

LANDING GEAR AND BRAKES

GENERAL

The landing gear is controlled from the landing gear control panel located on the tilted panel, which forms the lower part of the copilot's instrument panel. The landing gear is normally electrically controlled and hydraulically actuated by the airplane A system. A pneumatic alternate system is incorporated to extend the gear in the event of a hydraulic or electrical failure which might otherwise disable the landing gear. Each landing gear uses a dual wheel assembly. The nose gear has chined tires for water and slush deflection. The main landing gear is of the articulated trailing link type. The two-piece main landing gear doors are mechanically connected to the main gear trunnion and extend and retract with the individual gear assemblies. The nose gear utilizes three doors. The rear door is mechanically connected to the nose gear actuator and extends aft, or retracts forward with the nose gear assembly. The two forward side doors are operated mechanically by extension and retraction of the nose gear by rollers mounted on the landing gear trunnion, which operate the left and right bellcrank assemblies. The doors remain open when the gear is down and are closed when the gear is retracted.

The nose and main gear actuators each incorporate an internal lock to hold the gear in the extended position. Once the gear is locked in the down position, no hydraulic pressure is required to maintain the lock. Hydraulic pressure is required to unlock the down locks. The gear is held retracted by mechanical uplocks that are normally released hydraulically, but in case of hydraulic or other malfunction, can be unlocked mechanically through pull cables. The gear is locked up mechanically, after which the pressure is neutralized. The landing gear completes a retraction or extension cycle in less than six seconds. The gear can be operated at airspeeds up to 210 KIAS (V_{LO} / V_{LE}).

CONTROL

The landing gear control panel contains the landing gear handle, three green gear safe indicators and a red unlocked indicator. The landing gear handle has two positions: full down and full up; it must be pulled out to clear a detent before it can be repositioned. Operation of the gear and doors will not begin until the handle has been positioned in one of the two detents. A gear handle locking solenoid activated by either main gear squat switch and the nose gear squat switch, physically prevents inadvertent movement of the gear handle while on the ground. When the gear is retracted hydraulic pressure not only retracts the landing gear, but is also used to center the nose wheels prior to nose gear retraction, actuate the brake metering valve to provide anti-spin brake pressure, and to pressurize the retract side of the uplock actuators in order to ensure the uplock hooks are in the proper position to receive the gear.

NOTE

The nose gear torque links must be disconnected during towing operations or the system may be damaged. The torque link disconnect pin is removed by removing a safety pin from the shaft by pushing a release button and pulling out the pin. The torque links are spring loaded to extend horizontally from the nose gear strut when the pin is removed.

LANDING GEAR EXTENSION AND RETRACTION FLOW

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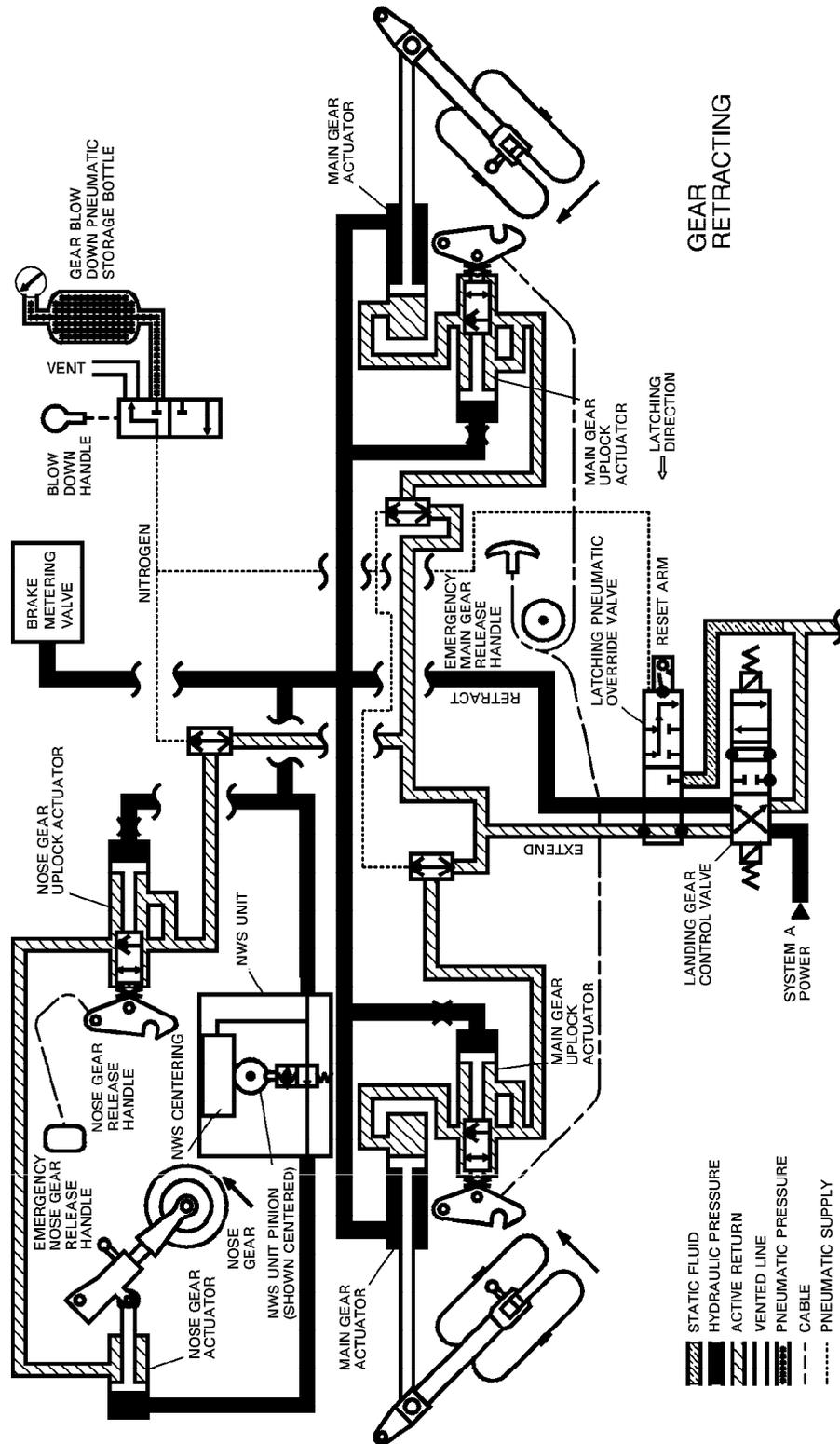


Figure 2-16 (Sheet 1 of 6)

6785T2003

LANDING GEAR EXTENSION AND RETRACTION FLOW

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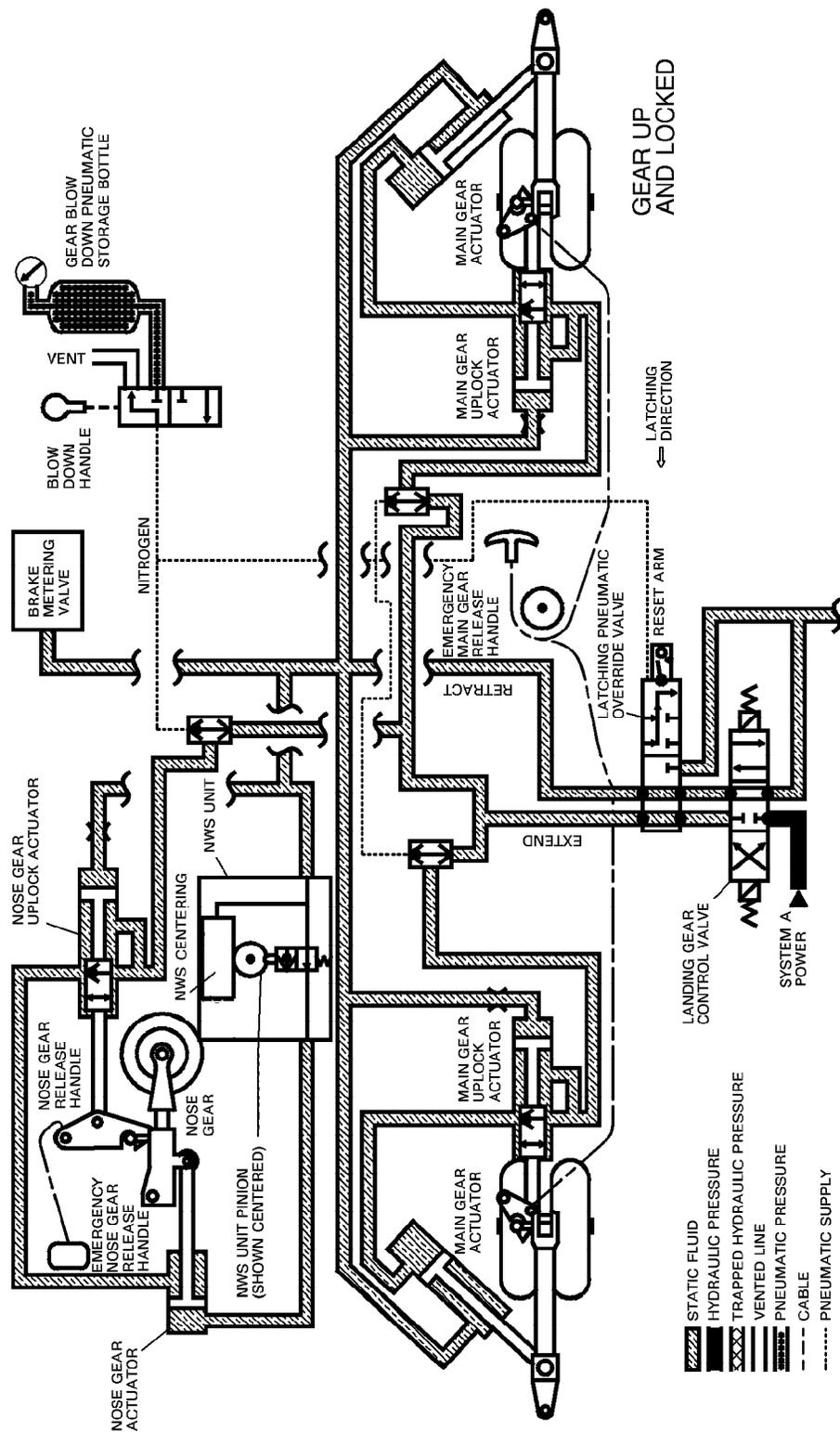
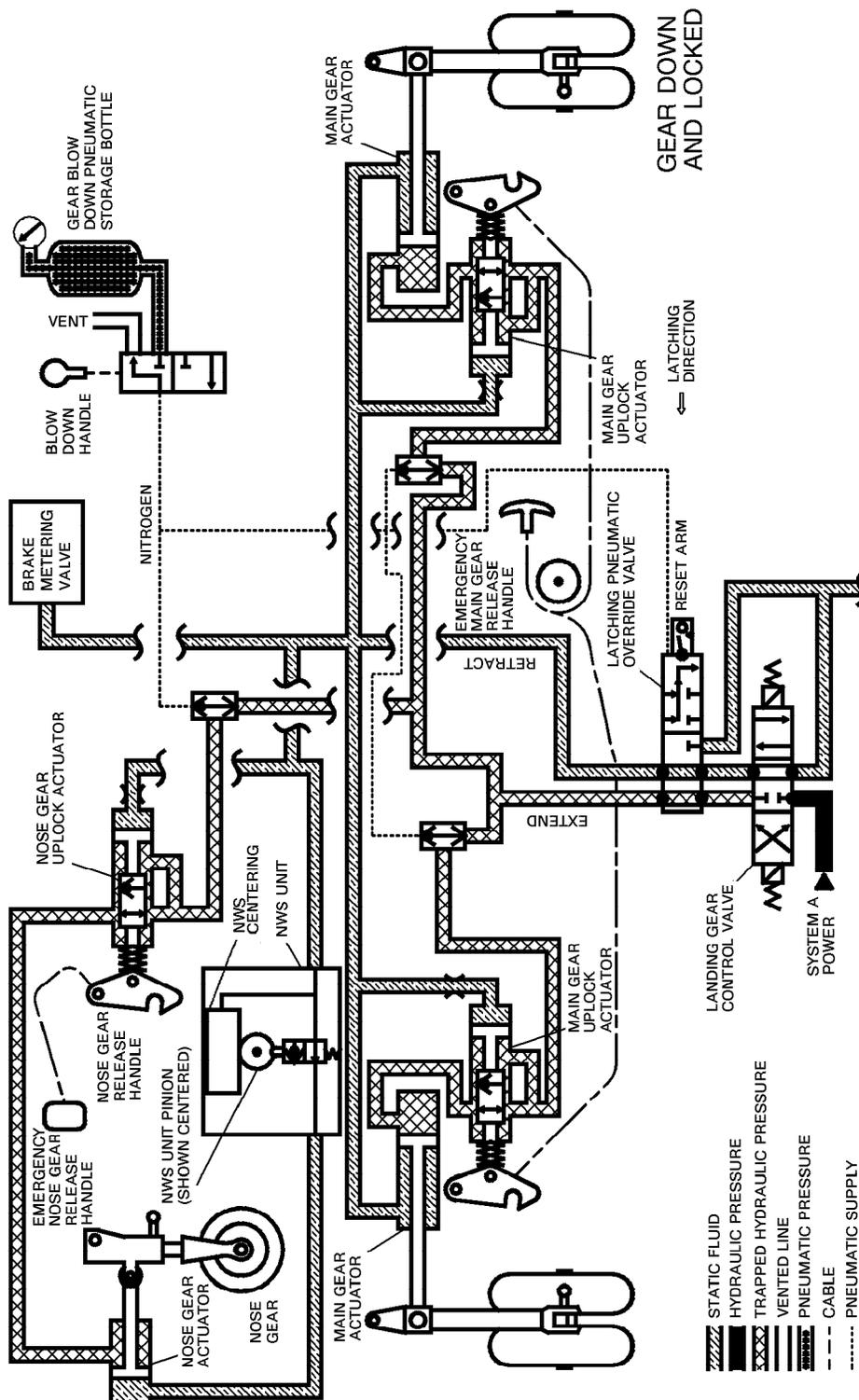


Figure 2-16 (Sheet 2)

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LANDING GEAR EXTENSION AND RETRACTION FLOW

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6785T2005

Figure 2-16 (Sheet 4)

LANDING GEAR EXTENSION AND RETRACTION FLOW

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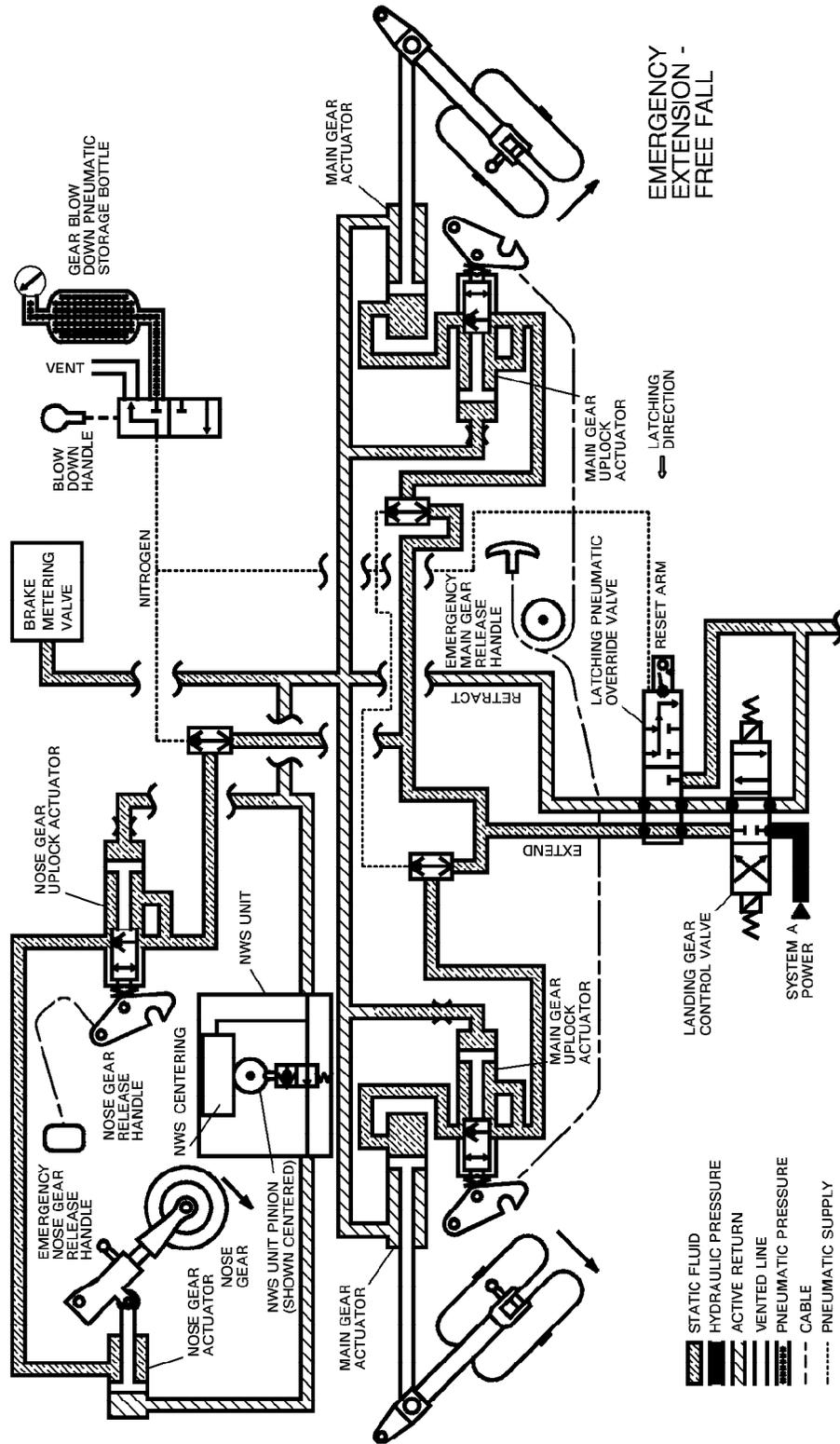
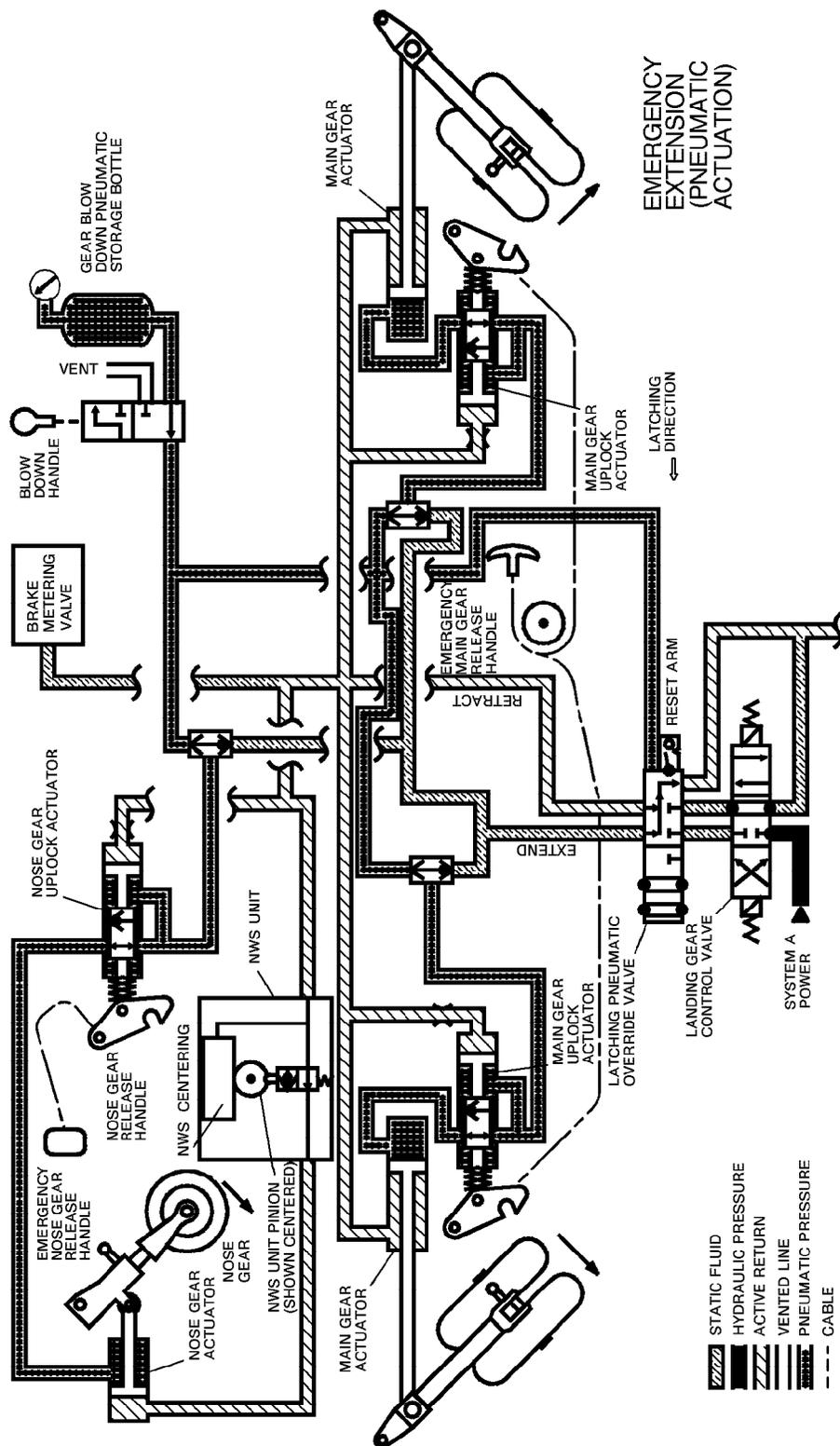


Figure 2-16 (Sheet 5)

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LANDING GEAR EXTENSION AND RETRACTION FLOW

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6785T2008

Figure 2-16 (Sheet 6 of 6)

EXTENSION AND RETRACTION

In a landing gear retraction cycle, the following takes place:

1. With the weight off the landing gear, the main gear and nose gear squat switches close. Power is applied to the lockout solenoid allowing the landing gear handle to be placed in the UP position.
2. Actuation of the UP microswitch by the gear handle simultaneously:
 - a. Lights the gear UNLOCK warning light.
 - b. Positions the landing gear control valve to route hydraulic fluid to the retract side of the the nose gear and main landing gear actuators. Landing gear retract pressure is routed through the power steering unit and is prevented from reaching the nose landing gear actuator until the nose wheels are in the centered position.
 - c. Momentarily applies the main wheel brakes.
3. Upon retraction the landing gear are latched and mechanically held in place by the uplock hooks. Hydraulic unlatching occurs at the beginning of the extension cycle.
4. Actuation of the three gear up microswitches:
 - a. Removes power from the landing gear control valve, which removes hydraulic pressure from actuators and main gear uplock hooks.
 - b. Extinguishes gear UNLOCK indicator light.

The reversed sequence during a gear extension is identical with the following exceptions:

1. Solenoid lock on landing gear handle is not in use.
2. Fluid is routed by the control valve through the uplocks to release them, and then to the extend side of the actuating cylinders.
3. GEAR DOWN microswitches extinguish gear UNLOCK light and illuminate the green LH, RH and NO gear indicating lights.

POSITION AND WARNING SYSTEM

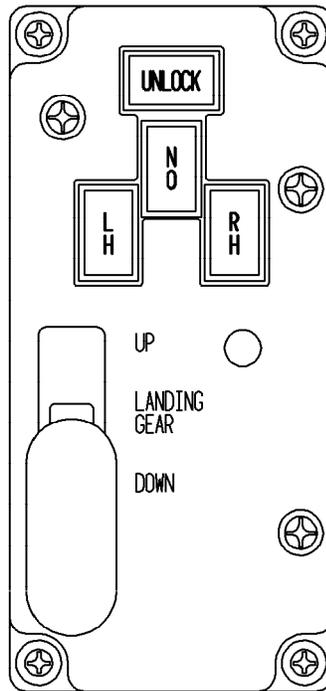
The landing gear position and warning system provides visual and audible indication of landing gear position. Three green safe lights and a red gear UNLOCK light are located in a group adjacent to the gear control handle. Each green light corresponds to one gear, NO (nose), LH or RH and indicates that it is in the down-and-locked position. The red light indicates an unsafe gear position (in transit or not locked). The landing gear warning system sounds an audible warning if the gear are not down and locked and the throttles are retarded past a certain point. The warning horn can only be silenced by advancing power, which will reset the horn, or by clearing the condition which has caused the warning.

The warning horn will sound when any of the following conditions exist:

1. The flaps are $>24^\circ$ and the landing gear are not down and locked.
2. Radar altitude is valid and radio altimeter is below 500 feet, the TLA (throttle lever angle) of both throttles is less than 30 degrees, and the gear are not down and locked.
3. The radar altitude is not valid, the flaps are $<24^\circ$, both throttles TLA IS $<30^\circ$, both angle-of-attack probes are sensing >0.4 , and the gear are not down and locked.
4. If the rotary test switch is placed in the LDG GR position, (electrical power available) all green and red gear lights will light. If the flaps are $<24^\circ$ the horn will sound. Also if both throttles =TLA $<30^\circ$, radar altitude is valid, and the radio altimeter <500 feet, the horn will sound.

LANDING GEAR POSITION WARNING

A34194



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Figure 2-17

EMERGENCY EXTENSION

In the event of normal system malfunction, an emergency (nitrogen bottle) backup system is provided to unlock the gear, blow it down, and lock it into place. Two manually operated systems (nose and main gear) are provided to release the landing gear for free-fall if the blowdown system did not unlock the uplock hooks.

The landing gear is extended with the blowdown system by first placing the gear handle down. The auxiliary gear control knob under the left side of the copilot's panel is then pulled to blow the gear down.

NOTE

If the gear handle is locked up, the blowdown will bypass the hydraulic system. After the gear blowdown has actuated, the gear cannot be retracted.

If the blowdown system does not unlock and extend the gear, the manual unlocking cables may be used to pull the uplock hooks. Manually releasing the landing gear from the up locks requires two separate actions. For the nose gear, the manual release is actuated by pulling the O-ring located under the left side of copilot's instrument panel. The main gear are released by pulling a T-handle which is located in the left aft cabin and is accessed through the left hand sink cabinet in the passenger compartment. These actions mechanically

disengage the main landing gear uplocks, allowing the gear to free-fall. After all three of the gear are released, yawing the airplane may be required to achieve green light indications for the main gear. This will cause the gear strut doors to pull the gear to the LOCK position. After all gear indicate safe the auxiliary gear knob is pushed in to stow it. It is not mechanically required that the landing gear handle be down to operate the manual system; however, it is recommended that the handle be placed down to properly position the landing gear control valve and to cause correct gear indications.

Once the pneumatic system is used, the pneumatic override valve will be locked into override position and must be reset (by maintenance personnel) by pulling it back to the normal position.

CAUTION

THE LANDING GEAR MUST NOT BE RETRACTED AFTER THE PNEUMATIC BLOWDOWN SYSTEM HAS BEEN USED UNTIL A MAINTENANCE INSPECTION IS PERFORMED.

WHEEL BRAKES

Toe-actuated multiple-disc self adjusting carbon disc brakes are installed on the main gear wheels. Braking can be accomplished by either of two independent systems: the power brake hydraulic system or the back-up pneumatic system. Normal braking can be applied from either cockpit seat. The emergency brake control is installed below the left instrument panel only.

ANTISKID/POWER BRAKE

The power brake metering valve accepts 3000 PSI hydraulic pressure from the airplane A system and uses it to regulate the brake pressure by metering the pressure, which it provides to the antiskid control valve, proportional to pilot/copilot pedal deflection. The brake metering valve can also receive system hydraulic pressure from the auxiliary hydraulic pump when required.

The antiskid system provides power assisted braking with skid protection. It is designed to provide maximum braking efficiency on all runway surfaces. It prevents skidding by limiting application of brake pressure to a specific wheel whenever a skidding of that wheel is detected. The system consists of four wheel speed transducers, two antiskid valves, a control box and an indicating system. The transducers, in the axles of each main landing wheel, generate current proportional to rotational speed of the wheel. These currents are monitored by a control box, and when a skid condition is detected (excessive deceleration of wheel rotation), the control box generates a signal to the appropriate antiskid control valve to modulate pressure to the skidding wheel(s). Below a taxi speed of approximately 12 (10 ± 2) knots, the antiskid system performance will be slightly degraded but it will still function.

To ensure proper braking on water, snow, and ice-covered hard-surface runways and all unimproved surfaces, it is necessary for the pilot to apply maximum effort to the brake pedals throughout the braking run. When the system anticipates a skid and releases the applied brake pressure, any attempt by the pilot to modulate braking can result in an interruption of the applied brake signal and may increase stopping distance significantly.

A switch on the instrument panel (HYDRAULIC PUMPS control panel) allows the pilot to select ANTISKID OFF or NORM. When the switch is in the NORM position, the antiskid function is operational. With the control switch in the OFF position, the pilot has power braking available without the antiskid function.

If the hydraulic system should fail due to failure of the pumps in both the A and B systems, the auxiliary pump may be used to operate the power brake system. Antiskid braking is still available when the auxiliary hydraulic pump is used.

Locked brake touchdown protection is provided by the antiskid control box. It prevents pilot input of hydraulic pressure to the brakes until the squat switches signal that a landing has occurred. Prior to touchdown and wheel spinup, it commands the antiskid valves to block all pressure from the brake metering valve and to release any pressure within the brake assembly into the system return line. This touchdown protection mode remains in effect for five seconds after main landing gear strut compression, to allow adequate time for wheel spinup when landing on wet or icy runways. However, touchdown protection mode is overridden when the wheel rotation reaches a speed equivalent to above thirty knots, at which time the touchdown protection mode will no longer be in operation and wheel braking will become effective.

During the antiskid system self-test CAS messages are inhibited.

PARKING BRAKE

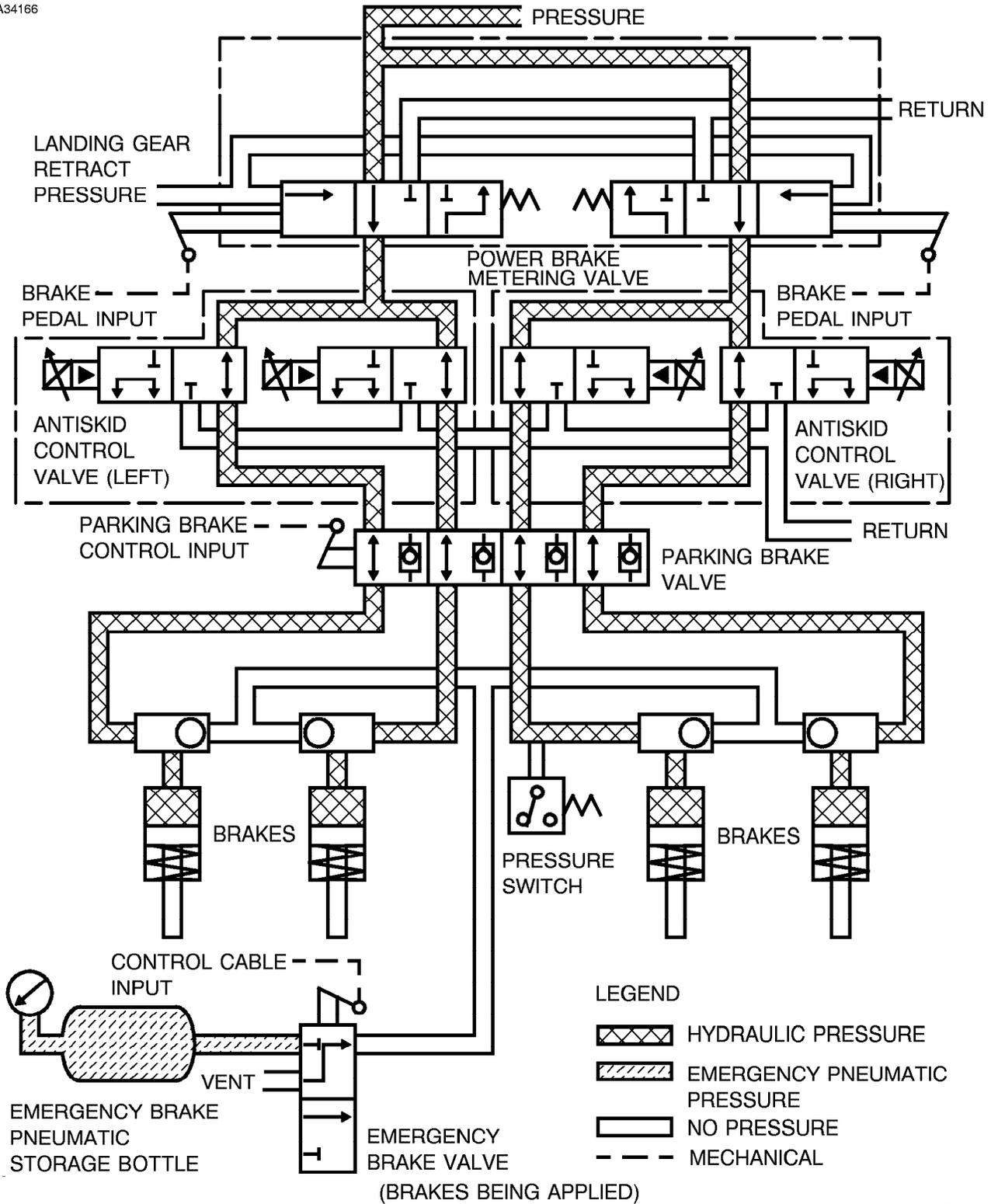
The parking brake is a part of the normal brake system and employs controllable check valves that can prevent the return of fluid after the brakes have been set. Parking brakes are set by depressing the toe brakes and pulling out the parking brake handle located at the aft end of the center pedestal, or by pulling the handle and then applying the brake pressure. The brakes are released by pushing the handle in. If engines are not running, the auxiliary hydraulic pump must be turned on in order to set the parking brakes. Subsequent application of brake pedal pressure will restore or increase pressure at the brake assemblies by actuating check valves within the parking brake valve. The parking brake should not be set if the brakes are very hot. This increases brake cool-down time due to decreased airflow, and may result in sufficient heat transfer from the brakes to cause the parking brake thermal relief valves to open or to melt the thermal relief plugs in the wheel, causing deflation of the tire. A situation of this sort is most likely after a rejected takeoff or a maximum effort stop on landing.

If pressure should increase in the parking brake system, due to an increase of temperature after the brakes are applied, thermal relief valves in the parking brake valve will relieve the excessive pressure.

When the parking brakes are set and there is electrical power to the engine indicating and crew alerting system (EICAS), a cyan EICAS message PARK BRAKE ON will be displayed. The message is activated by a pressure switch (1200 - 1500 PSI) in the right brake line; it operates in conjunction with a position switch on the parking brake valve input lever to provide input logic to the EICAS system. If the parking brake handle is pulled up in flight, an amber PARK BRAKE ON EICAS message will appear. In this case a chime will also sound.

ANTISKID BRAKE DIAGRAM

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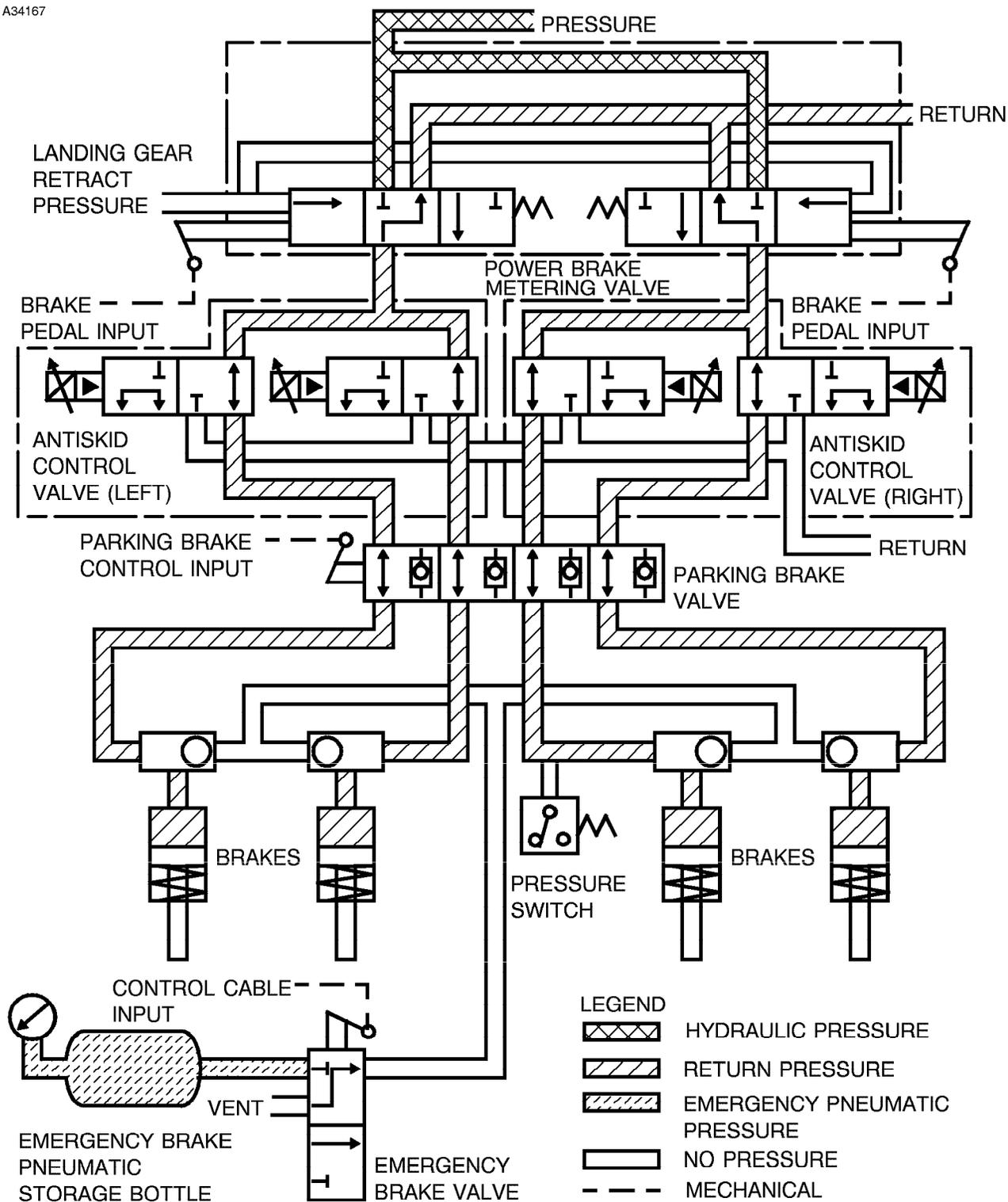


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Figure 2-18 (Sheet 1 of 4)

ANTISKID BRAKE DIAGRAM

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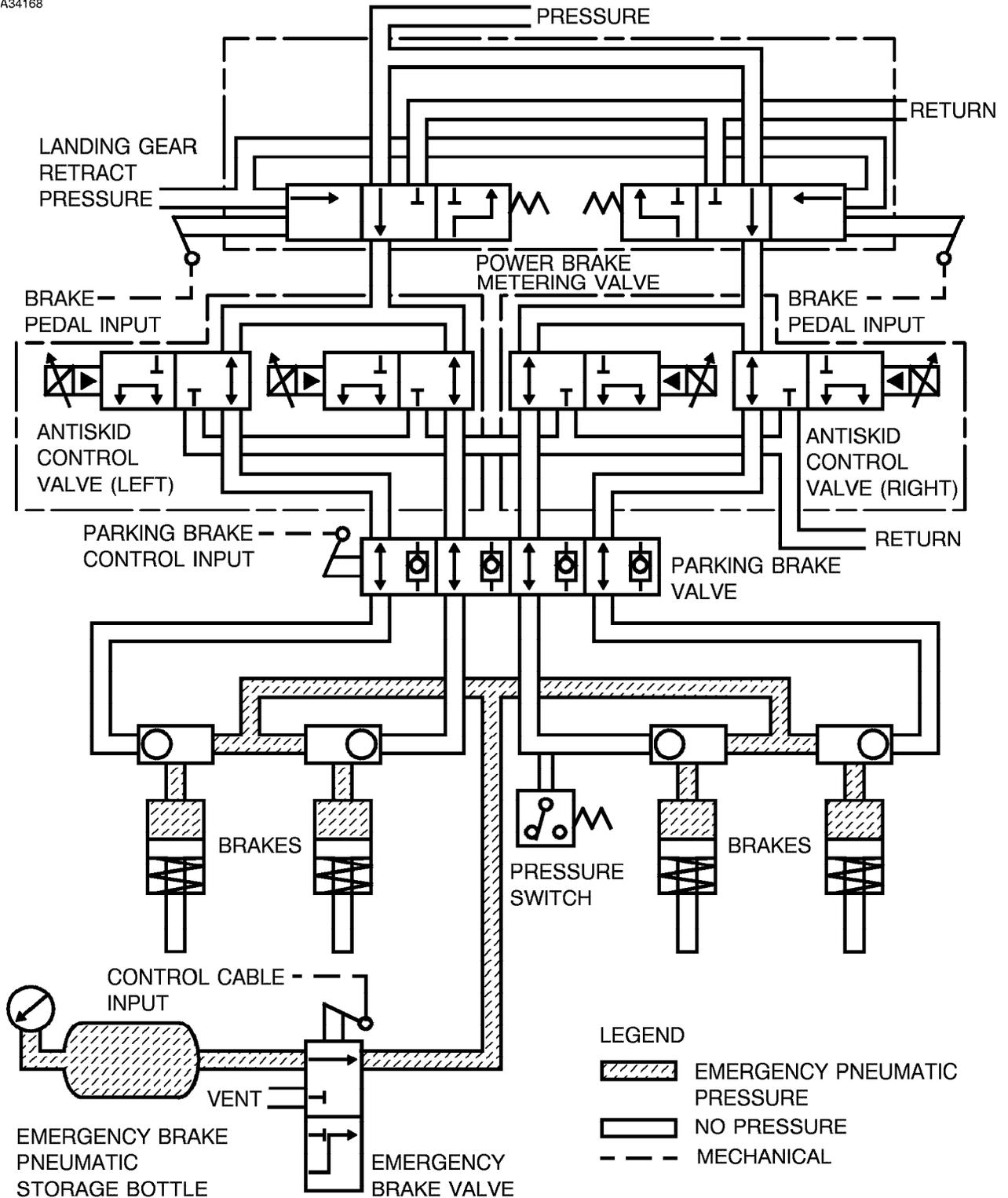
(BRAKES BEING RELEASED)

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Figure 2-18 (Sheet 2)

ANTISKID BRAKE DIAGRAM

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(EMERGENCY BRAKES BEING APPLIED)

Figure 2-18 (Sheet 3)

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ANTISKID BRAKE DIAGRAM

A34169

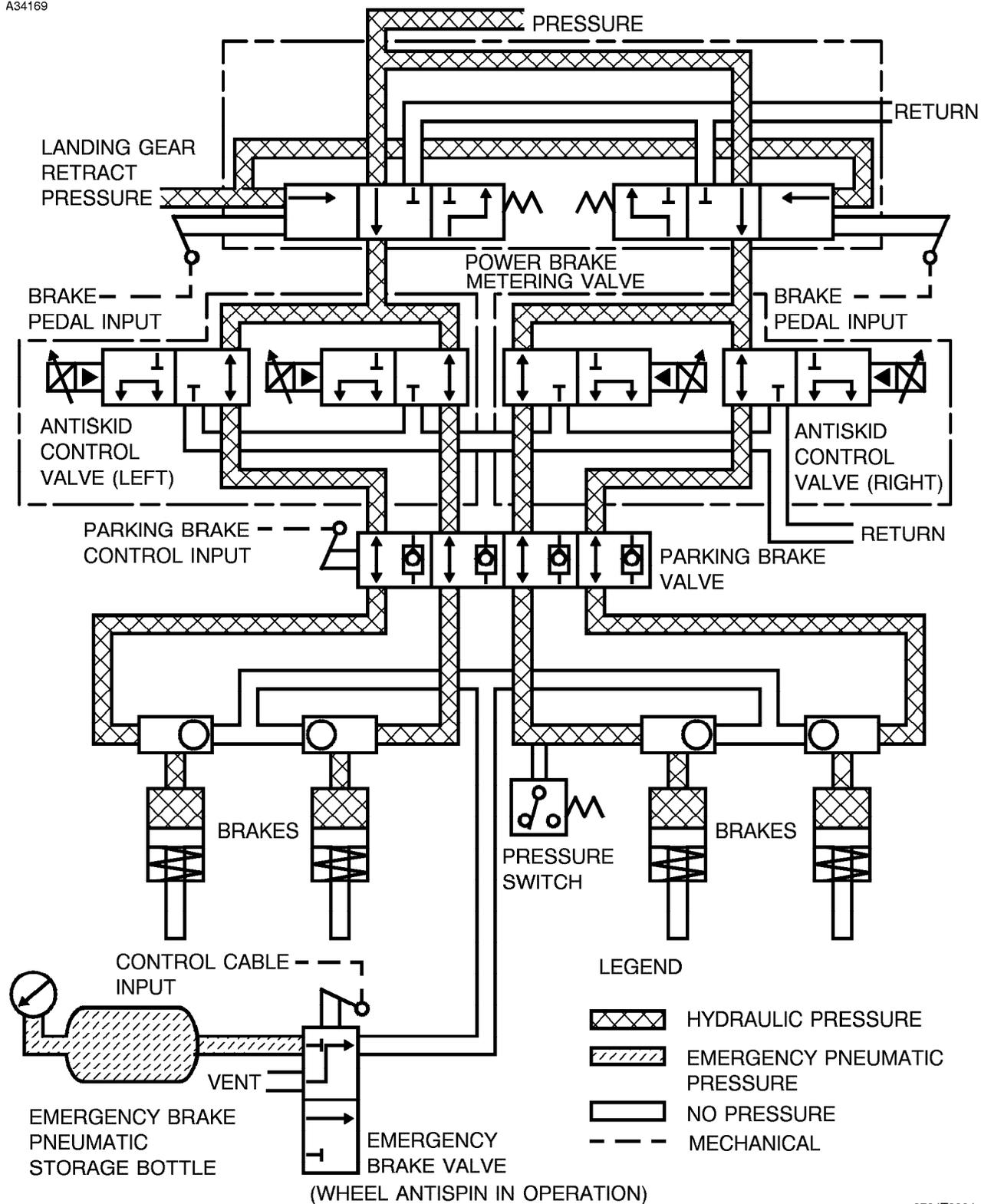


Figure 2-18 (Sheet 4)

6794T6004

If the parking brakes are set and the hydraulic pressure to the parking brake is less than 2350 PSI, when the lever is pulled an amber EICAS message PARK BRAKE/LOW PRESS will be presented. A chime tone will sound. The same two switches which illuminate the PARK BRAKE ON message also cause the low pressure annunciation.

EMERGENCY BRAKING

In the event of normal hydraulic braking system failure, a pneumatic brake system is installed. The pneumatic pressure required is contained in two emergency nitrogen bottles and is controlled by a lever with a red knob, located below the pilot's instrument panel. Pulling the lever aft will apply equal pressure to all four main landing gear brake assemblies. Releasing the back pressure on the lever and allowing it to move forward will relieve the pressure. The pressure to the brakes may be modulated to provide any braking rate desired, but differential braking and antiskid will not be available. The emergency nitrogen bottles, when fully charged, contains sufficient pressure for six full brake applications. For the most efficient use of the system, apply sufficient pressure to the brakes to obtain the desired deceleration rate. Maintain that pressure until airplane is stopped. When the handle is released, residual nitrogen pressure from the brakes is exhausted overboard.

NOTE

Pneumatic brake pressure is proportional to the lever position. Use caution in initial application of the emergency braking until a "feel" for the deceleration rate is obtained. Too sudden application can result in blown tires.

A fully serviced emergency brake bottle will initially provide approximately 95 cubic inches of nitrogen in each bottle at a maximum of 1800 to 2050 PSIG. The amount of brake application by the emergency brake handle is mechanically restricted in order to limit the amount of pressure metered to the brakes. Under normal braking conditions, full handle travel will result in braking that is short of that which would cause tire skidding, however caution should still be used so as not to over brake, since the antiskid will not function with emergency braking. When surface conditions are other than dry and normal, braking application should be adjusted accordingly.