G650

LANDING GEAR & BRAKES SYSTEM

Pedal Position Transducer (PPT)

L Hyd Sys

BCU A B

R Hyd Sys

Pedal deflection

Electrical signal

BCU commands amount of hydraulic power to brakes

Brake application

Inboard Brakes

Outboard Brakes
- Fully retractable tricycle landing gear

- Sequencing and operation of gear and gear doors are controlled by a microprocessor called the Landing Gear Control Unit (LGCU)

- The landing gear is **electrically** controlled/sequenced and **hydraulically** operated
- **If hydraulic pressure is not available the landing gear can be extended via compressed nitrogen stored in two (2) bottles located in the nose wheel well**

- Each gear incorporates a conventional oleo-pneumatic shock strut with dual wheels and tires

  **Tires:**
  - Nitrogen

  **Struts:**
  - MIL-H-5606

- The nose gear’s steering system is **electrically controlled and hydraulically driven by a steer-by-wire system**
• One set of two (2) nose wheel tires (Goodyear)

• Two sets of two (2) main tires each (Goodyear)

• Rated at: 195 kts (ground speed)

• Tire pressure: 216 Psi + 2 (All weights)

• Landings: Approximately 220
**Nose Tires and Wheels:**

A) Nose wheel tires are designed to deflect water away from the fuselage and the engine inlets

B) Each wheel has one safety plug to deflate the tire if the internal pressure exceeds 375 ± 25 psi due to over inflation of the tires

**Main Tires and Wheels:**

A) Each wheel has one fusible plug to deflate the tire if the internal pressure exceeds 415°F due to over heated wheel brakes

B) Each wheel has one safety plug to deflate the tire if the internal pressure exceeds 515 psi ± 40 due to over inflation of the tires

C) Each wheel has individual braking via a brake-by-wire system with anti-skid protection down to ten (10) knots
- Each of the four (4) main gear wheels has individual braking via a Brake-by-Wire system.

- Proximity sensors provide:
  - **WOW AIR** or **GROUND mode status**
  - Gear position
  - Gear door position

- A LANDING GEAR MAINTENANCE CONTROL PANEL (LGMC) allows retraction/extension of the landing gear on the ground while the aircraft is on jacks. It can also be used to open the gear doors during pre-flight inspection.
Landing Gear Control Unit (LGCU)

- The LGCU is the brains of the system
- The LGCU controls the electrical sequencing and operation of the landing gear and gear doors
- The LGCU contains two control lanes and one monitor lane. Either control lane is capable of controlling the landing gear system and has a different power source.
- The LGCU receives input from:

- Proximity sensors
- WOW data
- Landing gear handle

- The LGCU is located in the REER

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- Extension and retraction requires:

1. **Electrical** power to operate

2. **Hydraulic** power to actuate

   normally provided by the **Left Hydraulic System**
In the event of failure of the engine-driven hydraulic pump, the landing gear can be extended or retracted by the PTU or AUX pumps.
- The PTU activates automatically (< 2400 psi) and helps retract the landing gear following a left engine failure after \( V_1 \) (regulatory requirement).
- In the event of total failure of the Left Hydraulic System, the landing gear can be extended via two (2) Nitrogen bottles located in the nose gear wheel well.

- The Alternate Gear Extension System ports high pressure Nitrogen to the gear extension system to extend the gear. The Nitrogen repositions the nose and main gear dump valves to a dump position.
NORMAL LANDING GEAR EXTENSION

1. [L Hyd Sys] AND [PTU] AVAILABLE

2. \( \leq V_{LO} \) (225 KCAS)

3. Gear handle (Electrical switch) selected DOWN (illuminates RED)

4. Gear doors open fully

5. Landing gear extends and locks

6. Three GREEN (down and locked)

7. Landing gear doors close

8. Gear handle light Extinguishes
- Normal landing gear retraction

1. [L Hyd Sys] and [PTU] available

2. \( \leq V_{lo} \) (225 kCAS)

3. Gear handle (Electrical switch) selected UP (illuminates RED)

4. Gear doors open fully

5. Landing gear retracts into the uplocks

6. Landing gear doors close

7. Gear handle light Extinguishes
- **ALTERNATE LANDING GEAR EXTENSION**

1. \(< 175 \text{ KCAS}\)

2. Gear handle (Electrical switch) selected **DOWN** (illuminates **RED**)

3. Pull EMER LDG GEAR handle

4. Gear doors open fully and remain open

5. Landing gear extends in six (6) seconds

6. Three **GREEN** (down and locked)

7. Gear handle light Extinguishes

8. Landing gear doors remain open

- **Nose Gear Door Open**
- **L&R Main Gear Door Open**
Landing Gear **Warnings**

- **< 500' AGL**
- **< 190 KTS**

"Too low, gear"

Voice **ORIDE**

GPWS **ORIDE** = Silences aural warning

- **Flaps < 22°**
- **< 350' AGL**
- **Near idle**

**Gear unsafe**

Warning horn will sound (klaxon tone)

Horn silence = Silences warning horn

**Flaps > 22°**

**Gear unsafe**

Warning horn will sound (klaxon tone)

Horn silence = Will **not** silence warning horn
Limitations

Maximum altitude to operate gear or fly with the gear extended: 20,000 MSL

175 KCAS

VLO 225 KCAS

VLE 250 KCAS

Speed brakes and gear down inflight are prohibited.

Maximum tire speed: 195 knots (ground speed)
Nose Wheel Steering System (NWS)

- **Electrically-controlled**
- **Hydraulically-driven**
- **Mechanically-actuated**

by a **Steer-by-Wire System**

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- The **Nose Wheel Steering Control Unit (NWSCU)** is a microprocessor-based control unit located inside the control housing panel.

- The NWSCU is powered by 28 VDC.

- Provides **Steer-by-Wire inputs** to the **Nose Wheel Steering Unit (NWSU)**
- The **NWSCU** receives input from:

- Power Switch
- Pedal Disc Switch
- Tiller RVDT Position
- Electric Hydraulic Servo Valve
- Nose Wheel Position LVDT
- Oversteer Proximity Switch
- IRUs
- FCCs

- The **nose wheel steering unit (NWSU)** converts hydraulic pressure into torque to rotate nose wheels via the steering collar which transfers torque to the torque links.
- NWS = **RED** guarded switch "Clunks" on opening

- Speed Sensitive Steering:

**Pedal Steering:**

- Left 7° / Right 7°

**Tiller Steering:**

- 80° ± 2°

- Pedal steering (NWS failure) = Left 16° / Right 16°

- Pedal steering + Tiller steering = NW deflection

- NWS Overtravel Indicator:

  > 84°

  ![NWS Overtravel Indicator Diagram]
Main Wheel Brakes

- A digital two-channel microprocessor called brake control unit (BCU) controls the brake-by-wire system.

- The BCU is located in the REER and it contains two identical circuit card assemblies, each of which controls either the inboard or outboard systems.

- The two (2) identical brake control system channels, operating simultaneously from independent hydraulic and electrical systems, control normal braking.
- The purpose of the BCU is to prevent tire damage or failure caused by skidding or locked wheels during landing or a rejected takeoff.
- The brakes are hydraulically powered by:

  - Left Hydraulic System
  - Power Transfer Unit (PTU)
  - AUX pump
  - Inboard accumulator

  - Right Hydraulic System
  - Outboard accumulator

If AUX pump is selected on during ground operations with engines not running only the inboard accumulator is charged.
The parking brake system has two \(2^\text{nd}\) independent accumulators pre-charged to 700 psi with Nitrogen and hydraulically charged to 3,000 psi.

Parking brake accumulator pressure will decrease continuously over a short time. Always chock aircraft until ready for engine start. Otherwise it may roll away!
- Parking brake must be set prior to checking the Brake Wear Indicators (BWI) – “Life remaining”

- **Two (2) BWI per brake assembly**
- **Amount of protrusion indicates “Life remaining”**
- **No protrusion: MX**
- During ground operations with only AUX hydraulic pump available: inboard brakes BWI only
- **Brakes: approximately 1,400 landings**
If the brake pedals are applied and inboard accumulator pressure is low the AUX pump auto latch feature will command the AUX pump, if armed, to come on.

- **WOW GROUND** and brake pedal application

- **Inboard Accumulator**
  
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  **INBD** | **OUTBD**

- **Inboard Brakes**

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  **INBD** | **OUTBD**
- Anti-skid System:
  - Designed to safely minimize stopping distance
  - Modulates hydraulic pressure to the main wheel brakes when a skid is detected
  - Anti-skid protection is available down to ten (10) knots
  - Below ten (10) knots tight turns with differential braking can be made
  - The anti-skid system provides the following protections:

1. Touchdown protection:
   - Prevents landing with brakes on

Air mode

- Provided
  - Landing gear down/locked
  - Wheel speed < 70 knots

- Brakes available

- Wow(6) + five (5) seconds
  - OR
  - Wheel speed > 70 knots
3. **Locked wheel protection:**

- Compares wheel speeds

- If thirty (30%) < than its paired wheel brake pressure is released on that wheel

- Brake pressure remains modulated until speed recovers

3. **Controlled wheel spin down:**

- Brake pressure is applied during gear retraction/extension

- Controls rate of wheel spin down during retraction by applying 500-800 psi of brake pressure for 4.5 seconds

- Checks system health during extension and applies 1,500 psi of pressure for 4 seconds
**Autobrakes System:**

- **Automatic application of brakes during a rejected takeoff or during landing**

- **There are three (3) levels of deceleration on landing:** low, medium and high, and a single rejected takeoff (RTO) mode selected via four (4) position rotary switch

**Landing:**

- Initial brake application assists in de-rotation
- Deceleration braking ramps in over three (3) secs
- Three (3) rates of deceleration:
  - **Autobrake - Low**: 7'/$\text{sec}^2$
  - **Autobrake - Medium**: 10'/$\text{sec}^2$
  - **Autobrake - High**: Maximum anti-skid braking

- Autobrakes are disconnected by application of toe brakes (rudder pedals)

**Takeoff:** Autobrake - RTO

- Thrust levers to idle

- **Brake pressure application:**
  - 600 psi < 80 KTS > Maximum anti-skid braking
- **Brake Temperature Monitoring System (BTMS):**

  The BTMS monitors current brake temperatures sensed on all main wheel brakes

  - **Brake Overheat**
  - Speeds will not box
  - > 600°C sensed in one or more brake assemblies

- **Tire Pressure Monitoring System (TPMS):**

  The TPMS alerts the crew of improper pressures on all six (6) tires

  - \( \leq 186 \) psi: Tire Pressure Low
  - \( \leq 100 \) psi: Tire Pressure Low

  Recommended 210 psi for all weight measured after stationary for > two (2) hours

  Tire pressure is indicated on:

  - Standby Multifunction Controller (SMC) Utility page
  - Ground Service synoptic 1/6 page
Prior to towing the nose wheel TPMS harness and the nose gear torque link must be disconnected.
Landing Gear Control
Maintenance Panel (LGCMP)

The LGCMP is located on the right side of the fuselage and is used to:

1. Change WOW mode
   
2. Retract/Extend the landing gear while the aircraft (Maintenance function only)
   
3. Open/close landing gear doors
   (Expanded exterior pre-flight inspection)

* AUX pump is the normal source of hydraulic fluid and pressure for these activities
Safety Pins (8)

Each pin has a "Remove before flight" streamer.

- Three (3) gear pins are installed as part of the Post-flight inspection. The pins must also be installed prior to towing. Pins must be removed for flight.

One pilot removes/stores the pins. Then the other pilot confirms that all pins have removed and announces it. Failure to remove the pins will prevent the landing gear from retracting after takeoff.

The QRH addresses landing gear pins mistakenly left in.

Refer to: ATTEMPTED LANDING GEAR RETRACTION WITH SAFETY PINS INSTALLED
- Two (2) nose gear and two (2) main gear door pins are installed before opening the gear doors via the LGCMP

- One (1) LG mode PiP pin is installed in the LGCMP when changing modes — **NORMAL** → **MAINTENANCE**

A CAS message will alert the crew when the LGCMP is set to maintenance mode

**LG MAINTENANCE Mode**

Returning to **NORMAL** mode requires removal of the pin
Questions, comments or errors...please send me an email: ivan@code7700.com

Thank you!