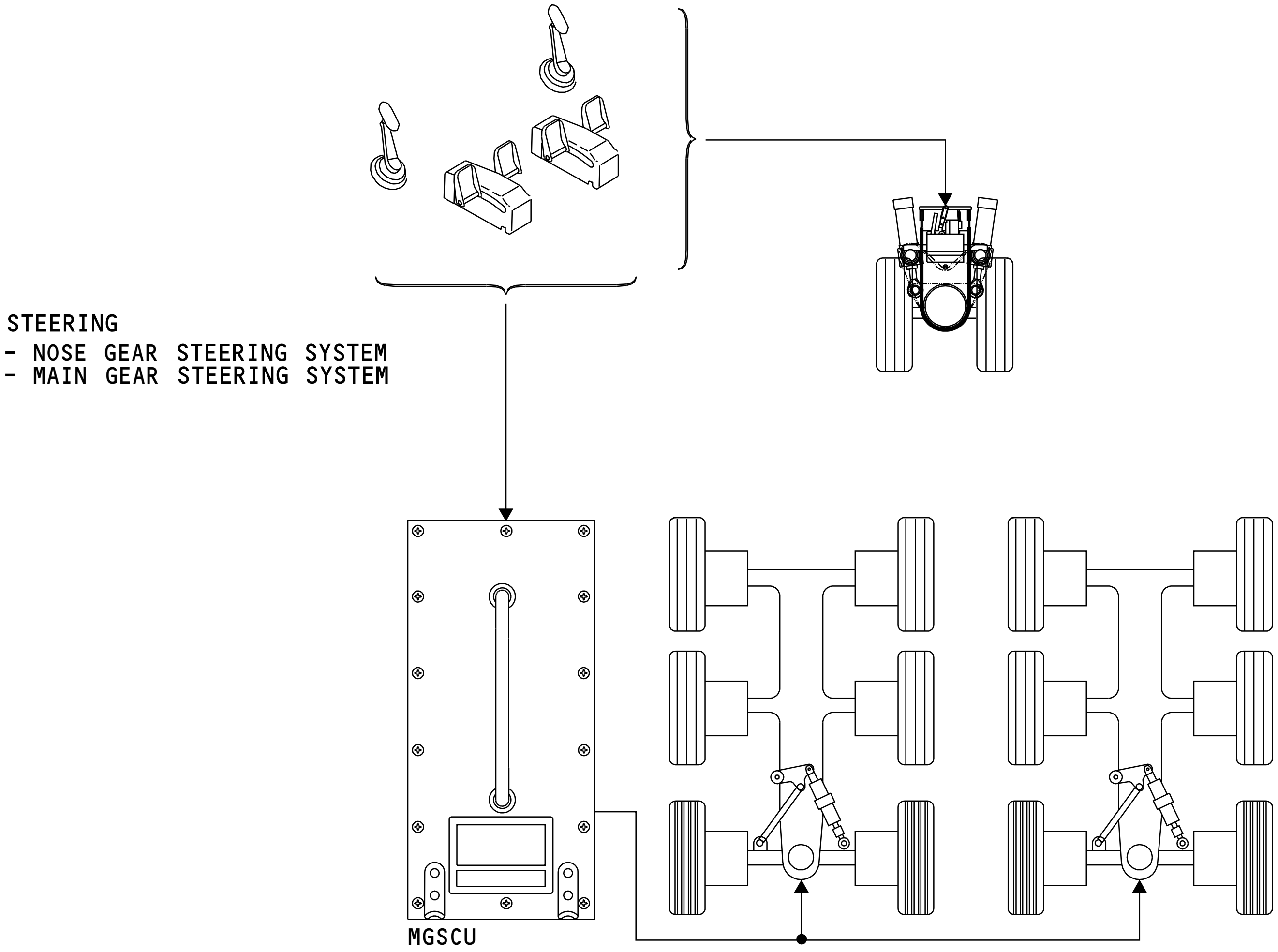
The main gear steering operates when the nose gear turns more than 13 degrees.

The aft axles on each main gear truck move up to 6.5 degrees in each direction.

The main gear steering system gets position inputs from the NGS. A main gear steering control unit (MGSCU) controls the main gear steering system.

Abbreviations and Acronyms

- AIMS - airplane information management system
- ARINC - Aeronautical Radio, Inc.
- EHSV - electrohydraulic servovalve
- F/O - first officer
- LVDT - linear variable differential transformer
- MGSCU - main gear steering control unit
- MGSS - main gear steering system
- MLG - main landing gear
- MFD - multi-function display
- NG - nose gear
- NGS - nose gear steering
- NLG - nose landing gear
- PCA - power control actuator
- pos - position
- PSI - pounds per square inch
- RVDT - rotary variable differential transformer
- WES - warning electronic system
- xdcr - transducer.



M42421 S000618776_V1

STEERING - INTRODUCTION

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NOSE GEAR STEERING SYSTEM - INTRODUCTION

Purpose

The nose gear steering system supplies the primary ground directional control of the airplane.

Inputs

Steering inputs are from the steering tillers or the rudder pedals.

Cable Loops

Steering inputs move an upper cable loop. This loop connects to a lower cable loop. The lower cable loop makes inputs to a NLG steering metering valve module.

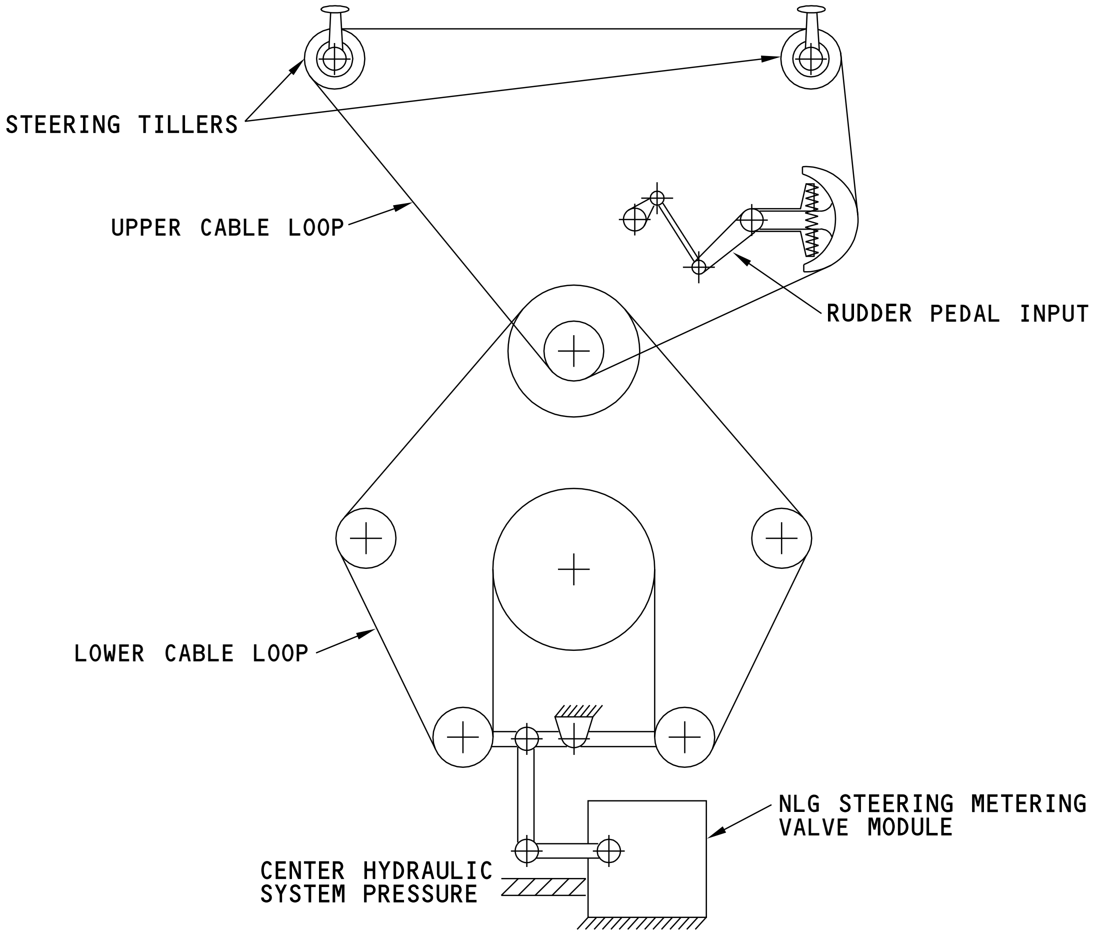
Hydraulic Supply

The center hydraulic system supplies the pressure to operate the nose gear steering system.

Limits

Steering tiller input turns the nose gear up to 70 degrees in each direction.

Rudder pedal input turns the nose gear approximately 7 degrees in each direction.



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NOSE GEAR STEERING SYSTEM - INTRODUCTION

NOSE GEAR STEERING SYSTEM - COMPONENTS

Upper Cable Loop Components

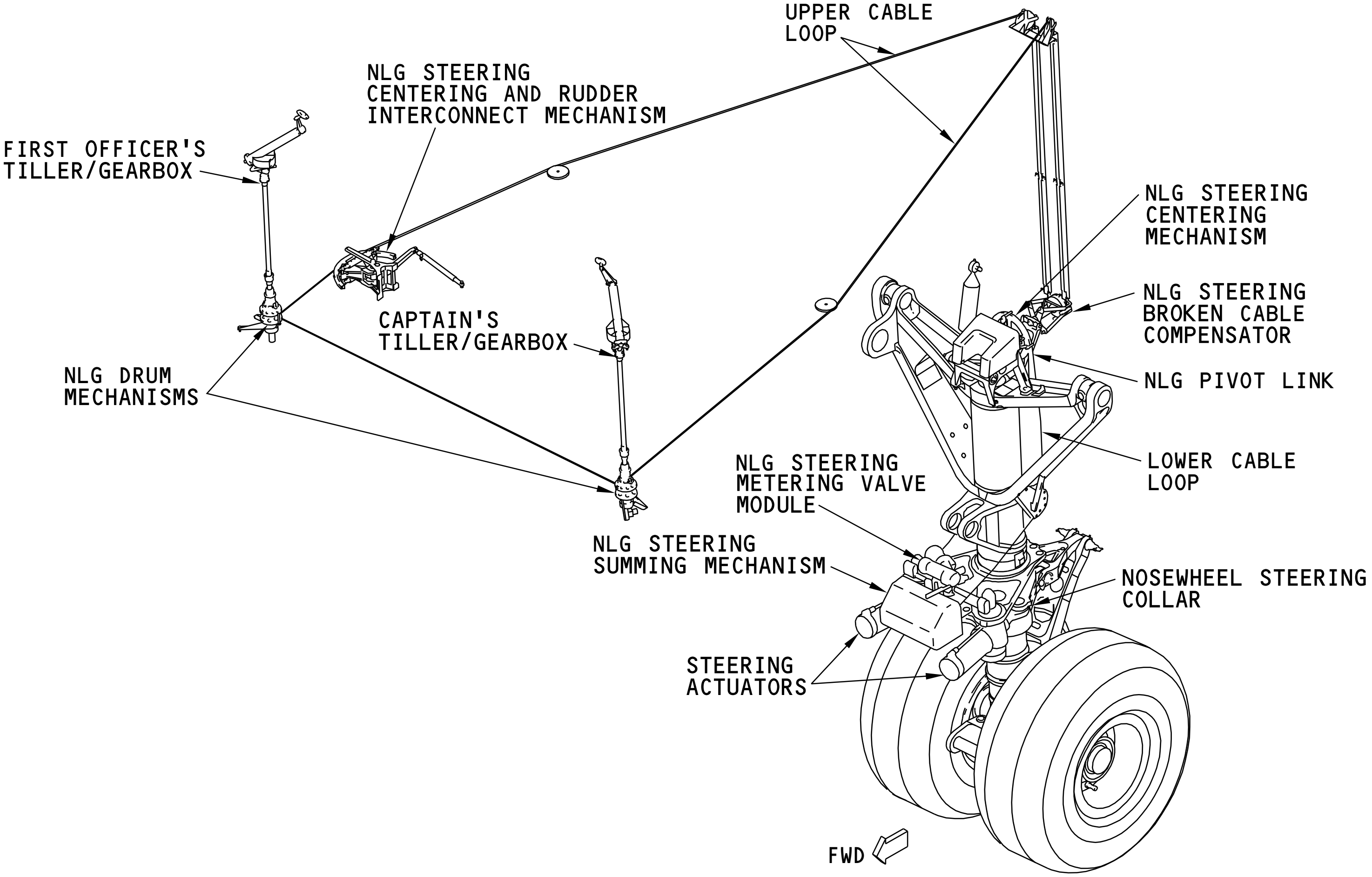
These are the nose gear steering components on the upper cable loop:

- NLG steering tiller and gearbox (2)
- NLG drum mechanism (2)
- NLG steering centering and rudder interconnect mechanism
- NLG steering broken cable compensator
- NLG steering pivot link.

Lower Cable Loop Components

These are the nose gear steering components on the lower cable loop:

- NLG steering centering mechanism
- NLG steering summing mechanism
- NLG steering metering valve module
- NLG steering actuator (2)
- Nosewheel steering collar.



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NOSE GEAR STEERING SYSTEM - COMPONENTS

NOSE GEAR STEERING SYSTEM - NLG STEERING TILLER, GEARBOX, AND DRUM MECHANISM

Purpose

Two NLG steering tillers control nose gear steering up to 70 degrees in each direction.

Physical Description

The tillers mechanically connect to each other through the upper cable loop.

Each tiller attaches to a gearbox assembly. The gearbox assembly has a bevel gear to change the angle of rotation from the tiller.

The gearbox decreases tiller motion and increases tiller input torque by a ratio of 3.9 to 1. Maximum tiller rotation is 350 degrees in each direction.

A torque shaft connects the gearbox to the drum mechanism. The cable drums move the upper cable loop. The torque shaft and drum mechanism can turn 90 degrees in each direction.

Location

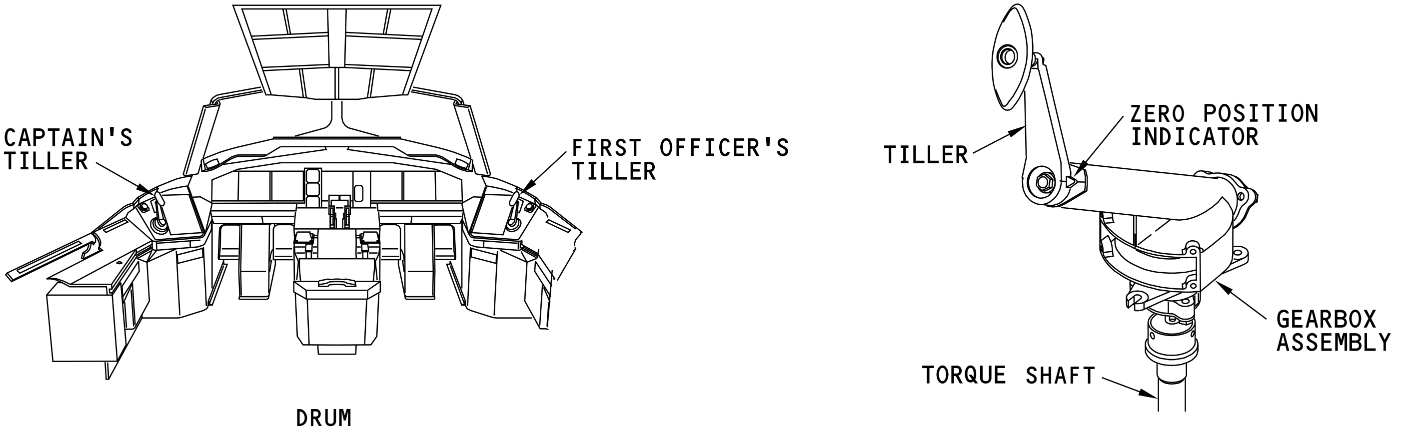
The captain's tiller is forward and to the left of the captain. The first officer's tiller is forward and to the right of the first officer.

The drum mechanisms are below the steering tillers. You get access to the drum mechanisms through the forward equipment center access door.

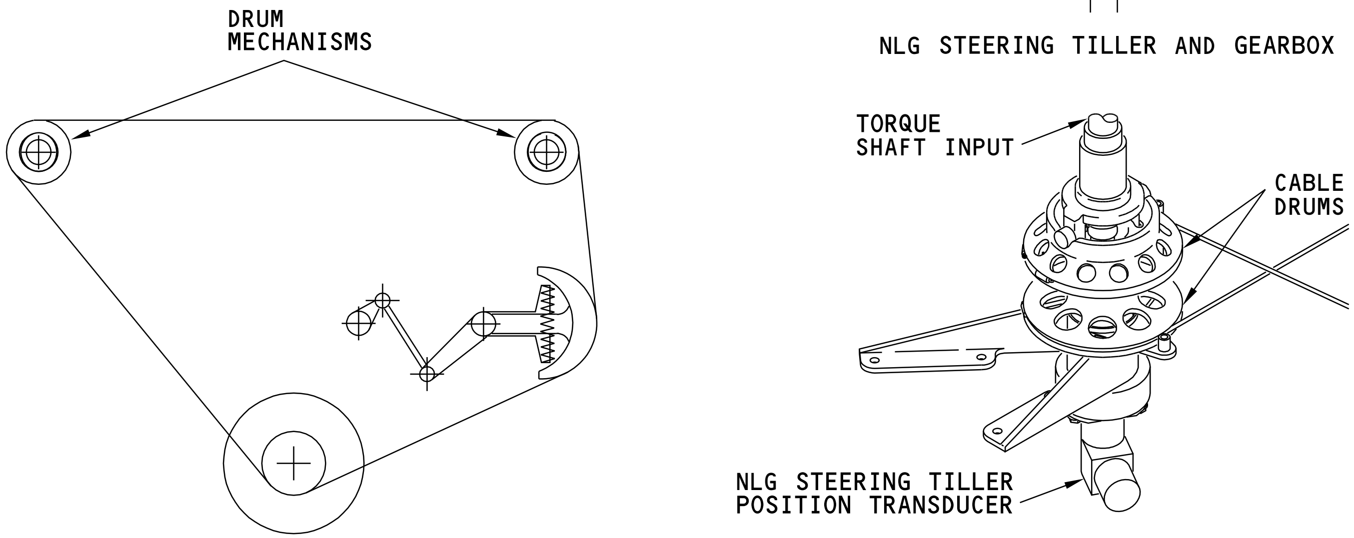
Training Information Point

Zero-position indicators are at the base of each tiller. These show when the steering tiller is in the neutral position.

NLG steering tiller position transducers are at the base of each drum mechanism. These transducers supply the input to operate the main gear steering system.



NLG STEERING TILLER AND GEARBOX (2)



UPPER CABLE LOOP (LOOKING DOWN)

DRUM MECHANISM (2)

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NOSE GEAR STEERING SYSTEM - NLG STEERING TILLER, GEARBOX, AND DRUM MECHANISM

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NOSE GEAR STEERING SYSTEM - NLG STEERING CENTERING AND RUDDER INTERCONNECT MECHANISM

Purpose

The NLG steering centering and rudder interconnect mechanism connects the rudder pedals to the upper cable loop. It also moves the steering system to the neutral position when there are no inputs.

The NLG steering centering and rudder interconnect mechanism permits the tillers to move the upper cable loop without moving the rudder pedals. It also permits the rudder pedals to move the upper cable loop.

Physical Description

The NLG steering centering and rudder interconnect mechanism has these components:

- Cable quadrant
- Cable quadrant arm
- Rudder pedal arm
- Free arm assembly (2)
- Roller (2)
- Centering spring (4).

The cable quadrant and cable quadrant arm are one assembly. The cable quadrant attaches directly to the upper cable loop.

The rudder pedal arm is directly below the cable quadrant arm and connects through a rod to rudder system forward control components.

A roller attaches to each of the free arm assemblies. The rollers can touch the cable quadrant arm and the rudder pedal arm.

Two centering springs are above and two centering springs are below (not shown) the cable quadrant arm. The springs are connected to the two free arm assemblies.

The cable quadrant and cable quadrant arm, the rudder pedal arm, and the free arm assemblies pivot about the same point.

Location

The NLG steering centering and rudder interconnect mechanism is below the flight deck floor. You get access to the mechanism through the forward equipment center access door.

Neutral Position

When the tillers and the rudder pedals are in the neutral position, the centering springs keep or return the cable quadrant and cable quadrant arm to the centered position. This keeps the upper cable loop and the nose gear steering system in the centered position.

Tiller Inputs

Tiller inputs move the upper cable loop. The upper cable loop directly moves the cable quadrant and cable quadrant arm. The cable quadrant arm pushes on one of the two rollers. This causes one of the free arm assemblies to move and pulls on the centering springs.

The centering springs pull the other free arm assembly and roller against the rudder pedal arm.

The rudder pedal arm does not move because the rudder pedal centering force (from springs in the rudder system forward control components) is greater than the force that pulls on the centering springs. This causes the centering springs to extend.

The result is that the tiller input moves the cable quadrant to make a steering input but the rudder system does not get an input.

Rudder Pedal Inputs

Rudder pedal inputs through the rudder system forward control components move the rudder pedal arm. This arm pushes against one of the two rollers and moves one of the free arm assemblies. The centering springs pull on the other free arm assembly and roller. If the nose landing gear is in the extended position, the roller pushes and moves the cable quadrant arm, the cable quadrant, and the upper cable loop. This results in a nose gear steering input.

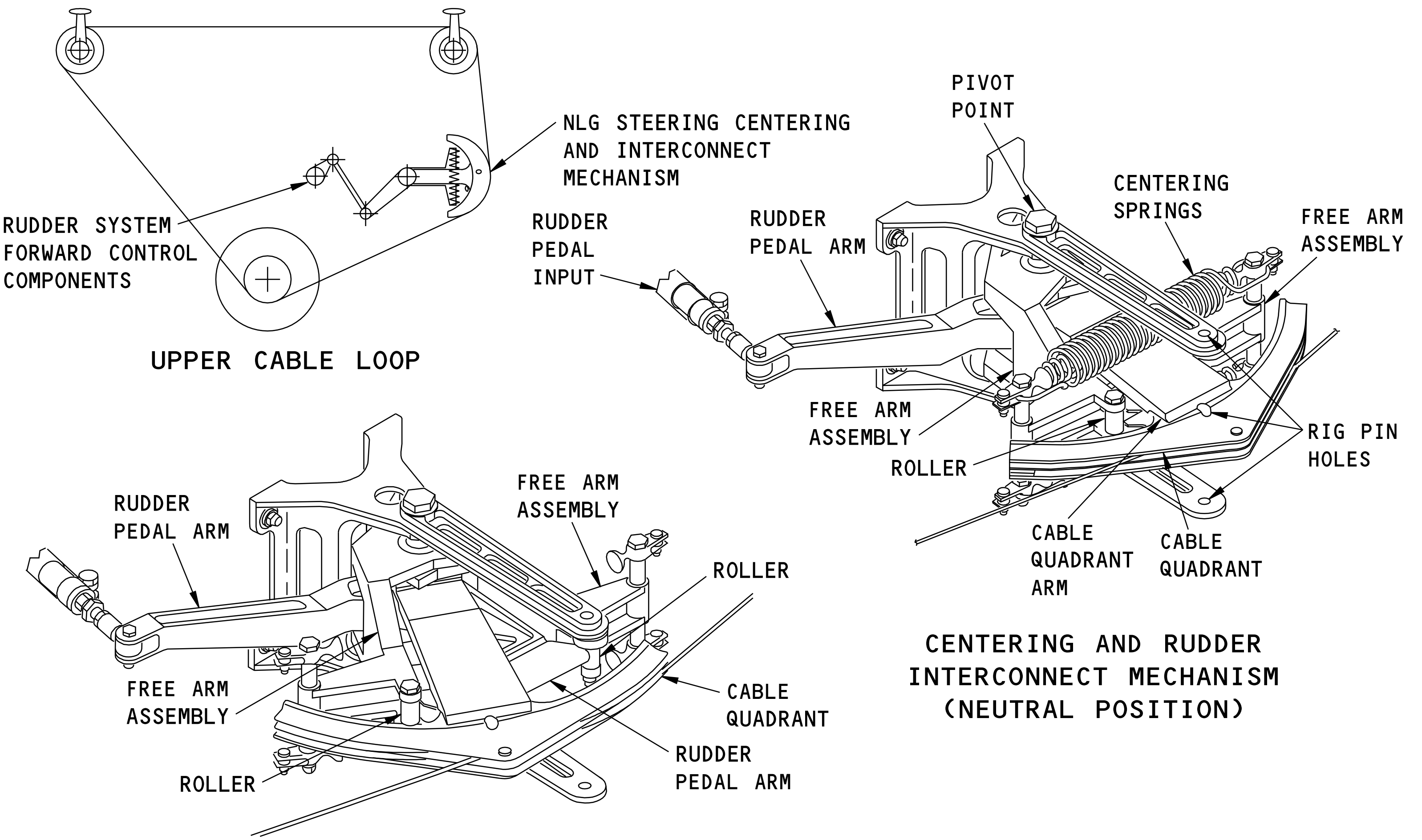
The upper cable loop motion moves the steering tillers.

NOSE GEAR STEERING SYSTEM - NLG STEERING CENTERING AND RUDDER INTERCONNECT MECHANISM

If the nose landing gear is in the retracted position, the upper cable loop is locked. This also locks the cable quadrant and quadrant arm. Rudder pedal inputs will then cause the centering springs to extend.

Training Information Point

Rig pin holes in the mechanism keep the system in the neutral position during cable rigging.



UPPER CABLE LOOP

CENTERING AND RUDDER INTERCONNECT MECHANISM (NEUTRAL POSITION)

CENTERING AND RUDDER INTERCONNECT MECHANISM (TILLER INPUT) (CENTERING SPRINGS REMOVED)

M42425 S000618780_V2

NOSE GEAR STEERING SYSTEM - NLG STEERING CENTERING AND RUDDER INTERCONNECT MECHANISM

NOSE GEAR STEERING SYSTEM - NLG STEERING BROKEN CABLE COMPENSATOR

Purpose

The NLG steering broken cable compensator protects the steering system from inputs caused by a break in the upper cable loop.

Physical Description

These are the NLG steering broken cable compensator components:

- Two pulleys
- Two force links
- A roller
- An output cam and shaft.

The pulleys are bearing-mounted on the output shaft. A roller connects to each of the pulleys by force links. The output cam attaches to the output shaft.

Location

The NLG steering broken cable compensator is on the aft side of the nose gear wheel well rear bulkhead in the main equipment center.

The output shaft of the broken cable compensator goes through the bulkhead into the wheel well.

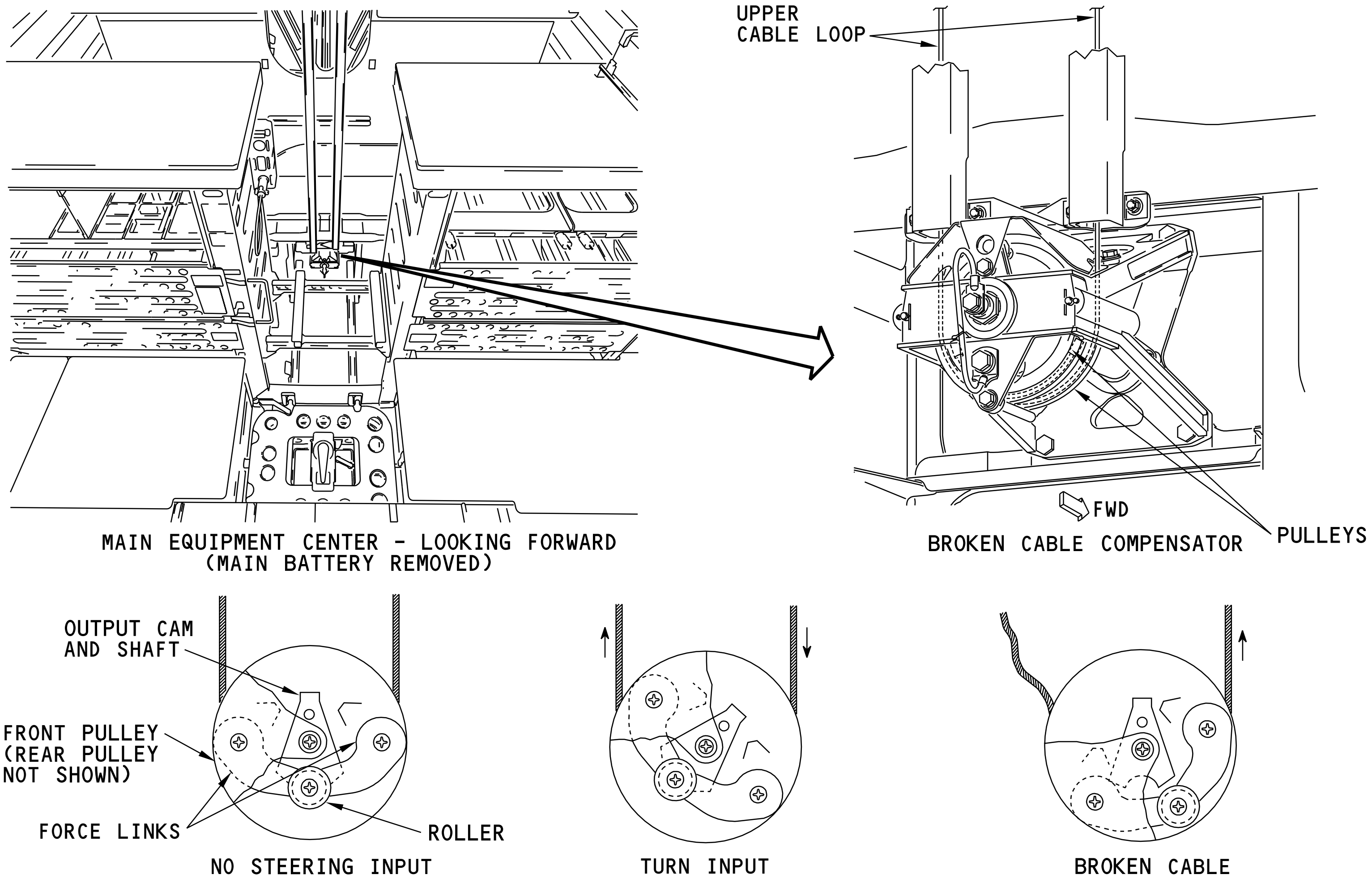
Functional Description

Tension in the upper cable loop pulls on the force links. This keeps the roller in the output cam and permits cable motion to move the output cam.

A break in the upper cable loop causes tension to be lost in one cable. Asymmetric tension moves the roller out of the cam detent. This stops all steering inputs.

Training Information Point

You must remove the main battery to get access to the NLG steering broken cable compensator.



MAIN EQUIPMENT CENTER - LOOKING FORWARD (MAIN BATTERY REMOVED)

BROKEN CABLE COMPENSATOR

NO STEERING INPUT

TURN INPUT

BROKEN CABLE

M42426 S000618781_V1

NOSE GEAR STEERING SYSTEM - NLG STEERING BROKEN CABLE COMPENSATOR

NOSE GEAR STEERING SYSTEM - NLG STEERING PIVOT LINK AND NLG STEERING CENTERING MECHANISM

Purpose

The NLG steering pivot link connects the upper cable loop to the lower cable loop.

The NLG steering centering mechanism locks the NGS system in the centered position during gear retraction.

Physical Description

The hinged pivot links connect the output shaft of the NLG steering broken cable compensator to the NLG steering centering mechanism.

The NLG steering centering mechanism has these components:

- Spring cartridge
- Crank and shaft
- Driver
- Guide link
- Cam assembly
- Cam follower
- Drum.

Location

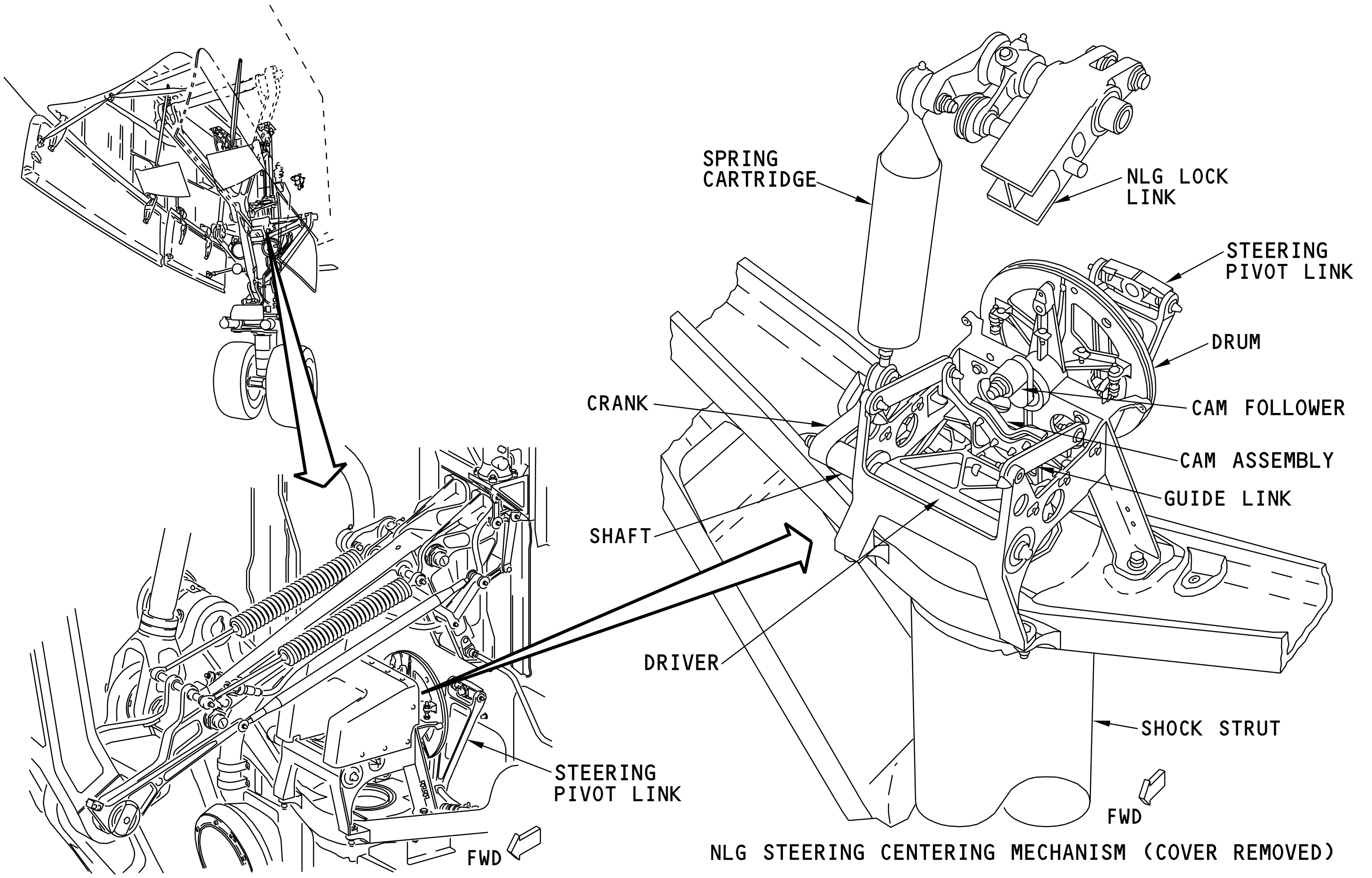
The NLG steering centering mechanism is on top of the nose landing gear.

Functional Description

When the nose gear starts to retract, the movement of the nose gear lock link moves the spring cartridge.

The spring cartridge turns the shaft through the crank. This lifts the driver and cam assembly.

The driver and cam assembly moves the cam follower to the centered position. This moves the upper and lower cable loops to the neutral position.



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NOSE GEAR STEERING SYSTEM - NLG STEERING PIVOT LINK AND NLG STEERING CENTERING MECHANISM

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NOSE GEAR STEERING SYSTEM - NLG STEERING SUMMING MECHANISM AND METERING VALVE MODULE

General

The NLG steering summing mechanism adds steering tiller input and nose gear position feedback to control the NLG steering metering valve module.

The NLG steering metering valve module controls the flow of hydraulic fluid to the NLG steering actuators.

The summing mechanism is on top of the upper steering plate on the front of the nose gear. A protective cover is on the summing mechanism.

The NLG steering metering valve module is on the upper steering plate on the front of the nose gear shock strut.

NLG Steering Summing Mechanism

The NLG steering summing mechanism contains these components:

- Summing lever
- Pulley (2)
- Input rod.

The pulleys connect to each side of the summing lever. The lower cable loop winds around each pulley.

The summing mechanism pivots about its center. The input rod connects the summing mechanism to the metering valve module.

NLG Steering Metering Valve Module

The NLG steering metering valve module contains these components:

- Metering valve
- Dynamic load damper
- Bypass/relief valve (not shown)
- Compensator
- Towing shutoff valve and lever
- Swivel valve (2).

The metering valve controls hydraulic flow to the steering actuators. The valve is spring-loaded to the centered position.

The dynamic load damper supplies shimmy damping to the nose gear.

The bypass/relief valve protects the steering actuators against high hydraulic pressures. When pressure in an actuator goes above 4000 psi, the bypass/relief valve opens and permits hydraulic fluid to move between the actuators.

The compensator keeps a 250 psi backpressure in the steering metering valve module. This prevents steering actuator cavitation during shimmy damping.

A towing lever on the metering valve module controls a towing shutoff valve. In the tow position, the towing valve shuts off pressure to the nose gear steering system. This permits the nose gear to turn during towing. A towing lever pin holds the towing lever in the TOW position.

The swivel valves control hydraulic flow to the two sides of the steering actuators.

Functional Description

Tiller operation moves the summing mechanism from the neutral position. This makes an input to the metering valve module which sends pressure to the NLG steering actuators. The NLG steering actuators turn the nose gear.

The rotation of the nose gear moves the summing mechanism back towards the neutral position. When the nose gear position agrees with the tiller position, the summing mechanism moves the metering valve to the neutral position. This shuts off the flow to the NLG steering actuators.

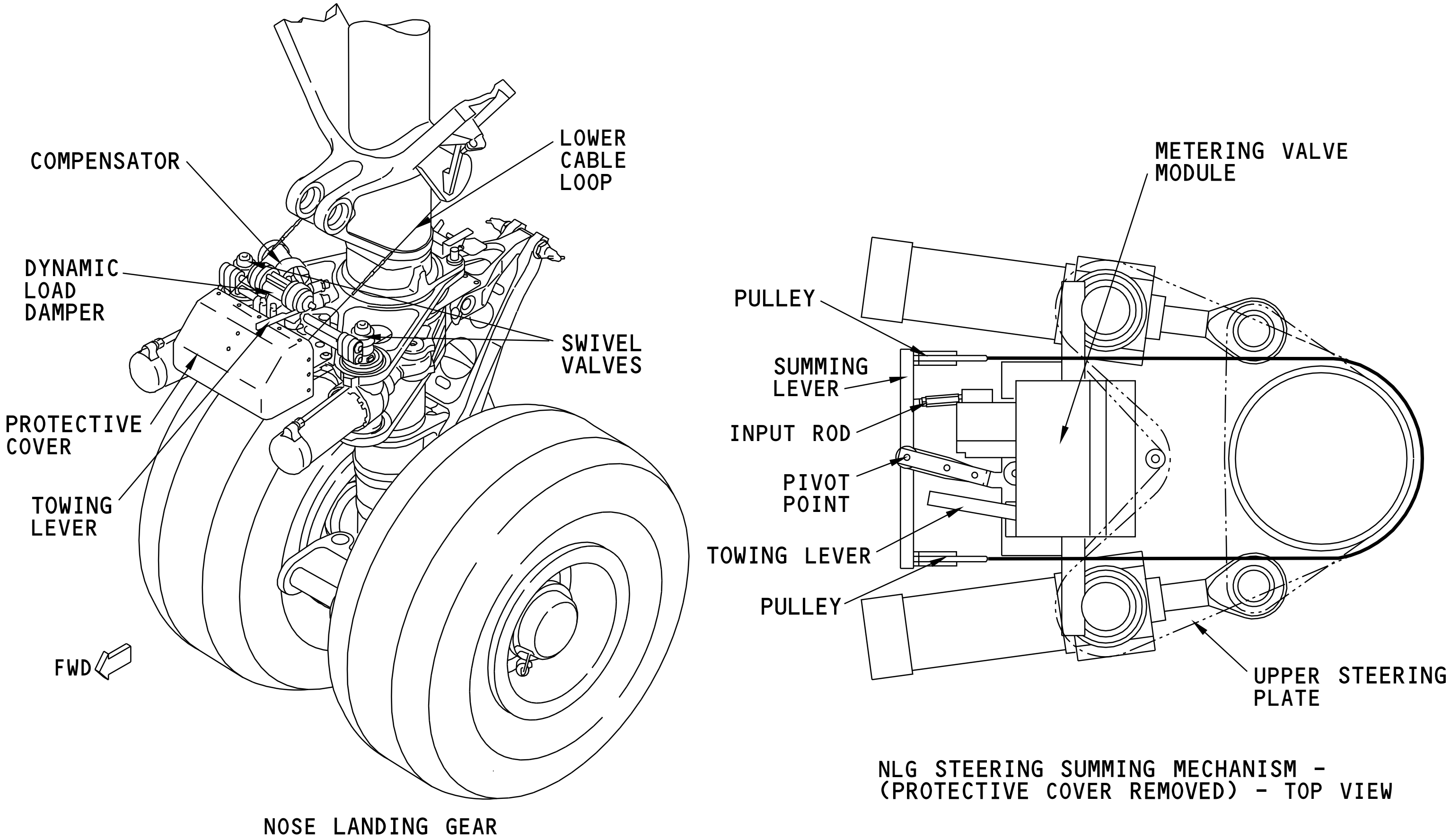
Training Information Point

A towing lever permits you to depressurize the nose gear steering system. This permits towing without depressurizing the center hydraulic system.

Obey this warning when you tow the airplane:

NOSE GEAR STEERING SYSTEM - NLG STEERING SUMMING MECHANISM AND METERING VALVE MODULE

WARNING ONLY USE THE CORRECT PIN FOR THE AIRPLANE MODEL. IF YOU USE AN INCORRECT PIN, THE HYDRAULIC STEERING CAN OPERATE. THIS CAN CAUSE INJURIES TO PERSONNEL AND DAMAGE TO EQUIPMENT.



NOSE LANDING GEAR

NLG STEERING SUMMING MECHANISM -
(PROTECTIVE COVER REMOVED) - TOP VIEW

M42428 S000618783_V1

NOSE GEAR STEERING SYSTEM - NLG STEERING SUMMING MECHANISM AND METERING VALVE MODULE

NOSE GEAR STEERING SYSTEM - NLG STEERING ACTUATORS AND NOSEWHEEL STEERING COLLAR

Purpose

The NLG steering actuators supply the force to turn the nose gear.

The nosewheel steering collar transmits the actuator steering forces to the nose gear.

Steering Actuators

The NLG steering actuators are trunnion-mounted between the upper and lower steering plates.

The rod ends of the actuators attach to the steering collar.

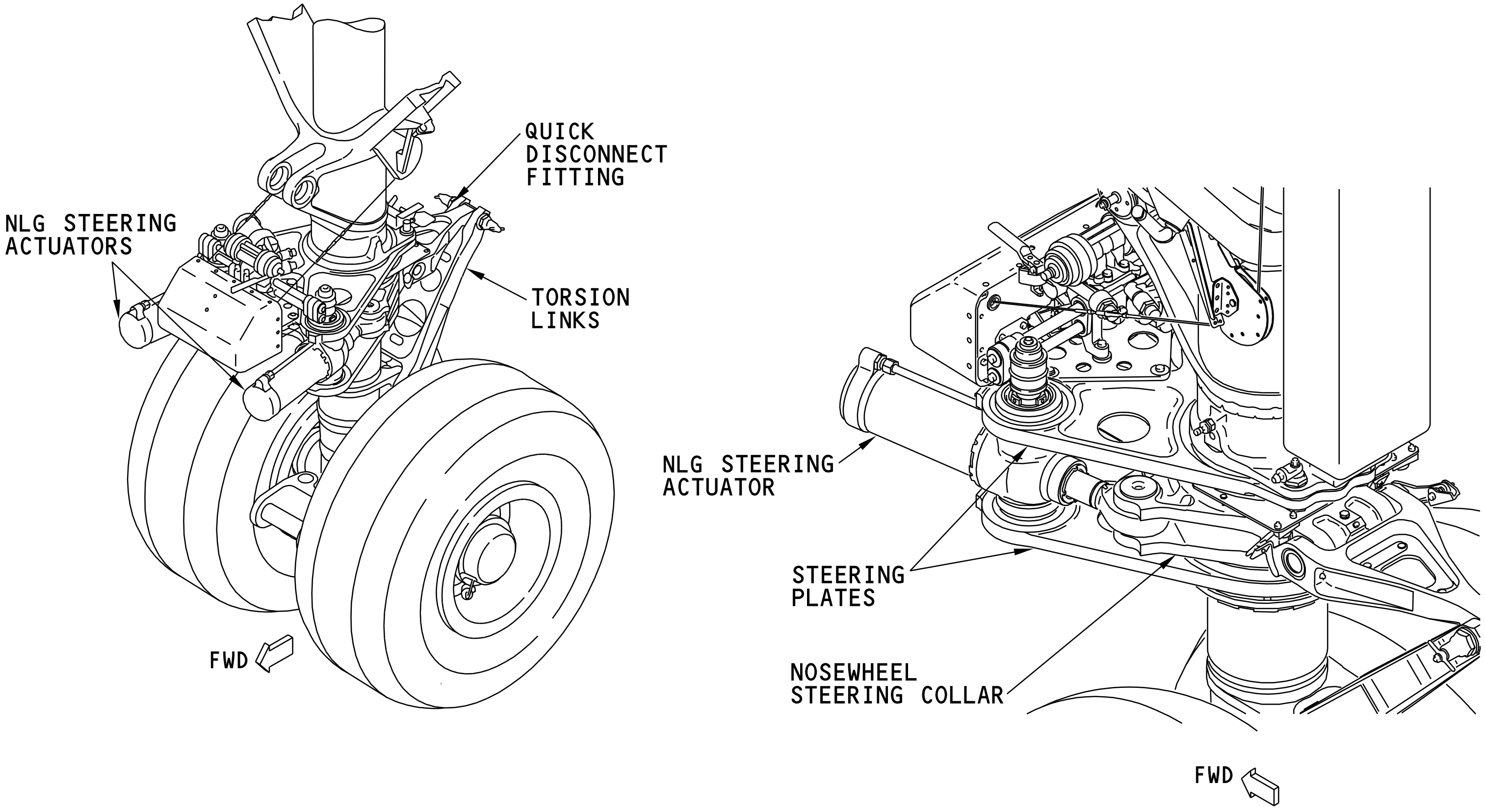
Steering Collar

The nosewheel steering collar is trunnion-mounted on the nose gear shock strut. Torsion links connect the steering collar to the inner shock strut cylinder.

Training Information Point

A protractor scale is on the aft side of the steering collar.

Quick disconnect fittings permit easy torsion link disconnection.



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NOSE GEAR STEERING SYSTEM - NLG STEERING ACTUATORS AND NOSEWHEEL STEERING COLLAR

NOSE GEAR STEERING SYSTEM - FUNCTIONAL DESCRIPTION

General

The NGS system uses center hydraulic system pressure to turn the nose gear.

Steering inputs move the upper and lower cable loops. This makes an input through the summing mechanism to move the NLG steering metering valve. This permits hydraulic pressure to go through the swivel valves to the steering actuators.

The actuators get pressure on the extend side, the retract side, or both sides to move the nose gear from 0 - 70 degrees.

Rotation: 0 - 27 Degrees

One actuator gets pressure to its head end and the other actuator gets pressure to its rod end. This causes one actuator to extend and the other to retract.

This rotates the nose gear through the torsion links.

Rotation: 27 - 70 Degrees

When the nose gear turns to approximately 27 degrees, the swivel valve for the retracting actuator sends pressure to both sides of that actuator.

Both actuators now extend and permit nose gear rotation to the 70 degree limit.

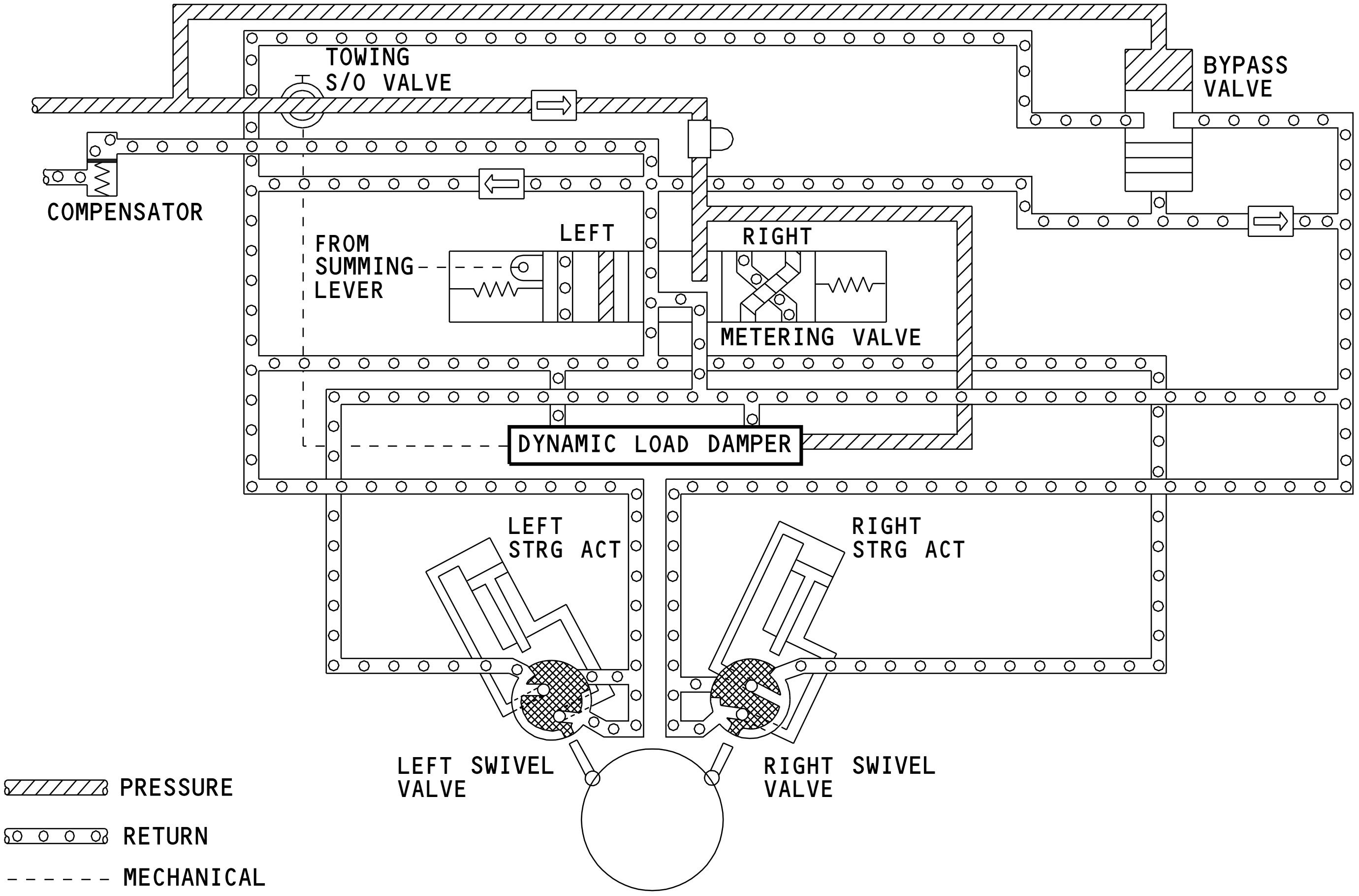
Feedback

When the nose gear gets to the commanded position, the summing mechanism moves the metering valve back to neutral. This stops hydraulic pressure to the actuators and stops nose gear movement.

Training Information Point

To tow the airplane, you move the towing lever on the metering valve module to the tow position. This closes the towing shutoff valve to stop hydraulic pressure to the metering valve module. The towing lever also moves the dynamic load damper to let fluid flow between the steering actuators. This lets an external force move the nose gear wheels.

The bypass/relief valve lets fluid flow between the steering actuators when the pressure in either actuator is approximately 4000 psi. This lets an external force move the nose gear wheels if the tow lever is not in the tow position.



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NOSE GEAR STEERING SYSTEM - FUNCTIONAL DESCRIPTION

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MAIN GEAR STEERING SYSTEM - INTRODUCTION

Purpose

The main gear steering system reduces tire scrub and airplane turn radius.

Main gear steering also decreases the force necessary to turn the airplane.

Components

The main gear steering system components include:

- NLG steering tiller position transducer (2)
- Main gear steering control unit (MGSCU)
- Main gear steering/locking power control actuator (2)
- Main gear steering crank (2)
- Main gear steering reaction link (2).

General Description

The NLG steering tiller position transducers supply steering tiller position data to the MGSCU.

The center hydraulic system supplies the hydraulic power for main gear steering operation.

The MGSCU supplies main gear steering position and fault data to the AIMS for flight deck indications.

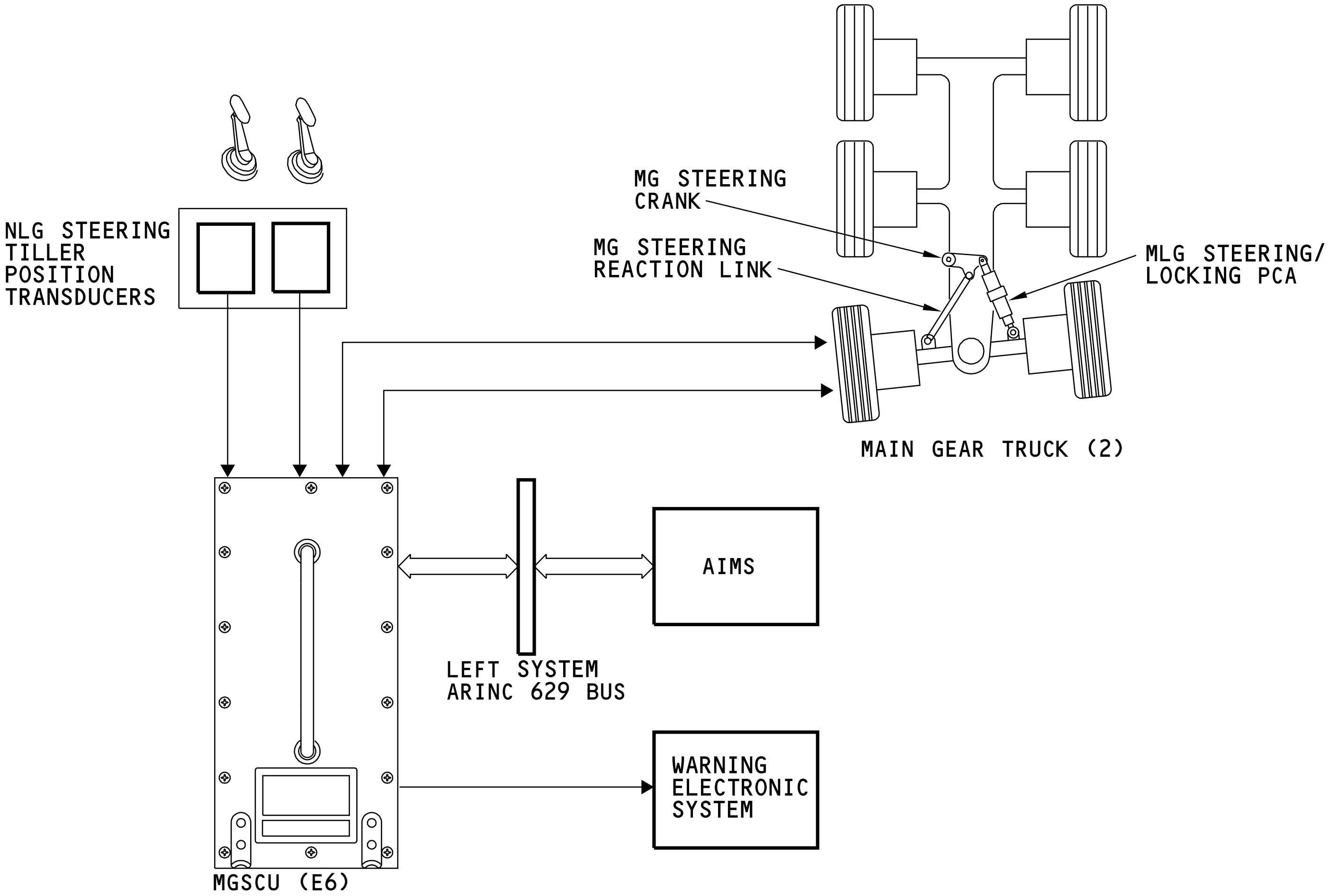
ARO 001-004

The MGSCU also supplies aft axle lock status to the warning electronic system (WES). The WES uses this data to calculate the CONFIG GEAR STEERING takeoff configuration warning.

ARO 005-999

The MGSCU also supplies aft axle lock status and aft axle steered position to the warning electronic system (WES). The WES uses this data to calculate the CONFIG GEAR STEERING takeoff configuration warning.

ARO ALL



M42430 S000618786_V1

MAIN GEAR STEERING SYSTEM - INTRODUCTION

MAIN GEAR STEERING SYSTEM - NLG STEERING TILLER POSITION TRANSDUCERS

Purpose

Two NLG steering tiller position transducers supply steering tiller data to the MGSCU. The MGSCU uses this data to control the main gear steering.

Physical Description

The two NLG steering tiller position transducers are the same. The transducers are rotary variable differential transformers (RVDTs).

The input shafts of the position transducer turn through a 90 degree arc with the torque shaft from the steering tiller and gearbox.

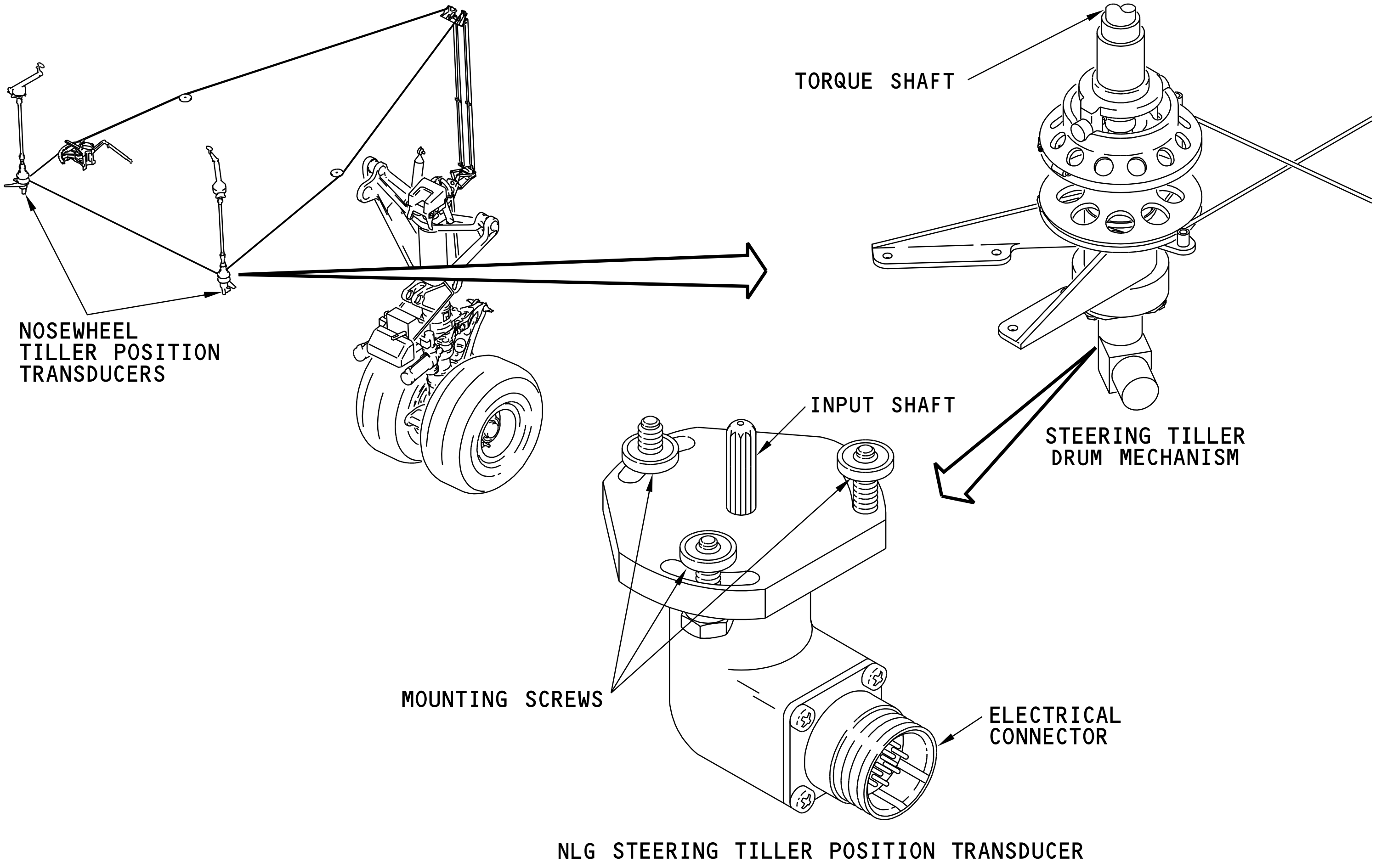
Location

A transducer is on the bottom of each steering tiller drum mechanism in the forward equipment center.

Training Information Point

Before installation, the transducer input shaft is locked in the zero (neutral) position.

The transducer input shaft is unlocked when you install the three captive mounting screws.



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MAIN GEAR STEERING SYSTEM - NLG STEERING TILLER POSITION TRANSDUCERS

MAIN GEAR STEERING SYSTEM - MAIN GEAR STEERING CONTROL UNIT

Purpose

The MGSCU gets the steering inputs from the nosegear steering tiller position transducers and controls the main gear steering/locking power control actuators.

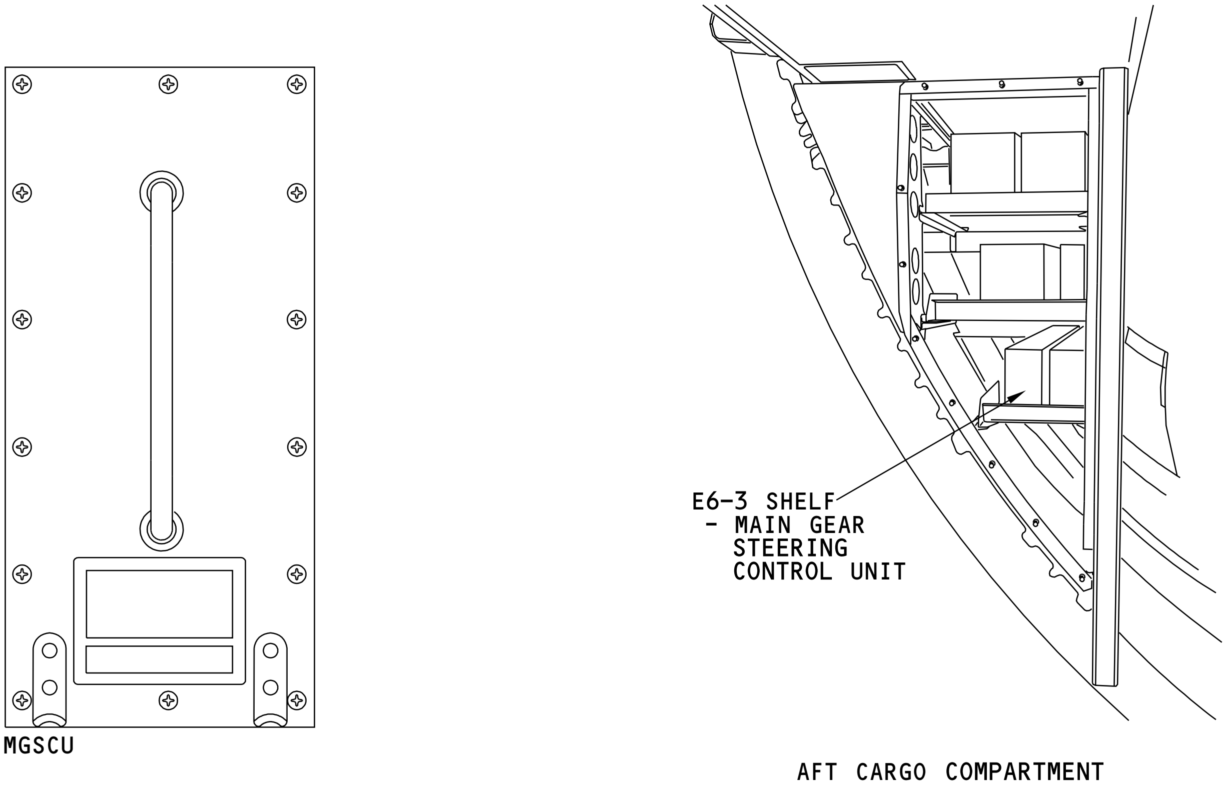
The MGSCU also monitors the main gear steering system for faults.

Location

The MGSCU is on the E6-3 shelf in the aft cargo compartment.

Training Information Point

The MGSCU is electrostatic discharge sensitive.



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MAIN GEAR STEERING SYSTEM - MAIN GEAR STEERING CONTROL UNIT

MAIN GEAR STEERING SYSTEM - MAIN GEAR TRUCK COMPONENTS

General

These components are on the aft part of each main gear truck assembly:

- MLG steering/locking power control actuator (PCA)
- Reaction link
- Steering crank.

Steering/Locking Power Control Actuator

The MLG steering/locking PCA unlocks and turns the aft main gear axle. The PCA locks the aft axle when main gear steering is not used.

The MLG steering/locking PCAs are two-way actuators and have internal locks to keep them in the centered position. An LVDT in the actuator rod supplies position feedback to the MGSCU.

These are the other components in each MLG steering/locking PCA:

- Arming solenoid
- Unlock solenoid
- Electrohydraulic servo valve
- Isolation/power centering valve
- Anti-cavitation check valves
- Compensator
- Manual shutoff valve
- Lock position linear variable differential transformer (LVDT).

Reaction Link

A reaction link transmits steering forces back to the steering crank. This link connects the left side of the aft axle to the steering crank.

Steering Crank

The steering crank transmits actuator and the reaction link loads to the truck beam.

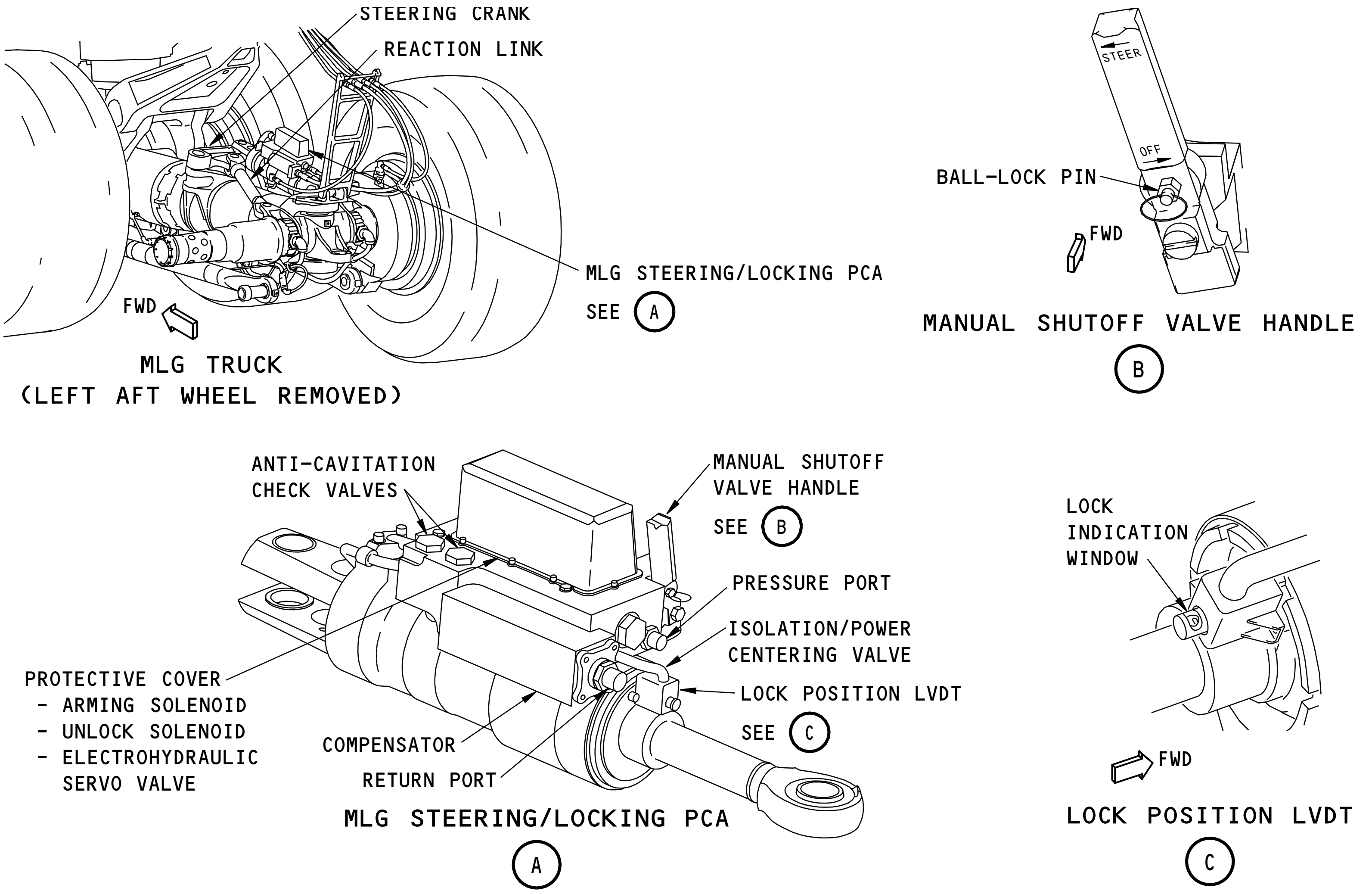
Training Information Point

A manual shutoff valve permits you to stop the hydraulic flow to the steering locking PCA to disable the main gear steering. You operate the valve with the manual shutoff valve handle. A ball-lock pin keeps the shutoff valve in the selected position.

A valve position sensor sends shutoff valve position data to the MGSCU. The MAIN GEAR STEERING status message show when the handle is in the OFF position.

A silver indicator in the lock indication window on the unlock LVDT shows the lock/unlock condition of the PCA. If you can see the indicator, the PCA is unlocked. If you can not see the indicator, the PCA is locked.

⚠ **WARNING** MAKE SURE THE MAIN LANDING GEAR STEERING SYSTEM IS ISOLATED FROM HYDRAULIC POWER BEFORE YOU DO WORK NEAR THE TIRES, WHEELS, OR BRAKES. IF YOU DO NOT DO THIS, THE AFT AXLES CAN AUTOMATICALLY TURN. THIS CAN CAUSE INJURIES TO PERSONS AND DAMAGE TO EQUIPMENT.



M42433 S000618789_V2

MAIN GEAR STEERING SYSTEM - MAIN GEAR TRUCK COMPONENTS

MAIN GEAR STEERING SYSTEM - ELECTRIC FUNCTIONAL DESCRIPTION

General

The MGSCU gets the inputs from the NLG steering tiller position transducers and sends signals to operate the left and right steering/locking PCAs. Both PCAs move the same amount in the same direction.

The MGSCU has these functions:

- Arm/unlock logic
- Steering control law
- Left and right PCA control
- BITE/Monitor.

The left 28v dc main bus supplies the electrical power to operate the main gear steering system.

Control Inputs

The captain's and first officer's NLG steering tiller position transducers supply tiller position data to the MGSCU. The MGSCU uses the captain's position transducer to control the steering/locking PCAs. The BITE/Monitor in the MGSCU compares the first officer's position transducer to the captain's position transducer to find failures.

Arm/Unlock Logic and Steering Control Law

The arm/unlock logic energizes the arm solenoid and the unlock solenoid for both PCAs when the NLG steering input is more than 13 degrees. This unlocks the PCAs.

The steering control law sends signals to the EHSVs for both PCAs to turn the main gear in proportion to the nose gear position. These signals start when the nose gear position is more than 10 degrees. A maximum of 6.5 degrees of aft axle command occurs when the nose gear command angle is at 70 degrees.

The steering position LVDTs in the PCAs supply feedback signals to the MGSCU to null out the command when the PCAs are at the commanded position.

The arm/unlock logic removes the arm signal when the NLG steering input is less than 9 degrees.

BITE/Monitor

The BITE/Monitor function gets inputs from:

- The steering position LVDT
- The lock/unlock position LVDT
- The shutoff valve position switch
- The NLG steering tiller position transducers.

The BITE/Monitor function uses these inputs to find failure conditions and to monitor the shutoff valve position. The MGSCU sends fault and position data to the AIMS for flight deck indication.

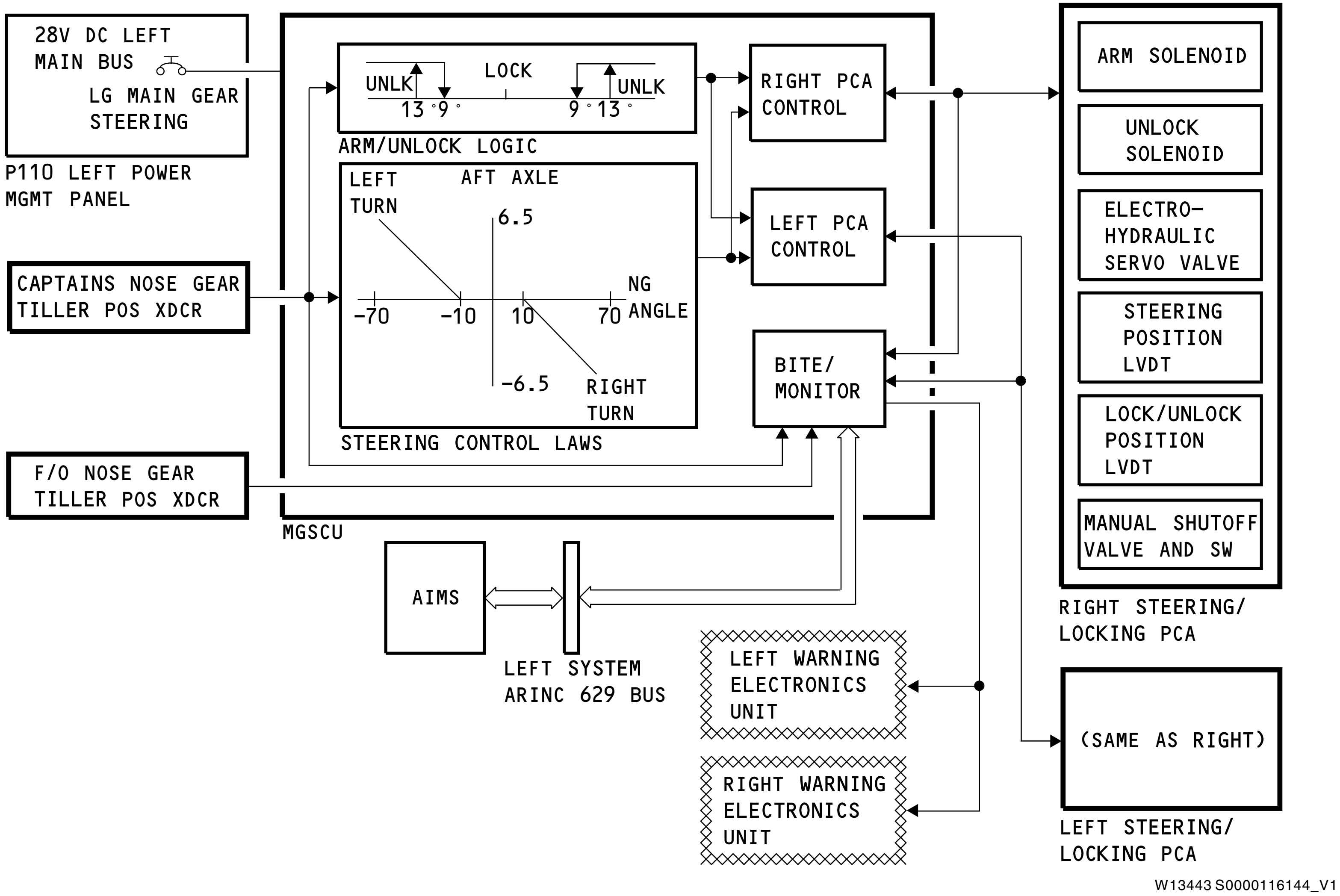
ARO 001-004

The MGSCU also sends main gear steering lock status to the left and right warning electronics units. A CONFIG GEAR STEERING warning message shows if a steering/locking PCA is not locked during takeoff.

ARO 005-999

The MGSCU also sends main gear steering lock status and axle steered position to the left and right warning electronics units. A CONFIG GEAR STEERING warning message shows if a steering/locking PCA is steered and not locked during takeoff.

ARO ALL



MAIN GEAR STEERING SYSTEM - ELECTRIC FUNCTIONAL DESCRIPTION

MAIN GEAR STEERING SYSTEM - HYDRAULIC FUNCTIONAL DESCRIPTION

General

The MGSCU gets input from the two NLG steering tiller position transducers and sends signals to the steering/locking PCAs. LVDTs on the PCAs send signals back to the MGSCU.

PCA Initial Condition

Each steering/locking PCA is centered and locked. Center system hydraulic pressure is on both sides of the PCA piston. The lock collar is in the locked position.

Arm - Unlock

When steering tiller input is more than 13 degrees of NLG steering angle, the MGSCU sends a signal to energize the unlock solenoid. This moves the unlock solenoid valve to the unlock position.

The MGSCU then sends a signal to energize the arm solenoid. Hydraulic pressure now goes through the unlock solenoid valve to unlock the lock collar on the actuator. The unlock LVDT sends an actuator unlock feedback signal to the MGSCU.

Pressure through the arm solenoid also moves the isolation/power centering valve to the ON position. This permits pressure to go to the electrohydraulic servo valve (EHSV).

Main gear steering is now armed and unlocked.

Control

The MGSCU sends signals to the EHSV to extend or retract the actuator. The aft axles turn in proportion to tiller position.

Maximum aft angle of 6.5 degrees occurs at a nose gear angle of 70 degrees.

The actuator position LVDT sends actuator position data to the MGSCU.

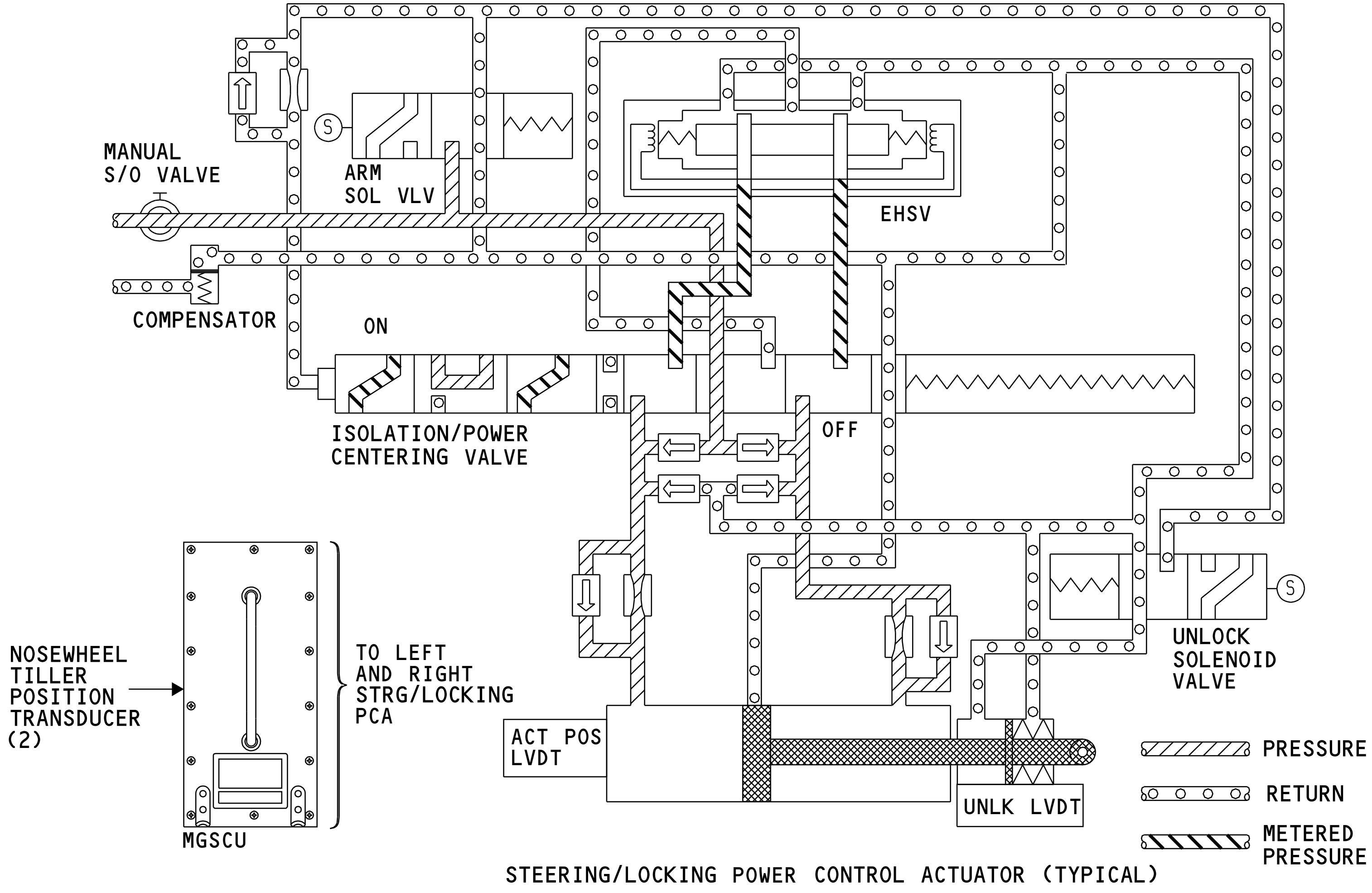
Disarm

When tiller angle is less than 9 degrees, the MGSCU removes power from the arm solenoid and the unlock solenoid. This stops hydraulic pressure to the lock collar and to the isolation/power centering valve.

A spring moves the isolation/power centering valve to the OFF position. This removes power from the EHSV and supplies pressure to both sides of the actuator. A return port in the center of the actuator (hole-in-the-wall) reduces pressure in the side of the actuator that is opposite to the actuator position. This moves and keeps the actuator in the centered position.

The spring-loaded lock collar locks the actuator after the pressure unlock solenoid removes the hydraulic pressure.

System faults will also disarm the main gear steering system.



M42476 S000618791_V1

MAIN GEAR STEERING SYSTEM - HYDRAULIC FUNCTIONAL DESCRIPTION

MAIN GEAR STEERING SYSTEM - INDICATIONS

ARO 001-004

Alert and Status Messages

NOTE: This message is generated by the WES based on the three discrete outputs from the MGSCU. The following information is reference only.

The CONFIG GEAR STEERING warning message shows when a steering/locking PCA is not locked during takeoff.

The MAIN GEAR STEERING advisory message shows if a main gear steering/locking PCA is commanded locked and is not locked.

The MAIN GEAR STEERING status message shows if there is a failure in a component in the main gear steering system or if a steering/locking PCA is disabled.

ARO 005-999

Alert and Status Messages

The CONFIG GEAR STEERING warning message shows when the main gear aft axles are not locked and not centered with takeoff thrust applied.

The MAIN GEAR STEERING advisory message shows if there is a fault in the main gear steering system such that an aft axle is indicating not locked and not centered when it should be locked and centered.

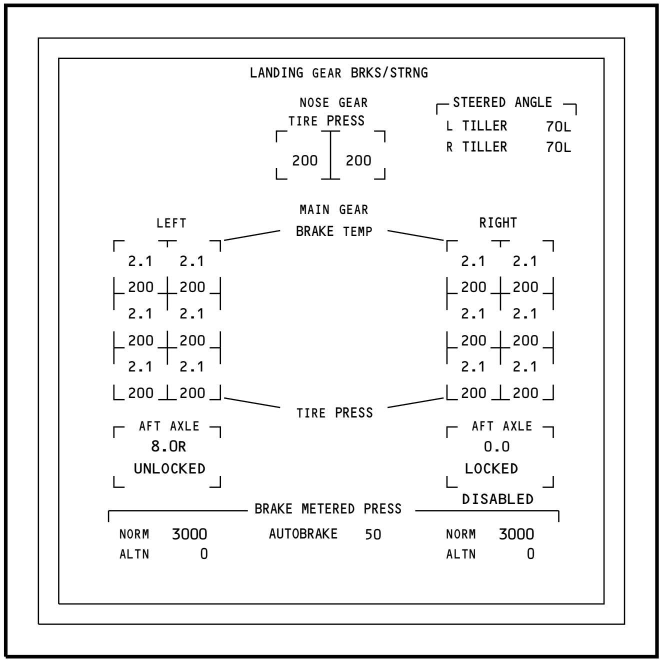
The MAIN GEAR STEERING status message shows if there is a fault in the main gear steering system such that an aft axle is not responsive to commands, an aft axle is indicating not locked when it should be locked, or there is a loss of ARINC 629 output communication. One or both PCAs have been manually disabled.

ARO ALL

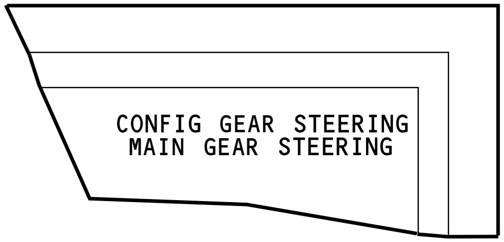
Maintenance Page Indications

The multi-function display (MFD) shows steering tiller position on the landing gear brake and steering maintenance page. The angle of the main gear aft axles and locked/unlocked status also show on this display.

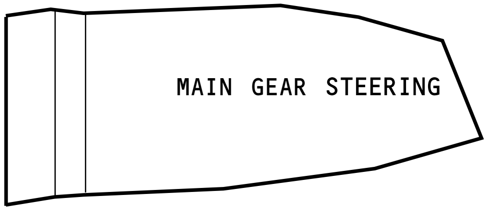
The page also shows failure or disable (manual shutoff valve closed) conditions below the aft axle angle display.



BRAKE AND STEERING MAINTENANCE PAGE



EICAS DISPLAY



STATUS DISPLAY

M42435 S000618792_V1

MAIN GEAR STEERING SYSTEM - INDICATIONS

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LG POSITION INDICATING AND WARNING SYSTEM - INTRODUCTION

Purpose

The landing gear position indicating and warning system shows landing gear position on the flight deck displays.

Inputs

The landing gear position indicating and warning system uses these proximity sensors to supply landing gear position data to the PSEUs:

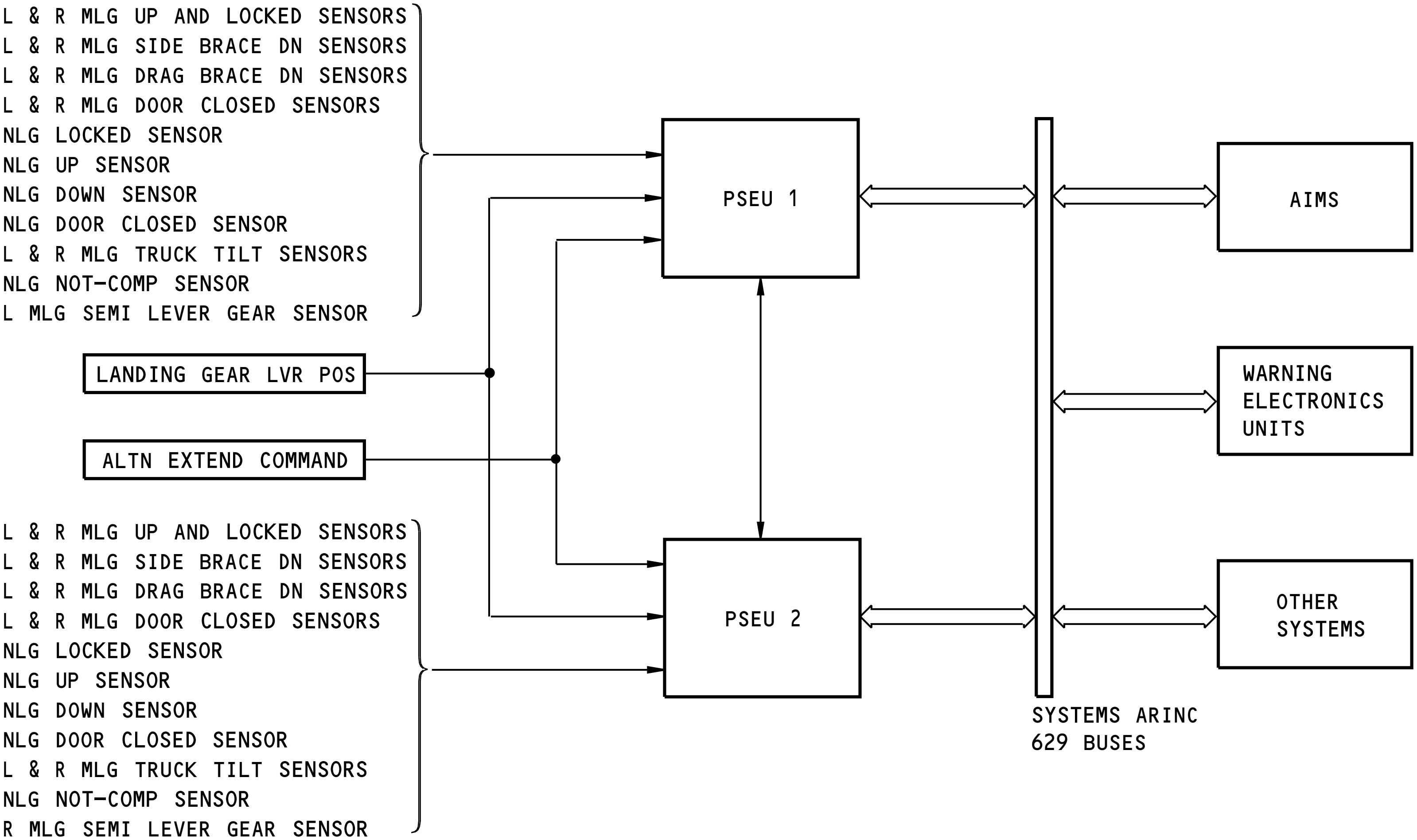
- Left and right MLG up and locked proximity sensors (4)
- Left and right MLG side brace down proximity sensors (4)
- left and right MLG drag brace down proximity sensors (4)
- Left and right MLG door closed proximity sensors (4)
- Left and right MLG truck tilt proximity sensors (4)
- Left and right MLG semi lever gear proximity sensors (2)
- NLG locked proximity sensors (2)
- NLG up proximity sensors (2)
- NLG down proximity sensors (2)
- NLG not compressed proximity sensors (2)
- NLG door closed proximity sensors (2).

The PSEUs also use input from the landing gear control lever and the alternate gear extend switch to.

General Description

The landing gear position indicating and warning system is a dual redundant system. Each PSEU gets position input from a different proximity sensor in each location.

The PSEUs supply the position data through the left and right ARINC 629 buses to AIMS, the Warning Electronics Units and to other systems.



M97531 S0000103031_V1

LG POSITION INDICATING AND WARNING SYSTEM - INTRODUCTION

LG POSITION INDICATING AND WARNING SYSTEM - MLG UP AND LOCKED PROXIMITY SENSORS

Purpose

Two MLG up and locked sensors on each of the MLG supply uplock input to the PSEUs.

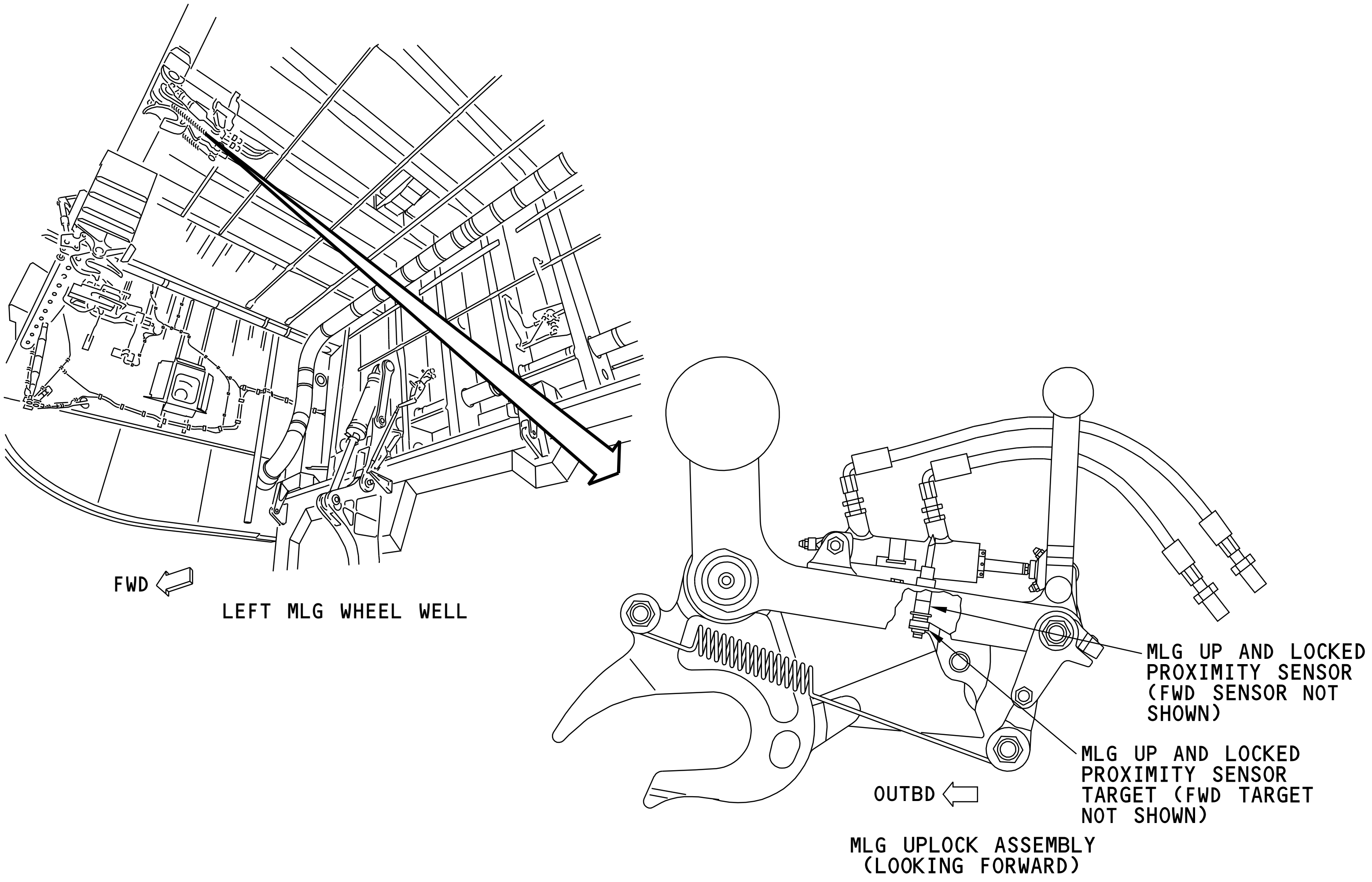
Location

The sensors are on the forward and aft sides of the MLG uplock assembly.

The proximity sensor targets are also on the uplock assembly and move with the uplock hook.

Functional Description

The targets are near the proximity sensors when the uplock assembly is in the uplocked position.



M42438 S000618795_V1

LG POSITION INDICATING AND WARNING SYSTEM - MLG UP AND LOCKED PROXIMITY SENSORS

LG POSITION INDICATING AND WARNING SYSTEM - MLG DOWN PROXIMITY SENSORS

Purpose

Main landing gear down proximity sensors supply downlock data to the PSEUs. There are four MLG down proximity sensors for each MLG.

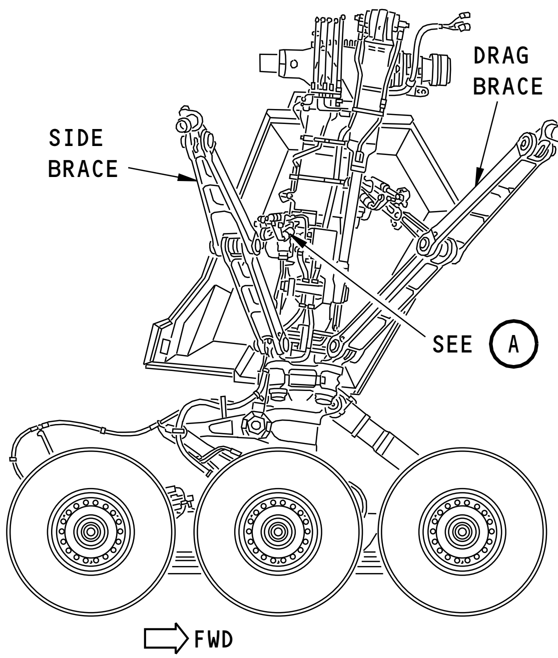
Location

The two MLG drag brace down sensors are on the upper drag brace lock link. The targets (not shown) are on the upper toggle.

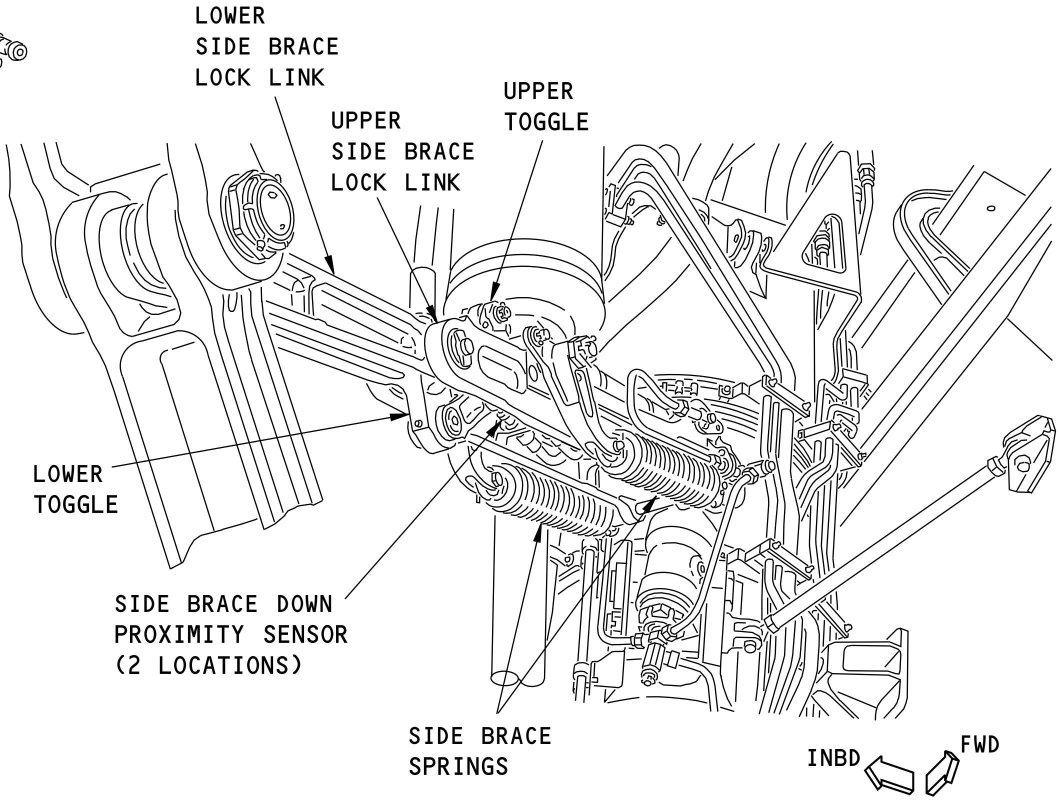
The two MLG side brace down sensors are on the upper side brace lock link. The targets (not shown) are on the upper toggle.

Functional Description

For both the drag and the side braces, the targets are near the sensors when the gear is down and the toggles are in the over-center locked position.



LEFT MAIN LANDING GEAR



MLG SIDE BRACE PROXIMITY SENSOR
(MLG DRAG BRACE PROXIMITY SENSOR IS EQUIVALENT)

A

M97684 S0000103052_V1

LG POSITION INDICATION AND WARNING SYSTEM - MLG DOWN PROXIMITY SENSORS

LG POSITION INDICATING AND WARNING SYSTEM - MLG DOOR CLOSED PROXIMITY SENSORS

Purpose

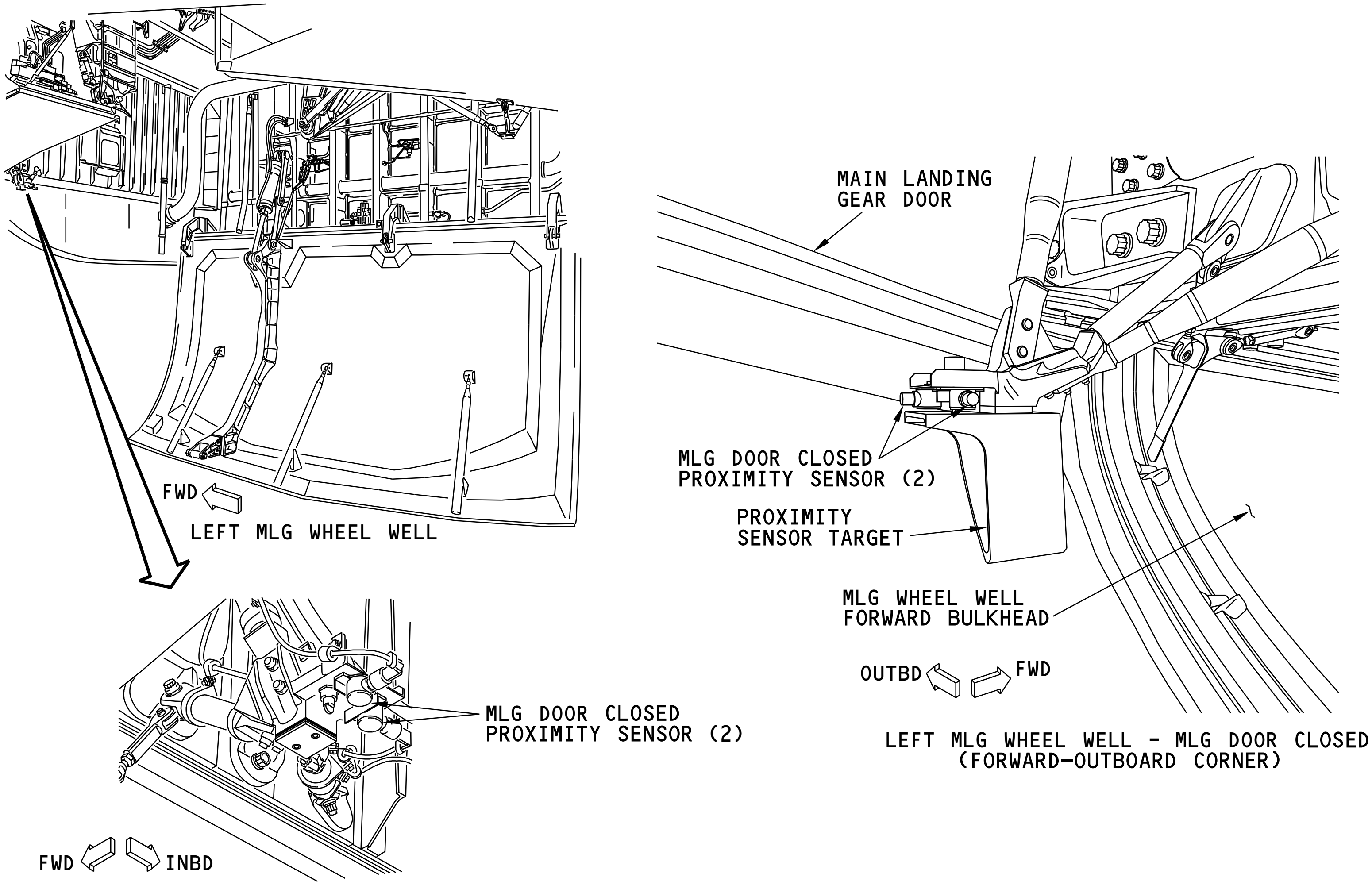
Two MLG door closed sensors for each main landing gear door supply door position data to the PSEUs.

Location

The sensors are on the outboard forward corner of the wheel wells. The targets are on the main landing gear doors.

Functional Description

The targets are near the sensors when the main landing gear doors are in the closed position.



M42441 S000618798_V1

LG POSITION INDICATING AND WARNING SYSTEM - MLG DOOR CLOSED PROXIMITY SENSORS

LG POSITION INDICATING AND WARNING SYSTEM - NLG LOCKED PROXIMITY SENSORS

Purpose

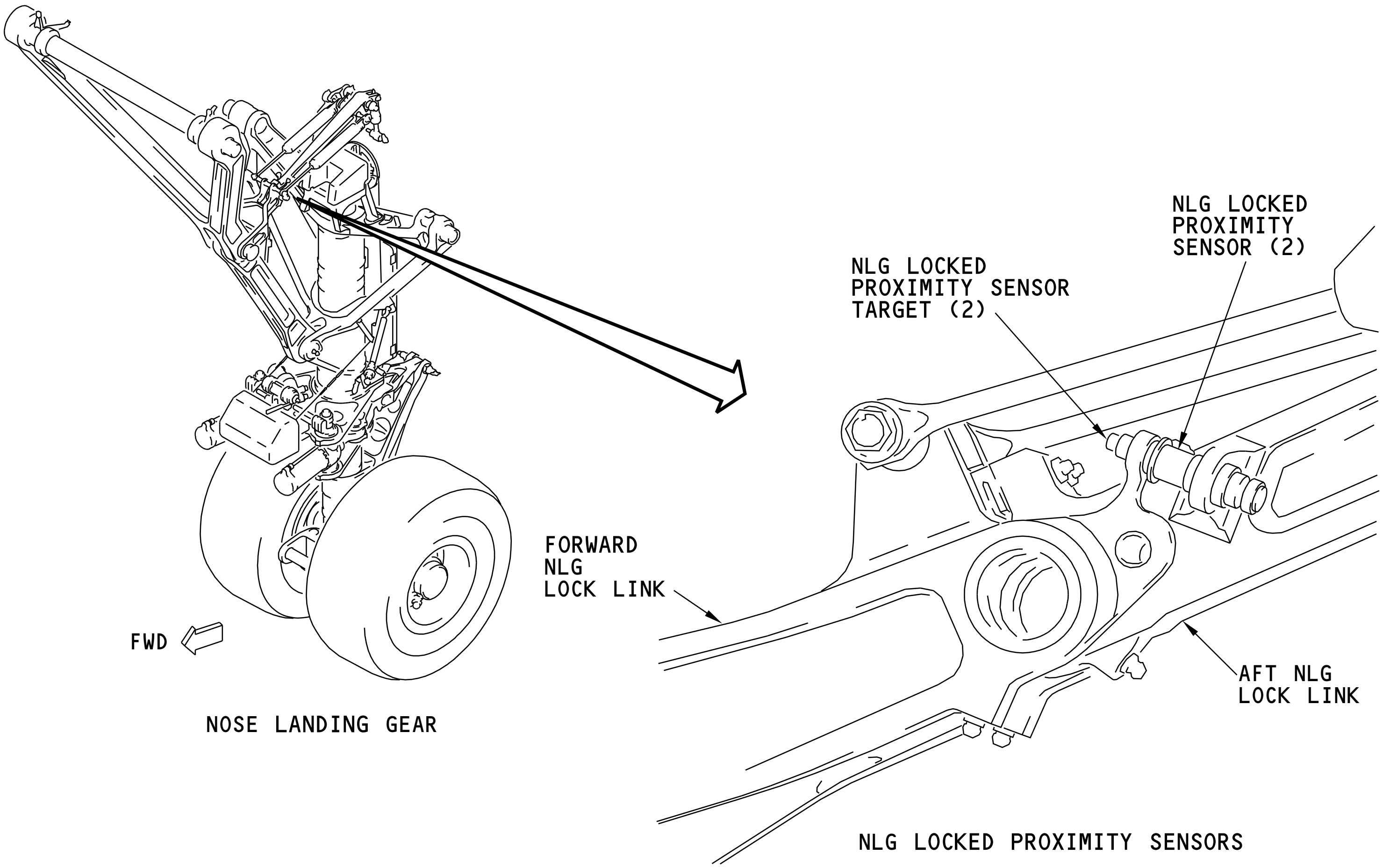
Two NLG locked sensors supply nose landing gear lock link lock position data to the PSEUs.

Location

The sensors are on the aft NLG lock link. The targets are on the forward lock link.

Functional Description

The targets are near the sensors when the NLG lock link is in the locked position.



M42442 S000618799_V1

LG POSITION INDICATING AND WARNING SYSTEM - NLG LOCKED PROXIMITY SENSORS

LG POSITION INDICATING AND WARNING SYSTEM - NLG UP AND NLG DOWN PROXIMITY SENSORS

Purpose

Two NLG up sensors and two NLG down sensors supply nose gear position data to the PSEUs.

Location

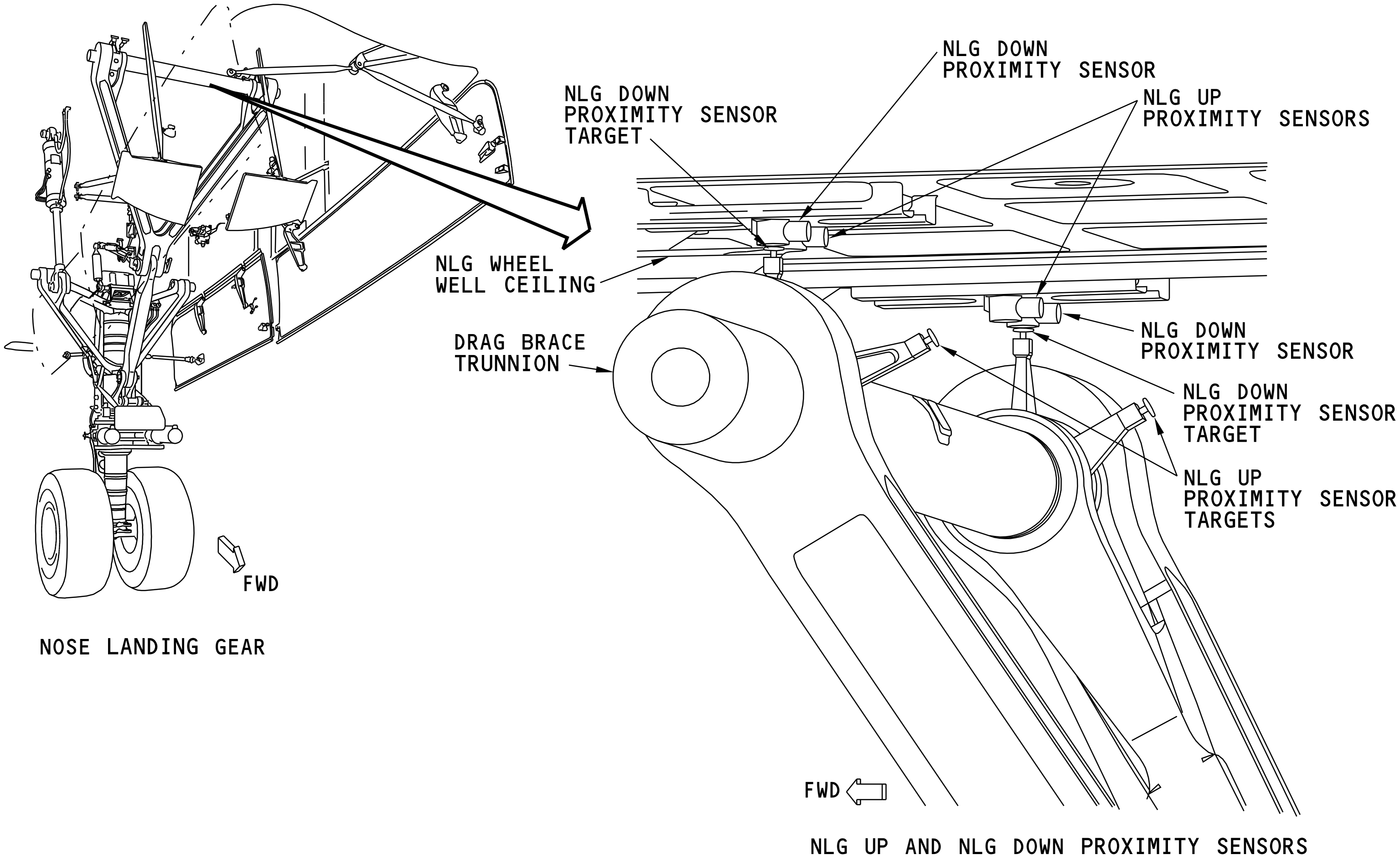
All four sensors are on the ceiling of the nose landing gear wheel well above the drag brace trunnions. The NLG down sensors are outboard. The NLG up sensors are inboard.

The targets attach to brackets which are on, and rotate with the drag brace trunnions.

Functional Description

When the NLG is up, the NLG up targets will be near their sensors. The NLG down targets will not be near their sensors.

When the NLG is down, the NLG down targets will be near their sensors. The NLG up targets will not be near their sensors.



M42443 S000618800_V1

LG POSITION INDICATING AND WARNING SYSTEM - NLG UP AND NLG DOWN PROXIMITY SENSORS

LG POSITION INDICATING AND WARNING SYSTEM - NLG DOOR CLOSED PROXIMITY SENSORS

Purpose

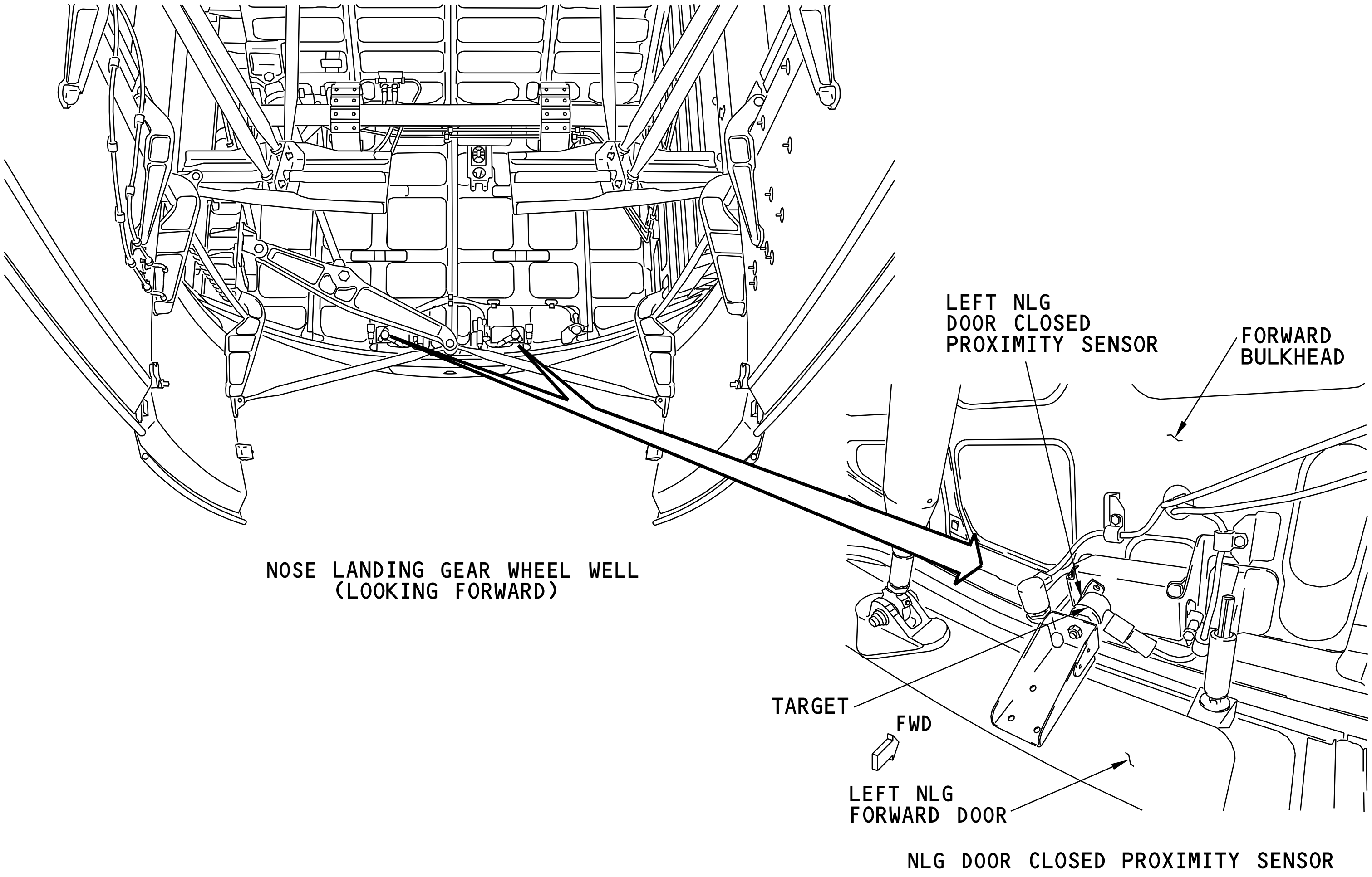
Two NLG door closed sensors supply NLG door position data to the PSEUs.

Location

The sensors are on the forward bulkhead of the NLG wheel well. One sensor is above the left forward NLG door and the other sensor is above the right NLG door. The targets attach to the each NLG forward door.

Functional Description

The targets are near the sensors when the NLG doors are in the closed position.



M42444 S000618801_V1

LG POSITION INDICATING AND WARNING SYSTEM - NLG DOOR CLOSED PROXIMITY SENSORS

LG POSITION INDICATING AND WARNING SYSTEM - MLG TRUCK TILT PROXIMITY SENSORS

Purpose

Two MLG truck tilt sensors for each main landing gear supply truck tilt position data to the PSEUs.

Physical Description

The MLG truck tilt sensors are on the sensor target bracket assemblies which include the sensor targets.

A rod connects each sensor target bracket assembly to the inner shock strut cylinder. This rod moves the target near and far as the truck tilts.

Location

One sensor target bracket assembly is on the left side of each MLG truck beam forward of the shock strut. The other sensor target bracket assembly is on the right side of each MLG truck aft of the shock strut.

Functional Description

The target is near the sensors when the MLG truck is tilted between 8 and 11.1 degrees forward wheels up (TILT position). The target is in the far position when the MLG truck is less than 8 degrees forward wheels up (UNTILT position).

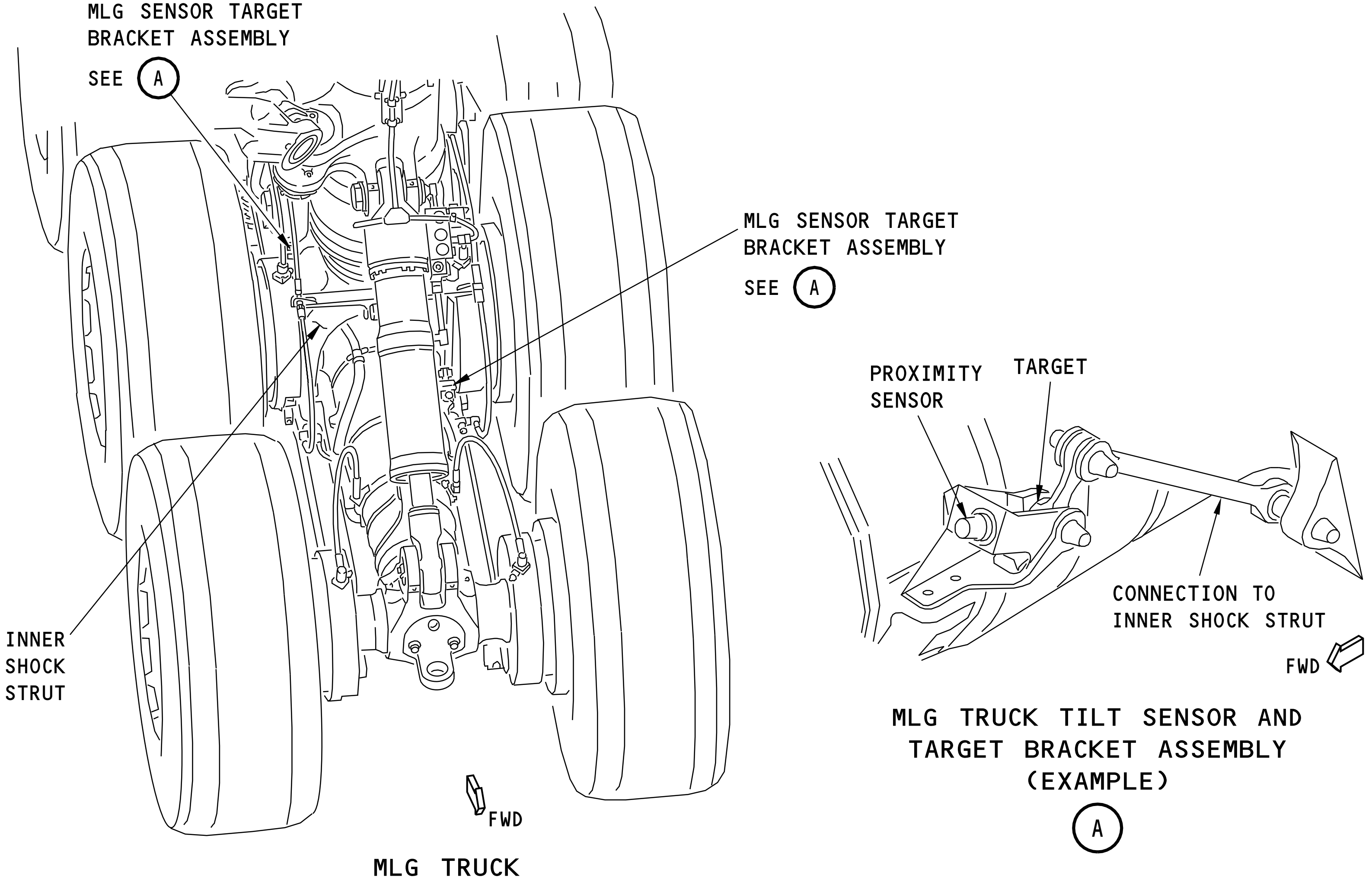
The PSEU supplies a signal that the airplane is on the ground.

Training Information Point

The sensor assemblies on the forward part of the MLG truck are different than the sensor assemblies on the aft part of the truck.

The truck tilt sensors are LRUs. There is no adjustment of the sensors or the target after replacement.

The primary flight computers (PFCs) use the truck position signal to operate the auto speedbrakes. The brake system control unit (BSCU) uses the same signal to operate the autobrakes.



MLG TRUCK

MLG TRUCK TILT SENSOR AND
TARGET BRACKET ASSEMBLY
(EXAMPLE)

M98652 S0000103166_V1

LG POSITION INDICATING AND WARNING SYSTEM - MLG TRUCK TILT PROXIMITY SENSORS

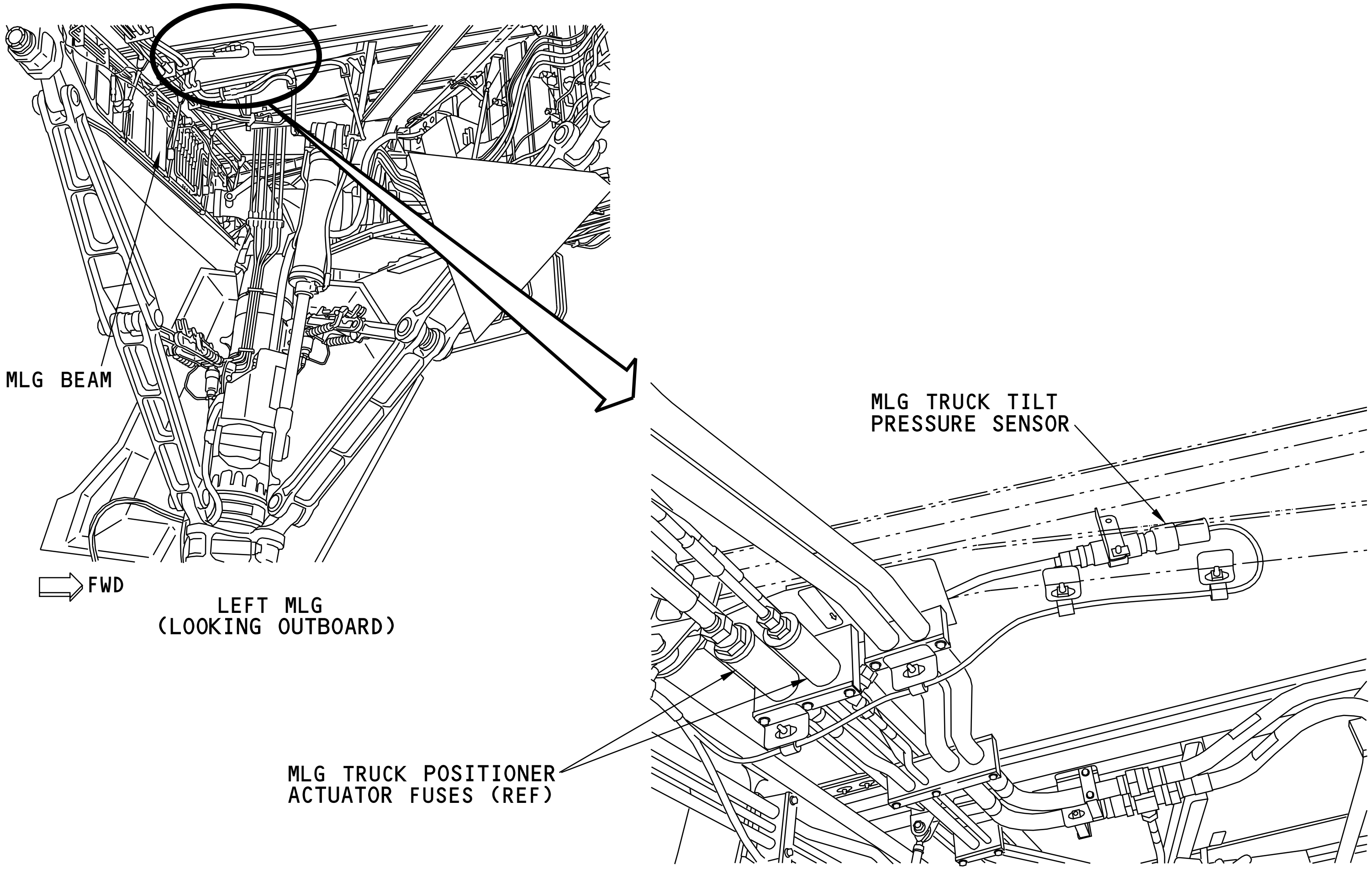
LG POSITION INDICATING AND WARNING SYSTEM - MLG TRUCK TILT PRESSURE SENSORS

Purpose

A truck tilt pressure sensor for each of the MLG truck tilt actuators sends truck tilt pressure data to the HYDIM cards. The HYDIM cards send a high pressure signal to the AIMS when the truck tilt pressure is more than 2500 psi. The HYDIM cards send a low pressure signal when the truck tilt pressure is less than 2400 psi. The AIMS sends these signals to the primary flight control computers (PFCs) to operate the auto-speedbrakes.

Location

The MLG truck tilt pressure sensors are above the MLG truck near the main landing gear beam.



M42446 S000618803_V1

LG POSITION INDICATING AND WARNING SYSTEM - MLG TRUCK TILT PRESSURE SENSORS

LG POSITION INDICATING AND WARNING SYSTEM - MLG SEMI-LEVER GEAR PROXIMITY SENSOR

Purpose

Two semi-lever gear (SLG) sensors monitor the hydraulic struts on the left and right main landing gear. These sensors provide input to the PSEUs.

Physical Description

The semi-lever gear proximity sensors are flange mount inductance-type sensors.

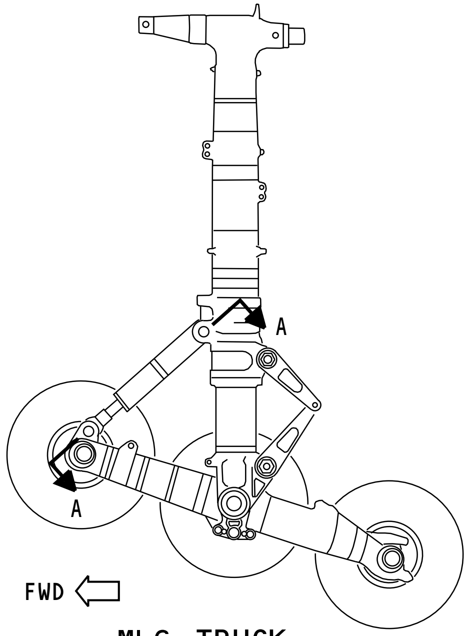
Location

There is one semi-lever gear (SLG) sensor on each main landing gear hydraulic strut. The sensor is located at the top of the hydraulic strut.

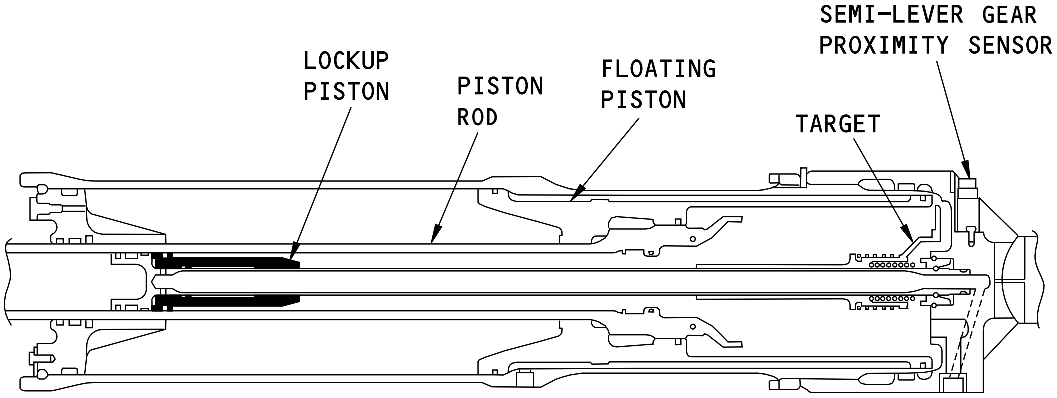
Functional Description

The hydraulic strut allows the MLG truck to tilt the forward wheels up (TILT position) at landing and take-off. The hydraulic strut is LOCKED into the tilt position only at take-off.

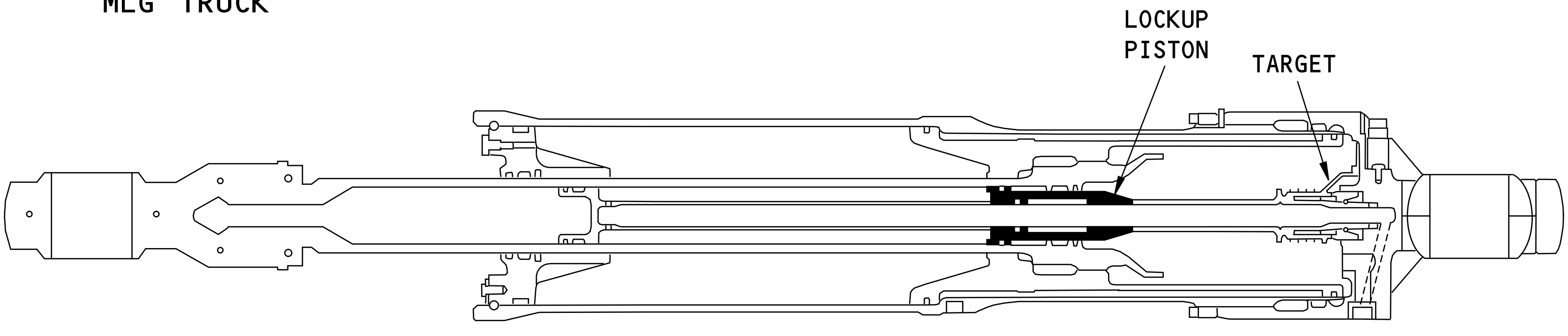
The SLG sensor monitors a target that is inside the hydraulic strut near the top of the cylinder. The target remains separated from the top of the cylinder except at take-off. At the take-off the lockup piston is hydraulically moved upwards to lock the strut in the truck tilted position. The upward movement of the lockup piston pushes the target to the top of the cylinder and the SLG sensor detects the target being near it. The sensor sends the target location data on to the PSEU.



MLG TRUCK



TILT POSITION FOR LANDING (UNLOCKED)
A-A



LOCKED TILT POSITION FOR TAKE-OFF
A-A

W00966 S0000107188_V1

LG POSITION INDICATION AND WARNING SYSTEM - MLG SEMI-LEVER GEAR PROXIM

LG POSITION INDICATING AND WARNING SYSTEM - NLG NOT-COMPRESSED PROXIMITY SENSORS

Purpose

Two NLG not-compressed sensors supply NLG shock strut compressed - not compressed data to the PSEUs.

Location

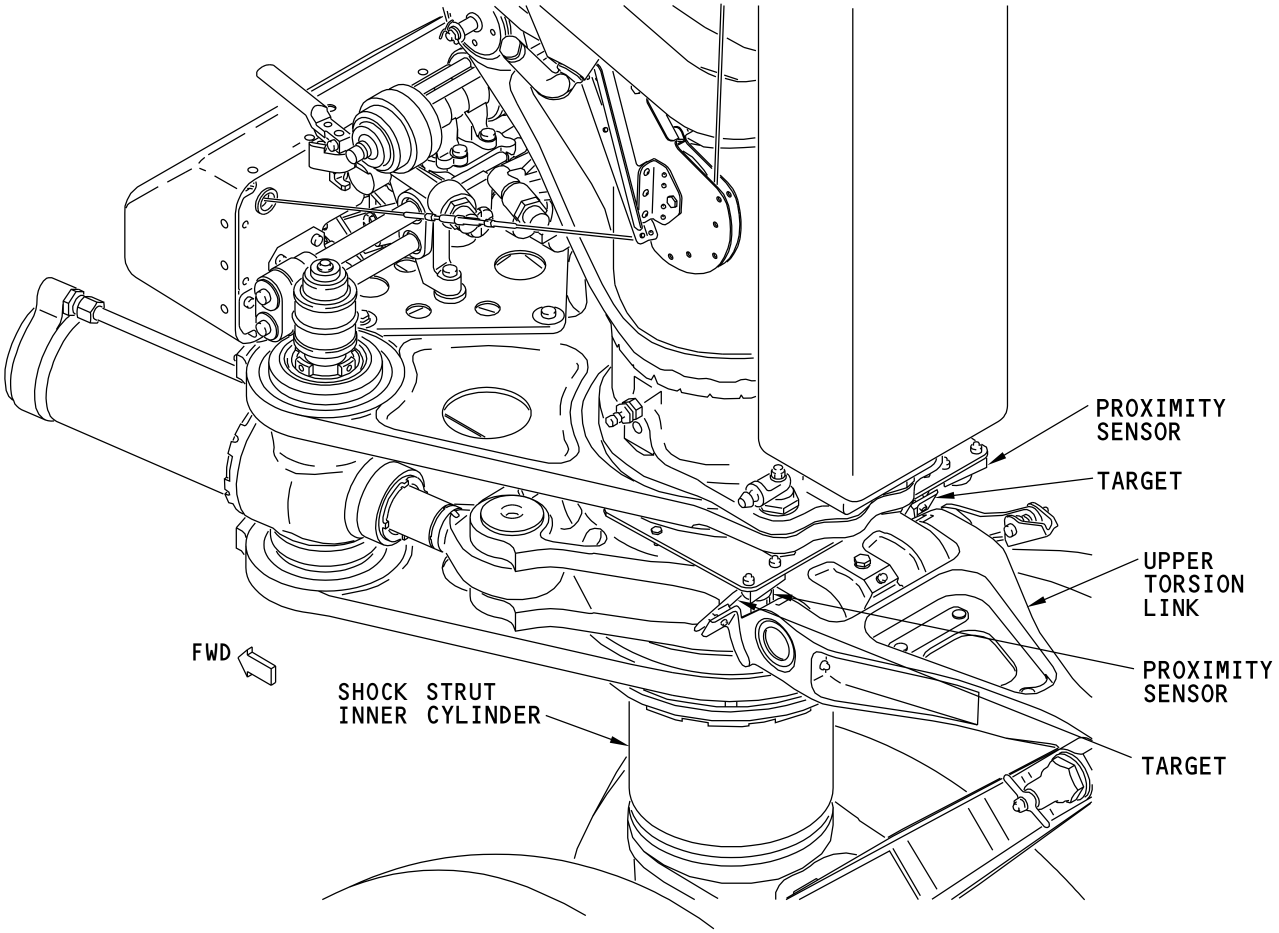
The sensors are on the aft side of the NLG shock strut. The targets attach to the upper torsion link.

Functional Description

When the airplane is on the ground, airplane weight compresses the nose landing gear. The NLG compressed targets are in the far position.

When the airplane is in the air, the inner cylinder of the NLG shock strut extends to move the torsion links to the not-compressed position. This moves the targets near the NLG not-compressed sensors.

The PSEUs supply NLG not-compressed sensor data to the ECS miscellaneous cards and to the equipment cooling controllers to operate the equipment cooling supply fans.



M42448 S000618805_V1

LG POSITION INDICATING AND WARNING SYSTEM - NLG NOT-COMPRESSED PROXIMITY SENSORS

LG POSITION INDICATING AND WARNING SYSTEM - INDICATIONS - EICAS DISPLAY

General

In normal operation, the EICAS display shows the position of the three landing gear with a single symbol format.

The format shows individual gear position for non-normal conditions.

Single-Symbol Display

The single symbol display shows the all gears down and locked condition with a green DOWN, in a box.

A white hatched box shows the gear in the in-transit condition.

An empty white box shows the loss of gear position data.

The display shows the all gears up and locked condition with a white UP, in a box. This display goes out of view approximately ten seconds after the gear moves to this position.

Multi-Symbol Display

The landing gear display shows all three gears for these conditions:

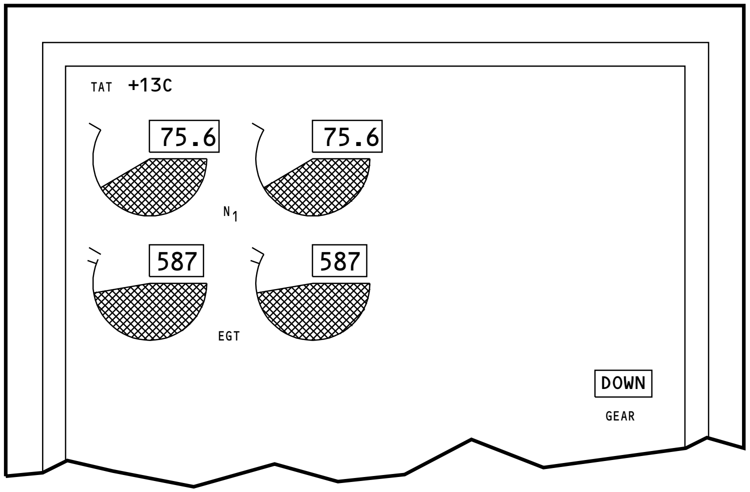
- There is a disagreement between the landing gear lever and the landing gear position for more than 40 seconds (normal actuation time is approximately 17 seconds for retraction and 23 seconds for extension)
- The landing gear doors are open (alternate extension or ground operation of the landing gear doors).

The display shows the gear down and locked condition with a green DN, in a box.

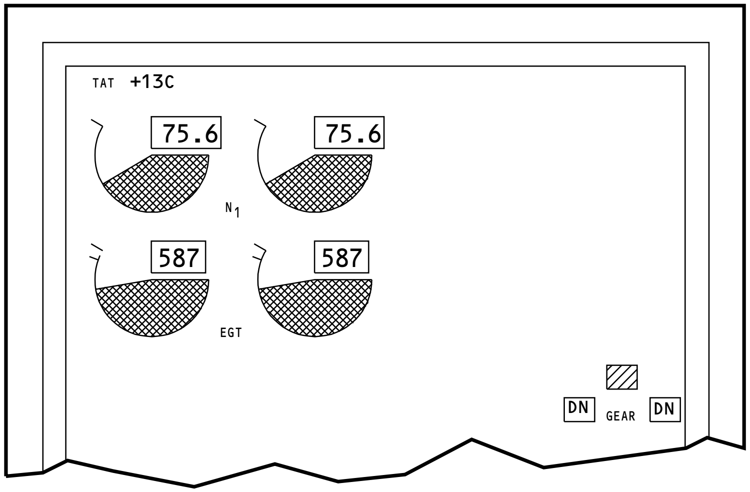
The display shows the gear in-transit condition with a white hatched box.

The display shows the gear up and locked condition with a white UP, in a box.

An empty white box shows the loss of position data for the applicable gear.



EICAS DISPLAY - SINGLE-SYMBOL DISPLAY



EICAS DISPLAY - MULTI-SYMBOL DISPLAY

SINGLE-SYMBOL DISPLAY

DOWN - (GREEN) ALL GEAR DOWN AND LOCKED

▨ - (WHITE HATCHED) GEAR IN-TRANSIT

UP - (WHITE) ALL GEARS UP AND LOCKED (DISPLAY BLANKS AFTER 10 SECONDS)

☐ - INDICATION INOPERATIVE

MULTI-SYMBOL DISPLAY

▨
DN GEAR DN } EXPANDED DISPLAY

DN - (GREEN) GEAR DOWN AND LOCKED

▨ - (WHITE HATCHED) GEAR IN-TRANSIT

UP - (WHITE) GEAR UP AND LOCKED

☐ - INDICATION INOPERATIVE

M42477 S000618806_V1

LG POSITION INDICATING AND WARNING SYSTEM - INDICATIONS - EICAS DISPLAY

LG POSITION INDICATING AND WARNING SYSTEM - INDICATIONS - ALERT AND STATUS MESSAGES

Alert Messages

These alert messages show for non-normal landing gear conditions:

- CONFIG GEAR (Warning) - any landing gear is not down and locked and the airplane is in a landing configuration (the flap lever is in a landing position or a thrust lever is at idle with the radio altitude less than 800 feet)
- GEAR DISAGREE (Caution) - disagreement between the landing gear lever and one or more gear positions 40 seconds after landing gear lever movement
- MAIN GEAR BRACE L (Caution) - one brace on the left gear is unlocked for more than 40 seconds after the landing gear lever is in the down position and the other brace on the left gear is locked
- MAIN GEAR BRACE R (Caution) - one brace on the right gear is unlocked for more than 40 seconds after the landing gear lever is in the down position and the other brace on the right gear is locked
- GEAR DOOR (Advisory) - one or more landing gear doors are not closed 40 seconds after landing gear lever movement. This message also shows after an alternate extension or after ground door operation.

Status Messages

The GEAR INDICATION SYS status message shows for any of these conditions:

- Failure of both up sensors on the same gear
- Failure of both door sensors on the same gear
- Failure of any side brace sensor
- Failure of any drag brace sensor
- Failure of either NLG down sensor
- Failure of either NLG locked sensor
- Failure of any truck tilt sensor
- Failure of either NLG not-compressed sensor
- Invalid PSEU channel.

One or more of these status messages show for landing gear door sensor or gear uplock sensor failures:

- L GEAR DOOR SENSOR
- R GEAR DOOR SENSOR
- NOSE GEAR DOOR SENSOR
- L GEAR UPLOCK SENSOR
- R GEAR UPLOCK SENSOR
- NOSE GEAR UP SENSOR.

The SEMI LEVER GEAR status messages show for any of these conditions:

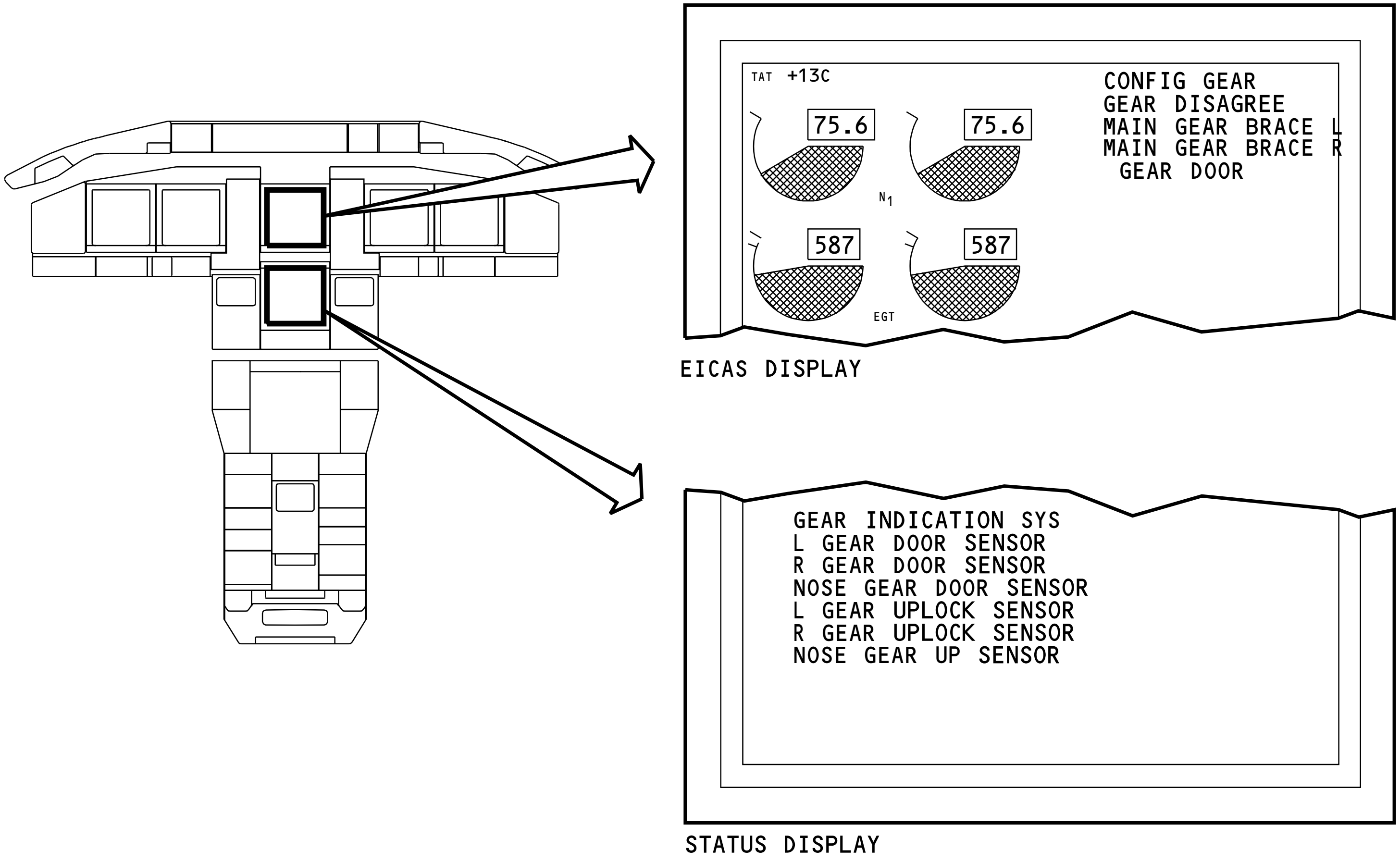
- One or both of the SLG hydraulic struts failed to lock
- One or both of the SLG hydraulic struts failed to remain locked
- One or both of the SLG relays are failed in the de-energized state
- One or both of the SLG proximity sensors are failed
- One or both PSEU SLG output driver has failed.

The SEMI LEVER GEAR LOCK status messages show for any of these conditions:

- One or both of the SLG hydraulic struts are locked while commanded unlocked
- One or both of the SLG relays have failed closed.

The SEMI LEVER GEAR SYSTEM status messages show for any of these conditions:

- One or both SLG circuit breakers are open.
- One or both of the PSEUs are no longer receiving LOCK command discretes from both AIMS cabinets
- One or both of the PSEUs are no longer receiving on-ground information from both AIMS cabinets

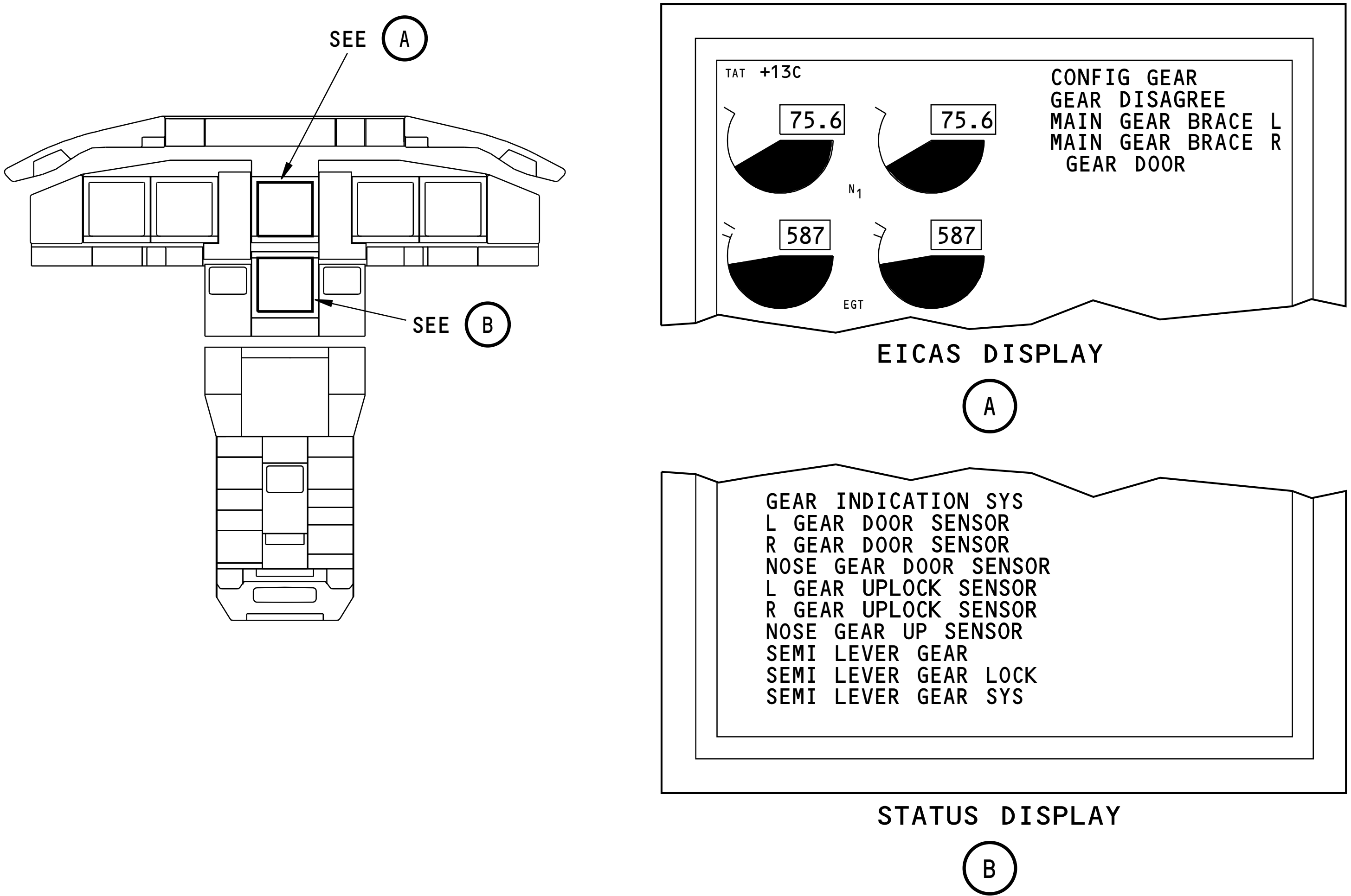


CONFIG GEAR
GEAR DISAGREE
MAIN GEAR BRACE L
MAIN GEAR BRACE R
GEAR DOOR

GEAR INDICATION SYS
L GEAR DOOR SENSOR
R GEAR DOOR SENSOR
NOSE GEAR DOOR SENSOR
L GEAR UPLOCK SENSOR
R GEAR UPLOCK SENSOR
NOSE GEAR UP SENSOR

M42480 S000618816_V1

LG POSITION INDICATING AND WARNING SYSTEM - INDICATIONS - ALERT AND STATUS MESSAGES



CONFIG GEAR
GEAR DISAGREE
MAIN GEAR BRACE L
MAIN GEAR BRACE R
GEAR DOOR

GEAR INDICATION SYS
L GEAR DOOR SENSOR
R GEAR DOOR SENSOR
NOSE GEAR DOOR SENSOR
L GEAR UPLOCK SENSOR
R GEAR UPLOCK SENSOR
NOSE GEAR UP SENSOR
SEMI LEVER GEAR
SEMI LEVER GEAR LOCK
SEMI LEVER GEAR SYS

W64076 S0000127449_V1

LG POSITION INDICATION AND WARNING SYSTEM - INDICATION - ALERT AND STATUS MESSAGES

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LG POSITION INDICATING AND WARNING SYSTEM - INDICATIONS - MULTI-FUNCTION DISPLAY

General

The multi-function display shows landing gear position data on the landing gear synoptic display. Additional landing gear data and PSEU outputs show on the landing gear actuation/indication maintenance page.

Landing Gear Synoptic Display

The landing gear synoptic display shows the position of the landing gear doors.

The display shows a door closed condition with the word CLOSED in white, in a box.

The display shows a door not closed condition with a white hatched box.

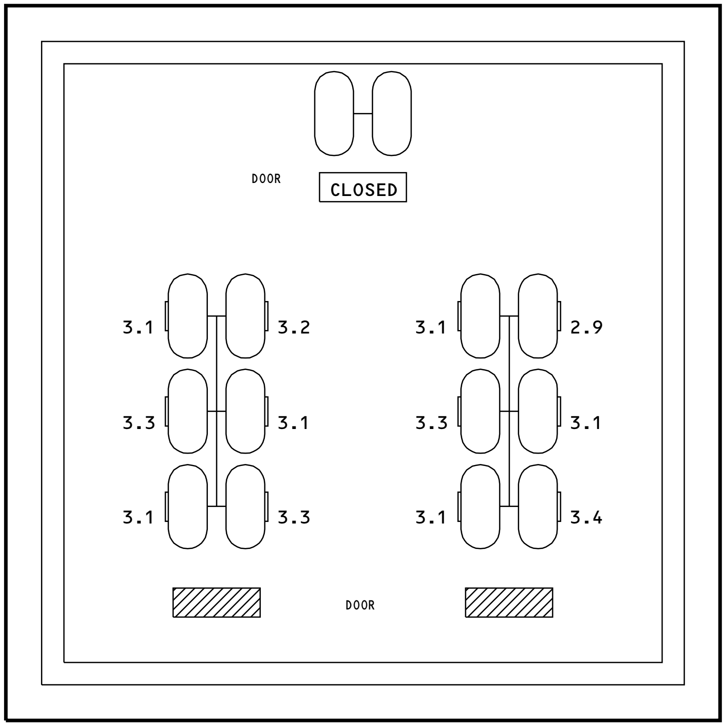
The display shows a loss of input data from both PSEUs with an empty white box.

Landing Gear Actuation/Indication Maintenance Page

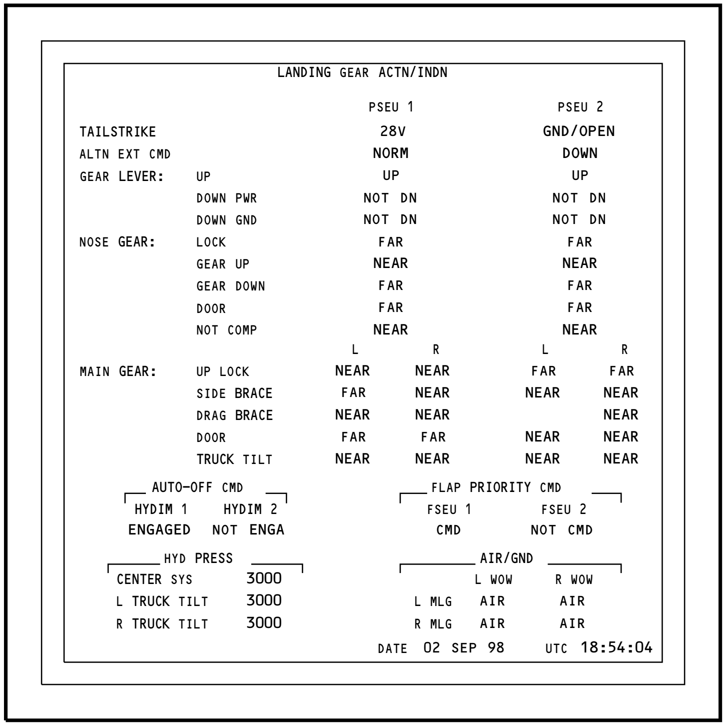
The landing gear actuation/indication maintenance page shows the NEAR/FAR position for all the landing gear proximity sensors for both PSEUs.

The display shows the loss of a proximity sensor input or an invalid input as an empty space.

The display also shows the gear lever switch positions and the alternate extension system status.



LANDING GEAR SYNOPTIC DISPLAY



LANDING GEAR ACTN/INDN

		PSEU 1		PSEU 2	
TAILSTRIKE		28V		GND/OPEN	
ALTN EXT CMD		NORM		DOWN	
GEAR LEVER:	UP	UP		UP	
	DOWN PWR	NOT DN		NOT DN	
	DOWN GND	NOT DN		NOT DN	
NOSE GEAR:	LOCK	FAR		FAR	
	GEAR UP	NEAR		NEAR	
	GEAR DOWN	FAR		FAR	
	DOOR	FAR		FAR	
	NOT COMP	NEAR		NEAR	
		L	R	L	R
MAIN GEAR:	UP LOCK	NEAR	NEAR	FAR	FAR
	SIDE BRACE	FAR	NEAR	NEAR	NEAR
	DRAG BRACE	NEAR	NEAR		NEAR
	DOOR	FAR	FAR	NEAR	NEAR
	TRUCK TILT	NEAR	NEAR	NEAR	NEAR

AUTO-OFF CMD

HYDIM 1	HYDIM 2
ENGAGED	NOT ENGA

FLAP PRIORITY CMD

FSEU 1	FSEU 2
CMD	NOT CMD

HYD PRESS

CENTER SYS	3000
L TRUCK TILT	3000
R TRUCK TILT	3000

AIR/GND

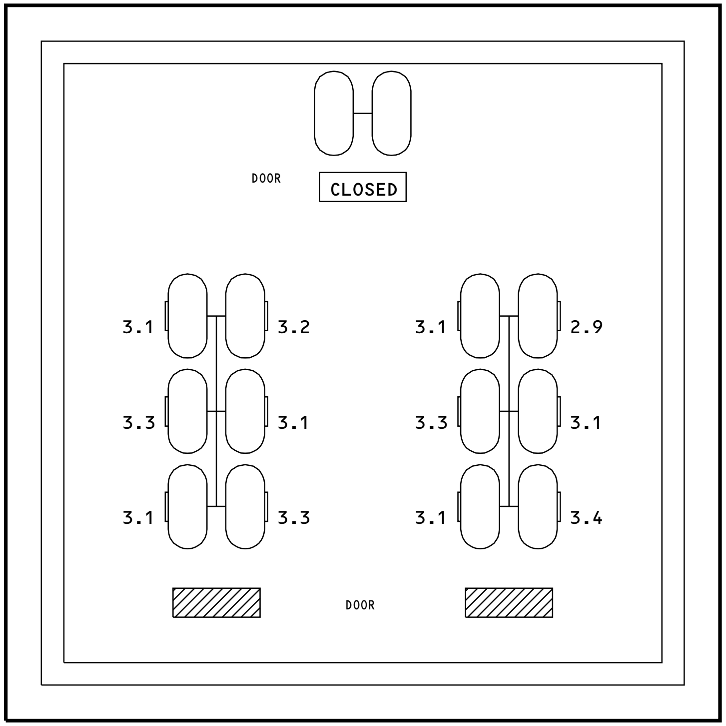
	L WOW	R WOW
L MLG	AIR	AIR
R MLG	AIR	AIR

DATE 02 SEP 98 UTC 18:54:04

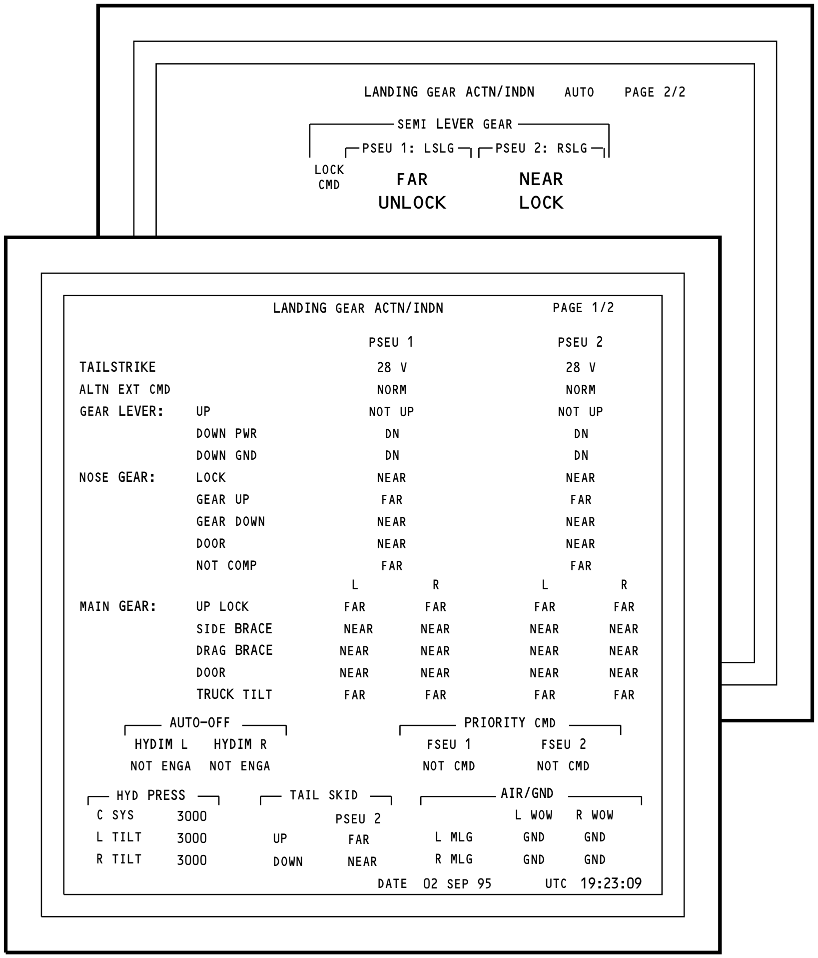
LANDING GEAR ACTUATION/INDICATION MAINTENANCE PAGE

M42450 S000618809_V1

LG POSITION INDICATING AND WARNING SYSTEM - INDICATIONS - MULTI-FUNCTION DISPLAY



LANDING GEAR SYNOPTIC DISPLAY



```
                              LANDING GEAR ACTN/INDN     AUTO     PAGE 2/2

                                ┌──────── SEMI LEVER GEAR ────────┐
                                │  ┌PSEU 1: LSLG┐  ┌PSEU 2: RSLG┐ │
                              LOCK
                              CMD       FAR              NEAR
                                       UNLOCK            LOCK
```

```
                      LANDING GEAR ACTN/INDN              PAGE 1/2

                                   PSEU 1                  PSEU 2
TAILSTRIKE                          28 V                    28 V
ALTN EXT CMD                        NORM                    NORM
GEAR LEVER:    UP                  NOT UP                  NOT UP
               DOWN PWR              DN                      DN
               DOWN GND              DN                      DN
NOSE GEAR:     LOCK                 NEAR                    NEAR
               GEAR UP              FAR                     FAR
               GEAR DOWN            NEAR                    NEAR
               DOOR                 NEAR                    NEAR
               NOT COMP             FAR                     FAR
                               L           R           L          R
MAIN GEAR:     UP LOCK        FAR         FAR         FAR        FAR
               SIDE BRACE     NEAR        NEAR        NEAR       NEAR
               DRAG BRACE     NEAR        NEAR        NEAR       NEAR
               DOOR           NEAR        NEAR        NEAR       NEAR
               TRUCK TILT     FAR         FAR         FAR        FAR

     ┌──── AUTO-OFF ────┐                 ┌───── PRIORITY CMD ─────┐
      HYDIM L    HYDIM R                     FSEU 1        FSEU 2
      NOT ENGA   NOT ENGA                    NOT CMD       NOT CMD

 ┌─ HYD PRESS ─┐   ┌─ TAIL SKID ─┐   ┌────────── AIR/GND ──────────┐
  C SYS    3000                                  L WOW   R WOW
  L TILT   3000          PSEU 2         L MLG     GND     GND
  R TILT   3000    UP     FAR           R MLG     GND     GND
                   DOWN   NEAR
                              DATE  02 SEP 95        UTC  19:23:09
```

LANDING GEAR ACTUATION/INDICATION
MAINTENANCE PAGE

M99585 S0000103250_V1

LG POSITION INDICATING AND WARNING SYSTEM - INDICATIONS - MULTI-FUNCTI

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TAIL STRIKE SYSTEM - INTRODUCTION

Purpose

The tail strike system supplies tail strike indication to the flight deck if a tail strike occurs.

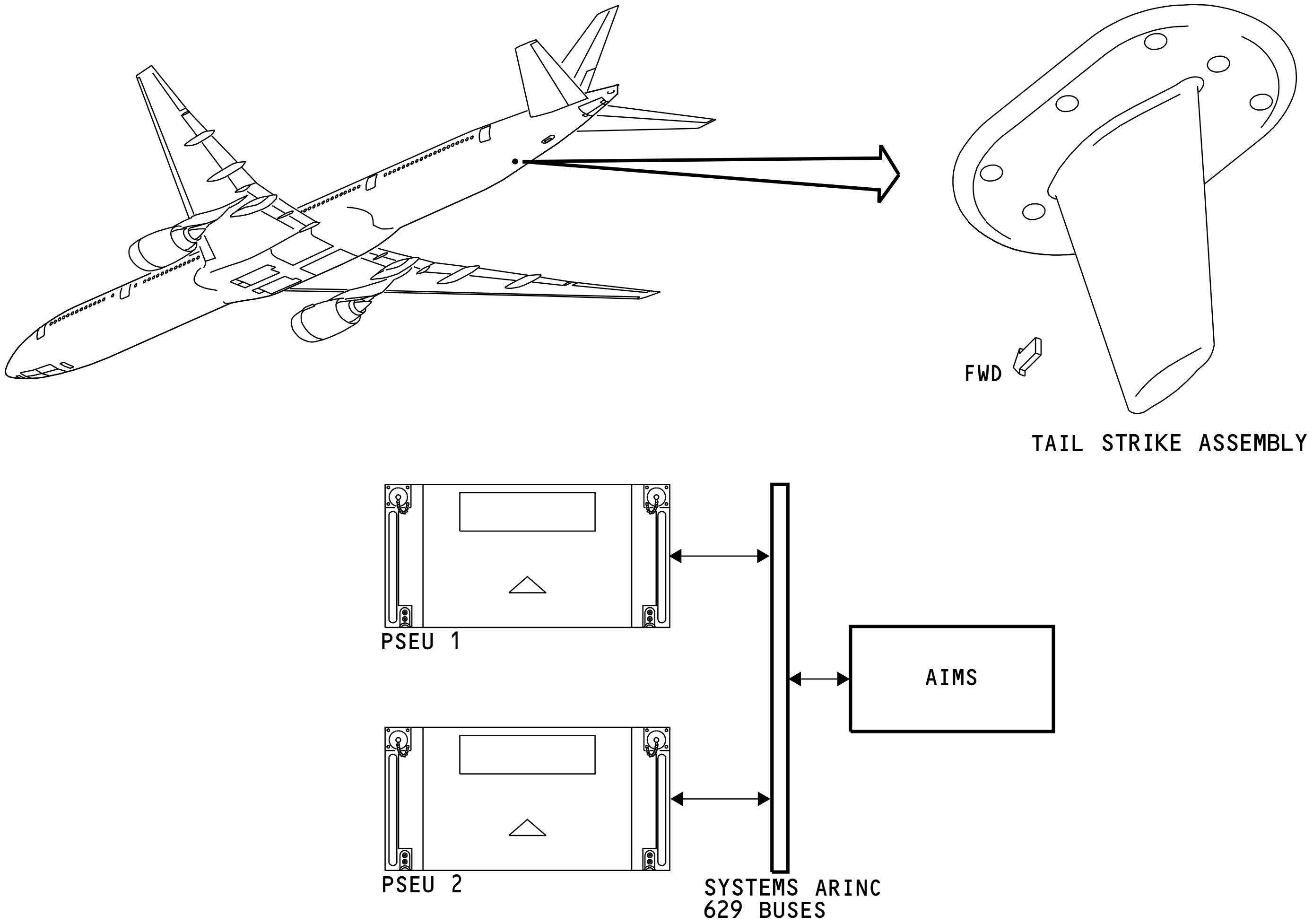
Tail Strike Assembly

The tail strike assembly (TSA) is a blade antenna shaped device. There are two wires in the assembly which are near the outside surface of the TSA.

The TSA is in the airplane tail strike area on the bottom of the aft fuselage.

Interface

The two wires in the TSA make inputs to the two proximity sensor electronics units (PSEUs). The PSEUs supply tail strike data to the AIMS for flight deck display.



M42454 S000618818_V1

TAIL STRIKE SYSTEM - INTRODUCTION

TAIL STRIKE SYSTEM - FUNCTIONAL DESCRIPTION

General

The two wires in the TSA are on separate channels. Both wires get 28v dc power. One wire gets electrical power from the primary power circuit breaker that also supplies primary power to PSEU 1. PSEU 1 monitors this wire. The other wire gets electrical power from the circuit breaker that also supplies primary power to PSEU 2. PSEU 2 monitors this wire. Both channels are normally closed circuits.

Detection

If a tail strike occurs, the TSA contacts the ground and becomes damaged or breaks off the airplane. This damages both wires and causes both PSEUs to get open/short circuit inputs.

Indication

If both PSEUs get open/short circuit inputs, a TAIL STRIKE caution message shows.

The landing Gear actuation/indication maintenance page shows the status of the inputs from the tail strike system.

Training Information Point

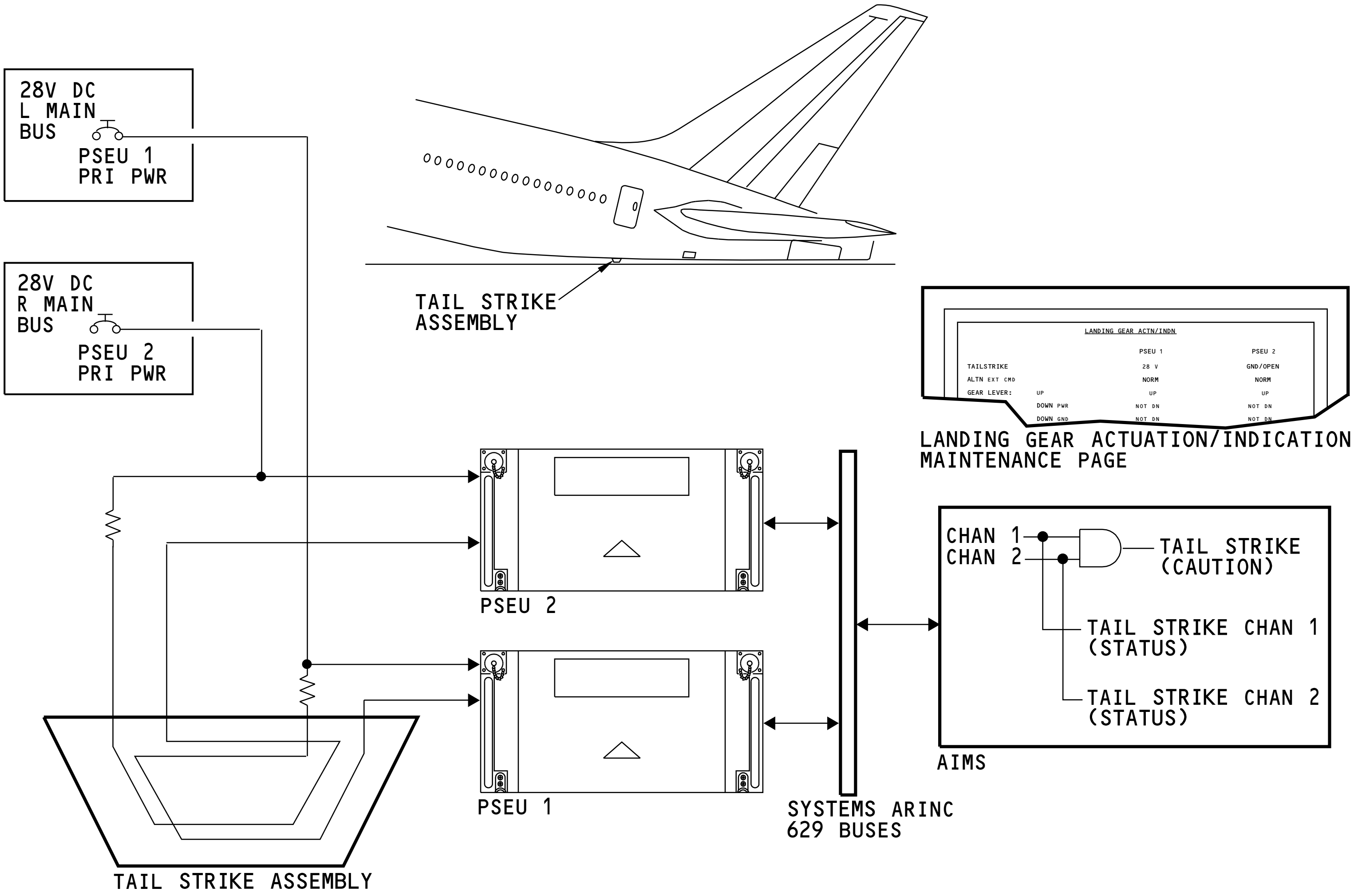
If there is a failure (open/short circuit) in a single channel, the TAIL STRIKE CHAN 1 or TAIL STRIKE CHAN 2 status message shows.

Both of these messages also show if there is a tail strike.

ARO 001-004

The tail skid touches the ground before the tail strike assembly. See the tail skid section for more information (SECTION 32-72).

ARO ALL

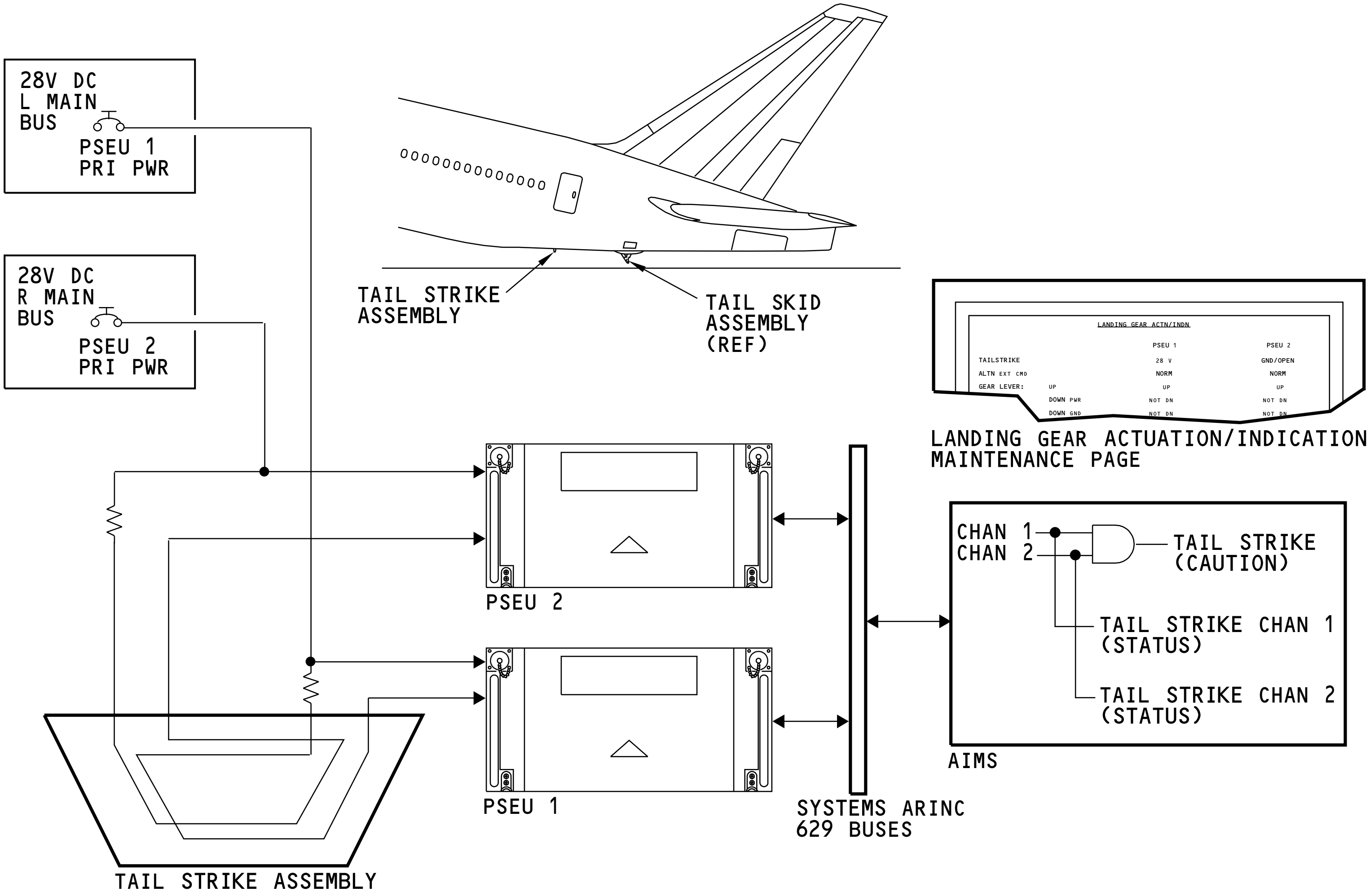


LANDING GEAR ACTN/INDN

		PSEU 1	PSEU 2
TAILSTRIKE		28 V	GND/OPEN
ALTN EXT CMD		NORM	NORM
GEAR LEVER:	UP	UP	UP
	DOWN PWR	NOT DN	NOT DN
	DOWN GND	NOT DN	NOT DN

M42455 S000618819_V1

TAIL STRIKE SYSTEM - FUNCTIONAL DESCRIPTION



M42456 S000618820_V1

TAIL STRIKE SYSTEM - FUNCTIONAL DESCRIPTION

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TAIL SKID SYSTEM - INTRODUCTION

General

The tail skid system provides some protection for the aft fuselage structure if over-rotation occurs during takeoff or landing. The tail skid extends for takeoff and landing and retracts during flight. Fairings provide an aerodynamic enclosure when the tail skid is retracted.

Without a tail skid, the tail strike assembly and aft fuselage structure would touch the runway during over-rotation. This area of the airplane is below the aft galley and below the aft passenger doors. If this pressurized part of the airplane touches the ground, the tail strike system senses the contact. See the tail strike system section for more information (SECTION 32-71).

The tail skid helps protect this pressurized part of the airplane from contact with the runway. The tail skid extends below the tail strike assembly to absorb airplane rotational energy.

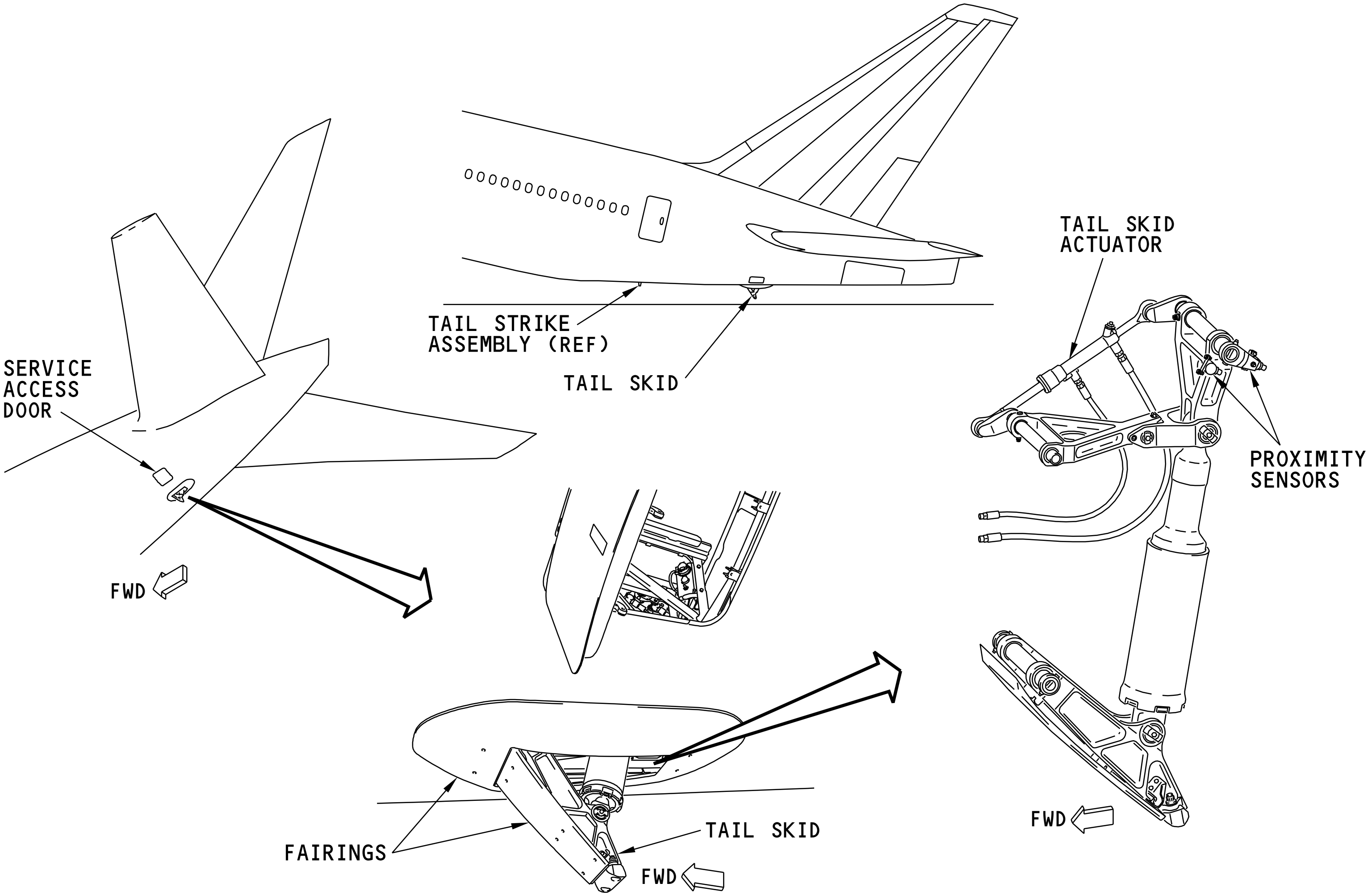
Location

The tail skid is aft of the tail strike assembly on the airplane centerline at the bottom of the stabilizer compartment.

Interfaces

A hydraulic tail skid actuator extends and retracts the tail skid. The main landing gear actuation system controls the hydraulic pressure to the tail skid actuator.

Two proximity sensors sense the position of the tail skid. The proximity sensing system monitors these sensors.



M42457 S000618821_V1

TAIL SKID SYSTEM - INTRODUCTION

TAIL SKID SYSTEM - ABSORBER ASSEMBLY, DRAG LEVER, AND SKID SHOE

General

The drag lever extends below the bottom of the fuselage during takeoff and landing. If over-rotation occurs, the skid shoe on the drag lever may touch the runway. If this occurs, the drag lever transmits the rotational energy to the absorber assembly. The absorber assembly absorbs the energy.

Location

The absorber assembly, drag lever, and skid shoe are on the airplane centerline at the bottom of the stabilizer compartment.

Physical Description

The absorber assembly attaches to the drag lever at one end. It attaches to structure at the other end by the upper attach link.

The absorber assembly includes these components:

- Upper end fitting
- Lower end fitting
- Outer sleeve
- Crushable cartridge
- Indicator assembly.

The lower end fitting and outer sleeve attach to each other. The upper end fitting can slide within the outer sleeve. The crushable cartridge is inside the outer sleeve between the upper and lower end fittings. The indicator assembly attaches to the lower end fitting and is between the outer sleeve and the crushable cartridge.

The crushable cartridge is an aluminum honeycomb cylinder.

The indicator assembly is a plastic housing with two metal pins.

The skid shoe is a painted metal part. It attaches to the end of the drag lever. It is the part that touches the runway if the airplane over-rotates during takeoff or landing.

The lock links hold the upper attach link, the absorber assembly, and the drag lever in the extended position.

Functional Description

If the airplane over-rotates during takeoff or landing, the skid shoe on the drag lever touches the runway. This causes the drag lever to rotate about its forward axis and compress the absorber assembly. The compressive load crushes the crushable cartridge in the absorber assembly. This permanently deforms the cartridge.

The amount of absorber assembly compression is shown by the indicator assembly. During compression, the metal pins of the indicator assembly move towards the upper end fitting. After the skid shoe touches the runway, the indicator assembly will show one of these conditions:

- Neither pin is extended (this shows a very low energy skid contact)
- One pin is extended (this shows a moderate energy skid contact or many soft touches)
- Both pins are extended (this shows a high energy skid contact)
- Both pins and assembly extended

If there is more rotational energy than the absorber assembly can absorb, the upper attach link separates from the fixed structure at the fuse pin.

If the fuse pin is not broken, the tail skid can be retracted and locked after the cartridge is crushed. The absorber assembly will extend as the drag lever retracts against the bumper stop.

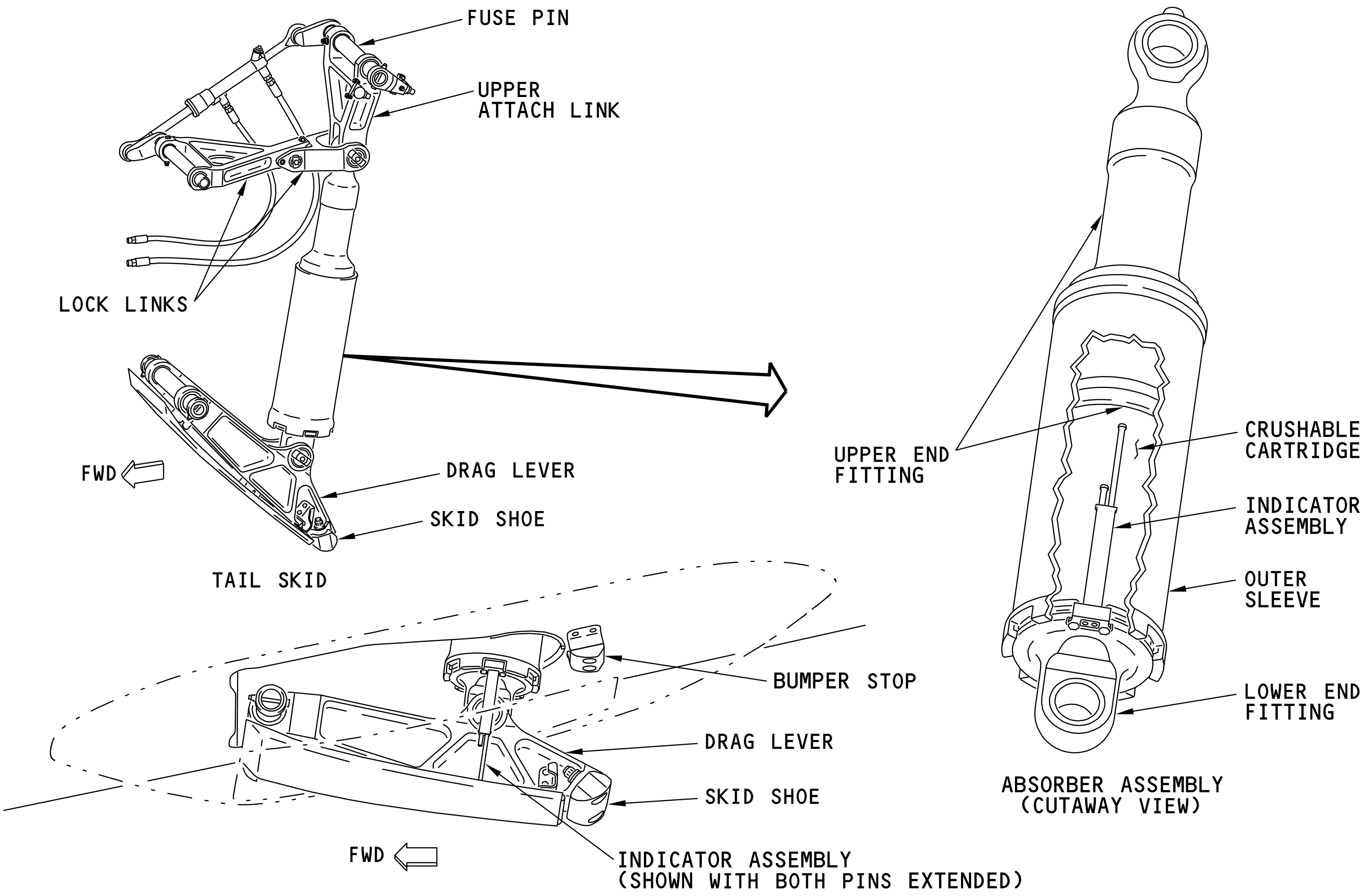
Training Information Point

If paint is scraped from the skid shoe, you must inspect the tail skid indicator assembly. You also must repaint the skid shoe.

You must discard the crushable cartridge and indicator assembly when you replace them. The crushable cartridge and the indicator assembly are LRUs. Remove the indicator assembly to separate the lower end fitting from the outer sleeve. With the lower end fitting removed, replace the crushable cartridge.

The skid shoe is an LRU.

The tail skid system does not require lubrication.



M42458 S000618822_V1

TAIL SKID SYSTEM - ABSORBER ASSEMBLY, DRAG LEVER, AND SKID SHOE

TAIL SKID SYSTEM - TAIL SKID ACTUATOR - PHYSICAL DESCRIPTION

Purpose

The tail skid actuator extends and retracts the tail skid. The hydraulic pressure to extend or retract the tail skid comes from the main landing gear actuation system up and down hydraulic lines. See the MLG extension-retraction section for more information on the retraction and extension sequences (SECTION 32-32).

Physical Description

The tail skid actuator is a two-position hydraulic actuator. The actuator retracts to extend the tail skid. The actuator extends to retract the tail skid. Restrictors and check valves limit the rate of extension and retraction.

The tail skid actuator includes a relief valve in the head end. The relief valve and check valve keep hydraulic fluid in the head end of the actuator. The relief valve opens at approximately 200 psi. This keeps the tail skid actuator extended when the hydraulic line is depressurized. The relief valve opens during tail skid actuator retraction. The relief valve also opens for thermal expansion of the hydraulic fluid.

Location

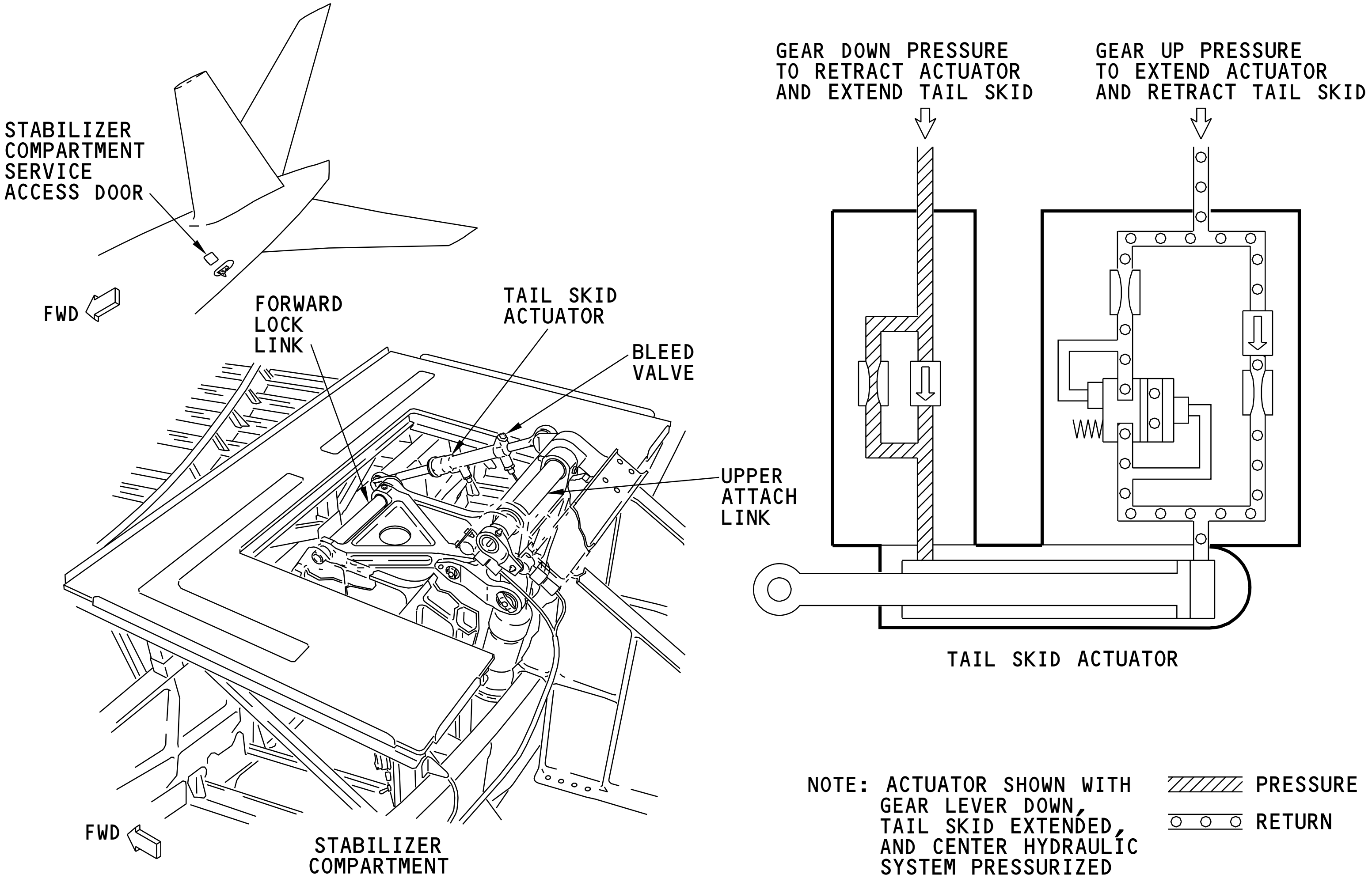
You get access to the tail skid actuator through the stabilizer compartment service access door.

The actuator rod end attaches to a crank on the forward lock link. The actuator head end attaches to a crank on the upper attach link. Neither end of the actuator is attached to fixed structure. Both cranks will move during tail skid actuation.

Training Information Point

The tail skid actuator includes a bleed valve to bleed the hydraulic system. You also use the bleed valve to release the hydraulic lock and manually deploy the tail skid.

The tail skid actuator does not require lubrication.



NOTE: ACTUATOR SHOWN WITH GEAR LEVER DOWN, TAIL SKID EXTENDED, AND CENTER HYDRAULIC SYSTEM PRESSURIZED

M42459 S000618823_V1

TAIL SKID SYSTEM - TAIL SKID ACTUATOR - PHYSICAL DESCRIPTION

TAIL SKID SYSTEM - TAIL SKID ACTUATOR - FUNCTIONAL DESCRIPTION

General

The tail skid actuator controls the position of the tail skid. The tail skid actuator attaches to a crank on the forward lock link and a crank on the upper attach link. The upper attach link and the absorber assembly are locked in the retracted and extended position by over-center lock links. There are no springs in the tail skid mechanism.

Main landing gear up and down hydraulic pressure controls the tail skid actuator. The landing gear control system controls the main landing gear actuation system up and down pressure. See the landing gear control system section for more information (SECTION 32-31). See the MLG extension-retraction section for more information on the extension and retraction sequences (SECTION 32-32).

Tail Skid Extension

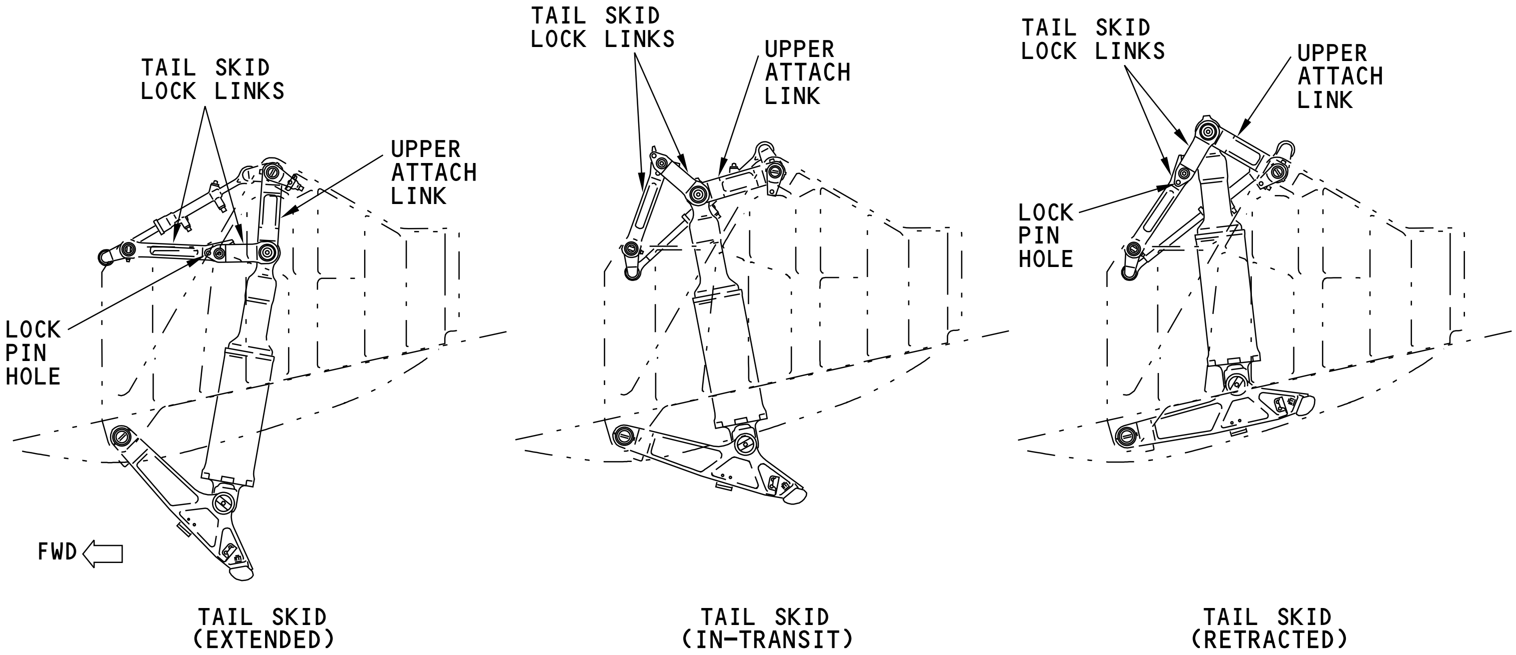
The tail skid actuator retracts to extend the tail skid. The actuator unlocks the lock links from the up position, extends the tail skid, and again locks the lock links in the extended position. The tail skid actuator has pressure to hold the tail skid in the extended position whenever there is pressure to the main landing gear down hydraulic circuit. When the center hydraulic system is depressurized, the weight of the lock links and the weight of the tail skid keep the tail skid extended.

Tail Skid Retraction

The tail skid actuator extends to retract the tail skid. The actuator unlocks the lock links from the down position, retracts the tail skid, and again locks the lock links in the retracted position. The tail skid actuator has pressure to hold the tail skid in the retracted position for only ten seconds after the landing gear retracts and the landing gear doors close. See the landing gear control system section for more information on the auto-off function(SECTION 32-31) . The weight of the lock links and the hydraulic lock in the head end of the tail skid actuator keep the tail skid retracted.

Training Information Point

You install a ground lock pin to lock the tail skid in the retracted or extended positions. The lock pin locks the lock links. See the landing gear section for more information on the tail skid lock pin (SECTION 32-00).



M42460 S000618824_V1

TAIL SKID SYSTEM - TAIL SKID ACTUATOR - FUNCTIONAL DESCRIPTION

TAIL SKID SYSTEM - TAIL SKID UP AND TAIL SKID DOWN PROXIMITY SENSORS

General

The tail skid up and tail skid down proximity sensors supply tail skid position data to PSEU 2. These sensors monitor the tail skid mechanism position and the proper operation of the tail skid actuator and mechanism.

See the proximity sensor system section for more information (SECTION 32-08).

Location

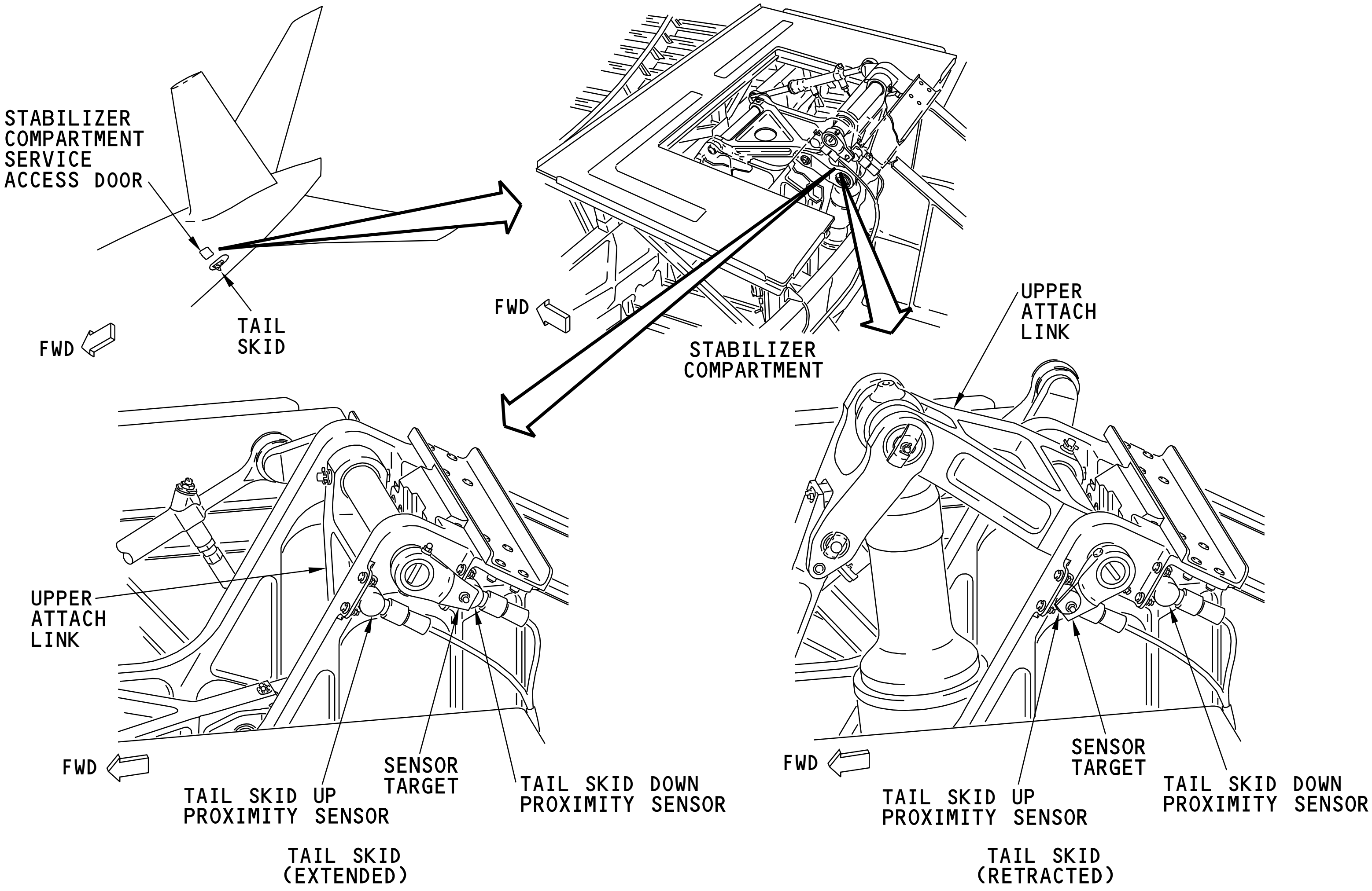
The two flange mount type proximity sensors are on fixed structure in the stabilizer compartment. The sensor target is attached to a crank on the upper attach link of the tail skid mechanism. The upper attach link and target move during tail skid actuation.

Functional Description

When the main landing gear is in the extended position, the tail skid is extended. The sensor target is near to the tail skid down proximity sensor and far from the tail skid up proximity sensor.

When the main landing gear is in the retracted position, the tail skid is retracted. The sensor target is near to the tail skid up proximity sensor and far from the tail skid down proximity sensor.

PSEU 2 monitors these sensors for proper tail skid operation.



M42461 S000618825_V1

TAIL SKID SYSTEM - TAIL SKID UP AND TAIL SKID DOWN PROXIMITY SENSORS

TAIL SKID SYSTEM - INDICATIONS

Alert and Status Messages

The TAIL SKID advisory message shows when the tail skid is not in the correct position. Any of these three conditions cause the advisory message to show:

- The tail skid is not up, and the landing gear lever is UP, and the tail skid up sensor is not failed (40 second delay)
- The tail skid is not down, and the landing gear lever is DOWN, and the tail skid down sensor is not failed (40 second delay)
- The tail skid is not down, and alternate extension was commanded (40 second delay).

NOTE: The 40 second delay allows time for the tail skid to move to the commanded position.

NOTE: The alternate extension system does not release the tail skid.

The TAIL SKID status message shows when the tail skid is not in the correct position because of a failure. Either of these two conditions cause the TAIL SKID status message to show:

- The tail skid is not up and the landing gear lever is UP, and the tail skid up sensor is not failed, and alternate extension was not commanded (40 second delay)
- The tail skid is not down and the landing gear lever is DOWN, and the tail skid down sensor is not failed, and alternate extension was not commanded (40 second delay).

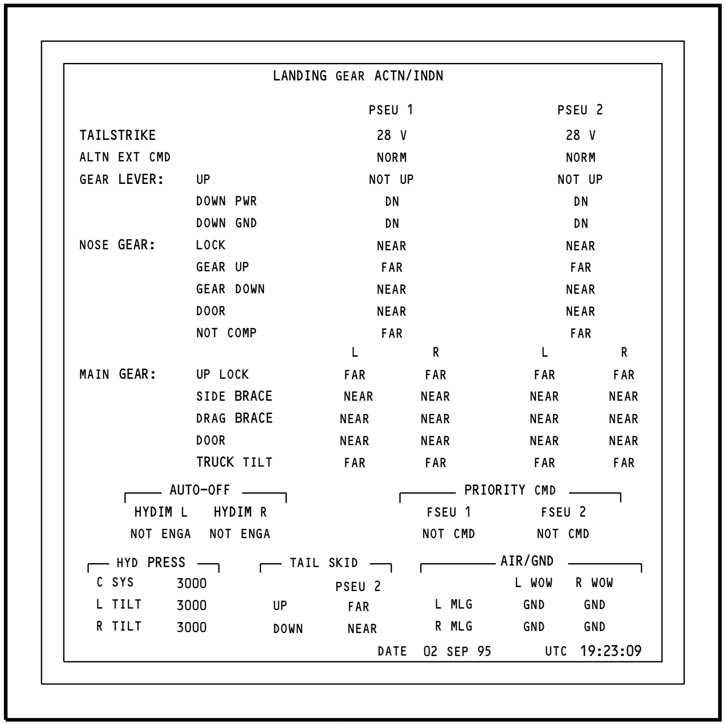
The TAIL SKID SENSOR status message shows when a tail skid proximity sensor fails. Any of these three conditions cause the TAIL SKID SENSOR status message to show:

- The tail skid up sensor is failed (5 second delay)
- The tail skid down sensor is failed (5 second delay)
- The tail skid up sensor and the tail skid down sensor indicate target near at the same time (5 second delay).

Maintenance Page Indications

The landing gear actuation/indication maintenance page shows the tail skid position. The tail skid up and tail skid down proximity sensor are monitored by PSEU 2.

The display shows the target NEAR or target FAR condition for each sensor. The display shows the loss of a proximity sensor input or an invalid input as an empty space.



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                     LANDING GEAR ACTN/INDN

                                PSEU 1                PSEU 2
TAILSTRIKE                       28 V                  28 V
ALTN EXT CMD                     NORM                  NORM
GEAR LEVER:    UP               NOT UP                NOT UP
               DOWN PWR           DN                    DN
               DOWN GND           DN                    DN
NOSE GEAR:     LOCK              NEAR                  NEAR
               GEAR UP           FAR                   FAR
               GEAR DOWN         NEAR                  NEAR
               DOOR              NEAR                  NEAR
               NOT COMP          FAR                   FAR
                              L         R           L         R
MAIN GEAR:     UP LOCK       FAR       FAR         FAR       FAR
               SIDE BRACE    NEAR      NEAR        NEAR      NEAR
               DRAG BRACE   NEAR       NEAR        NEAR      NEAR
               DOOR         NEAR       NEAR        NEAR      NEAR
               TRUCK TILT    FAR       FAR         FAR       FAR

        ┌─── AUTO-OFF ────┐                ┌──── PRIORITY CMD ────┐
         HYDIM L   HYDIM R                    FSEU 1       FSEU 2
        NOT ENGA  NOT ENGA                  NOT CMD      NOT CMD

  ┌─ HYD PRESS ─┐    ┌─ TAIL SKID ─┐   ┌───────── AIR/GND ─────────┐
   C SYS    3000                                   L WOW   R WOW
                               PSEU 2
   L TILT   3000       UP       FAR       L MLG     GND     GND
   R TILT   3000       DOWN     NEAR      R MLG     GND     GND
                                DATE  02 SEP 95       UTC  19:23:09
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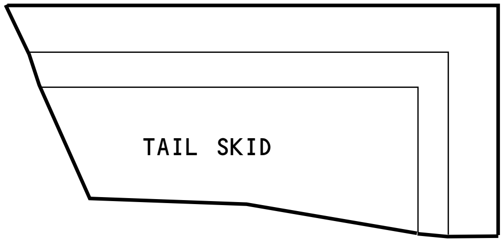
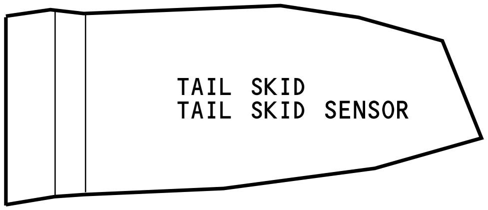
LANDING GEAR ACTUATION/INDICATION MAINTENANCE PAGE



TAIL SKID

EICAS DISPLAY



TAIL SKID
TAIL SKID SENSOR

STATUS DISPLAY

M42462 S000618826_V1

TAIL SKID SYSTEM - INDICATIONS