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MOUNTS

Introduction

The PW150A engine has three front mount pads, two side and one top, mounted on the Reduction Gearbox (RGB). The engine also has two aft mount pads located on the left and right sides of the Intercompressor Case.

General Description

The front mount pads transmit axial, vertical and lateral loads. The front side pads transmit most of the engine torque loads. The aft mount pads transmit vertical and lateral loads, and the remaining engine torque loads. The RGB also has two pads for a torsion bar type torque restraint system, but these are not used in this installation.

Detailed Description

The Engine Vibration Isolator System (EVIS) and the Hydraulic Torque Compensation System (HTCS) work together, to provide a load path from the engine mount pads to the nacelle Engine Mount Structure (EMS). The EVIS has a vibration isolator (i.e. a soft isolation mount) for each engine mount pad.

The HTCS has two hydraulic actuator cylinders, a hydraulic fluid reservoir, a restrictor and check valve and connecting tubes. The HTCS provides high torsional stiffness to react engine torque loads, and low translational stiffness to minimize the transmission of vibrations (Refer to SDS 71–22–00).

Refer to Figures 1 and 2.

The EMS includes the front frame (horsecollar), mid–frame, strut attachment fittings, 14 tubular struts and the lower cowl. The front frame provides attachment points for the forward vibration isolators, the lower cowl forward lugs and the HTCS. It distributes the loads to the six forward mount struts. The mid–frame provides attachment points for the aft vibration isolators, the forward struts and the center lugs of the lower cowl. It distributes loads to the rear mount struts. The lower cowl is attached to the frames by the use of quick release “Expander Bolts”.

The EMS is arranged to provide a “multiple loadpath redundant structure”. The two upper rear struts distribute loads to the wing front spar through steel fittings, and the remaining six rear struts distribute loads to the nacelle A–frame through similar fittings. The two upper rear strut front fittings include vernier adjustment features to facilitate nacelle alignment during manufacture or replacement. The lower cowl aft lugs attach to the lowest strut rear fittings.

Snubbing distances are controlled at each isolator by clearances between metallic components. Isolator drift may be checked in service by snubbing clearance measurement using go/no–go gauges. The engine mount system is designed to permit inspection and/or removal of each isolator individually without removing the engine.

Bonding straps are taken from the engine RGB to each HTCS actuator and from the RGB to the two forward side isolators (two straps each side).

Forward Top Vibration Isolator

Refer to Figures 3 and 4.

The forward top vibration isolator is installed on the forward top mount pad of the engine. The isolator reacts axial, lateral and vertical loads and gives engine restraint in the event that both aft mounts fail. The isolator has a titanium bracket and two isolator plates that have elastomer pads bonded to each inner surface. The forward plate is titanium and the aft plate is aluminum. The bracket is bolted to the engine mount pad by four stainless steel bolts. A single steel bolt and core assembly, attaches the plates to the fore and aft sides of the bracket and fastens the complete assembly to the front frame. Clearance between the core and the bracket gives the snubbing envelope.

In the unlikely event of fire burning out the elastomer pads and aluminum plate, the titanium bracket, front plate and stainless steel bolt and core assembly will remain in place. The mounts will snub and allow increased fore and aft motion of the engine, but the load carrying capacity will not be impaired.

Forward Side Vibration Isolators

Refer to Figures 5 and 6.

The forward side vibration isolators are installed on the left and right side mount pads of the engine. They use identical hardware and can be assembled in either a left or right configuration. They react axial, lateral and vertical loads and are linked to the HTCS to react torque loads. The mounts are redundant, so that system integrity is maintained after loss of one mount. The isolator has a bracket assembly, two isolator plates and a HTCS link. The isolator plates have a single plate with two elastomer pads bonded to one side. The bracket is installed to the engine mount pad by four bolts.

The HTCS link has a spherical bearing at each end, with the lower end bolted to the bracket on the engine. The upper end is bolted to the HTCS actuator on the front frame. A single bolt and core assembly attaches the isolator plates to the front and rear sides of the bracket. The bolt then passes through the front frame and is secured with a nut and cotter pin. Clearance between the core and the bracket provides the snubbing envelope.

The bracket assembly, link, core and all bolts are stainless steel. The forward isolator plate is titanium and the rear plate is aluminum. In the event of fire burning out the elastomer pads and aluminum plate, the metallic components of the isolator will snub and still react engine loads.

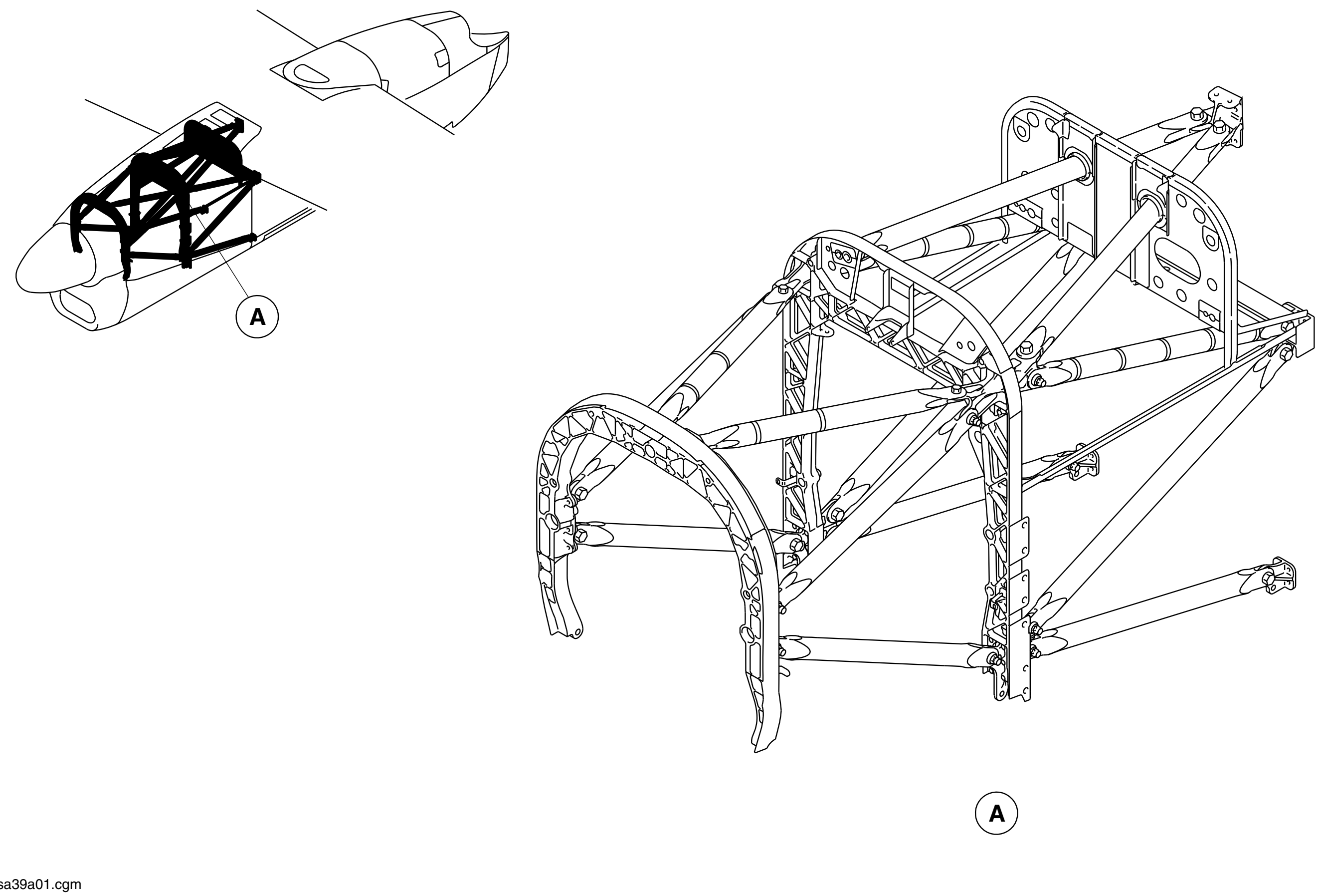
Aft Vibration Isolators

Refer to Figures 7 and 8.

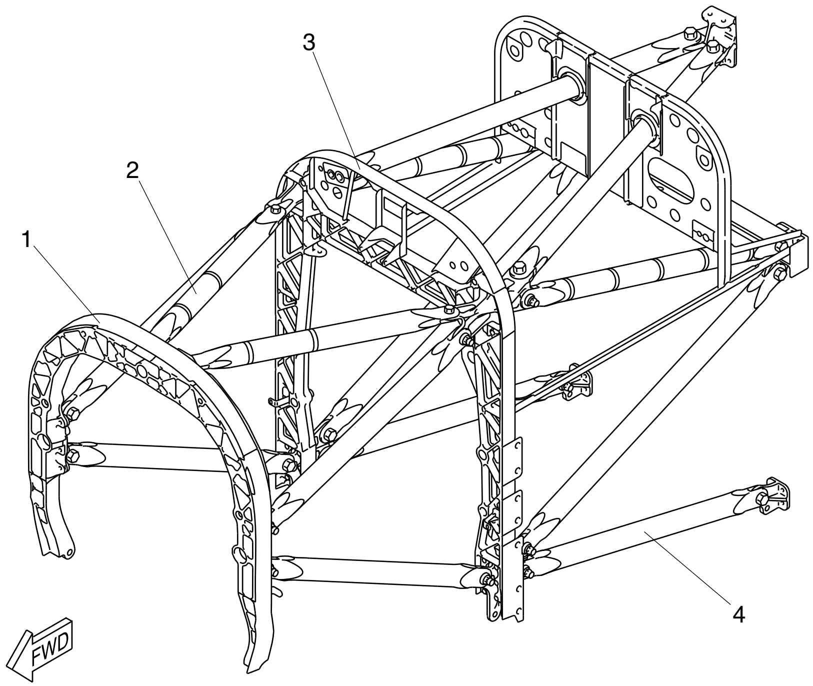
The aft vibration isolators are installed on the left and right aft mount pads of the engine. They use identical hardware and can be assembled in right or left configuration. They react vertical and lateral engine loads, and a small percentage of the engine torque loads. The isolator has an engine bracket, mid–frame bracket, two outer plates and a link. The outer plates have elastomer pads bonded to their inner faces. The engine bracket is bolted to the engine mount pad by four bolts. A single through bolt attaches spigots on the outer plates to a spherical bearing in the engine bracket. The inner surfaces of the elastomer pads key to the faces of the mid–frame bracket. The mid–frame bracket attaches to the mid–frame at the top, using a spherical bearing and a bolt, and at the bottom using a link, a spherical bearing and a bolt.

The arrangement of link and spherical bearings allows for differential expansion of the engine and structural components, without affecting load transmission. Clearance between the pad spigots and the mid–frame bracket gives the snubbing envelope.

The engine bracket and all the bolts are made of steel. The centre bracket and isolator plates are titanium. In the event of fire burning out the elastomer pads, the metallic components of the isolator will snub, but still react engine loads.



Nacelle Support Frames and Struts Location
Figure 1



LEGEND

1. Forward Frame.
2. Forward Strut.
3. Mid Frame.
4. Aft Strut.

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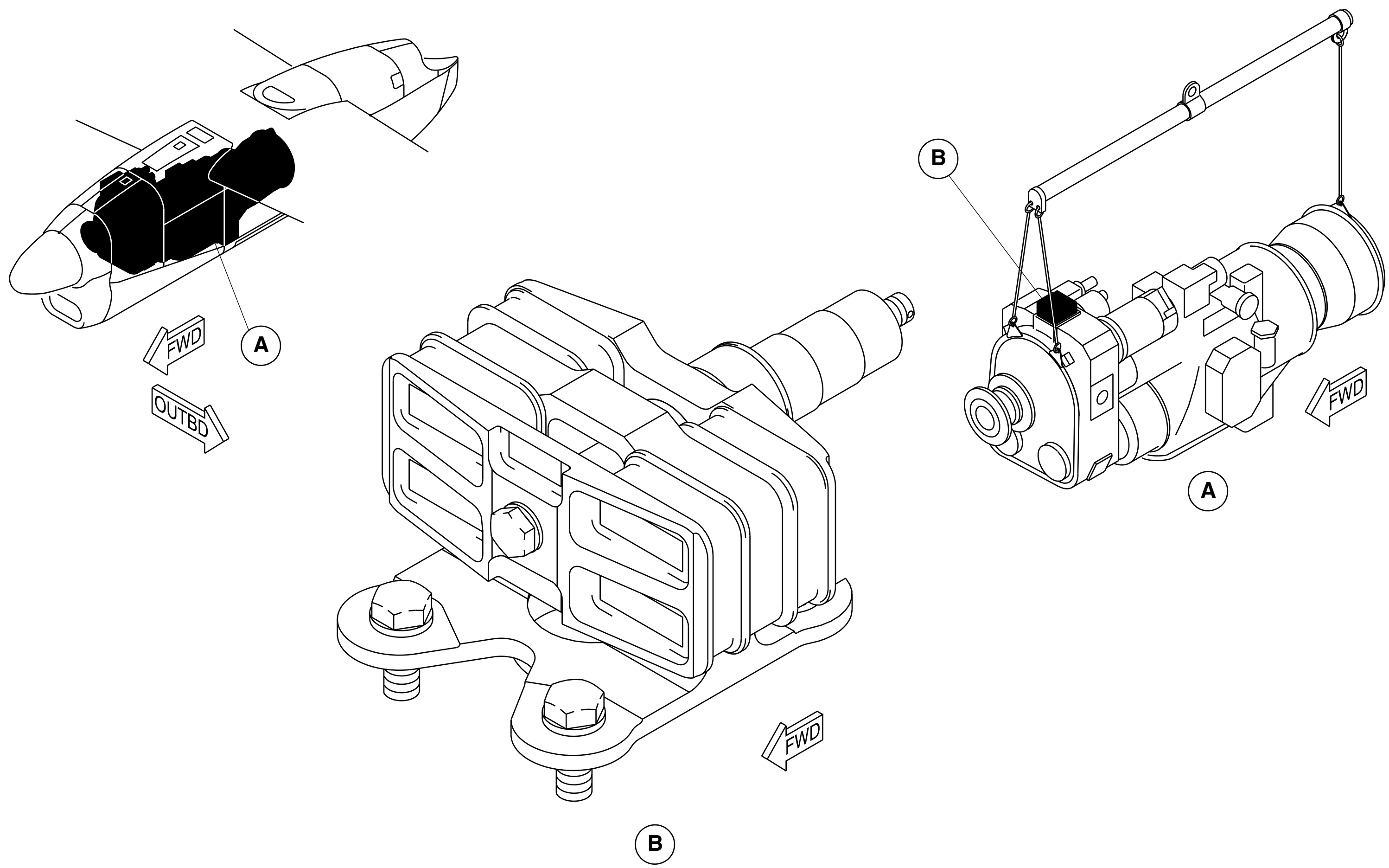
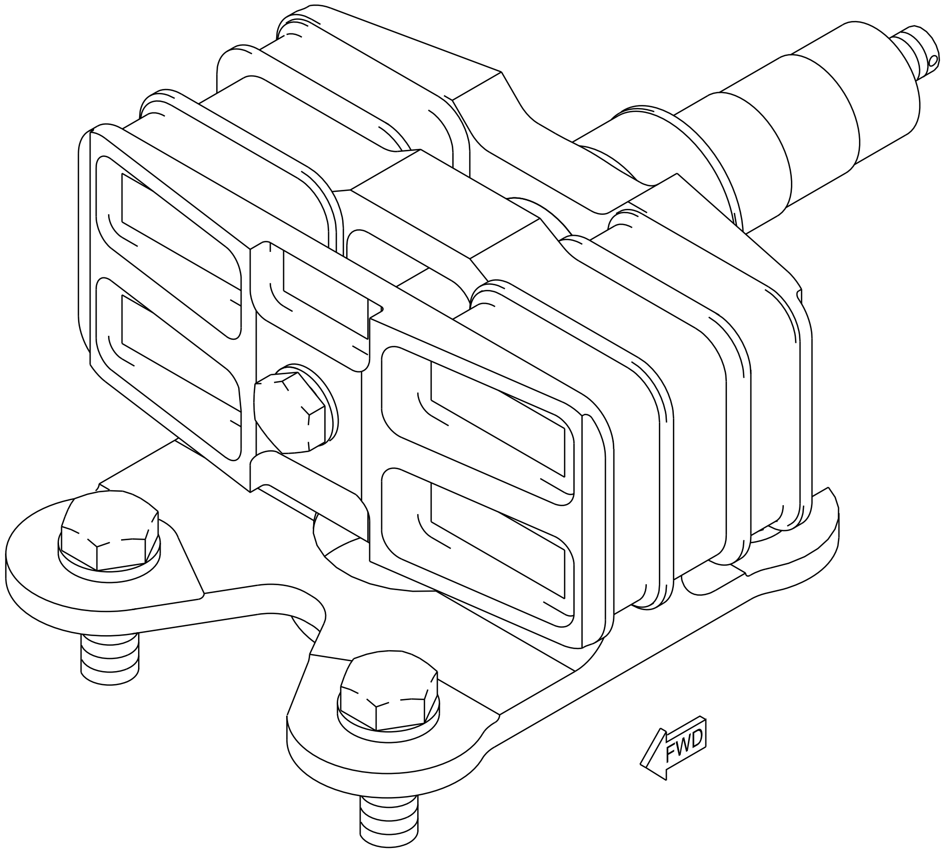
Nacelle Support Frames and Struts Detail
Figure 2



Forward Top Mount Locator
Figure 3



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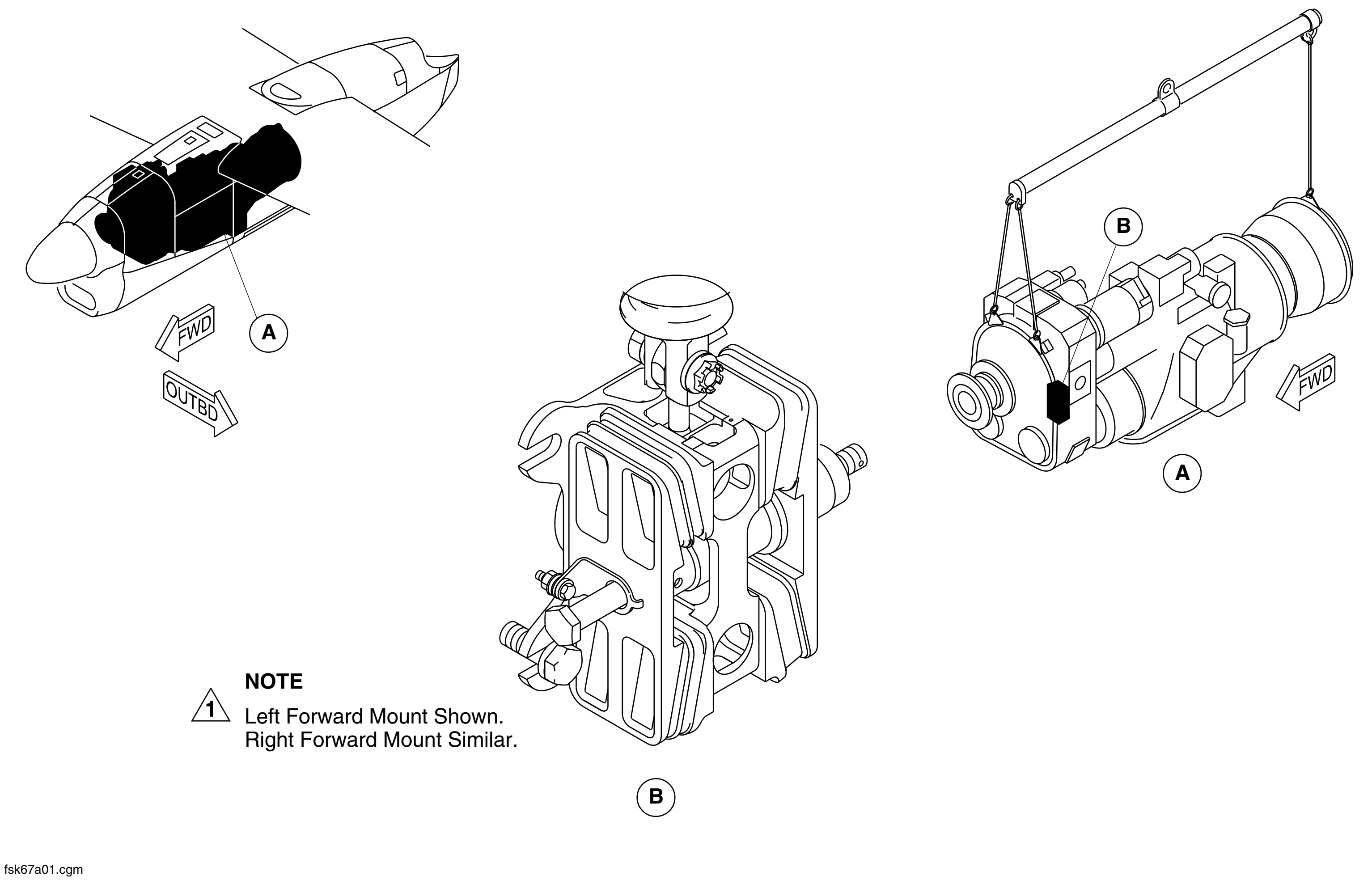
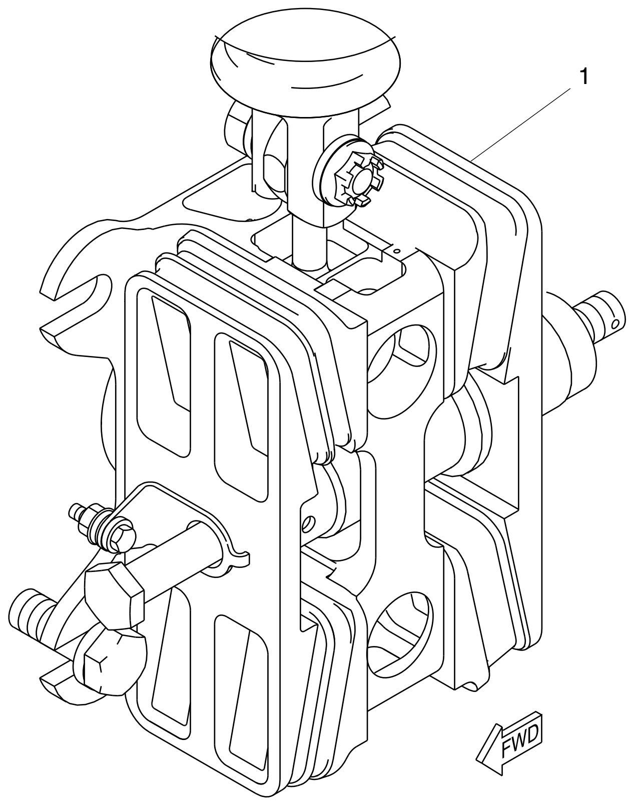
LEGEND

1. Forward Top Isolator.

Forward Top Mount Assembly
Figure 4



Front Side Mount Locator
Figure 5



LEGEND

1. Forward Isolator Assembly.

NOTE

1 Left Forward Mount Shown.
Right Forward Mount Similar.

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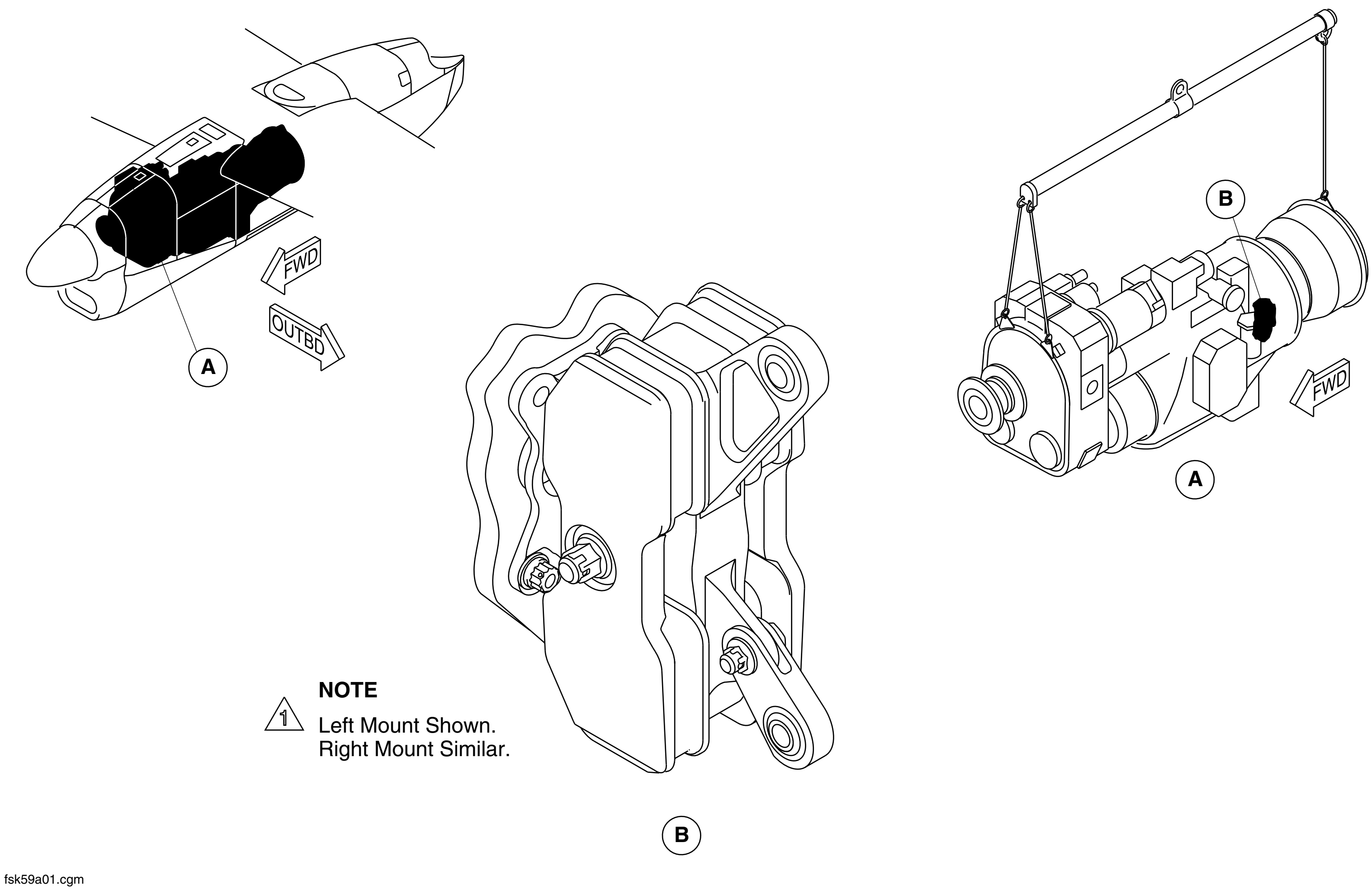
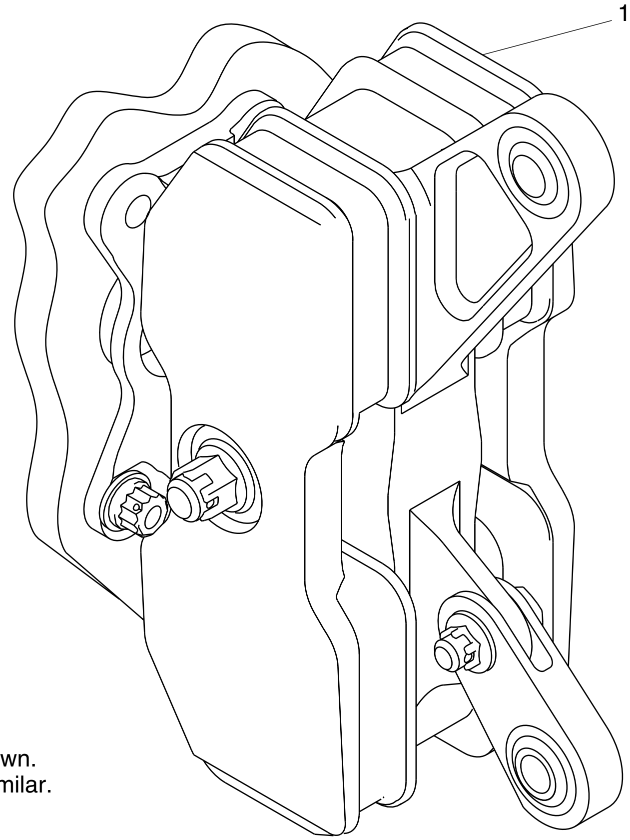
Front Side Mount Assembly
Figure 6



Rear Side Mount Locator Page 1
Figure 7



LEGEND

1. Aft Left Isolator Assembly.

NOTE

1 Left Mount Shown.
Right Mount Similar.

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Rear Side Mount Locator Page 2
Figure 8

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HYDRAULIC TORQUE RESTRAINT SYSTEM

Introduction

The Hydraulic Torque Compensation System provides high torsional stiffness to react engine torque loads. It also provides low translational stiffness to minimize the transmission of vibrations.

General Description

The Engine Vibration Isolator System (EVIS) and the Hydraulic Torque Compensation System (HTCS) work together, to provide a load path from the engine mount pads to the nacelle Engine Mount Structure (EMS). The HTCS has two hydraulic actuator cylinders, a hydraulic fluid reservoir, restrictor, check valve and connecting tubes.

Detailed Description

Refer to Figures 1 , 2 , 3 and 4.

The HTCS is installed to the forward face of the front frame. The HTCS provides the EVIS with high torsional stiffness, to react engine torque loads and low translational stiffness, to minimize the transmission of vibrations to the engine mount system (EMS).

Refer to Figure 5.

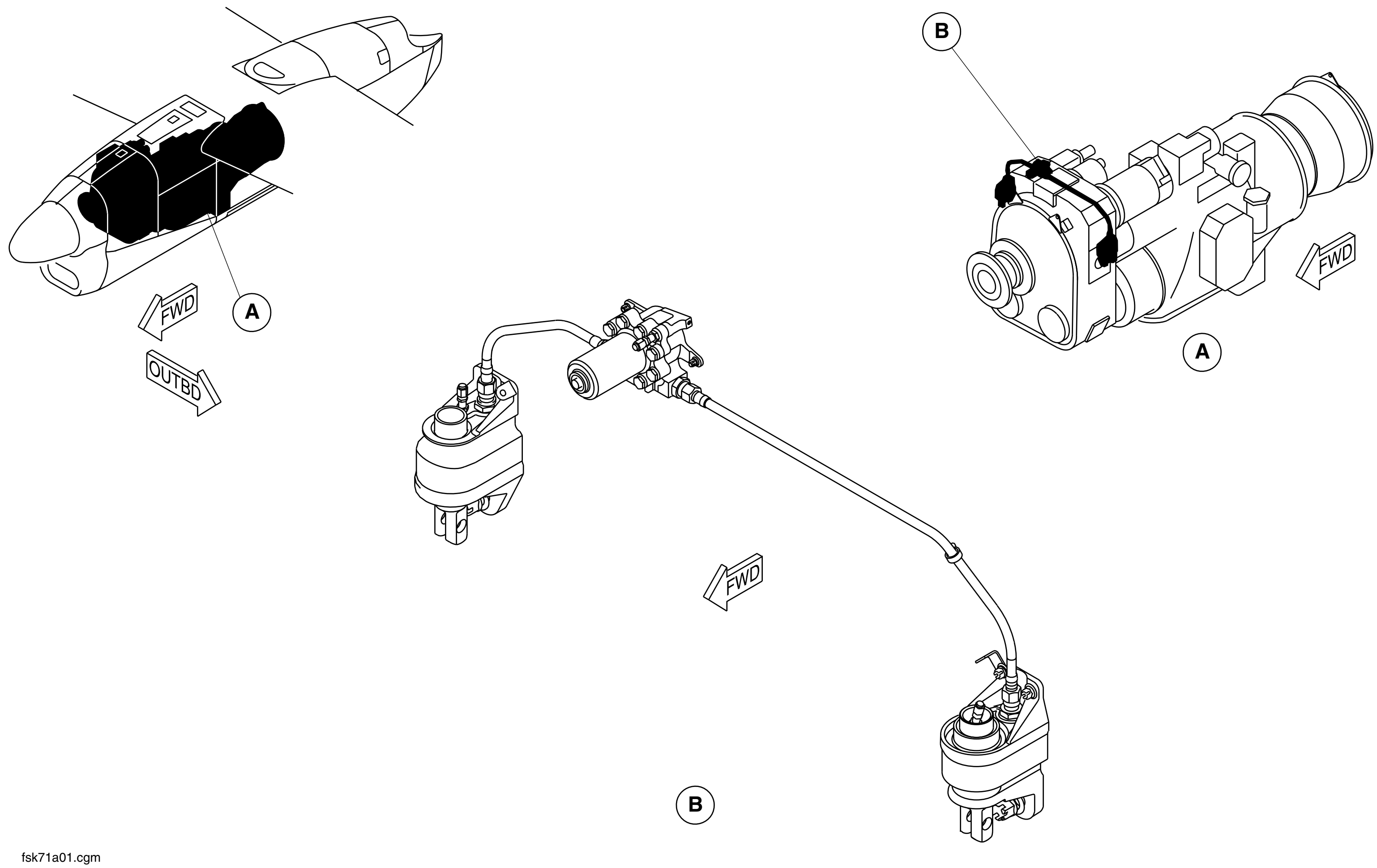
Under a clockwise (positive, as viewed from the front) torque load, the actuators compress the hydraulic fluid into the reservoir through an orifice. When the reservoir piston is bottomed against an internal stop, a high torsional stiffness is created by the trapped fluid.

The system has a near zero torsional stiffness under a counterclockwise (negative) torque load. Negative torque will be reacted mainly by the side and partly, by the rear isolators into the engine mounting structure. In this condition fluid will transfer rapidly from the reservoir into the actuators through the check valve. A high transient negative torque may rotate the engine to the snubbing limit of the side isolators. At the snubbing limit the HTCS actuators will not bottom out.

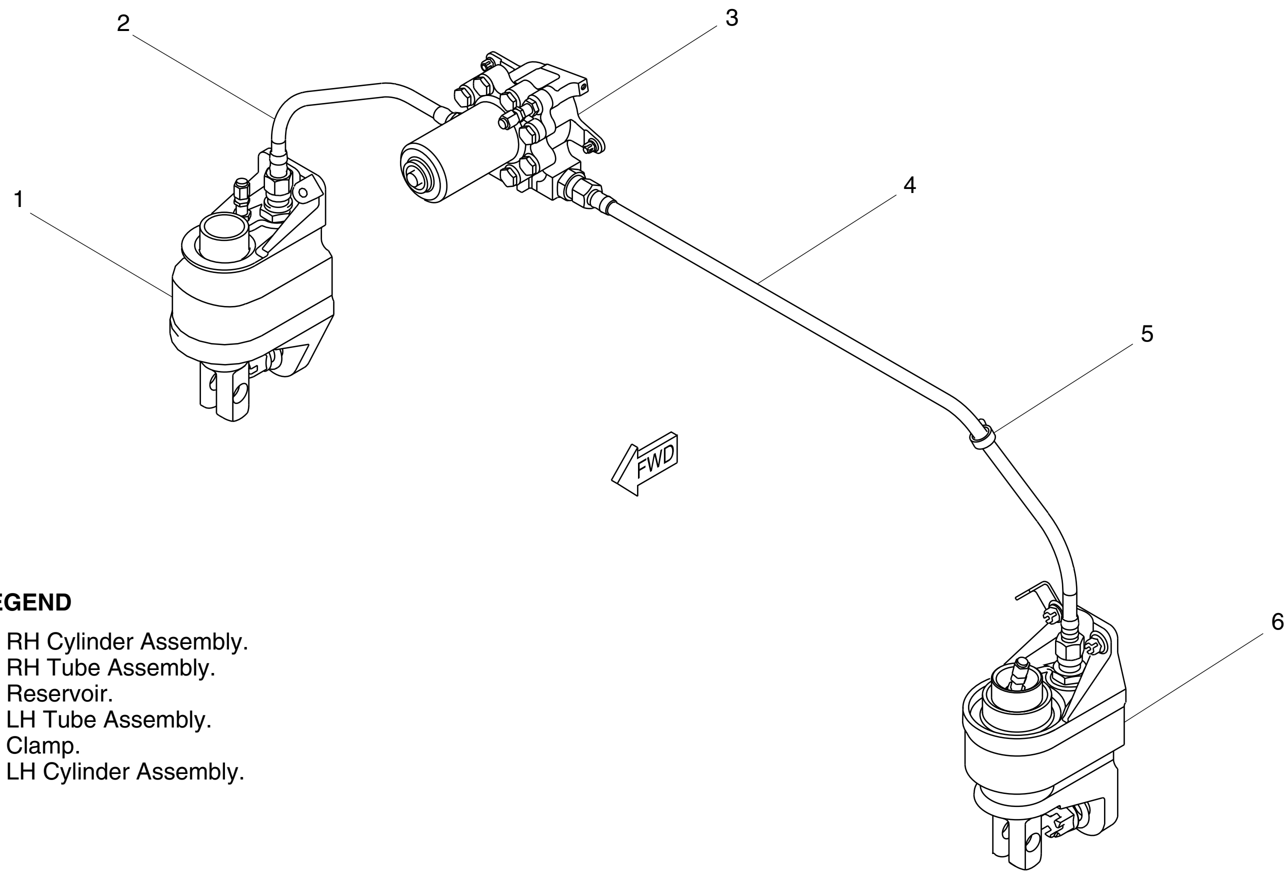
Under a vertical load The HTCS acts as a hydraulic damper by transferring fluid from one actuator to the other. The magnitude of the dampening is a function of the fluid pressure drop. At low frequencies and small displacements, there is insignificant vertical damping.

The system contains approximately 10 in^3 (163.9 cm^3) of MIL–H 5606 hydraulic fluid. The system is pre–pressurized against the reaction of the spring loaded piston in the reservoir, plus some reaction from the mounts, to 211 psig (1455 kPag). This is to avoid the possibility of cavitation during a rapid transition to negative torque. The pressure (volume of fluid) can be determined by measuring the stand–out of the indicator at the end of the reservoir. The nominal pressure at take–off is 3140 psig (21650 kPag).

The cylinders, reservoir, and supply tubes are made of stainless steel. In the event that fire causes leakage of the hydraulic fluid, the front mounts will snub and react the engine torque.



HTCS Complete Assembly Locator
Figure 1



LEGEND

1. RH Cylinder Assembly.
2. RH Tube Assembly.
3. Reservoir.
4. LH Tube Assembly.
5. Clamp.
6. LH Cylinder Assembly.

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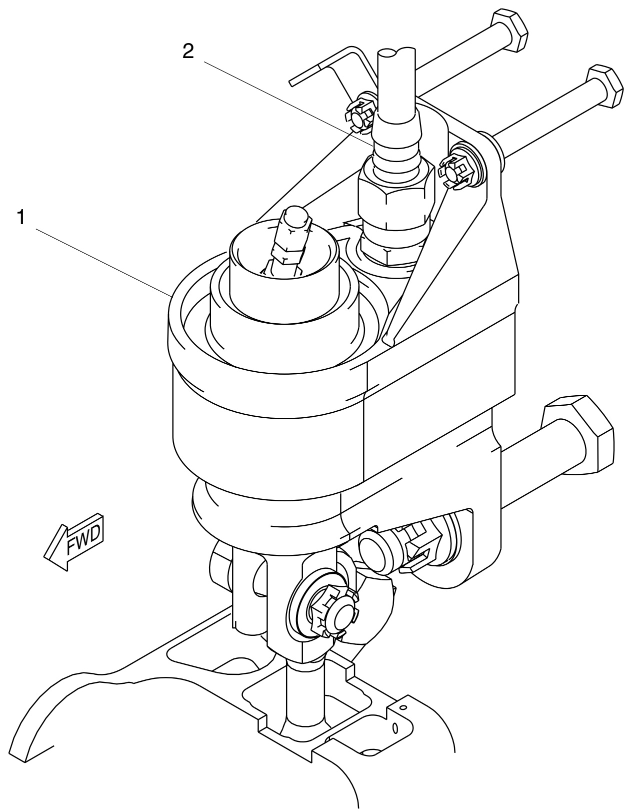
HTCS Assembly Detail
Figure 2



LEGEND

1. Left Cylinder Assembly.
2. LH Tube Assembly.

NOTE

1 Left Cylinder Assembly Shown.
Right Cylinder Assembly Similar.

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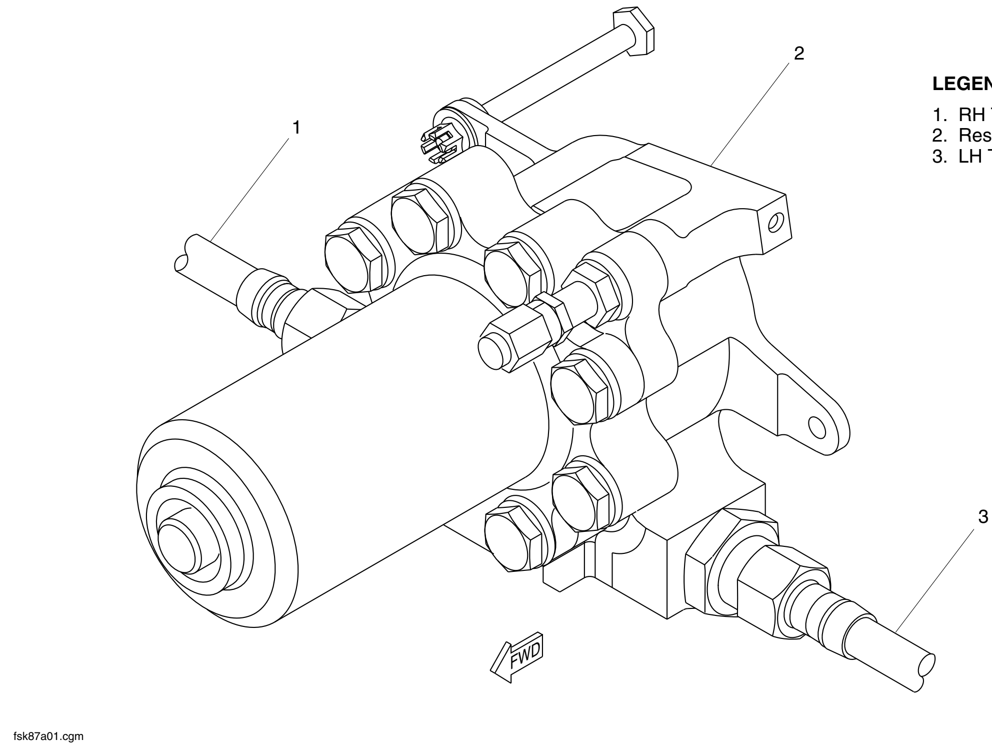
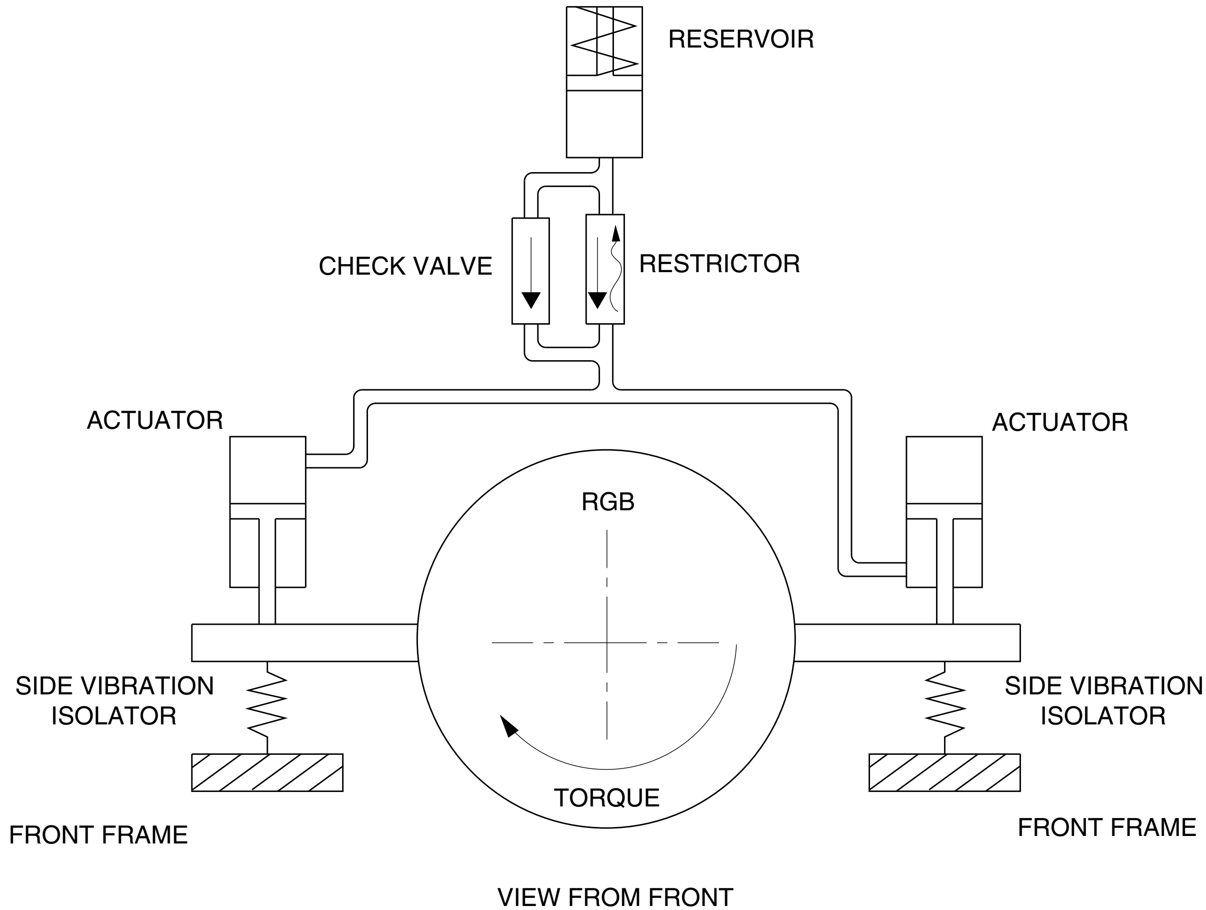
Side Cylinder Assembly
Figure 3



LEGEND

1. RH Tube Assembly.
2. Reservoir.
3. LH Tube Assembly.

Reservoir Assembly
Figure 4



HTCS Schematic
Figure 5

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71–61–00–001

FORWARD NACELLE AIR INTAKES

Introduction

The air induction system is part of the nacelle lower cowl. The air intake has cutouts for the engine air inlet and the oil cooler installation. A flexible, fireproof, silicone rubber P–seal between the engine air intake and the top of the air intake provides a seal and caters for relative motion.

General Description

The air induction system is designed to:

- Supply air to the engine with minimum pressure loss and minimum flow distortion
- Supply air to the air cooled oil cooler
- Provide inertial separation of foreign objects to minimize the risk of foreign object damage (FOD) to the engine, while maintaining a minimum bypass ratio.

The two assemblies for the air intakes in this chapter are the:

- Foreign Object Door (71–61–01).
- Foreign Object Door Actuator (71–61–06).

Detailed Description

The air intake entry area is elliptical in shape with a total flow area of approximately 233 in². This provides for acceptable inlet throat to freestream velocity ration at maximum takeoff power and at maximum cruise. The intake centerline is 30 inches below the propeller centerline to allow room for a boundary layer gutter between the spinner and upper lip of the intake. This maximizes the propeller pressure rise and reduces flow distortion at the intake entry plane.

Foreign Object Separation

The plenum duct immediately behind the intake throat is positioned such that the line of sight to the engine intake is minimized. A foreign object that enters the air intake will be carried by its own momentum to the rear of the plenum, where it will be deflected tot he floor by the sloping upper surface of the plenum and the secondary air flow. The secondary airflow will recirculate up into the engine, but will not be strong enough to carry an object of a size or mass that would be hazardous to the engine.

Refer to Figure 1.

The foreign object door assembly (the door) is installed on the bottom surface of the lower cowl. The rear of the door is attached to a hinge in the lower cowl with a bolt, two washers and a nut. A bush is installed in the hinge assembly. There is also a hinge in the center of the door where the FOD door actuator is attached.

The FOD door actuator is installed in the lower cowl. The actuator is attached to the structure of the lower cowl with a bolt, two washers and a nut. The eye of the ram of the actuator is attached to a hinge on the FOD door with a bolt, two washers and a nut. An electrical connector installed on the top of the actuator connects it with the aircraft electrical system. When the actuator is operated, the ram extends and opens the FOD door. This lets foreign objects and debris be ejected from the lower cowl.

Oil Cooler Air Supply

The exit of the plenum is formed by two cones which create a barrier such that there is no direct line of sight from the intake entry to the oil cooler. The cones are staggered such that there is a sufficient gap between them to permit airflow to the oil cooler when the bypass door is open. When the bypass door is closed, intake bypass air flows from the plenum through the gap between the cones as well as through the secondary cone. The air then passes through the oil cooler and exits through the oil cooler outlet duct. The air flow rate through the oil cooler is controlled by a flap door and a blow down ejector which are both located in the oil cooler outlet duct (Refer to SDS 79–21–00 for more details).

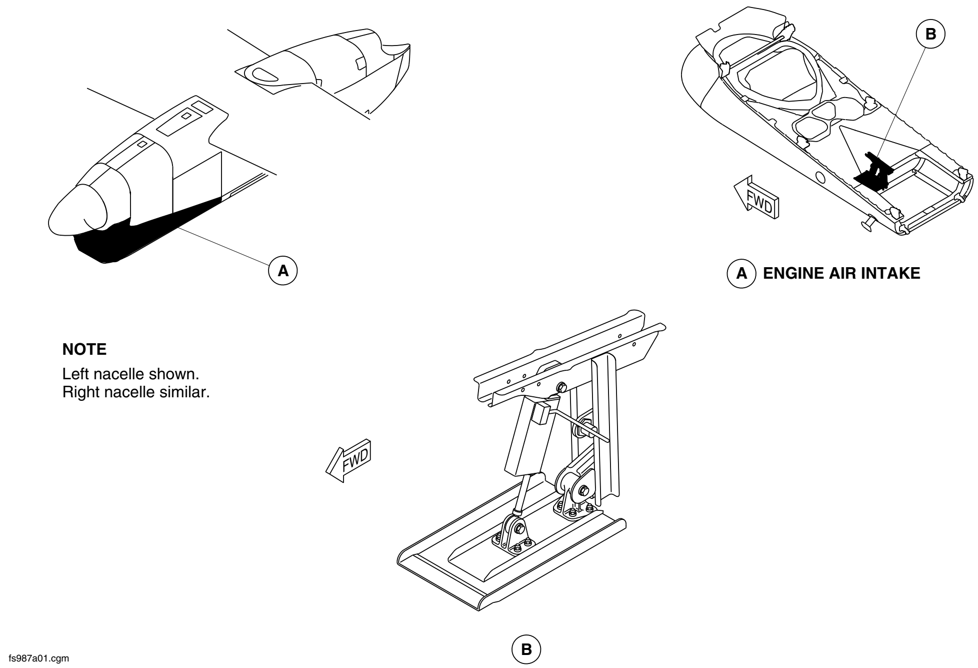
Snow and Ice Protection

Ice is removed from the intake lips by pneumatic deicing boots. Ice which is shed from the boots flows into the inlet and most of it is directed by momentum to the back of the plenum. Some ice will be ingested into the engine, but the deicer boots frequency of inflation is designed such that the shed ice is not of a size that is harmful to the engine. An engine intake adapter heater (EIAH) is installed around the engine intake with a V–band clamp. The EIAH is electrically operated using the aircraft AC power supply. The EIAH prevents the build up of ice around the intake interface and the P–seal (Refer to SDS 30–21–00 for more details).

A bypass door is installed at the rear of the inlet plenum and is opened when the intake deicing system is activated when the pilot selects the system on. The door is a hinged flat plate that is retracted into the lower cowl by an electromechanical linear actuator. The door is opened to increase the intake bypass ratio, so that the ice build up on the plenum floor is minimized and to expel ice and snow from the intake plenum.

Component Location Index

COMPONENT NAME	QTY	ACCESS/ ZONE	REFERENCE
Foreign Object Door	1	Zone 410	71–61–01
Foreign Object Door	1	Zone 420	71–61–01
Foreign Object Door Actuator	1	Zone 410	71–61–06
Foreign Object Door Actuator	1	Zone 420	71–61–06



Foreign Object Door
Figure 1

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71–71–00–001

ENGINE NACELLE DRAIN LINES

Introduction

To prevent the accumulation of flammable fluids or water in the nacelle, overboard drains are provided for all the nacelle zones. Engine drain lines are connected to the lower cowl drain system and routed overboard through the external drain mast.

General Description

Refer to Figures 1 and 2.

The engine drains are divided into a forward drain system and a rear drain system. The forward and the rear drains connect to the lower cowl drain lines and are routed separately to an external drain mast.

The forward drains are:

- Propeller Flange Seal
- Hydraulic Pump Seal
- Auxiliary Feathering Pump Seal
- Fuel Pump Seal
- DC Generator Seal.

The rear drains are:

- Inter Compressor Case (ICC)
- Centrisep
- Gas Generator Case (GGC)
- Turbine Support Case (TSC)

The forward drain lines are routed individually to a collector tank except for the auxiliary feathering pump seal and the engine driven hydraulic pump seal. These two drain lines are joined upstream of the collector tank. The collector tank connects to a drain line in the lower cowl through a flexible hose with two Camloc fasteners. This attachment allows for a quick release during removal or lowering of the lower cowl to the maintenance position.

The rear drain lines are routed to a manifold which is also connected to the lower cowl through a flexible hose with two Camloc fasteners. From these connections, the forward and the rear drains are routed separately to the aft end of the lower cowl and then overboard through the external drain mast.

The oil filler drain is not routed with the engine drains. Excess oil is discharged directly into the port side forward sump of Zone 1. Excess oil is drained from the oil filler cap area into the Zone 1 sump and is then routed overboard through the lower cowl drains.

Nacelle Zone Drains

Refer to Figures 2 and 3.

Zone 1 – Engine Compartment/Fire Zone

– Fluids in the engine compartment can drain overboard through eight sumps located on the firefloor. Three sumps are located in the forwards section and five are in the aft section. The sumps form a part of the lower cowl drain system which merges and routes the drain lines to an external drain mast located on the aft port side of the lower cowl.

– The drain mast consists of six lines: the forward engine drain, the rear engine drain, the Zone 1 sumps (three separate lines), and the Zone 3/fuel shroud drain. the six tubes are arranged so that the discharge from each tube will not interfere with or be reingested by another tube. There is also a run–back gate on the mast to prevent discharge fluids from running back along the inside of the mast and on the nacelle surface.

Zone 2 – Air Intake Zone

– Fluids in the lower cowl are drained overboard through holes in the bottom of the cowl.

Zone 3 – Leading Edge Zone

– The drain from this zone is located in the lowest part of the zone on the port side of the nacelle. It is routed through the firezone and through the lower cowl to the external drain mast. The tubing runs vertically down the aft firewall and along the top of the oil cooler cover where it is connected to a line in the lower cowl through a flexible coupling. The fuel shroud drain merges with this line just below the leading edge zone.

Zone 4 – Jet Pipe Shroud Zone

– Fluids are discharged directly overboard through a tube that is 0.62 inches (15.75 mm) below the exterior nacelle surface on the port side of the nacelle.

Zone 5 – Jet Pipe Zone

– No fluids can accumulate in the jet pipe as the pipe angles upwards at the entrance and downwards at the exit. Fluid will either drain into Zone 1 or aft towards the jet pipe exit.

Zone 6 – Undercarriage Zone

– Fluids in this zone are drained overboard through two stub tubes found on the aft main landing gear doors. The tubes are 0.77 inches (19.56 mm) below the nacelle exterior surface and are chamfered aft at a 45° angle to create a local depression to assist in drainage. There is an additional stub tube in the aft Zone 6 compartment.

Other Nacelle Drains

Refer to Figures 2 and 3.

Aft Nacelle Drainage System

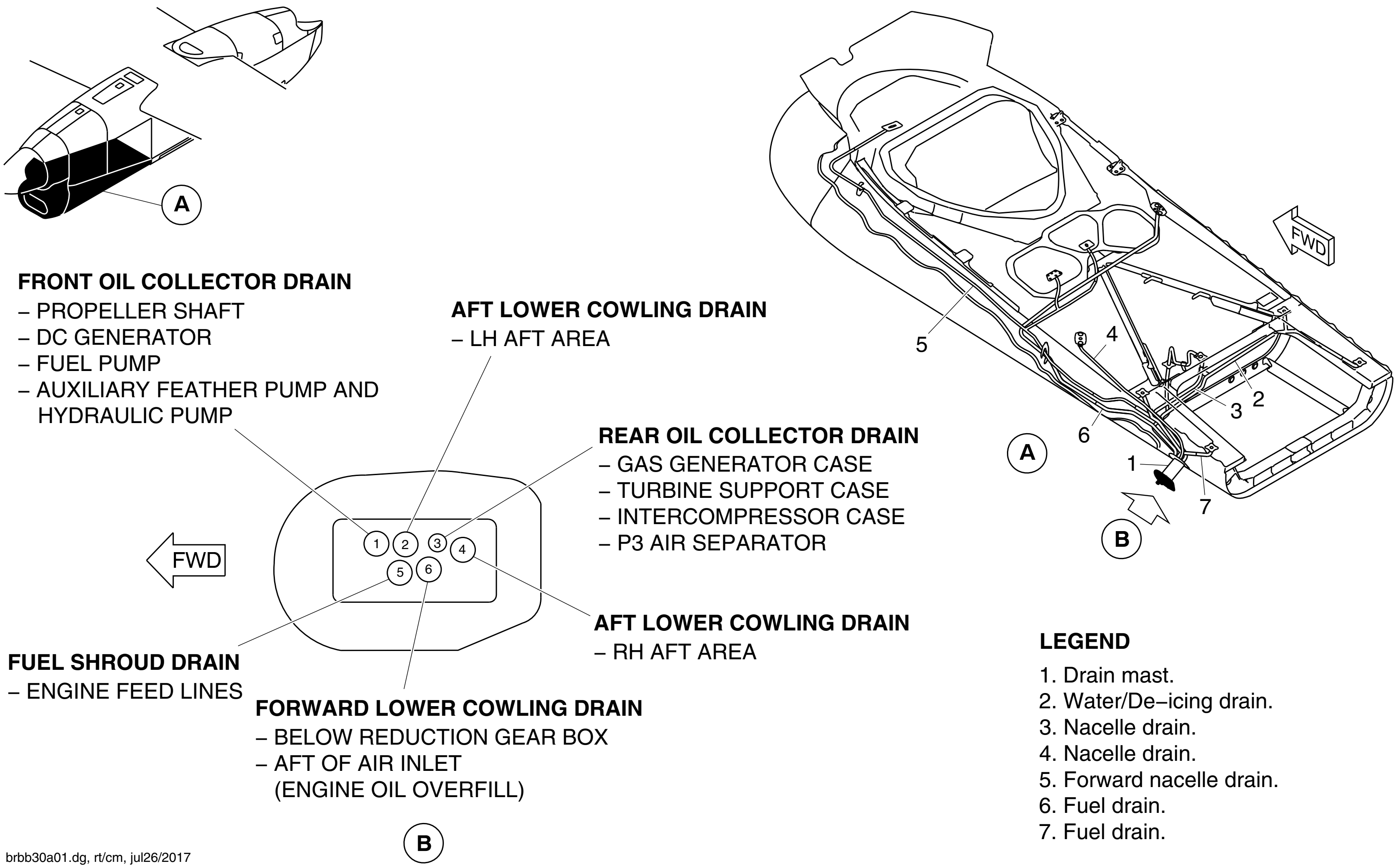
– The aft nacelle drainage system comprises the drains for the hydraulic system components in the undercarriage zone. Drain lines from the ecology bottles, reservoir and standby power unit (LH nacelle only) are merged and routed to the aft Zone 6 compartment. the drain discharges overboard through a drain mast that is 2.64 inches (67.06 mm) below the nacelle exterior. A run−back gate is used to prevent the fluid from running back along the outside of the mast an on the nacelle surface.

Refuel/Defuel Line Drain (RH Nacelle Only)

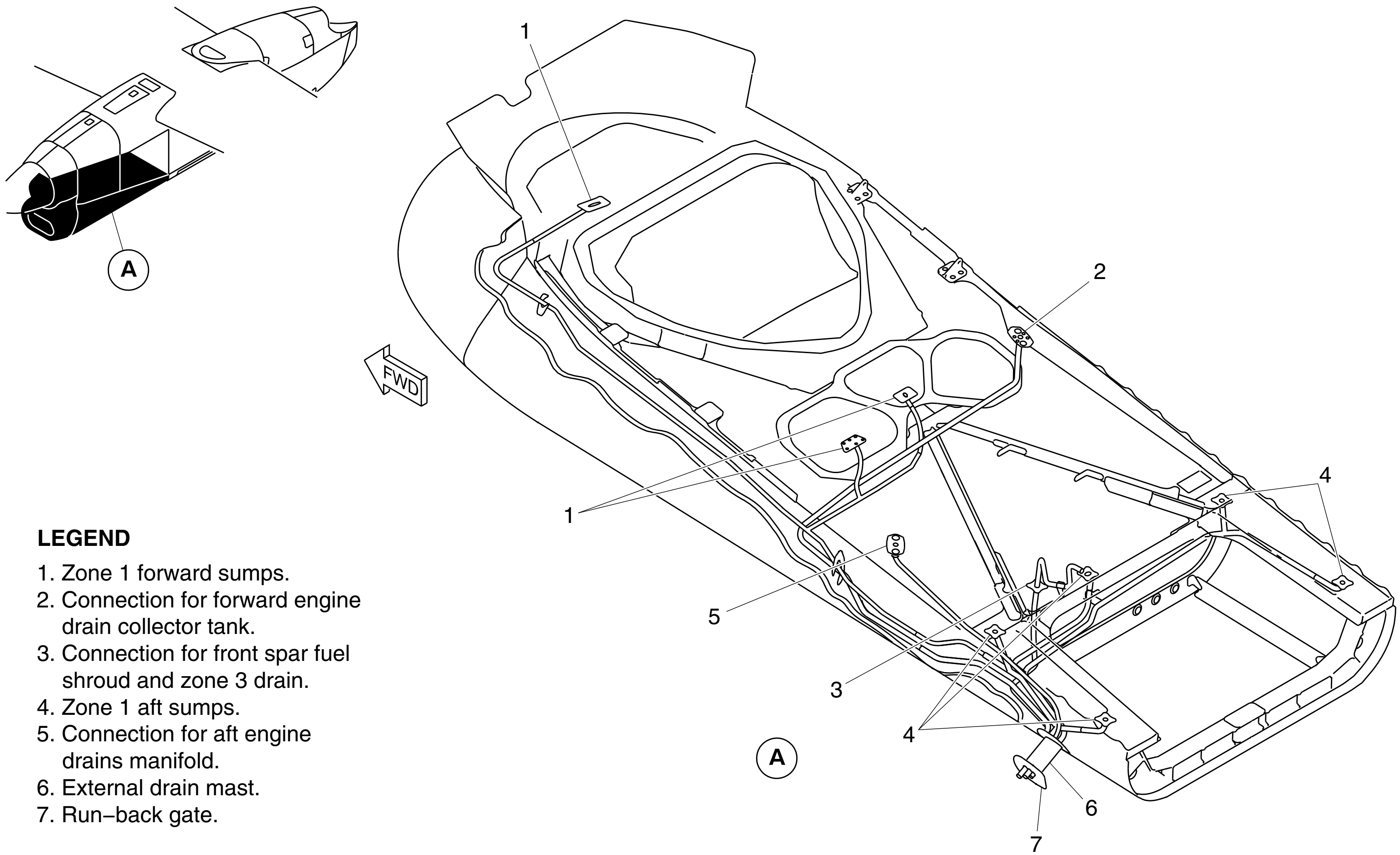
– This line is routed from the adapter in the aft Zone 6 compartment to the rear spar. The line is protected by a rubber shroud assembly. Drain provisions are provided for the shroud assembly in the event of a refuel/defuel line leak. You will find the drain line in the aft Zone 6 compartment and it discharges overboard through a tube that is 1.5 inches (38.1 mm) below the nacelle exterior surface.

Front Spar Fuel Shroud

– The two fuel fittings for the pressure feed and motive flow (found on the forward side of the front spar) are enclosed by a rubber shroud. This shroud connects to a drain line which is routed through the leading edge zone and into the engine compartment. It merges with the Zone 3 drain line and passes through the firezone through a stainless steel tube. The tube connects to the lower cowl and is routed to the external drain mast.



Engine Nacelle Drain Lines
Figure 1



LEGEND

1. Zone 1 forward sumps.
2. Connection for forward engine drain collector tank.
3. Connection for front spar fuel shroud and zone 3 drain.
4. Zone 1 aft sumps.
5. Connection for aft engine drains manifold.
6. External drain mast.
7. Run−back gate.

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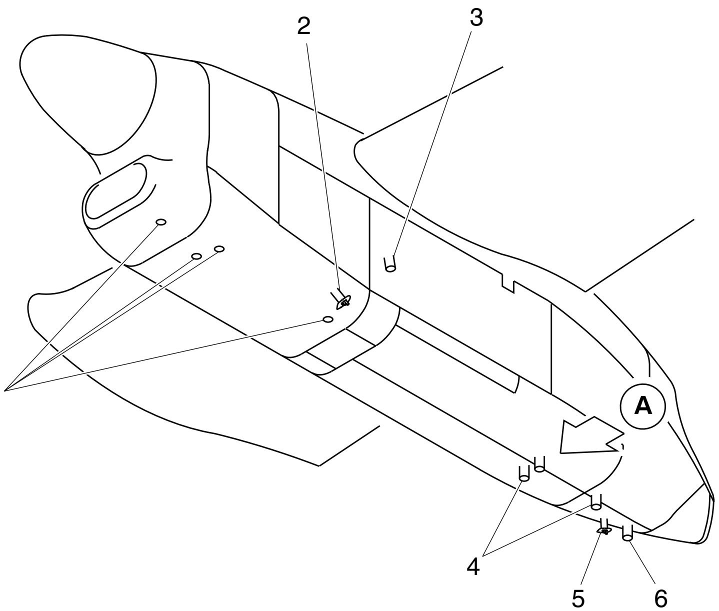
Fire Floor and Lower Cowl Drain Lines
Figure 2

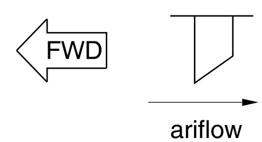


LEGEND

1. Lower cowl drain holes.
2. Zone 1 and 3 drain mast.
3. Zone 4 drain tube.
4. Zone 6 stub drain mast.
5. Zone 6 aft nacelle drain mast.
6. Refuel/Defuel shroud drain (RH nacelle only).

NOTE

RH and LH nacelles identical except for refuel/defuel shroud drain.



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Engine Nacelle Drain Openings
Figure 3

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