MAIN HYDRAULIC SYSTEM FAILURES

FAILURE OF ONE HYDRAULIC PUMP

HYD PUMP PRESS LOW message on indicates failure of respective engine-driven hydraulic pump.
If right system fails, auxiliary pump comes on to supply all right hydraulic system consumers.

MAIN HYD PRESS indicator - MONITOR

AUX HYD PRESS LOW message on indicates that pressure is low when the pump is on, or that AUX HYD PUMP switch is in OFF position

AUX HYD PUMP switch - CHECK AUTO

NOTE

If two hydraulic pumps (either main and auxiliary or both main) are inoperative, limit airspeed to 250 KIAS as a precautionary measure.

FAILURE OF COMPLETE MAIN HYDRAULIC SYSTEMS

A. LEFT MAIN HYDRAULIC SYSTEM FAILURE

If L HYD PUMP PRESS LOW message is on and pressure is below 1200 psi, left hydraulic system has failed. Inoperative systems: left thrust reverser, emergency brakes, ground (outboard) airbrakes.

NOTE

1. At touchdown, only FLIGHT AIRBRAKES (inboard) message comes on.
2. Do not use emergency brakes.
3. Use right thrust reverser as necessary; correct asymmetry using ground steering and reverse thrust setting.

B. RIGHT MAIN HYDRAULIC SYSTEM FAILURE

If R HYD PUMP PRES LOW and AUX HYD PRESS LOW messages are on and pressure is below 1200 psi, right hydraulic system has failed. Inoperative systems:

- right thrust reverser
- normal brakes / anti-skid
- parking brakes
- normal landing gear extension
- flight (inboard) airbrakes
- nosewheel steering
- krueger flaps
- stick pusher
- elevator feel.

1. AUX PUMP cb's - CHECK IN
2. AUX HYD PUMP switch - OVRRD

NOTE

Do not place AUX HYD PUMP switch in OVRRD position if R HYD LEVEL LOW message is on.

If pressure rises above 1200 psi, aux pump motor thermal protection may have been previously activated:

3. AUX HYD PUMP switch - AUTO
4. Before krueger flaps & landing gear extension, AUX HYD PUMP switch - OVRRD
5. After krueger flaps & landing gear extension, AUX HYD PUMP switch - AUTO
6. On final approach, AUX HYD PUMP switch - OVRRD
7. After aircraft is stopped clear of runway, AUX HYD PUMP switch - AUTO
8. EMERG BRAKE lever - EMERG

If pressure stays below 1200 psi:

9. Perform Emergency Landing Gear Extension (page III-66)
10. EMERG BRAKE lever - EMERG
11. Plan landing with no krueger flaps (page III-50)

(Continued)

HYDRAULIC SYSTEM OVER HEAT

NOTE

1. If excessive temperature is caused by a malfunction of an engine driven pump, thrust reduction on the affected side, descent to a lower altitude, or engine shut-down may bring temperature within limits.
2. Excessive temperature may be cause by bypass flow of hydraulic fluid through hydraulic component(s). If HYD OVER HEAT (L/R) message comes on shortly following the operation of a hydraulically powered component, if practicable, return the component to the condition prior to receipt of the message and monitor the message.

HYD OVER HEAT (L/R) message on indicates that hydraulic fluid temperature is high.

1. Verify that landing gear lever is at the full extent of travel (UP or DOWN as appropriate)
2. Thrust lever, affected engine - IDLE
3. Monitor hydraulic fluid temperature

If HYD OVER HEAT (L/R) message remains on and hydraulic fluid temperature is rising:

4. Perform either or both (as practicable) of the following actions to reduce / control hydraulic:

NOTE

After the performance of either of the actions below monitor HYD OVER HEAT (L/R) message and hydraulic fluid temperature to determine effectiveness of action.

a. Descend to 10,000 ft or below
b. Shutdown affected engine – Perform ENGINE SHUTDOWN IN FLIGHT, page III-23

5. If the engine was shutdown and is required for landing then, restart affected engine prior to landing – Perform AIR STARTS, page III-23;
   Otherwise - Perform SINGLE-ENGINE LANDING, page III-29

LANDING GEAR SYSTEM FAILURES

EMERGENCY LANDING GEAR EXTENSION

CAUTION

ONCE THE EMERGENCY GEAR DOWN HANDLE IS ACTUATED, LANDING GEAR CANNOT BE RETRACTED FOR THE REMAINDER OF THE FLIGHT AND THE LANDING GEAR LEVER MUST REMAIN IN THE DOWN POSITION.

1. SLATS/FLAPS lever - 20°
2. Reduce speed to minimum for aircraft configuration (V_{REF} + 5)
3. Landing gear lever - DOWN

NOTE

The landing gear lever must be at the full extent of travel in the DOWN position.

4. EMERGENCY GEAR DOWN handle - RELEASE, TURN and LIFT
5. LANDING GEAR - CHECK; all landing gear indicate DN and, if so, proceed with normal landing

If neither main landing gear indicate DN *and nose gear indicates* DN *then proceed to step 6 only if conditions DO permit in-flight shutdown of right engine.*

If any other combination of landing gear do not indicate DN *or conditions DO NOT permit in-flight shutdown of the right engine, then proceed to step 7*

CAUTION

PERFORM IN-FLIGHT SHUTDOWN OF THE RIGHT ENGINE ONLY IF CONDITIONS PERMIT.

NOTE

The following step attempts to obtain main landing gear DN indication by securing the right main hydraulic system and restoring incrementally as appropriate.

6. Attempt to obtain both main landing gear DN indication:

(Continued)

a. Shut down the right hydraulic system:
   i. AUX HYD PUMP switch - OFF
   ii. Shutdown right engine - Perform ENGINE SHUTDOWN IN FLIGHT, page III-23

b. LANDING GEAR - CHECK that all landing gears indicate DN

If all landing gear do not indicate DN*, proceed to step 7:*

c. AUX HYD PUMP switch – AUTO
d. LANDING GEAR - CHECK all gear indicate DN and, if so, then proceed to step 6.f
e. If any landing gear does not indicate DN following AUX HYD PUMP start:
   i. AUX HYD PUMP switch – OFF
   ii. LANDING GEAR - CHECK all gear indicate DN

If any landing gear does not indicate DN*, proceed to step 7*

   iii. In preparation for landing, review inoperative systems associated with right main hydraulic system failure. See B. RIGHT MAIN HYDRAULIC SYSTEM FAILURE, page III-62
   iv. Perform SINGLE-ENGINE LANDING, page III-29

f. Restart right engine - Perform AIR STARTS, page III-23
g. LANDING GEAR - CHECK all landing gear indicate DN and, if so, then perform normal landing
h. If any landing gear does not indicate DN following restart of right engine:
   i. Shutdown right engine - Perform ENGINE SHUTDOWN IN FLIGHT, page III-23
   ii. LANDING GEAR - CHECK all landing gear indicate DN and, if so, perform SINGLE-ENGINE LANDING, page III-29

If all landing gear do not indicate DN *following right engine shutdown then proceed to step 7*

7. If any landing gear does not indicate DN:
   a. If all or elements of step 6 were performed, perform / verify (as appropriate) the following:
      i. AUX HYD PUMP switch - AUTO
      ii. Restart right engine, perform AIR STARTS, page III-23
   b. Perform LANDING WITH ABNORMAL LANDING GEAR CONDITIONS, page III-71

LANDING GEAR LOCK DOWN INDICATION FAILURE

NOTE

Expect longer extension times after flying in cold soaking conditions.

If during landing gear extension, normal transit symbol or DN indication does not appear:

1. Verify landing gear lever is at full extent of travel in the DOWN position
2. SLATS/FLAPS lever - 20°
3. Reduce speed to minimum for aircraft configuration (V_{REF} + 5)
4. R hydraulic pressure - CHECK

If pressure indication is below 1200 psi, or if all landing gears remain in the UP and LOCKED position (regardless of right hydraulic system pressure) perform EMERGENCY LANDING GEAR EXTENSION, page III-66:

5. Landing gear lever - UP; monitor indication changes

After 30 seconds minimum:

6. Landing gear lever - DOWN; monitor indication changes

NOTE

It may take up to 22 seconds for green DN indication to appear.

7. Repeat steps 5 and 6 as necessary

NOTE

If step 7 is required, maintenance action is recommended.

8. If one or more landing gear does not indicate DN, Perform LANDING WITH ABNORMAL LANDING GEAR CONDITIONS, page III-71

LANDING WITH ABNORMAL LANDING GEAR CONDITIONS

The procedures in this section provide instructions for landing if any or all of the landing gears cannot be extended and locked.

PREPARATION FOR LANDING WITH ABNORMAL GEAR CONDITION

CAUTION

PRIOR TO EXECUTING ANY LANDING WITH AN ABNORMAL GEAR CONDITION THE FOLLOWING PROCEDURE MUST BE PERFORMED IN ORDER TO INSURE THE MAXIMUM SAFETY FOR THE PASSENGERS AND CREW AND TO MINIMIZE DAMAGE TO THE AIRCRAFT. IF PRACTICAL OBTAIN CONFIRMATION ON LANDING GEAR CONDITION FROM AIRPORT TOWER OR OTHER OUTSIDE SOURCE.

1. Fuel load - REDUCE AS MUCH AS PRACTICAL
   (If use of fuel jettison is desired, see FUEL JETTISON, page III-54)
2. Passengers - BRIEFED
3. Cabin Items - SECURED
4. SEAT BELTS light - ON
5. NO SMOKE light - ON

LANDING WITH NOSE GEAR UNSAFE OR RETRACTED, BOTH MAIN GEAR DOWN & LOCKED

NOTE

If it is suspected that ice or snow contamination of the landing gear system may be preventing extension, if practical, fly to an area where melting can occur. If nose gear is fully retracted, attempt to release from uplocks by applying positive “g” loading not to exceed 2.0g. If partially extended but not locked down, perform a normal approach and firmly bump the main wheels on the runway in an attempt to shake the nose gear down and locked. Execute go-around. Select runway with least amount of crosswind.

1. ECS selector - RAM (below 3000 feet AGL)
2. V_{REF} - SET
3. FLAPS/SLATS lever - 40°
4. Gear not down warning tone - CANCEL
   (To cancel tone, place the IND LIGHTS switch first to the DCU A & LTS position and then to the DCU B position, holding the switch in each position for 15 seconds)
5. GROUND A/B switch – OFF
6. SHOULDER HARNESSES - LOCKED
7. Touchdown - RUNWAY CENTERLINE
8. FLIGHT A/B switch - EXTENDED AS NECESSARY
9. Thrust reversers - USE MAXIMUM (BOTH ENGINES) to reduce load on nose gear
10. Wheel brakes - USE MINIMUM
11. Fly nose of aircraft onto the runway and continue to use elevator to relieve forces on the nose gear after runway contact
12. Wheel brakes - AS NECESSARY FOR DIRECTIONAL CONTROL AND STOPPING

(Continued)

When stopped:

13. FUEL CUTOFF pushbuttons – PRESS (light – on)
14. BATT MASTER switch - OFF
15. Passenger evacuation – INITIATE (see PASSENGER EVACUATION, page II-46)

LANDING WITH NOSE AND ONE MAIN LANDING GEAR DOWN AND LOCKED, OPPOSITE MAIN GEAR UNSAFE OR RETRACTED

NOTE

If one main gear is fully retracted, attempt to release by applying positive "g" loading not to exceed 2.0 g. If partially extended, yaw the airplane to apply spanwise air load to force the affected gear outboard: left rudder for the left main gear; right rudder for the right main gear to attempt to lock the gear down.

1. ECS Selector - RAM (below 3000 feet AGL)
2. V_{REF} - SET
3. FLAPS/SLATS lever - 40°
4. Gear not down warning tone - CANCEL
   (To cancel tone, place the IND LIGHTS switch first to the DCU A & LTS position and then to the DCU B position, holding the switch in each position for 15 seconds)
5. GROUND A/B switch – OFF
6. Shoulder harnesses - LOCKED
7. Touchdown - SIDE OF RUNWAY WITH THE SAFE GEAR
8. Unsafe gear - RELIEVE WEIGHT ON GEAR WITH AILERONS AND THRUST REVERSERS
9. Thrust reversers - USE MAXIMUM INITIALLY, GRADUALLY DECREASING ON FAILED GEAR SIDE FOR DIRECTIONAL CONTROL
10. Wheel brakes - AS NECESSARY FOR DIRECTIONAL CONTROL AND STOPPING

When stopped:

11. FUEL CUTOFF pushbuttons – PRESS (light – on)
12. BATT MASTER switch - OFF
13. Passenger evacuation – INITIATE (see PASSENGER EVACUATION, page II-46)

ONE MAIN GEAR ONLY DOWN & LOCKED, OPPOSITE MAIN GEAR AND NOSE GEAR UNSAFE OR RETRACTED

If only one main gear is extended, retract gear (if possible) and perform LANDING WITH GEAR UP, page III-70.

NOSE GEAR DOWN & LOCKED, BOTH MAIN GEAR UNSAFE OR RETRACTED

If unable to extend and lock down main gear, retract nose gear (if possible) and perform LANDING WITH GEAR UP, page III-70.

BEFORE LANDING

1. Landing reference speed (V_{REF}) - CONFIRM AND SET (Section VII, Figures 7-243 through 7-272)

NOTE

If engine anti-ice and/or surface de-ice are activated before landing, select “De-ice ON” in the FMS conditions to obtain the correct V-speed values.

2. Landing lights - AS REQUIRED
3. PRESSURIZATION - MONITOR DEPRESSURIZATION
4. ANTI-ICE/DE-ICE - AS REQUIRED
5. IGNITION and WINDSHIELD HEAT - AS REQUIRED

NOTE

For aircraft with Mod 10157 installed, L WINDSHIELD HEAT message may momentarily come on if LIGHTS MASTER switch is placed in ON position with WINDSHIELD HEAT switch in ON position.

6. ENGINE SYNC switch - OFF
7. SLATS/FLAPS lever - AS REQUIRED
8. Landing gear lever - DOWN

NOTE

Ensure that landing gear lever is moved to the full extent of travel to the DOWN position.

9. Landing gear - DOWN AND LOCKED (3 DN indications)

NOTE

1. Extension times vary with temperature. Expect longer extension times after flying in cold soaking conditions.
2. It may take up to 22 seconds for green DN indication to appear.

(Continued)