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SEPTEMBER 2004

STUDENT GUIDE

FOR

UH-60 POWERTRAIN

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SEPTEMBER 2004

UH-60 POWERTRAIN

TABLE OF CONTENTS

This TSP supersedes None, Dated NA.

SECTION I. - INTRODUCTION

TERMINAL LEARNING OBJECTIVE:

ACTION: Identify the characteristics of the UH-60 Powertrain system.

CONDITIONS: As a UH-60 maintenance test pilot.

STANDARD: IAW TM 1-1520-237-23-1, TM 1-1520-237-23-4, TM 1-1520-237-10, and TM 1-1520-237-MTF.

SAFETY REQUIREMENTS: Remove all watches, rings and other jewelry before operating, or maintaining electronic equipment.

RISK ASSESSMENT LEVEL: Low

ENVIRONMENTAL CONSIDERATIONS: There are no environmental concerns for this lesson.

EVALUATION: Evaluation will be accomplished with performance exam at the end of this module of instruction.

SECTION II. - PRESENTATION

A. ENABLING LEARNING OBJECTIVE ELO No. 1

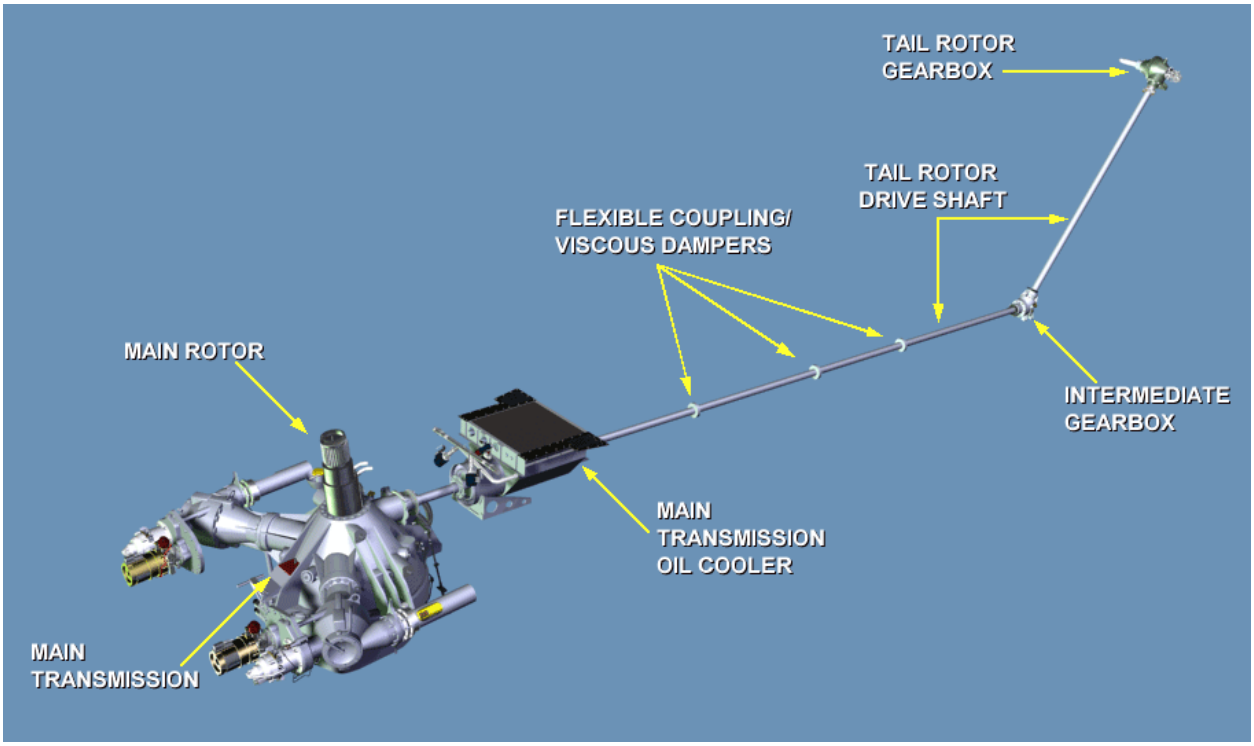
ACTION: Identify the function of the UH-60 Powertrain system.

CONDITION: Using TM 1-1520-237-23-1, TM 1-1520-237-23-4, TM 1-1520-237-10, and TM 1-1520-237-MTF.

STANDARD: IAW TM 1-1520-237-23-1, TM 1-1520-237-23-4, TM 1-1520-237-10, and TM 1-1520-237-MTF.

a. Powertrain System

Frame #0020 (Powertrain System)



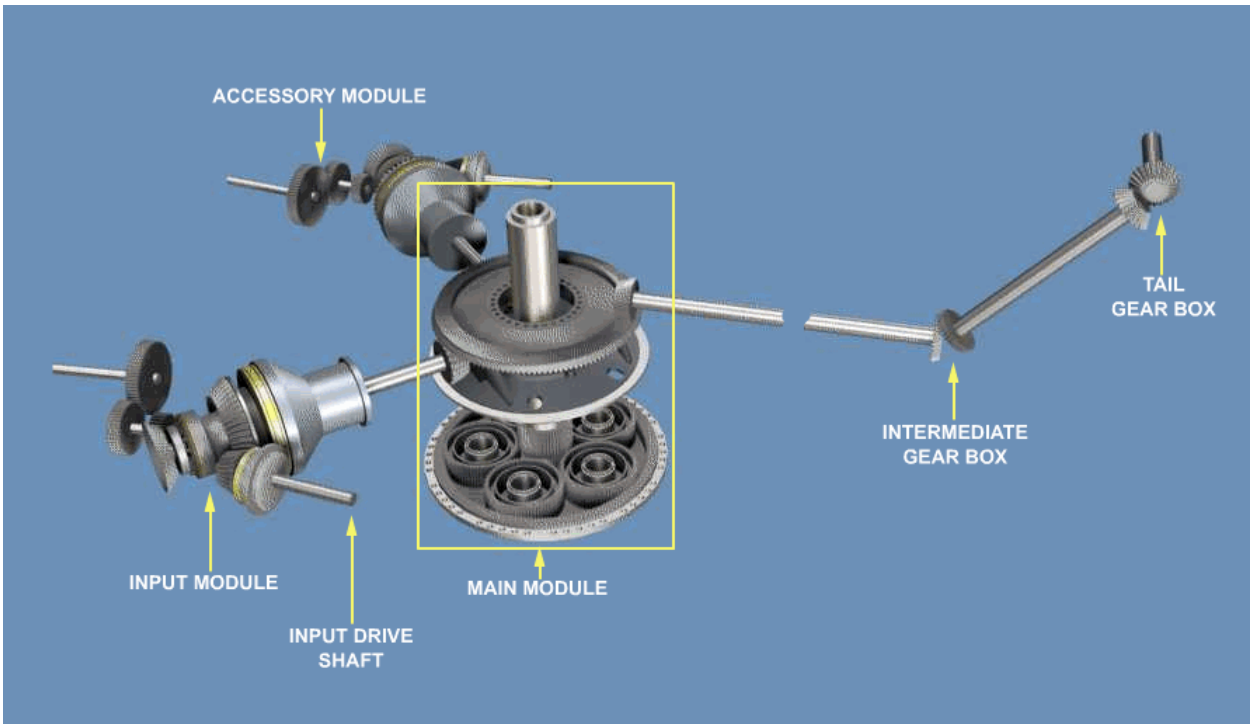
(1) The transmission system carries engine torque to the main rotor and tail rotor.

(2) It consists of a main transmission with oil cooler, intermediate gear box, tail gear box, and drive shafts.

(3) The transmission system has oil pressure and oil temperature indicating systems, hot oil and low oil pressure warning systems, and a chip detector system.

(4) The main transmission drives the main rotor, tail rotor, main transmission oil cooler fan, No. 1 and No. 2 hydraulic pump modules, and No. 1 and No. 2 generators.

Frame #0021 (Transmission System Schematic Diagram FLASH)



(5) The helicopter's power to the transmission begins at the front end of the engines.

(6) The engine input drive shaft, turning at 20,900 RPM (100% Nr), provides the power to the input module, which then drives the main module and accessory modules.

(7) The input module reduces engine input RPM to 5750 RPM and also allows the drive angle to be changed from the engine to the main module.

(8) The main module then provides reduction for the main rotor head down to 258 RPM and a reduction for the tail drive shaft and oil cooler to 4110 RPM.

(9) The intermediate gear box receiving the tail drive shaft RPM, then provides a reduction to 3319 RPM, plus changes the angle of drive about 58°.

(10) The tail gear box provides the remaining gear reduction for the tail rotor to 1190 RPM and a 105° change in drive direction.

(11) During operation of the main transmission, the hydraulic pump modules are driven at 7188 RPM and the generators at 11,809 RPM.

CHECK ON LEARNING

1. Where does the transmission carry engine torque to?

2. What is the angle of degree change in the tail rotor section of the transmission system?

SECTION III. - SUMMARY

1. REVIEW/SUMMARIZE:

You have completed the UH-60 Powerplant major components topic.
The key points to remember are:

- The main transmission drives the main rotor, tail rotor, main transmission oil cooler fan, No. 1 and No. 2 hydraulic pump modules, and No. 1 and No. 2 generators.
- The intermediate gear box receiving the tail drive shaft RPM then provides a reduction to 3319 RPM plus changes the angle of drive about 58°.
- The tail gear box provides the remaining gear reduction for the tail rotor to 1190 RPM and a 105° change in drive direction.
- The two engine input drive shafts, turning at 20,900 RPM (100% Nr), provides the power to the two input modules, main module, and two accessory modules.
- The input module reduces engine input RPM to 5750 RPM and also allows the drive angle to be changed from the engine to the main module.
- The main module provides reduction for the main rotor head down to 258 RPM, and reduction for the tail drive and oil cooler to 4,110 RPM.

B. ENABLING LEARNING OBJECTIVE ELO No .2

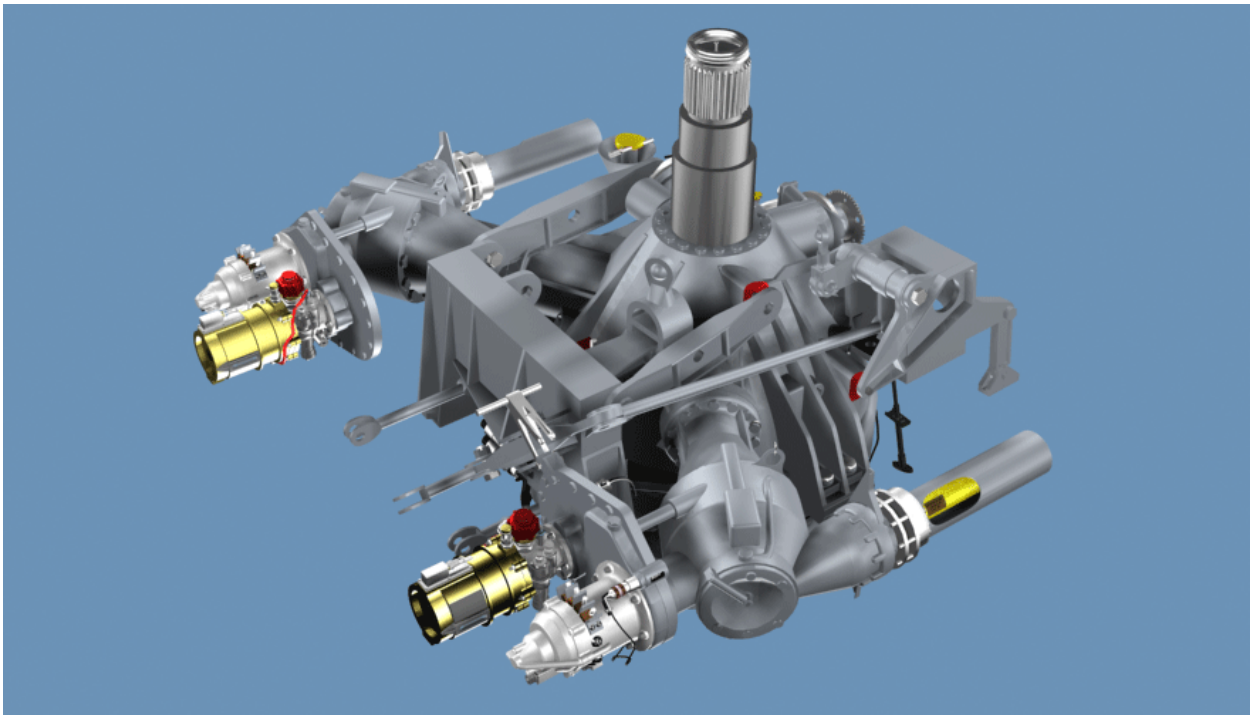
ACTION: Identify the components of the Powertrain system.

CONDITION: Using TM 1-1520-237-23-1, TM 1-1520-237-23-4, TM 1-1520-237-10, and TM 1-1520-237-MTF.

STANDARD: IAM TM 1-1520-237-23-1, TM 1-1520-237-23-4, TM 1-1520-237-10, and TM 1-1520-237-MTF.

a. Main Transmission

Frame #0025 (Main Transmission)



(1) The Main Transmission (XMSN) is mounted on the main fuselage with a built in 3º forward tilt.

(2) It consists of five modules:

(a) A main module

(b) Two input modules

(c) Two accessory modules

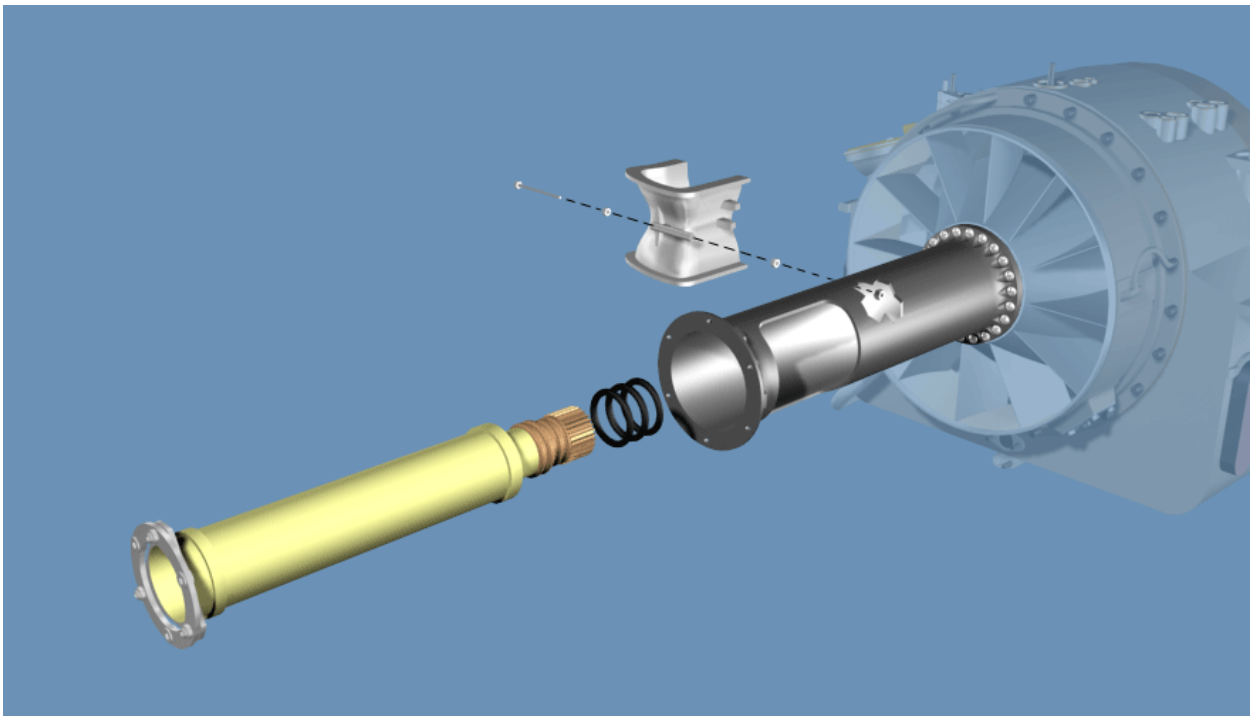
(3) The transmission mounts forward of the engines and drives the main rotor head, changes the angle of drive from the engines, reduces the engine RPM, and drives the tail rotor drive shaft along with the accessory modules.

(4) Both input modules and both accessory modules are interchangeable with one another and are replaceable without removing any major components.

(5) Connected to each accessory module are the Electric Generator and Hydraulic Pump.

b. Engine Input/Output Shaft

Frame #0035 (Engine Input/Output Shaft)



(1) The Forward Support Tube is bolted to the swirl-frame on the engine and attached to the Input module.

(2) It is used as the forward mount for the engine assembly and to protect the engine output shaft.

Frame #0038 (Engine Input/Output Shaft 2)

(3) The engine output shaft transmits engine power to the input module.

(4) It sits inside a set of splines on the engine and mounts to the input module using a disc pack coupling consisting of 12 disc.

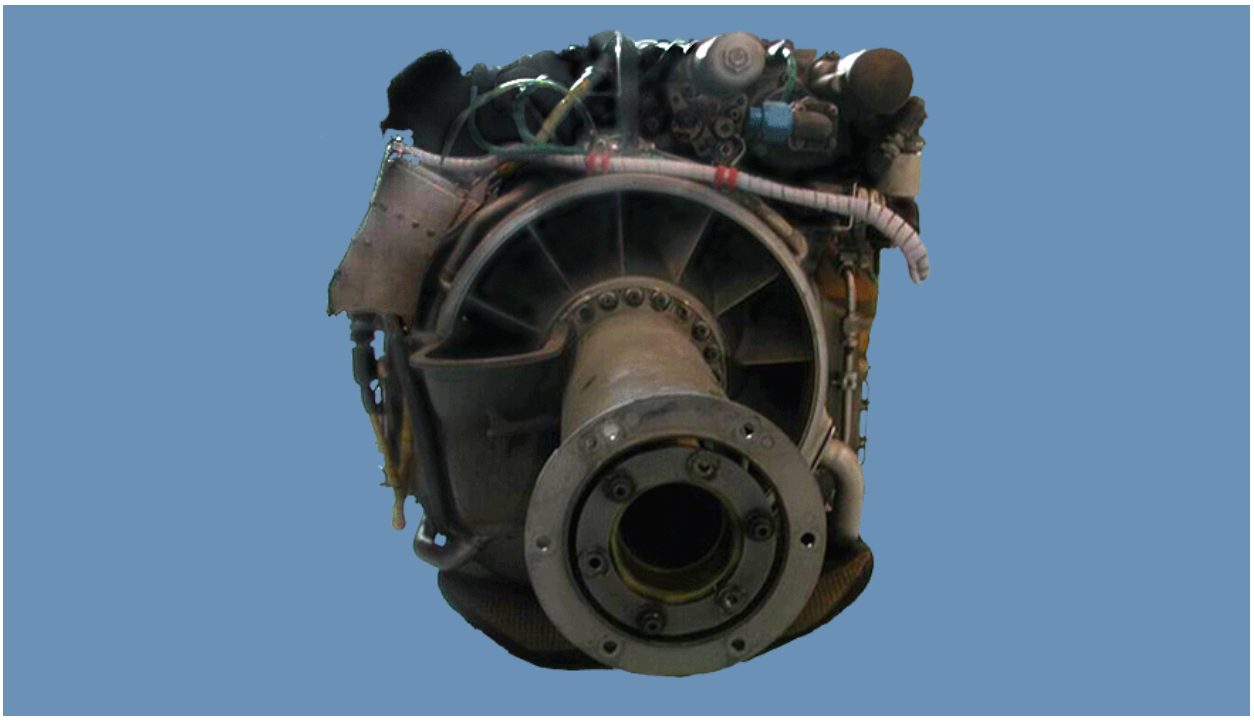
(5) Inspection criteria of the input shaft is:

(a) 1-3 flight hours inspection, re-torque check on mounting bolts, after initial ground run (after installation/reinstallation).

(b) 100 flight hours inspection, check the balance.

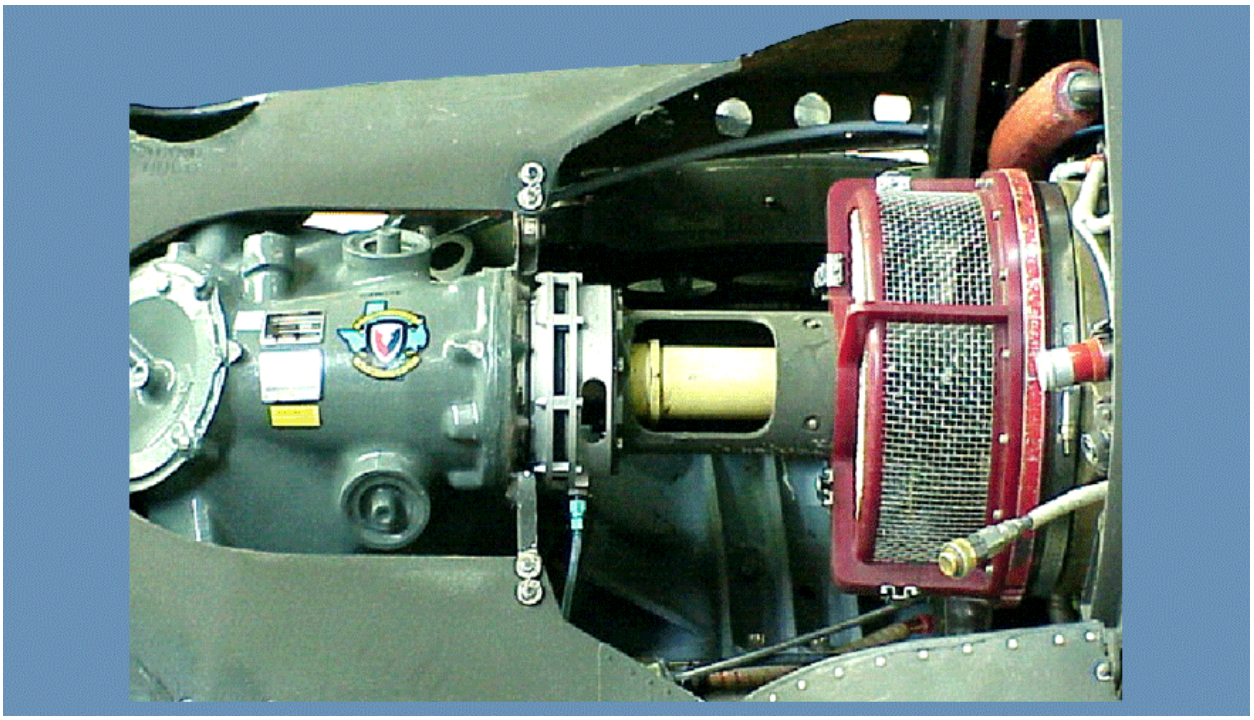
c. Engine Forward Support

Frame #0030 (Engine Forward Support)



(1) The Engine forward support tube has the crotch assembly attached to the inboard side, to direct air from the inlet to the inboard side of the engine.

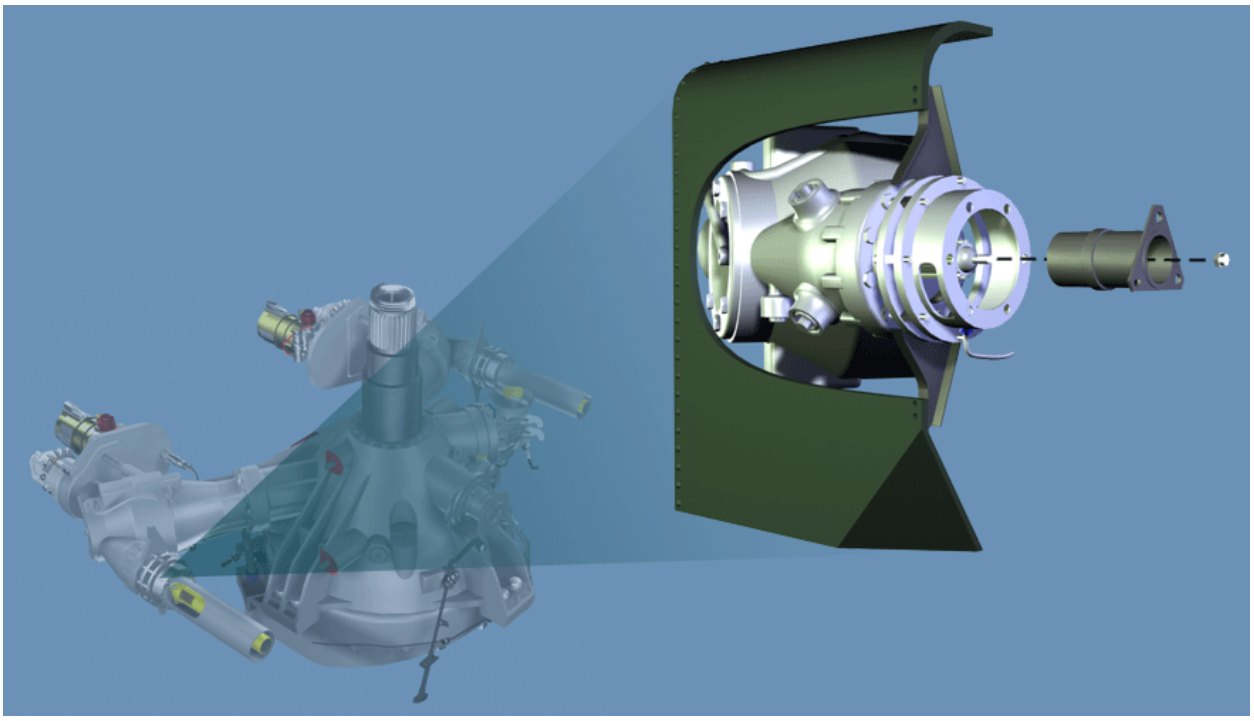
Frame #0030 (Engine Forward Support Tube)



(2) The crotch assembly must be removed anytime the Engine Foreign Object Damage (FOD) protection screen is installed for balancing of the engine output shaft.

d. Elastomeric Gimbal Assembly

Frame #0040 (Elastomeric Gimbal Assembly)



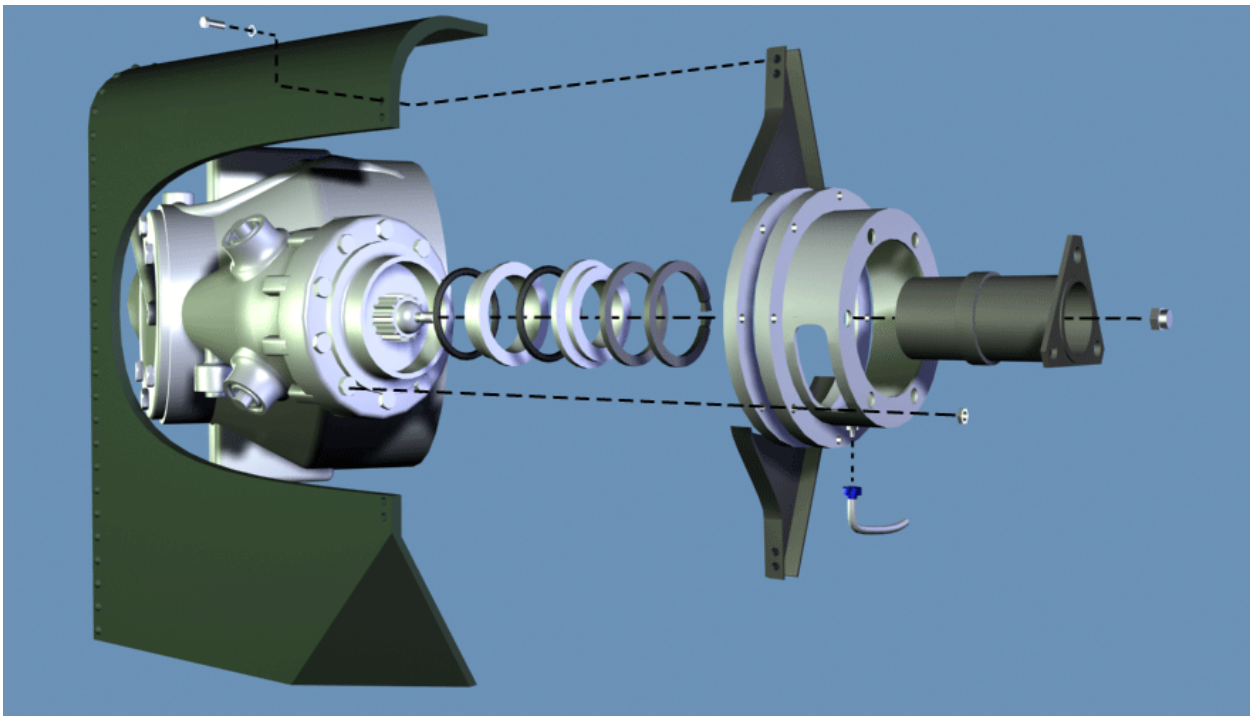
(1) The Elastomeric gimbal assembly consists of a gimbal housing and input flange.

(2) The newer type housing has a cut out portion for access to the nuts used to connect the input flange to the coupling on the engine output shaft.

(3) The Input flange is attached to the input module and goes through the gimbal seal.

(4) If the newer type housing is not available, insure the input flange has nut plates installed.

Frame #0040 (Elastomeric Gimbal Exploded View)



(5) The gimbal seal is actually a two piece seal compressed together to prevent leakage from the input module.

(6) The housing assembly has a drain line attached to the bottom.

(7) The input shaft (high speed shaft) spins at 20900 RPM; some seepage is expected.

(8) When installing the seal, use surgical gloves when handling the seal.

(9) Oil from the skin will break down the carbon seal material, causing them to leak.

(10) Leakage criteria for the seal are no more than 1/8" fluid during any one flight.

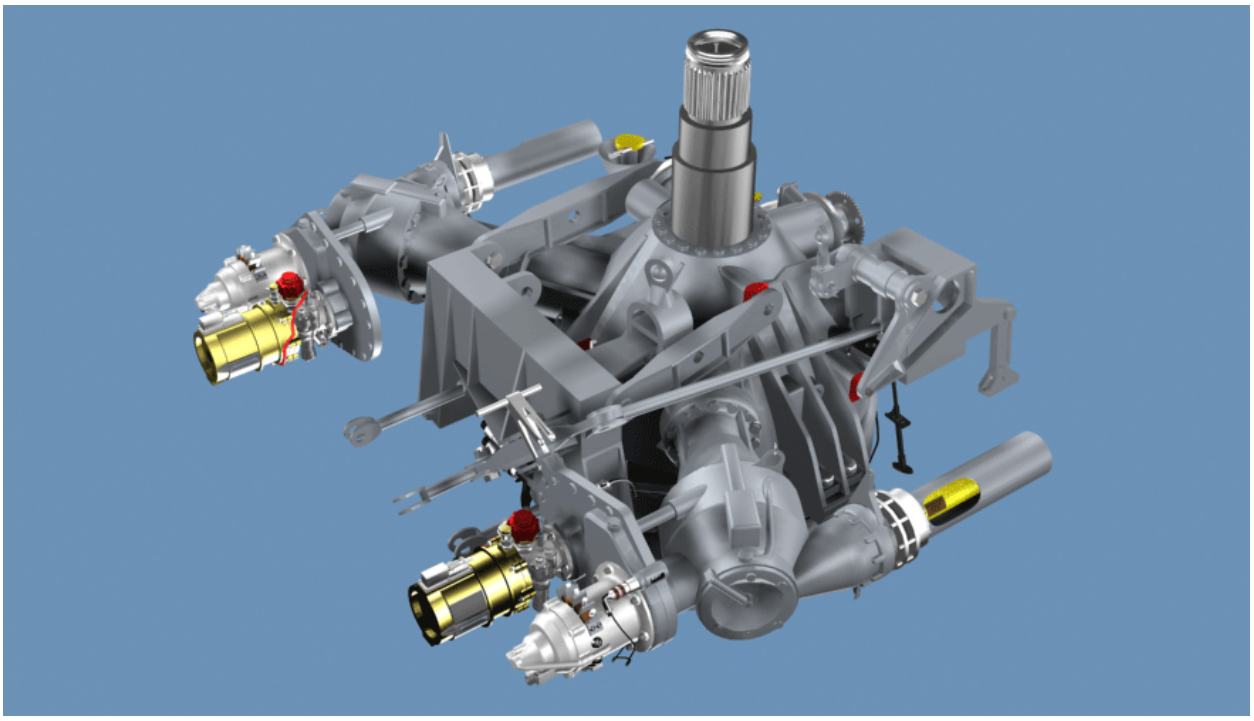
(11) Inspection requirements:

(a) 30 flight hours inspection.

(b) 100 flight hours inspection.

e. Input Module

Frame #0045 (Input Module)



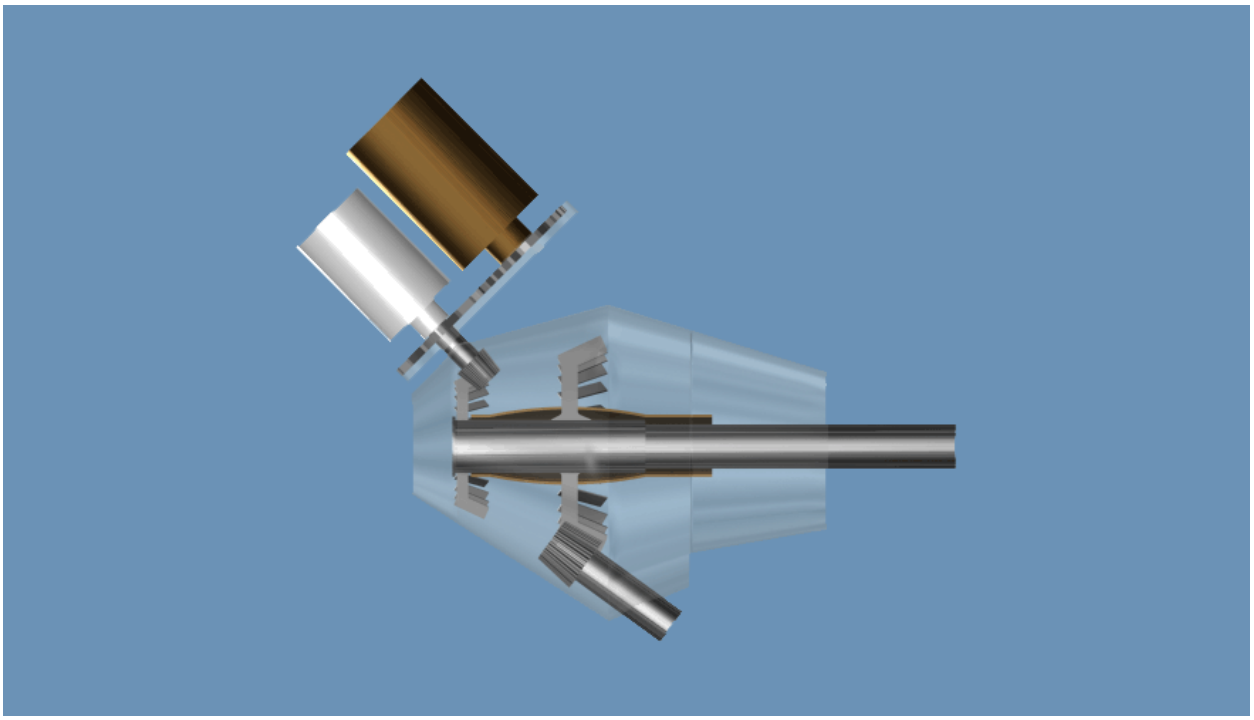
(1) The two input modules are mounted on the left and right front side of the main module.

(2) They connect the main module to the engines by shafting and gears.

(3) Each input module is identical and directly interchangeable.

(4) Over running clutches (free-wheeling units), disengage a nonoperating engine from the transmission, but not the accessory module.

Frame #0045 (Input Module)



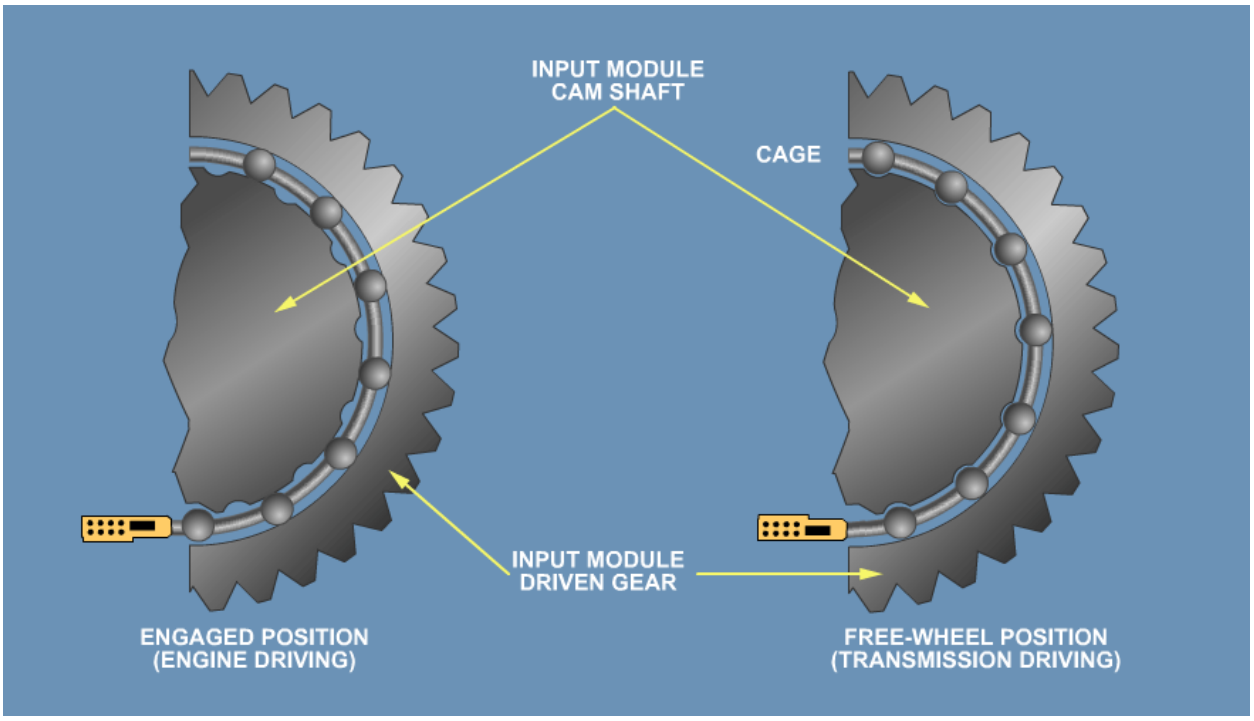
(5) The internal body of the input module has an input bevel pinion and gear, and free-wheel rollers.

(6) The free-wheel rollers allow for engine disengagement during autorotation, or in case of a nonoperating engine, the accessory module will continue to be driven by the main rotor.

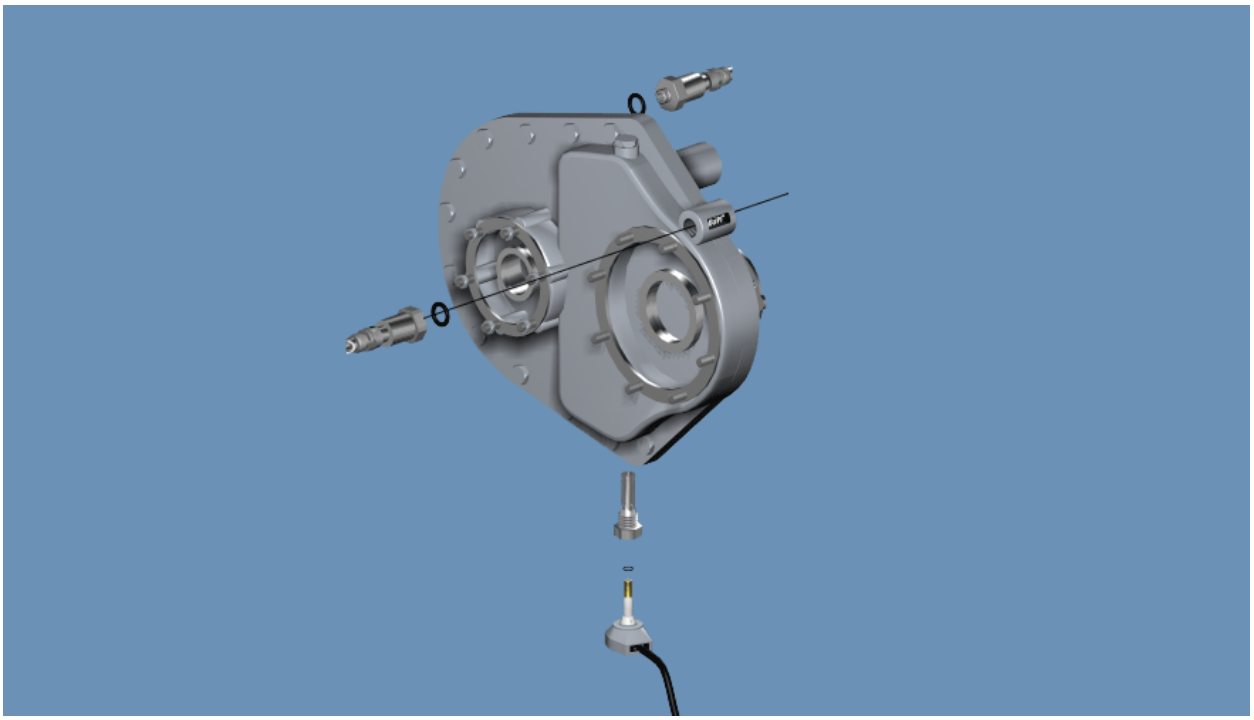
(7) The No. 1 input drive module provides the first gear reduction between engine and main module.

f. Accessory Module

Frame #0045 (Input Module Driven Gear)



Frame #0060 (Accessory Module)



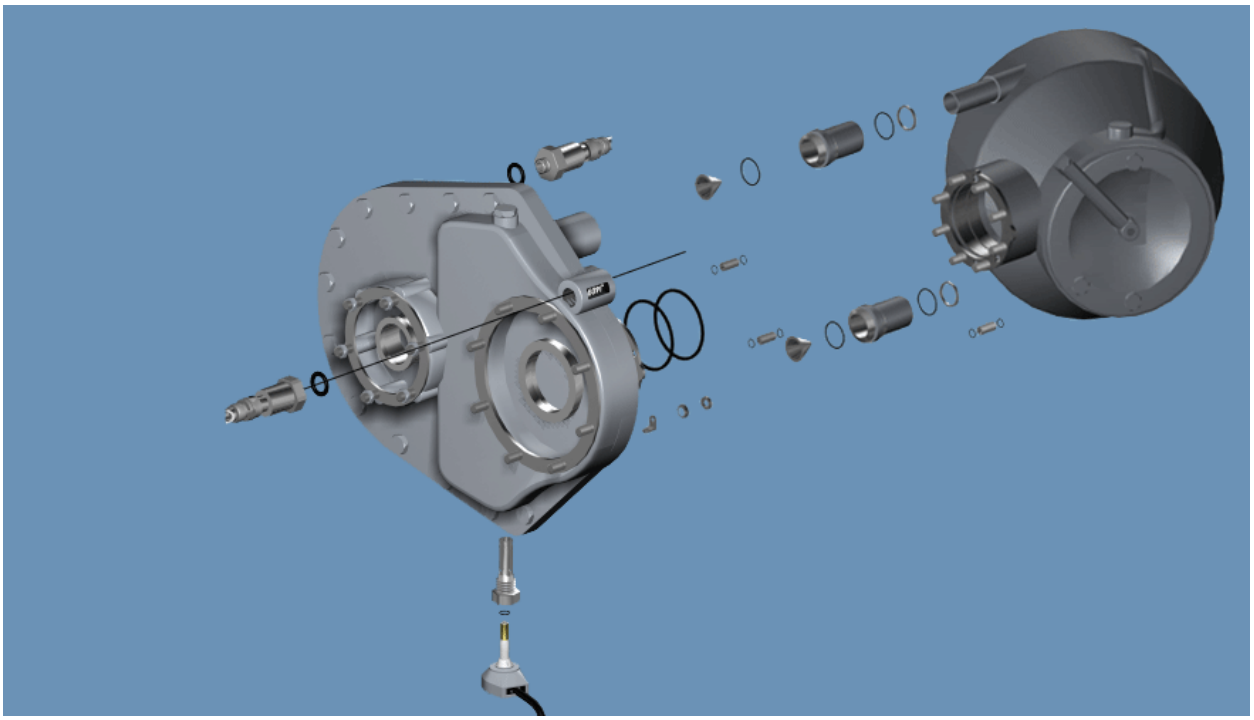
(1) One accessory module is mounted on the front of each input module, and each accessory module is interchangeable with the other.

(2) A rotor speed sensor on the right accessory module provides signals for the Vertical Instrument Display Systems (VIDS).

(3) On the UH-60L, an additional rotor speed sensor is mounted on the left accessory module, providing input signals to the Digital Electronic Control (DEC) for improved transient droop response.

(4) The left module has a low oil pressure switch and a chip detector, located the farthest point from the pump, which will cause the MAIN XMSN OIL PRESS caution light to come on when the pressure drops to 14 ±2 PSI.

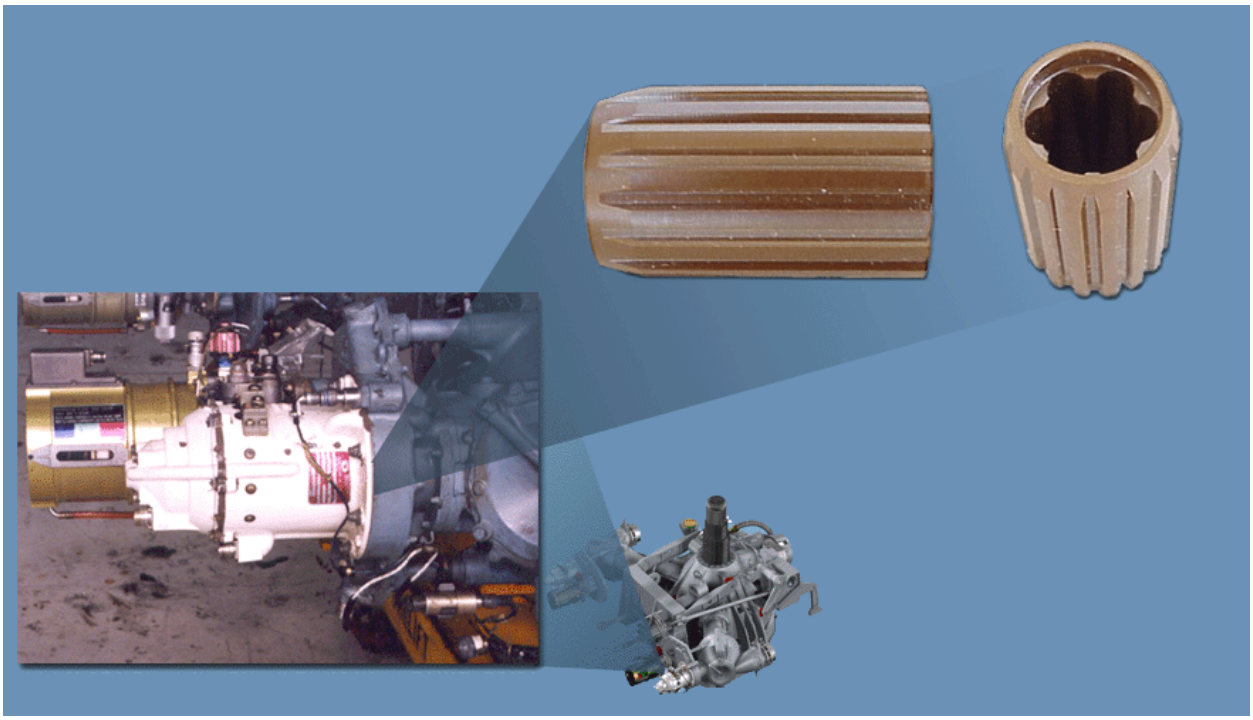
Frame #0060 (Accessory Module Exploded View)



(5) The accessory modules drive the electrical generators and the hydraulic pump modules.

(6) Both modules also contain a chip detector to monitor lubricating oil for possible metal contamination.

Frame #0060 (Accessory Module Spline Adapter)



(7) The No. 1 and No. 2 generators, driven by the left and right accessory gear box modules, respectively, are oil-spray cooled brushless generators rated at 30/45 KVA at 115/200 V AC, three-phase.

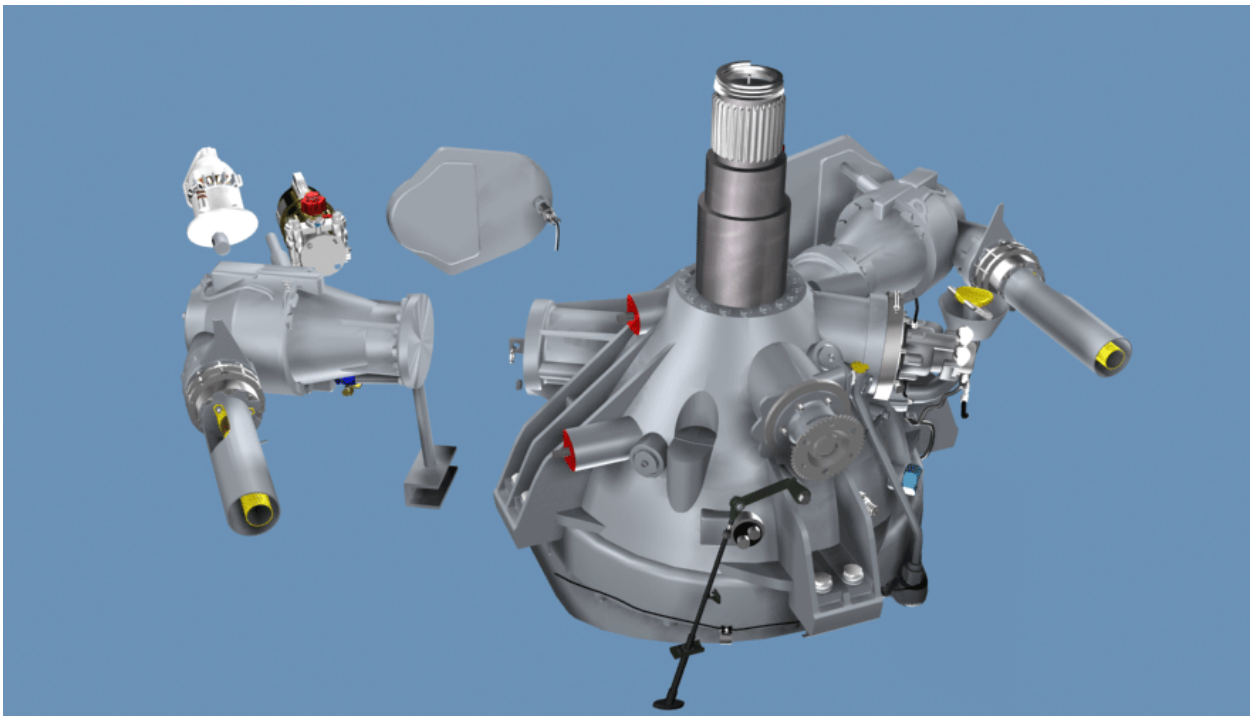
(8) The APU generator, driven by the APU turbine engine, is an air-cooled brushless generator rated at 20/30 KVA at 115/200 V AC, three-phase.

(9) The spline adapter is used for mounting the main generator to the accessory modules.

(10) If the spline adapter breaks apart, be aware that pieces will travel into the input module.

g. Main Module

Frame #0065 (Main Module)



(1) The main module is mounted on top to the cabin fuselage.

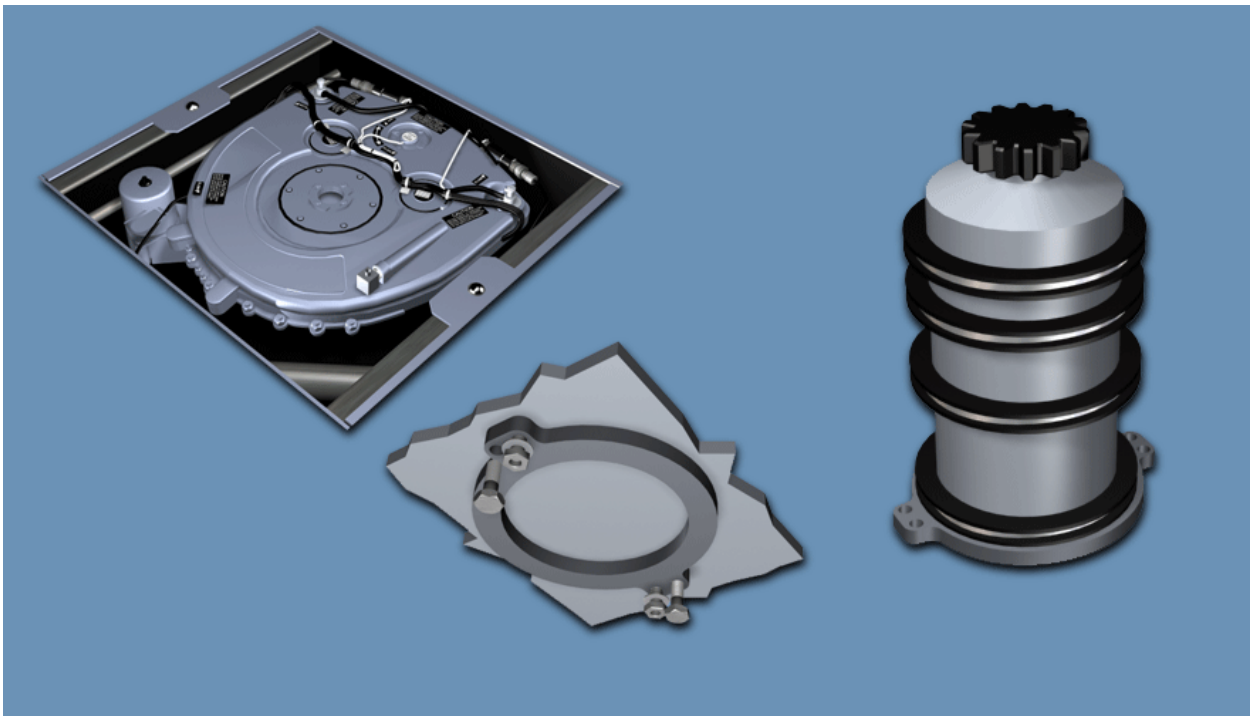
(2) The main module supports and drives the main rotor head.

(3) It also drives the tail rotor system.

(4) The main module has an oil pressure sensor, two oil pumps with pressure regulator valves, oil filter, main transmission chip detector with temperature sensor, and two input module chip detectors.

h. Oil Pumps

Frame #0070 (Oil Pumps)



WARNING: Lubricating oils MIL-L-23699, DOD-L-85734, and MIL-L-7808 contain materials hazardous to health. They produce paralysis if swallowed. Prolonged contact may irritate the skin. Wash hands thoroughly after handling. Oils may burn if exposed to heat or flames. Use only with proper ventilation.

(1) The main transmission lubrication pumps, driven internally by the main module, are combination pressure and scavenge vane-type pumps, operating in parallel.

(2) The pressure side of the pumps supplies oil at 15 Gallons Per Minute (GPM) at 50-55 PSI.

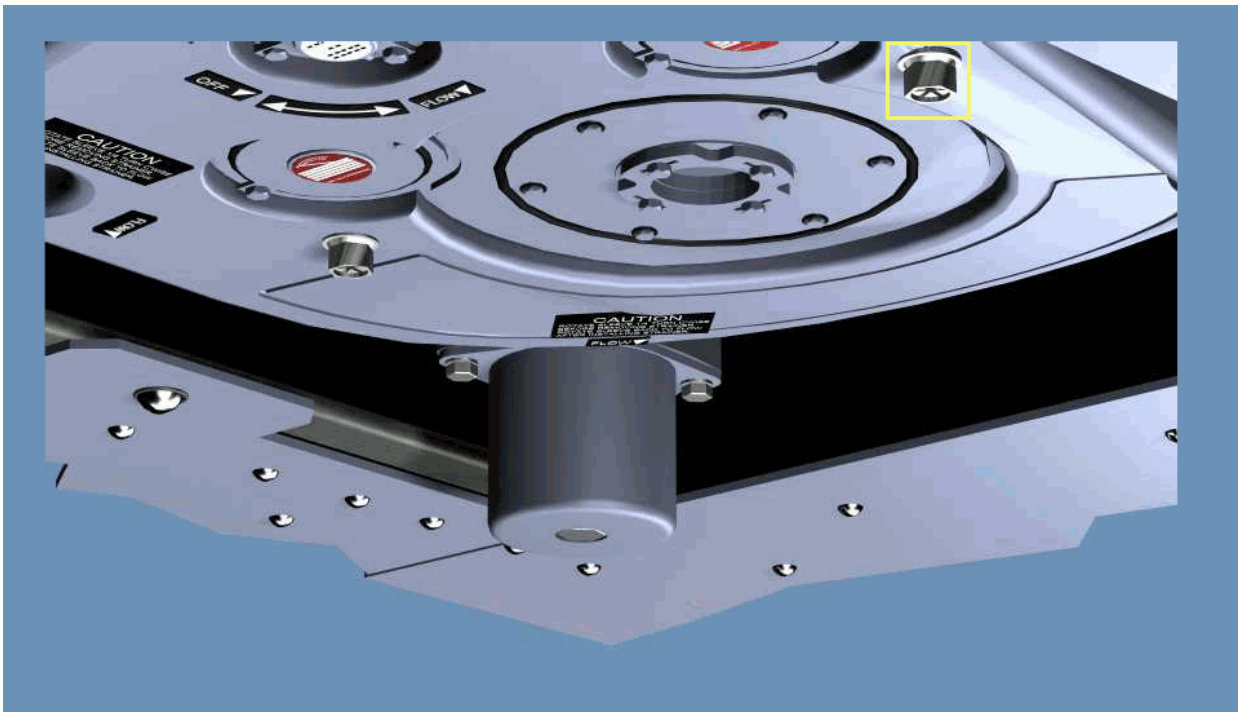
(3) The scavenge side returns oil at a rate of 7 GPM (L module 14 GPM), at a pressure between 50-55 PSI to the sump.

(4) The main transmission oil pressure may fluctuate when the aircraft is known to be in a nose-up attitude (i.e., slope landings or hover with an extreme aft Center of Gravity (CG).

(5) With a loss of all oil, the main transmission will continue to operate in flight for another 30 minutes.

i. Pressure Regulating Valve

Frame #0075 (Pressure Regulating Valve FLASH)



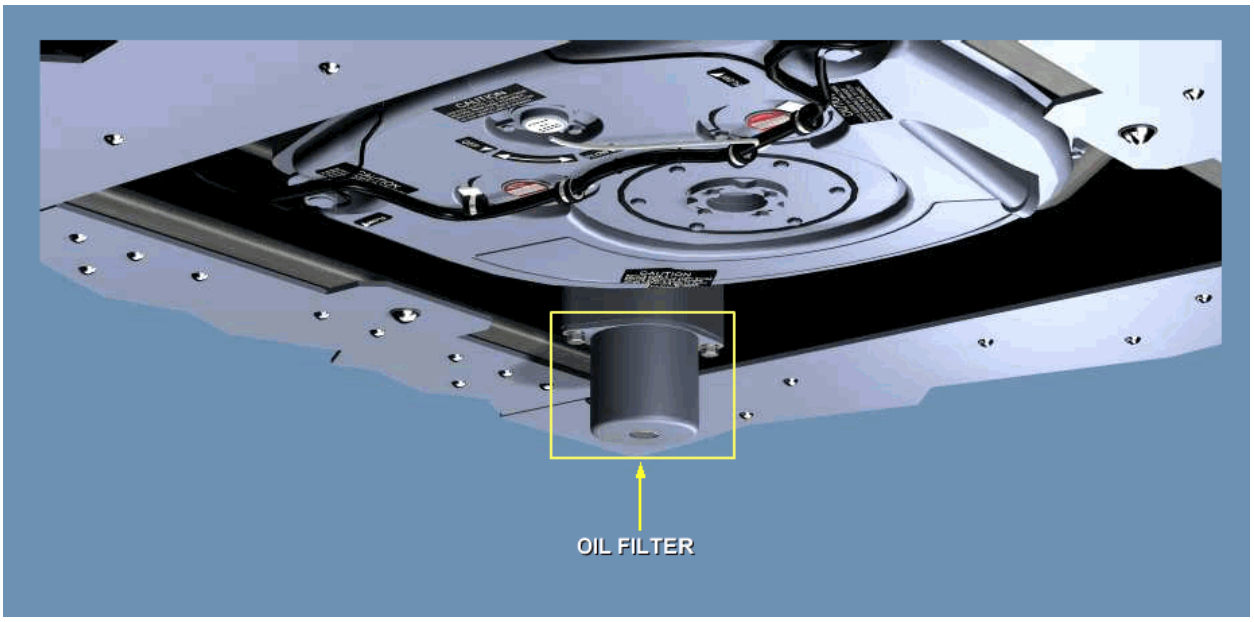
(1) The pressure side of each pump is regulated by an adjustable pressure regulating valve.

(2) As pressure exceeds 55 PSI, the bypass valve starts to open and extra oil is bypassed back to the inlet side of the pump.

(3) Adjustments should only be made on newly installed oil pump regulating valves or when specifically instructed by the maintenance manual.

j. Oil Filter

Frame #0083 (Oil Filter FLASH)



(1) The two-stage oil filter, at the right rear section of the sump, protects the lubrication system by removing lubricant contaminants.

(2) Filter elements are paper, throw-away types.

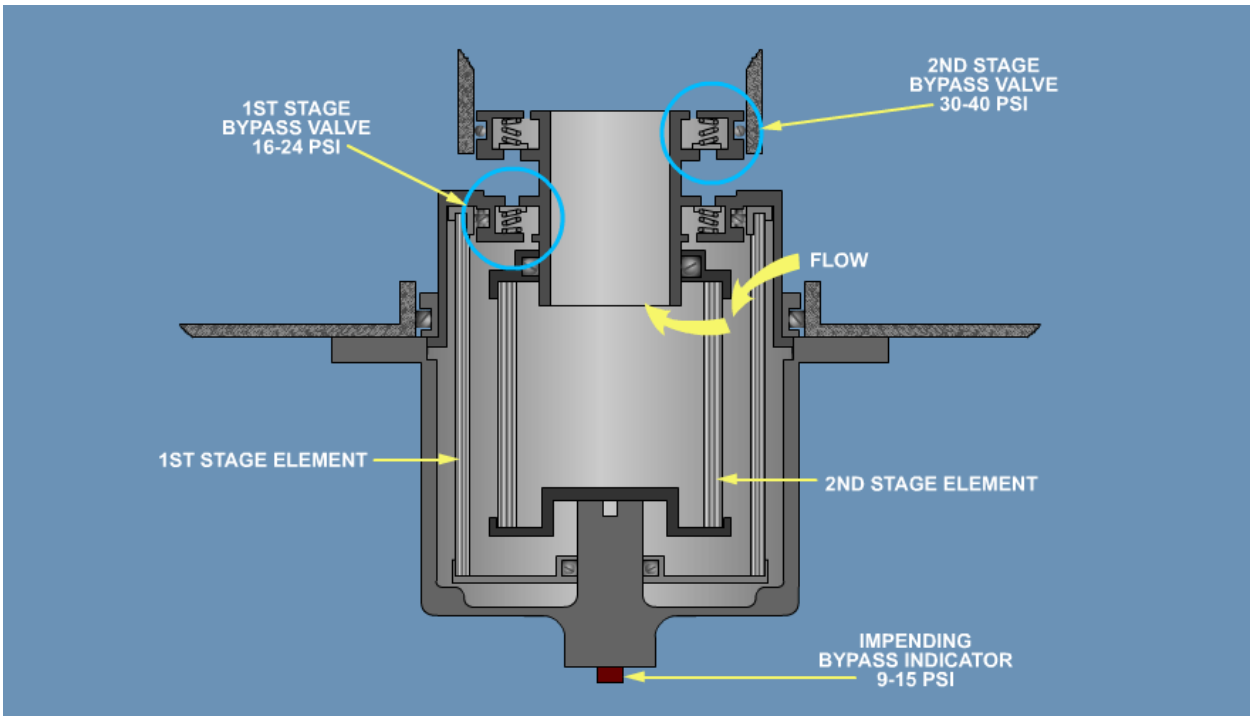
(3) UH-60A and EH-60A model aircraft filters have a 46-micron first stage element and a 75-micron second stage element.

(4) The UH-60L model aircraft is equipped with a 3-micron first stage and a 75-micron second stage filter element.

(5) When removing a filter bowl, a special tool is used to turn the oil flow off before removing bowl.

(6) A bypass indicator is incorporated into the bottom of the bowl.

Frame #0084 (Oil Filter Cutaway)



(7) When primary filter begins to clog and pressure drops between 9 and 15 PSI, a red button extends 3/16 inch from bottom of filter bowl.

(8) It cannot be reset unless filter elements are replaced.

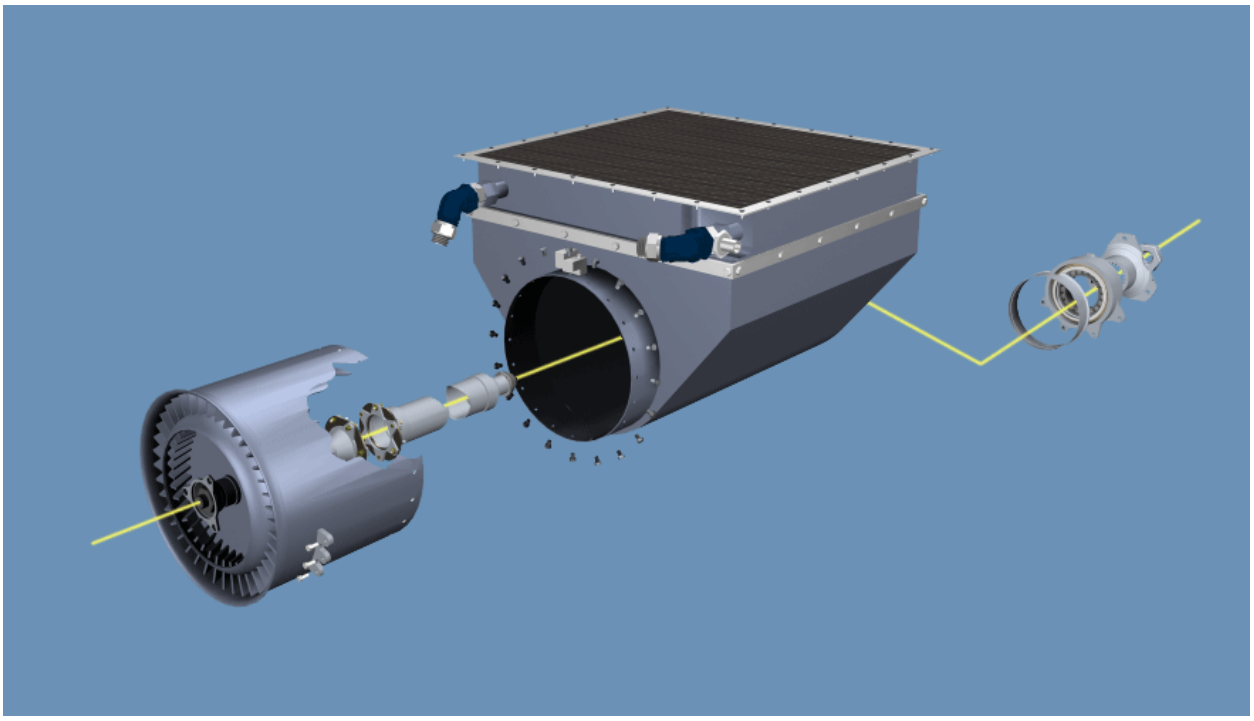
(9) A thermal lockout prevents the indicator from extending when the temperature goes below 125 °F to 155 °F.

(10) The first stage filter will protect the system up to a differential pressure of 16 to 24 PSI.

(11) At this point, the flow is bypassed to the second stage filter element, which will protect the system up to 30 to 40 PSI differential pressure.

k. Oil Cooler

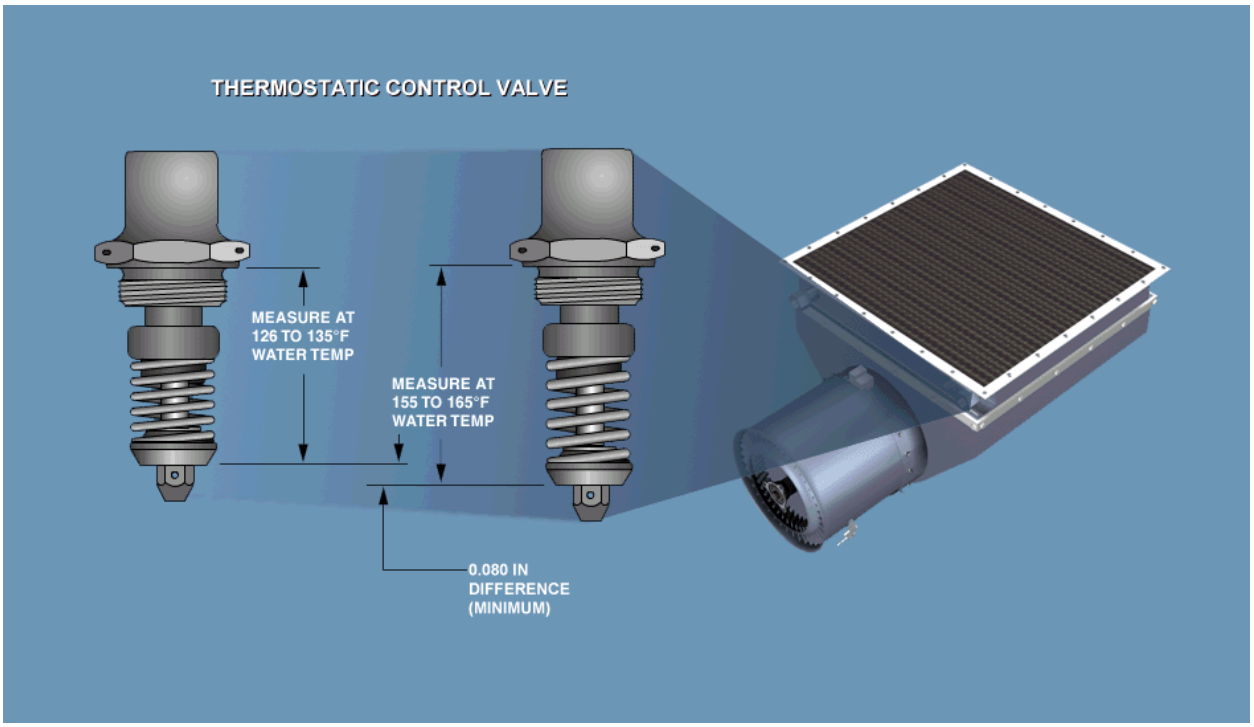
Frame #0085 (Oil Cooler)



(1) The oil cooler and fan, located aft of the main module, consists of a radiator, duct, fan, and shafting.

(2) The oil cooler fan is driven by the tail rotor drive shaft, which forces air through the radiator for oil cooling.

Frame #0085 (Thermostatic Control Valve)



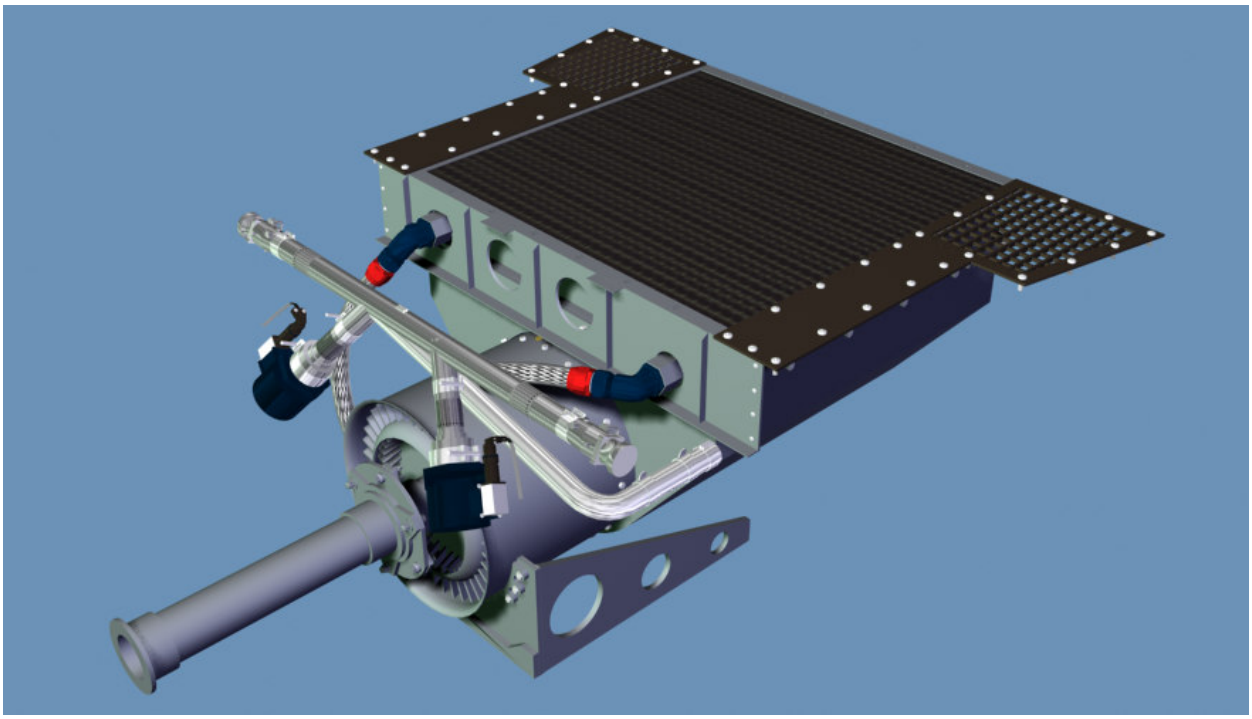
(3) A thermostatic control valve within the radiator, allows cold oil (less than 70 ℃) to bypass the radiator.

(4) Also, if the radiator becomes clogged, the oil will bypass the radiator.

(5) Oil is routed from the oil cooler to the main module manifold to be divided between the lubrication jets in the main module and the oil passages to the input modules, accessory modules, and generators.

l. Oil Cooler Fan

Frame #0090 (Oil Cooler Fan)

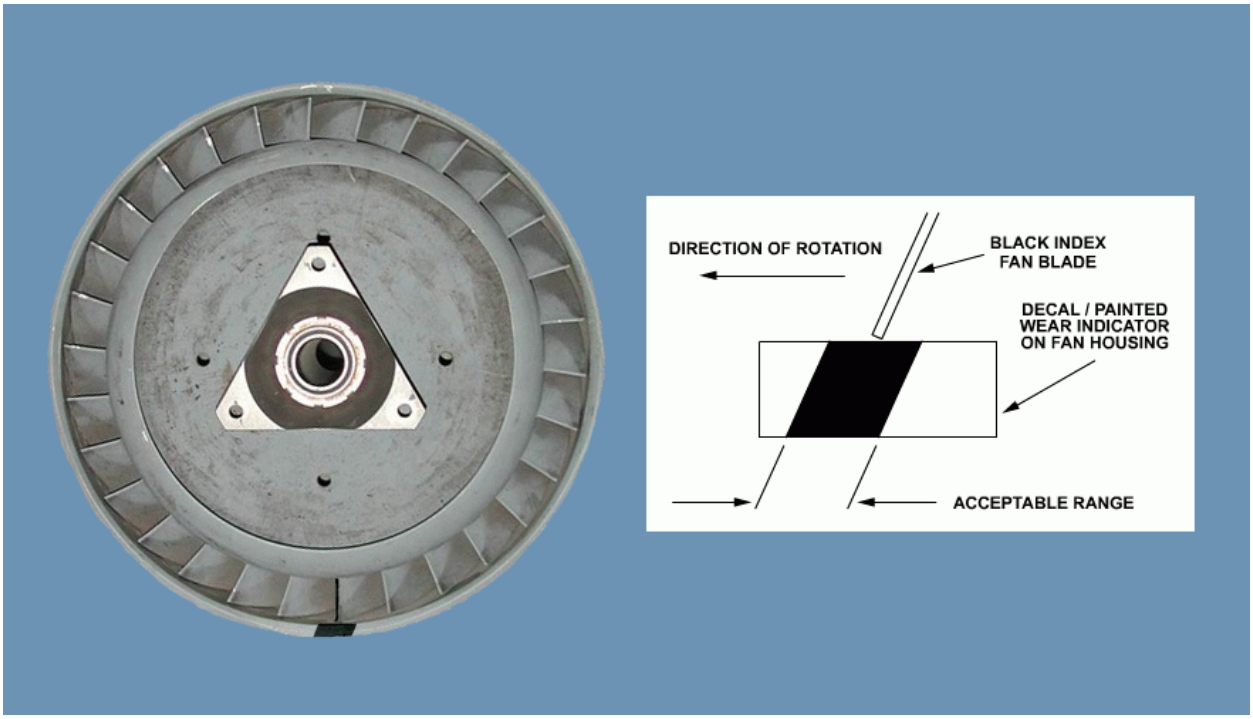


(1) The oil cooler fan is powered by the tail rotor drive system and forces air through the radiator, cooling the oil in the radiator.

(2) Hot oil from the main module sump is pumped into the radiator oil inlet valve.

(3) Oil is routed from the oil cooler outlet valve, to the main module manifold, which is then divided between the lubrication jets in the main module and oil passages, the input modules, accessory modules, and generators.

Frame #0090 (Cooler Fan Spline)



(4) Spline wear check is to be done on oil cooler fans with a part number that ends with -103 through -106.

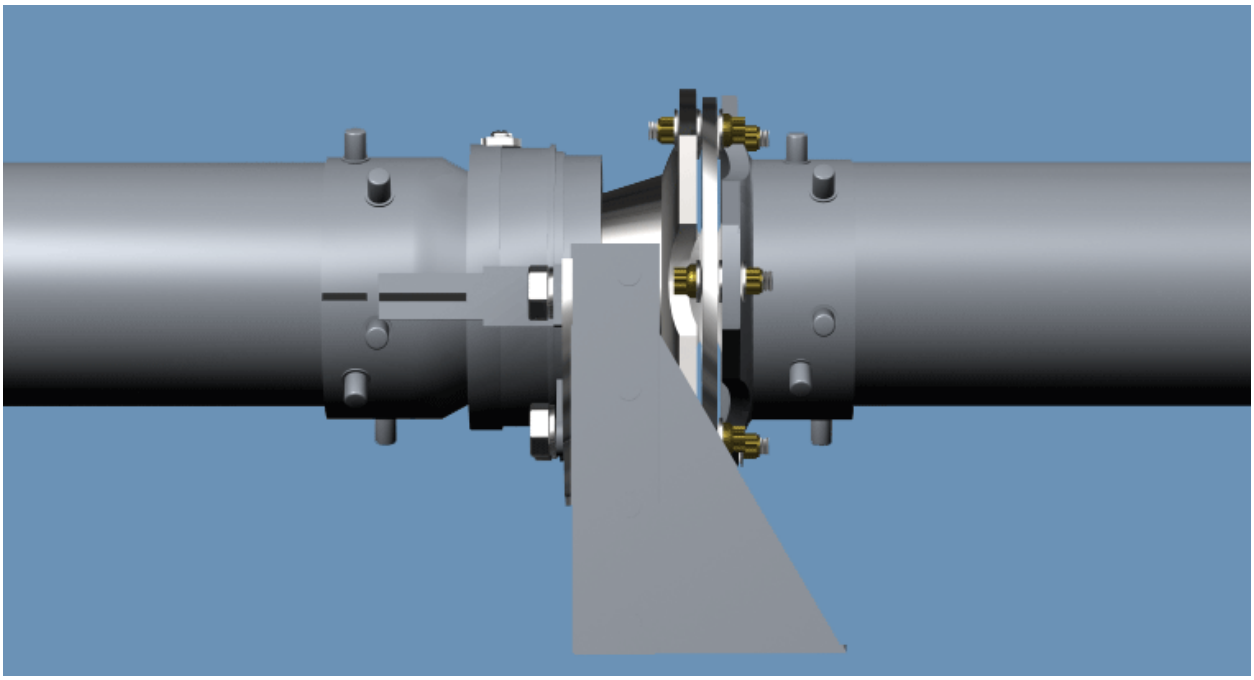
(5) A -107 oil cooler fan does not require a spline wear check.

(6) The -107 oil cooler fan is welded together instead of using spline and an input and output flange.

(7) Check the position of the black painted index blade on the oil cooler.

(8) A black painted index blade must be within wear indicator range.

Frame #0090 (Drive Shaft Index)



(9) Slowly rotate tail rotor blade in opposite direction of rotation until index mark on tail rotor drive shaft lines up with spline wear index bracket slot on No. 3 viscous damper.

(10) Use a 6 inch ruler or similar straight edge to line up bracket slot with the black index mark line.

(11) Release gust lock with load applied.

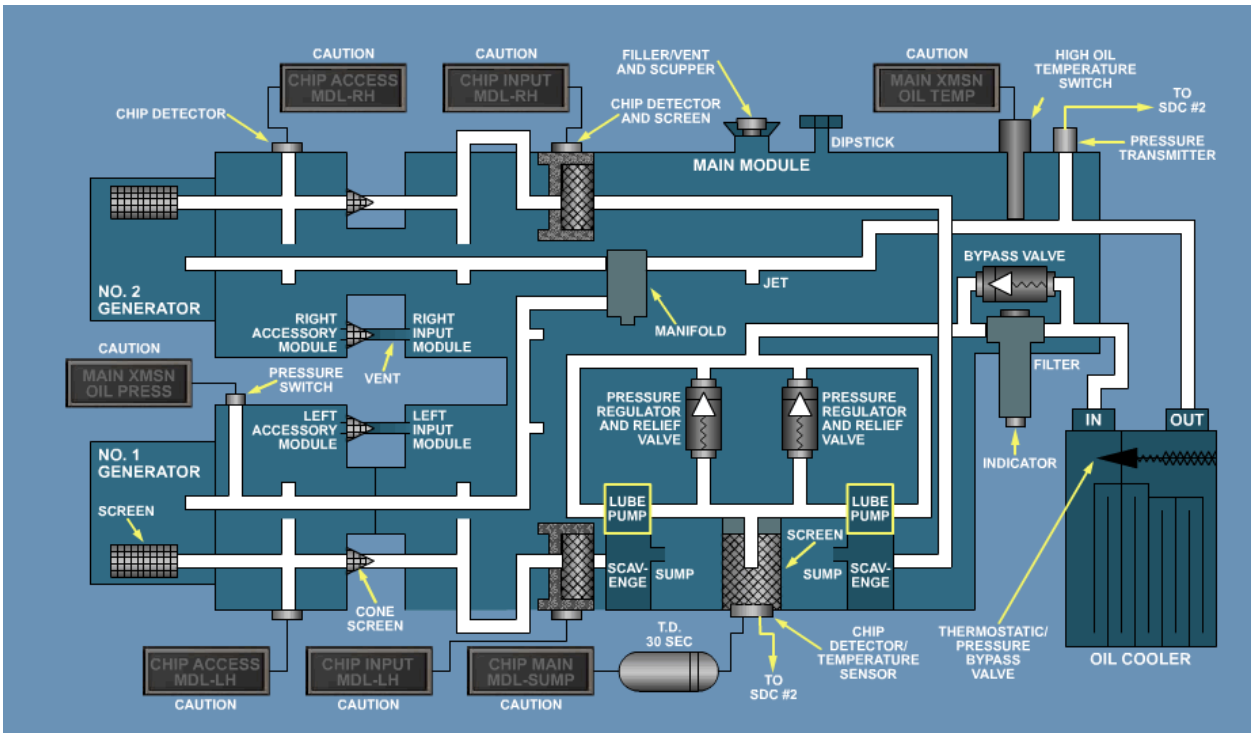
(12) If index mark on tail rotor drive shaft rotates past spline wear index bracket slot on No. 3 viscous damper, continue to rotate in opposite direction of normal rotation until index mark is aligned with slot.

(13) Check position of black painted index blade on oil cooler.

(14) Black painted index blade must be within black wear indicator range.

m. Main Transmission System Lubrication

Frame #0095 (Main Transmission System Lubrication FLASH)



(1) The main transmission is a wet sump lubrication system that cools and filters the oil to all the gears and bearings.

(2) The system includes two pressure and scavenge, vane-type lubricating pumps that supplies oil to the system.

(3) Oil from the pumps travel to the pressure regulator and relief valves and on to the oil filter.

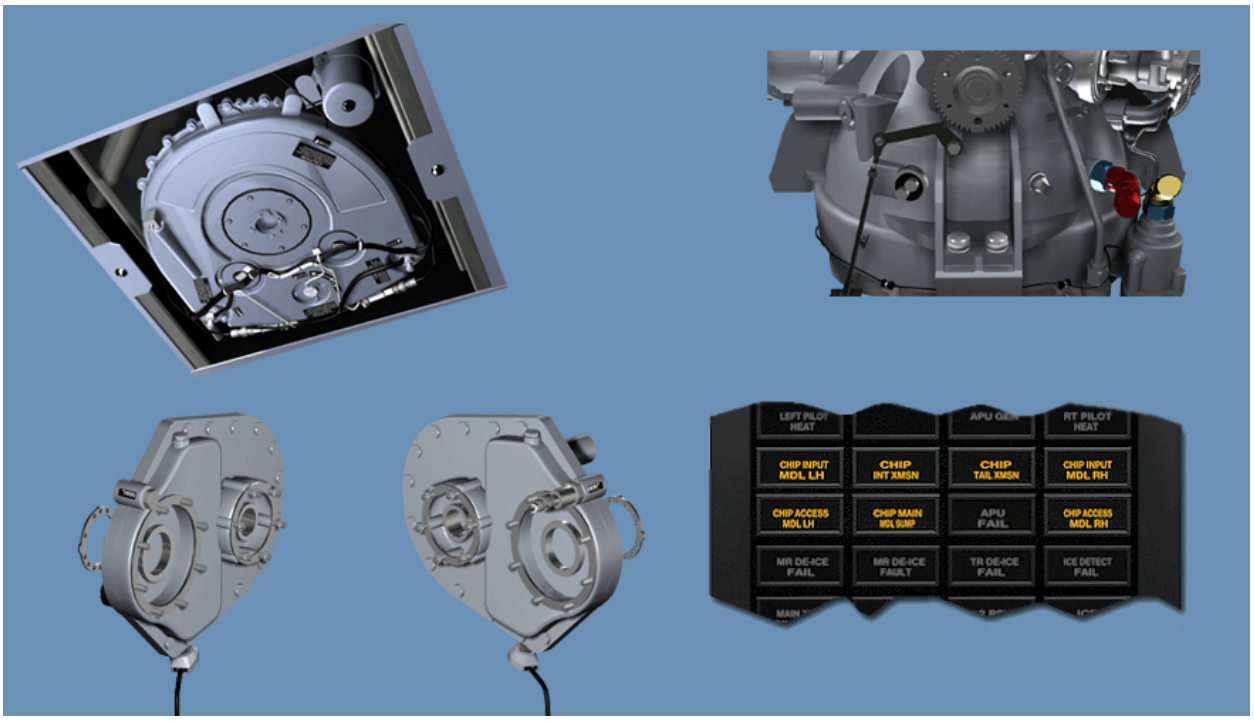
(4) From the oil filter, oil travels to the oil cooler and on to the oil pressure transmitter and the high oil temperature switch.

(5) The lubrication system uses internal cored lines to send oil to the oil jets in all the modules, No. 1 and No. 2 generators, and main transmission low oil pressure switch.

(6) Oil returns back to the main module, passing through a screen and chip detector system.

n. Main Transmission Chip Detector System

Frame #0100 (Main Transmission Chip Detector System)



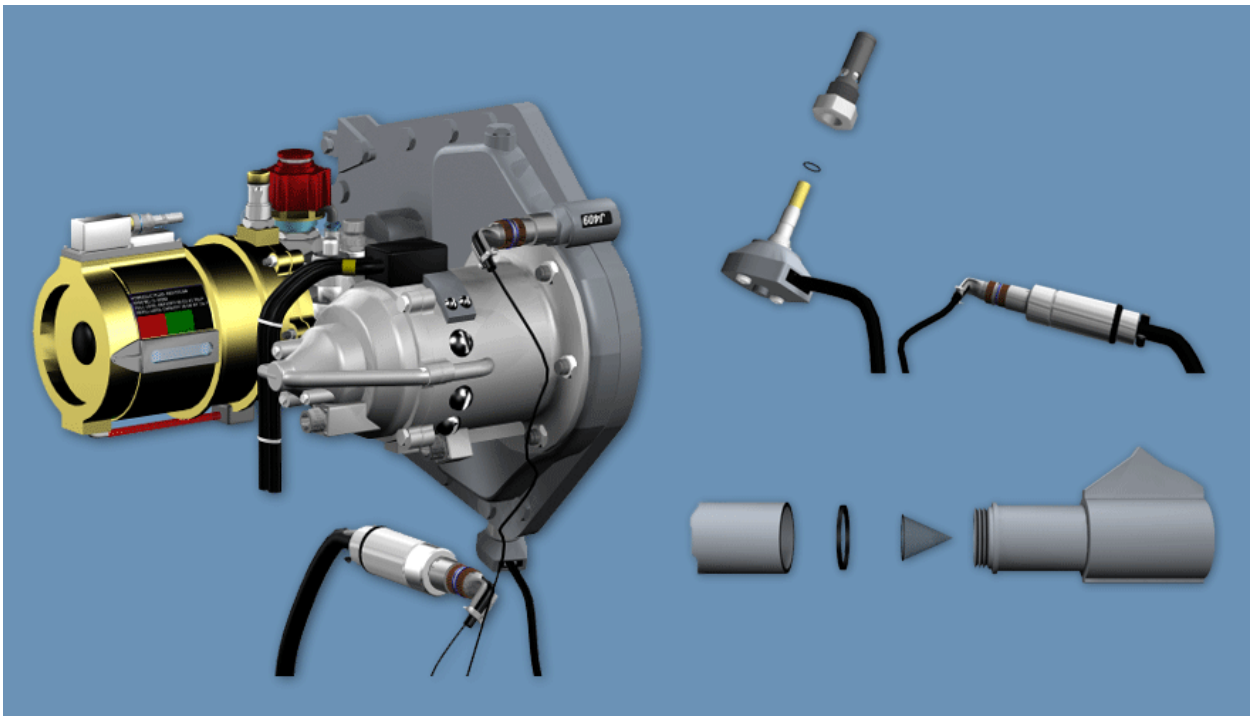
(1) The chip detectors are located on the left and right input accessory modules, and the main gearbox module.

(2) The main XMSN chip detector is connected to a 30 second time delay relay to allow small chips and fuzz to burn off and/or wash away.

(3) The main module chip detector has a temperature sensor to cut out the fuzz burning capability in the event of a high oil temperature.

(4) Chips that are too large to burn off or wash away, trigger the detection system, which illuminates a caution light on the caution/advisory panel.

Frame #0100 (Chip Detector Breakdown)



(5) These detectors provide warning of chips in any of five areas of the main XMSN system.

(6) Each chip detector incorporates a self-sealing sleeve so that it can be removed for visual inspection, without loss of oil.

(7) The magnetic plugs on each chip detector attract ferrous particles at any of the detector locations.

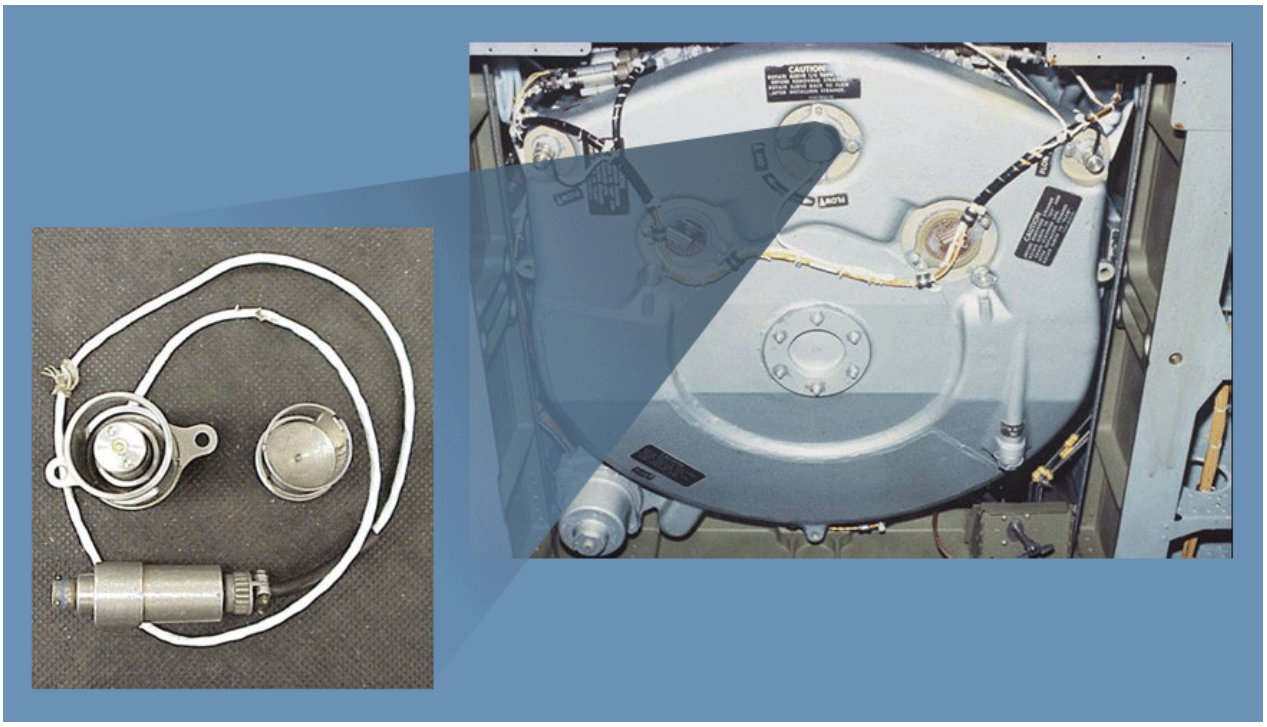
(8) The fuzz burn-off feature is deactivated when oil temperature reaches 140 ℃.

(9) Deactivation of the fuzz burn-off feature does not disable detection and illumination of caution lights.

(10) The pilot or maintenance personnel must check the caution/advisory panel, before removing power, to determine the location of the chip.

(11) The system is powered by the DC essential bus through a circuit breaker on the upper console circuit breaker panel marked CHIP DET.

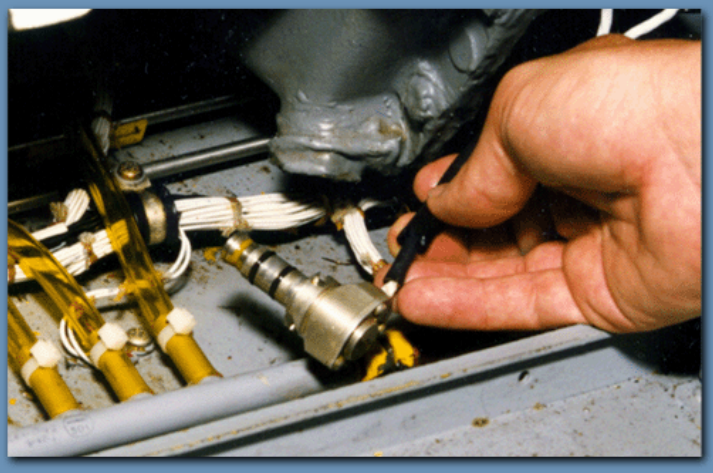
Frame #0102 (Main Transmission Chip Detector System)



(12) The main gear box has one chip detector, mounted on the sump assembly that constantly monitors lubricating oil for possible metal contamination.

(13) Metal chips that accumulate within the chip detector gaps close an electrical circuit that illuminates the CHIP MAIN MDL SUMP capsule on the caution/advisory panel.

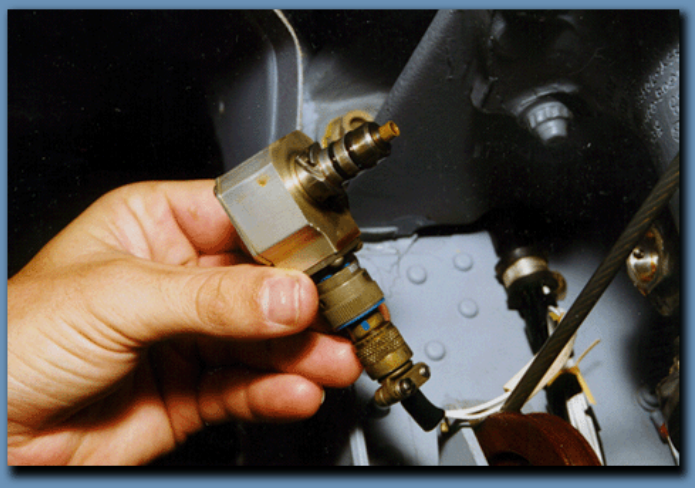
Frame #0102 (Accessory Module Chip Detector)



(14) There are two chip detectors, one mounted on each accessory module, constantly monitor lubricating oil for possible metal contamination.

(15) Any metal chips that accumulate within chip detector gaps close an electrical circuit that lights either chip access MDL- LH or - RH capsule on the caution/advisory panel.

Frame #0102 (Tail Gear Box Chip Detector)



(16) The tail gear box chip detector monitors possible metal contamination.

(17) Any metal chips that accumulate on the chip detector plug close an electrical circuit and light the CHIP TAIL XMSN light.

(18) The chip detector has a burn-off circuit that burns off minute metal particles (fuzz) to prevent unnecessary lighting of the caution light.

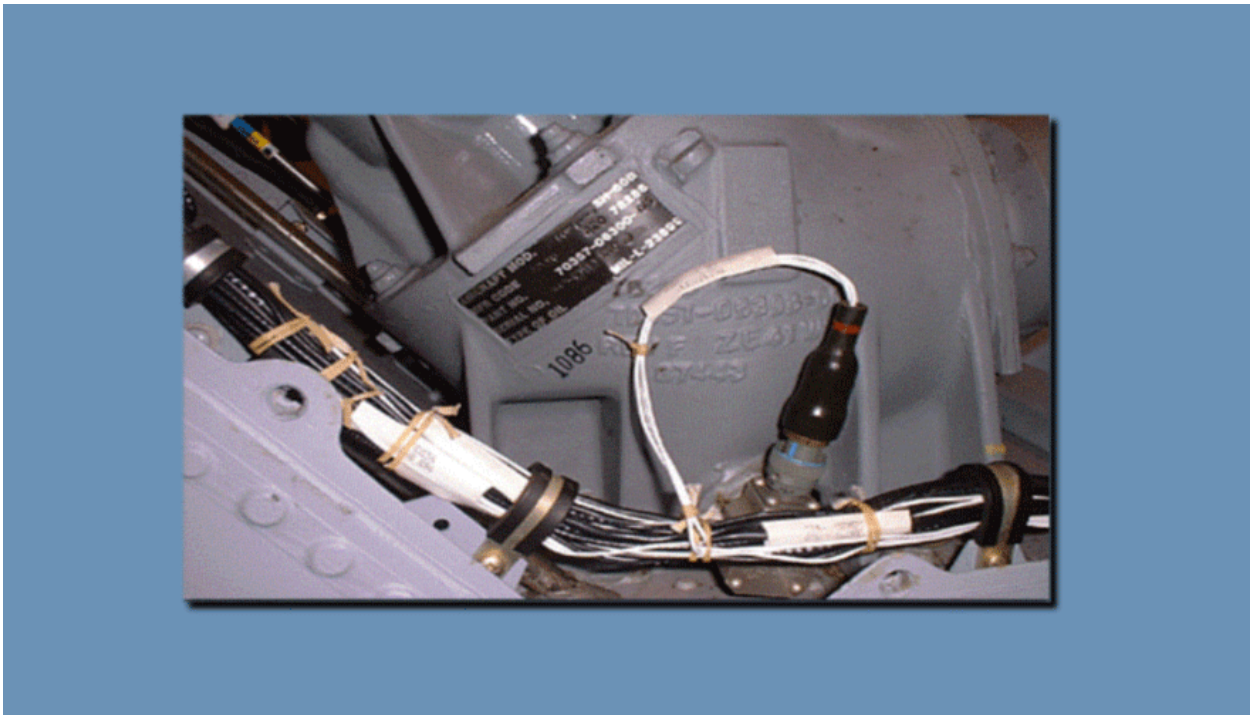
(19) The chip detector also contains a normally open bimetal temperature switch.

(20) When gear box oil temperature reaches 140 ℃ (284 ℉), the switch closes and causes the fuzz burn capacitor to discharge.

(21) This prevents arcing within the gear box when gear box oil is hot.

(22) When the temperature switch closes, the TAIL XMSN OIL TEMP light on the caution advisory panel goes on.

Frame #0102 (Intermediate Gear Box Chip Detector)



(23) The intermediate gear box chip detector monitors possible metal contamination.

(24) Any metal chips that accumulate on the chip detector plug close an electrical circuit and light the CHIP INT XMSN light.

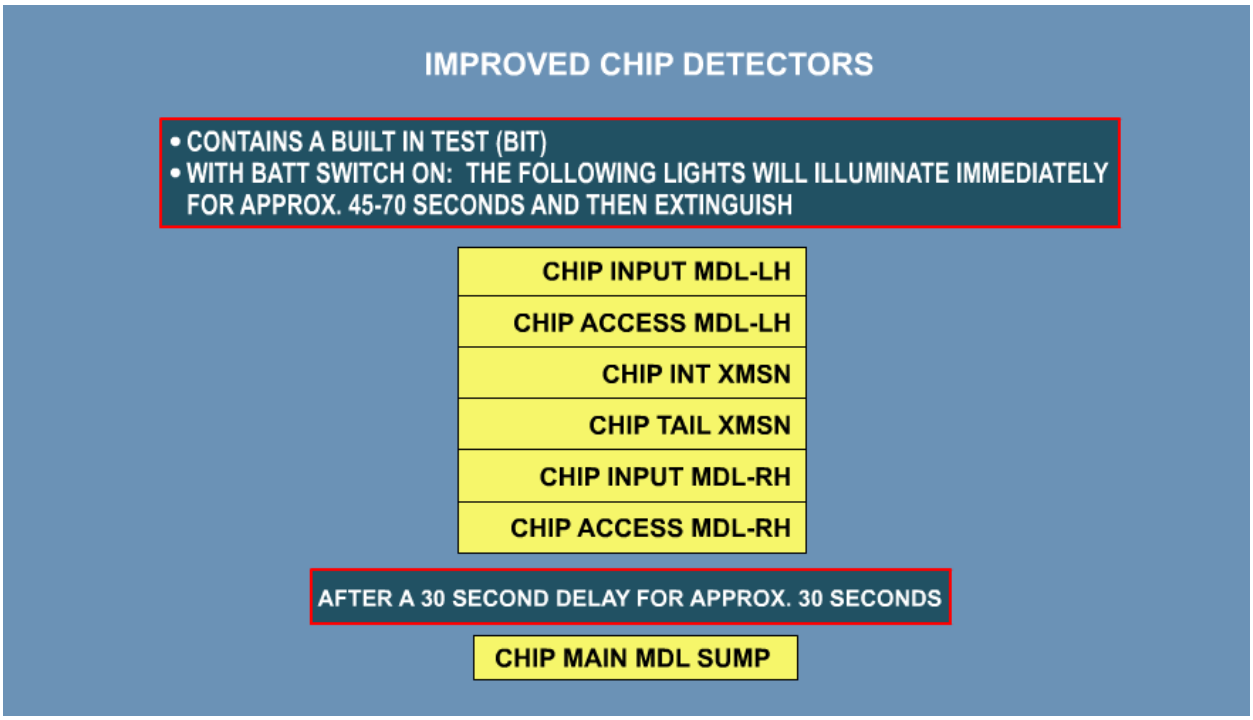
(25) The chip detector also contains a normally open bimetal temperature switch.

(26) When gear box oil temperature reaches 140 °C (284 °F), the switch closes and causes the fuzz burn capacitor to discharge.

(27) This prevents arcing within the gear box when gear box oil is hot.

(28) When the temperature switch closes, the INT XMSN OIL TEMP light on the caution advisory panel goes on.

Frame #0103 (Improved Chip Detectors)

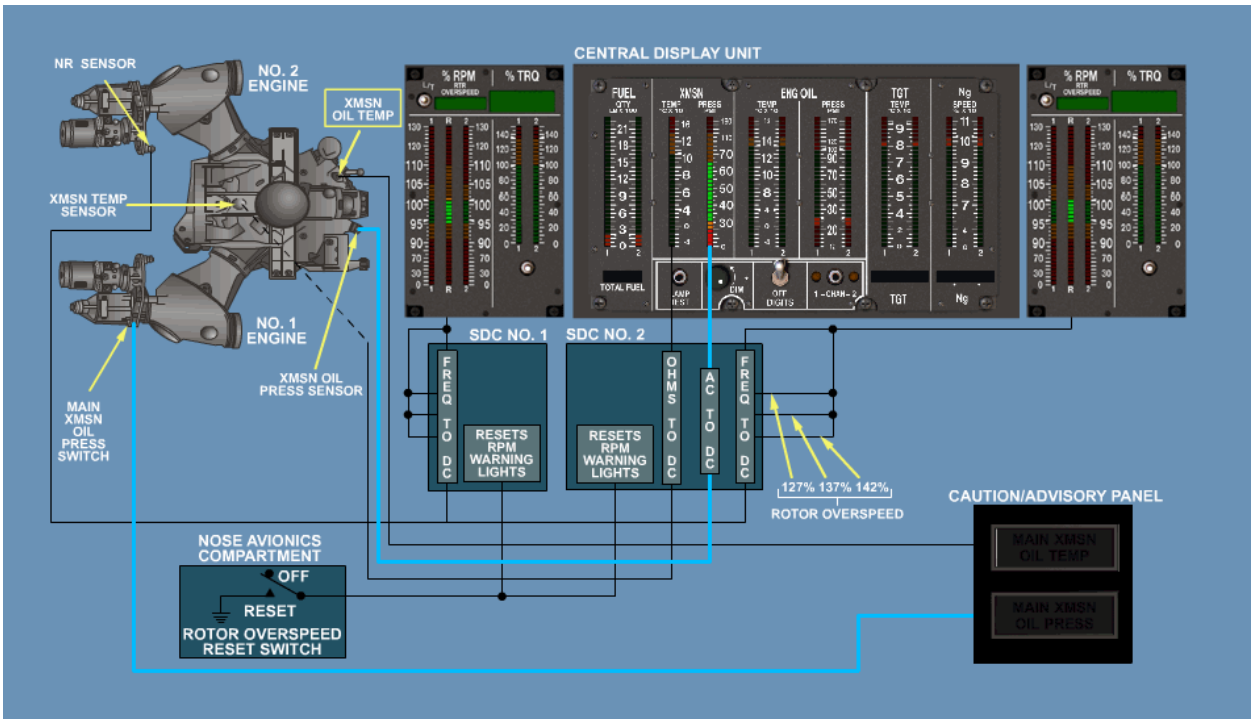


(29) The new Built-In-Test (BIT) circuits for the chip detectors will automatically test for a continuous circuit from the caution/advisory panel to each individual chip detector when power is first applied.

(30) The chip detector caution lights illuminate during test and extinguish after successful completion of test.

o. Warning and Indicating System

Frame #0105 (Warning and Indicating System)



(1) The warning and indicating systems indicate possible troubles in the transmission system.

(2) They cover oil pressure and oil temperature indications, and chip detectors throughout the main transmission.

(3) When the temperature of the oil entering the manifold is over 120° C, the sensor lights the MAIN XMSN OIL TEMP light in the caution/advisory panel and also sends a signal to the CDU.

(4) The oil pressure warning system has an oil pressure switch in the left accessory module connected to the MAIN XMSN OIL PRESS light in the caution/advisory panel.

(5) When the oil pressure in the left accessory module falls below 14 PSI, the switch turns on the MAIN XMSN OIL PRESS light.

(6) Power turbine and rotor speed (NR) are indicated for each engine on a single instrument marked% RPM 1 R 2 on the display panel with three vertical scales.

(7) Rotor speed is sensed by a sensor (NR SENSOR) on the right accessory module.

(8) Power turbine speed is sensed by a speed sensor on the engine exhaust frame.

(9) At the top of the panel are three warning lights that indicate varying degrees of rotor overspeed.

(10) These lights remain on, once tripped, and must be manually reset.

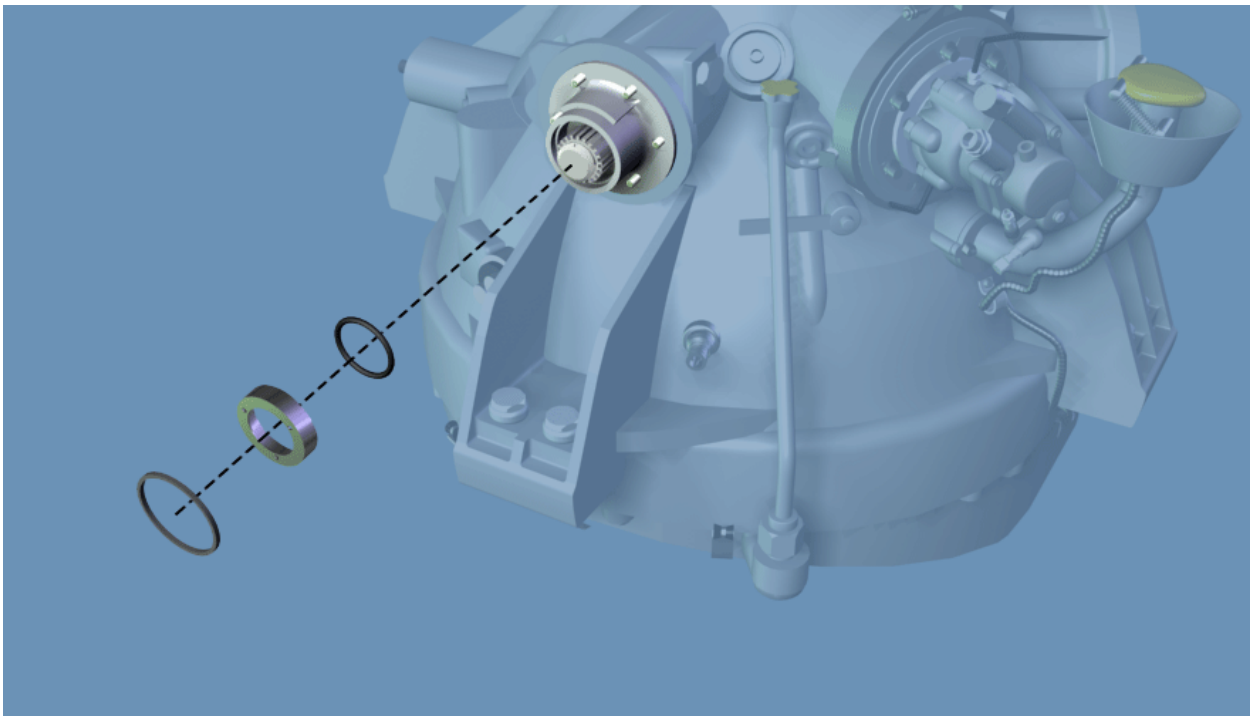
(11) Engine overspeed checks in flight are prohibited.

(12) Powers off (autorotation) up to 120% RPM R are authorized, for MTP during autorotational RPM checks.

(13) Engine overspeed checks, on the ground, are authorized by designated maintenance personnel only.

p. Tail Rotor Take Off Seal

Frame #0110 (Tail Rotor Take Off Seal)



CAUTION: Damage to main module will result if too much force is applied while using hammer and seal puller. Gearbox housing will crack. Use care when using hammer and seal puller.

NOTE: Checking the amount of seal leakage can prevent premature seal replacement before leakage is over recommended allowable limits. Leakage is gauged by measuring the drop in oil level as shown on dipstick. Total leakage must not be over 1/8-inch in any one flight. Allow at least 2 hours for oil to drain back before checking. If over 1/8-inch accumulation, replace seal.

For extended flights over 3 hours, the allowable leakage is to be compatible with ten-hour flight. Loss rate of 0.050-inch in 1 hour, 1/4-inch in 5 hours and 1/2-inch in 10 hours as indicated on dipstick. If loss of oil exceeds the above criteria, replace the seal.

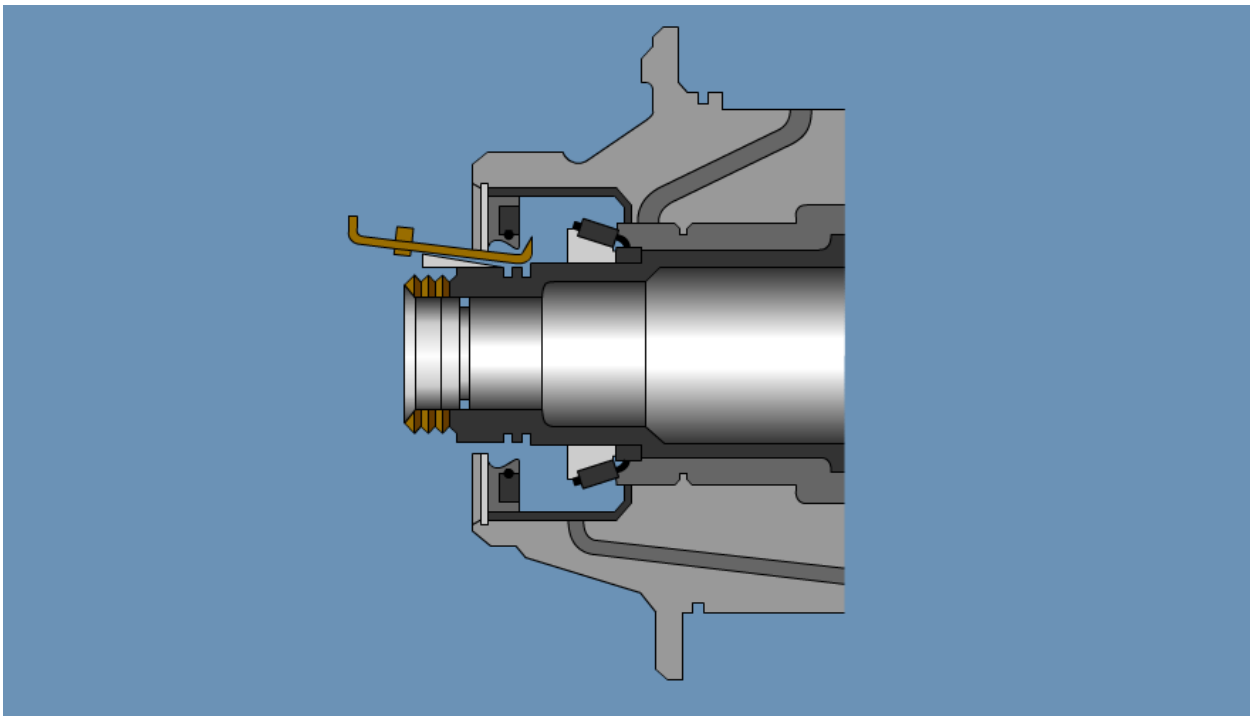
(1) Where the tail drive system exits the main module, there is a tail rotor take off seal that is not allowed to leak more than 1/8" in any one flight.

(2) Self-tapping screws may be used as an alternate way to remove the oil seal if damage.

(3) Damage to main module will result if self-tapping screws completely penetrate oil seal.

(4) Install the screws so the outer face of oil seal is penetrated.

Frame #0110 (Tail Rotor Take Off Seal Cutaway)



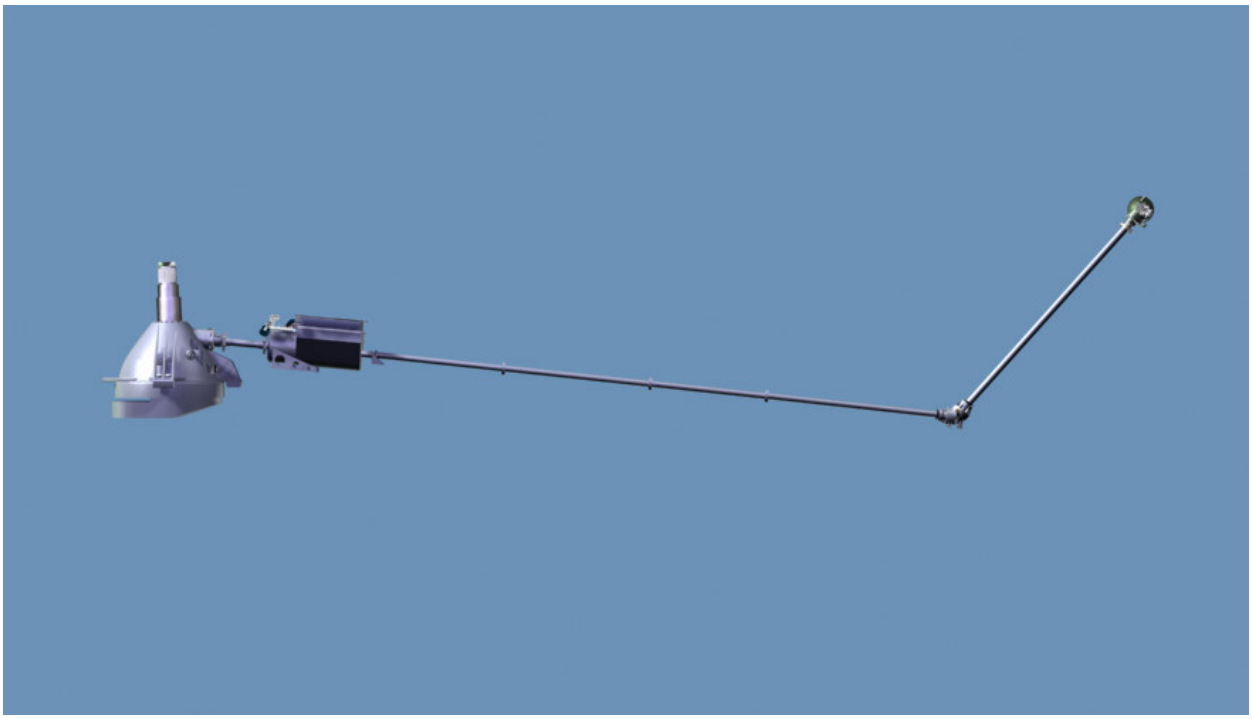
(5) Insert nylon wedge between seal puller and pinion shaft to protect gearbox.

(6) If there is no seal puller available, locally make a seal puller tool or make nylon wedge.

(7) (Refer to applicable TM for manufacturing instructions.) Exercise caution not damage pinion shaft.

q. Drive Shafts

Frame #0115 (Drive Shafts)



(1) The drive shafts are broken down into four sections and transmit torque from the main module to the tail rotor.

(2) The sections are joined together by flexible couplings.

(3) Six drive shafts connect the main module to the tail rotor gearbox.

(4) The shafts drive the oil cooler blower and transmit torque to the tail rotor.

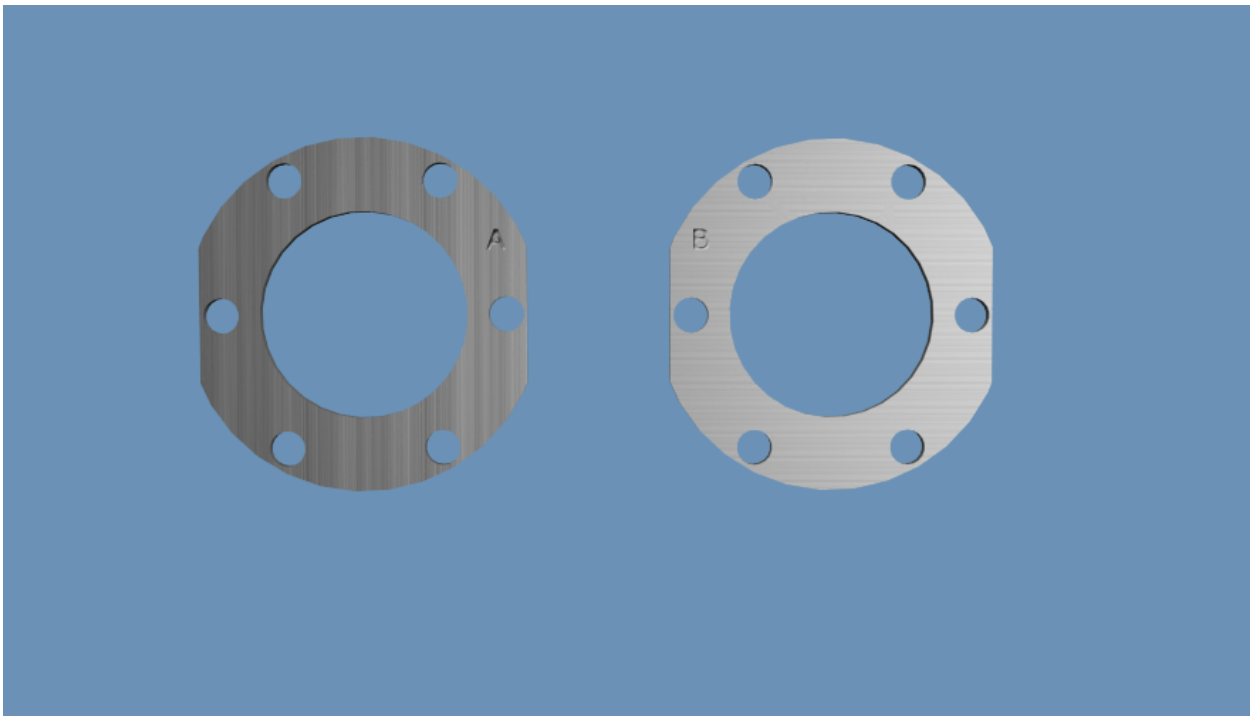
(5) Each shaft is dynamically balanced tubular aluminum.

(6) Multiple disc (flexible) couplings between sections eliminate universal joints.

(7) The shafts are ballistically tolerant if hit by a projectile and are suspended at four points in viscous-damper bearings mounted in adjustable plates and bolted to fuselage support brackets.

r. Flexible Coupling Disc

Frame #0120 (Flexible Coupling Disc)



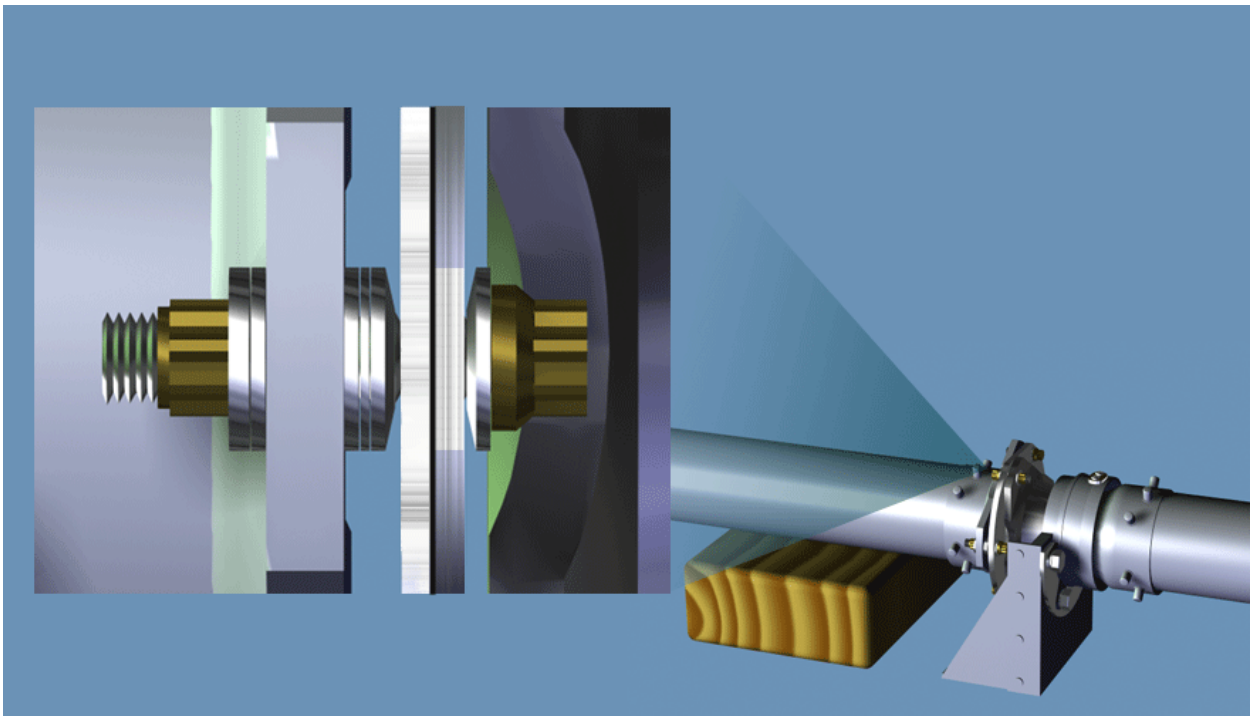
NOTE: There is no longer a requirement that the order of discs alternate between those marked "A" and those marked "B". The coupling may contain any order of "A" and "B" discs. Maintain the original orientation and order of discs when disassembling and inspecting coupling.

If any one disc making up tail rotor drive shaft coupling stack up is damaged, the entire flexible coupling must be replaced. Tail rotor drive shaft coupling discs are a matched set. Discs cannot be replaced individually. If any one disc is damaged beyond limits, the entire coupling must be replaced. Two or more discs between bolts on coupling flanges may separate or buckle. This is acceptable unless there is a sharp bend or crease in disc or in lamination spread (gap between 2 individual discs) is over 0.030-inch. To determine spread, measure gap between the disc laminations with a feeler gage.

(1) Multiple disc flexible couplings are used to carry torque and allow for minor misalignment of tail drive shaft components.

(2) Along with the special shock absorbing bearings, the couplings also allow the drive shaft to remain in alignment as the airframe flexes in flight.

Frame #0120 (Flex Coupling Spherical Washers)



(3) When inspecting tail rotor drive shaft couplings, pay particular attention to edges around the circumference of the spherical washers for cracking and improper installation.

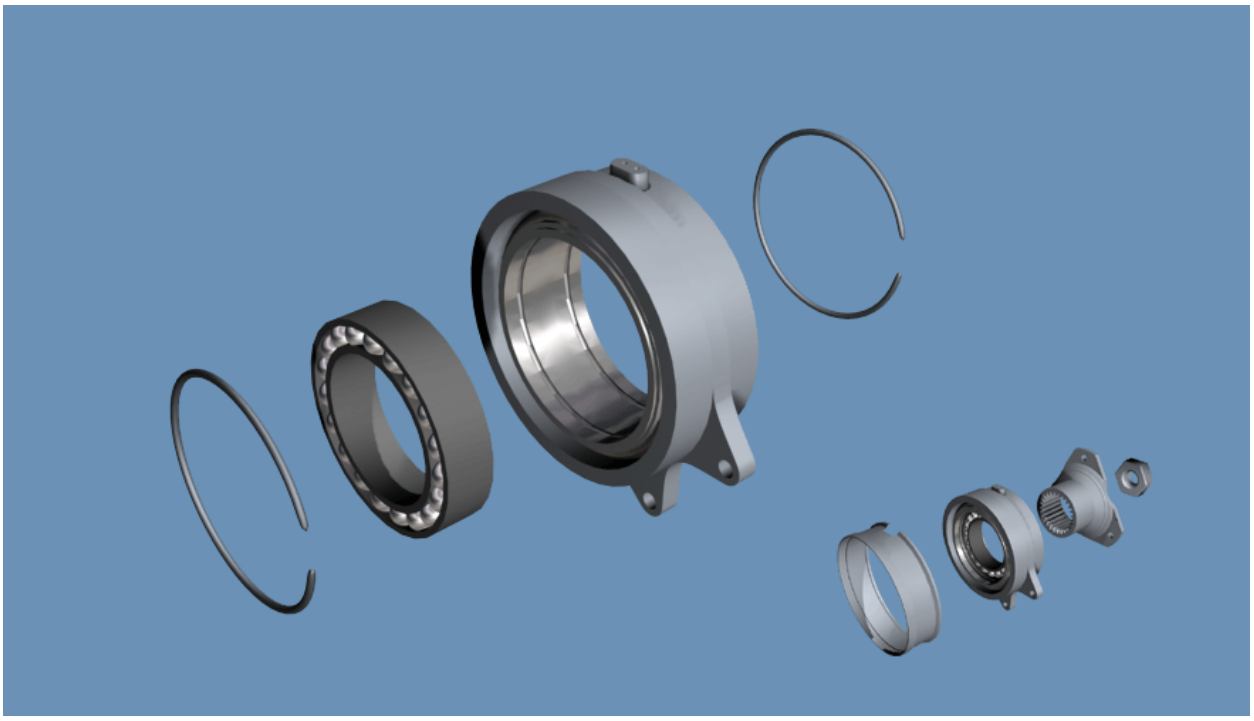
(4) The beveled edge of the spherical washer is always installed against the flexible coupling disc.

(5) Always use the manual when doing the shim stack-up, and installing spherical washers.

(6) Drive shafts are connected by a viscous damper and flexible coupling disc assembly.

s. Viscous Damper

Frame #0125 (Viscous Damper)

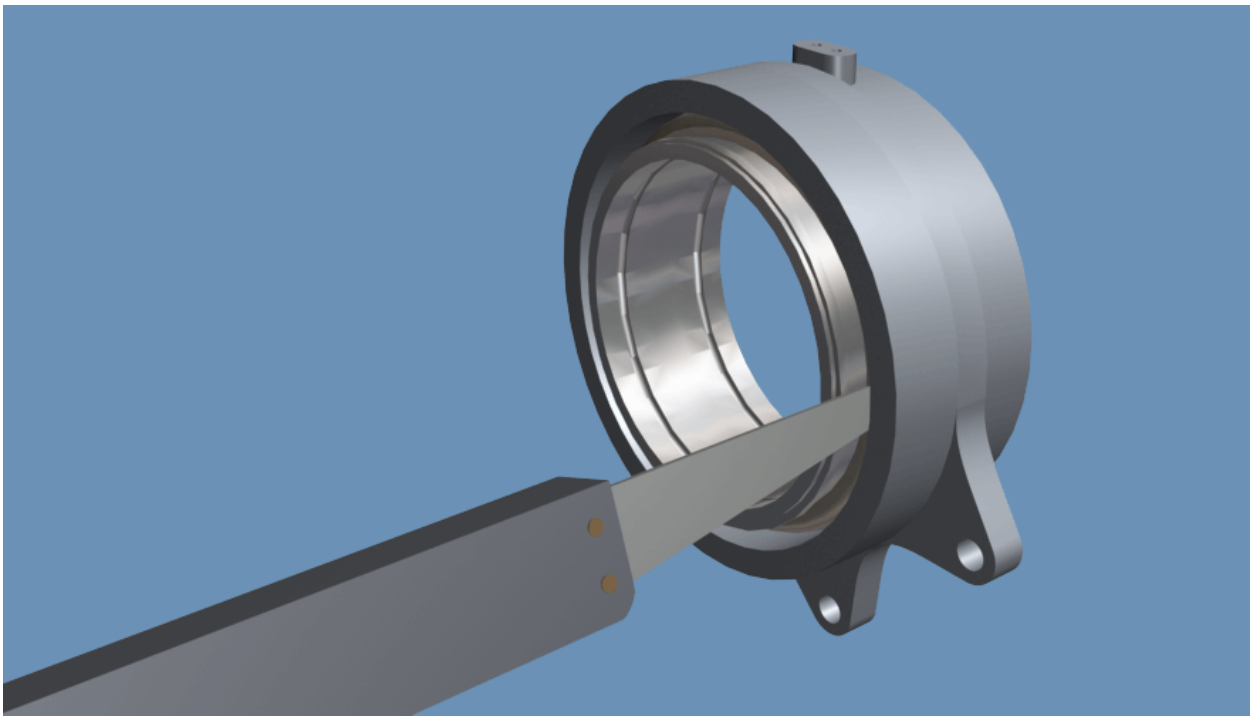


WARNING: Injury to personnel will result if care is not taken during flushing. Viscous dampers may contain a white powder (chloride and sodium cyanide), which is a hazardous substance. Use eye protection and rubber gloves during flushing.

(1) Viscous damper bearing tube assembly allows movement of bearing liner relative to support outer housing.

(2) Multiple disc (flexible) couplings between sections eliminate universal joints.

Frame #0125 (Inspection of Liner Assembly)



(3) The bladder assembly is serviceable and inspected during pre-flight.

(4) A feeler gauge inspection is done between the bladder and housing to check for wear.

(5) Do not allow corrosion preventive compound to contact ball bearings.

(6) Apply corrosion preventive compound to outer race only.

(7) The bearing is also replaceable at the Aviation Intermediate Maintenance (AVIM) level.

(8) The damper assembly is replaced every 500 hours.

(9) Viscous dampers are mounted to a bracket that is attached to the airframe by rivets.

t. Gust Lock

Frame #0130 (Gust Lock)

(1) The gust lock is designed to withstand torque from one engine at idle, thus allowing engine maintenance checks independent of drive train rotation.

(2) The locking system consists of a locking handle, gust lock lever, and gust lock rod, cabin seal pad, and a gust lock caution light on the caution/advisory panel.

(3) The gust lock is operated by pressing the handle release button, and moving the gust lock lever IN or OUT.

(4) This locking device engages the teeth on the tail rotor takeoff flange of the main transmission.

(5) The lock shall only be applied when the rotor system is stationary; it can only be released when both engines are shut down.

(6) An adjustable switch on the rod assembly illuminates the caution light.

(7) Electrical power is provided from the No. 1 DC primary bus, through a circuit breaker marked LIGHTS ADVSY.

u. Intermediate Gearbox

Frame #0135 (Intermediate Gearbox)

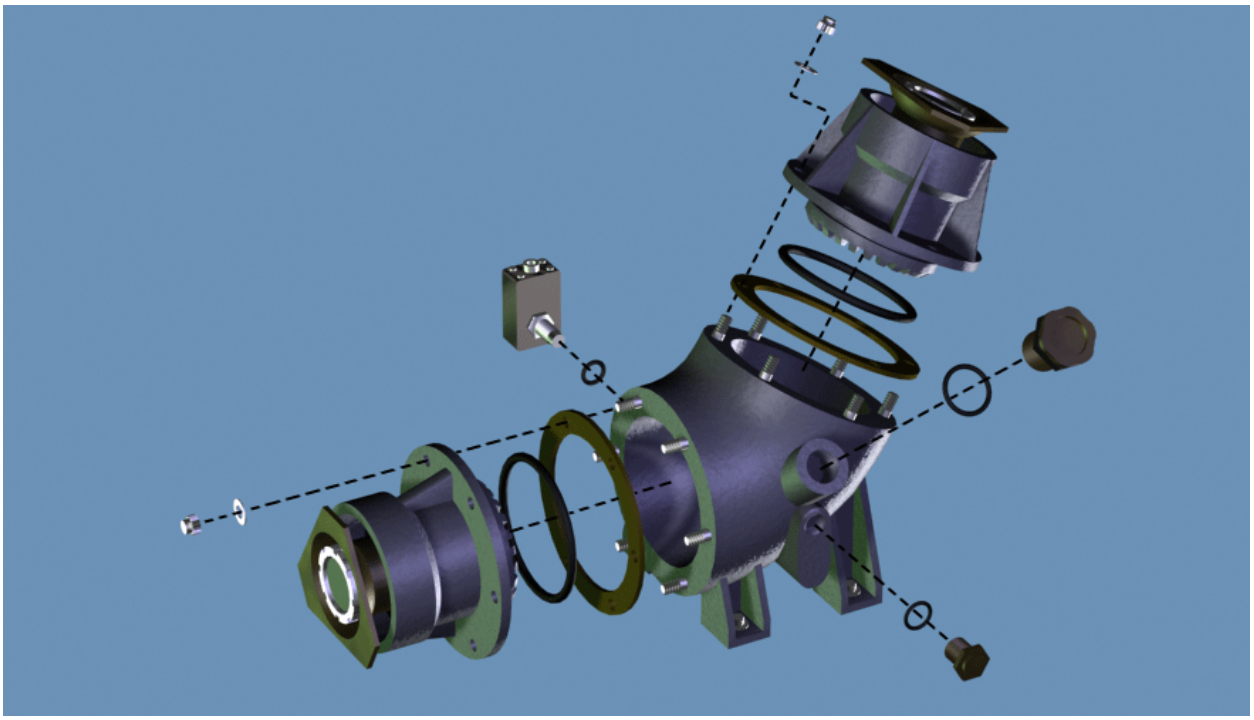
(1) Mounted at the base of the pylon is the oil-lubricated intermediate gearbox.

(2) It transmits torque and reduces shaft speed from the main gearbox to the tail gearbox.

(3) The intermediate gearbox may run at cruise flight for 30 minutes, with loss of all oil.

(4) The gearbox is divided into three sections, the input housing gear, the center housing, and the output housing gear, which changes the drive angle about 58º and reduces input speed of 4,110 RPM to 3,319 RPM tail drive output speed.

Frame #0135 (Intermediate Gearbox Exploded View)



(5) The intermediate gearbox center housing has a chip detector, oil level sight gauge/plug.

(6) The chip detector is self-sealing to permit removal for inspection without loss of oil, and has a burn-off circuit that eliminates minute metal particles (fuzz) to prevent lighting of the caution light.

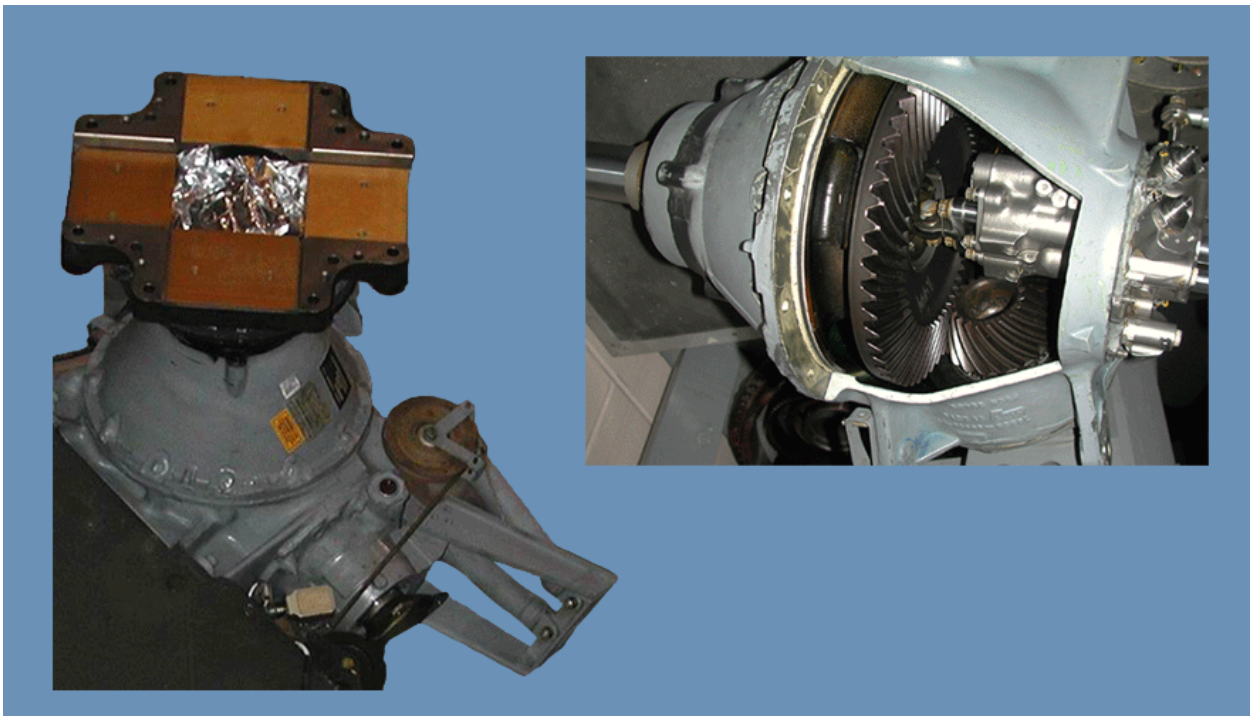
(7) When the gearbox oil temperature reaches 140 °C (284 °F), a normally open bi-metal temperature switch closes and causes the fuzz burn capacitor to discharge.

(8) This prevents arcing within the gearbox when oil is hot.

(9) An internal metal fuzz suppression chip/temperature sensor detects metal particles and gearbox over temperature conditions, to illuminate the caution panel marked CHIP INT XMSN and INT XMSN OIL TEMP.

v. Tail Rotor Gearbox

Frame #0140 (Tail Rotor Gearbox)



(1) The oil-lubricated tail gear box at the top of the tail pylon transmits torque to the tail rotor head.

(2) The gear box mounts the tail rotor, changes angle of drive 105º, and gives a gear reduction from 3,319 RPM input to 1,190 RPM output.

(3) It also enables pitch changes of the tail rotor blades through the flight control system.

(4) The gear box housing is magnesium.

(5) The tail gear box may run cruise flight for 30 minutes, with loss of all oil.

(6) An internal fuzz suppression metal chip/temperature sensor detects metal particles, and gear box over temperature conditions, to illuminate caution panel, marked CHIP TAIL XMSN and TAIL XMSN OIL TEMP.

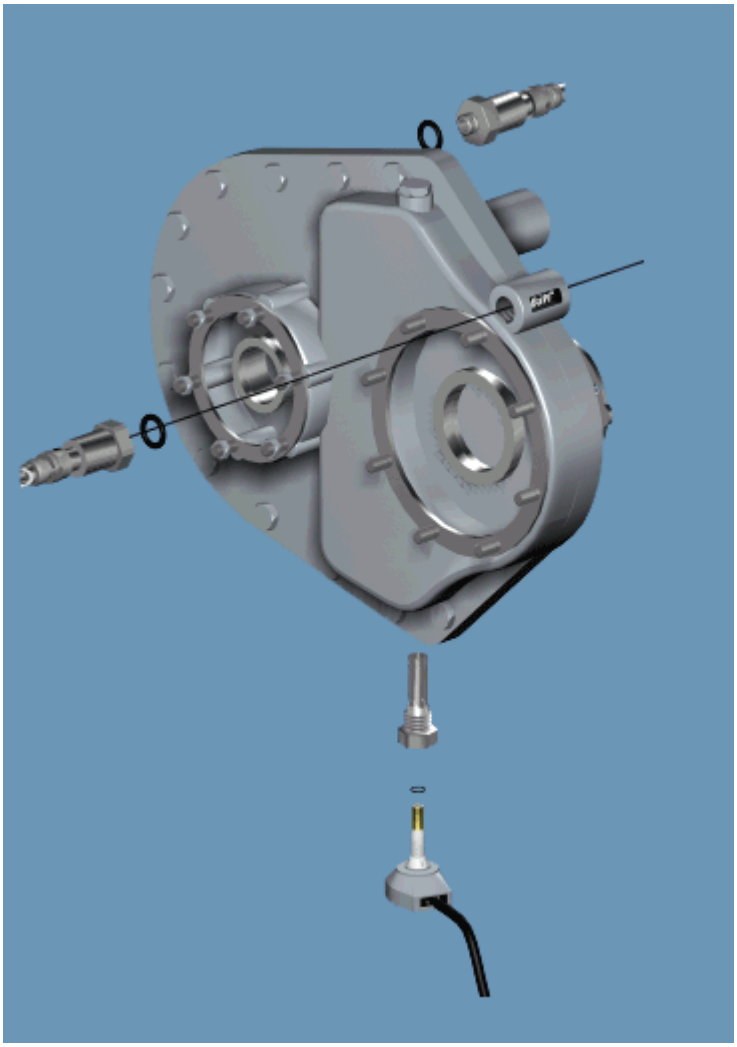
CHECK ON LEARNING

1. Which component contains a Free-wheel unit?

2. The oil cooler thermostatic control valve is used for what purpose in the Powertrain system?

3. Multiple disc flex couplings are used for what purpose on the UH-60 helicopter?

4. Select the NR speed sensor.



SECTION IV. -SUMMARY

1. REVIEW/SUMMARIZE:

You have completed the identifying the characteristics of the UH-60 Powertrain system.
Key Points to remember are:

- The Powertrain/main transmission (XMSN) is mounted on the main fuselage with a built in 3 º forward tilt. It consists of five modules: a main module, two input modules, and two accessory modules.
- The engine forward support tube mounts to the front of the engine and protects the airframe from the input/output (high speed) shaft. Attached to the inboard side is the crotch assembly to direct air from the inlet to the inboard side of the engine.
- The Elastromeric gimbal assembly consists of a gimbal housing and input flange. The housing assembly has a drain line attached to the bottom, because with the high-speed shaft spinning at 20900 RPM some seepage will occur.
- An Accessory Module is mounted on the front of each input module, and is interchangeable with one another.
- A rotor speed sensor is mounted on the right accessory module and provides signals for the VIDS. The UH-60L has an additional rotor speed sensor is mounted on the left accessory module which provides input signals to the DEC for improved transient droop response.
- The main transmission lubrication pumps are combination pressure and scavenge vane-type operating in parallel. The pressure side of the pumps supplies oil at 15 GPM at a pressure between 50-55 PSI.
- The 3-micron filter cannot be installed in place of the 46-micron filter. The filter has two separate elements, a 3-micron first stage, and a 75-micron second stage filter element. When primary filter begins to clog and pressure drops between 9 and 15 PSI, a red button extends 3/16 inch from bottom of filter bowl.
- A thermostatic valve is installed to bypass oil if oil temperature is not above 70 degrees Celsius. In the event the oil cooler becomes clogged, the valve is spring loaded closed, to allow oil to bypass the oil cooler.
- The oil cooler fan circulates air through ducting and to the radiator.
- Oil is routed from the oil cooler to the main module manifold, which is divided between the lubrication jets in the main module and the oil passages to the input modules, accessory modules, and generators.
- The lubrication system includes two lubrication pumps that are combination pressure and scavenge type pumps operating in parallel. The pressure regulating and bypass valves protect the lube system by returning excess high pressure oil back to the inlet side of the pump.
- The transmission High Oil Temperature warning system is triggered by an oil temperature switch at the oil cooler input to the main module, near the tail takeoff drive shaft flange.
- The chip detectors are located on the left and right input modules, left and right accessory modules, and the main gearbox module. These detectors provide warning of chips in any of five areas of the main XMSN system.
- An oil pressure switch on the left accessory module, the farthest point from the pumps, causes the MAIN XMSN OIL PRESS caution light to go on when the pressure drops to 14 plus/minus 2 PSI.

APPENDIX A

ILLUSTRATION LISTING

FRAME #	FRAME TITLE
0011	MENU
0020	Powertrain System
0021	Transmission System Schematic Diagram FLASH
0025	Main Transmission
0030	Engine Forward Support
0030	Engine Forward Support Tube
0035	Engine Input/Output Shaft
0038	Engine Input/Output Shaft 2
0040	Elastromeric Gimbal
0040	Elastromeric Gimbal Exploded View
0045	Input Module
0045	Input Module Cutaway
0045	Input Module Driven Gear
0060	Accessory Module
0060	Accessory Module Exploded View
0060	Accessory Module Spline Adapter
0065	Main Module
0070	Oil Pumps
0075	Pressure Regulating Valve FLASH
0080	Oil Filter
0083	Oil Filter FLASH
0084	Oil Filter Cutaway
0085	Oil Cooler
0085	Thermostatic Control Valve
0090	Oil Cooler Fan
0090	Oil Cooler Fan Spline
0090	Drive Shaft Index
0095	Main Transmission System Lubrication FLASH
0100	Main Transmission Chip Detector System
0100	Chip Detector
0102	Main Transmission Chip Detector System
0102	Accessory Module Chip Detector
0102	Tail Gear Box Chip Detector
0102	Intermediate Gear Box Chip Detector
0103	Improved Chip Detector.
0105	Warning and Indicating System FLASH
0110	Tail Rotor Take Off Seal
0110	Tail Rotor Take Off Seal
0115	Drive Shafts
0120	Flexible Coupling Disc
0120	Flexible Coupling Spherical Washers
0125	Viscous Damper
0125	Viscous Damper Inspection
0130	Gust Lock
0135	Intermediate Gearbox
0135	Intermediate Gearbox exploded View
0140	Tail Rotor Gearbox

APPENDIX B

TEST AND TEST SOLUTIONS

1. This appendix is only used when the test and solutions are internal to the POI file.

2. When the test and solutions are internal to the POI file, then the POI file becomes a FOR OFFICIAL USE ONLY document.