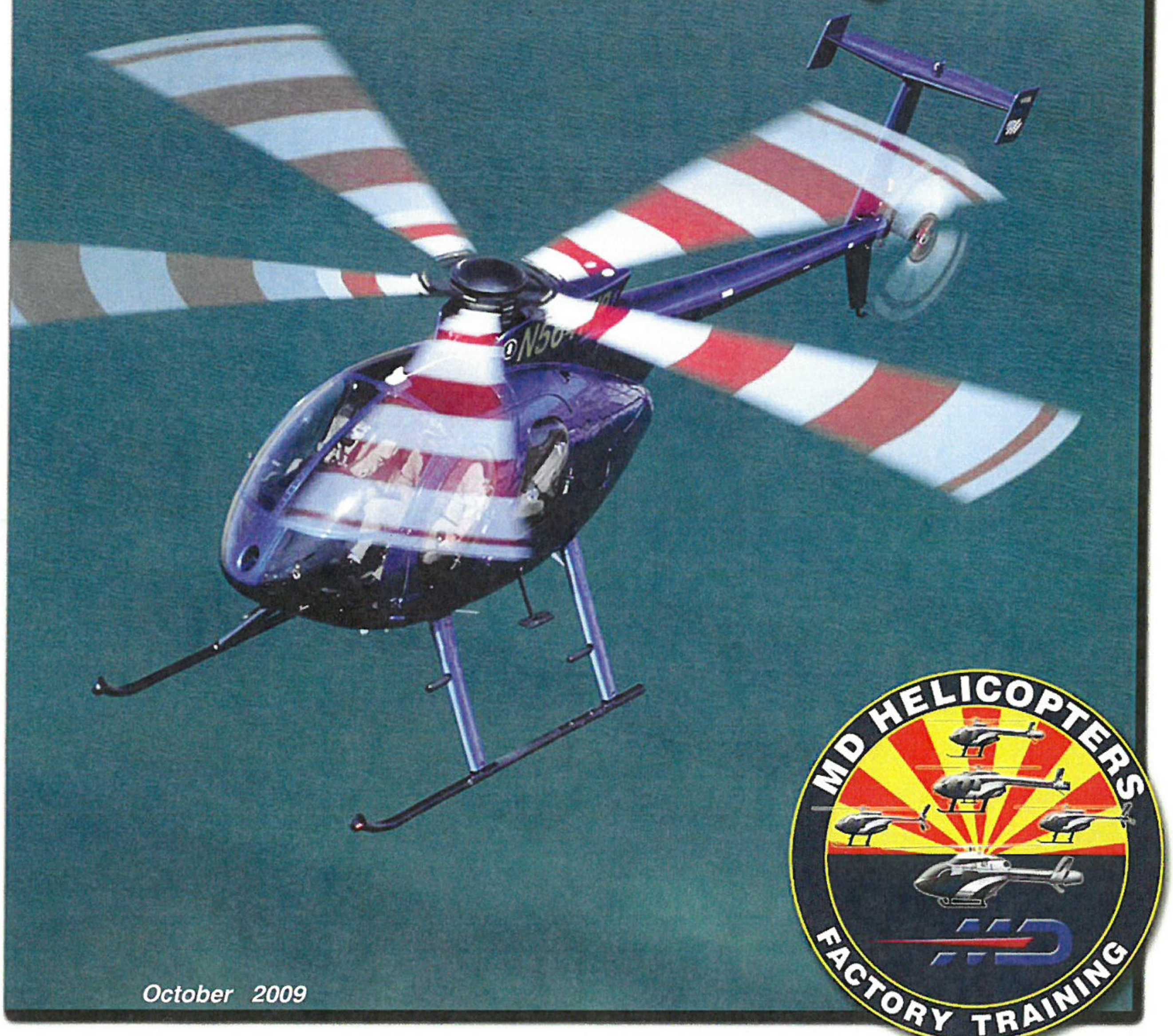
CTP–500PTM–1

MD HELICOPTERS™

MD 500D/E and 530F-Plus

Pilot Transition Training



October 2009

CAUTION

THIS MANUAL IS INTENDED FOR TRAINING USE ONLY.

LIMITATIONS AND PROCEDURES DESCRIBED IN THIS MANUAL ARE SUBJECT TO CHANGE. ALWAYS REFER TO THE APPROPRIATE PILOT FLIGHT MANUAL TO DETERMINE THAT THE INFORMATION STATED IN THIS MANUAL IS UP–TO–DATE!

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MD 500 Pilot Transition Training Manual

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INTRODUCTION

1–1. GENERAL

History

McDonnell Douglas Corporation (MDHC), headquartered in St. Louis, Missouri, is the parent company of McDonnell Douglas Helicopter Company (MDHC), which has been engaged in development and production of helicopters since 1948. This division was founded in 1934 by aviation pioneer Howard Hughes and operated as Hughes Helicopters, Inc. (HHI) until its acquisition by MDC in January 1984. In August 1997 McDonnell Douglas merged with the Boeing Company who in turn, sold the Commercial Light Helicopter Division to MD Helicopters, Inc. (MDHI) in February 1999.

In parallel with its heavy lift helicopter research programs, HHI undertook the company–funded development of light helicopters. In 1955, the company began work on a two–place, piston–engine vehicle. The U.S. Army purchased this helicopter, designated as the TH–55A Osage, for use as a primary light helicopter trainer. By 1967, there were approximately 800 TH–55As in the Army inventory, and it continues to be used as that service's standard primary trainer.

HHI entered the turbine–powered helicopter field in 1961 when its helicopter, designated the OH–6A Cayuse, was selected as the Army's light observation helicopter. It stressed lightweight, low cost, high speed, unmatched maneuverability, and unprecedented crash survivability. In 1966, the OH–6A established 23 world records for speed, distance, and altitude, 16 of which are still on the international record books.

Nearly 1,500 OH–6As were delivered to the U.S. Army between 1966 and 1971. In more than 2 million combat flight hours in Vietnam, the OH–6A earned unparalleled respect from pilots for its ruggedness, reliability, and ability to bring crews home safely despite extensive damage from intense ground fire.

Models 500 and 530

The model 500, the commercial version of the OH–6A, went into production in 1969 as a multipurpose business machine. Its ability to lift over 1 1/4 times its empty weight earned it a reputation as a profit-making machine. It was the first helicopter to require as little as 0.5 hour of maintenance per flight hour. Nearly 900 were sold commercially throughout the world, and a significant number were sold to allied defense forces in the scout, attack, antisubmarine warfare (ASW), and special patrol configurations.

In December 1976, the HHI Model 500D was certificated by the Federal Aviation Administration (FAA), and it replaced the 500C on the company's production line. The 500D incorporated a new five–bladed main rotor, an all new drive train with a larger tail rotor, and a distinctive "T" tail. These advanced technological improvements provided a substantial increase in speed, lifting capability, and reliability. Capable of a top speed of nearly 3 miles per minute, the 500D is one of the fastest helicopters in its class in the world. In addition, the Model 500 series has a certificated gross weight capability of 3000 pounds. In a sling load configuration, it can carry a one ton load, the rough equivalent of a 150-pound man lifting a 350-pound weight.

In January 1979, the first commercial version of the Quiet 500 was produced. The Quiet 500 dramatically reduces external noise levels approximately 50 percent below a standard Model 500 - enabling more effective operation in urban environments where noise is the biggest objection by residents to helicopter operation. The Quiet 500 differs from a standard Model 500 only in its four-bladed tail rotor system. In the military configuration, the quiet tail rotor significantly reduces detection distance, thus increasing the probability of mission success and survivability.

The Models 500/530 have been received enthusiastically and are now the leading sellers in the light, single-turbine helicopter marketplace. HHI has delivered over 1400 Model 500/530 helicopters marking an important milestone in this successful production program.

In January 1983, HHI certificated the improved 500E. This helicopter replaced the "D" on the production line and featured improved aerodynamics, improved interior design, and better visibility.

In 1984, the Model 530F Plus was introduced with an Allison 250-C30 engine which provides 650 horsepower. This helicopter with improved high altitude/hot day lifting performance immediately gained acceptance in the U.S. and world markets.

MD520N MDHI continued its commitment to advanced helicopter technology through the development of a revolutionary helicopter that flies without a conventional tail rotor. Through the NOTAR (no-tail-rotor) program, MDHI demonstrated a viable alternative to the tail rotor. This alternative offers the same maneuver capabilities at reduced power requirements but eliminates the conventional but less desirable features of the tail rotor (exposure to safety problems, aerodynamic inefficiencies, noise, and higher maintenance costs).

1-2. INTRODUCTION

Model Designation

The FAA model designation is - Model 369.

The MDHI commercial designation is - MD 500.

The 369D, E and FF Models of the MDHI 500 Series helicopter are advanced version of the earlier 369H Series helicopter, and is a direct result of a continuous program to improve the operation, performance, safety, and maintenance aspects of the helicopter.

1-3. HELICOPTER DESIGN

General

In addition to advanced aerodynamic performance, this helicopter exhibits an unusually low empty-weight to gross-weight ratio. However, strength and safety were not compromised or relaxed in any way in the original design philosophy in order to achieve these results. In fact, the weight reduction evidenced in this helicopter results primarily from the extremely compact design and efficient space utilization and from a constant adherence in the design approach to extreme functional simplicity.

To assure maximum safety and freedom from catastrophic failures, the design incorporates a number of fail-safe features in the rotors, airframes, and mechanical systems. Generally speaking, the adverse effects on design complexity, cost, and weight, in order to provide these obviously worthwhile features, are extremely minor. A few of the more important, and possibly novel, fail-safe application in the Model 500 Series helicopter will be discussed in detail within applicable chapters.

1-4. MAJOR COMPONENTS

Airframe

The airframe structure is an assembly of riveted aluminum beams, frames, bulkheads, supports, and other structural components. The high strength airframe is built around a rigid, three-dimensional truss structure. Crew seats and restraints are mounted on the forward member of the truss structure. A center beam forms a load carrying for the helicopter and supports most of the helicopter components, including the landing gear. This "roll bar" design gives the model 500 Series the safest airframe ever introduced in the helicopter industry.

Interior Arrangements

Several interior arrangements are available with the MD500 Series helicopter. Crew and passenger compartment seating may vary from a two to seven place configuration with seat belts at each position.

An instrument panel is located forward of the crew compartment seats. The instrument panel includes flight and engine instruments, in addition to warning and caution lights and various switches and controls.

Landing Gear

The landing gear is a horizontal skid–type gear and is not retractable. Fore and aft braces, struts, and shock absorbing dampers are attached to the underside of the fuselage center frame section. Skid tubes are attached to contoured fittings at the lower ends of the struts, and provide attachment points for installation of ground handling wheels.

Tailboom

The tailboom assembly extends rearward from its attachment to the aft fuselage boom fairing. It is a monocoque structure of aluminum skin over aluminum frames at the forward and aft ends of the tailboom, and houses the tail rotor drive shaft, tail rotor control rod and electrical conduit. The aft end supports a tail rotor gearbox and tail rotor, in addition to the horizontal and vertical stabilizers.

Propulsion System

The power plant is an Allison Model 250 Series free turbine, turboshaft engine. The engine is mounted at a 47 degree angle from horizontal and is supported by three engine mounts within the engine compartment. The engine installation is designed for rapid replacement as a unit. Removal of the engine is readily accomplished by disconnecting plumbing, wiring, engine mounts, etc., and lowering the engine from the engine compartment.

Drive System

Power from the engine is transmitted to the rotors through a clutch assembly, gearboxes and connecting shafts.

The overrunning clutch is mounted on the engine accessory drive gearbox and acts as a free–wheeling unit in the event of engine failure. Thus, in autorotation, the rotor system does not expend energy to drive an idling or dead engine.

The main transmission is mounted at the lower end of the non–rotating main rotor mast and is rigidly fixed in position by support members connected to the center truss section. The transmission is lubricated by an air cooled lubrication system.

The main rotor drive shaft transmits power from the main transmission to the main rotor hub. The tail rotor drive shaft is a single aluminum tube with Bendix or Kamatics couplings which operate without intermediate supports. Excessive oscillation of the drive shaft during acceleration and deceleration of the drive system is suppressed by the drive shaft damper(s) located at the rear of the boom fairing.

Both the main and tail rotor transmissions utilize spiral bevel gears. Lubrication of the main rotor gearbox is by an integral oil pump. A splash system provides tail rotor gearbox lubrication. A sight gage in the main rotor gearbox and on the tail rotor gearbox simplify oil level inspection.

Flight Controls

Cyclic, collective and adjustable pedal controls are provided at the left crew position. Adjustable friction devices, which may be varied to suit the individual pilot, are incorporated on the left side collective, cyclic and throttle controls. In addition , electric cyclic control trim actuators allow all flight loads to be trimmed out. Since stick control forces are low, a boost system is unnecessary. The right controls may be removed to provide space for cargo or passengers.

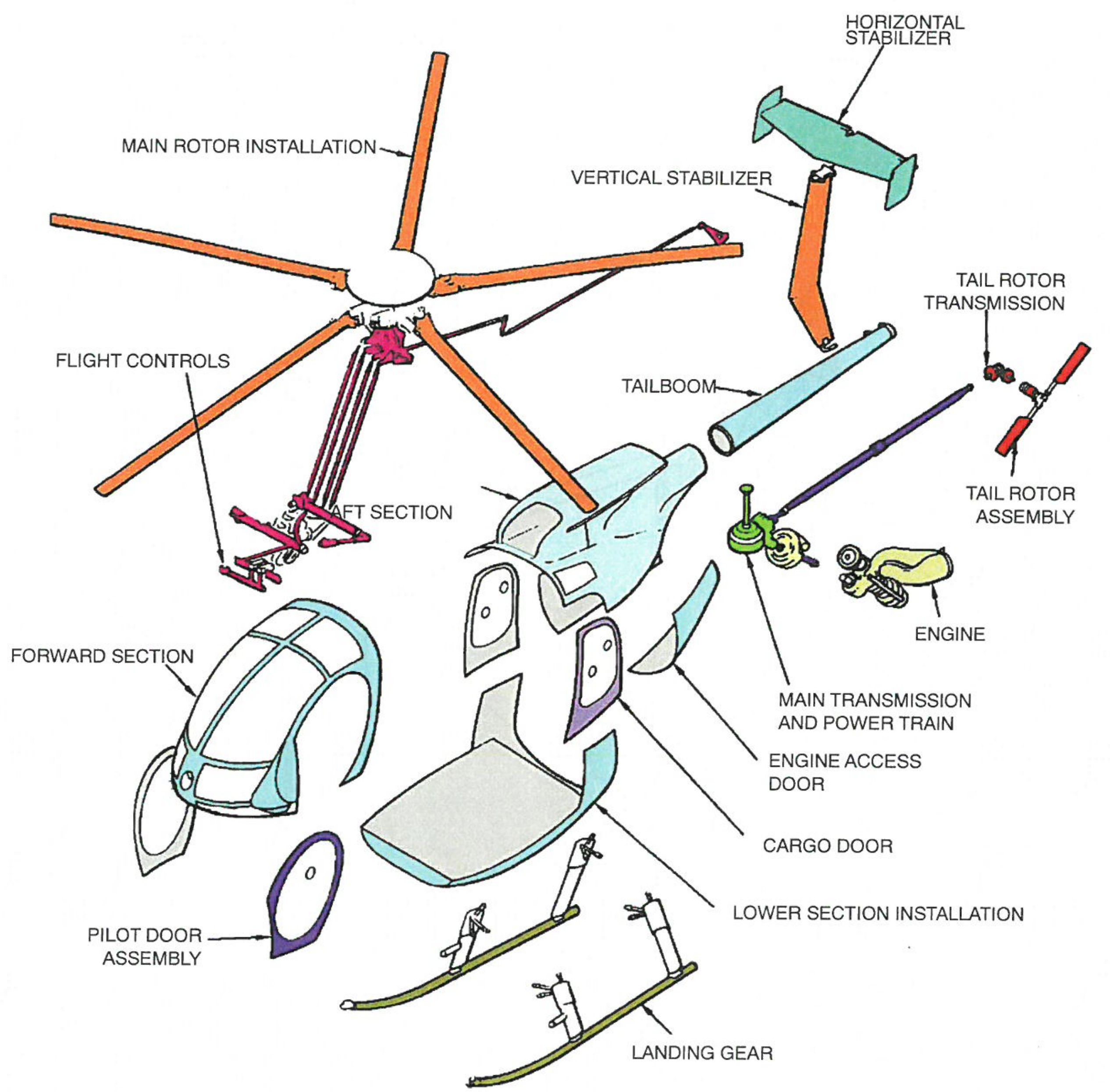

Figure 1-1. Major Aircraft Components

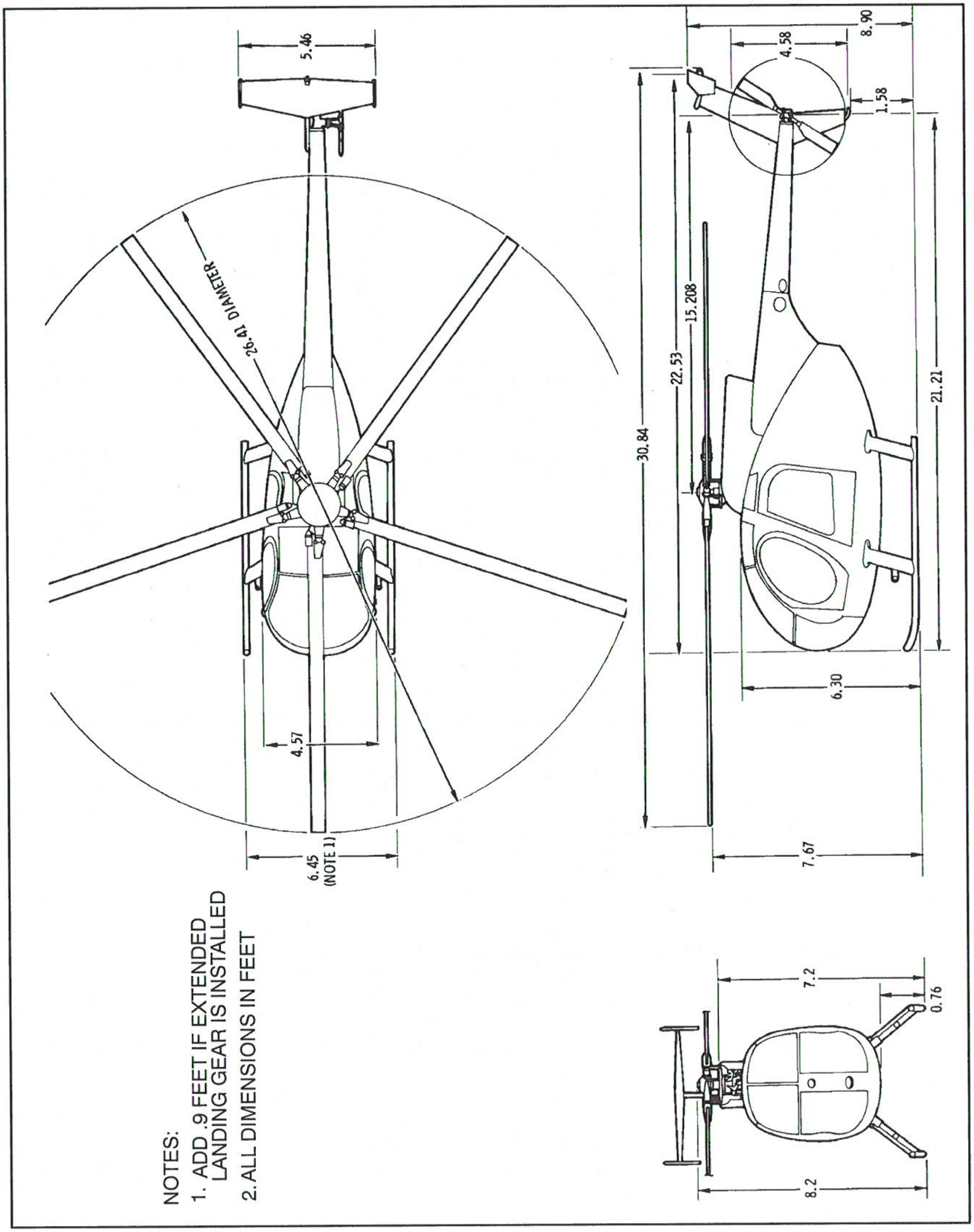

Figure 1-2. Principal Dimensions 500D

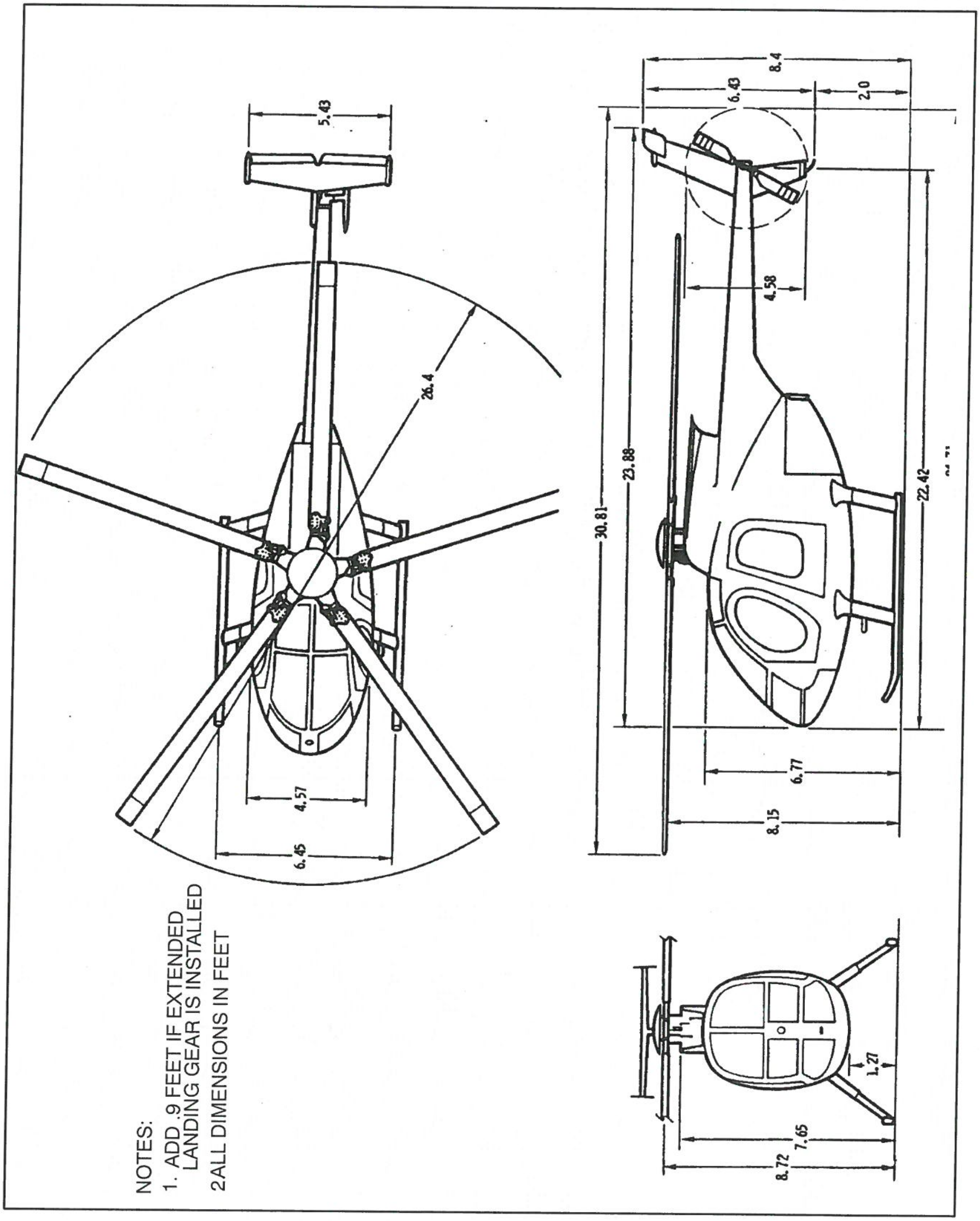

Figure 1–3. Principal Dimensions 500E

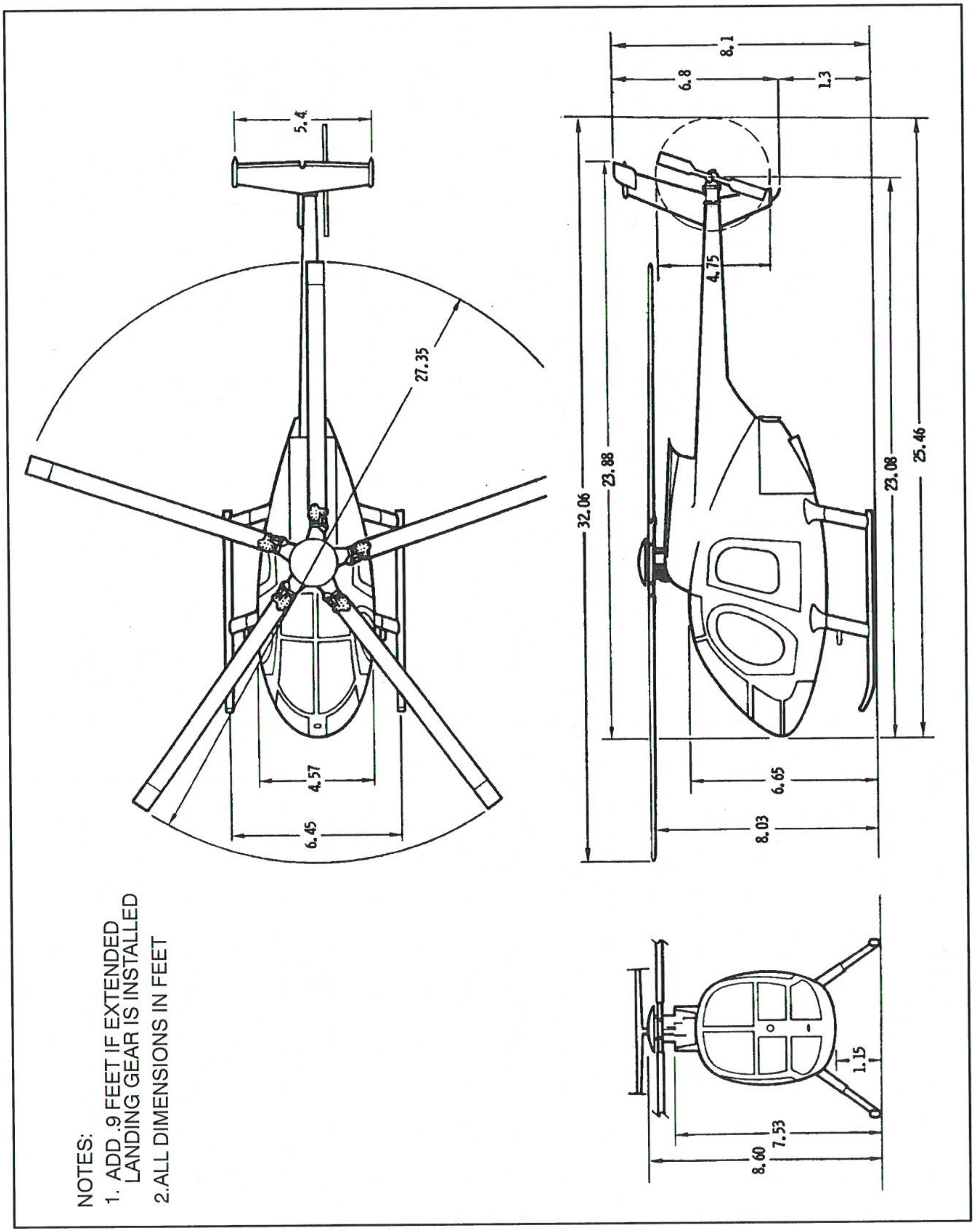

Figure 1-4. Principal Dimensions 530F-Plus

HELICOPTERS

MD 500 Pilot Transition Training Manual

SECTION II
TECHNICAL PUBLICATIONS

2–1. MDHI PUBLICATIONS

Principal Publications

CSP-D-1, CSP-E-1, CSP-FF-1, CSP-520N-1: Pilot's Flight Manual

CSP-A-1: MD 500 parts and technical publications ordering policy and procedures

CSP-A-2: Commercial warranty/Exchange Program Information

CSP-A-3: Corrosion Control Manual

CSP-HMI-2: Basic handbook of Maintenance Instructions - Servicing and Maintenance all models including Notar.

CSP-HMI-3: Basic handbook of Maintenance Instructions - Instruments/Electrical/Avionics - all models.

CSP-IPC-4: Illustrated Parts Catalog - all models

CSP-COM-5: Component Overhaul Manual - all models

CSP-SRM-6: Structural Repair Manual - all models

Tecnical and Service Bulletins (formerly Notices)

Letters

Optional Equipment Instructions and Illustrated Parts List for fourteen optional equipment items are now incorporated in the Maintenance Manuals.

NOTE: While MDHC supports 100 optional equipment items, some may not be approved for use on your particular model helicopter.

NOTES: ______________________________

McDonnell Douglas Helicopter Company

NOTICE NO.: HN-208.1*
DN-146.1*
EN-34.1*
FN-23.1*
NN-002

SERVICE INFORMATION NOTICE

DATE: 10 September 1992

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MANDATORY MANDATORY

Supersedes Service Information Notices HN-208, DN-146, EN-34 and FN-23, dated 16 February 1987.

SUBJECT: Daily Preflight Examination of Main Rotor Blade Leading Edge Abrasion Strip Bonding.

MODELS AFFECTED: All McDonnell Douglas Helicopter Company (MDHC) Model 369 Series helicopters, including the 369A (OH–6A), and 500N Series helicopters equipped with 369A1100–503, 369A1100–505, 369A1100–507, 369D21100–505 369A21100–509, 369D21100–513, 369D21100–515, 369D21100–516, 369D21102, 369D21102–501 and 369D21102–503 main rotor blades.

TIME OF COMPLIANCE: This Service Information Notice shall be complied with immediately upon receipt and is considered part of the pilot's preflight check.

PREFACE: The information given in this Notice lists criteria for examining the leading edge abrasion strip bonding on the main rotor blades prior to each flight. Abrasion strips with excessive bonding separation may separate from the main rotor blade which could result in serious balance problems. To ensure safe helicopter operation, MDHC is requiring all affected operators to perform the following examination of the main rotor blade leading edge abrasion strip for adequate bonding.

PROCEDURE

- **During the pilot's preflight check of the helicopter**, perform a visual inspection of the main rotor blade leading edge abrasion strip bonding. Any blisters, bubbling or lifting of the abrasion strip indicates a void. Voids not closer than .5 inch to any outside edge of the abrasion strip, which do not exceed 1.5 inches square in size and which are no closer than one inch to any other voids are acceptable. Also, there cannot be more than three voids on either the top or bottom of 36 inch long abrasion strip surface or more than two voids on either the top or the bottom abrasion strip surface of an 18 inch section of abrasion strip.
- Record all voids noting size and location in the helicopter Log Book and check each void prior to each flight for growth and acceptance criteria.

(|) Denotes portion of text added or revised.

Figure 2–1. Sample Service Information Notice

SERVICE AND OPERATIONS REPORT

SOR NO.

1. NAME OF PERSON REPORTING	2. DATE	3. SUBJECT OF REPORT

4. DATE OF OCCURANCE	5. ACFT MODEL NO.	6. ACFT SERIAL NO.	7. ACFT HRS	8. ACTIVITY OR OWNER

9. PART NUMBER	10. DASH NO.	11. PART SERIAL NO.	12. TIME SINCE NEW	13. TSO	14. QTY

15. WAS THIS PART/COMPONENT INVOLVED IN AN ACCIDENT/INCIDENT? YES ☐ NO ☐	16. DATE OF ACCIDENT/INCIDENT

17. WAS THIS PART/COMPONENT MAINTAINED/OPERATED IN ACCORDANCE WITH THE HANDBOOK OF MAINTENANCE INSTRUCTIONS AND FAA APPROVED ROTORCRAFT FLIGHT MANUAL? YES ☐ NO ☐

18. NEXT ASSEMBLY PART NUMBER	19. ASSY. NOMENCLATURE	20. ASSY. SERIAL NUMBER	21. TIME SINCE NEW	22. TSO

23. SUBMITTED BY (COMPANY)	24. ADDRESS	25. WARRANTY CONSIDERATION YES ☐ NO ☐ EXHIBITS AVAILABLE YES ☐ NO ☐

26. PHONE NUMBER	27. E- MAIL ADDRESS

28. I CERTIFY THAT THE ABOVE INFORMATION IS ACCURATE AND TRUE	29. REPAIR STATION/ A&P LICENSE/ ENDORCEMENT NUMBER

30. DESCRIBE BRIEFLY NATURE OF CIRCUMSTANCES FOR DISCREPANCY

WARRANTY INFORMATION (COMMERCIAL)

HELICOPTER SALE	WARRANTY FOR SPARE PART SALE			REPLACEMENT PART INFORMATION		
31. DELIVERY DATE	32. SPARE INSTALL DATE	33. S. O. NO.	34. S. O. DATE	35. S. O. NO.	36. S. O. DATE	37. REPLACEMENT PART NO.

SHIP REPLACEMENT PART TO

38. SERVICE CENTER NAME AND ADDRESS	39. SERVICE CENTER/DISTRIBUTOR PURCHASE ORDER NUMBER	
	40. R.M. NUMBER	41. RECEIVED DATE
	42. CCN	

WARRANTY PARTS SHIPPED TO MDHI

43. WAYBILL	44. ROUTING	45. DATE

46. **FACTORY DISPOSITION**

47. REPLACEMENT PARTS COST $	48. LABOR REIMBURSEMENT $	49. TOTAL WARRANTY COST $

Form 1601 (Rev 8/00) Original – MDHI Copy - Customer *MD Helicopters, Inc.*

Figure 2-2. Sample Service and Operations Report

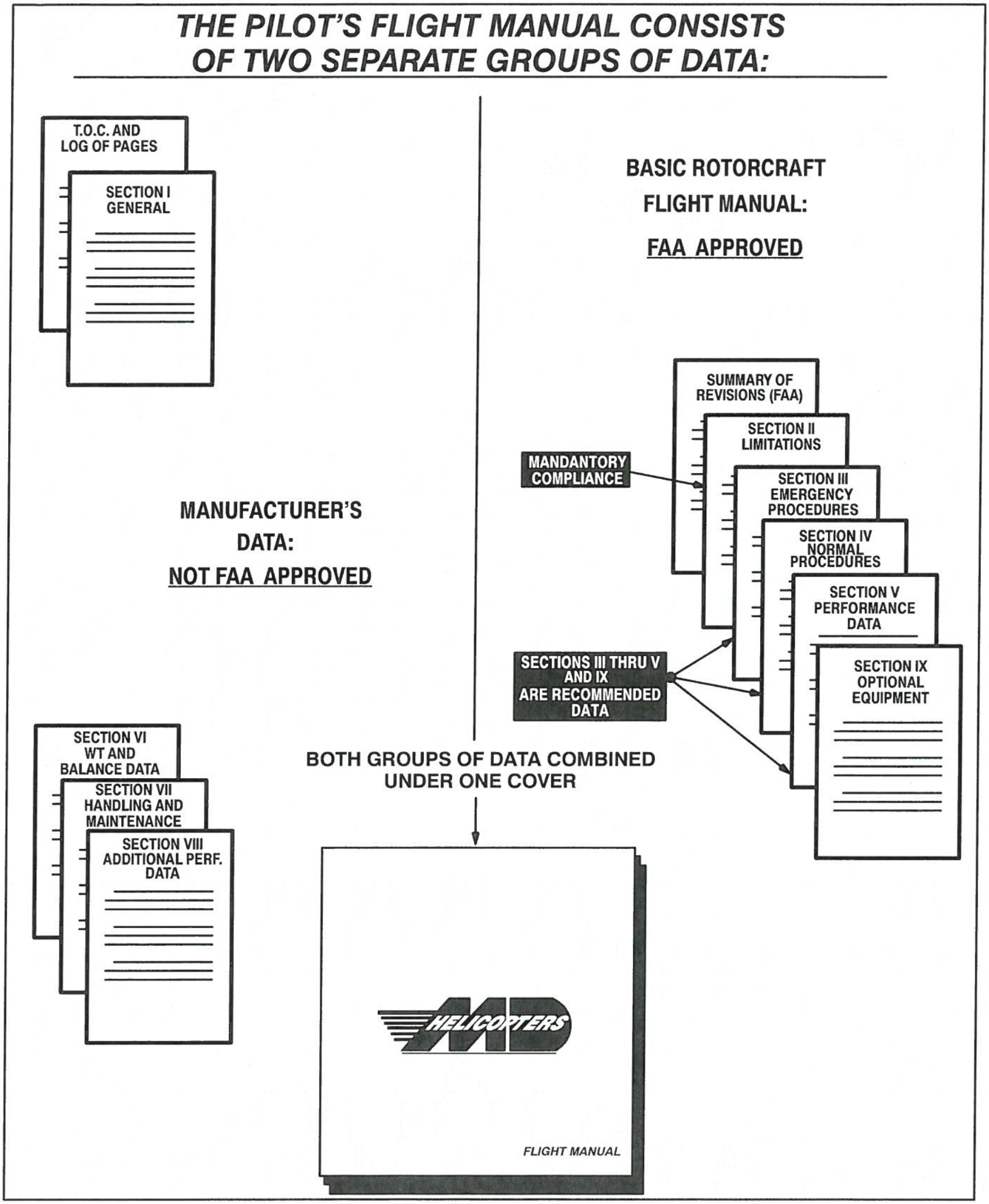

Figure 2–3. Pilot Flight Manual Structure

2-2. ALLISON PUBLICATIONS

Principal Publications

Operation and Maintenance Manual

Illustrated Parts Catalog

Commercial Service Letter (CSL's)

Commercial Engine Bulletins (CEB's)

NOTES: ______________________________

HELICOPTERS

MD 500 Pilot Transition Training Manual

SECTION III
AIRFRAME

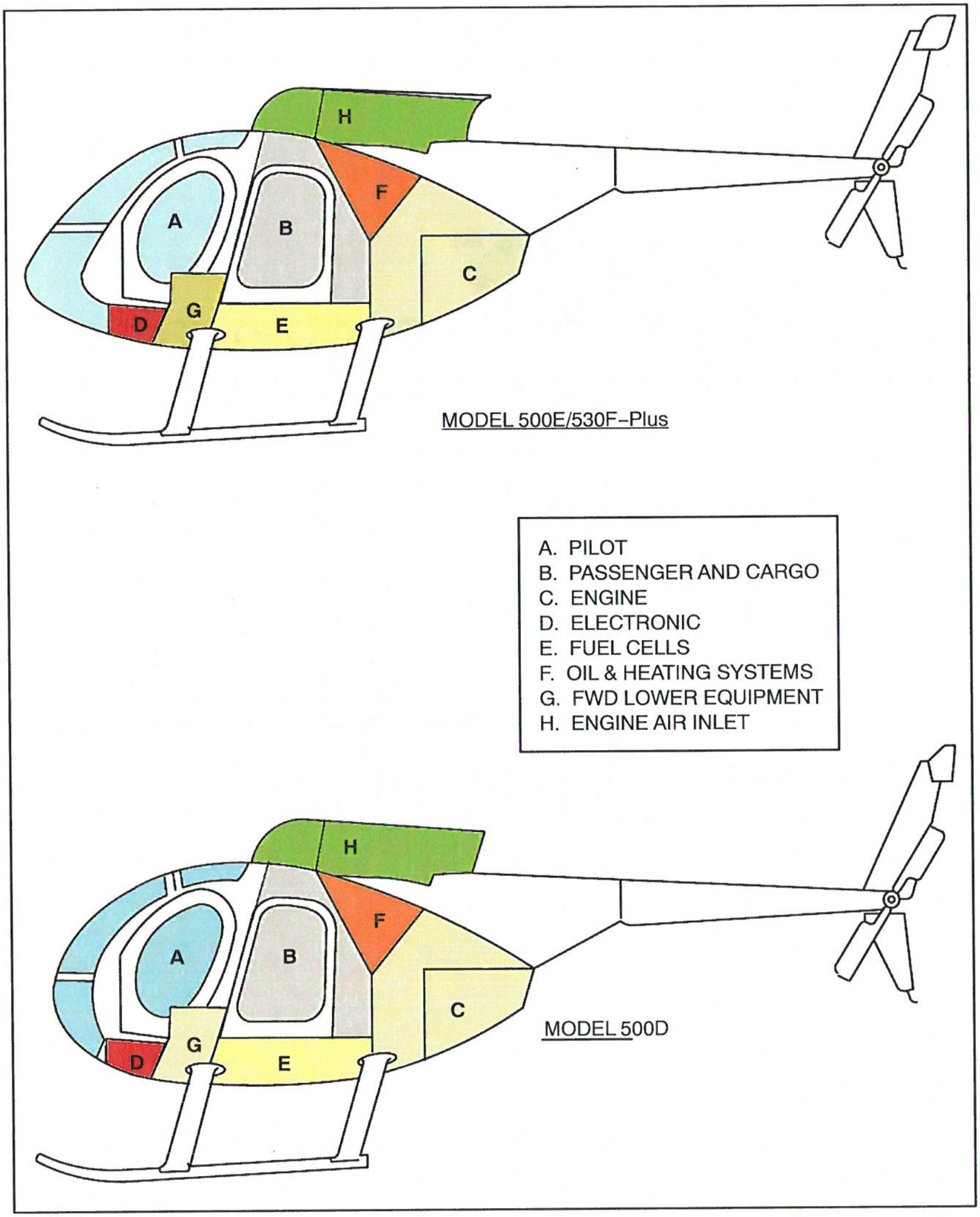

Figure 3–1. Compartments

3-1. COMPARTMENTS

NOTES:

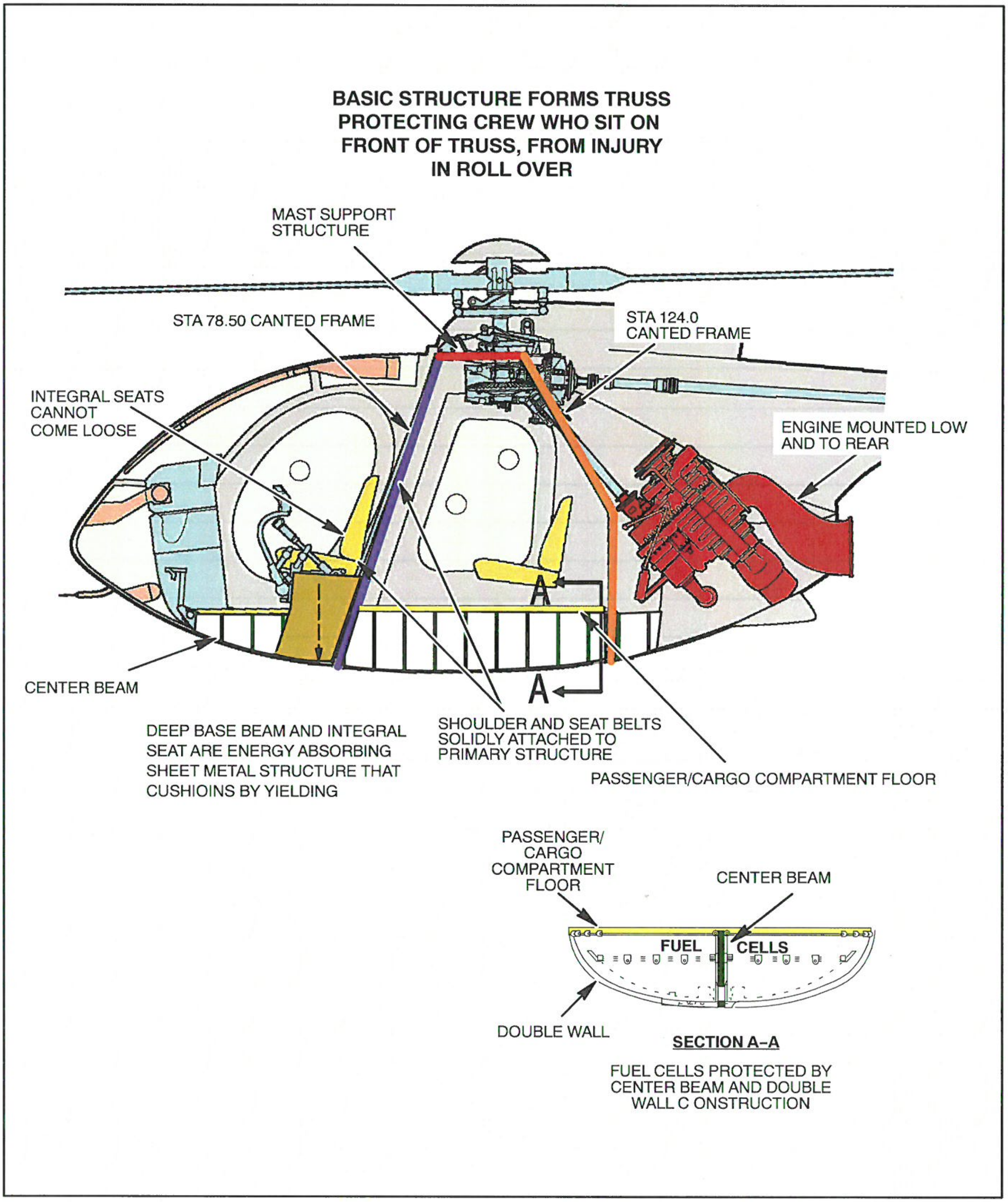

Figure 3-2. Basic Airframe Truss

3-2. BASIC AIRFRAME TRUSS

General Although the materials, fasteners, and fabrication methods used in construction of the Model500 Series airframes are commonplace aerospace items and applications, they do not result in a commonplace structure. The resulting airframe, in fact, possesses an aggregate of features that provide an optimum strength to weight ratio. The high strength of the primary fuselage structure is derived from the interaction of the basic airframe truss, composed of the following members:

Center Beam Assembly The center beam assembly extends longitudinally along the center line of the lower fuselage section, and is the primary structural member of the basic airframe truss. The center beam is made up of aluminum panels, stiffeners, doublers, and forged landing gear fittings.

Station 78.5 Canted Frame The station 78.50 canted frame is the forward member of the basic airframe truss, and establishes the cross sectional contour of the fuselage. The station 78.50 canted frame is aluminum with panel and frame members forming the crew compartment seat back.

Station 124.0 Canted Frame The station 124.00 canted frame is the aft member of the basic airframe truss, and establishes the cross sectional contour of the aft fuselage. The upper portion is aluminum and stainless steel, and the lower portion is aluminum and titanium. The station 124.00 canted frame forms the aft compartment seat back and the engine compartment firewall.

Passenger/ Cargo Floor The floor structure of the passenger/cargo compartment is the lower member of the basic airframe truss, and interconnects the lower ends of the two canted frames. The floor structure is constructed of aluminum channels and sheet members.

Mast Support Structure The mast support structure is the upper member of the basic airframe truss, and interconnects the upper ends of the two canted frames. The mast support is constructed of aluminum, steel forgings, and sheet metal fasteners.

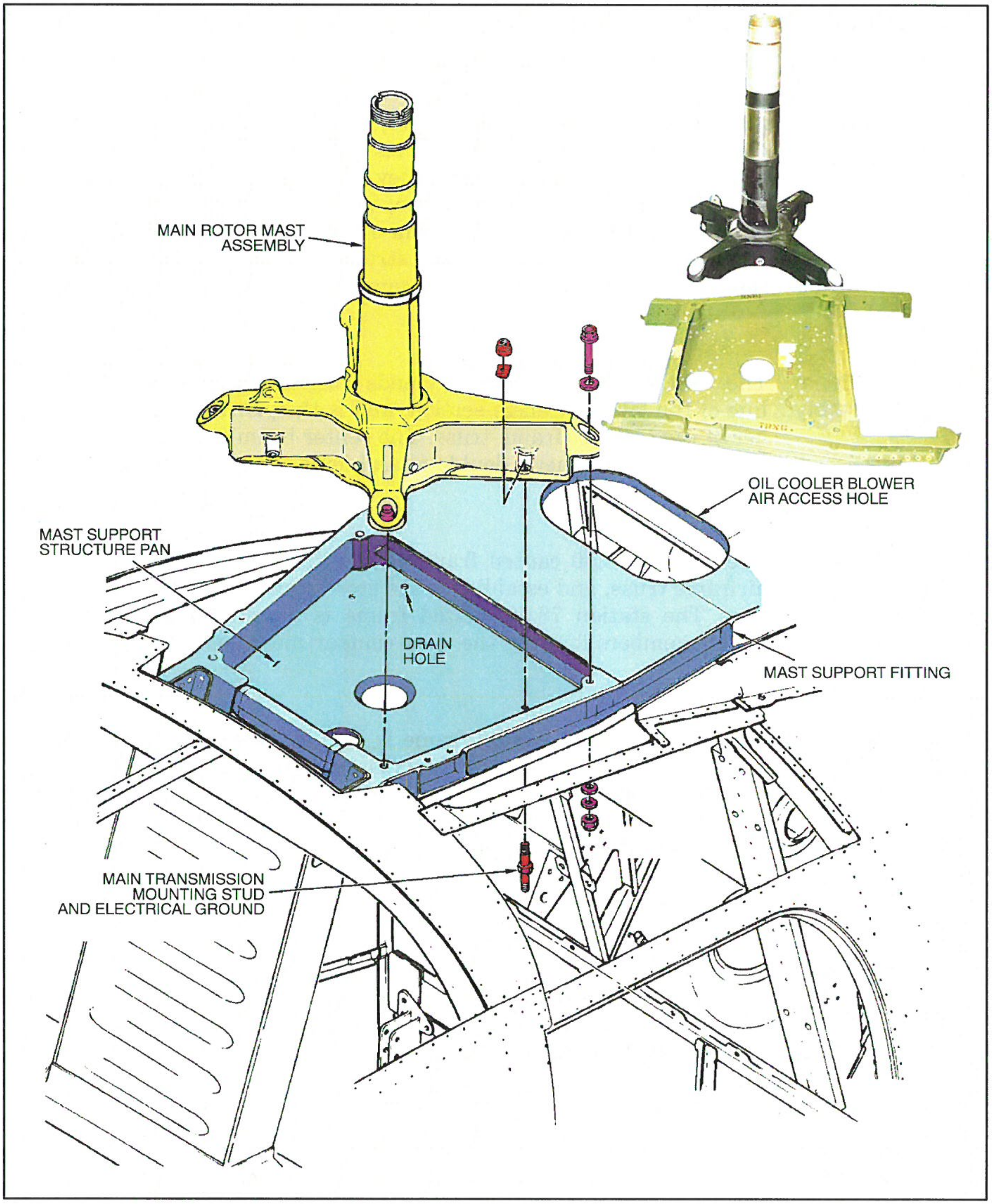

Figure 3-3. Mast Support Structure

3–3. DYNAMIC/STATIC LOADS

General All dynamic and static loads are displaced by the basic airframe truss as a result of the interaction of the structural members.

Flight loads are displaced from the nonrotating main rotor mast to the mast support, which is the upper member of the basic airframe truss. The mast assembly, because of the floating axle type main rotor drive shaft, receives main rotor thrust and moment vectors normal to the axis of rotation directly from the bearings between the mast and the rotor hub. The main rotor mast is nonrotating, and thus receives the major rotor support loads as predominantly steady loads rather than rotating beam loads, as in conventional practice. Propulsion (torque) is transmitted independently through the main rotor drive shaft, which is not relied upon to transmit primary flight loads to the airframe.

Static loads are displaced from the landing gear to the landing gear fittings in the center beam structure which is the primary member of the basic airframe truss.

NOTES:

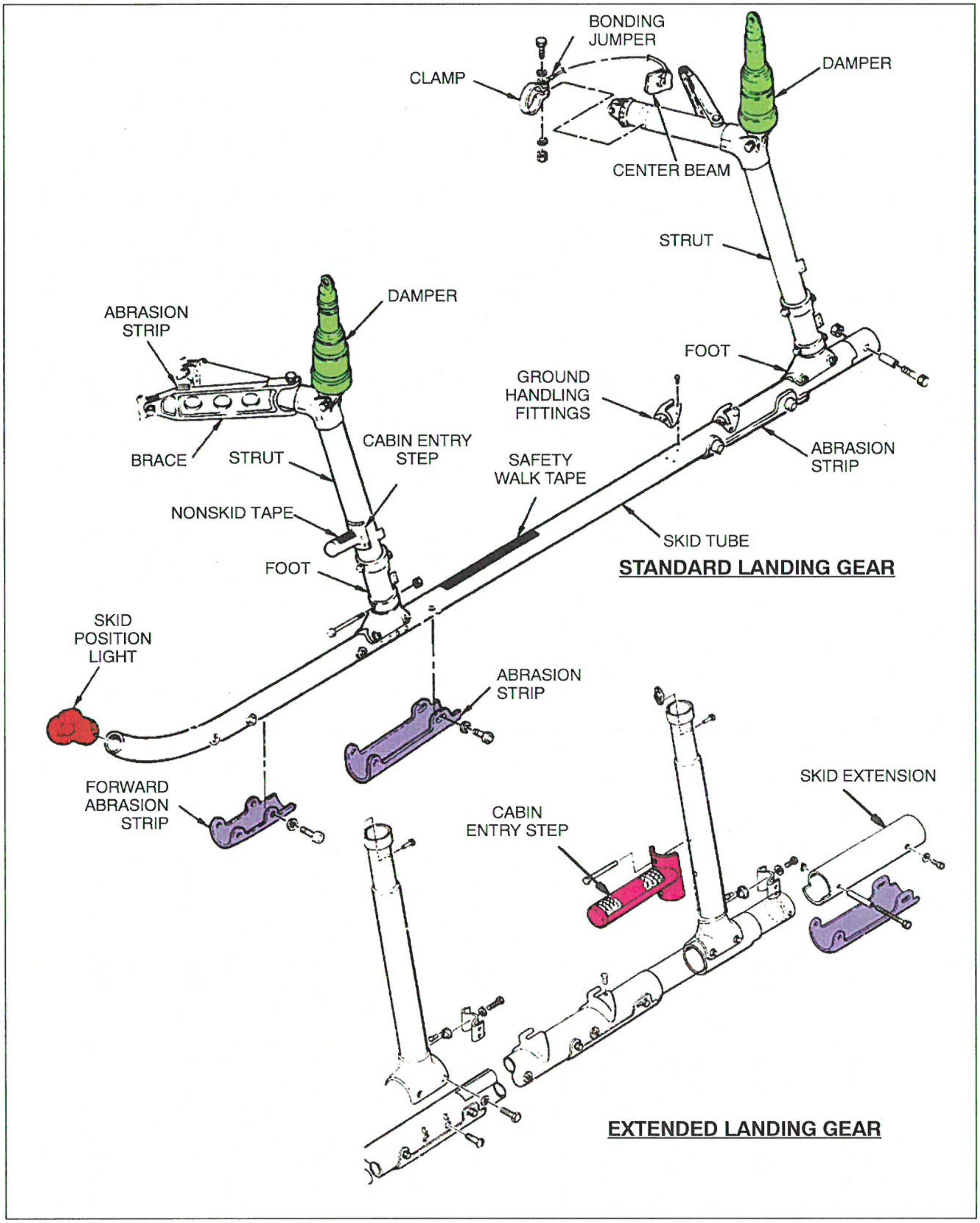

Figure 3-4. Landing Gear

3-4. LANDING GEAR

General The purpose of the landing gear is threefold. It must act as the aircraft supporting carriage when the aircraft is in ground contact, withstand the shocks encountered in landing and ground handling, and provide a stable platform to prevent ground resonance.

The external appearance of the landing gear is quite misleading, as it appears to conform to a rigid gear installation that absorbs shock solely through the elasticity of its metal members.

The landing gear primarily absorbs landing forces via shock struts (dampers). The elastic capabilities of the skids and struts function only as a backup for the landing gear dampers when overload conditions warrant.

Landing Gear Design Details The landing gear consists of two strut-mounted, shock-dampened, individually replaceable skids aligned longitudinally along the lower exterior of the fuselage. Each left and right hand skid is connected to the fuselage through two struts with side braces. The struts pivot from fuselage landing gear fittings as a unit when the damper assemblies are displaced vertically through their normal working stroke.

Each strut extends downward from the lower fuselage exterior and is provided with a fiberglass telescopic fillet and fairing assembly to reduce aerodynamic drag of the tubular struts while enabling unrestricted movement of the struts.

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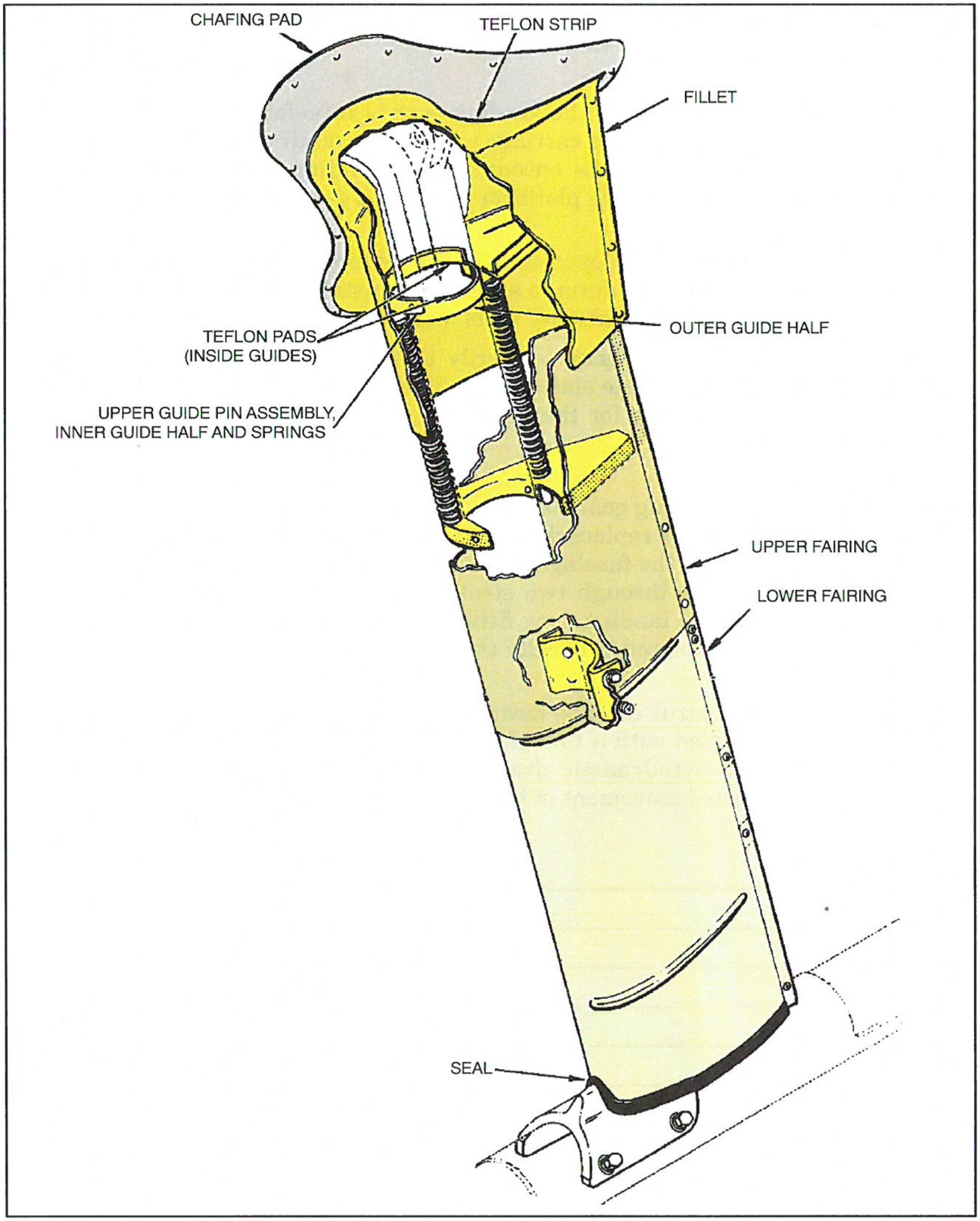

Figure 3-5. Landing Gear Fairing Assembly

3-5. LANDING GEAR FAIRING ASSEMBLY

General The landing gear fairings are constructed of aluminium and form an aerodynamic contour around each landing gear strut.

The fairing is a two-piece cover attached to the strut by two aluminum brackets and a contour rib. The fairings are constructed with a longitudinal split line at the approximate midposition and are externally beaded for additional reinforcement.

Lower Fairing Half The lower fairing half-section is attached to the strut brackets and at the trailing edge by screw retention for ease of removal and/or replacement. The upper fairing half-section is rivet-retained to the strut-affixed contour rib and a bracket. The leading edge of the lower forward strut fairings is provided with a cutout for a tubular cabin entry step.

Fillet Assemblies The fillet assemblies are constructed of fiberglass and establish a transition to the fuselage lower section contour. The fairing telescopes inside the fillet to allow displacement of the struts upon landing gear compression or extension. A combination fillet, internal strut-aligned sliding rib, spring, and guide pin assembly is used in the flexible assembly's construction.

Flexibility is accomplished through two springs and guide pins that are oriented and attached to the sliding fillet rib. The springs are aligned and retained by a guide rod protruding through two corresponding holes in the strut-attached contour rib. The applied spring tension between the sliding fillet rib and fixed fairing rib positions the fillet assemblies against a fuselage-contoured fiberglass chafe strip.

NOTES: ______________________________

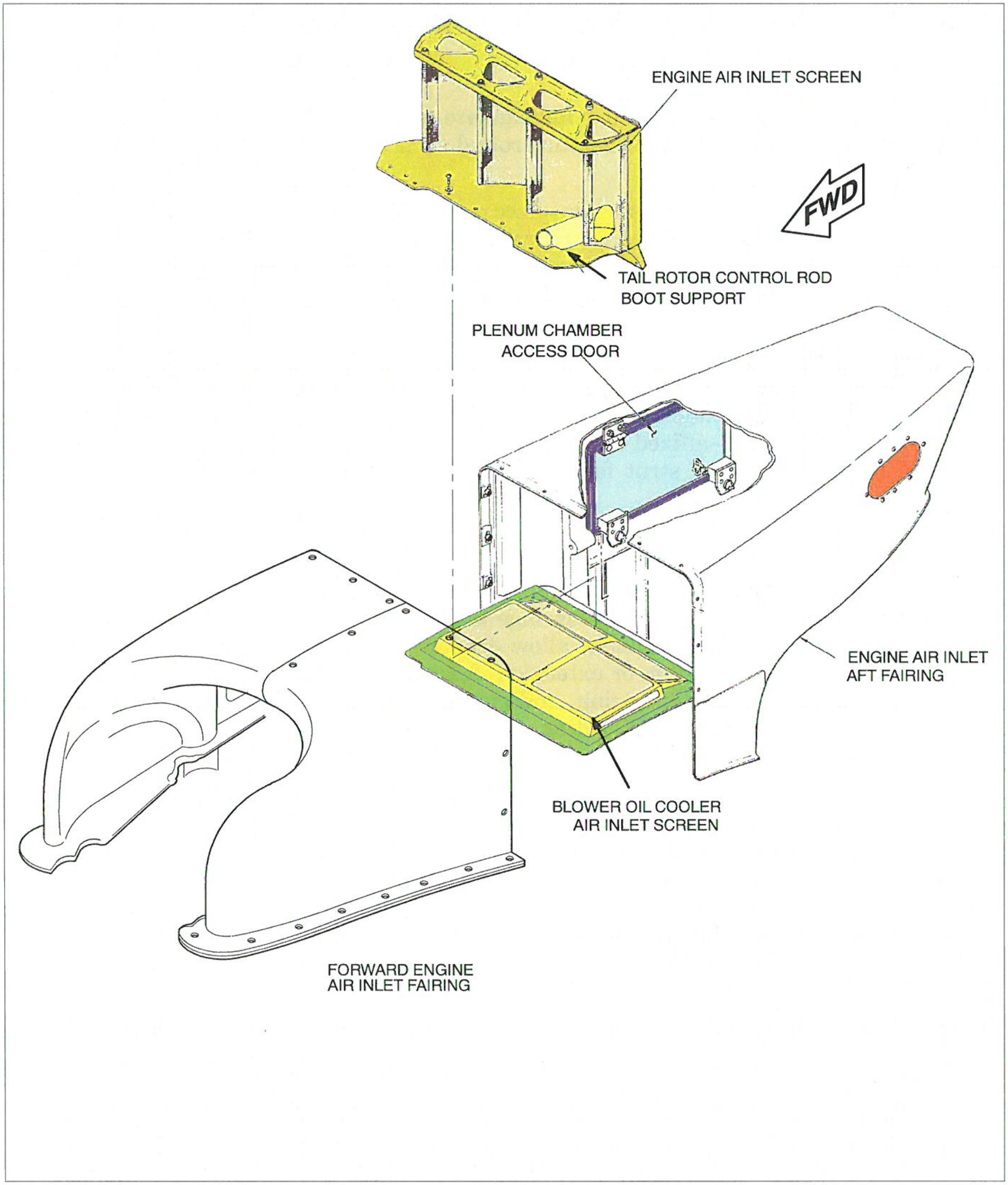

Figure 3-6. Engine Air Inlet

3-6. ENGINE AIR INLET FAIRING

Construction Engine air inlet fairings utilized on the helicopter are constructed of fiberglass and polyurethane foam reinforcements, and a lower aluminum channel bonded into the structure edge for assembly attachment.

Front Fairing Section The front fairing consists of two removable sections with an airfoil top and vertical walls. The two front sections are attached to the top of the fuselage skin and to the rear fairing with screws for ease of removal or inspection. The aft portion of the engine air inlet fairing is permanently riveted to the airframe external skin.

Aft Fairing Section An access door is provided on the right aft fairing for maintenance access into the engine air inlet duct areas. A UHF/VHF antenna and static port are bonded to the aft vertical face and is part of the aft fairing.

Airflow Airflow to the engine and oil cooler blower is directed by the air inlet fairings. Air being rammed or drawn into the front air inlet fairing moves through the center of the fairing to the oil cooler air inlet screen where some of the air is diverted to the oil cooler blower. The remaining air passes through the engine air inlet screen and is turned downward through the engine plenum chamber and into the engine compressor.

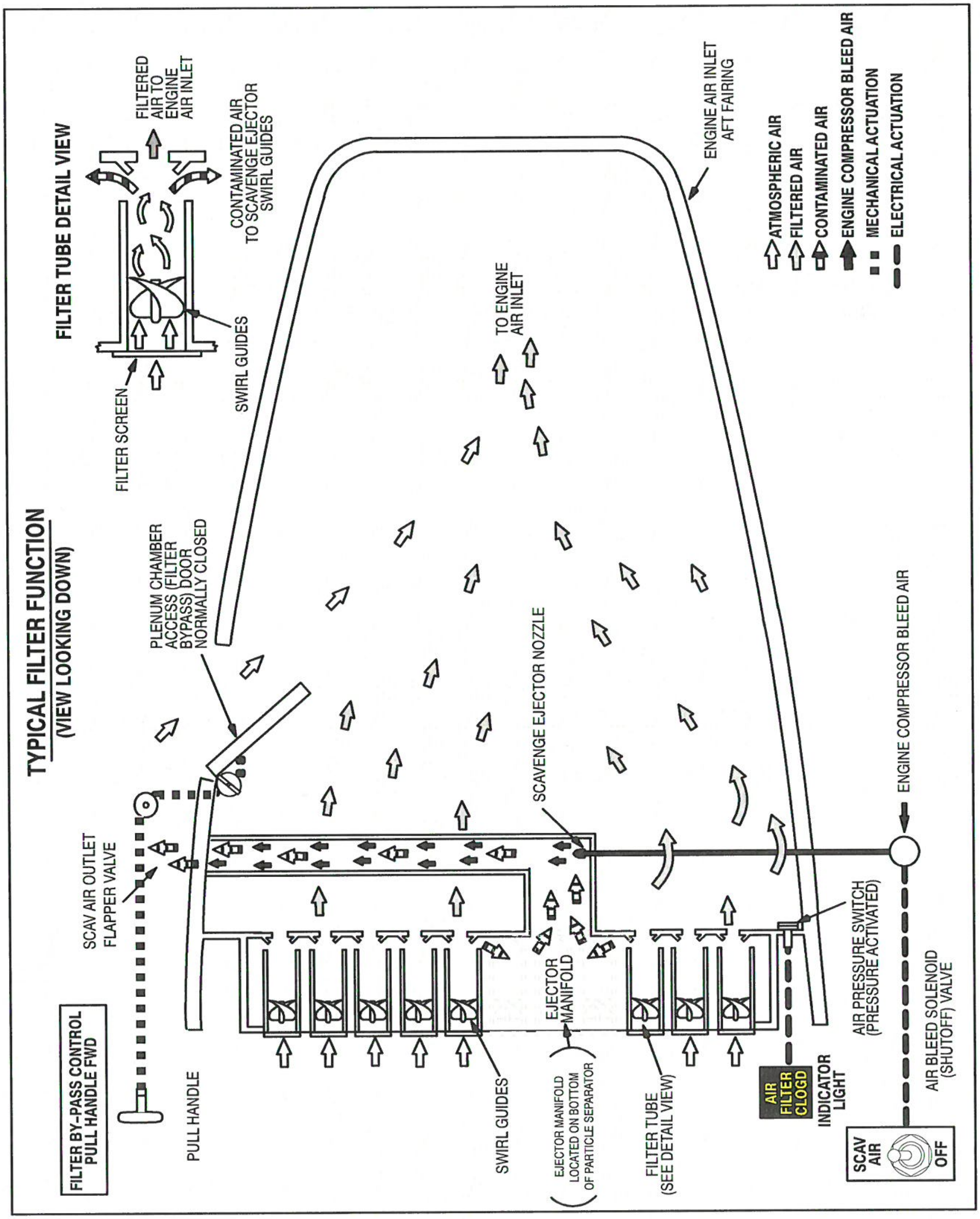

Figure 3-7. Particle Separator Filter Schematic

3–7. ENGINE AIR PARTICLE SEPARATOR

Description and Operation

There are two different types of engine air particle separators manufacturerd by different companies: Donaldson and APM. Donaldson filters were first installed on earlier production "D" models. Later "D" models were fitted with an improved filter manufactured by APM.

The helicopter may be equipped with an optional inertial type particle separator which replaces the standard engine air inlet screen. The inertial particle separator modifies the helicopter with electrical, mechanical, and scavenge air equipment for control of filter operation. The particle separator contains swirl guides, which increase air velocity, separate heavy contaminant particles, and filters engine air. A solenoid air valve and air lines route engine compressor bleed air to the particle separator manifold which ejects the contaminants. Mechanical door operating equipment opens a hinged plenum chamber access door for air bypass in the event of a clogged filter. On later E and F Plus Models, a hinged access panel is installed at the forward top center of the engine air inlet fairing at approximately station 127.00 to allow easy access to the mist eliminator.

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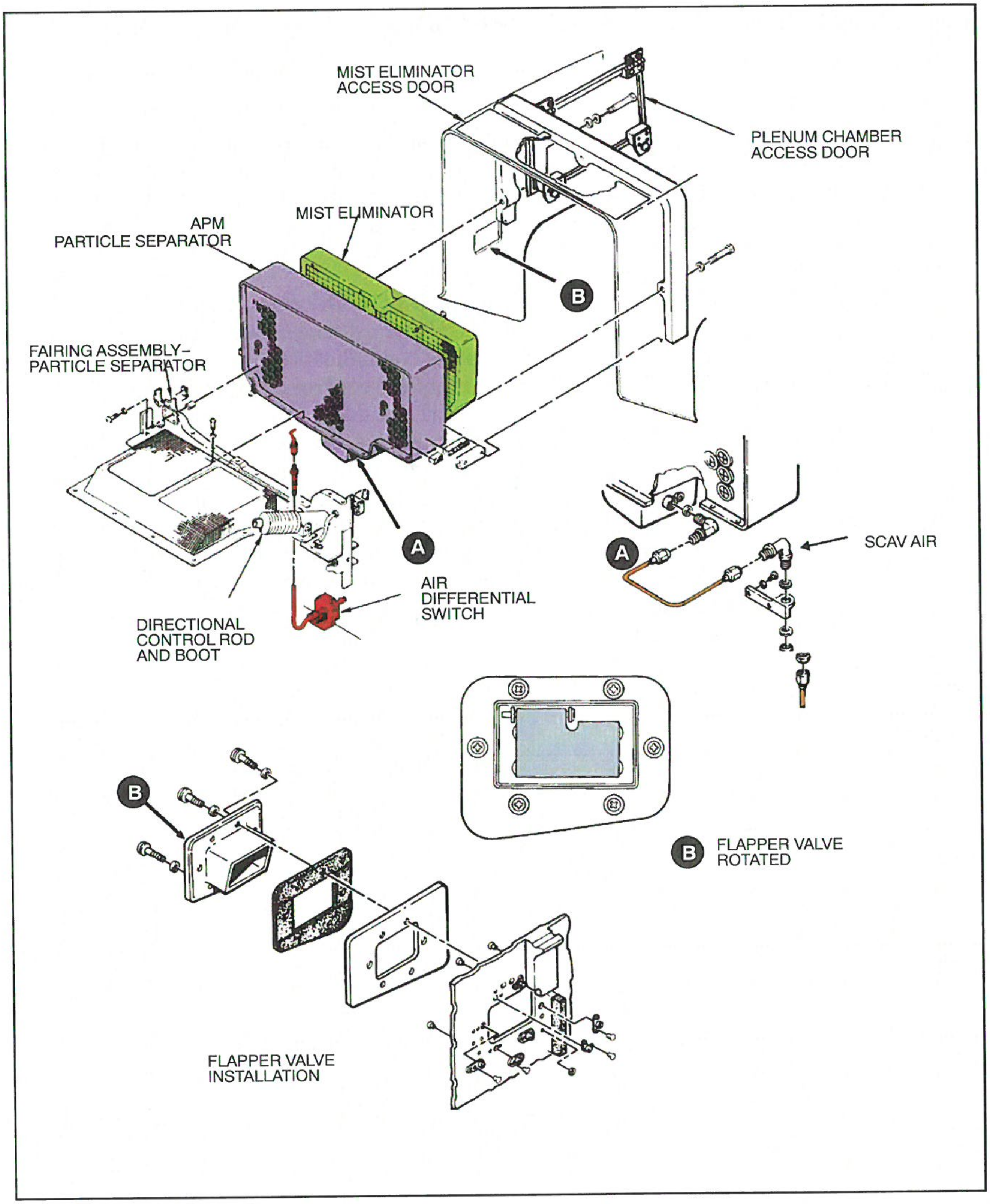

Figure 3–8. Particle Separator (APM)

3-8. APM PARTICLE SEPARATOR

Application All current production 500E and 530F Plus models can be equipped with the APM filter.

Description and Operation The APM particle separator, with optional mist eliminator screen, modifies the helicopter with electrical, mechanical, and scavenge air equipment for control of filter operation. The particle separator contains swirl guides, which increase air velocity, separate heavy contaminant particles, and filters engine air. A solenoid air valve and air lines route engine compressor bleed air to the particle separator manifold which ejects the contaminants. Mechanical door operating equipment opens a hinged plenum chamber access door for air bypass in the event of a clogged filter. A hinged access panel is installed at the forward top center of the engine air inlet fairing at approximately station 127.00 to allow easy access to the mist eliminator.

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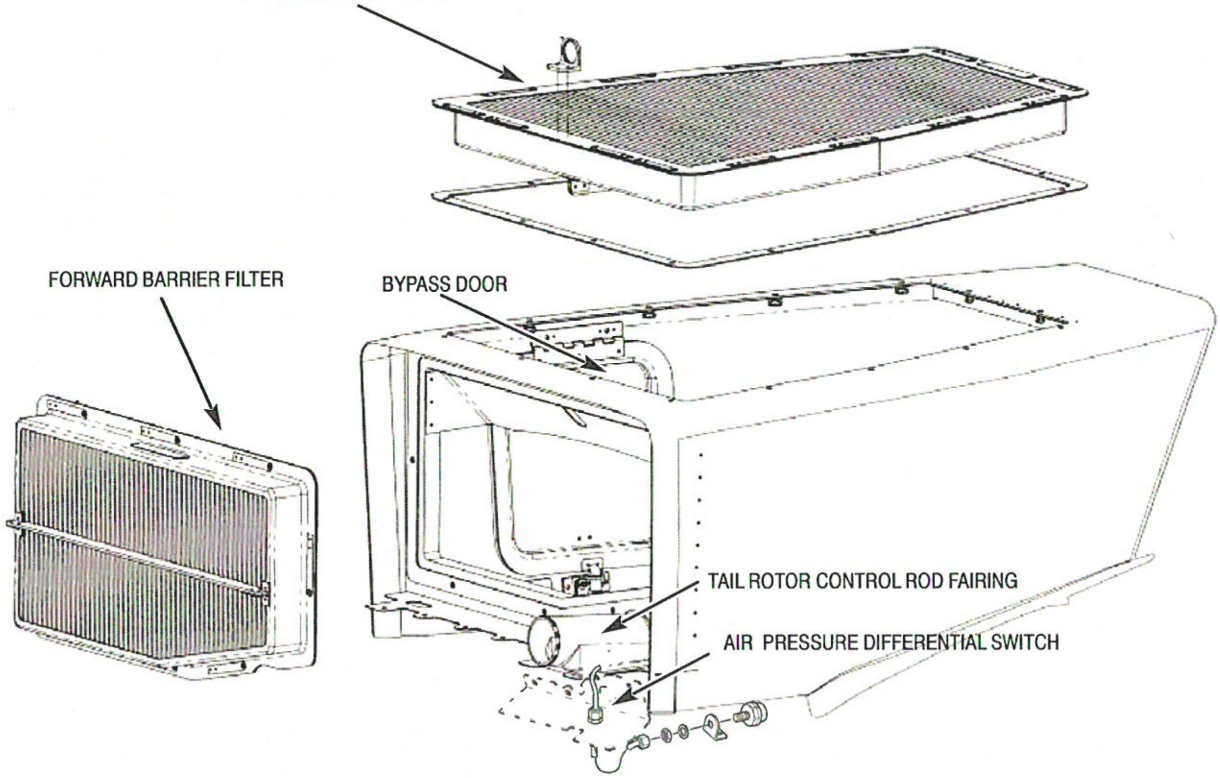

Figure 3-9. AFS Inlet Barrier Filter

3-9. AFS INLET BARRIER FILTER (IBF)

Description and Operation

The Aerospace Filtration Systems (AFS) IBF is comprised of an aerodynamic structural fairing, integral structural frame and deflector, integral bypass system, two barrier filter assemblies (forward and upper), integral seals, plumbing for the existing differential pressure switch, two forward floor plates and a control rod fairing that interfaces with the existing flexible boot and tail rotor control rod to seal the inlet plenum. The IBF fairing employs a mechanically operated inlet bypass system to permit unfiltered air to enter the engine inlet plenum chamber should the IBF filter media become obstructed. Once the bypass system is rigged during the IBF system installation, no recurring maintenance is required. The standard MDHI MD500 aircraft inlet differential pressure sensor is used. The sensor provides an indication to the pilot of debris accumulation on the filter elements, glossing over due to ice or snow, and when to activate the bypass system prior to the pressure drop across the filters exceeding operational limits.

The AIR FILTER CLOGGED caution light illuminates when the pressure drop across the IBF elements reaches the aircraft inlet differential pressure switch setting. The pilot must evaluate current conditions, closely monitor TOT, and assess mission requirements to determine whether to continue the flight, open the bypass door or return to place of origin or nearest airfield. The bypass door is mechanically opened by the pilot from the cockpit by pulling the filter bypass control.

The actual service interval must be based on a combination of tracking engine Power Check data (Refer to Section V of the applicable MD500 Series Rotorcraft Flight Manual), cumulative operating hours, AIR FILTER CLOGGED indication and visual inspections. Any steady illumination of the AIR FILTER CLOGGED light, where the pressure sensor and indicating system are shown to be working properly, requires servicing of the filter elements at the earliest opportunity. The gradual increase in pressure drop across the IBF elements causes a reduction in temperature margin as measured by the Power Check. When possible, in order to minimize unnecessary filter changes, the servicing of the IBF should only be performed after standard troubleshooting methods are exhausted and the only remaining suspect performance driven anomaly is inlet pressure loss. The recommended service interval is 100 hours, which can be coupled with other aircraft/engine inspections. The decision whether to service the filter based on the results of a visual inspection will reside with the pilot. If physical evidence is present that a fungus is growing over a substantial portion of the filter media assembly (30% per assembly), it will require servicing. Maximum number of service cycles (i.e., cleaning/oiling) is limited to 15 for each filter assembly. The forward and upper filter assemblies include a data plate that must be scribed to track filter service cycles.

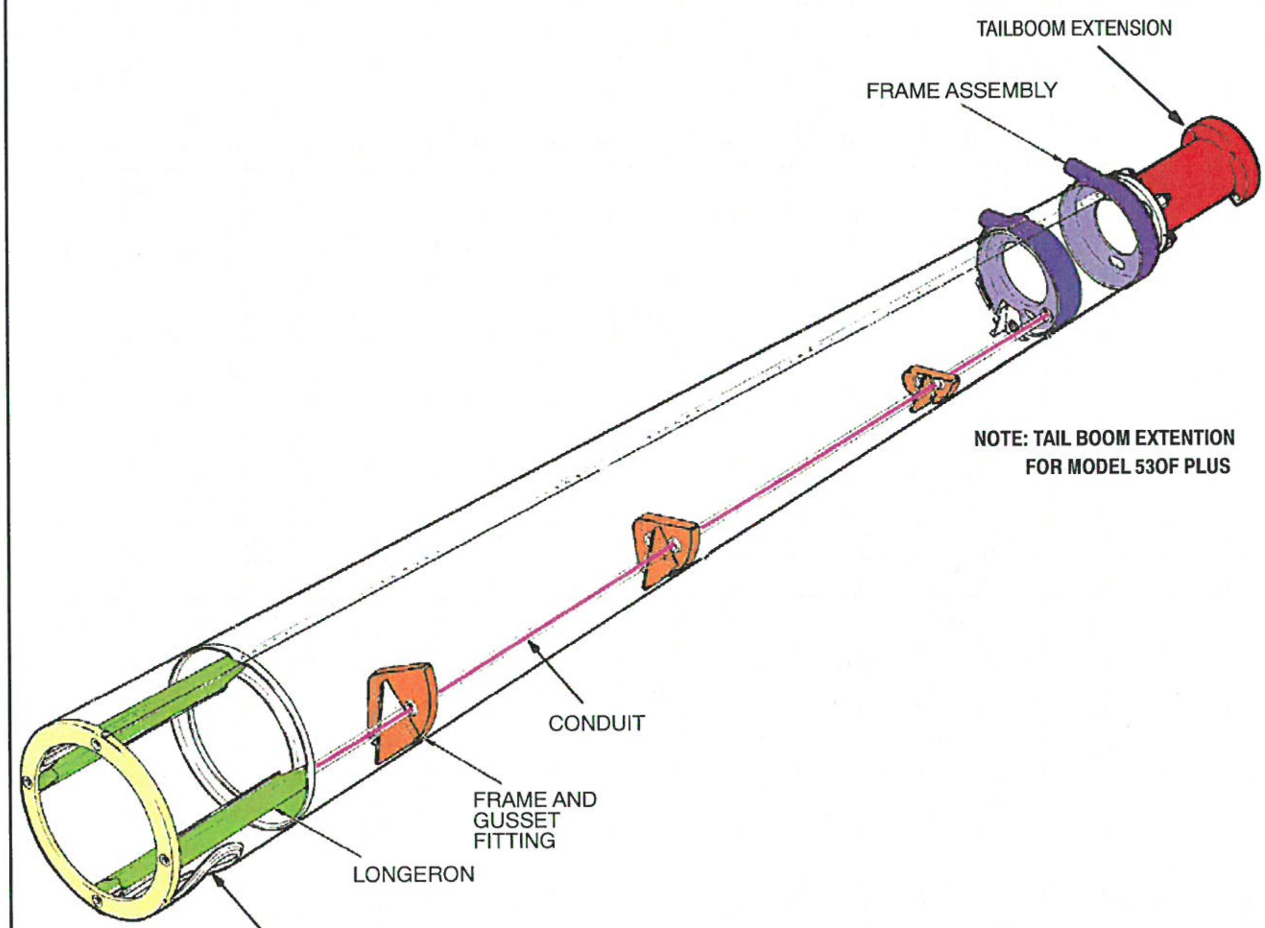

Figure 3–10. Tailboom

3-10. TAILBOOM ASSEMBLY

Design and Construction

The tailboom is constructed from two 85 inch long 0.040 inch thick aluminum sheets longitudinally riveted over three fittings and a frame. The forward frame fitting is a 12 inch diameter aluminum forging that is longitudinally drilled to accommodate four bolts for attaching the tailboom to the fuselage boom fairing fitting.

The boom's taper is formed by a rearmost 6-1/4 inch diameter forged aluminum frame assembly with studs for attaching the tail rotor gearbox and aft root fittings of the vertical stabilizer.

Three tail rotor rod supports are mounted inside the tailboom assembly, with the flange of each support formed to match the concave contour of the inner boom skin. Each support has a grommet-lined passage hole for alignment and guidance of the tail rotor control and provides security for the tail position light, chip detector wire and anti-collision light conduit.

NOTES:

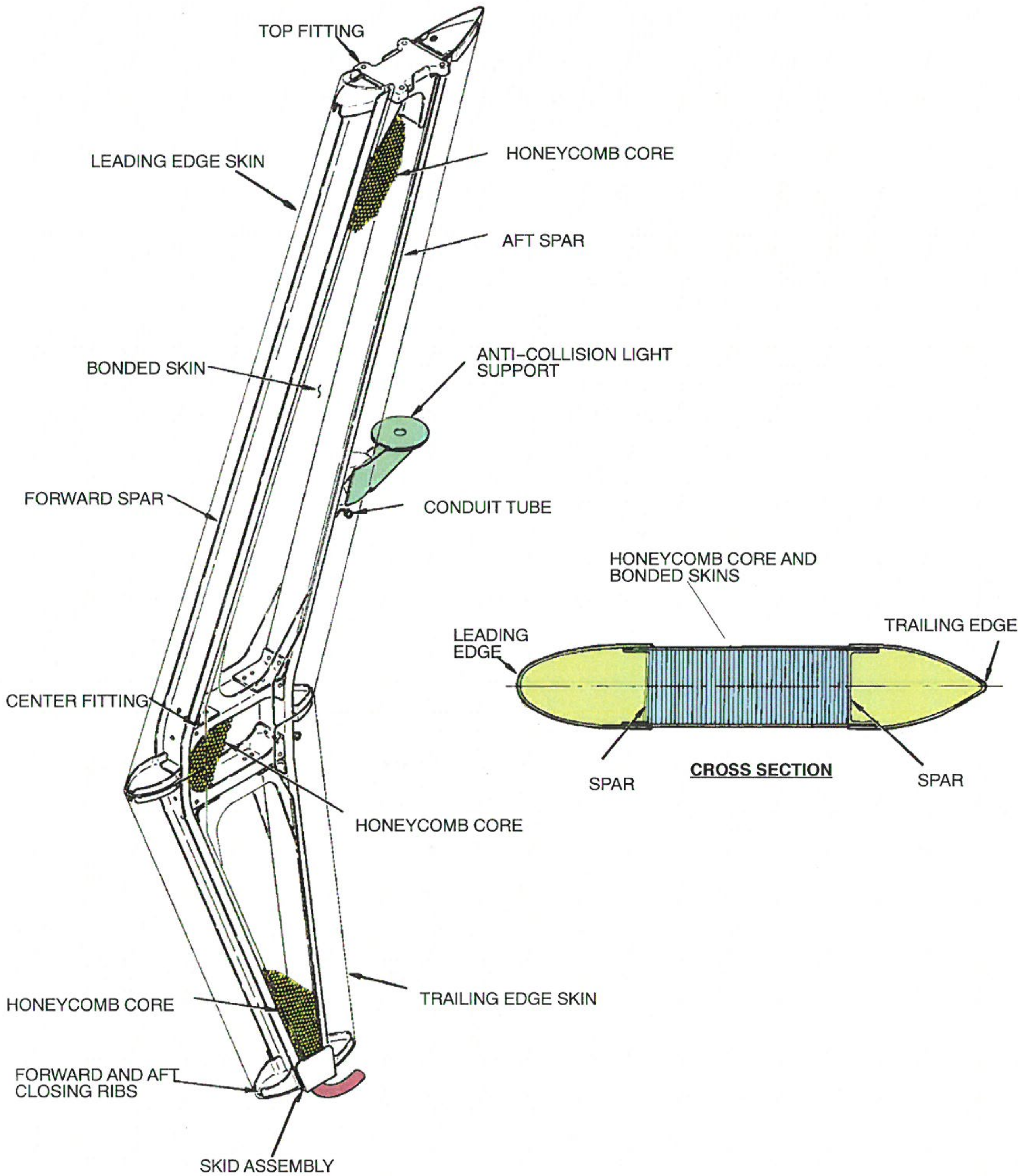

Figure 3-11. Vertical Stabilizer

3–11. VERTICAL STABILIZER

General The vertical stabilizer is mounted aft, right of the tailboom and is bolted to the tail rotor transmission and stabilizer mount fittings.

Design and Construction The entire cavity between the spars is filled with a honeycomb core, to which two outside skin surface panels are bonded. The leading and trailing edges are formed with contoured aluminum sheets bonded to these outside skin panels. The upper and lower sections of the leading and trailing edges are reinforced and joined at the center by aluminum ribs. The gap formed by these ribs is closed with glass cloth and adhesive. The ends of the leading and trailing edges are closed by ribs riveted and bonded in place. Provisions for electrical wiring for anti-collision and position lights are contained within the trailing edge structure attached to the trailing edge U–shaped spar.

NOTES:

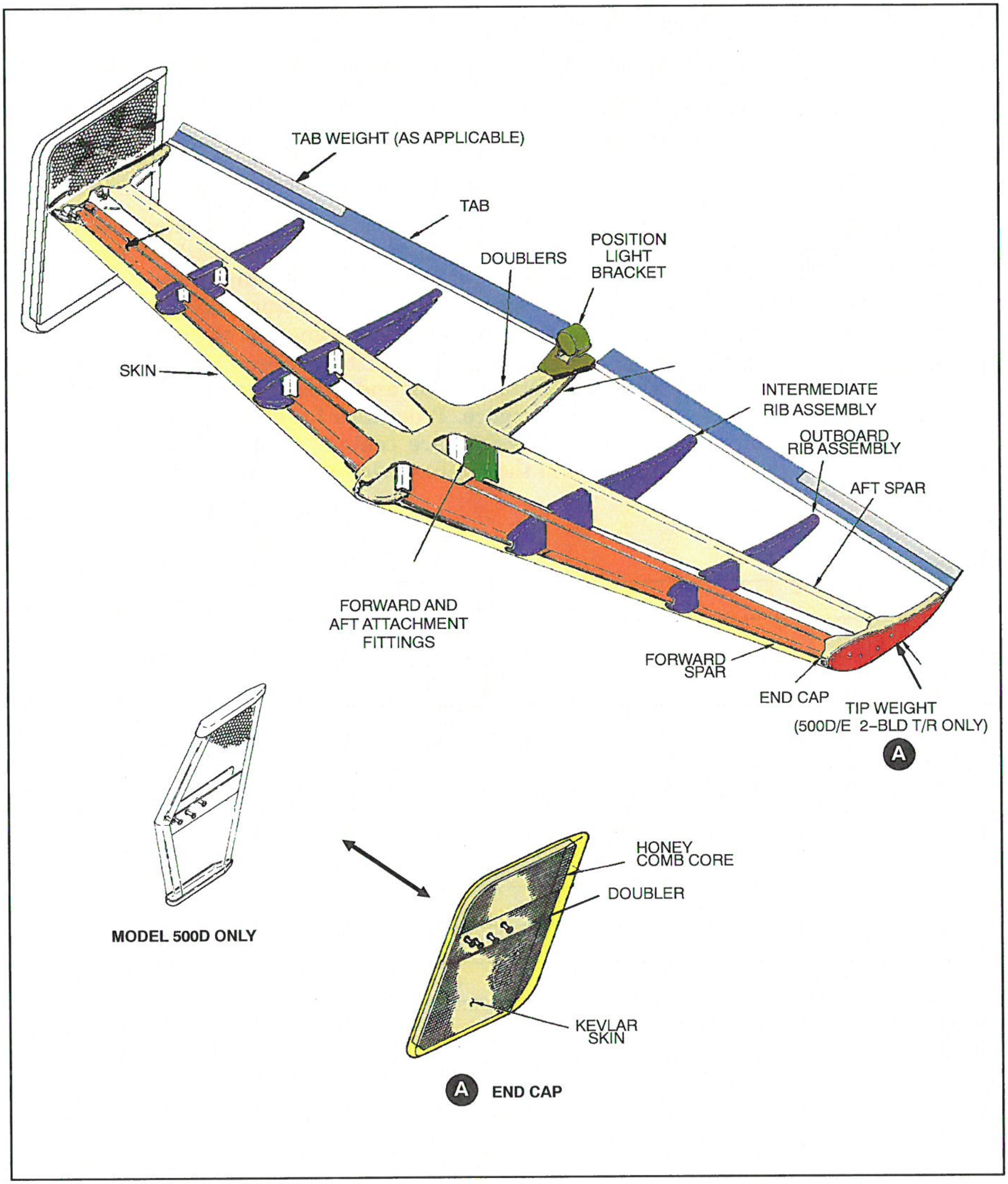

Figure 3–12. Horizontal Stabilizer

3-12. HORIZONTAL STABILIZER

Design and Construction

The horizontal stabilizer consists of two U-shaped spars, four riveted attachment fittings located at the center, a center rib assembly, four ribs, two end caps, and two skin sections used to close the internal structure. The skin is riveted to the ribs and spars and the gap formed by the two skin halves is closed with glass cloth and adhesive. Provisions for electrical wiring and attachment of the position light are provided by the center rib assembly.

Stabilizer End Plates - Design and Construction

The Model 500D stabilizer tip plates consist of a one-piece aluminum skin wrapped around a Nomex honeycomb core with the trailing edge formed by the bend radius. The leading edge is formed by two aluminum caps bonded to the skin. The upper and lower ends are closed with fiberglass end caps. The Model 500E/530F-Plus stabilizer tip plates are constructed of 2 ply Kevlar skins bonded over a honeycomb core. Four aluminum sleeve bushings are installed through each structure to provide for attachment to the horizontal stabilizer.

Stabilizer Tip Weights

There are two one-pound carbon weights installed on the Model 500D/E horizontal stabilizer between the ends and tip plates. The purpose of these weights is to prevent a sympathetic vibration between the tail rotor and horizontal stabilizer trailing edge tabs. These weights are not installed on helicopters equipped with the optional four-bladed tailrotor kit.

NOTES:

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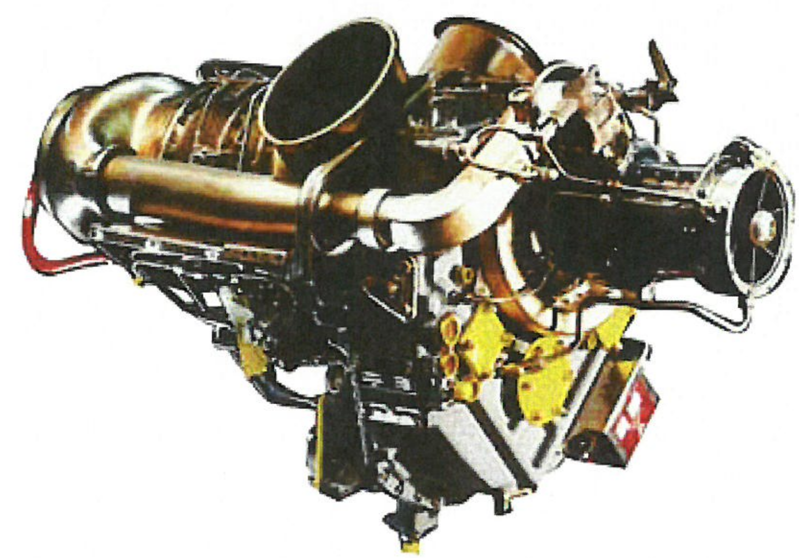
HELICOPTERS

MD 500 Pilot Transition Training Manual

SECTION IV
POWERPLANT 250-C20B



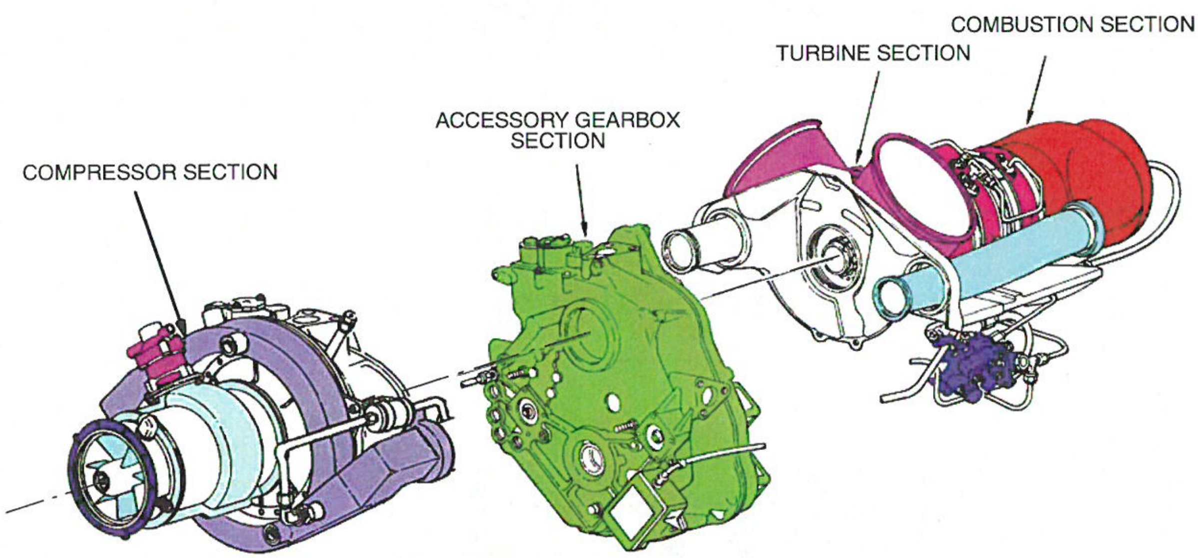


Figure 4-1. Major Engine Sections - 250-C20B

4-1. INTRODUCTION ROLLS ROYCE 250-C20B

Engine Type and Specifications

The Model 500D/E helicopter is equipped with an air cooled Rolls Royce Model 250-C20B turboshaft engine. The engine is a light-weight, free turbine engine, developing 420 horsepower. The engine is secured in the engine compartment with the centerline of the engine at a 47 degree angle up from horizontal and the output shaft to the transmission located below the centerline of the engine.

Design

Engines are of modular design consisting of a:

Compressor section

Combustion section

Turbine section

Accessory Gear box section

NOTES: ____

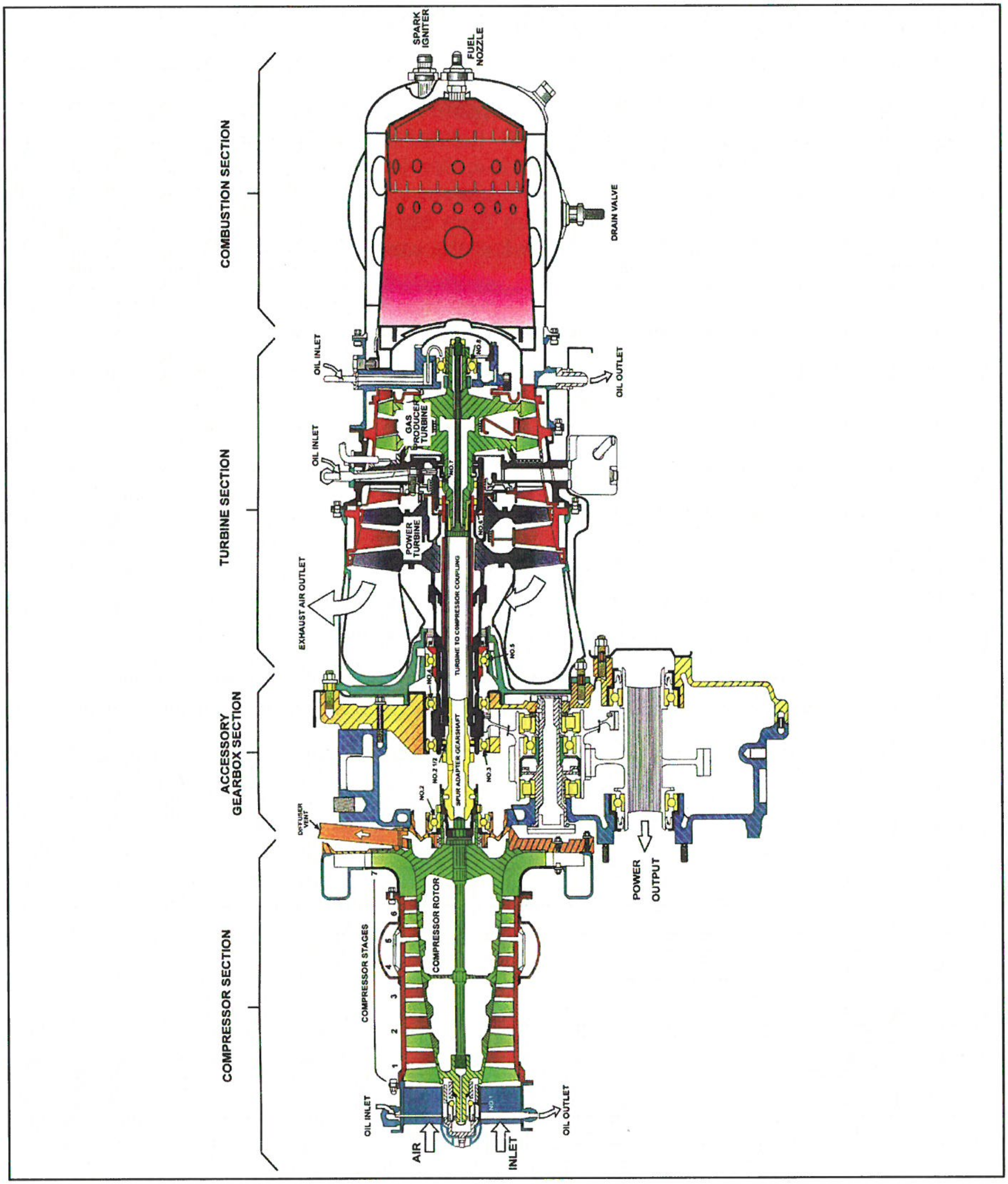


Figure 4-2. Engine Sections and Gas Flow

4-2. ENGINE SECTIONS AND GAS FLOW

Compressor Section The compressor is a combination of 6 axial stages and 1 centrifugal stage and compresses air for combustion.

Combustion Section The combustion section consists of a combustion outer case and a liner burner jacket and incorporates the burner drain valve, fuel nozzle, and spark igniter.

Turbine Section The turbine section of the engine incorporates the components necessary to develop rotary power by absorbing the energy of hot expanding gases.

Accessory Gearbox Section The accessory gear box transmits the rotating forces to the aircraft drive system, at the desired speed, as well as providing drive for the other engine accessories.

NOTES: ______________________________

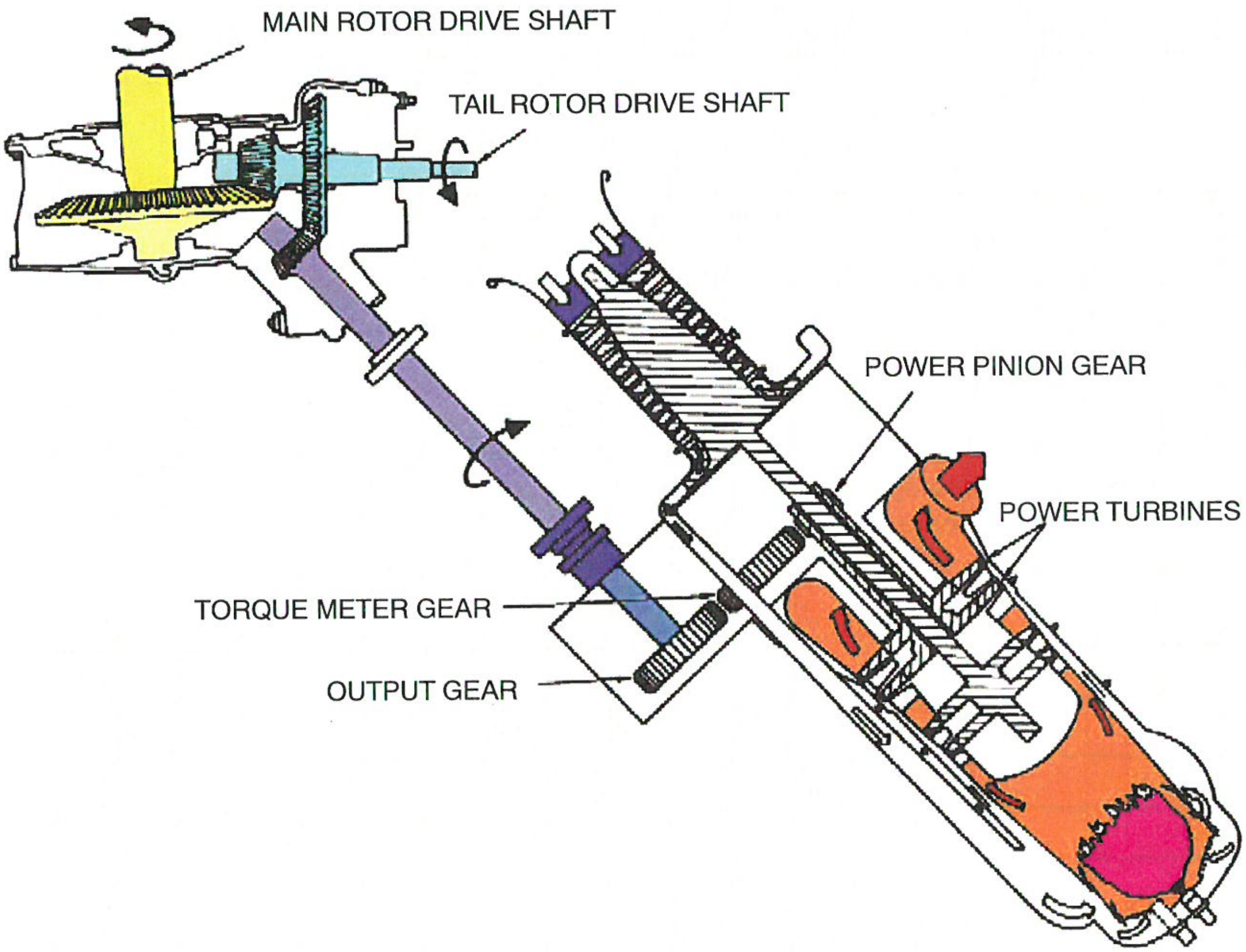


Figure 4-3. Engine Power Distribution

4-3. ENGINE POWER DISTRIBUTION

Description Power from the turboshaft engine is coupled to the main and tail rotors by drive shafts and two transmissions. An over running (one-way) clutch in the drive between the engine and main rotor transmission permits free-wheeling of the rotor system in the event of an engine failure.

NOTES:

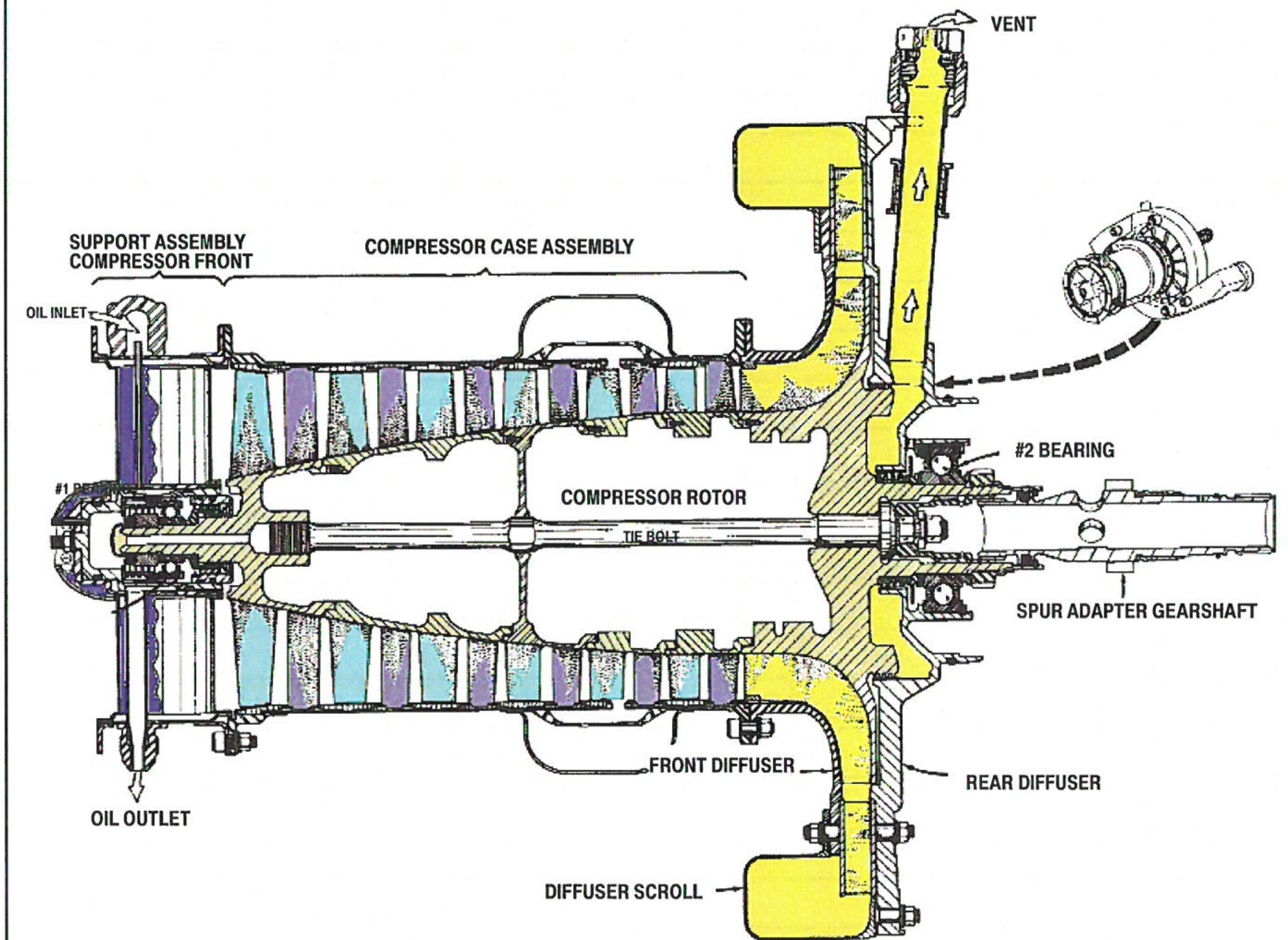


Figure 4–4. Compressor Section Schematic

4-4. COMPRESSOR SECTION

Components and Function

The compressor assembly consists of the following: Compressor Front Support, Compressor Case, Diffuser Scroll, Front Diffuser, Rear Diffuser, Rotor, Rotor Bearings, Oil Seals, and Vents.

Air enters the engine through the compressor inlet and is compressed by six axial compressor stages and one centrifugal stage. The compressed air is discharged through the scroll type diffuser into two ducts which convey the air to the combustion section.

Design and Construction

The compressor front support is a fabricated sheet metal component consisting of a double-wall outer skin, seven hollow radial struts, and a double-wall inner hub which provides mounting for the compressor rotor front bearing and oil seal assembly. The upper left and bottom strut leading edges extend further forward than the remaining radial struts. Pressure oil is delivered through a tube within the upper left strut for the lubrication of the bearing. Oil is scavenged from the bearing through a tube within the bottom strut.

Anti-Ice Function

During icing conditions, the anti-icing valve, mounted on the top front of the diffuser scroll, delivers hot compressor discharge air to two fittings on the compressor front support. Anti-icing air is distributed around the support through the cavity formed by the double-wall outer skin. Anti-icing air flows from this cavity into the hollow struts and is exhausted either out of slots on the tailing edge of the struts or through the forward position of the double-wall inner hub.

NOTES: ______________________________

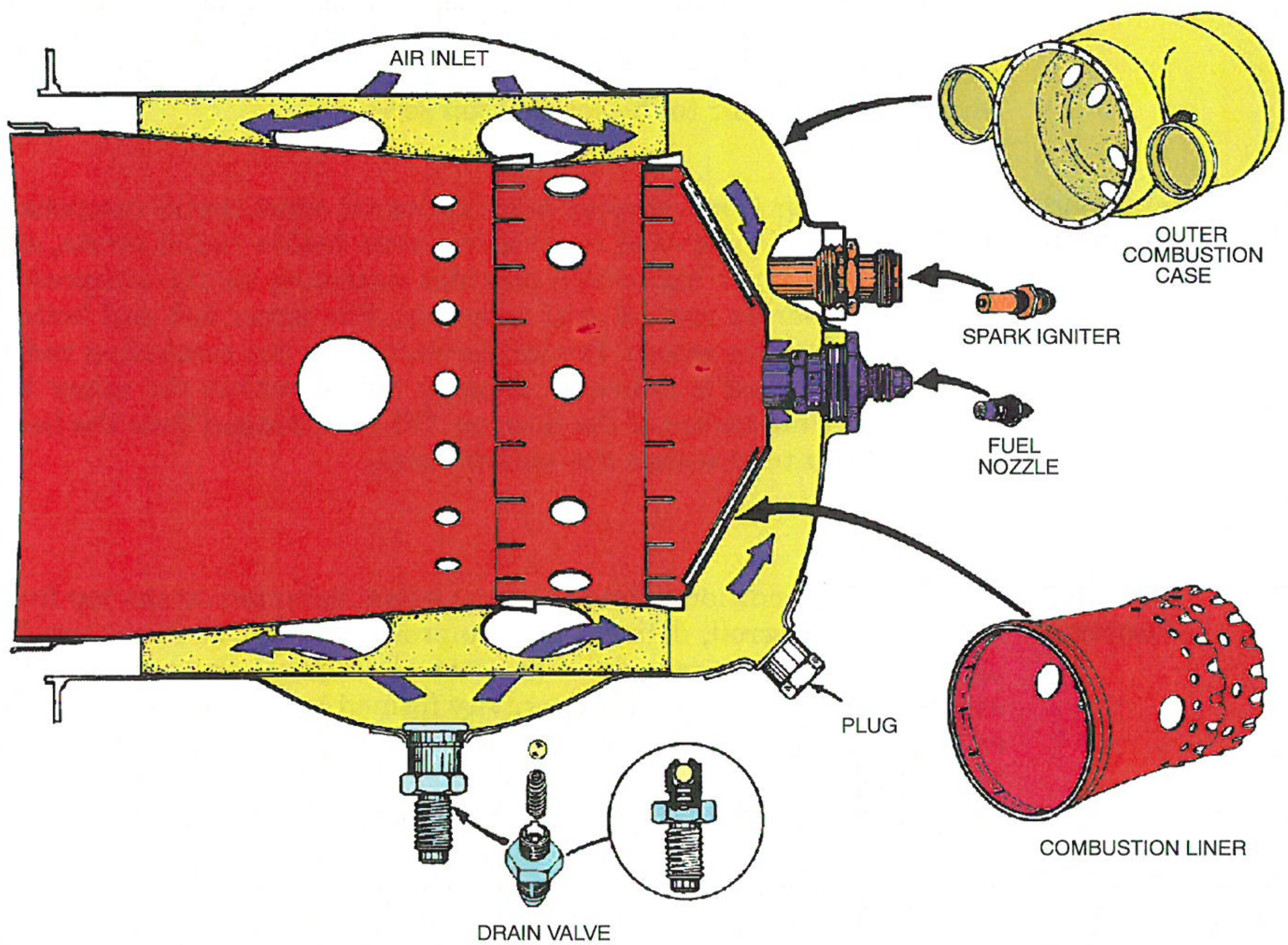


Figure 4-5. Combustion Section Schematic

4-5. COMBUSTION SECTION

Construction and Function

The combustion section consists of the outer combustion case and combustion liner. A spark igniter and a fuel nozzle are mounted in the aft end of the outer combustion case. Air enters the single combustion liner at the aft end through holes in the liner dome and skin. The air is mixed with fuel sprayed from the fuel nozzle and combustion takes place. Combustion gases move forward out of the combustion liner to the first-stage gas producer turbine nozzle.

In addition the combustion section must:

1. Provide efficient combustion
2. Enable engine starting
3. Mix compressor air for combustion and cooling
4. Control flame pattern and
5. Prevent carbon formation

NOTES:

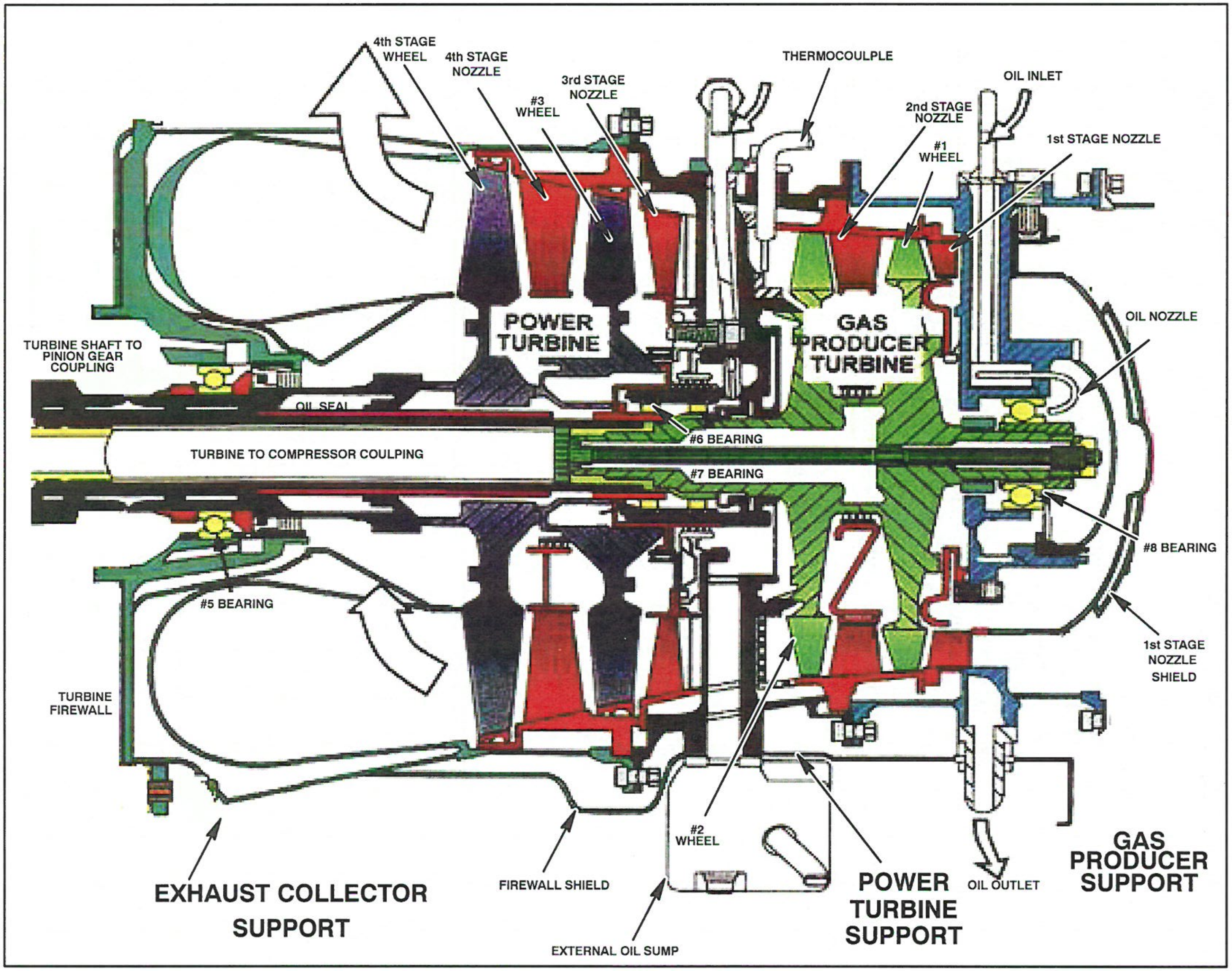


Figure 4–6. Turbine Section

4-6. TURBINE SECTION

Design and Function

The turbine section of the engine incorporates a two-stage gas producer turbine and a two-stage power turbine. Power to drive the compressor rotor and gas producer gear train is provided by the gas producer turbine rotor. The power turbine rotor develops the power which drives the power turbine gear train and the helicopter rotor system. The two turbine rotor assemblies are not mechanically coupled, but they are gas-coupled: exhaust gases flow through the four turbine stages.

Gas Producer Turbine Support

The gas producer turbine support is a one-piece, stainless steel, investment casting. It consists of a hub with five hollow radial struts and a cylindrical flanged case. The gas producer turbine support serves primarily as a casing for containment of the turbine operating gas and as the rear supporting structure for the gas producer turbine rotor.

The gas producer turbine support oil pressure tube delivers pressure oil through the upper left strut to the oil nozzle that is interference fit in the gas producer turbine support.

NOTES:

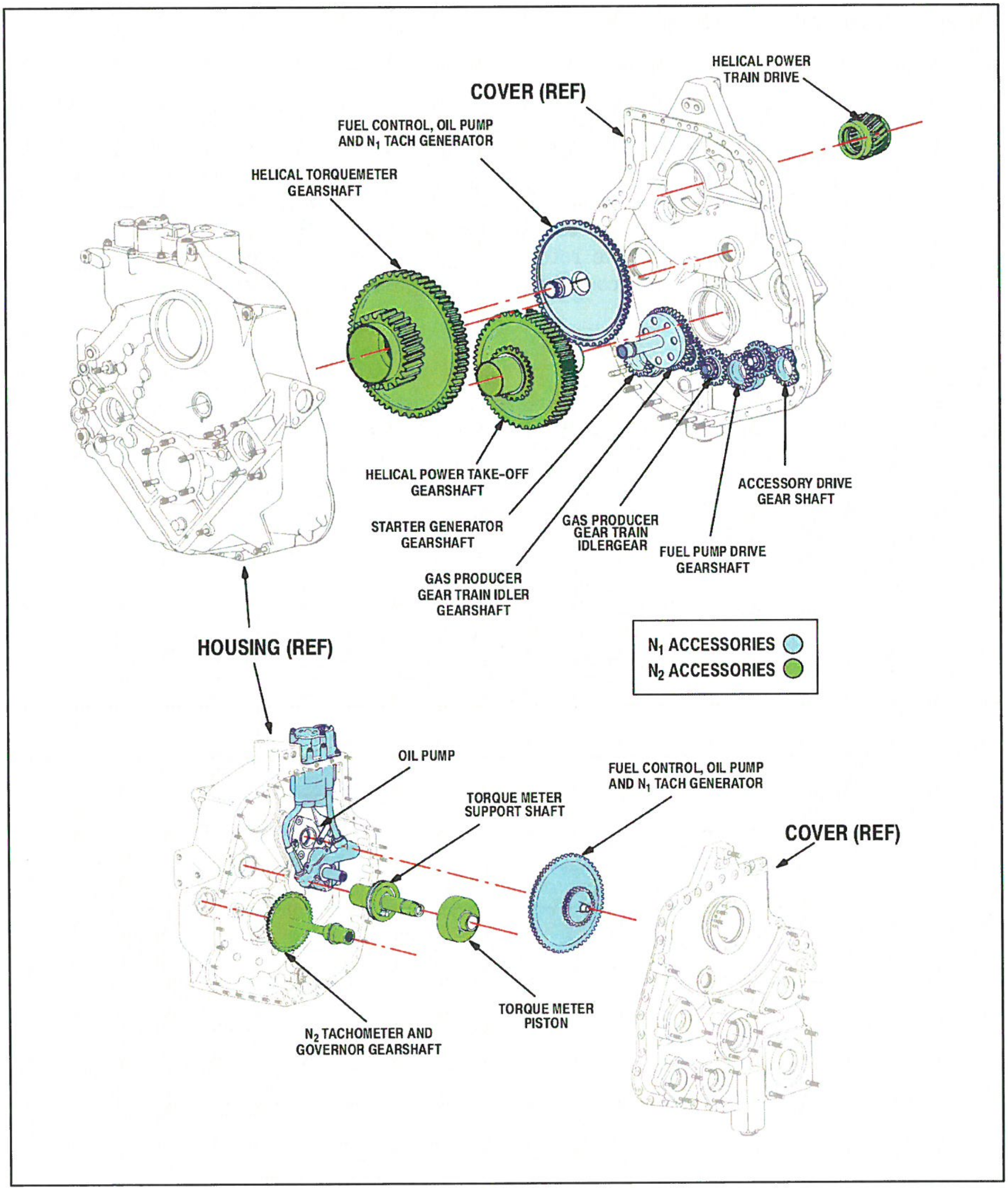


Figure 4-7. Accessory Gearbox

4-7. ACCESSORY GEARBOX

Design and Construction

The accessory gearbox assembly consists of a gearbox housing, gearbox cover, gas producer gear train, power turbine gear train, oil pump assembly, oil filter assembly, and the necessary oil tubes to provide pressure and scavenge oil as required by the lubrication system.

Gas Producer Gear Train

The gas producer gear train is designed to reduce relatively high N_1 RPM speeds to more useable speeds to drive the N_1 accessories.

The gas producer turbine rotor develops the torque required to drive the compressor rotor and the gas producer gear train which includes:

1. Spur Adapter Gearshaft
2. Spur Centrifugal Breather Gearshaft
3. Spur Idler Gearshaft
4. Spur Idler Gearshaft
5. Spur Fuel Pump, Fuel Control, and Oil Pump Gearshaft
6. Generator Idler Gearshaft
7. Starter-Generator Gearshaft & Spare Drive

Power Turbine Gear Train

The power turbine gear train is designed to reduce relatively high N_2 RPM speeds to more useable speeds to drive the N_2 accessories and power the helicopter.

The power turbine rotor develops the torque required to drive the power turbine gear train which includes:

1. Helical Power Train Drive (Pinion) Gear
2. Helical Torquemeter Gearshaft
3. Helical Power Take-off Gearshaft
4. Spur Power Train Idler Gear
5. Spur Power Train Tachometer Governor Gearshaft

NOTES: ______________________________

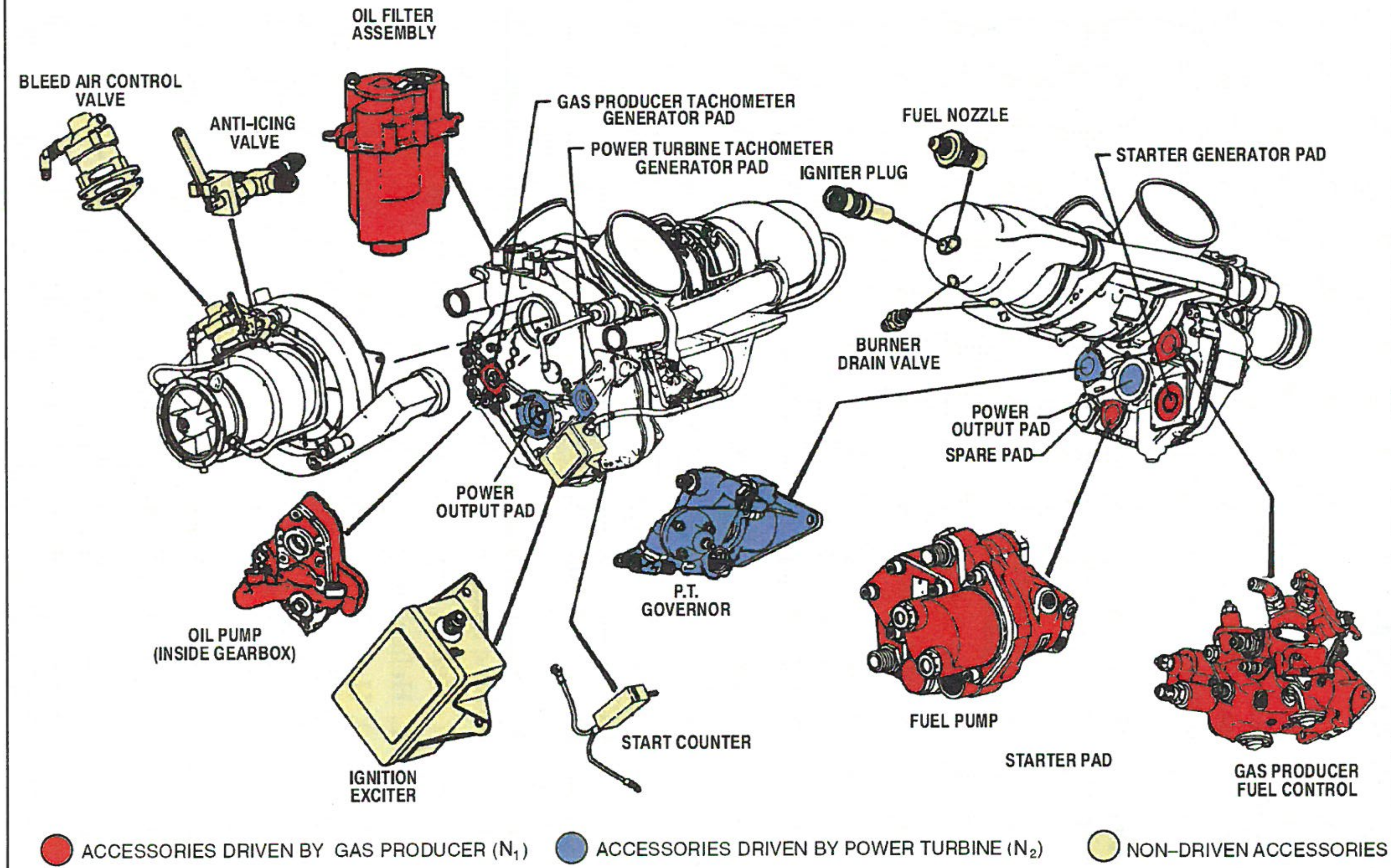


Figure 4-8. Engine Accessories Location

4-8. ENGINE ACCESSORIES

ENGINE ACCESSORIES LOCATION

Driven by N_1	Driven by N_2	Non-Driven
Starter-Generator	N_2 Tach Generator	Ignition Exciter Igniter Plug
N_1 Tach Generator	Power Output Drive	Start Counter
Oil Pump	Power Turbine Governor	Bleed Air Control Valve
Fuel Pump	Torque Meter Gearshaft	Oil Filter Assembly
Fuel Control Unit		Fuel Nozzle
		Anti-Ice Valve
		Burner Drain Valve

NOTES:

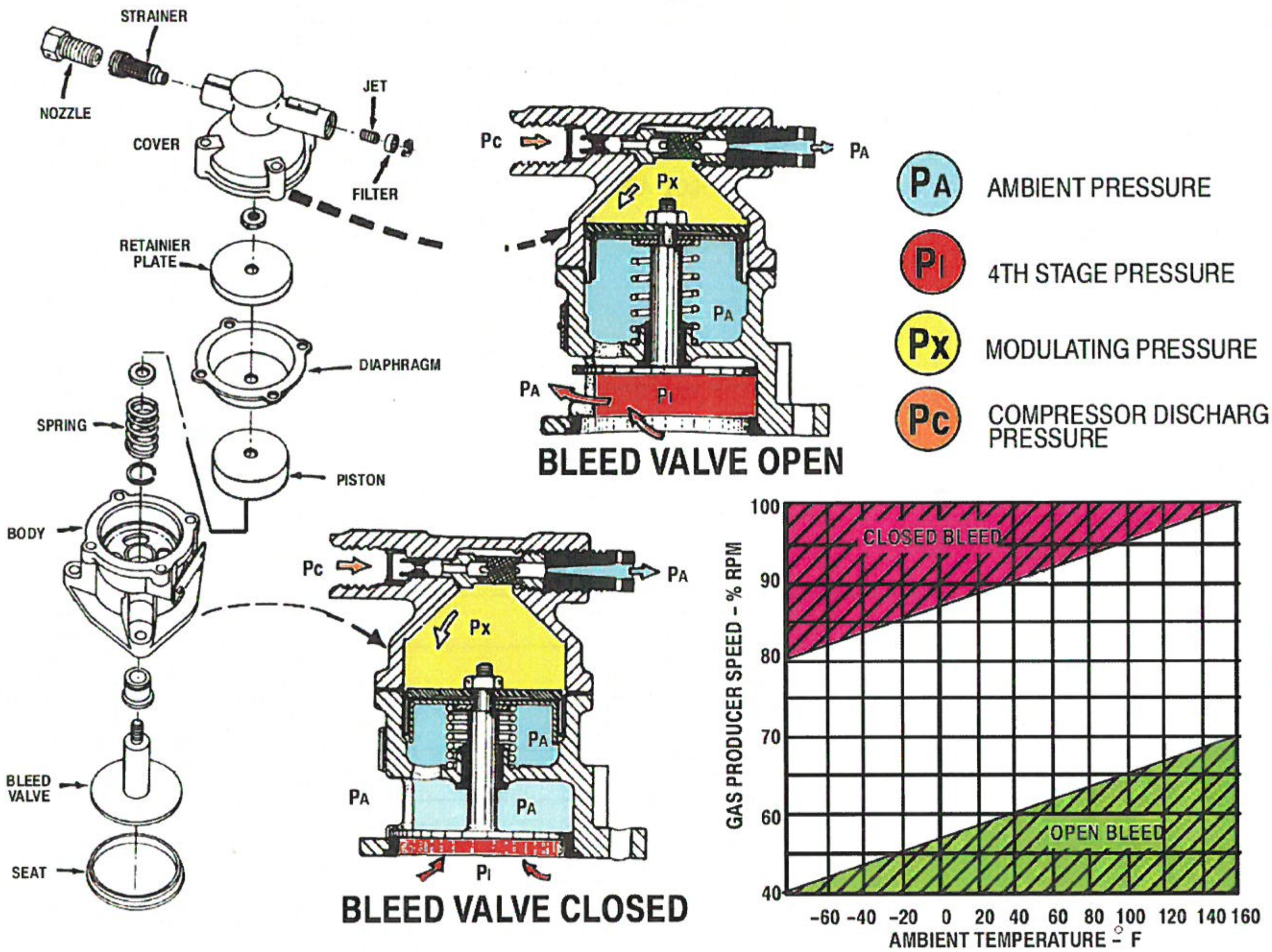


Figure 4-9. Compressor Bleed Air

4-9. COMPRESSOR BLEED AIR SYSTEM

General The compressor blades are airfoils. If the angle of attack becomes too great, or if the velocity of air flowing over an airfoil is too low, air flow separation occurs and the airfoil stalls. This results in a loss in efficiency, a loss in pressure ratio and, therefore, a reduction in pressure level at the compressor outlet. In order to produce engines with superior fuel consumption and rapid acceleration characteristics, it is necessary to operate as close to the stall region as possible.

Bleed Valve Function The ability of the compressor to pump air is a function of RPM. At low RPM's the compressor does not have the same ability to pump air as it does at higher RPM's. In order to keep the angle of attack and air velocity within desired limits, it is necessary to "unload" the compressor in some manner during starting and low power operation. This is to say that it is necessary to make the compressor "see" less restriction to the flow of air through the use of a compressor bleed air system.

This bleed air function is accomplished by using a bleed air valve that is operated by the varying air pressure working against spring pressure which holds the bleed air valve open in the starting and low power phases and closes the valve during high power phases.

Bleed Air Device Checks **SCAV-AIR** Switch (if installed) ON observe slight rise in TOT of________
then OFF - notice decrease in TOT.

Engine **ANTI-ICE** ON - Observe increase in TOT of ______________, then OFF - notice decrease in TOT.

CABIN HEAT (if installed) - ON - Observe increase in TOT of ________, then OFF - notice decrease in TOT.

MALFUNCTIONS

Compressor Stalls Compressor stall or surge can occur when the proper balance between fuel flow and air flow are upset. The stall may vary in intensity and usually occurs during a rapid increase in power. An indication of compressor stall is an audible "popping" noise possibly accompanied by torque oscillations, TOT fluctuations and decreasing or fluctuating N_1 rpm.

For one or two low intensity "pops", continue operation avoiding the condition that caused the "pop".

For high intensity "pop" or multiple "pops", if at high power, reduce power with collective stick until "popping" ceases. If at low power, increase power slowly until "popping" ceases. Monitor TOT and N_1 for normal indications. Collective changes during remainder of flight should be performed slowly. Return to base.

For continuous series of high intensity "pops" that do not cease following power changes, land as soon as possible. Be prepared to autorotate.

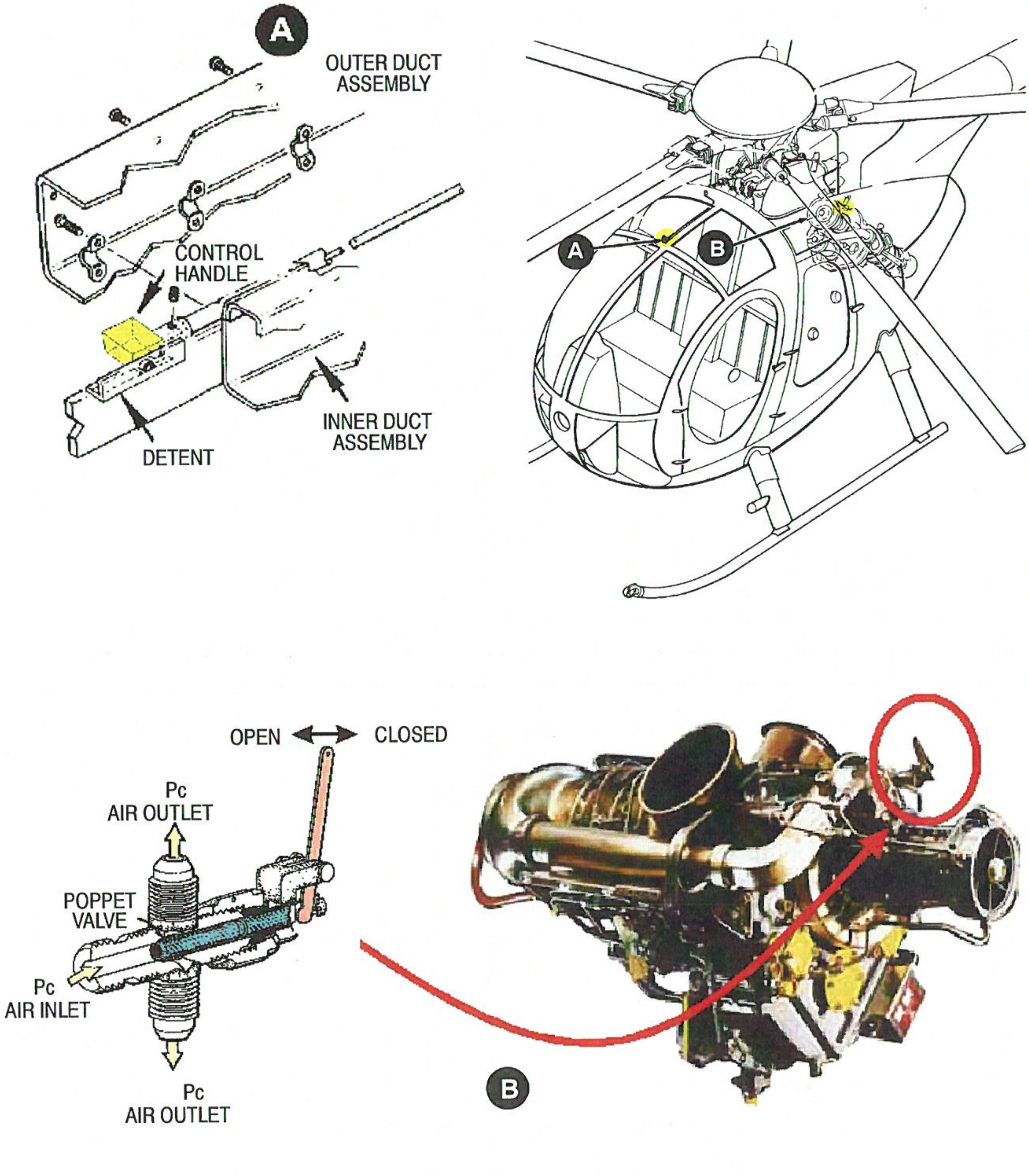


Figure 4-10. Anti-Icing System

4-10.ENGINE ANTI-ICING SYSTEM

Design and Construction

The engine is equipped with an anti-icing system that provides hot air to the compressor front support areas that are subject to the formation of ice during icing conditions. This system is entirely separate and independent of any other bleed air system. Operation of the engine anti-icing system must be selected, when required, by the pilot.

The anti-icing system consists of an anti-icing valve, two anti-icing tubes, and passages within the compressor front support.

Function

As air passes through the engine compressor, it is compressed. As a result of this compression, the air is heated considerably; thus, compressor discharge air, which is extracted from the diffuser scroll, is an excellent source of the hot air required by the engine anti-icing system.

USE

Use

Use engine anti-ice when the OAT is below ______ and visible moisture is present.

NOTES: ____

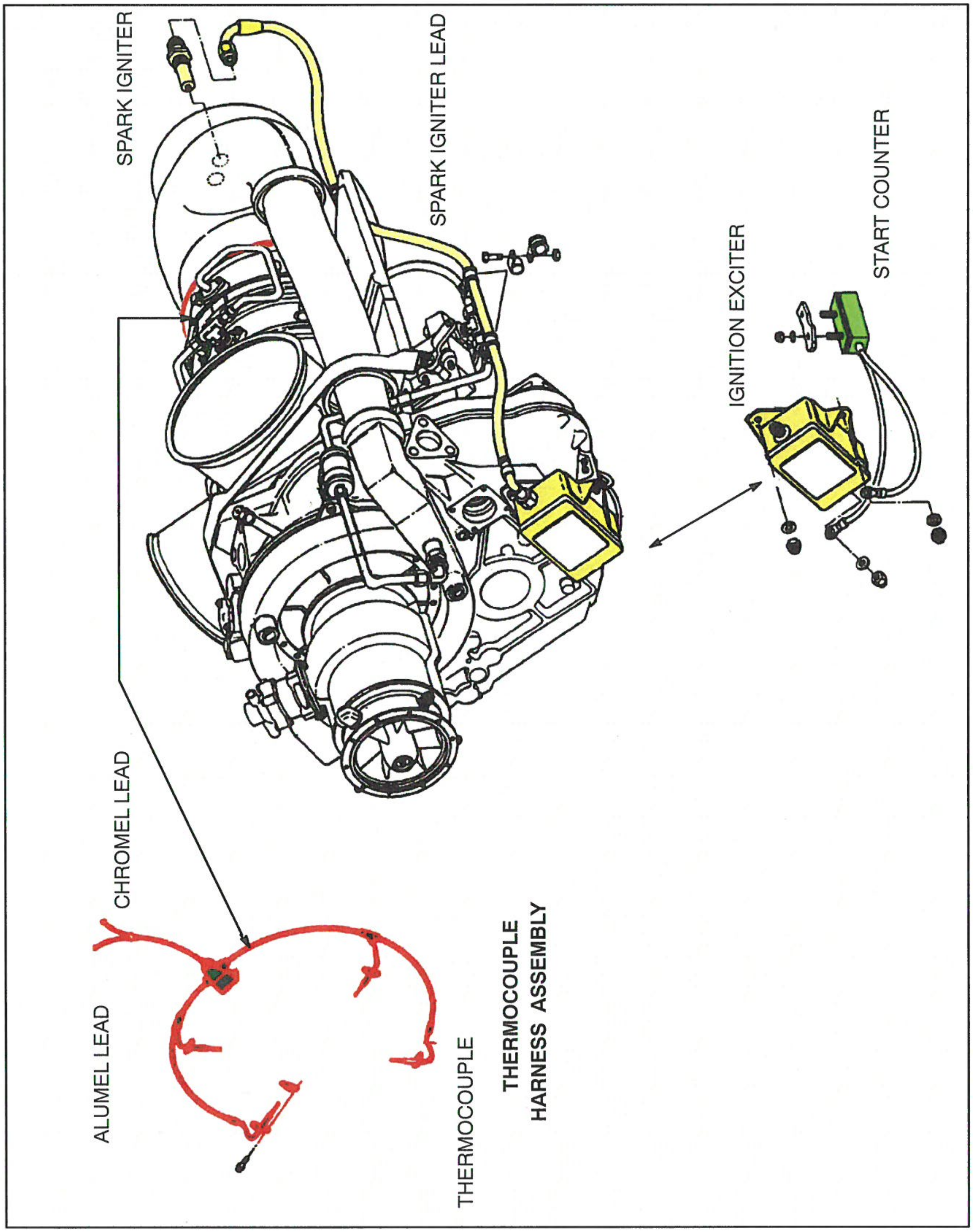


Figure 4-11. Electrical Components

4-11. ENGINE ELECTRICAL

Components

- Ignition exciter
- Starter counter
- Spark igniter
- Spark igniter lead
- Thermocouple harness

NOTES:

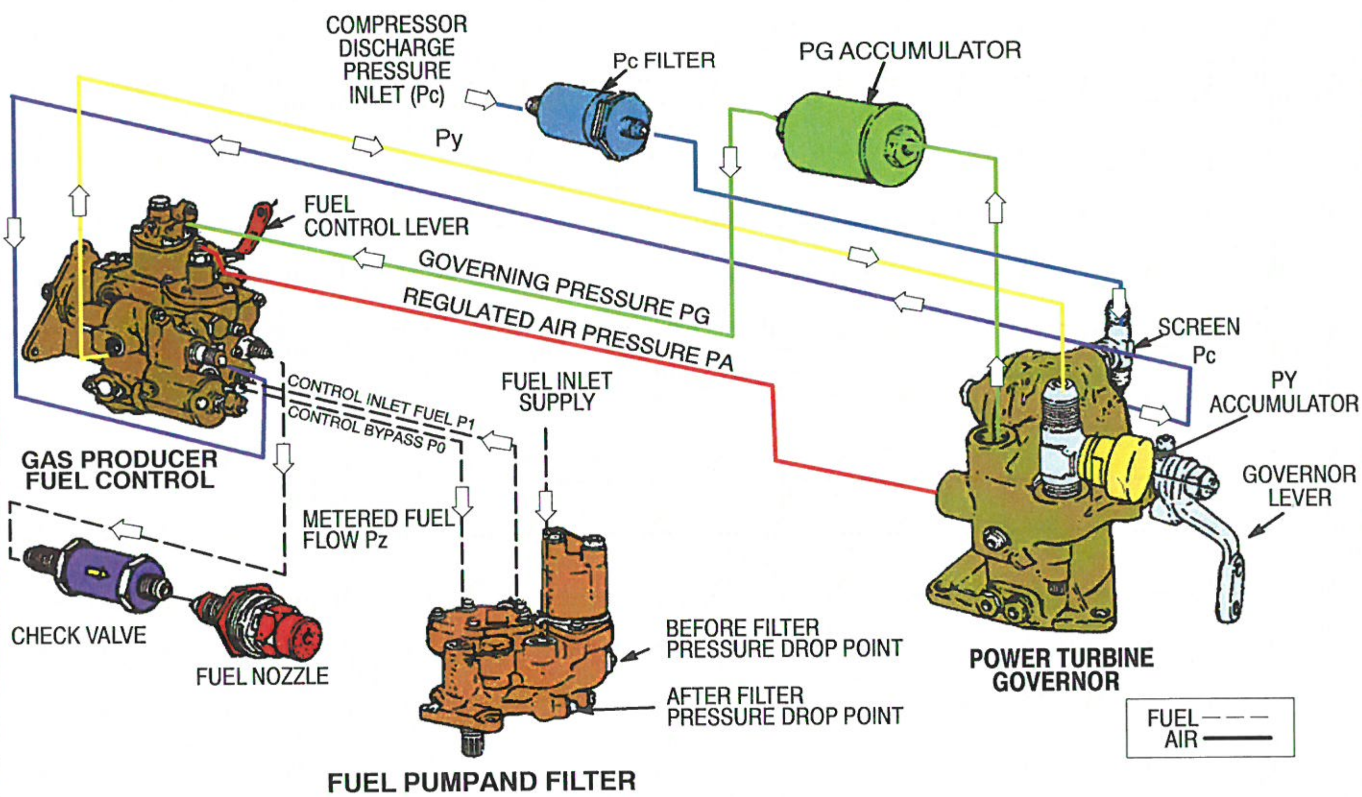


Figure 4-12. Fuel System Schematic

4–12. ENGINE FUEL SYSTEM

General The principal components of the fuel system are a fuel pump, a gas producer fuel control, a power turbine governor, and a fuel nozzle. The fuel control is located schematically in the system between the fuel pump and the fuel nozzle.

Functions The fuel system musthave the capability of starting the engine on the ground or in flight.

Meter fuel so as to prevent compressor stall and surge.

Meter fuel as a function of N_1 RPM during starting and ground idle operation.

Meter fuel as a function of N_1 and N_2 RPM while pilot increases throttle from ground idle to full open.

Meter fuel as a function of N_2 RPM when twist grip is full open.

Maintain the selected N_2 RPM during all flight conditions.

Provide overspeed protection.

Provide a means for shutting down the engine.

System Description The system controls engine power output by controlling the gas producer speed. Gas producer speed levels are established by the action of the power turbine governor which senses power turbine speed. The power turbine (load) speed is selected by the operator with the N_2 "beeper" and the power required to maintain this speed is automatically maintained by the power turbine governor resetting the fuel control.

Power Turbine Governor The power turbine governor lever schedules the power turbine governor requirements. The power turbine governor, in turn, schedules the gas producer speed to a changed power output to maintain output shaft speed.

Operating Scenario When the pilot increases collective pitch, the helicopter rotor system will demand more power for a constant N_2 of 100%. This causes the fuel system to schedule more fuel and results in an increase in T.O.T. As the T.O.T. increases, the expansion through the turbine rotors increases. The power developed by the gas producer turbine rotor increases, causing N_1 to increase. As N_1 increases, the mass airflow through the engine increases. With an increased mass airflow and increased expansion, the power turbine rotor will develop more power as called for by the pilot. Thus, the result of increased collective pitch is the same N_2 RPM, but a higher N_1 RPM, a higher T.O.T., an increased fuel flow, and a higher power output from the engine.

FUEL SYSTEM MALFUNCTIONS

Malfunction Indications

Failure will be indicated by an instrument needle fluctuation, or a rise or drop of any of the following indications:

N_1

N_2

TOT

Torque

Engine Overspeed:

Increase collective to load the main rotor, simultaneously rolling the twistgrip toward the ground idle position until control of N_2 speed is obtained.

Manually control N_2 speed (________________) with the pilots twistgrip.

If operating RPM cannot be controlled, close twistgrip to CUTOFF and make an autorotational landing.

CAUTION: **Immediate pilot action is necessary because engine torque, TOT, N_2 and rotor RPM may suddenly increase beyond approved limits. When shutting down the engine, do not reduce collective pitch until the rotor RPM has decreased to normal limits.**

Engine Underspeed:

Lower collective to maintain rotor RPM in the green (410–______) and attempt level flight at 60 knots IAS.

If power is insufficient for level flight or a power–on decent, make an autorotational landing.

Governor Surging:

If power turbine governor surges, beep N_2 to maximum and control N_2 (______________ percent) manually with the twistgrip.

NOTES: ____

NOTES:

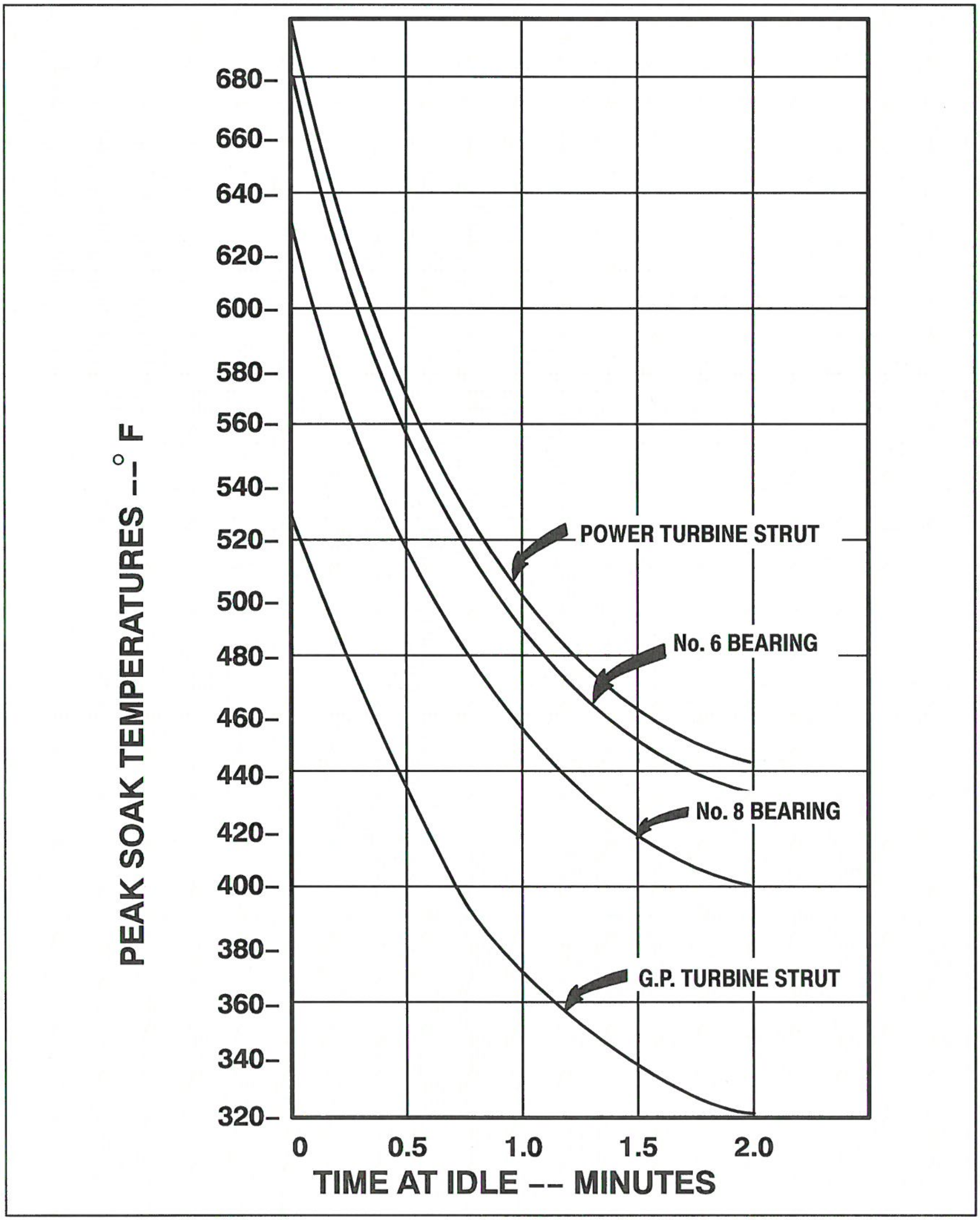


Figure 4–13. Peak Soak Temperatures Vs Time at Idle

4–13. TURBINE COOL DOWN

WARNING: **Idle dwell time prior to shutdown is important to prevent harmful accumulation of carbon in the engine which can result in engine failure.**

Maintain the engine speed at 59-65% N_1 for a minimum of two minutes prior to shutdown.

After two minutes: position the throttle to the cutoff position.

NOTES: ____________________

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HELICOPTERS

MD 500 Pilot Transition Training Manual

SECTION V
ENGINE CONTROLS/INDICATING

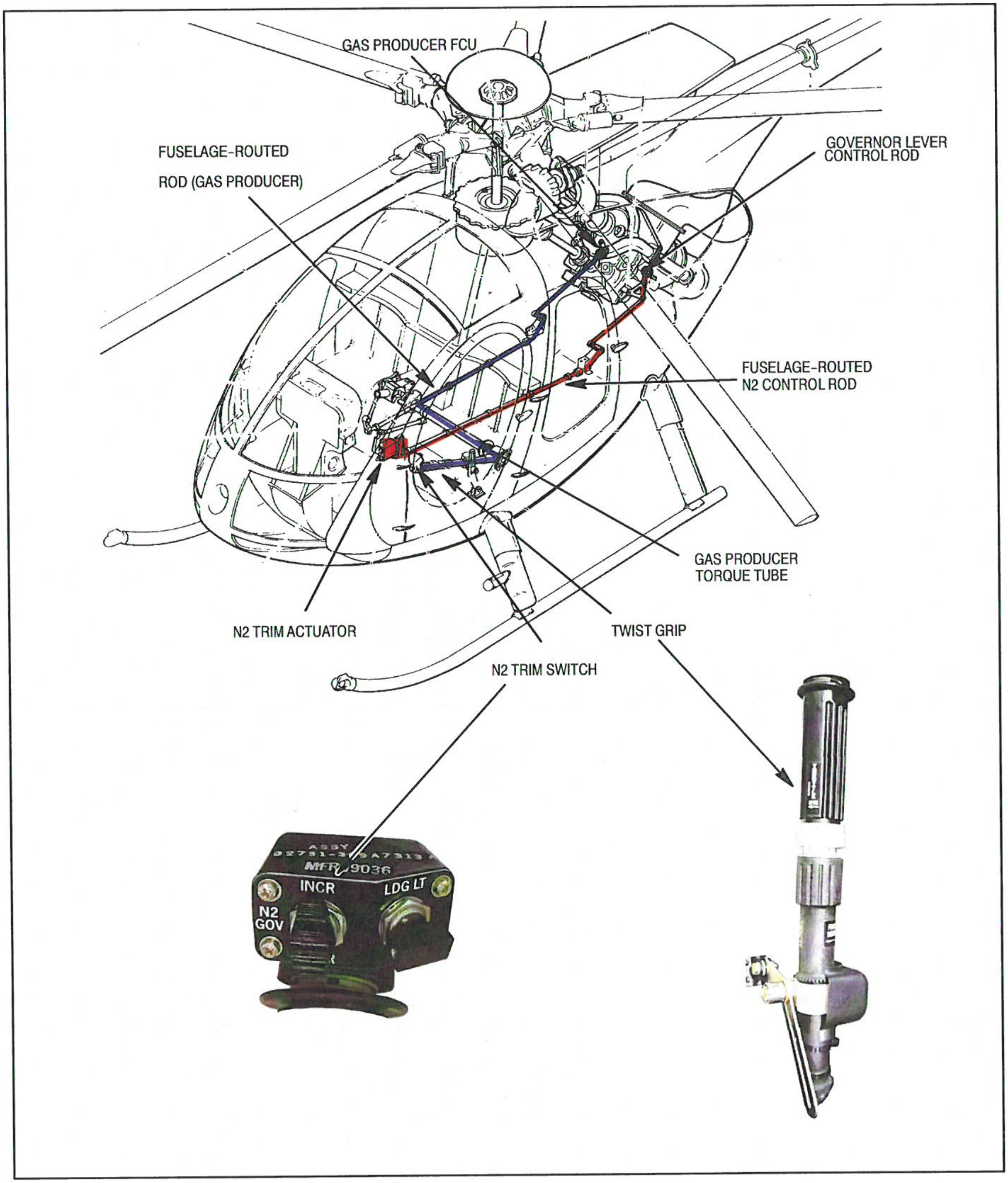

Figure 5-1. Control Linkage - Engine

5-1. ENGINE CONTROLS - MD 500D/E

Throttle Control (N_1) Throttle control linkage originates at the throttle twist grip on the collective control and is routed internally through the collective interconnect torque tube and a series of bellcranks, push pull tubes to the fuel control unit.

OPERATIONAL CHECKS - FUEL CONTROL UNIT (FCU)

Throttle Rigging: Preflight Checks Located on the side of the FCU is the gas producer fuel control lever quadrant on which the cutoff valve pointer sweeps. The pointer is utilized to indicate throttle angle and corresponding cockpit twist grip position. The scale range of the quadrant is marked 0, 5, 30, and 90. During preflight: (1) with the twistgrip in cutoff, check that the pointer is positioned between 0 and 5 and the gas producer lever is against it's upper stop; (2) with the twistgrip fully opened, the pointer will be at 90 with the gas producer lever is against it's lower stop; (3) with the twistgrip at the idle position, the cutoff valve opens and the pointer will indicate 30. Repeat checks with copilot twist grip: a 5/64 inch difference between twist grips is allowed below the 30 mark in the ground idle position.

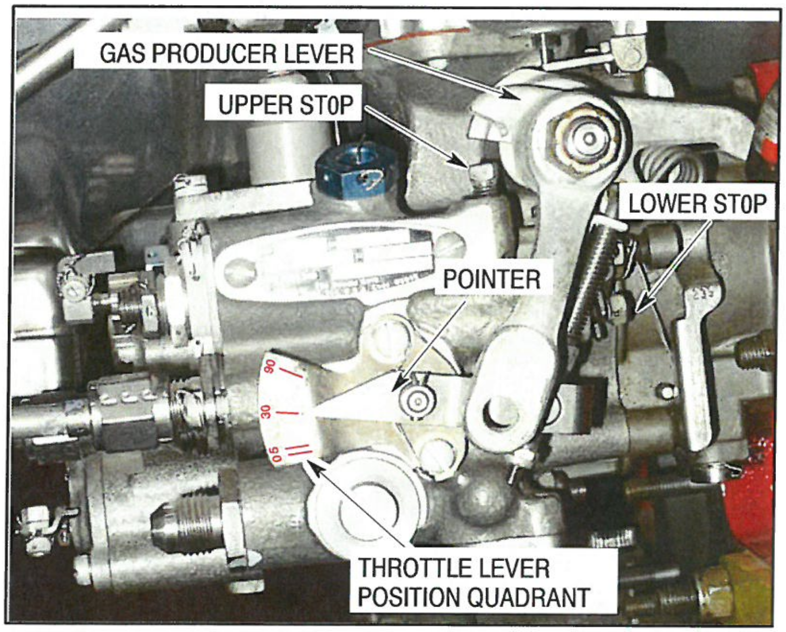

Figure 5-2. Gas Producer Lever and Pointer (Allison 250-C20 Series)

Throttle Rigging: After Starting Checks Position the throttle to the full open position; then snap the throttle to the ground idle position. Engine should not flame out. Repeat check with the co-pilot's throttle if dual controls are installed.

OPERATIONAL CHECKS - POWER TURBINE GOVERNOR

P.T. Governor Control (N_2) Power turbine governor control originates at a bellcrank attached to the collective interconnect torque tube, through an actuator and a bellcrank, push pull tube arrangement. The governor droop control adjustment is provided at the forward end of the governor beep actuator.

Governor Beep Range Check Maximum N_2 beep: ________ RPM.

Minimum N_2 beep: ________ RPM.

5-2. ENGINE CONTROLS - MD 530F-PLUS

Throttle Control (N_1) Throttle control linkage originates at the throttle twist grip on the collective control and is routed internally through the collective interconnect torque tube and a series of bellcranks, push pull tubes to the fuel control unit.

OPERATIONAL CHECKS - FUEL CONTROL UNIT (FCU)

Throttle Rigging: Preflight Checks Located on the side of the FCU is the gas producer fuel control lever quadrant on which the cutoff valve pointer sweeps. The pointer is utilized to indicate throttle angle and corresponding cockpit twist grip position. The scale range of the quadrant is marked 0, 10, 40, and 100. During preflight: (1) with the twistgrip in cutoff, check that the pointer is positioned between 0 and 10 and the gas producer lever is against it's upper stop; (2) with the twistgrip fully opened, the pointer will be at 100 with the gas producer lever is against it's lower stop; (3) with the twistgrip at the idle position, the cutoff valve opens and the pointer will indicate 40. Repeat checks with copilot twist grip: a 5/64 inch difference between twist grips is allowed below the 40 mark in the ground idle position.

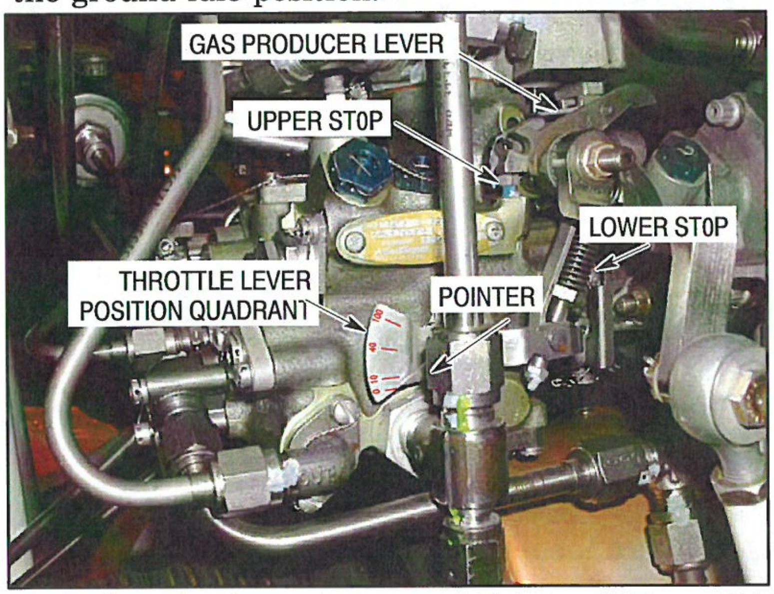

Figure 5-3. Gas Producer Lever and Pointer (Allison 250-C30)

Throttle Rigging: After Starting Checks Position the throttle to the full open position; then snap the throttle to the ground idle position. Engine should not flame out. Repeat check with the co-pilot's throttle if dual controls are installed.

OPERATIONAL CHECKS – POWER TURBINE GOVERNOR

P.T. Governor Control (N_2)

Power turbine governor control originates at a bellcrank attached to the collective interconnect torque tube, through an actuator and a bellcrank, push pull tube arrangement. The governor droop control adjustment is provided at the forward end of the governor beep actuator.

Governor Beep Range Check 530F+

Maximum N_2 beep: _______ RPM.

Minimum N_2 beep: _______ RPM.

N_2 Droop Compensation 500 Series

Generally, the the primary function of N_2 droop compensation in the model Model 500 Series helicopters is to reduce the amount of N_2 droop by mechanically increasing the preset governor speed when the collective is rapidly increased, and provides a certain amount of N_2/N_R overspeed protection when the collective is rapidly lowered by decreasing the preset governor speed.

NOTE: Preset governor speed for the **500D/E** should increase _______ once helicopter is airborne.

NOTE: Preset governor speed for the **530F Plus** should increase _______ once helicopter is airborne.

NOTES: ____

____

____

____

____

____

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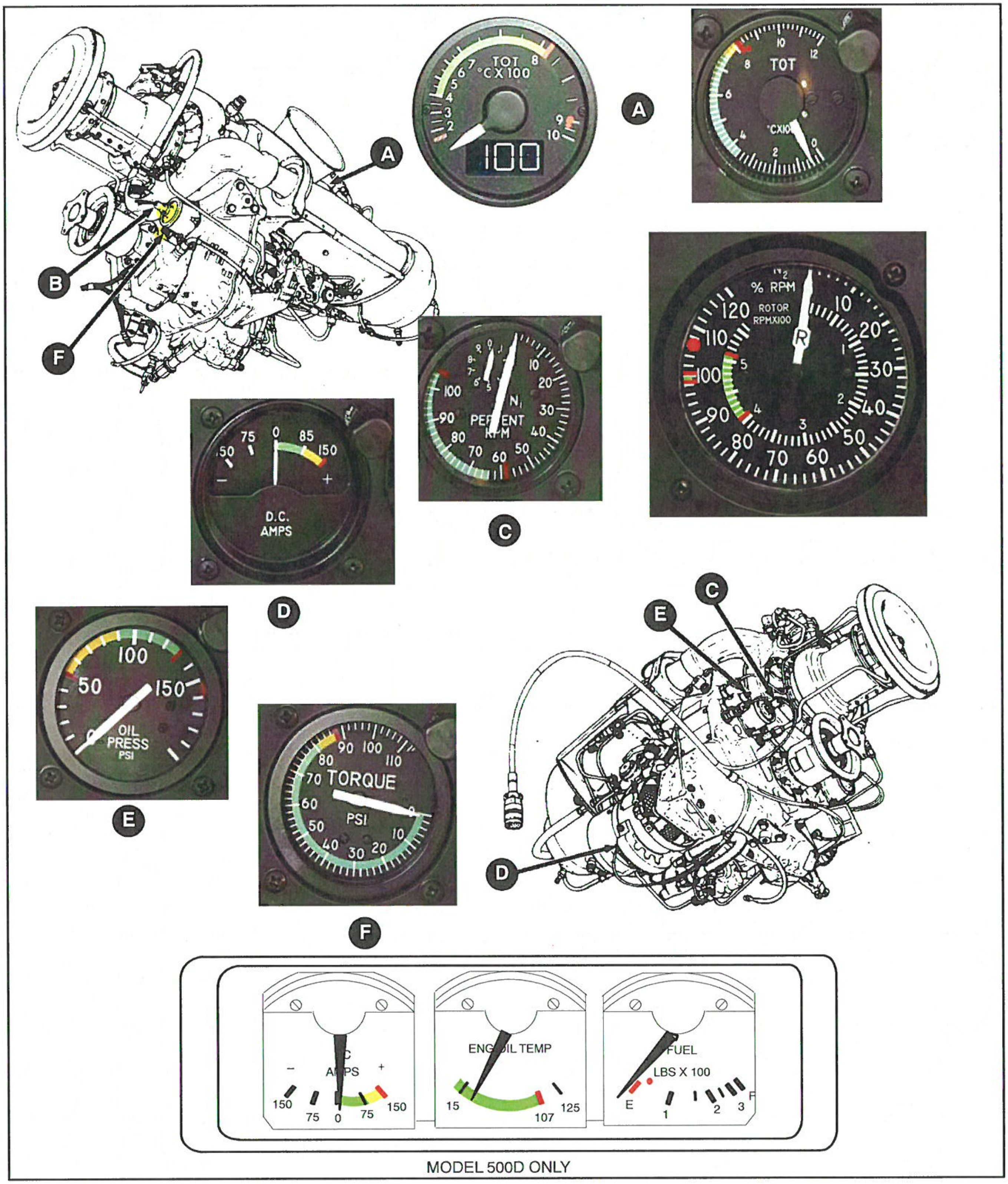

Figure 5-4. Instrumentation - 250-C20 Series

5–3. INSTRUMENTATION

Gauges Turbine outlet temperature - C20B has red dot at 843°C

Power turbine tachometer

Gas producer tachometer

Engine oil pressure

Engine oil temperature

Torque meter - C20B has blue dot at 74.3 PSI

Fuel quantity indicator

Electrical ammeter

NOTES:

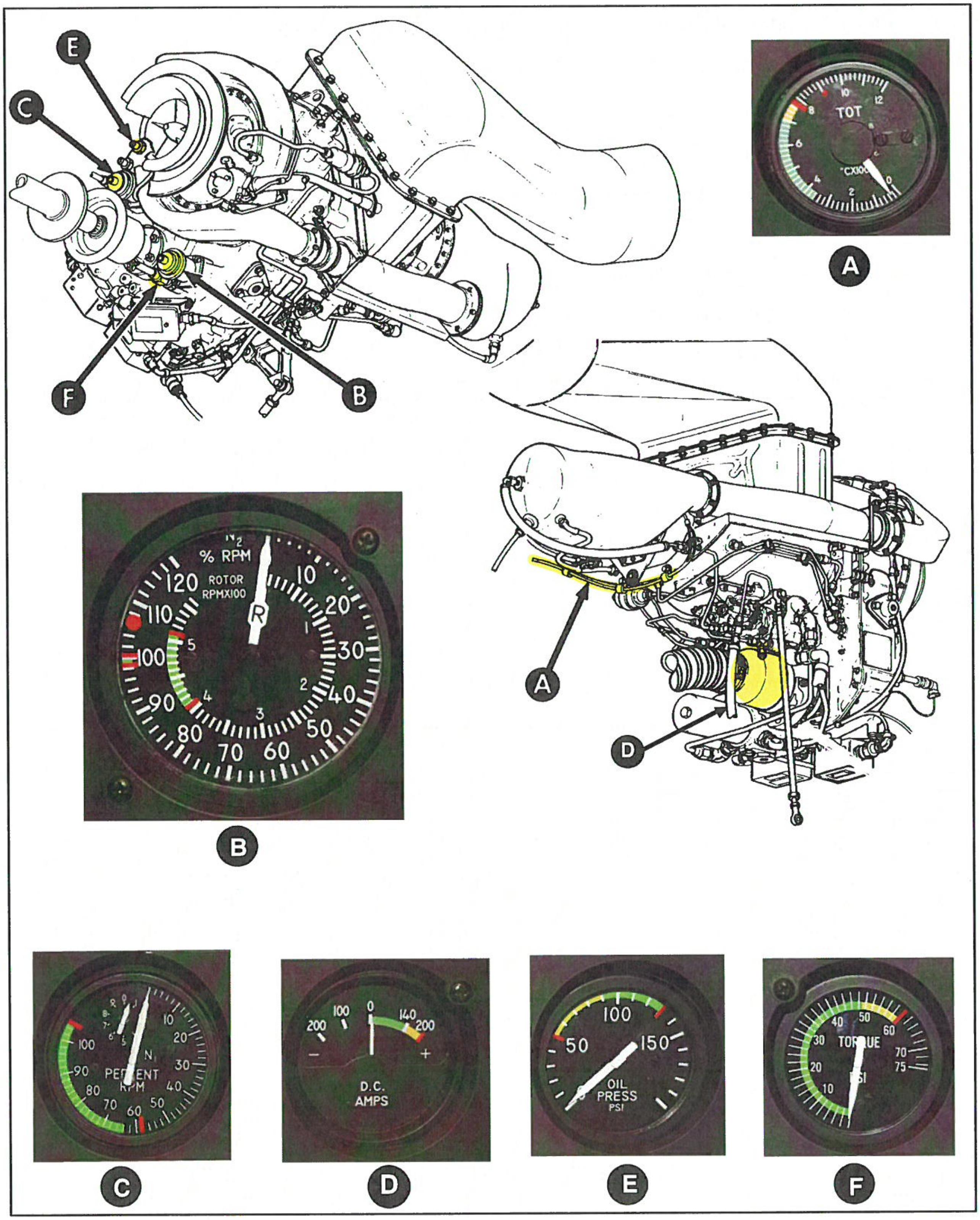

Figure 5-5. Engine Instrumentation: Allison 250-C30

5-4. INSTRUMENTATION - 250-C30

Gauges
- Turbine outlet temperature
- Power turbine tachometer
- Gas producer tachometer
- Engine oil pressure
- Engine oil temperature
- Torque meter
- Fuel quantity indicator
- Electrical ammeter

NOTES:

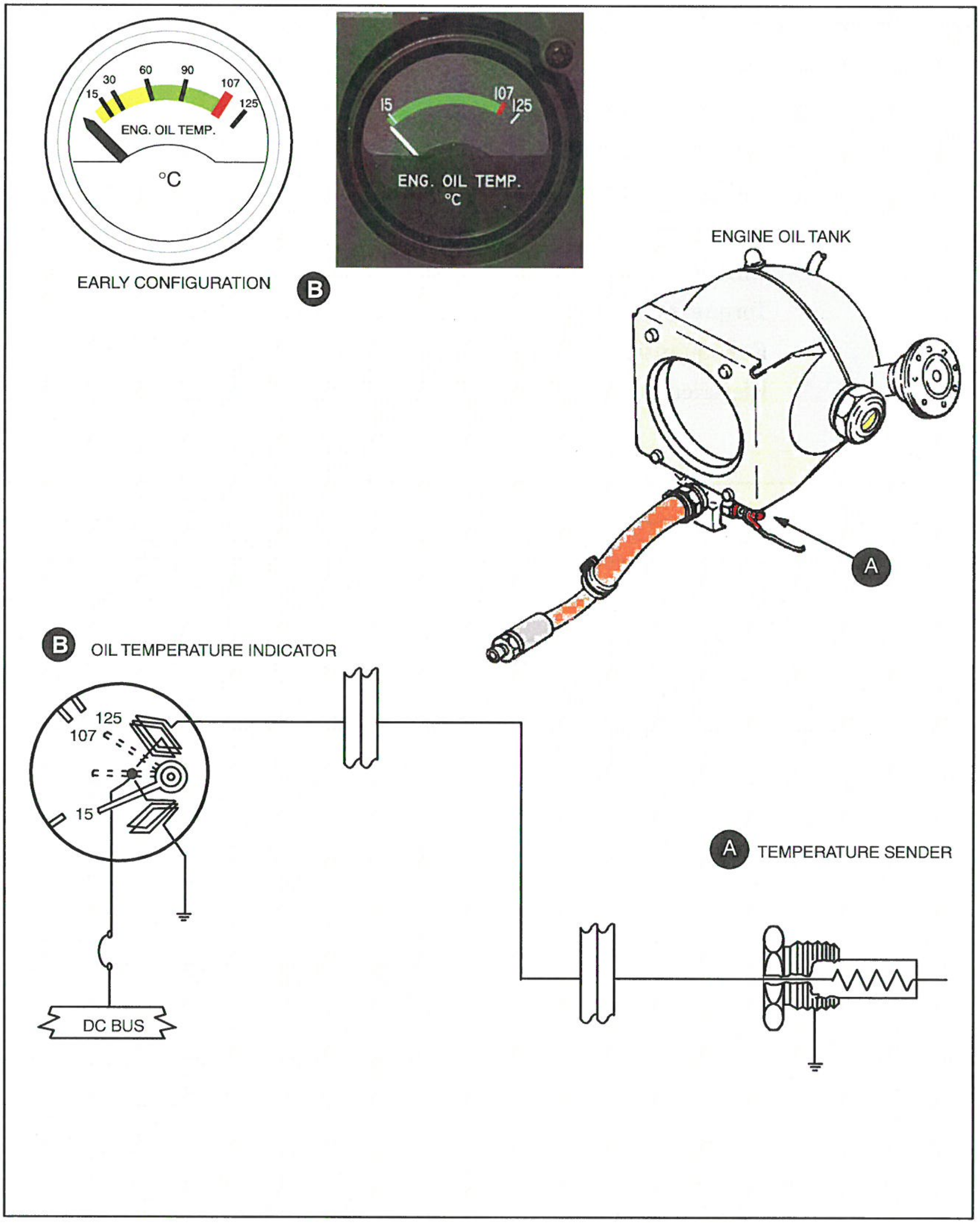

Figure 5–6. Engine Oil Temperature Indicating

5–5. ENGINE OIL TEMPERATURE INDICATING

General The engine oil temperature indicator, marked **ENG OIL TEMP**, electrically measures engine oil temperature with a thermally controlled variable resistance sender unit installed at the outlet of the engine oil tank. Indicator calibration is in degrees centigrade.

NOTES: ____

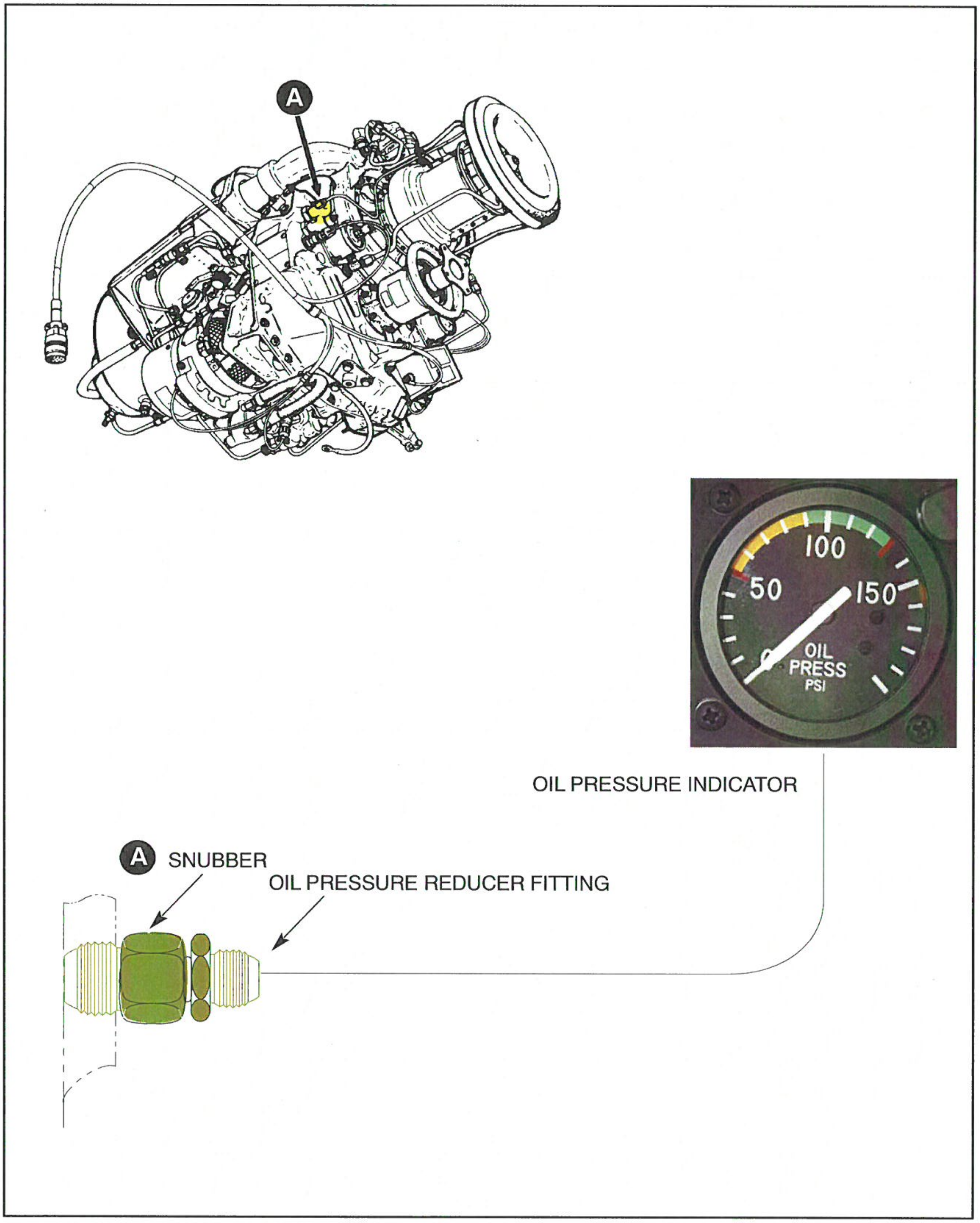

Figure 5-7. Engine Oil Pressure Indicating System

5-6. ENGINE OIL PRESSURE INDICATING SYSTEM

Description and Operation

The direct reading engine oil pressure indicating system utilizes a pressure gauge of 0 to 150 psi capacity that is mounted near other engine instruments in the instrument panel. The gauge is connected to an oil pressure port on the front face of the engine accessory section by a snubber and reducer fitting and 1/8 inch diameter corrosion resistant steel and nylon tubing.

The snubber acts as a flow restricting device should any of the tubing to the gauge fail. The tubing is in two sections, with corrosion resistant steel being used aft of the engine firewall and nylon tubing from the firewall to the instrument panel. Tie straps and clamping arrangements are common to both systems.

NOTES: ______

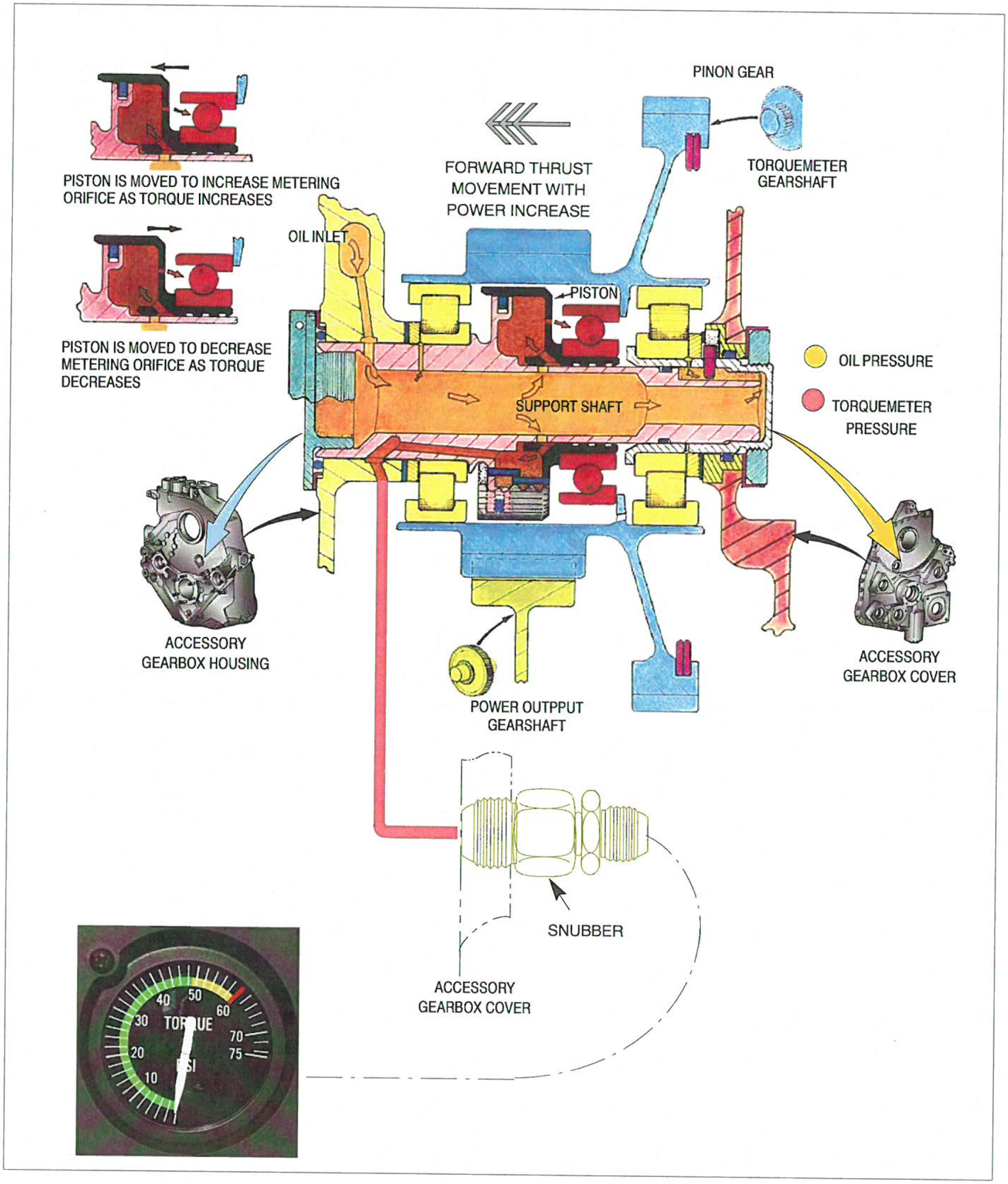

Figure 5–8. Engine Torque System

5–7. TORQUE METER

Description and Operation

The torque meter gear shaft is incorporated in the accessory gearbox to provide a hydraulic pressure signal which is directly proportional to output torque. The power turbine gear train has two stages of helical gearing. The first stage reduction is accomplished by the helical power train drive gear driving the larger diameter gear on the helical torque meter gearshaft. The second stage reduction is accomplished by the smaller diameter gear on the helical torque meter gearshaft driving the helical power takeoff gearshaft. Helix angles are such that both stages of reduction produce a forward axial thrust on the helical to torque meter gearshaft. If friction is neglected, this axial thrust is directly proportional to the torque transmitted through the gears. The torque meter assembly incorporates two roller bearings which provide radial support for the helical torque meter gears shaft, but which allows axial movement.

As in the engine oil pressure indicating system, the gauge is connected to an oil pressure port on the front face of the engine accessory section by a snubber and reducer fitting and 1/8 inch diameter corrosion resistant steel and nylon tubing.

NOTES: ____

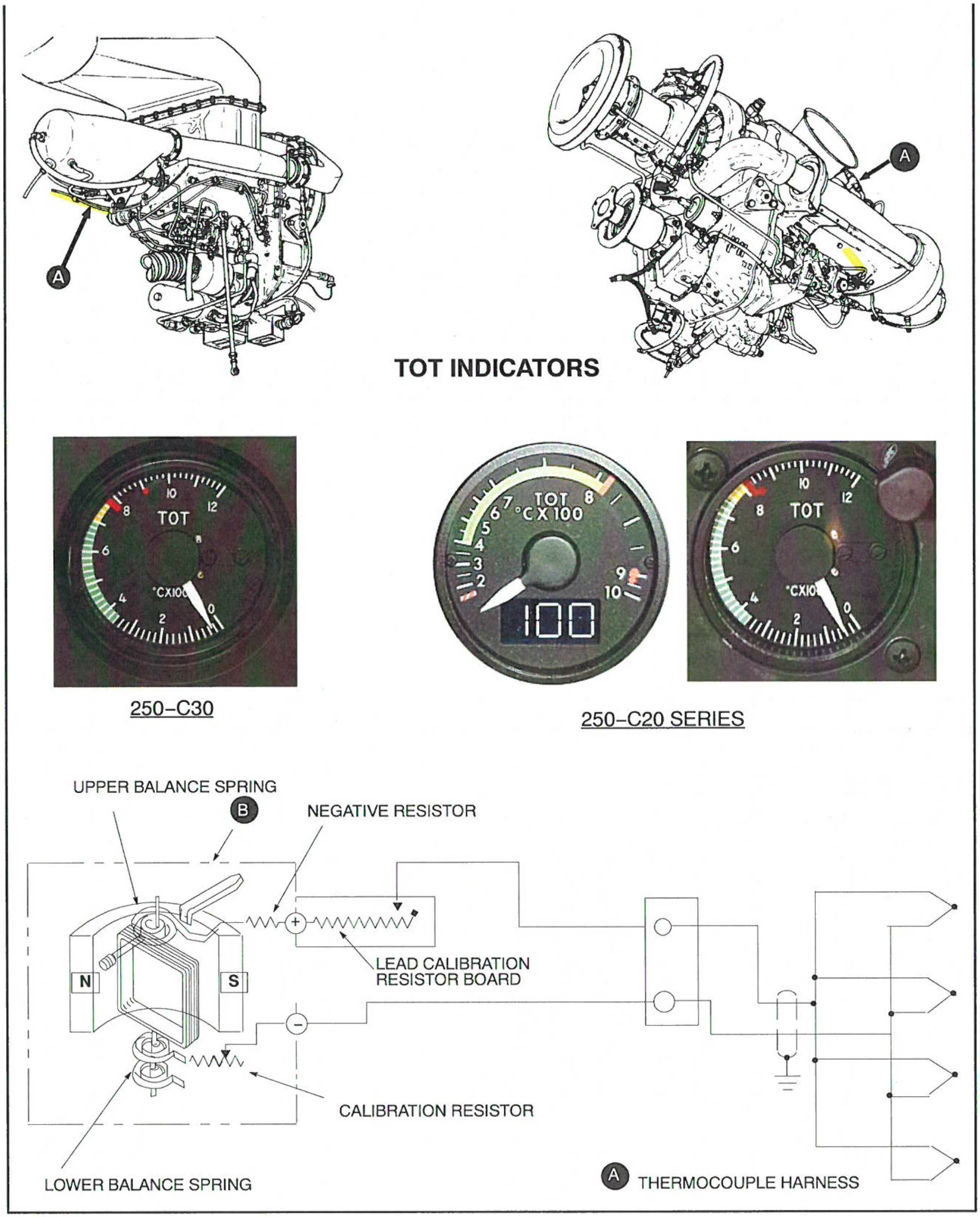

Figure 5–9. Turbine Outlet Temperature Indicating System

5-8. TOT INDICATING SYSTEM

Description and Operation

The turbine outlet temperature indicating system provides an indication of the "operating temperature" of the engine. Turbine outlet temperature (TOT) is sensed by a thermocouple network and the operation is based upon the principle that a small voltage is created when certain dissimilar metals are placed in contact with one another. The magnitude of the voltage is dependent upon the temperature at the junction of the two metals. The thermocouple probes employ chromel and alumel as active materials, because of their ability to withstand high temperature. It is possible to connect two or more thermocouple junctions in parallel to a single indicator and obtain an average temperature at all junctions.

Thermocouple Harness

The turbine outlet temperature thermocouple harness for the Allison turboshaft engine consists of four thermocouples permanently attached to the leads and harness. The probe wires are insulated with mineral oxide powder and supported in an Inconel tube. The leads and harness wires are insulated by fiberglass with a stainless steel braid cover.

TOT Indicator

The TOT indicator is housed within a hermetically sealed case. Screw terminals are provided for the attachment of the thermocouple leads to the indicator. A calibration adjustment screw is also located on the rear of the case.

The overall resistance of the indicator must remain constant if system accuracy is to be expected. A carbon resistor is connected in series with the copper moving coil. A rise in ambient temperature will cause the copper's resistance to increase, but the carbon's resistance will decrease, thus providing a stable indicator resistance.

TOT LIMITATIONS

Maximum Continuous:____________________

Transient Limits (during power changes in flight) ____________________

During starting ____________________

____

____

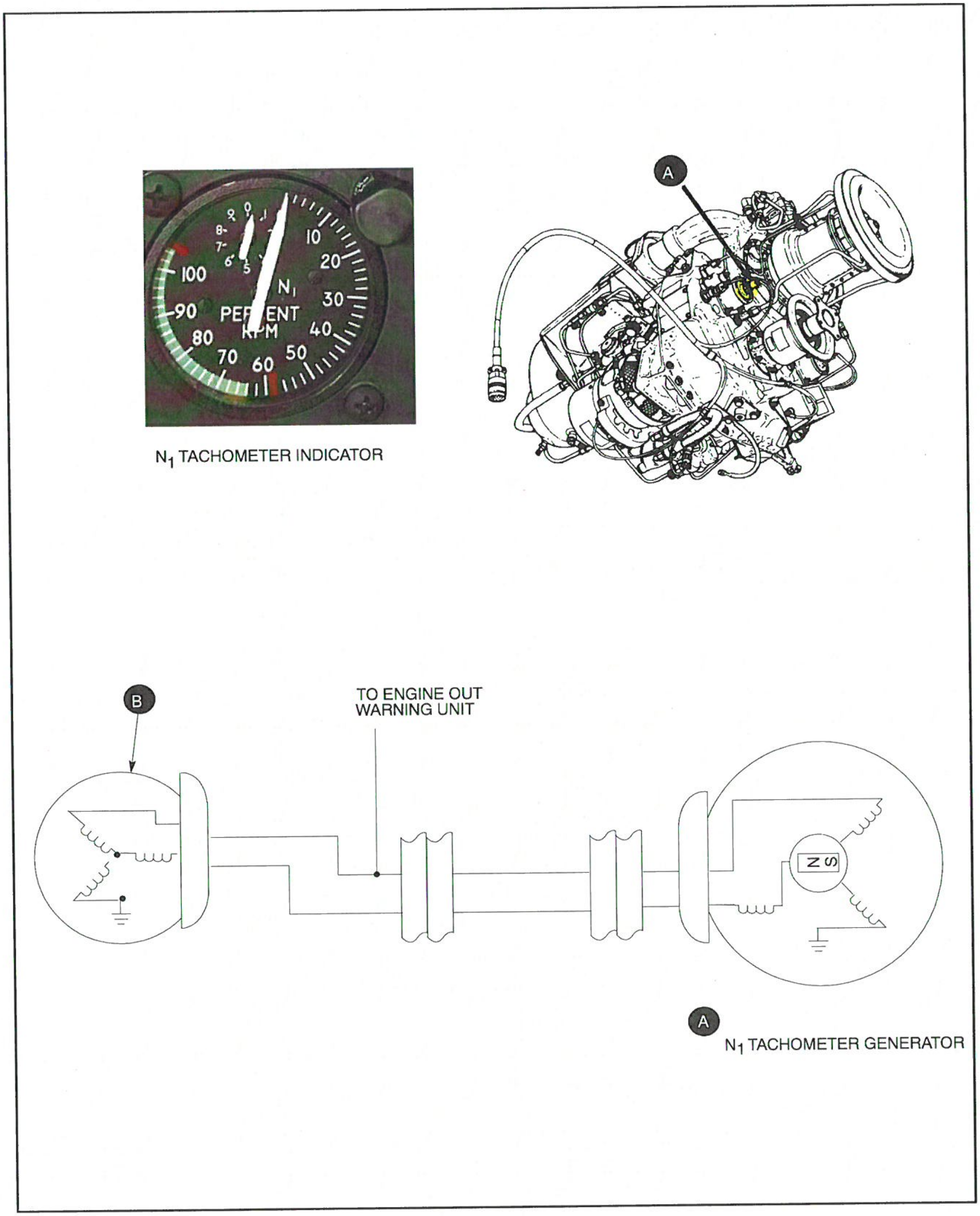

Figure 5–10. N_1 Indicating

5-9. N_1 INDICATING

Description and Operation

The N_1 tachometer system is provided to give the pilot visual indication of engine N_1 gas producer speed. The system consists of one indicator mounted on the instrument panel, and a flange-mounted tachometer generator attached to the right front side of the engine accessory gearbox. The tachometer generator is driven mechanically by the N_1 gear train, and produces 3-phase ac electrical power which is transmitted to a synchronous motor inside the indicator unit. As the speed of the N_1 gear train changes, the speed of the tachometer generator changes, causing a corresponding change in the speed of the synchronous motor of the indicator.

The face of the instrument is calibrated in percent of rpm, (0 to 100) in increments of 2 percent. A smaller dial, which is graduated from 0 to 10 percent, is located in the upper left portion of the indicator. This pointer provides a vernier reading between each 10 percent, thus the smaller pointer will make one complete rotation for every 10 percent indication on the large pointer.

NOTES:

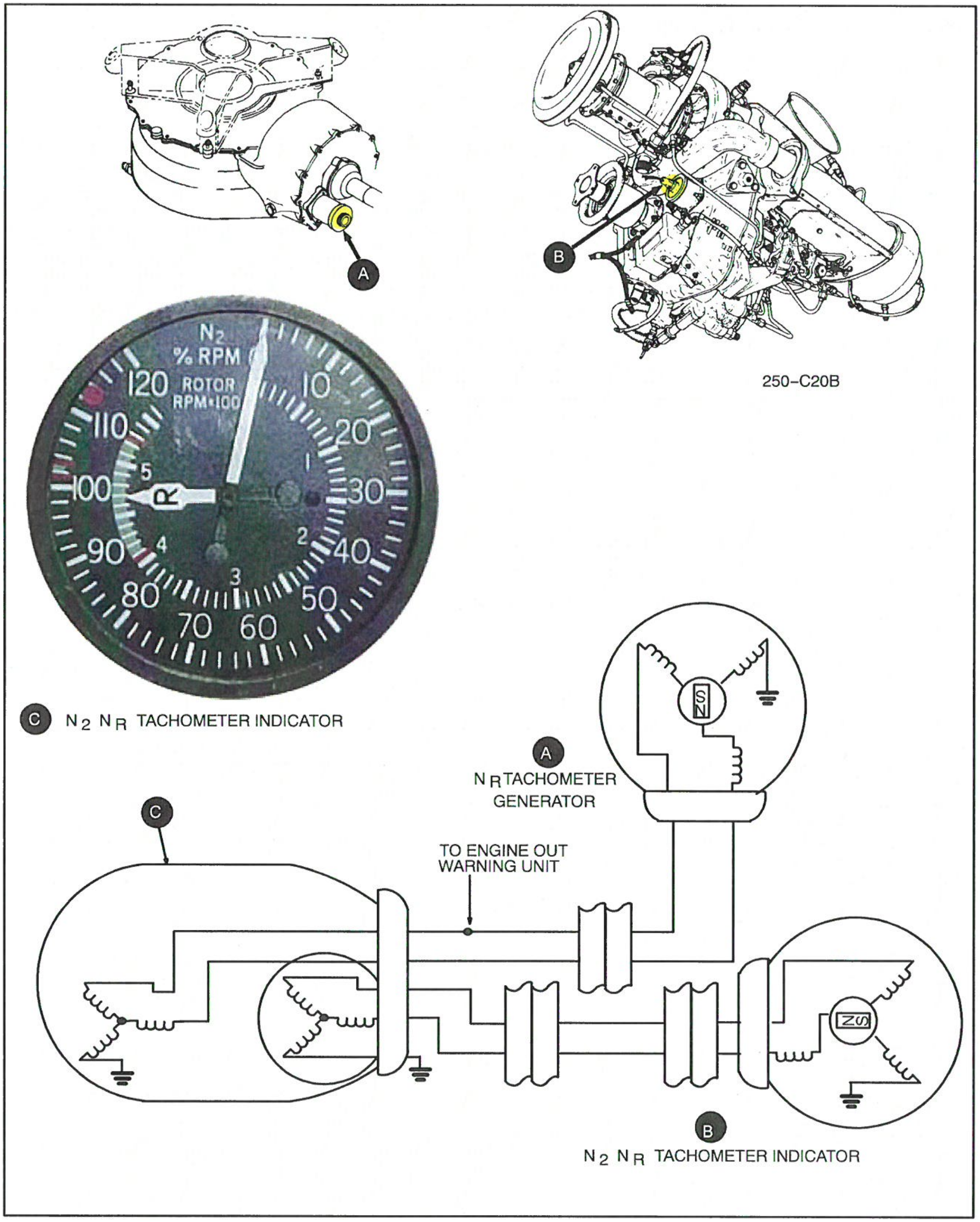

Figure 5-11. N_2 – N_R Tachometer System 500D/E

5-10. N_2 - N_R TACHOMETER

Tachometer Indicator

The N_2 - N_R tachometer indicator has two dial scales and two concentrically mounted pointers which operate independently of each other. The outer scale (N_2) indicates percent of rpm of the power turbine, while the inner scale (N_R) indicates the actual main rotor rpm.

The N_2 tachometer indicator is activated by an ac signal developed by the N_2 tachometer generator mounted on the left hand side of the engine accessory gearbox.

Tachometer Generator

The N_2 tachometer generator is driven mechanically by the N_2 gear train, and produces 3-phase ac electrical power which is transmitted to a synchronous motor inside the indicator unit. As the speed of the N_2 gear train changes, the speed of the tachometer generator changes, causing a corresponding change in the speed of the synchronous motor of the indicator. The N_R tachometer indicator is operated in an identical manner by the N_R tachometer generator mounted at the rear of the main rotor transmission.

NOTES:

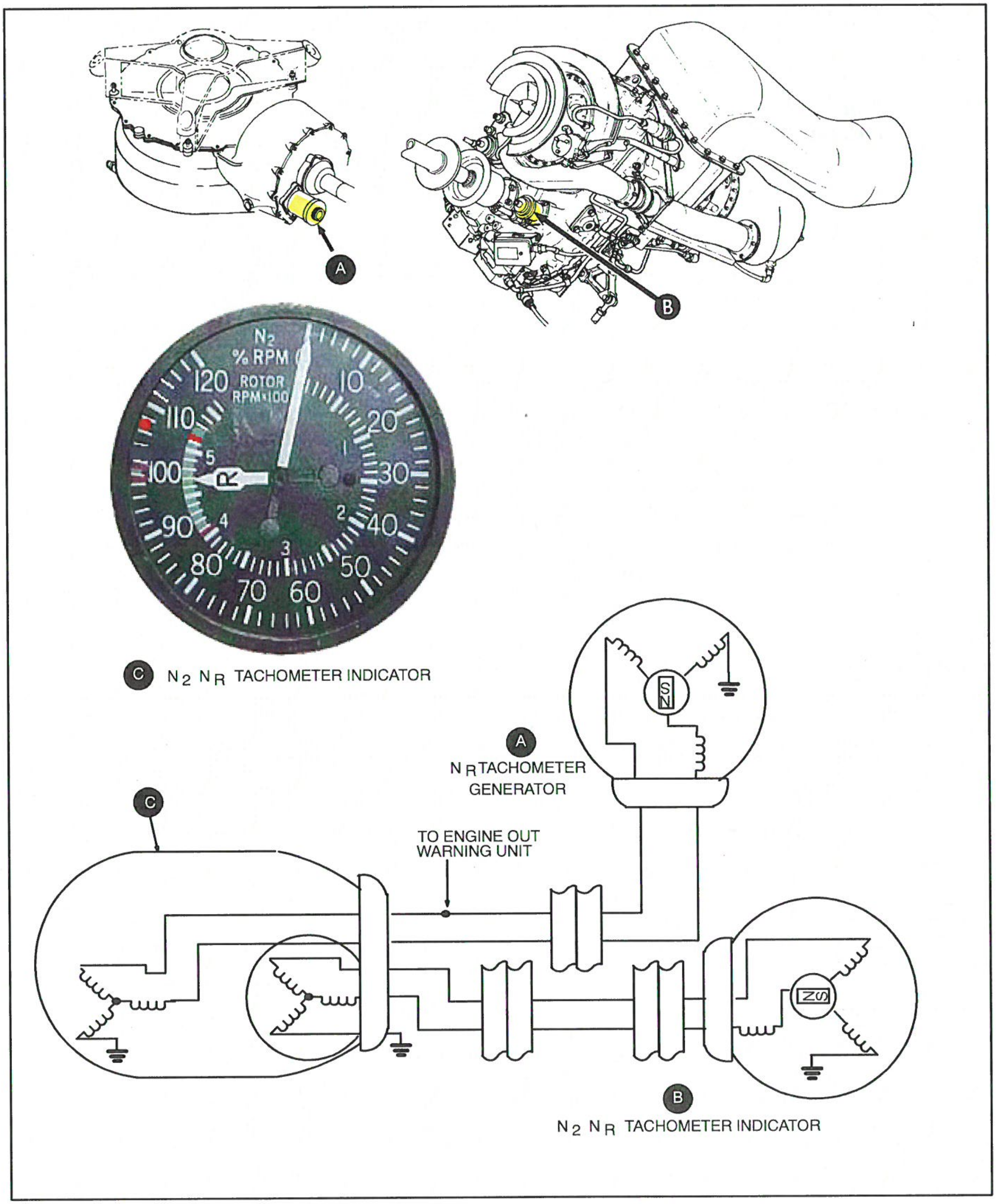

Figure 5-12. N_2 – N_R Tachometer System – 530F Plus

5–11. N_2 - N_R TACHOMETER - 530F PLUS

Tachometer Indicator

The N_2 - N_R tachometer indicator has two dial scales and two concentrically mounted pointers which operate independently of each other. The outer scale (N_2) indicates percent of rpm of the power turbine, while the inner scale (N_R) indicates the actual main rotor rpm.

The N_2 tachometer indicator is activated by an ac signal developed by the N_2 tachometer generator mounted on the left hand side of the engine accessory gearbox.

Tachometer Generator

The N_2 tachometer generator is driven mechanically by the N_2 gear train, and produces 3-phase ac electrical power which is transmitted to a synchronous motor inside the indicator unit. As the speed of the N_2 gear train changes, the speed of the tachometer generator changes, causing a corresponding change in the speed of the synchronous motor of the indicator. The N_R tachometer indicator is operated in an identical manner by the N_R tachometer generator mounted at the rear of the main rotor transmission.

NOTES:

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HELICOPTERS

MD 500 Pilot Transition Training Manual

SECTION VI
LUBRICATION SYSTEM

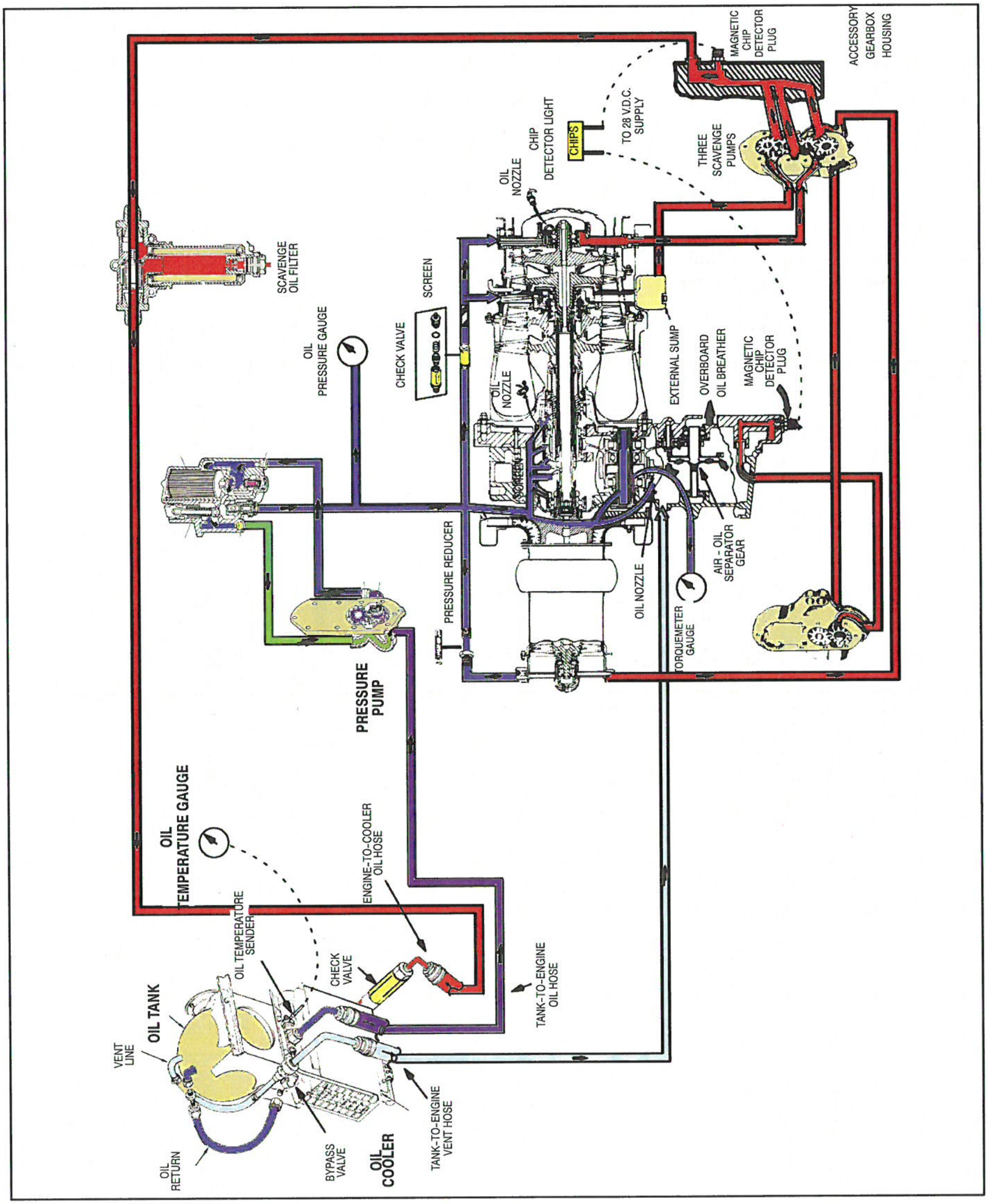


Figure 6–1. Engine Lubrication System Schematic

6-1. ENGINE LUBRICATION SYSTEM

Description

The lubrication system is a circulating dry sump type with an external oil tank and oil cooler both, of which, are mounted and furnished by the helicopter manufacturer. This system is designed to furnish adequate lubrication, scavenging, and cooling as needed for bearings, splines, and gears regardless of helicopter attitude or altitude. Jet lubrication is provide to all compressor, gas producer turbine, and power turbine rotor bearing, and to bearings and gear meshes of the power turbine gear with the exception of the power output shaft bearings. The power output shaft bearings and all other gears and bearings are lubricated by oil mist.

Engine oil capacity is _____ quarts (2.84 liters)

Oil Pump and Filters

A spur gear type oil pump assembly, consisting of one pressure element and four scavenge elements, is mounted within the accessory gearbox. An assembly, consisting of an oil filter, filter bypass valve, and pressure regulating valve, is located in the upper left hand side of the accessory gearbox. A check valve is located in the oil filter outlet passage.

An additional airframe-mounted scavenge oil filter is installed in the oil return line to the engine oil cooler.

Oil Pressure Limits

50 - 130 psi with the following minimums:

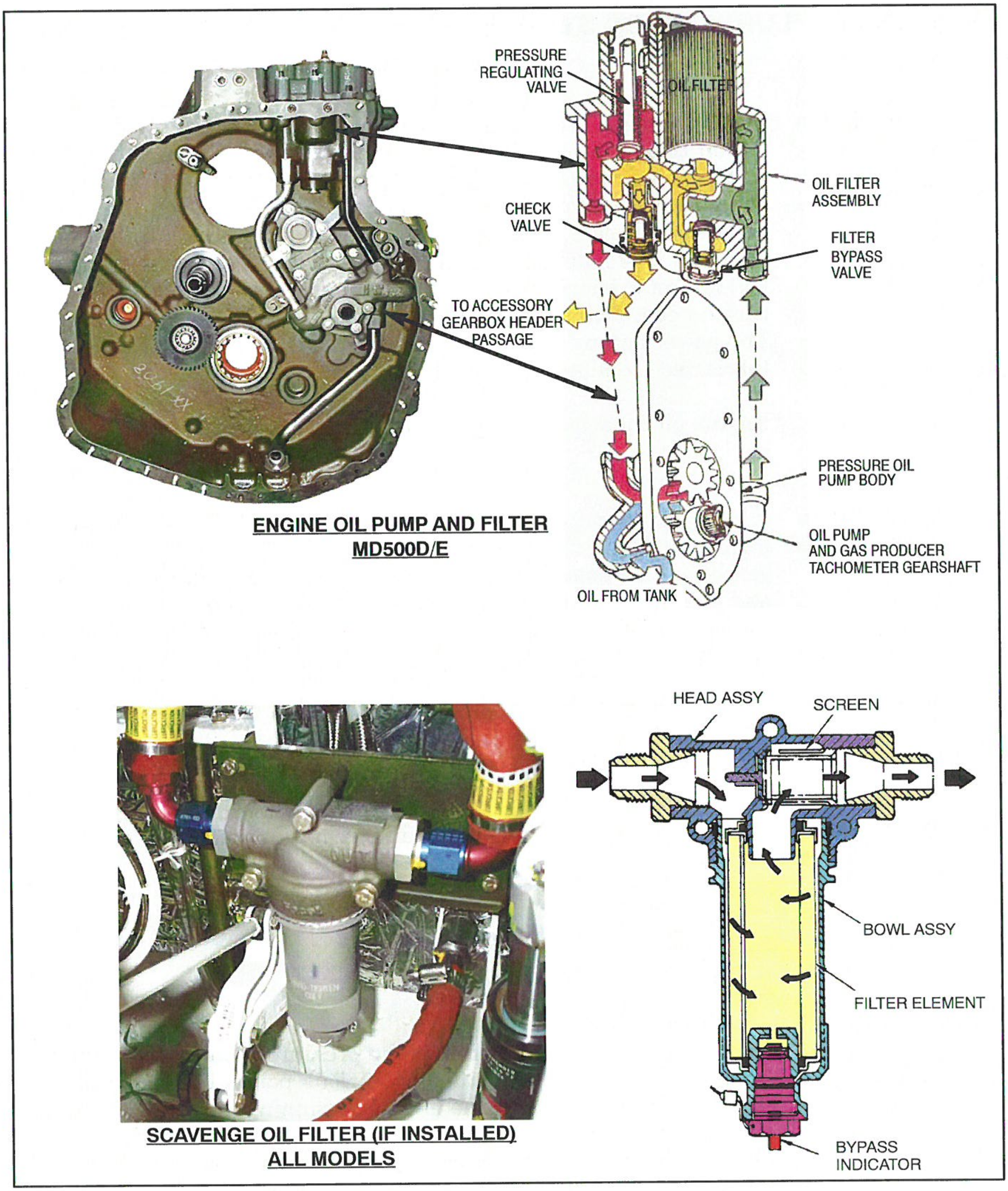
_____ psi when below 79 percent N_1.

_____ psi at 79 percent N_1

_____ psi at 94 percent N_1 and above.

Oil Distribution

Oil from the tank is delivered to the pressure pump which pumps oil through the oil filter and then to various points of lubrication. The check valve is open when the engine is running, and closed when engine is not in operation. The system oil pressure is regulated to 130 psig by the pressure regulating valve. The oil pressure is regulated to this relatively high value in order to balance high axial gear thrust in the torque meter. This high thrust value is necessary to minimize friction effects and provide accurate measurement of torque.



ENGINE OIL PUMP AND FILTER
MD500D/E

SCAVENGE OIL FILTER (IF INSTALLED)
ALL MODELS

Figure 6-2. Engine Oil Pump/Filter and Scavenge Oil Filter

6-2. ENGINE OIL PUMP AND FILTER - MD500D/E

Oil Pump A gear type pressure pump is mounted within the accessary gearbox and receives its drive from the gas producer gear train. Oil from the oil supply tank is delivered to the oil inlet port on the gearbox, and then through an internal oil transfer tube to the inlet side of the pressure pump. The pressure element delivers oil through an internal oil transfer tube to a filter.

Oil Filter The oil filter will remove particles as small as 81-microns. Normally, all the oil flows through the filter to the pressure regulating valve and the inlet check valve. As oil flows through the oil filter there will be a slight drop in pressure; as the filter picks up contamination, the pressure drop across the filter will increase. In the event of heavy filter contamination, the bypass valve will open, bypassing the filter. Filtered oil passes through a check valve into the accessory gearbox main pressure header passage. The check valve is not a physical part of the oil filter, but is attached fo the pressure outlet port. When the engine is not in operation, the spring loaded check valve will close to prevent the oil supply tank from draining into the engine. It is opened by a differential pressure of 2 to 3.5 psi.

6-3. SCAVENGE (FACET) OIL FILTER

Description and Operation The scavenge oil filter is installed in the return line between the engine and oil cooler. The scavenge filter supplements the engine oil filter and provides the capacity to keep the oil clean enough to operate 200 hours between changes. In addition, oil system component inspection and cleaning frequency may be extended to 200 operating hours as opposed to 100 hours.

The 10 micron filter element keeps otherwise recirculated microscopic carbon and metal particles from accumulating in the cooler, supply tank, engine or on magnetic plugs.

The filter body is equipped with a bypass valve and red impending bypass warning indicator that extends when differential pressure across the filter element reaches 6 - 8 psid. The indicator is inoperative until the oil temperature exceeds 85 - 115°F. The filter bypass valve opens at 9 - 11 psid.

Scavenge Oil Filter Check Inspect red bypass indicator button on bottom of filter bowl. Button extension indicates a filter element impending bypass condition. Press and turn indicator button 90° to reset.

Operate engine per Pilot's Flight Manual until engine oil reaches normal operating temperature.

Shut down engine. Check indicator button.

If button has reappeared, investigate cause of filter bypass condition per the applicable Allison Operation and Maintenance Manual.

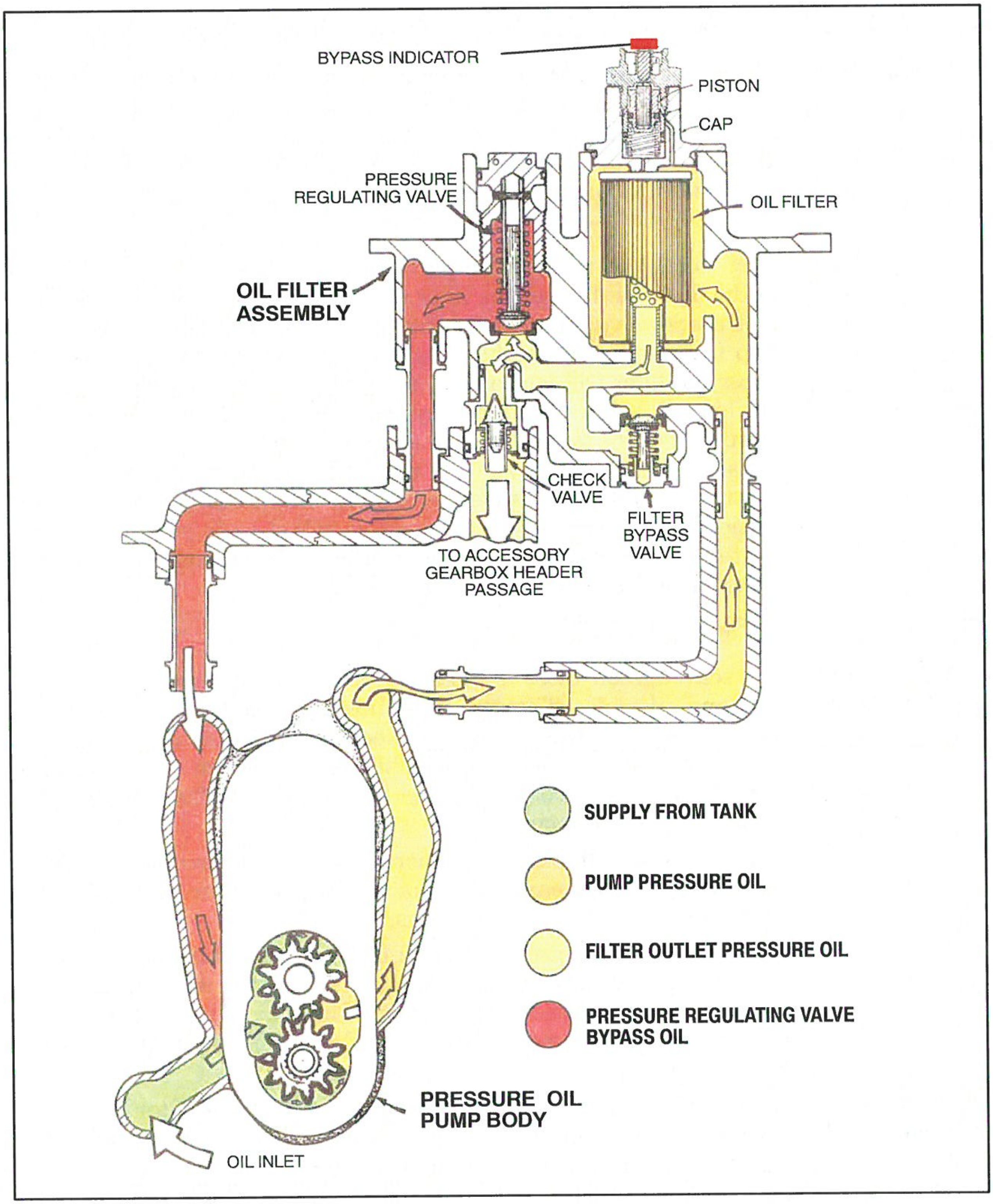


Figure 6–3. Pressure Oil Pump and Filter 530F–Plus Only

6-4. ENGINE OIL PUMP AND FILTER - MD530F-PLUS

Oil Pump A gear type pressure and scavenge pump assembly, consisting of one pressure element and four scavenge elements, is mounted within the accessory gearbox. This pump assembly has three levels of gears which are numbered from front to rear. The first level has four gears which are housed in the scavenge oil pump body and covered by the pump cover. The second level has two gears which are housed in the scavenge oil pump body and covered by a separator. The third level has two gears which are housed in the pressure oil pump body and covered by a separator.

Oil Filter Oil from the pump is directed to the filter and to the filter bypass valve. Normally, all the oil flows through the filter and to the oil pressure regulating valve and to the check valve. The filter bypass valve is in parallel with the oil filter. As oil flows through the filter, there will be a slight drop in pressure and as the filter picks up combination from the oil, the pressure drop across the filter increases. In the event of abnormal filter contamination, the filter bypass valve will open and oil bypasses the filter. To help determine oil filter contamination, a visual indicator is located in the oil filter cap. This is a pressure differential pressure indicator that with a 25 ± 15 percent PSID a red button extends 3/16". There is a thermal lockout below 120 degrees F oil temperature. Filtered oil is delivered through the check valve and into the accessory gearbox header passage which distributes the oil. The check valve is not a physical part of the oil filter assembly. When an engine is not in operation, the check valve is spring loaded closed to prevent the oil supply tank from draining into the engine.

NOTES: ______

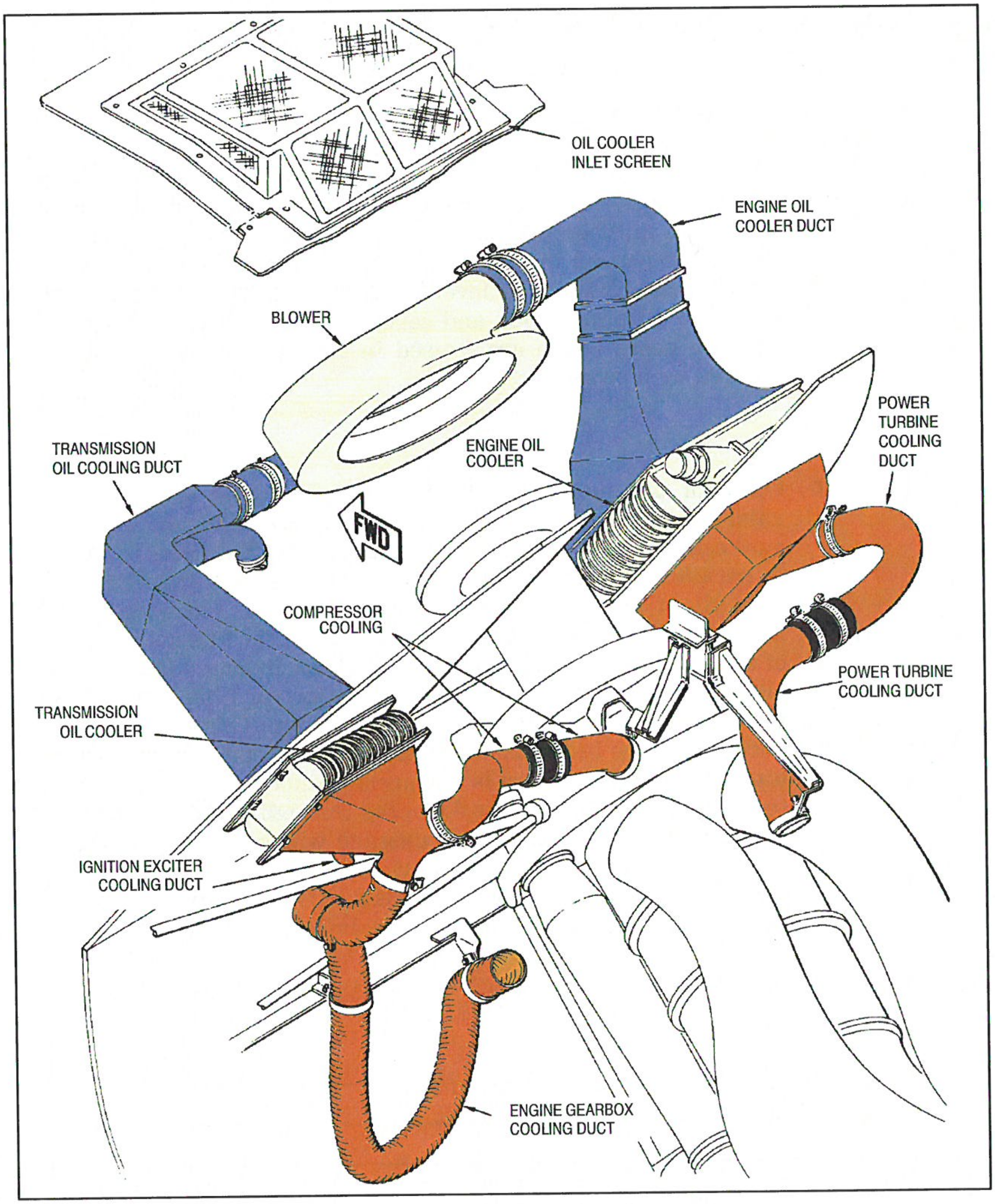


Figure 6-4. Heat Rejection System

6-5. HEAT REJECTION SYSTEM

Description and Operation

The engine lubricant heat rejection system consists of an air inlet screen, located within the airframe air inlet fairing, and oil cooler blower (impeller and scroll) belt-driven from the main transmission input gearshaft, and interconnecting ducting.

Ambient air enters the air inlet screen and flows into the oil cooler blower. The airflow is increased in velocity and pressure by the impeller, and is ducted to and through the center cooling core fins of an airframe mounted engine oil cooler. The exiting airflow from the cooling fins vents rearward into the engine compartment.

The oil cooler blower also provides a duct distributed constant airstream to the transmission oil cooler, engine accessory gearbox housing, and the compressor section. The combined engine cooling airflow and oil cooler airflow exits from the engine compartment through gaps provided around and between the engine exhaust pipes and the engine access door.

NOTES:

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HELICOPTERS

MD 500 Pilot Transition Training Manual

SECTION VII
FUEL SYSTEM

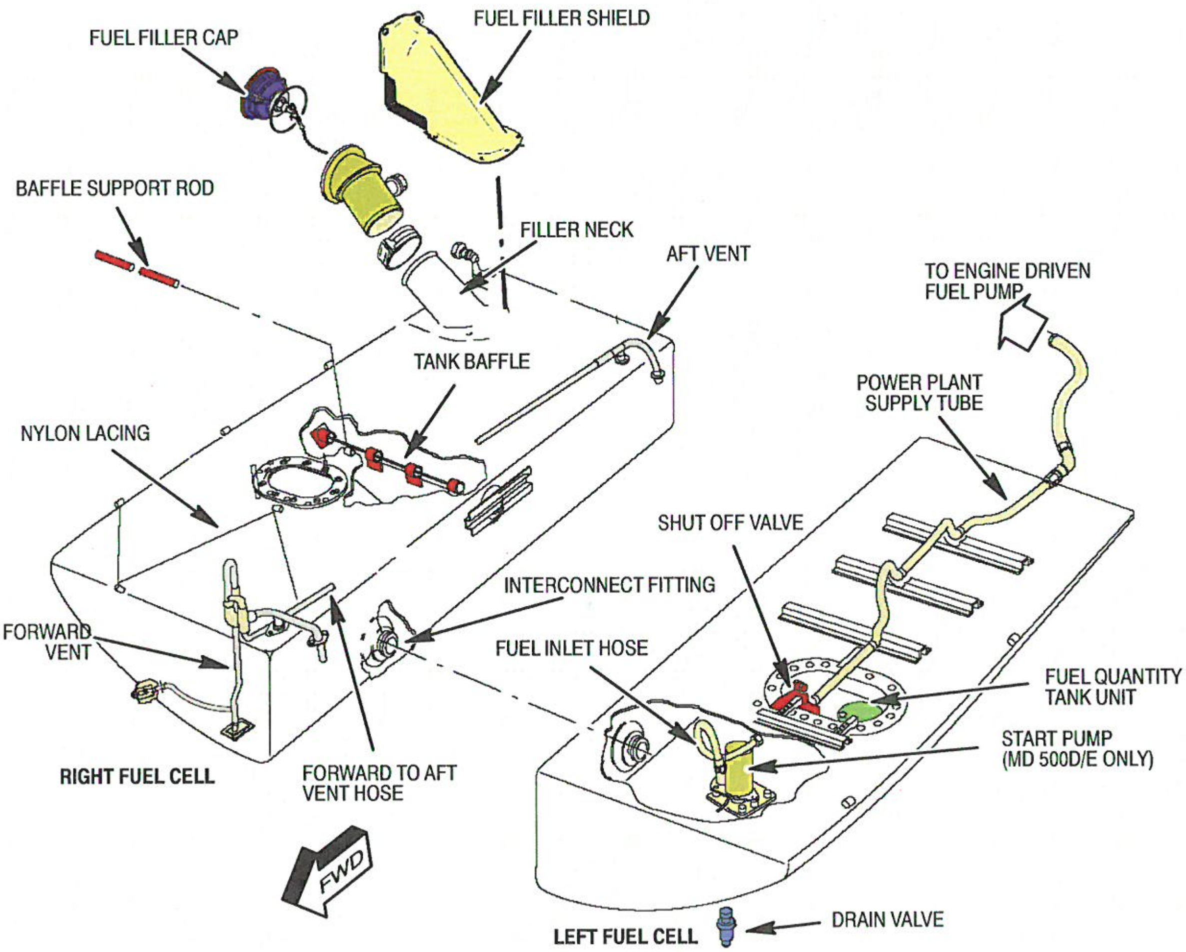

Figure 7–1. Airframe Fuel System

7-1. GENERAL

Description

The MD 500 Series helicopter fuel supply system is a suction type (nongravity feed) system that consists of two interconnected main fuel cells, located in separate compartments beneath the cargo/passenger floor.

Both fuel cells are vented to atmosphere through a manifolded vent system, to the underside of the aircraft structure and are serviced through a common filler neck on the right hand side of the fuselage.

The cells are seated on a single-ply fiberglass liner that is rivet-attached to the fuselage lower section ribs. The liner provides a load distribution surface across the rib structure. In addition to providing load distribution, each cell is afforded overhead lacing support to prevent movement or collapsing. Approximately 15 feet of 3/16 inch nylon cord is routed through eye loops on the cells top surfaces to the mating fuselage eye receptacles, to support and retain the cells.

Additional Components

Forward and aft vents
Drain valves - fuel tank sump and on anti-ice fuel filter (if installed)
Engine start pump
Fuel shutoff control and valve
Engine-driven fuel pump
Fuel quantity indicating system,
Filler neck with an extended range cell fuel line connection and various interconnecting lines and associated electrical wiring.

Capacity - JET A

Standard non self-sealing tanks:
Capacity is 64.0 U.S. gallons (242 liters), 435.0 pounds.
Usable fuel is 62.1 U.S. gallons (235 liters), 421.9 pounds.

Capacity - JET B

Standard non self-sealing tanks:
Capacity is 64.0 U.S. gallons (242 liters), 416.0 pounds.
Usable fuel is 62.1 U.S. gallons (235 liters), 403.5 pounds.

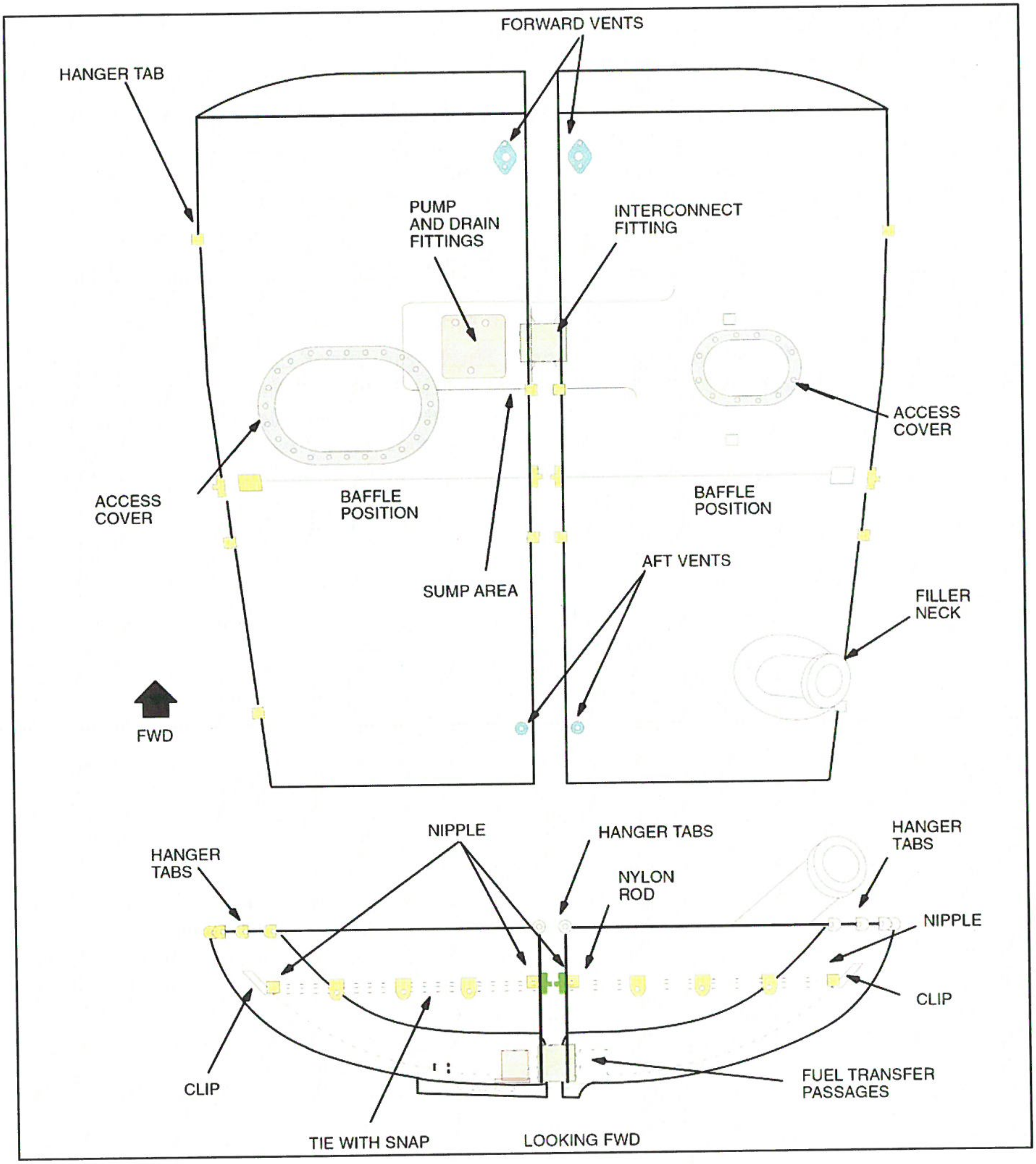

Figure 7-2. Fuel Cell Construction

7–2. FUEL CELL

Cell Construction The two fuel cells are of the conventional synthetic rubber type. Each cell is constructed on a building fixture and consists of a nylon fabric retainer impregnated with synthetic rubber, a barrier of nylon film, a liner of synthetic rubber, and a finish of synthetic rubber vinyl–like coating.

Baffles Both fuel cells incorporate an intercell nylon baffle curtain laterally spanning the interior of each cell, providing a surge barrier. Each cell baffle curtain is supported by a nylon rod at the top of each baffle and is retained by three tabs integral with the curtain.

Fuel Cell Drain Valve Located in the bottom of the left fuel cell is a mounting pad for the start pump and engine fuel supply lines. A drain valve threads into a center threaded boss of this mounting pad and protrudes downward, passing through the lower fuselage skin. The drain valve consists of a spring loaded plunger that is depressed to open and spring loaded to close.

NOTES:

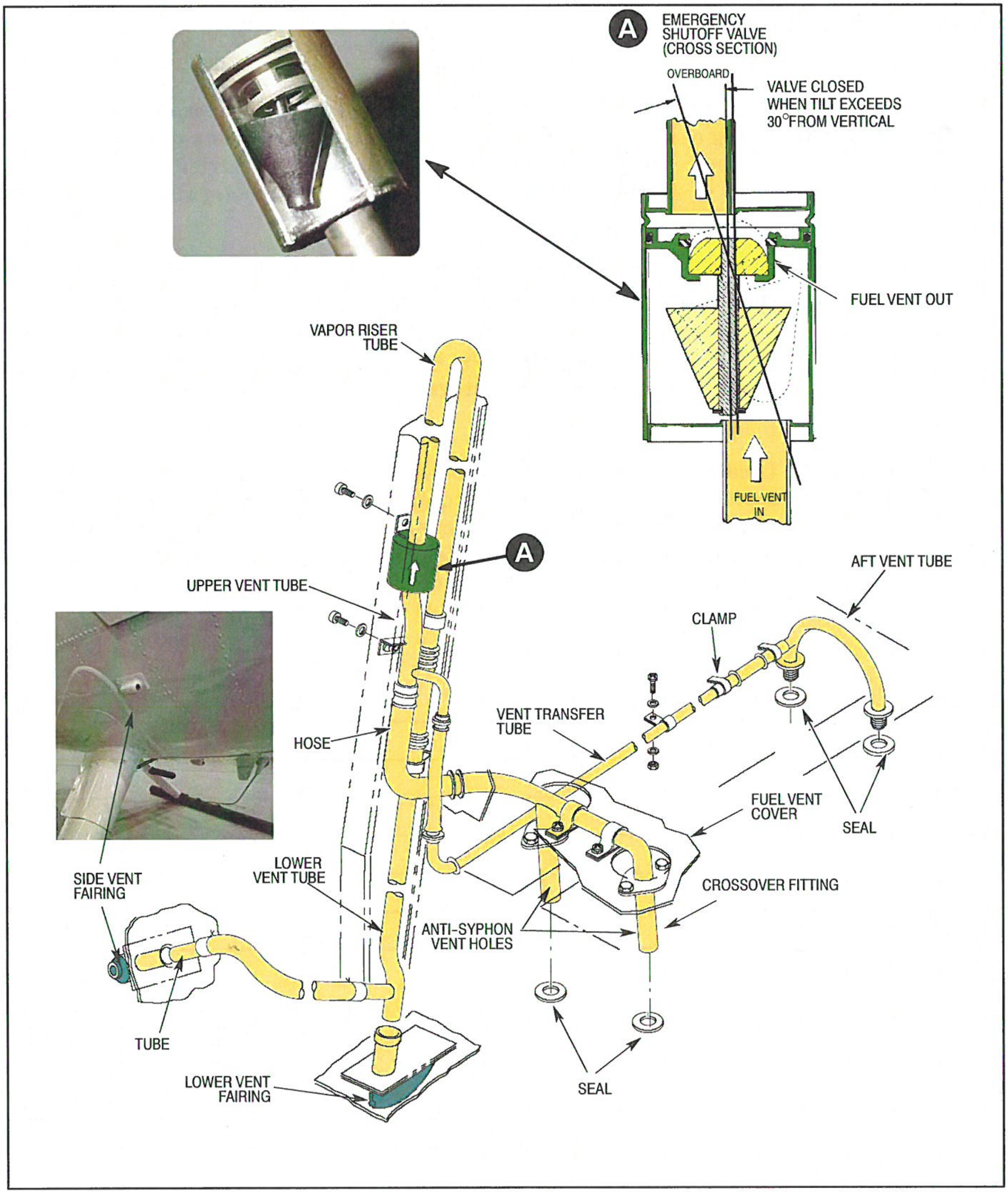

Figure 7-3. Fuel Cell Vent System

7–3. FUEL CELL VENT SYSTEM

Location and Function

Fuel cell vents are located at the forward and aft ends of each fuel cell. A vapor riser tube with an emergency shutoff valve interconnects the forward and aft vent lines. The design of the vent system provides for the following:

Elimination of vapor fume hazard.

Equalization of cell pressure.

Prevention of fore and aft cell pressurizing during helicopter operation.

A rapid servicing rate without fuel blowback.

Prevention of fuel spillage.

NOTES: ______________________________

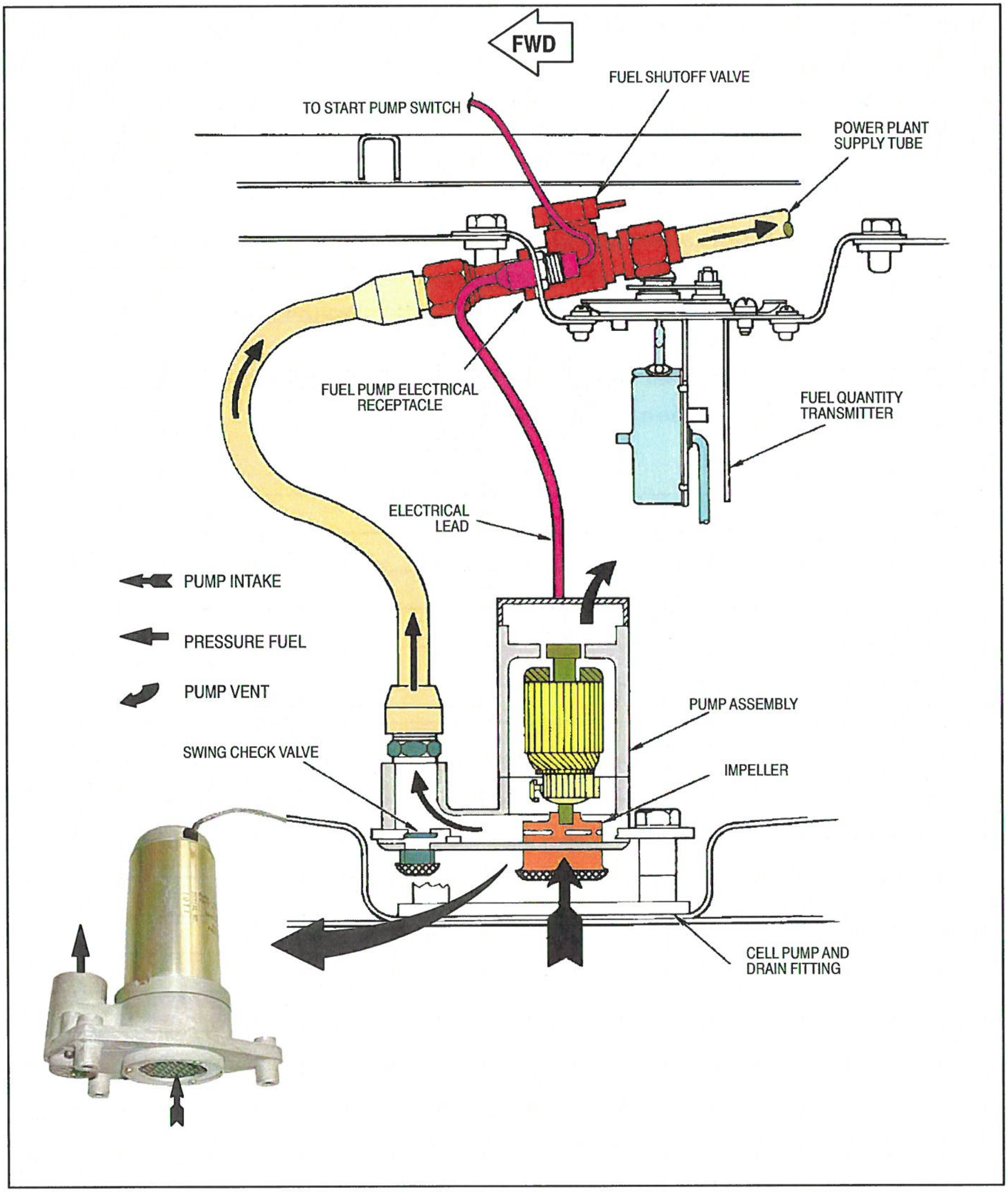

Figure 7–4. Engine Start Pump (MD500D/E only)

7–4. ENGINE START PUMP

Description The engine start pump is mounted in the left fuel cell and is a submergible, single stage, centrifugal, constant displacement type pump and is operated by a switch on the pilot's instrument panel.

A single stage impeller housing is built into the frame of a 28 volt dc motor and will displace 300 pounds per hour at 10 psig minimum pressure at sea level. The pump impeller housing serves as the main fuel pickup point for the engine-driven fuel pump during times when the start pump is being used.

When the start pump is non-operational, fuel is engine-pump-drawn through a second parallel port of the start pump impeller housing. The fuel enters through a number eight mesh screen and is routed through the check valve.

USE OF START PUMP

General The start pump is used at the pilot's discretion. however, there are certain times when the start pump must be used.

They are: ______________________________

____

____

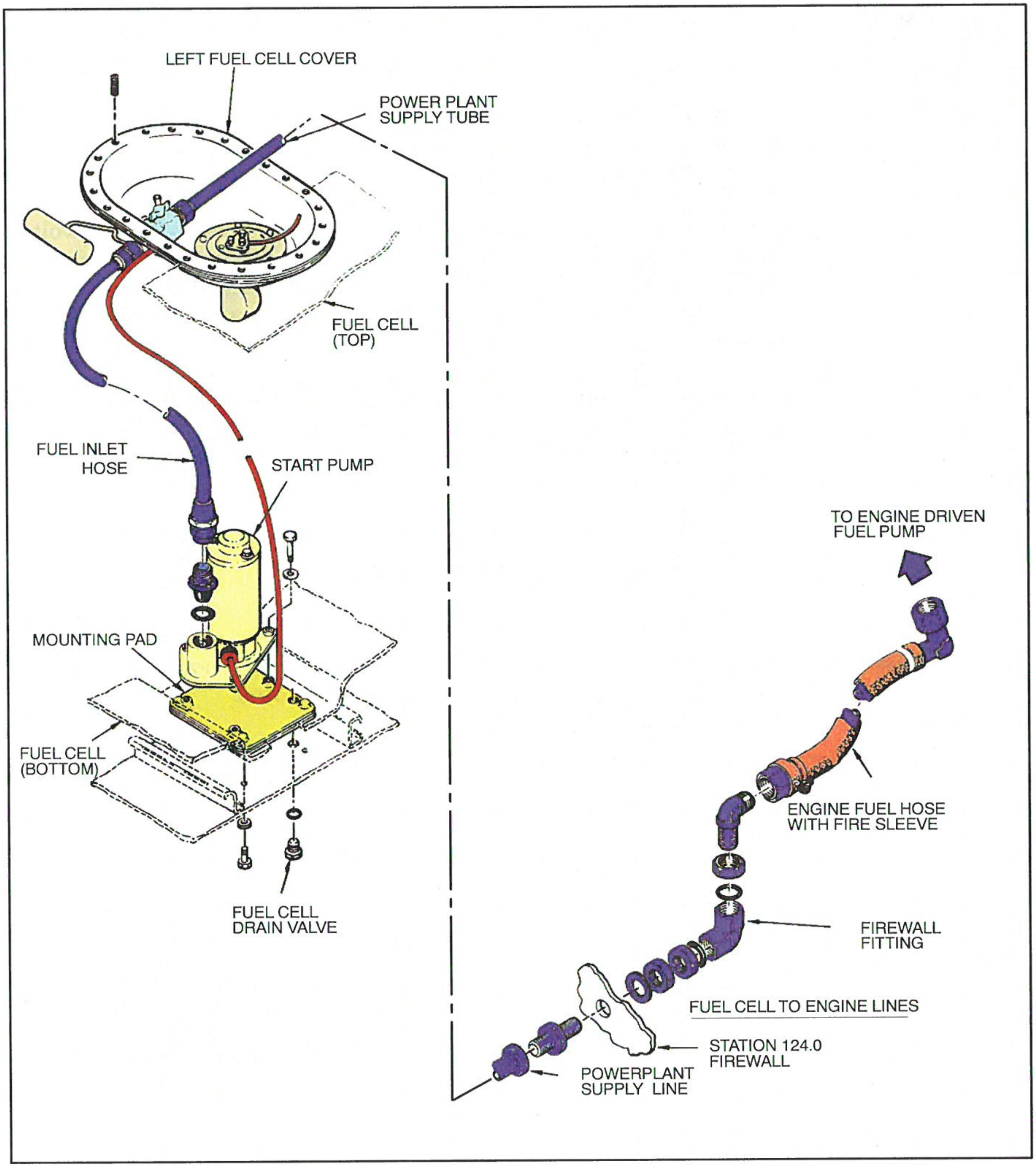

Figure 7–5. Engine Start Pump and Fuel Supply Lines (MD500D/E only)

7–5. FUEL SUPPLY

Supply Lines A stainless steel braided flex hose extends from the outlet of the fuel shutoff valve to a firewall fitting at the station 124.00 bulkhead. The power plant supply hose is clamp-secured below the passenger/cargo compartment floor.

A stainless steel braided flex house with fire sleeve is installed at the top leg of the firewall fitting and attaches to the engine-driven fuel pump inlet.

FUEL SYSTEM RESTRICTIONS

The fuel system must be purged of air following: ______________________________

____

____

____

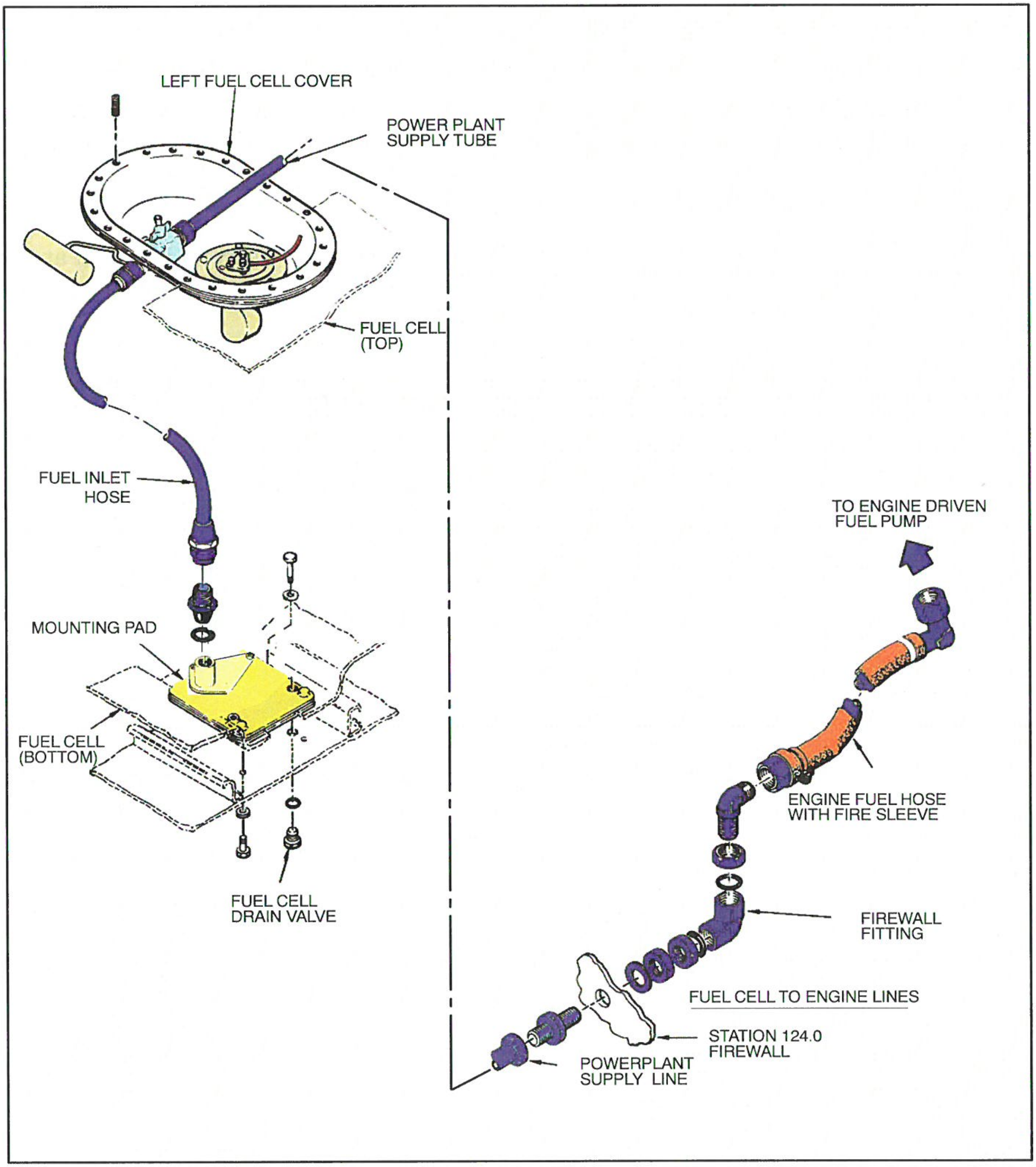

Figure 7-6. Engine Fuel Supply Lines (MD 530F-Plus)

7–6. ENGINE FUEL SUPPLY LINES

General The Rolls Royce 250–C30 engine used in the MD 530F Plus does not require the use of an electric start pump for operation.

The fuel supply originates from a threaded fitting that is mounted in the fuel cell at the point where the start pump would normally be mounted in 500D/E Models

Current configuration 530F models do not have this valve installed.

FUEL SYSTEM RESTRICTIONS

The fuel system must be purged of air following: ______________________

____

____

____

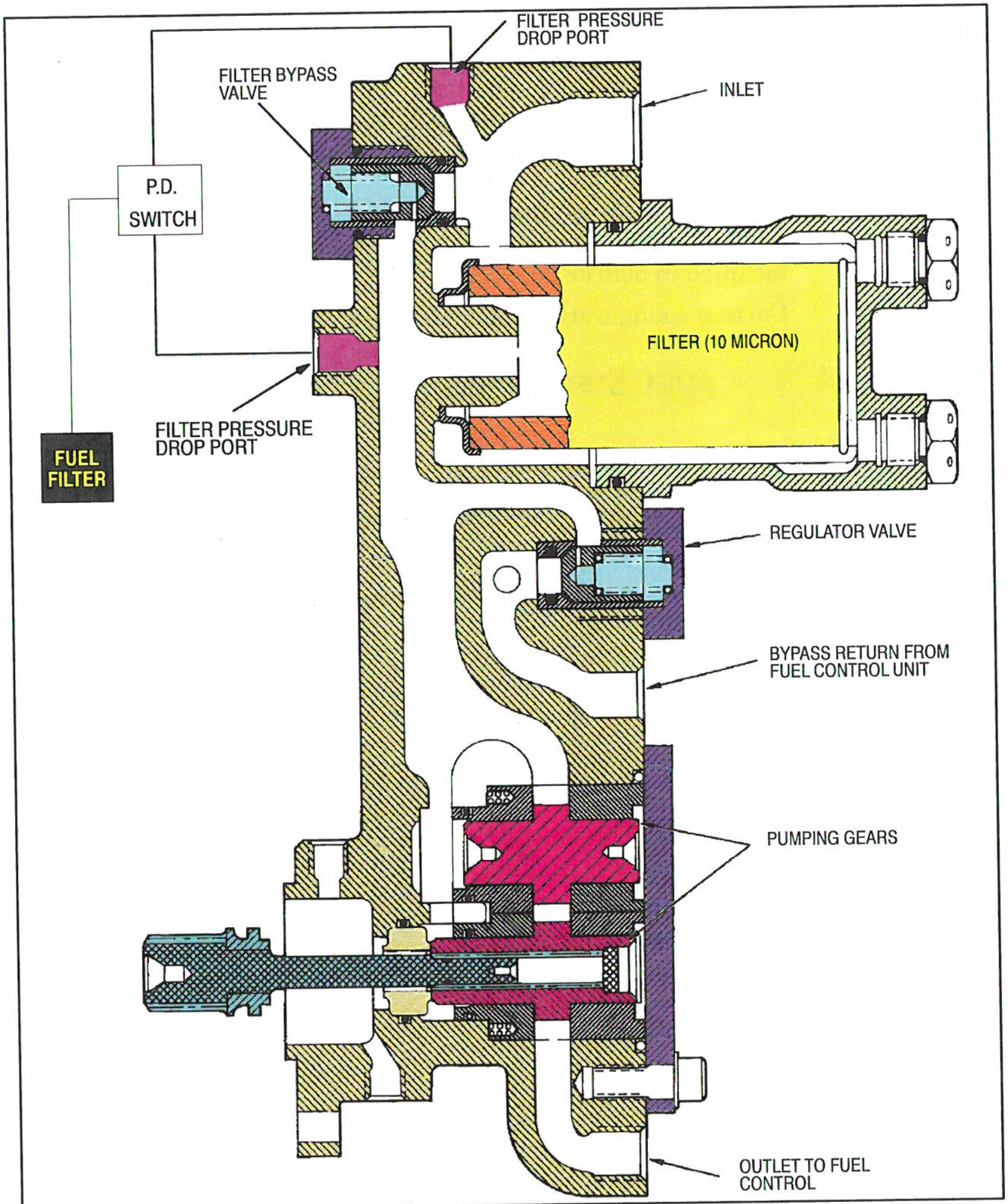

Figure 7–7. Single Element Engine–Driven Fuel Pump (Rolls Royce 250–C20 Series Only)

7-7. SINGLE ELEMENT ENGINE-DRIVEN FUEL PUMP

General The single element fuel pump assembly consists of one spur gear type pump, filter bypass valve, and regulator valve. Fuel from the helicopter fuel system is delivered to the pump fuel inlet port, where it is directed to, and through, a number 5 micron filter. A filter bypass valve, in parallel with the fuel filter, is normally closed. As fuel flows through the filter, there is a slight decrease in pressure, with the pressure on the inlet side being higher than the pressure on the outlet side.

MALFUNCTIONS

Indications Yellow FUEL FILTER indicator-ON, indicates clogged filter.

Turn start pump on.

Monitor instruments

CAUTION: **If any unusual indications or conditions occur, land as soon as possible.**

The lighted indicator indicates that a predetermined pressure differential has been reached and that an impending bypass condition exists. **The fuel filter must be serviced prior to the next flight.**

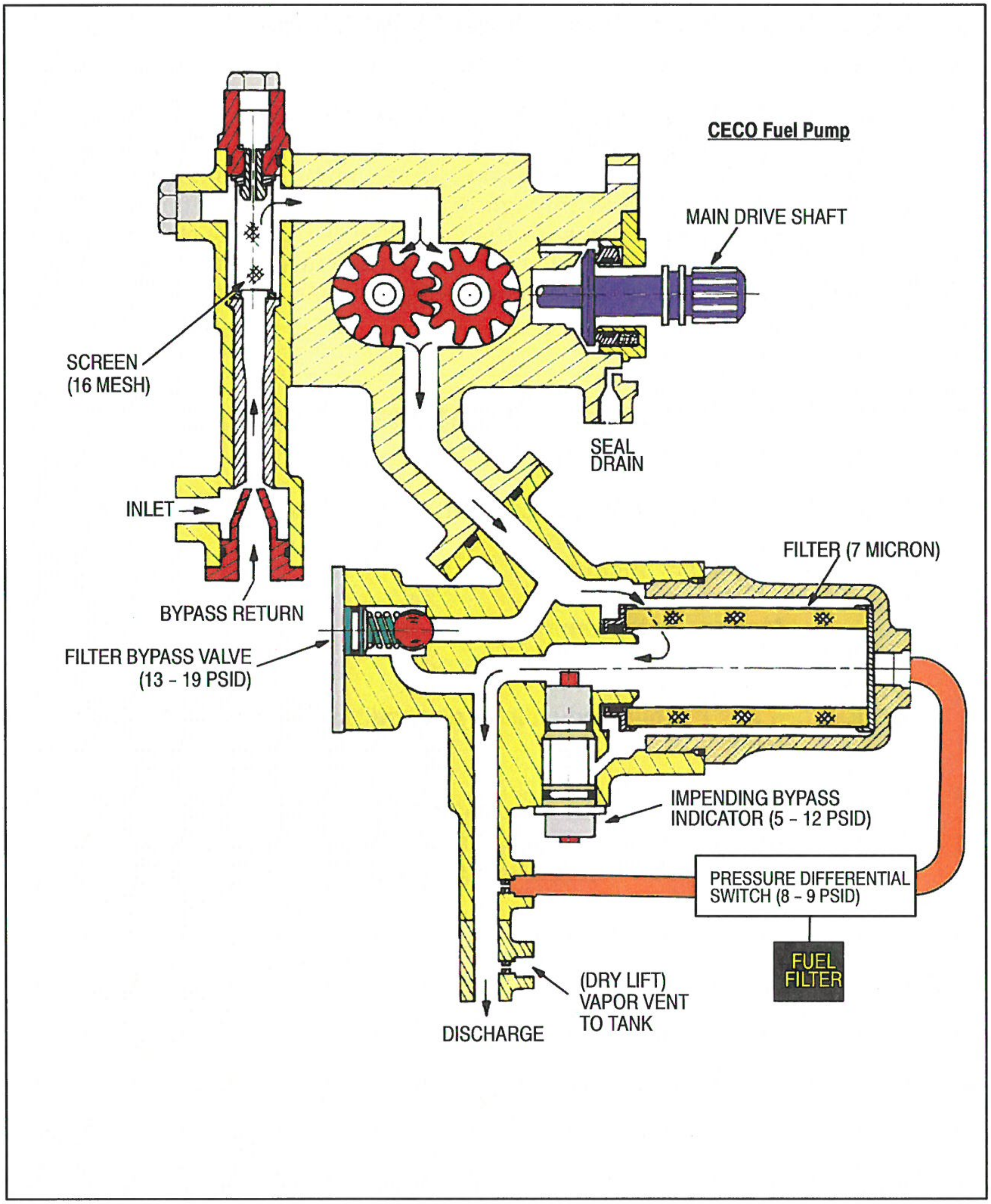

Figure 7–8. Single Element Engine–Driven Fuel Pump for 250–C20R/2 Engines

7-8. ENGINE DRIVEN FUEL PUMP - CECO

Description and Construction

The Model MFP-262/HPF-262 pump and filter assembly is used to supply filtered pressurized fuel to the fuel control of the Rolls Royce 250-C20R/2 series engines.

The assembly is composed of two distinct units: the pump assembly and the filter assembly.

The filter assembly is a single aluminum casting that incorporates a 7-micron filter, filter bypass valve, and an impending bypass indicator.

Operation

The drive shaft, driven by the N_1 gear train, is splined to and drives the driver gear which, in turn drives the driven gear. A seal drain port is provided to drain shaft leakage.

Inlet fuel mixes with fuel-control bypass return fuel, and flows through the diffuser and screen in the eductor housing. The fuel then flows to the main fuel housing and to the pumping gears. Pressurized fuel from the pumping gears passes out the discharge port to the filter assembly.

Fuel Filter

At the filter assembly, pressurized fuel flows through the filter element and exits out the discharge port.

As foreign material accumulates in the filter element, a differential pressure develops across the filter (between the filter inlet and discharge port). At a differential pressure slightly less than the filter bypass valve setting, the red button on the impending bypass indicator will extend to provide a visible warning to ground crew personnel to change the filter element. The impending bypass indicator cannot be reset without removing (and replacing) the filter element.

With further clogging of the filter element, the filter bypass valve will open to allow the fuel to bypass the filter element.

MALFUNCTIONS

Indications

Yellow FUEL FILTER indicator-ON, indicates clogged filter.

CAUTION: **If any unusual indications or conditions occur, land as soon as possible.**

The lighted indicator indicates that a predetermined pressure differential has been reached and that an impending bypass condition exists. **The fuel filter must be serviced prior to the next flight.**

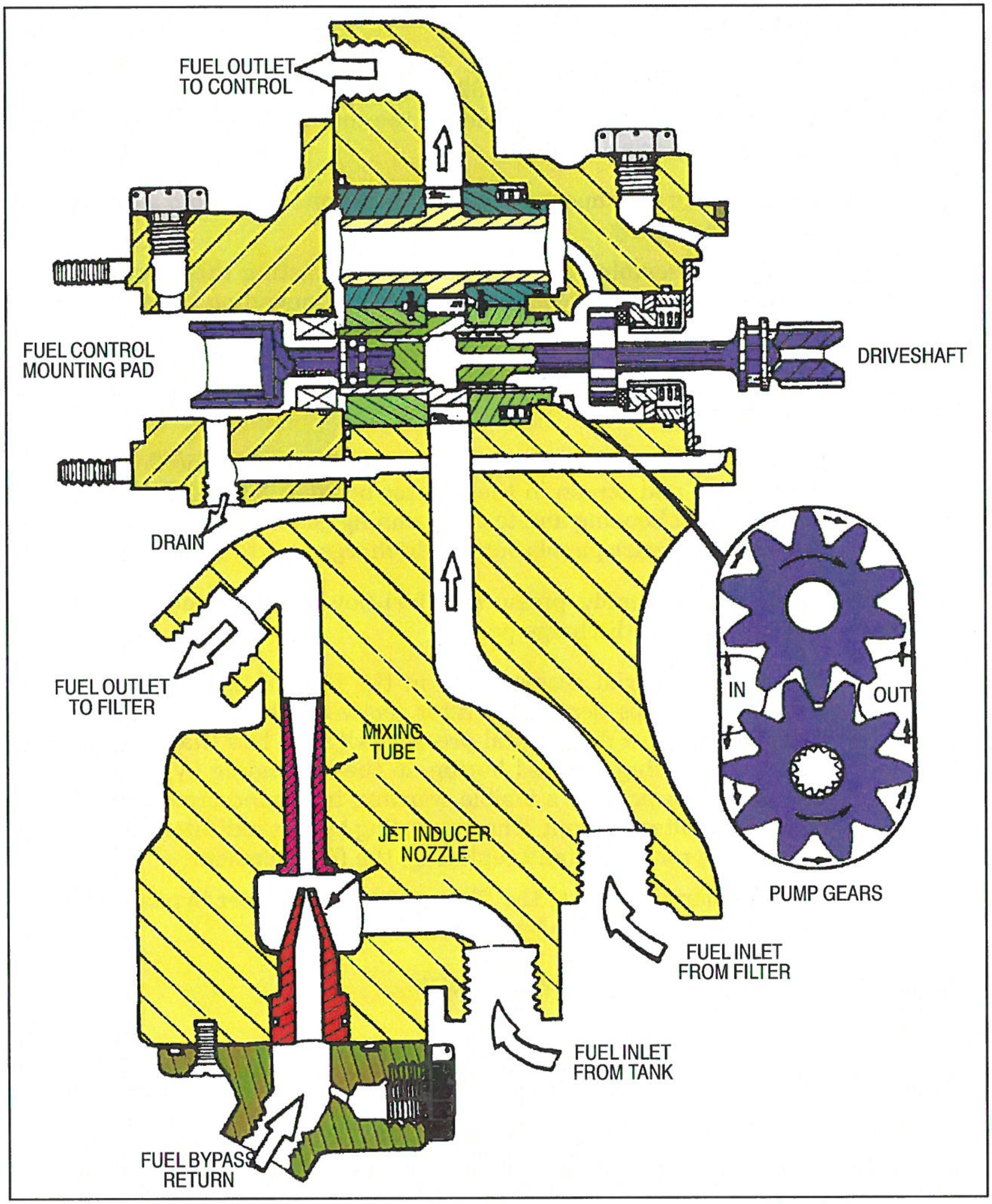

Figure 7-9. Fuel Pump Schematic (Sundstrand) Rolls Royce 250-C30

7–9. SUNSTRAND – ROLLS ROYCE 250–C30

Description and Construction

The fuel pump is a positive displacement gear–type pump incorporating a jet inducer, and a single pumping element. Fuel from the A/C fuel tank(s) is delivered to the fuel inlet port and flows into the low pressure chamber of the jet inducer. After the initial start, bypass return flow from the fuel control is directed into the nozzle inlet chamber of the jet inducer.

Both Sundstrand and TRW fuel pumps are basically the same except in the TRW pump, the jet inducer design is different and the anti-cavitation feature is deleted.

Jet Inducer

The jet inducer section consist of two separate venturi jets in series and a low pressure chamber. Bypass fuel from the fuel control is accelerated by the first jet. Fuel, in the low pressure chamber, is picked up and accelerated with an increase in static pressure by the second jet. The fuel then flows through the low pressure fuel filter to the inlet port of the pump gears.

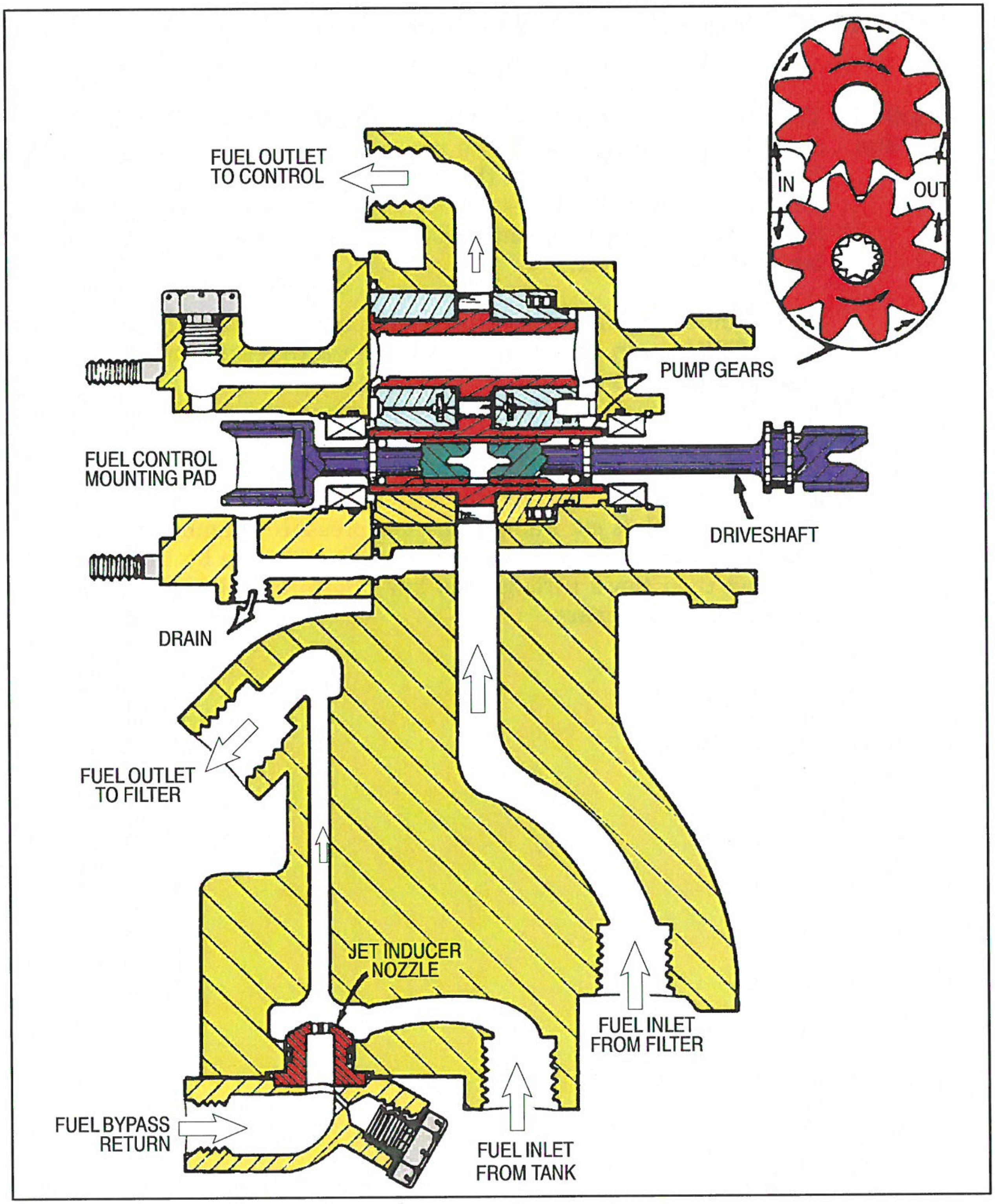

Figure 7–10. Fuel Pump Schematic – 250–C30 (TRW)

7-10. TRW FUEL PUMP - ROLLS ROYCE 250-C30

Description and Construction

The fuel pump is a positive displacement gear-type pump incorporating a jet inducer, and a single pumping element. Fuel from the A/C fuel tank(s) is delivered to the fuel inlet port and flows into the low pressure chamber of the jet inducer. After the initial start, bypass return flow from the fuel control is directed into the nozzle inlet chamber of the jet inducer.

Jet Inducer

The jet inducer section consists of a venturi jet in series and a low pressure chamber. Bypass fuel from the fuel control is accelerated by the first jet. Fuel, in the low pressure chamber, is picked up and accelerated with an increase in static pressure by the second jet. The fuel then flows through the low pressure fuel filter to the inlet port of the pump gears.

Both Sundstrand and TRW fuel pumps are basically the same except in the TRW pump, the jet inducer design is different. Also, the anti-cavitation feature is deleted.

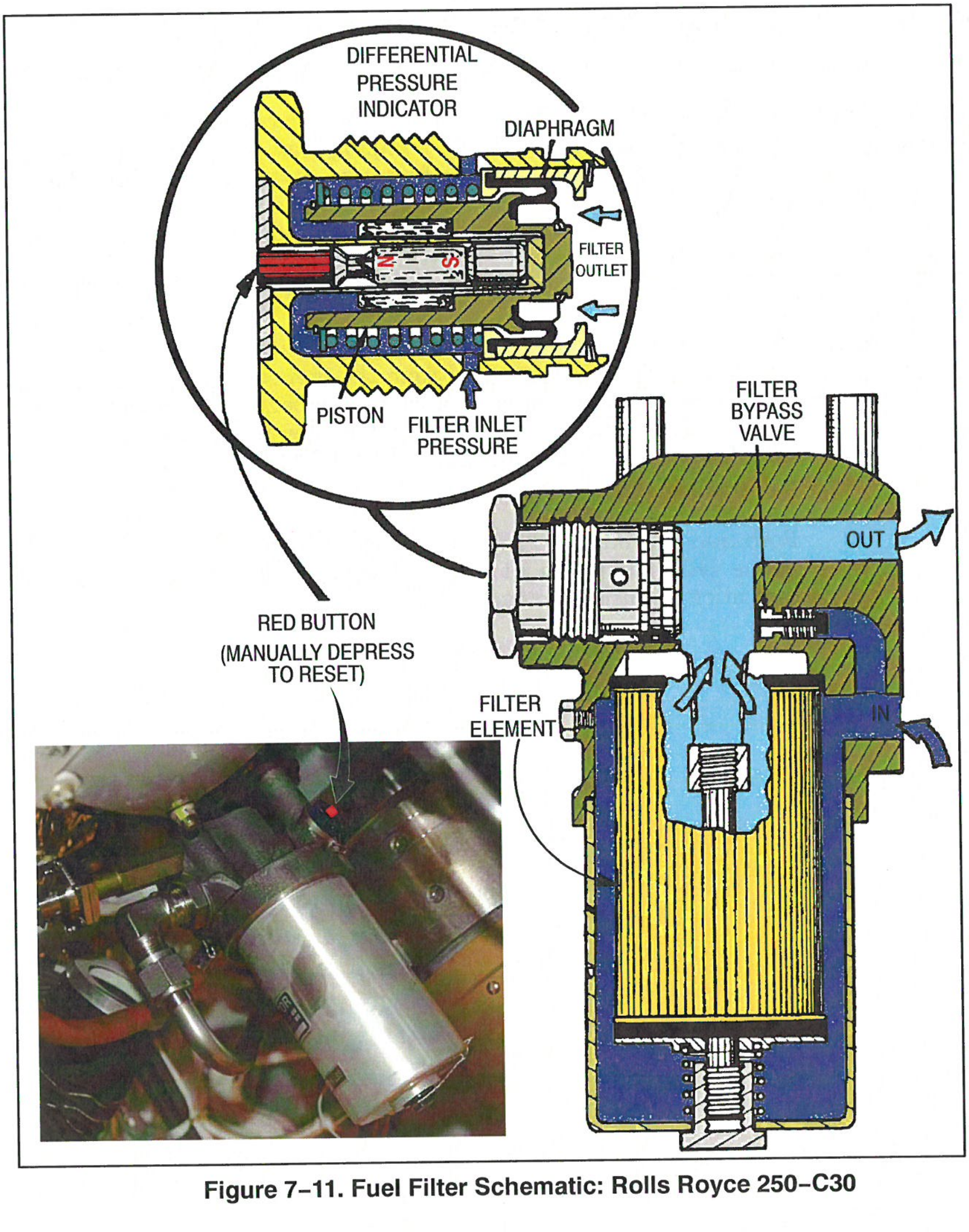

Figure 7-11. Fuel Filter Schematic: Rolls Royce 250-C30

7-11. FUEL FILTER MODEL 530F PLUS

Description and Construction The assembly consists of a housing which contains a replaceable 5 micron nominally rated filter element, a bypass valve, and pressure ports for measuring the pressure drop across the filter element. Also drain ports are provided at the top and bottom of the filter head assembly.

Operation Fuel from the helicopter fuel system is delivered to the fuel pump where it is directed to the 5 micron nominal paper filter. Normally, all the inlet fuel flows through the filter and to the inlet of the gear pump. The filter bypass valve, in parallel with the filter, is normally closed.

Filter Operation As fuel flows through the filter, there will be a slight decrease in pressure, with the pressure on the inlet side being higher than the pressure on the outlet side. As the filter collects contaminants from the fuel, the pressure differential across the filter increases. The filter head contains a pop out indicator and a bypass valve. The bypass valve is set to open when the pressure drop across the filter element reaches 2.0-2.5 PSID. The pressure drop indicator button pops out when the fuel bypasses the filter.

MALFUNCTIONS

Indications Amber FUEL FILTER indicator-ON, indicates clogged filter.

Turn start pump on.

Monitor instruments

CAUTION: **If any unusual indications or conditions occur, land as soon as possible.**

The lighted indicator indicates that a predetermined pressure differential has been reached and that an impending bypass condition exists. **The fuel filter must be serviced prior to the next flight.**

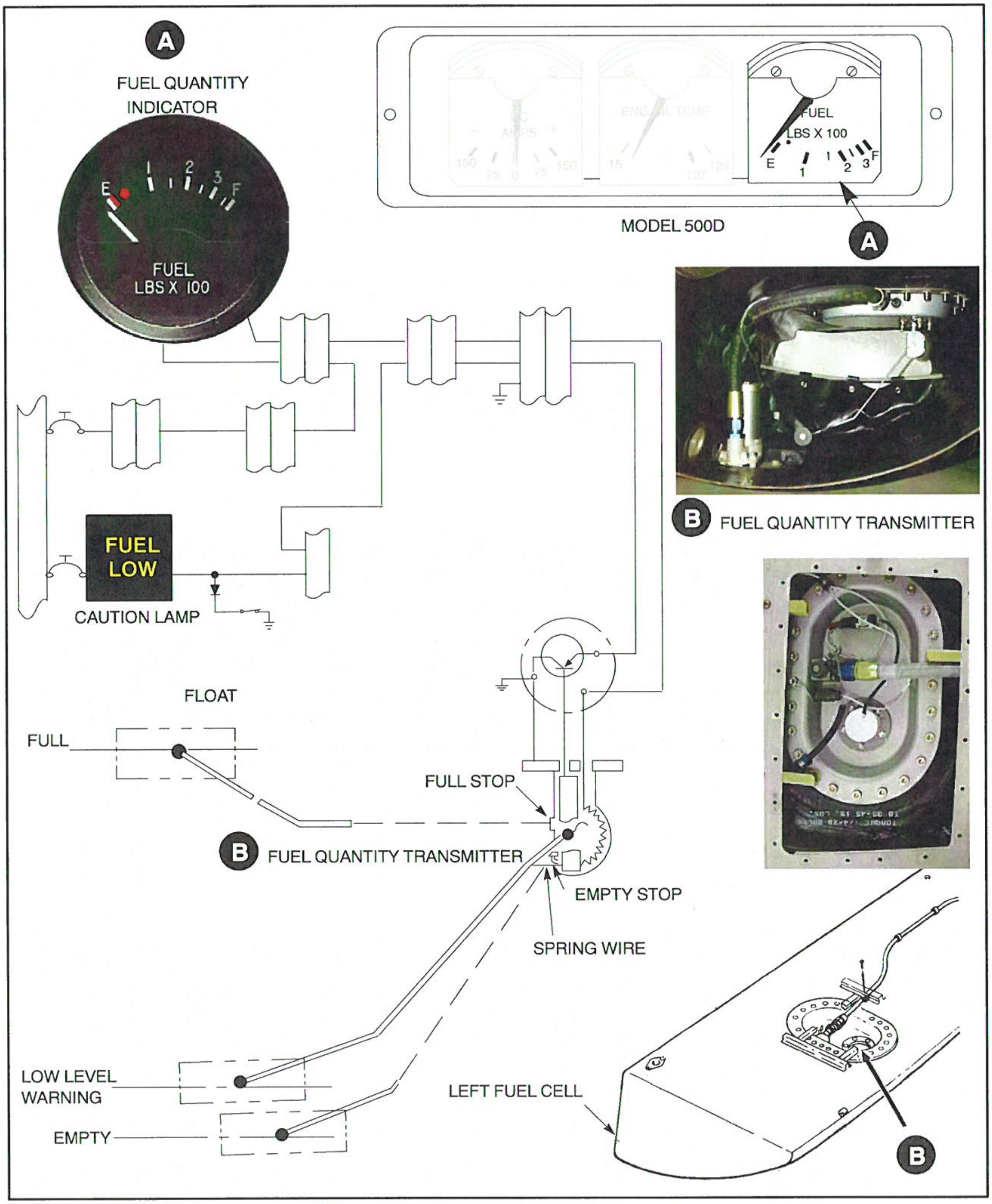

Figure 7-12. Fuel Quantity Indicating System

7-12. FUEL QUANTITY

General The fuel quantity transmitter is a float-type unit located in the left fuel cell attached to the fuel cell cover. The transmitter functions as a variable resistance coil with mechanical stops which may be adjusted for minimum and maximum resistance requirements. Adjustment at the mechanical stops is accomplished by bending the float arm to form a straight edge alignment of the float arm top at the transmitter housing and the center line of the float pivot. The transmitter has a transistor, mounted on the bottom side of the terminal board, which is used as an electrical switch to illuminate the **FUEL LEVEL LOW** caution lamp when the base is grounded by the float arm contacting the wire spring.

FUEL LEVEL LOW

Indications Amber FUEL LEVEL LOW indicator-ON when approximately _______ pounds of fuel (______ pounds usable) remain in fuel tank.

Warning: **Sideslips may cause fuel starvation and result in unexpected power loss or engine failure. Avoid large steady side slip angles, uncoordinated maneuvers, or speeds above ______ knots IAS when FUEL LEVEL LOW caution indicator is illuminated.**

Caution: Never use the FUEL LEVEL LOW light as a working indication of fuel quantity.

Land as soon as possible.

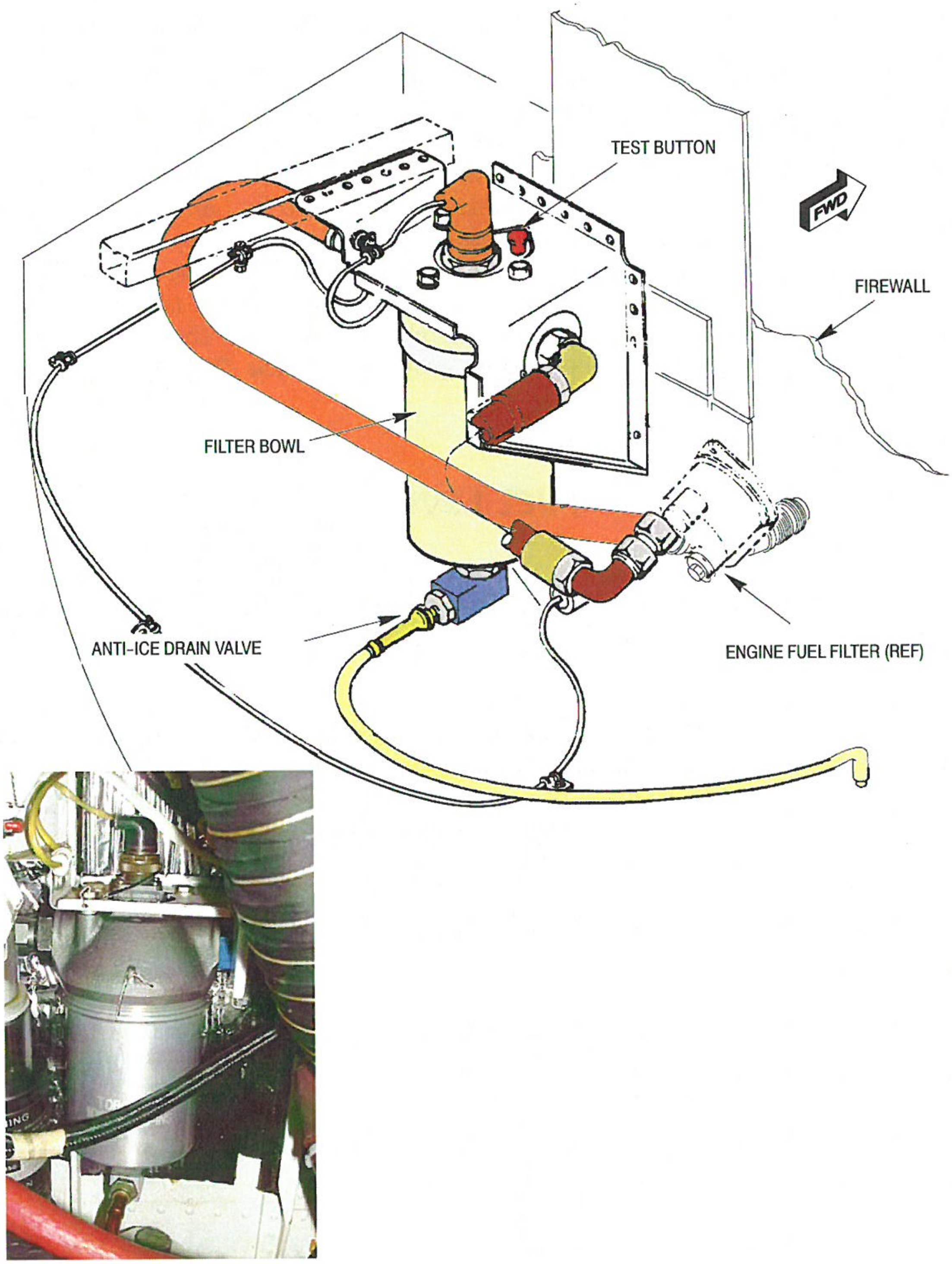

Figure 7-13. Anti-Ice Airframe Fuel Filter

7-13. ANTI-ICE AIRFRAME FUEL FILTER - 500D/E ONLY

Description The anti-ice airframe fuel filter incorporates a filter unit mounted in series between the aircraft fuel system and the engine fuel system. Electrical and mechanical equipment sense the build-up of ice in the filter unit and will automatically illuminate a cockpit caution on the annunciator panel. The pilot then actuates a switch to activate the aircraft start pump. When the filter becomes fully clogged, a by-pass valve contained in the filter unit opens and the fuel by-passes the filter element.

Refer to Section IX of the flight manual for operating instructions.

MALFUNCTIONS

Indications: Yellow 

caution indicator ON.

Conditions: Anti-ice airframe fuel filter becoming clogged with ice or other solid contaminants.

Procedures:

- ______________________
- ______________________
- ______________________

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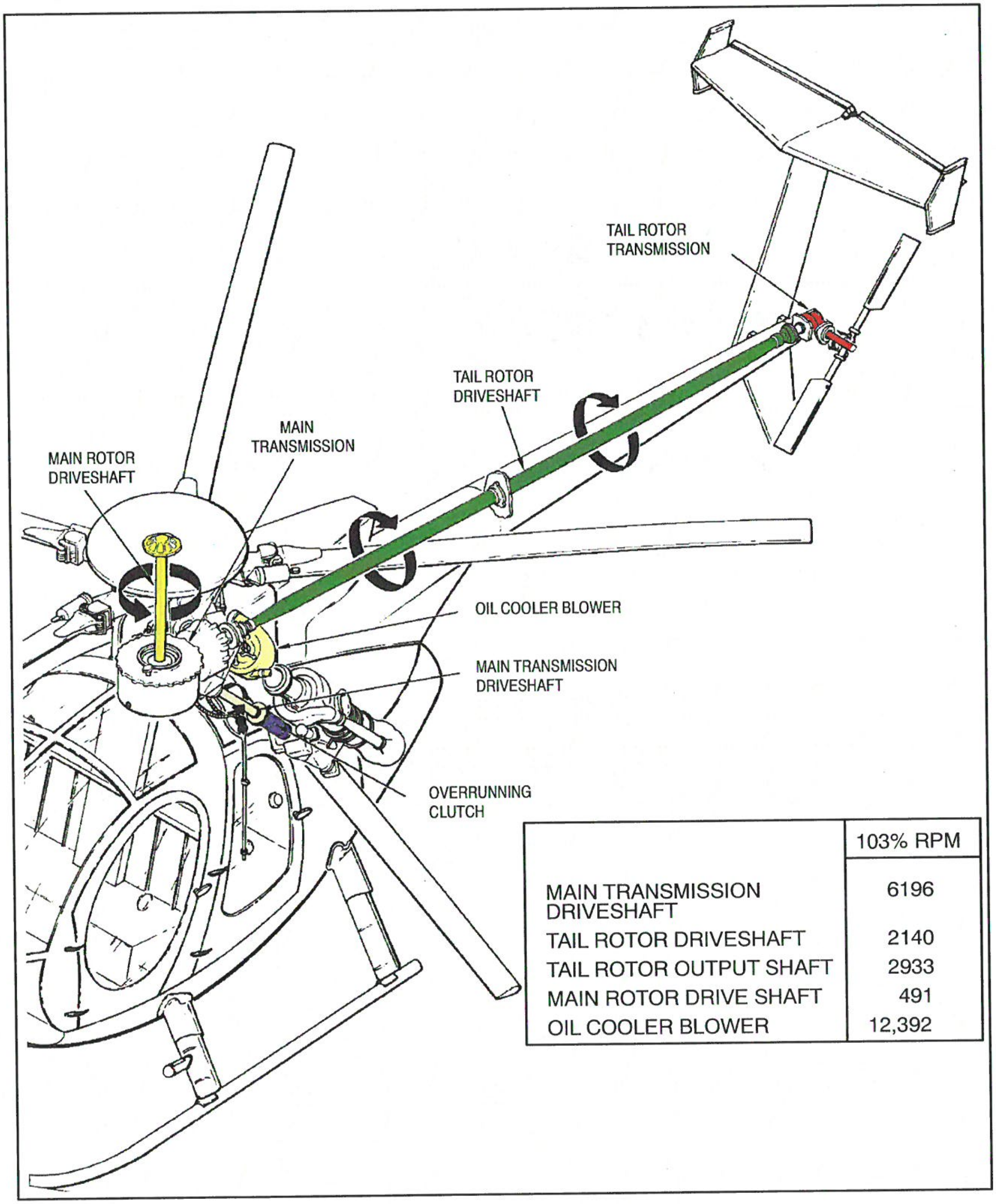
HELICOPTERS

MD 500 Pilot Transition Training Manual

SECTION VIII
POWERTRAIN SYSTEM



	103% RPM
MAIN TRANSMISSION DRIVESHAFT	6196
TAIL ROTOR DRIVESHAFT	2140
TAIL ROTOR OUTPUT SHAFT	2933
MAIN ROTOR DRIVE SHAFT	491
OIL COOLER BLOWER	12,392

Figure 8-1. Drive System - MD 500D/E

8–1. DRIVE SYSTEM

Function

The drive system serves to convey the engine produced torque to the main and tail rotors.

Drive System Components

Overrunning clutch - Acts as a freewheeling unit in the case of engine failure and autorotation.

Main transmission drive shaft - Situated between the overrunning clutch and the main transmission. Transmits engine torque from the output of the overrunning clutch to the input for the main transmission.

Oil cooler blower - Cools the engine oil and main transmission oil, Supplies air to the heater, defogger, and to the engine compartment.

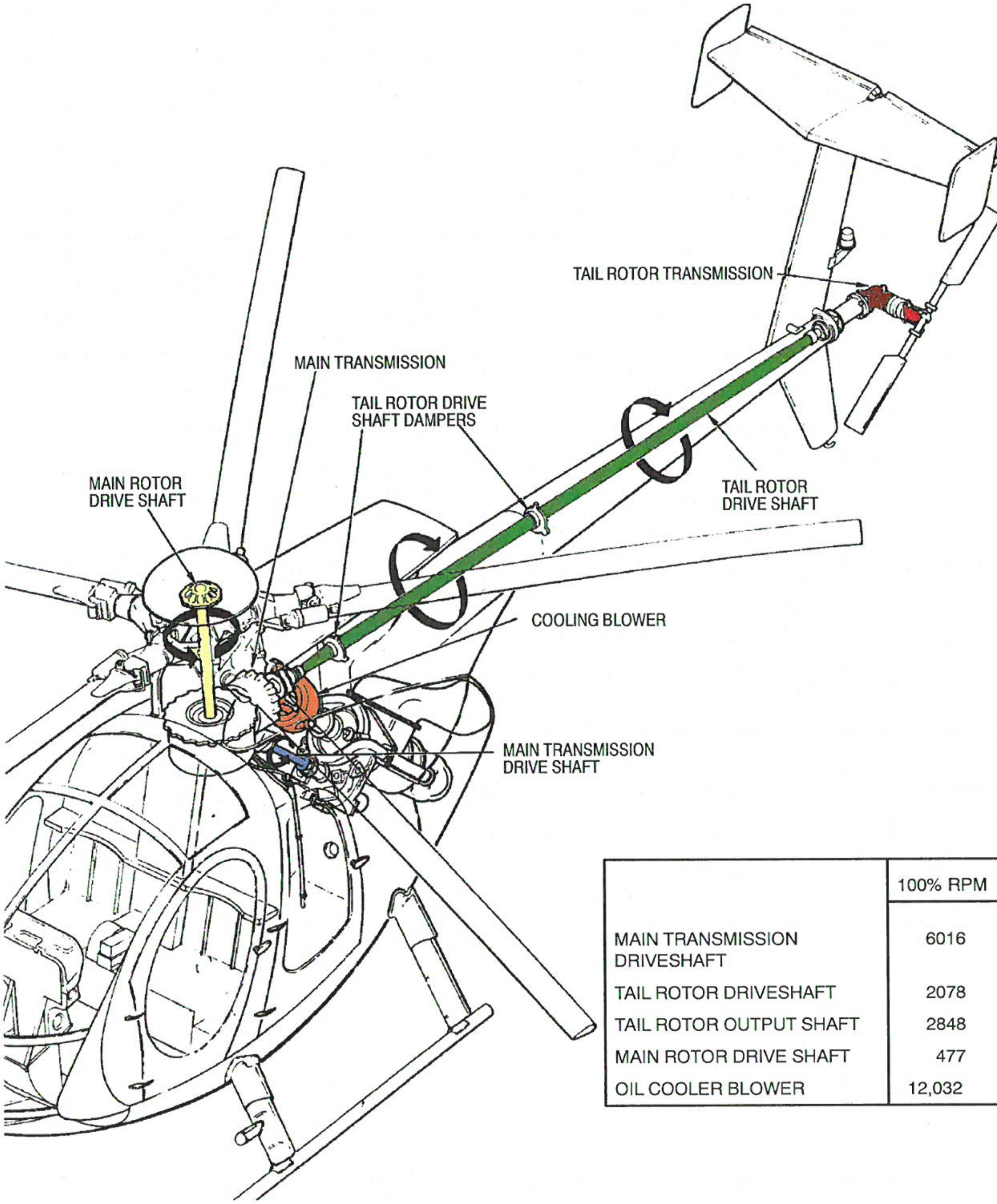
Main transmission - Acts as speed reducer, changes the angle of drive to the main and tail rotor takeoffs, and drives several accessories.

Main rotor drive shaft - Driven by the main transmission and flanged to, and therefore turns, the main rotor hub.

Tail rotor drive shaft - Connects the main transmission and the tail rotor transmission. A damper located near the center of the shaft reduces vibration in the tail rotor drive system.

Tail rotor transmission - Acts as a speed increaser, changes the angle of drive, and serves as the mount for the tail rotor assembly.

NOTES:



	100% RPM
MAIN TRANSMISSION DRIVESHAFT	6016
TAIL ROTOR DRIVESHAFT	2078
TAIL ROTOR OUTPUT SHAFT	2848
MAIN ROTOR DRIVE SHAFT	477
OIL COOLER BLOWER	12,032

Figure 8–2. Drive System – MD 530F–Plus

8–2. DRIVE SYSTEM – MODEL 530F–PLUS

Function

The drive system serves to convey the engine produced torque to the main and tail rotors.

Drive System Components

Overrunning clutch - Acts as a freewheeling unit in the case of engine failure and autorotation.

Main transmission drive shaft - Situated between the overrunning clutch and the main transmission. Transmits engine torque from the output of the overrunning clutch to the input for the main transmission.

Oil cooler blower - Cools the engine oil and main transmission oil, Supplies air to the heater, defogger, and to the engine compartment.

Main transmission - Acts as speed reducer, changes the angle of drive to the main and tail rotor takeoffs, and drives several accessories.

Main rotor drive shaft - Driven by the main transmission and flanged to, and therefore turns, the main rotor hub.

Tail rotor drive shaft - Connects the main transmission and the tail rotor transmission. A damper located near the center of the shaft reduces vibration in the tail rotor drive system.

Tail rotor transmission - Acts as a speed increaser, changes the angle of drive, and serves as the mount for the tail rotor assembly.

NOTES:

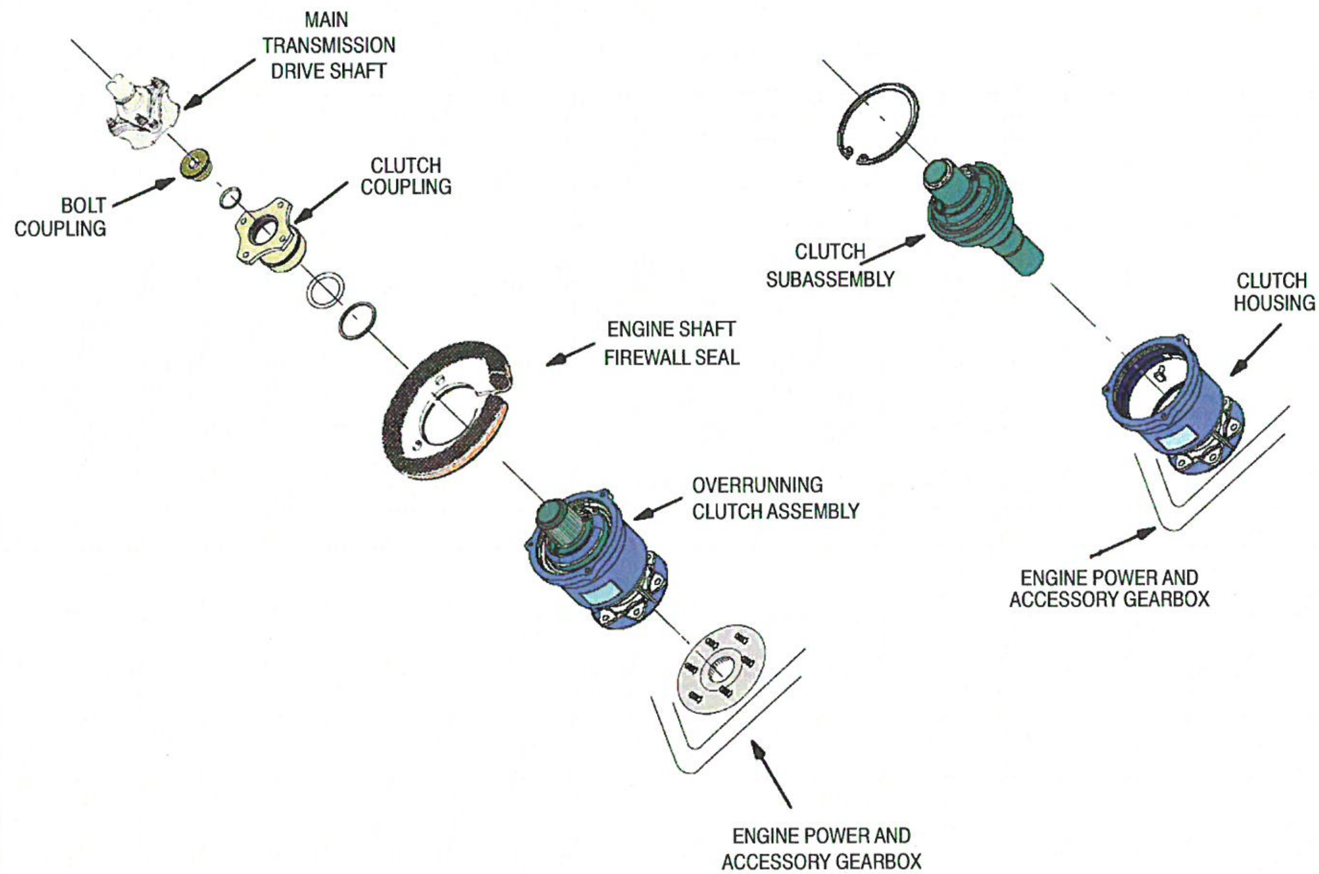


Figure 8-3. Overrunning Clutch

8-3. OVERRUNNING CLUTCH

Description and Operation

Normally, the engine supplies torque through the overrunning clutch to drive the transmission system. Should the engine fail to deliver power or the rotor system turn faster than the engine relative output, the overrunning clutch disconnects internally so that the transmission/rotor system can freewheel. Thus, in autorotation, the transmission/rotor system does not have to expend energy to drive an idling or failed engine.

Component Location

The overrunning clutch is located between the engine forward power takeoff and the main drive shaft on the engine side of the firewall. The clutch assembly is attached to the engine output pad. No gasket is used between the engine and clutch, and the clutch housing is provided with drain holes to detect any seal leakage. The clutch may be repaired by replacing the clutch subassembly without disassembly of the entire clutch or removal of the engine.

OPERATIONAL CHECKS

Preflight Checks

Turn main rotor blades forward and then aft. Check for engine noise.

Operational Checks

Check that N_R and N_2 needles are joined after starting and that the needles

______________ during shutdown.

MALFUNCTION PROCEDURES

Component Failure

If the failure causes the unit to stop transmitting torque to the main drive shaft, N_2 RPM will rapidly increase and N_R will decrease at a high rate.

The correct procedure then should be:

____

____

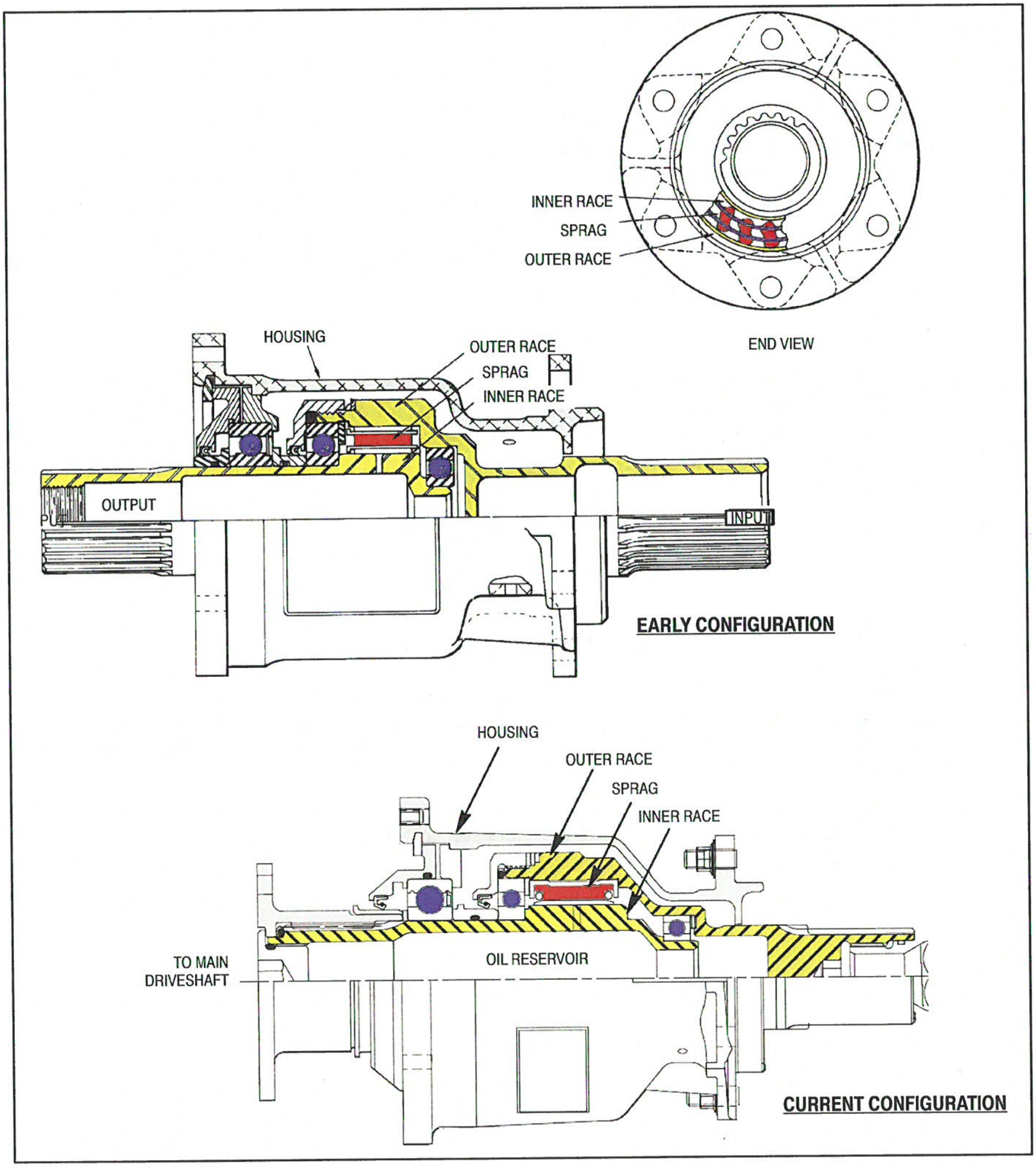


Figure 8–4. Clutch Components

Clutch Components

Shafting: Two shafts that project from each end of the housing and are referred to as the inner race shaft (transmission system connection) and the outer race shaft (engine connection). The inner race shaft projects into the outer race shaft. The inner and outer races are separated by two ball bearings and a sprag unit.

The "early" sprag assembly has 18 sprags. The sprags resemble rollers of a roller bearing that have been deformed to a figure eight cross section. The vertical height of the sprags slightly exceeds the gap between the ID of the outer race and the OD of the inner race. The sprags are held together by a double cage arrangement that is spring loaded to the engaged position. The engaged position situates the sprags against both races at a slight angle. Clockwise rotation of the outer race (from the engine) jams the sprags between the races, and this interference drives the inner race. If the inner race overspeeds the outer race, the interference is broken and the inner race can turn freely.

The "current" sprag assembly has 27 sprags. The sprags resemble rollers of a roller bearing that have been formed to a figure eight cross-section. When the engine produces power to drive the rotor system, the sprags are engaged, locking the inner and outer races which, in turn, drives the transmission. When the rotor system RPM exceeds the engine output such as during autorotation, the sprag disengages and allows the rotor system to disengage from the engine.

NOTES: ____

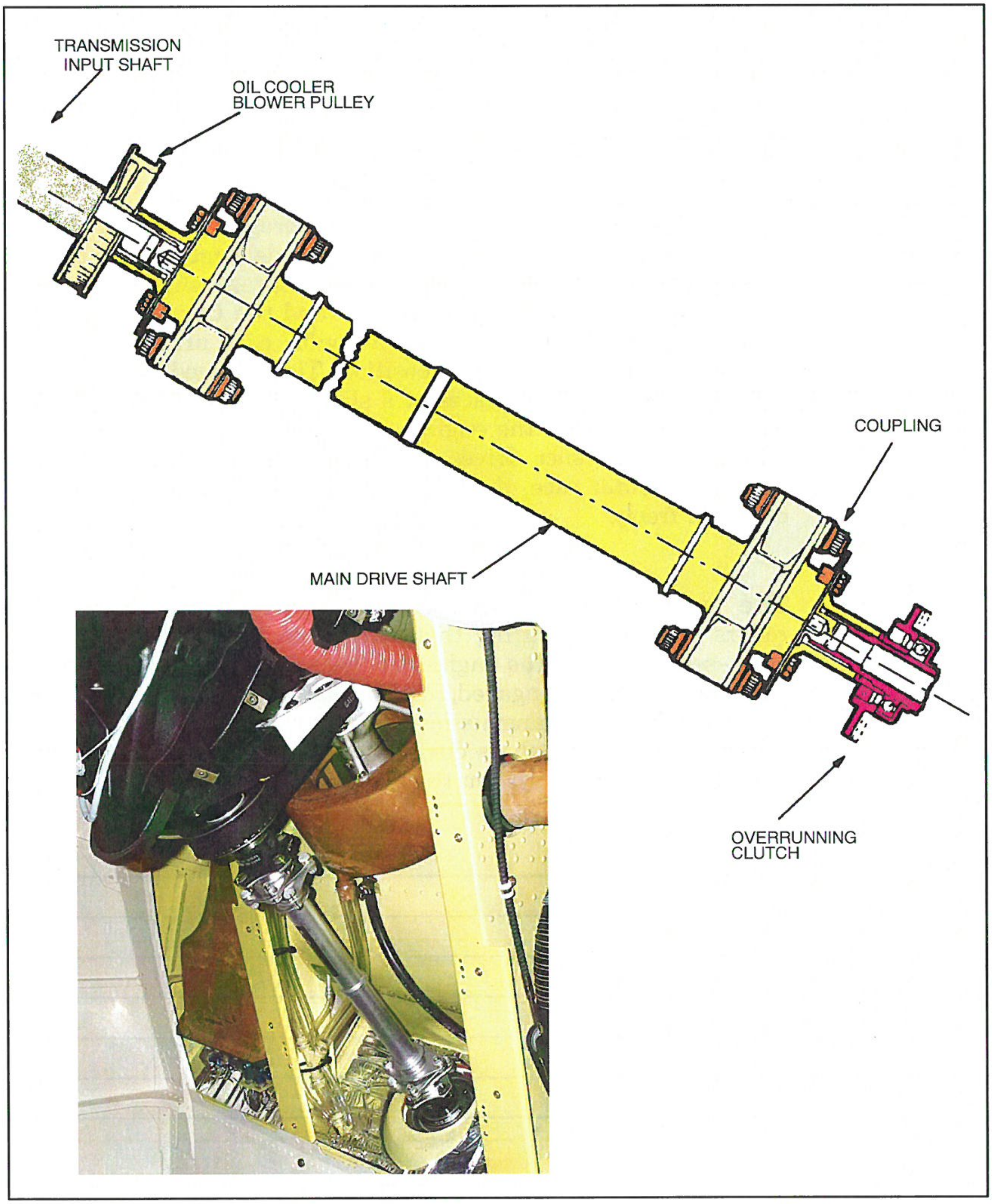


Figure 8-5. Main Transmission Drive Shaft (Kaflex)

8-4. MAIN TRANSMISSION DRIVE SHAFT AND COUPLING

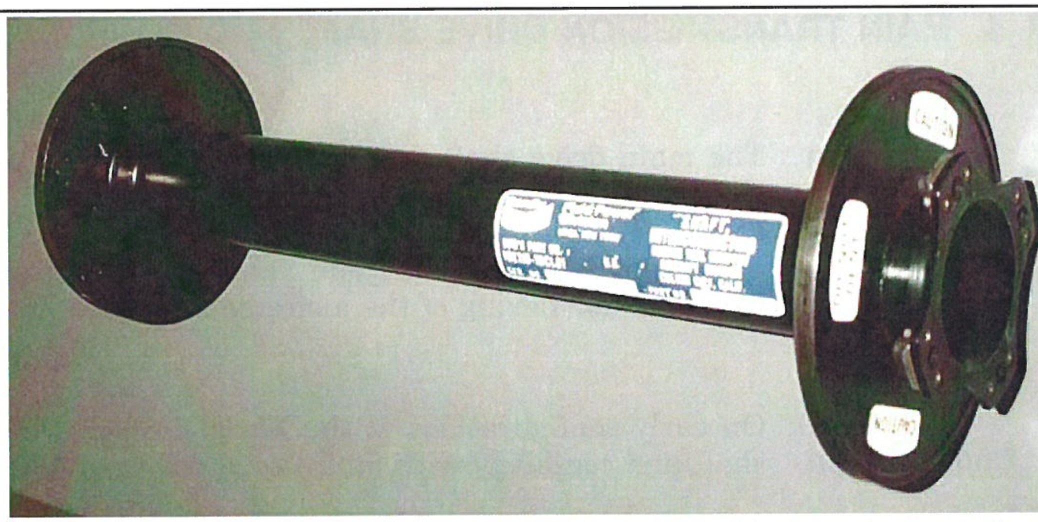
Function The main drive shaft transmits engine torque from the overrunning clutch to the main transmission. The drive shaft is a three piece assembly. The center shaft is a steel tube with a flexible joint and flange at each end. The flexible joints allow some degree of shaft misalignment and for flexing of the airframe and drive line during flight.

Early Configuration On early configurations of the Model 500D/E Series, a Bendix drive shaft and couplings with an internal fail-safe device was used.

Current Configuration On later configurations, and for spares replacement, a new Kamatics (Kaflex) shaft is used. The exceptional characteristics of this shaft are the kaflex couplings. The couplings combine the inherent advantage of flexing couplings while retaining a high misalignment and length change capability. It incorporates a unique fail-safe which allows continued power transmission through the couplings following failure of a primary load carry member. Torque is transmitted from a rigid hub, bolted to an input shaft through the yoke extension arms to the end bolts at the two opposing corners of the flex frame. Each side of the flex frame provides a load path; two sides acting in tension and two in compression. The shaft is dynamically balanced.

Couplings The couplings are splined to the overrunning clutch and the main transmission and are held in place by special internal bolts. The couplings are jointed to the center section by bolts and nutplates. The drive shaft arrangement requires no servicing or adjustments during operation.

NOTES: ____



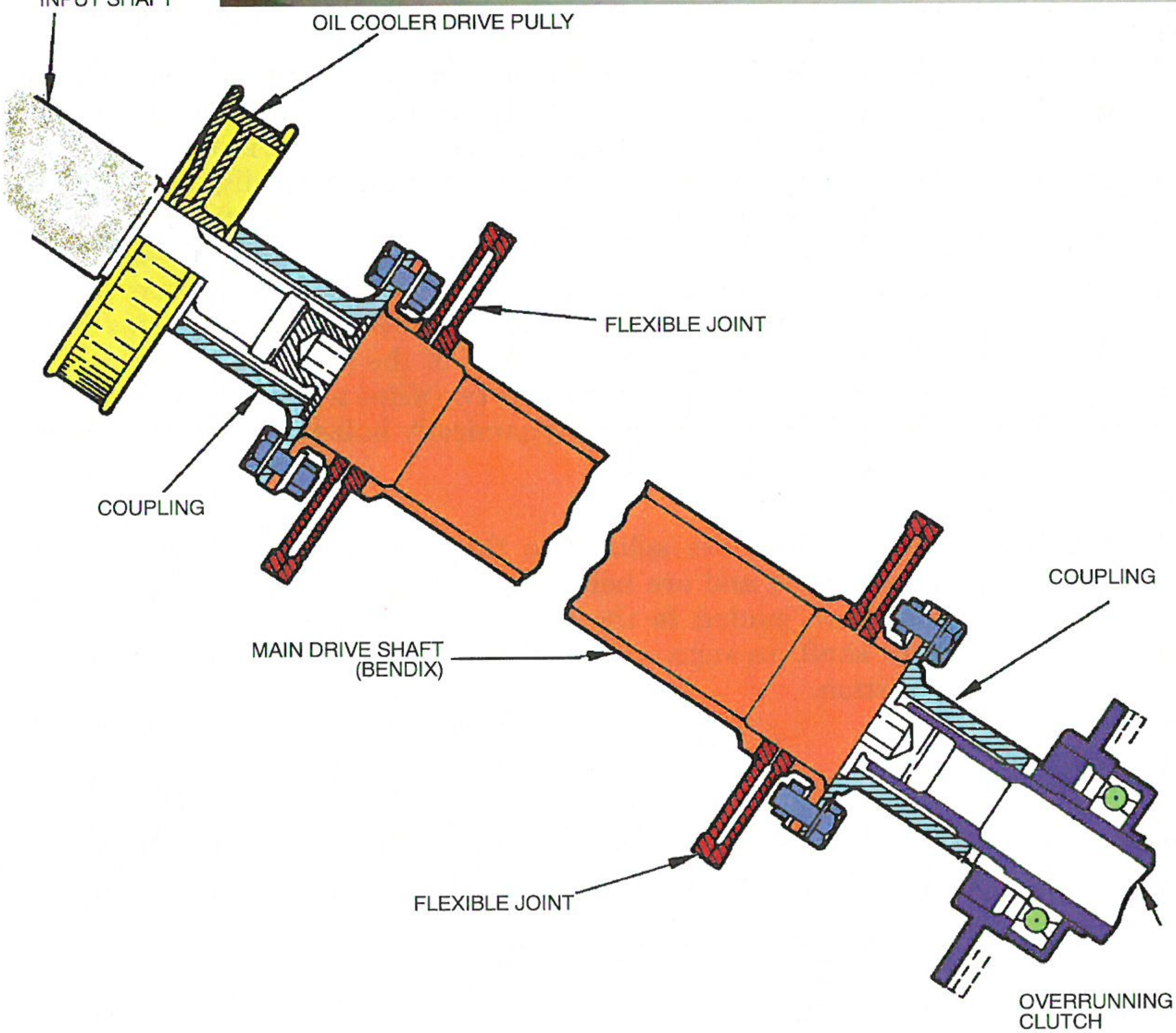


Figure 8-6. Main Drive Shaft - Bendix

8-5. MAIN TRANSMISSION DRIVE SHAFT AND COUPLING - BENDIX

Description The interconnecting drive shaft, commonly referred to as the main transmission drive shaft, transmits engine torque from the output of the overrunning clutch to the input for the main transmission. On early configurations of the Model 500 Series, a Bendix shaft was used. On later configurations, and for spares replacement, a new Kamatics (Kaflex) shaft is used. The Bendix drive shaft is a three piece assembly composed of a steel tube with a Bendix flexible joint and flange at each end, joined to the shaft by means of electron beam welds. The flexible joints provide for some degree of misalignment and flexing of the airframe and drive system components during flight. The shaft is dynamically balanced at 7000 rpm.

NOTES:

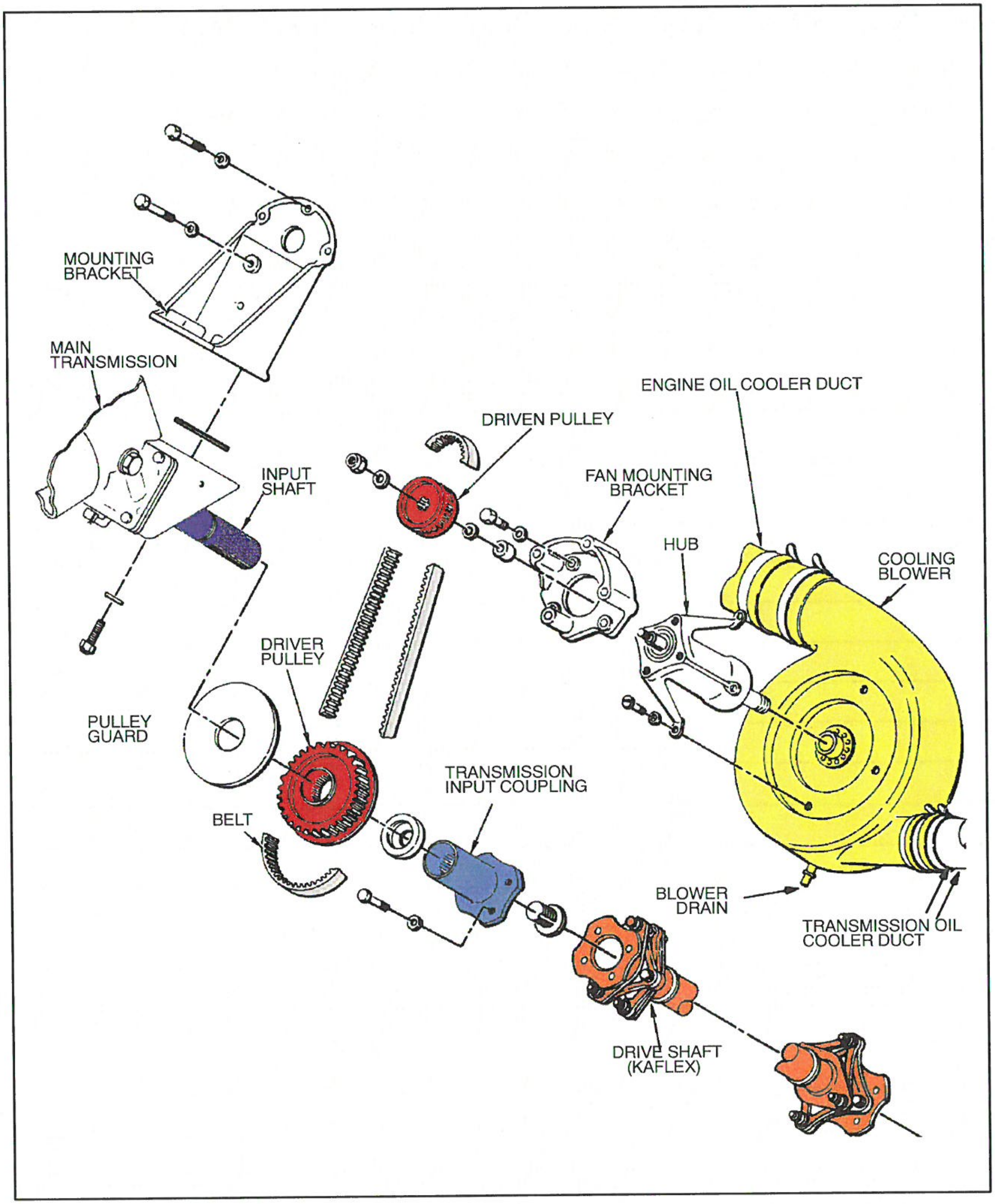


Figure 8-7. Oil Cooler Blower

8-6. OIL COOLER BLOWER

Function and Construction

The blower assembly draws air in through the horizontally mounted oil cooler inlet screen located in front of the engine air inlet screen. The blower provides air, through ducting, to the engine oil cooler, transmission oil cooler, engine compartment, and to the cabin heater mixing valve.

The blower consists of a front and back panel brazed to 12 blades within the scroll. The blower is dynamically balanced for high rpm and will process approximately 950 cfm of air.

Location

The blower is above the parallel to the main drive shaft and is belt driven. A drive pulley on the main transmission input shaft supplies power to the driven pulley by means of a belt.

NOTES:

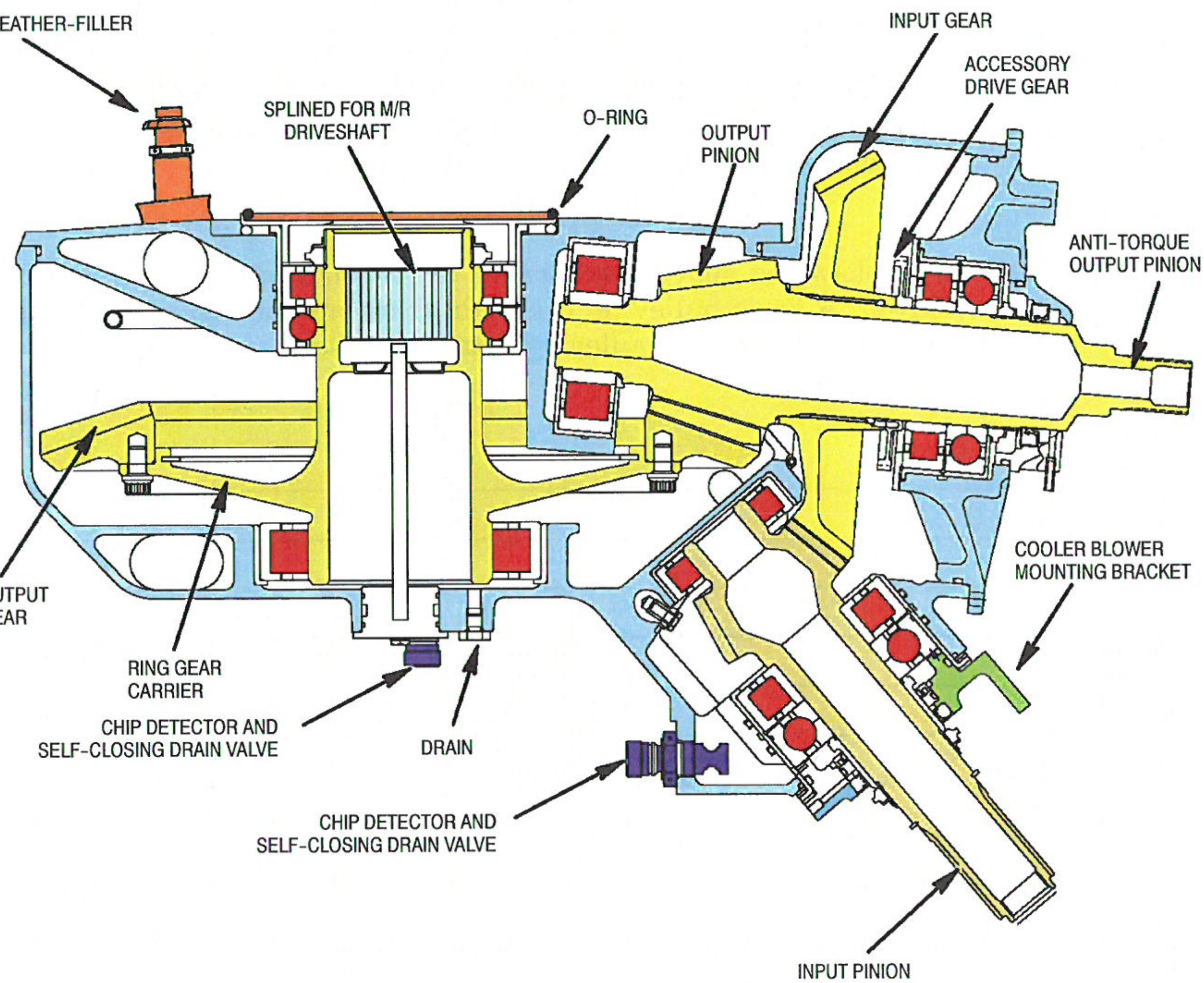


Figure 8-8. Main Rotor Transmission - 369F5100

8-7. MAIN ROTOR TRANSMISSION - 369F5100

General The main rotor transmission is located on the main rotor centerline and is secured to the lower side of the static mast, making it accessible from inside the passenger/cargo compartment. It transmits engine power to the main rotor drive shaft and fan drive shaft at reduced speeds.

Description and Construction The transmission housing assembly consists of the main housing, the output cover, and the tail rotor drive cover, and is made of magnesium alloy. A sight gauge is located on the right side of the transmission in the reservoir area. An inspection port has been placed above the sight gauge to allow inspection of the inside of the transmission without removing the transmission from the aircraft. Located in the bottom of the housing are two magnetic self-closing chip detectors that also serve as drains. Any metallic particle coming in contact with either detector closes a circuit which illuminates an instrument panel yellow caution light marked **XMSN CHIPS** causing it to illuminate. On the top front side of the transmission housing, there is a filler breather for servicing the transmission with oil. A oil pressure switch and snubber are located on the lower, right rear portion of the main housing near the transmission pressure pump. The switch is set to close when the transmission oil pressure drops below 15 psi and illuminates a red warning light on the instrument panel marked **XMSN OIL PRESS**. The snubber dampens the lubrication pump pressure pulses going to the switch to preclude momentary illumination of the warning light.

Internal Gearing All the gears are spiral bevel type gears, except for the accessory drive gears, which are the spur gear type. Spiral bevel gears have proven strength, durability, and high contact ratio.

The input pinion gear meshes with the input bevel gear on the tail rotor output pinion shaft and steps down the input speed from 6196 to 2140 (6016 to 2848 RPM respectively for the 530F-Plus) at the tail rotor output shaft. The output pinion gear meshes with the output bevel gear, turning the output gear shaft at 492 RPM (475 RPM 530F-Plus) for the main rotor drive.

Accessory Drives Four accessory drive pads are located on the tail rotor drive cover. The lower right pad mounts the transmission lubrication pump and filter. The filter has an impending bypass indicator that is viewable by removing a plug that is aft of the transmission oil sight gauge. The lower left pad mounts the scavenge oil pump. The upper right pad mounts the N_R tachometer for main rotor RPM indicating.

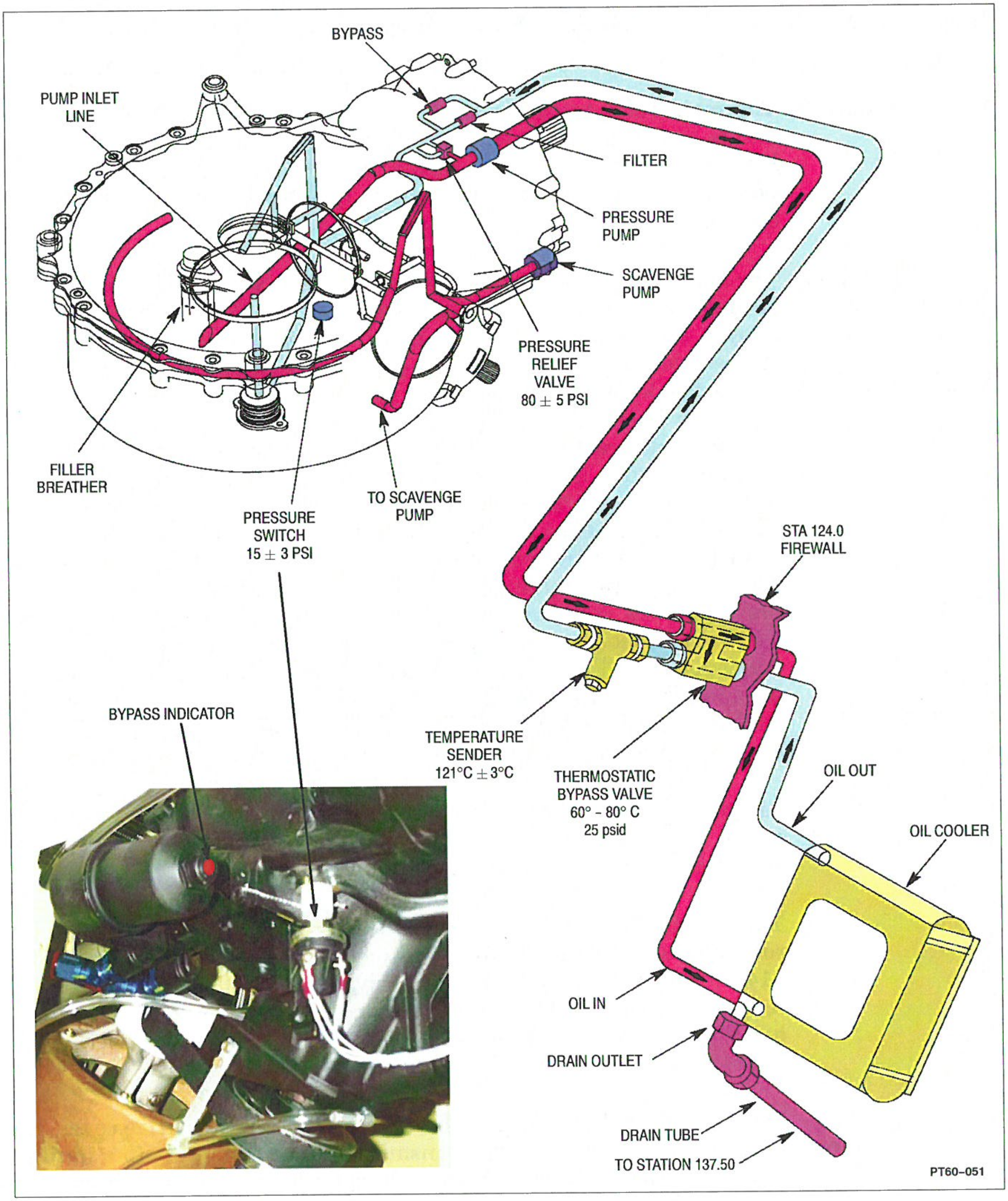


Figure 8–9. Main Transmission Lubrication System – 369F5100

8-8. MAIN TRANSMISSION LUBRICATION SYSTEM - 369F5100

General The main transmission has a pressure lubrication system, which uses an external oil cooler and a scavenge system to draw oil from the input sump. The total system capacity is approximately seven quarts, of which five are in the transmission. The pressure lubrication system consists of an externally-mounted pressure pump with an internal oil filter, external oil filter bypass indicator, oil filter bypass valve, thermostatic bypass valve, oil cooler, oil temperature sensing switch, and miscellaneous lines and fittings. The scavenge system consists of an externally-mounted scavenge pump and an aluminum tube that sprays oil around the output gear to the main sump.

Pressure oil leaves the externally-mounted pressure pump and flows directly to the oil cooler, located on the engine side of the firewall. When the thermostatic bypass valve senses oil temperatures of 60°C or more, it modulates toward the closed position and reaches the fully-closed position at 82°C, allowing the oil to pass through the cooler. If the oil cooler becomes plugged, the bypass valve senses differential pressure and opens at 25 psid to allow the oil to again bypass the cooler. Under normal operation, when the oil leaves the cooler, it passes through a temperature switch that is the sensing unit for the high transmission oil temperature warning lamp (**XMSN OIL TEMP**) on the instrument panel. If the oil temperature reaches 121 ± 3°C, the red transmission oil temperature warning light illuminates. The oil then returns to the pressure pump and passes through the 3 micron oil filter. If stoppage occurs in the pump filter, a pressure-sensitive bypass opens and allows oil to flow around the filter. For normal operation, after the oil passes through oil filter, the oil pressure is sensed at the system relief valve, which opens if the pressure reaches 80 ± 5 psig. The oil now enters the lubrication passages to the various parts of the transmission. Oil pressure is sensed at the entrance to these oil passages by a pressure switch which activates if the pressure falls below 15±3 psig. This pressure switch is the sensing unit for the transmission oil pressure warning light on the instrument panel.

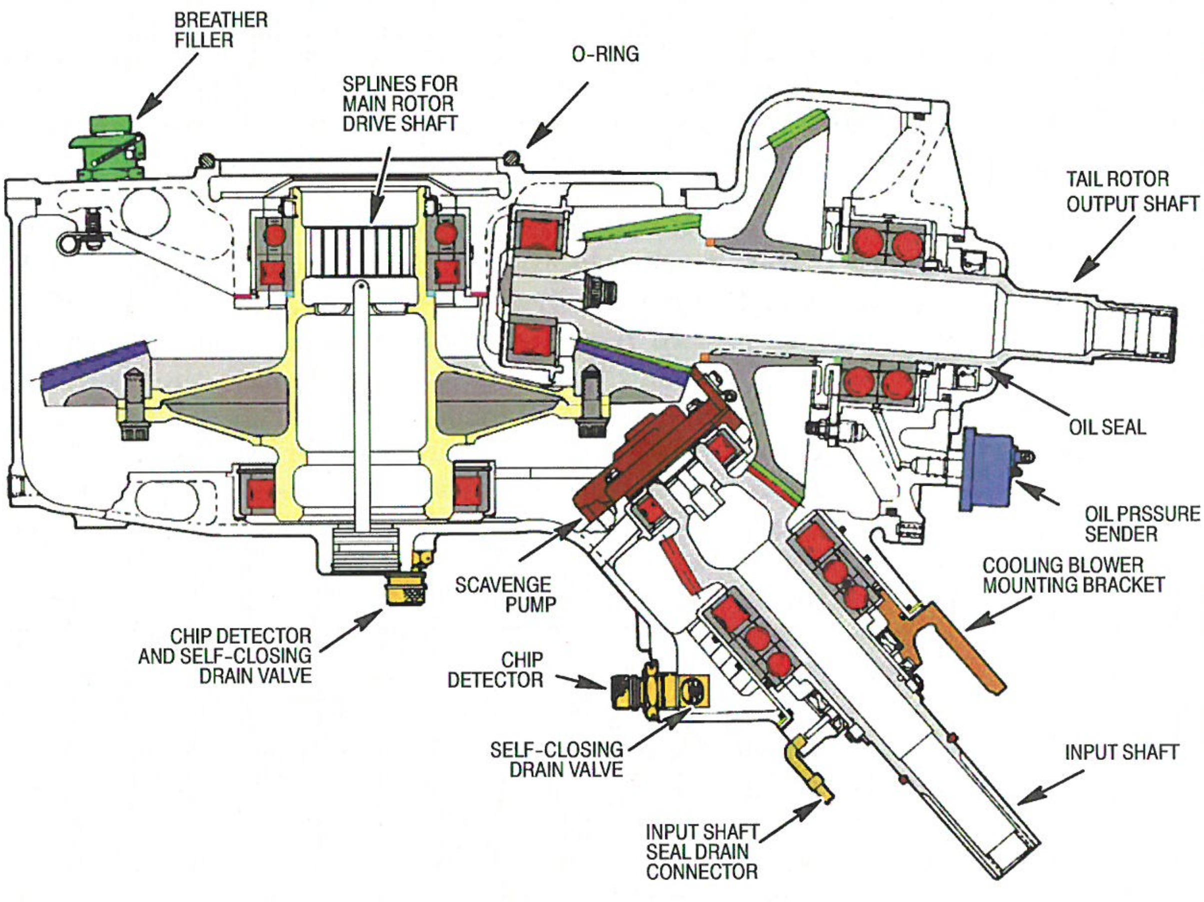


Figure 8–10. Main Rotor Transmission – 369D25100

8-9. MAIN ROTOR TRANSMISSION - 369D25100

General

The main rotor transmission is located on the main rotor centerline and is secured to the lower side of the static mast, making it accessible from inside the passenger/cargo compartment. It transmits engine power to the main rotor drive shaft and tail rotor drive shaft at reduced speeds.

Description and Construction

The transmission housing assembly consists of the main housing , the output cover, and the tail rotor drive cover, and is made of magnesium alloy. A sight gage is located on the right hand side of the transmission in the reservoir area. Located in the bottom of the housing are two magnetic self-closing chip detectors that also serve as drains. Any metallic particle coming in contact with either detector closes a circuit to an instrument panel amber caution light marked **XMSN CHIPS** causing it to illuminate. On the top forward side of the transmission housing, there is a filler breather for servicing the transmission with oil. At the rear of the housing, mounted on the tail rotor output cover, there is an oil pressure switch. This switch is set to close when the transmission oil pressure drops below 15 psi and causes a red warning light on the instrument panel marked **XMSN OIL PRESS** to illuminate.

Internal Gearing

All the gears are spiral type gears, except for the accessory drive gears, which are the spur gear type. Spiral bevel gears have proven strength, durability, and high contact ratio. The shafts are straddle-mounted on heavy duty rollers and ball bearings to provide rigid construction desirable for spiral bevel gears.

The input pinion gear meshes with the input bevel gear on the tail rotor output pinion shaft and steps down the input speed from 6196 to 2140 rpm at the tail rotor output shaft (6016 and 2848 respectively for 530F Plus). The output pinion gear meshes with the output bevel gear, turning the output gear shaft at 492 rpm for the main rotor drive.

Accessory Drives

Two accessory drive pads are located on the tail rotor drive cover. The right hand pad mounts the transmission lubrication pump and filter. The left hand pad mounts the tachometer generator for main rotor rpm (N_R) sense. The accessory drive gear is pinned to the input bevel gear and drives the accessory pinions, increasing the speed from 2140 to 4328 rpm or a ratio of about 2 to 1. The accessory drive shafts are mounted on ball bearings.

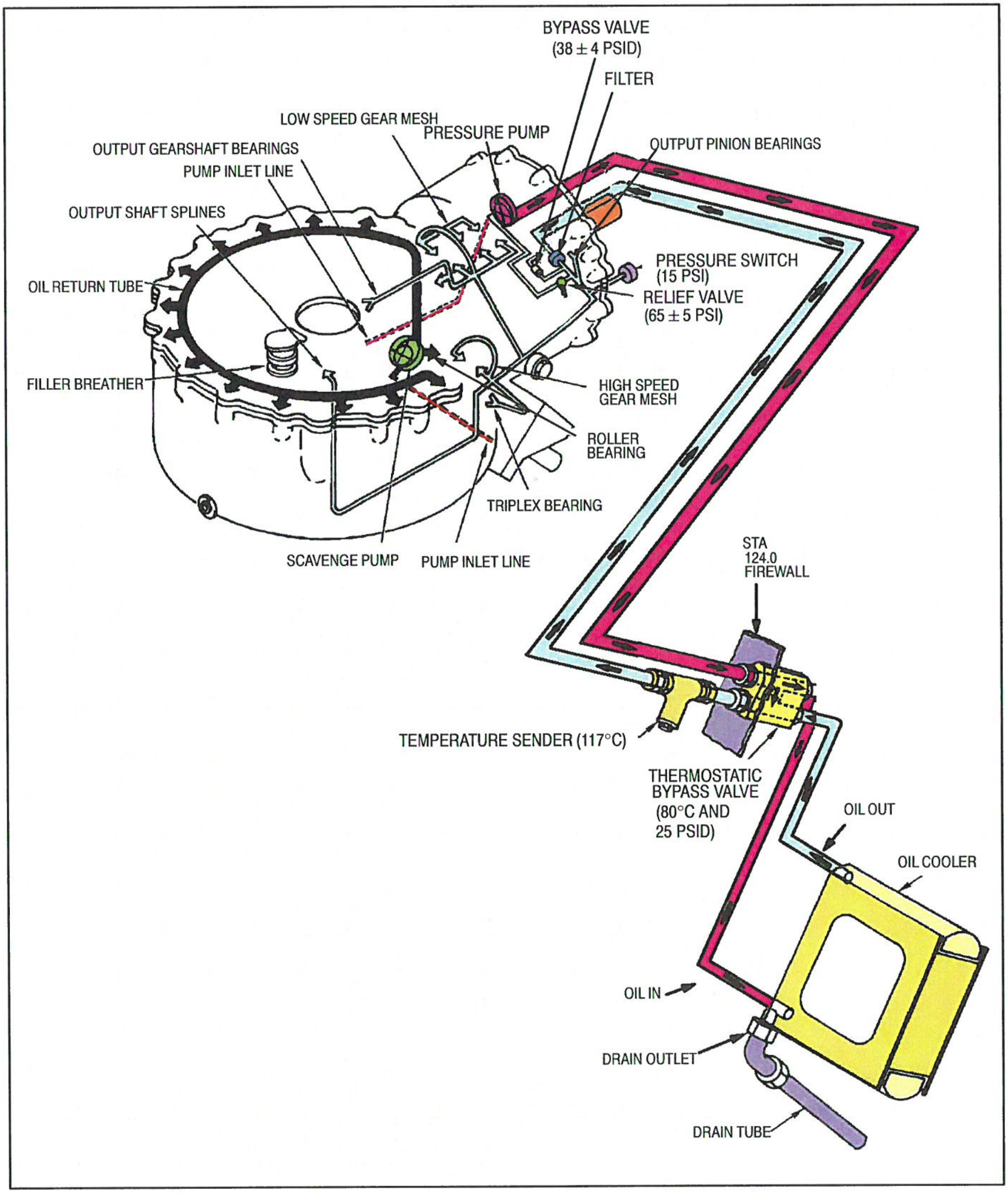


Figure 8-11. Main Transmission Lubrication System 369D-25100

8-10. MAIN TRANSMISSION LUBRICATION SYSTEM - 369D25100

General The main transmission has a pressure lubrication system, which utilizes an external oil cooler and a scavenger system that draws oil from the input sump. The transmission has a capacity of four quarts and the total system capacity is approximately six quarts. The pressure lubrication system consists of an externally mounted pressure pump with an internal oil filter, oil filter bypass valve, thermostatic bypass valve, oil cooler, oil temperature sensing switch, and miscellaneous lines and fittings. The scavenge system consists of an internally mounted scavenge pump and two aluminum tubes.

NOTES:

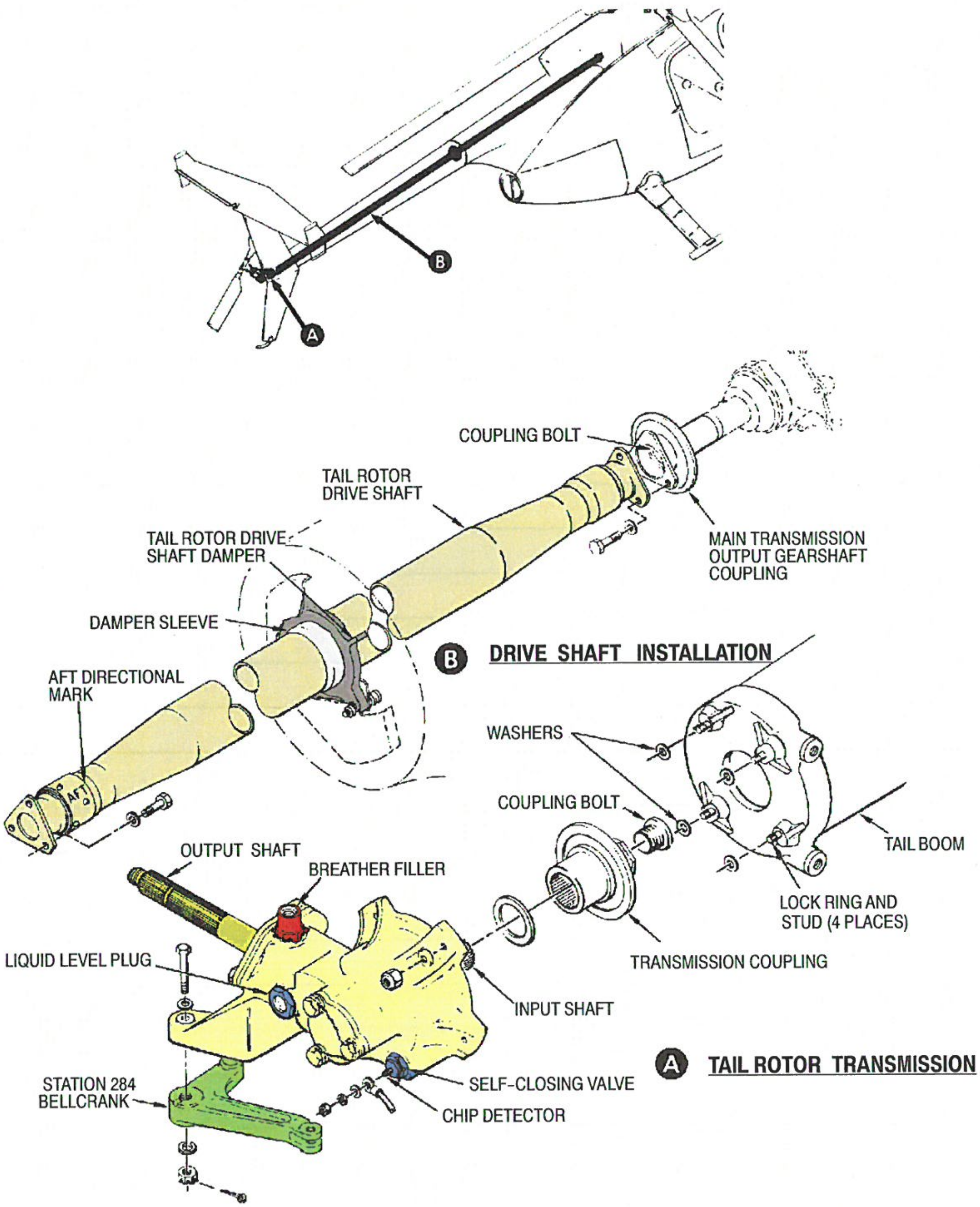


Figure 8-12. Tail Rotor Drive Shaft 500D/E

8–11. TAIL ROTOR DRIVE SHAFT – MD 500D/E

Description and Construction

The tail rotor drive shaft is installed between the the main rotor transmission and the tail rotor transmission. The drive shaft is a dynamically balanced aluminum alloy tube with bonded and riveted aluminum flange couplings at each end. A chrome plated steel sleeve is bonded 77.07 inches from the forward end of the tube and is used as the bearing surface for the drive shaft damper. The sleeve is not centered midway on the tube.

Drive Shaft Couplings

Splined couplings mounted on the main transmission output shaft and the tail rotor transmission input shaft provide connections for the tail rotor drive shaft. The couplings are made of steel and incorporate flexible couplings similar to those on the main drive shaft. The flexible couplings compensate for slight misalignment between the transmissions.

NOTES:

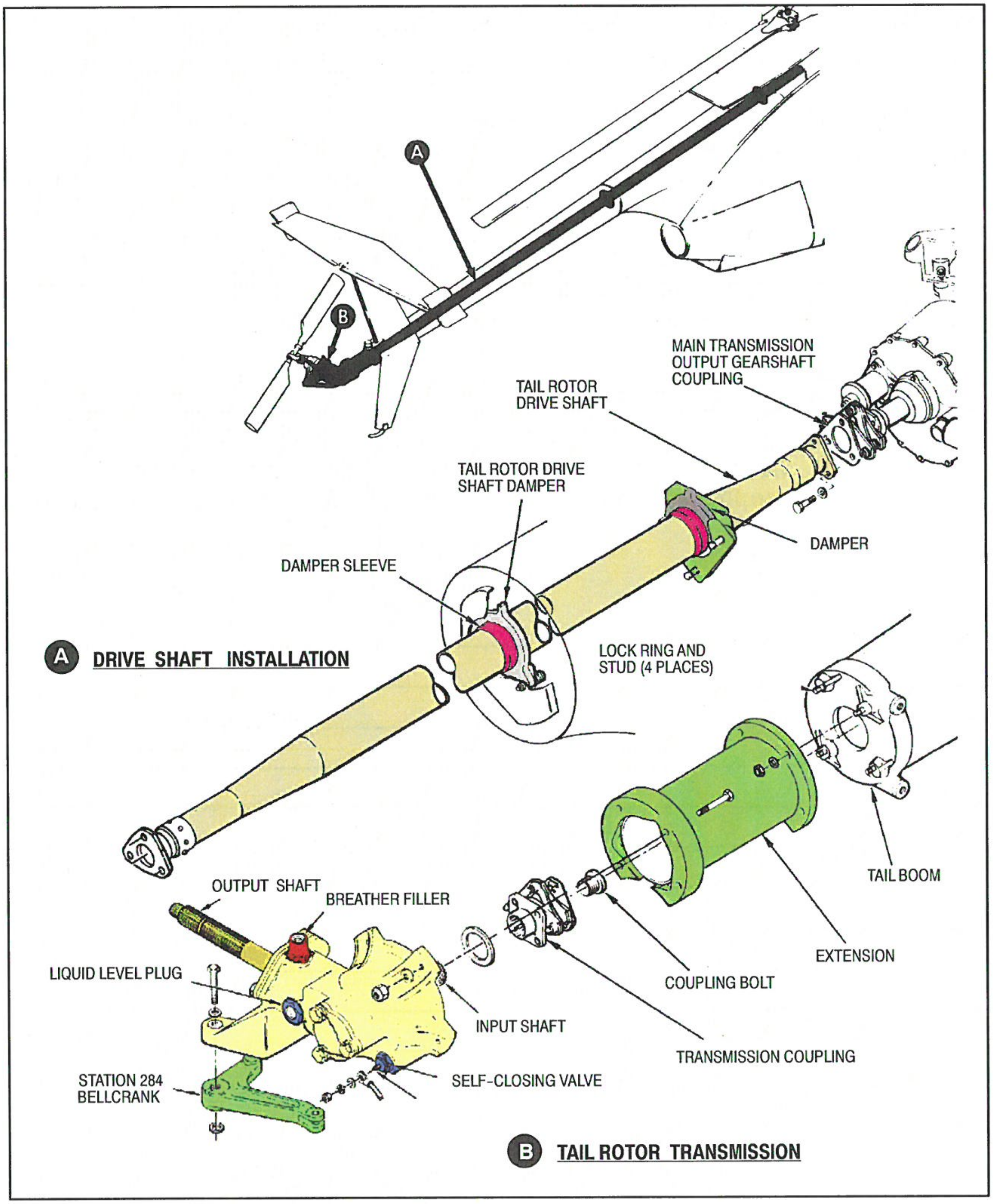


Figure 8–13. Tail Rotor Drive Shaft 530F Plus

8-12. TAIL ROTOR DRIVE SHAFT - MODEL 530F-PLUS

Description and Operation

The tail rotor drive shaft is installed between the main rotor transmission and tail rotor transmission. The drive shaft is a dynamically balanced aluminum tube with bonded and riveted aluminum flange couplings at each end. Two chrome plated steel sleeves are bonded to the tube and serve as the bearing surface for the drive shaft dampers. The sleeves are not centered midway on the tube.

Drive Shaft Couplings

Splined couplings mounted on the main transmission output shaft and the tail rotor transmission input shaft provide connections for the tail rotor drive shaft. The couplings are made of steel and incorporate Kaflex flexible couplings, similar to those on the main drive shaft. The flexible couplings compensate for slight misalignment between the transmissions and require no field lubrication or service.

The forward flex coupling is secured to the main transmission output pinion with a coupling bolt. The aft flex coupling is secured to the tail rotor transmission input pinion with a coupling bolt. The coupling bolts are self-locking. In between the tail rotor drive shaft and coupling flanges and the flex couplings are two sockets, one on each end. The combination of coupling bolts and sockets provide fail safe operation.

NOTES:

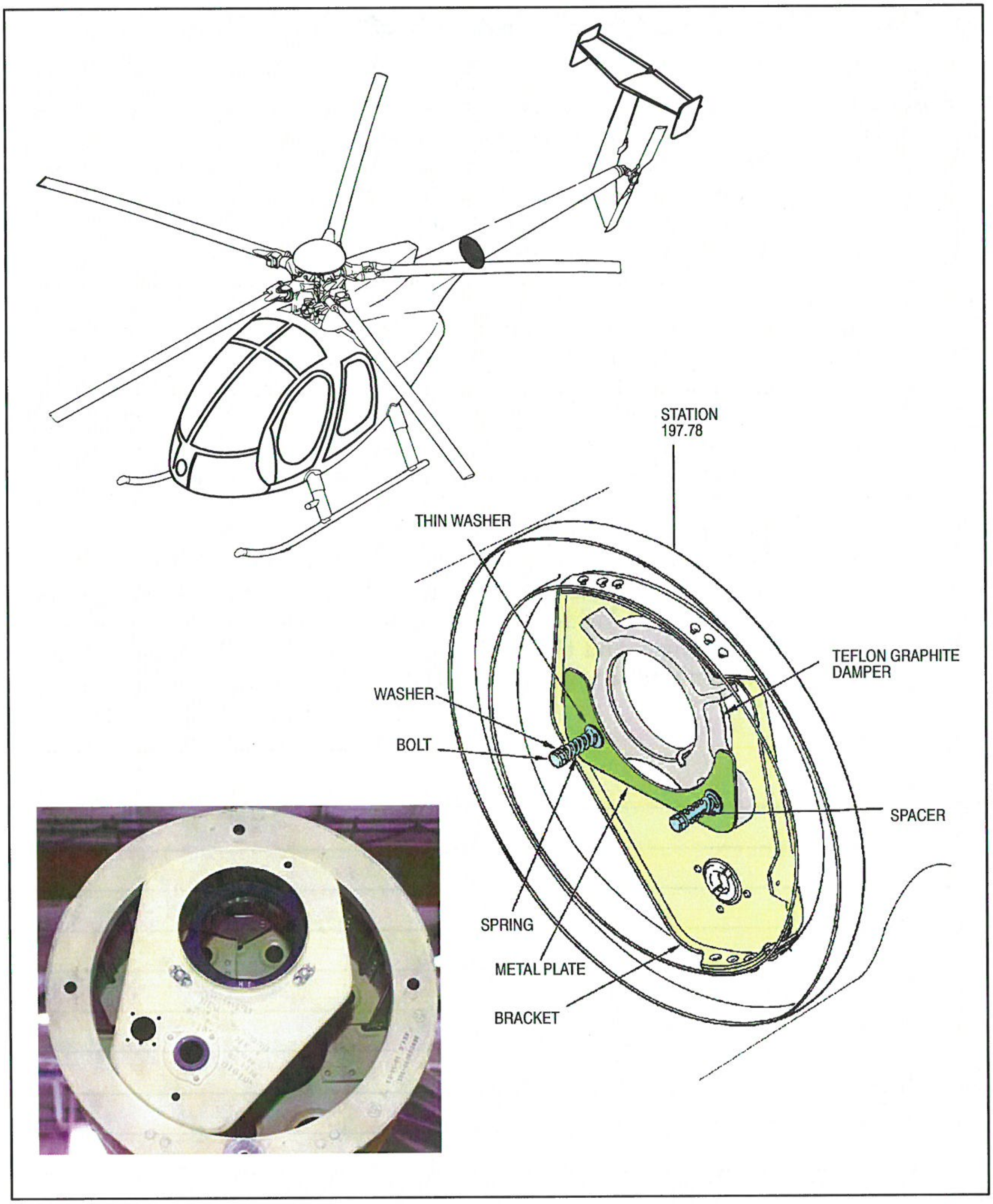


Figure 8-14. Tail Rotor Drive Shaft Damper

8–13. TAIL ROTOR DRIVE SHAFT DAMPER

Description

The tail rotor drive shaft damper is mounted in the aft fuselage boom fairing and surrounds the chrome plated steel sleeve on the tail rotor drive shaft. The damper consists of a 15 percent graphite, 85 percent Teflon, heat treated block, an aluminum plate, two bolts, tow spacers, two springs, and washers as required.

In the case of the 530F Plus an additional damper is installed forward of the normal installation.

Construction

A steel bracket is riveted to the boom fairing and forms the support for the damper assembly. The damper block is sandwiched between this support bracket and the damper plate and secured with the two bolts, spacers, springs, and washers. The spring force, acting on the steel plate, establishes a friction of 2±1/4 pounds on the damper block and is governed by the number of washers between the springs and the plate. The bolts are torqued against the spacers and are not used to adjust friction.

The tail rotor drive shaft must be removed when checking or adjusting damper friction. Access to the damper assembly is through an access plate on the lower side of the tailboom. Damper friction should be checked at regular intervals.

NOTES: ______________________________

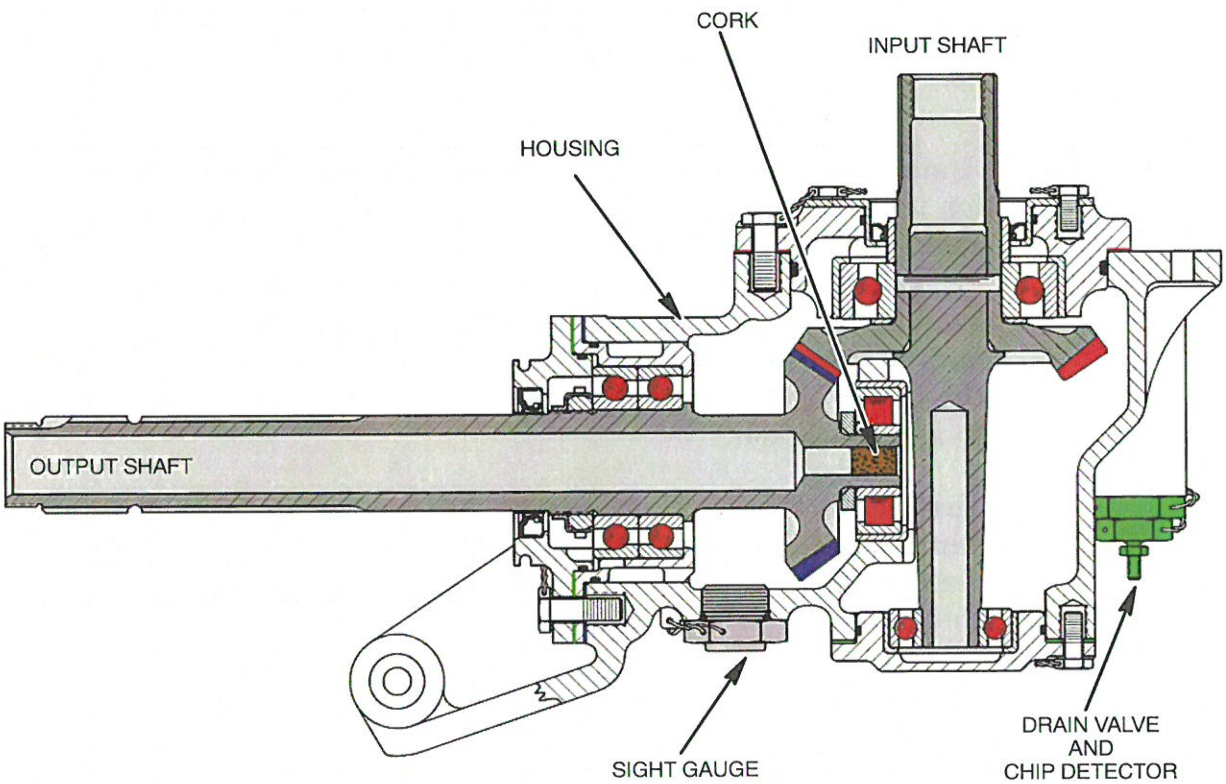


Figure 8–15. Tail Rotor Transmission

8-14. TAIL ROTOR TRANSMISSION

General The tail rotor transmission, mounted on the aft end of the tailboom, serves as the attach point for the tail rotor, changes the direction of drive 90 degrees, and increases shaft speed from 2140 to 2933 rpm.

Construction The transmission contains a single mesh ring and pinion spiral bevel gear set made of vacuum-melted forged alloy steel, carburized, and ground to precision tolerances. Both gears are straddle-mounted to provide the rigid construction desirable for spiral bevel gears. The input shaft has two ball bearings; one on the aft end and one on the forward end. The output shaft has a roller bearing on the inboard end and a duplex bearing set on the outboard end. The housing assembly incorporates input bearing retainers.

Lubrication The transmission has an integral lubrication system and uses the splash method to lubricate the gears and bearings. It is designed so not all oil will be depleted in the event the rotating shaft seals fail. The oil level sight gage is located on the aft end of the gearbox and the filter-breather is located on top. The tail rotor transmission is serviced with 0.5 pint of oil.

Chip Detection In the drain port at the rear of the transmission, a self-closing electrical chip detector is installed. It is wired to an amber caution light on the instrument panel marked **TR XMSN CHIPS**. The instrument is magnetic and any ferrous metal particles that come in contact with it close the electrical circuit and illuminate the lamp.

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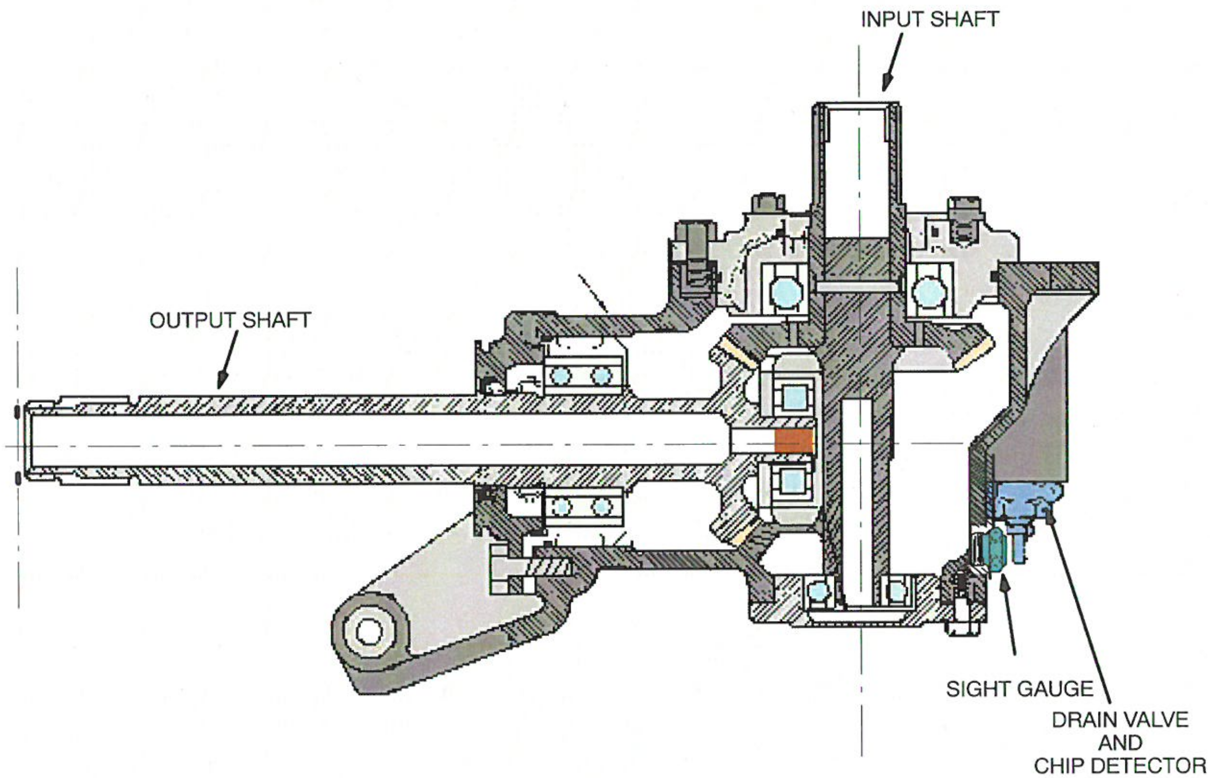

Figure 8–16. Four–Bladed Tail Rotor Transmission

8-15. FOUR-BLADED TAIL ROTOR TRANSMISSION

General The 4-bladed tail rotor transmission is identical in function to the standard 2-bladed transmission, however, the internal gearing is different allowing it to rotate at a reduced RPM.

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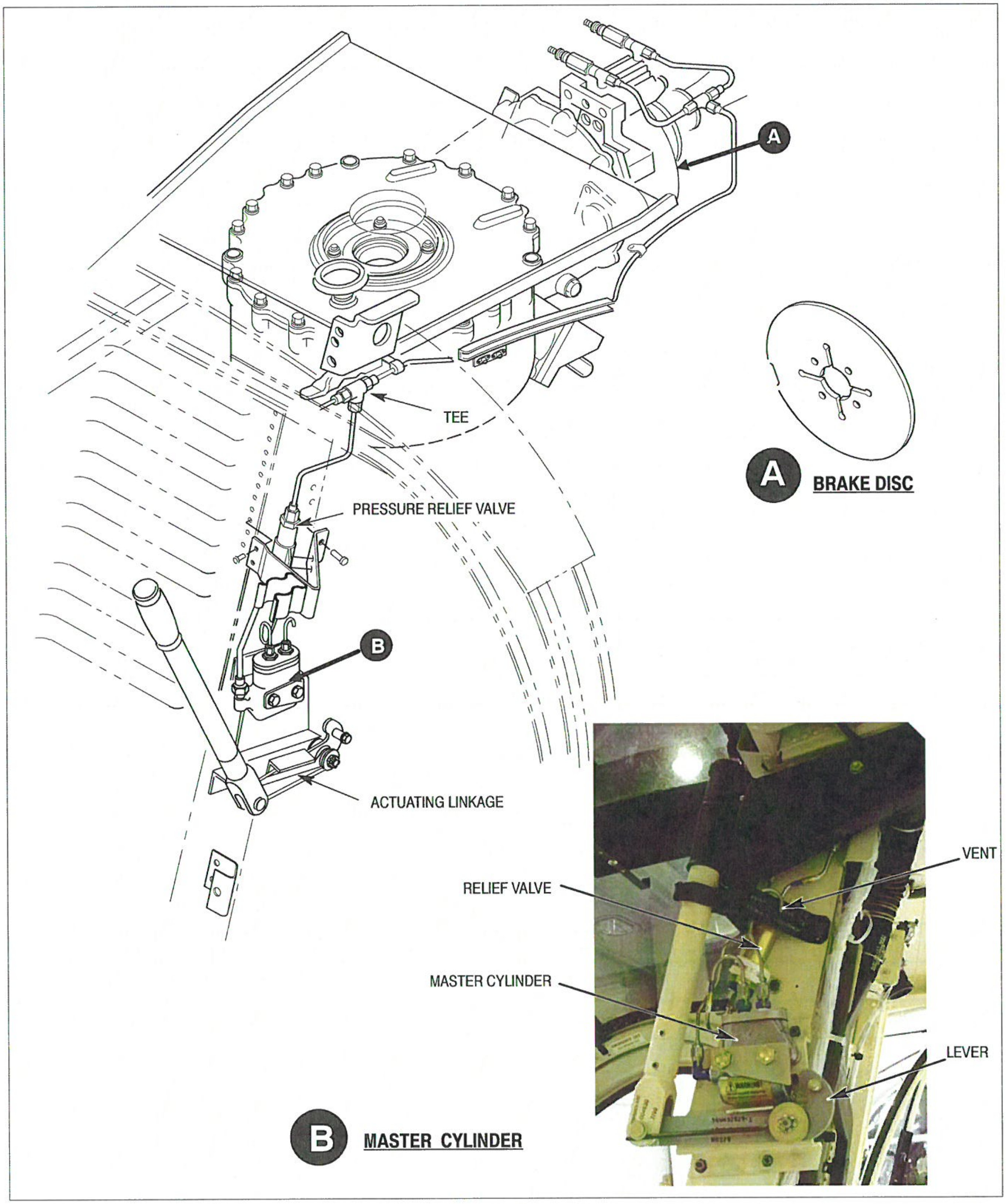

Figure 8–17. Rotor Brake Installation

8–16. ROTOR BRAKE

General

The rotor brake enables the pilot to manually brake the rotor system to a stop by operating a single brake handle. The handle is installed on the upper left (or upper right, depending on helicopter seating configuration) side of the canted bulkhead 78.50 control tunnel in the pilot's compartment. Operation of the brake handle actuates a master cylinder, causing dual pucks to grip a brake disc installed on the tail rotor drive shaft. Braking force is transmitted through the main transmission to the main rotor. A friction clip secures the handle in an out-of-the-way position when the brake is not in use.

The rotor brake installation includes:

- A master cylinder with an actuating handle mechanism (master cylinder and linkage assembly).
- A caliper assembly with dual opposing pistons to which friction pads (brake pucks) are attached.
- A brake disc installed on the tail rotor drive shaft coupling at the aft end of the main transmission.
- A hydraulic pressure relief valve.
- A trim panel assembly and installation.

Rotor Brake Operation

When manual force is applied to the brake handle (master cylinder piston), hydraulic pressure is produced; this pressure is transmitted through the tubing to the caliper assembly where it acts on the pistons. This causes the pucks to apply clamping pressure (braking force) to the brake disc. System pressure is held within safe limits, regardless of the force applied to the brake handle, by operation of the pressure-relief valve. When hydraulic pressure exceeds 500 psig (3447 kPa), the pressure-relief valve opens, venting excess pressure to the master cylinder

NOTE: Repeatedly applying excess force ("pumping the handle") to the control handle may cause hydraulic fluid to vent overboard.

When application of force is discontinued, caliper pistons (and the pucks) are retracted by return springs in the caliper assembly. Puck-to-disc clearance is maintained by action of a self-adjusting mechanism in the caliper assembly.

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HELICOPTERS

MD 500 Pilot Transition Training Manual

SECTION IX
ROTOR SYSTEM

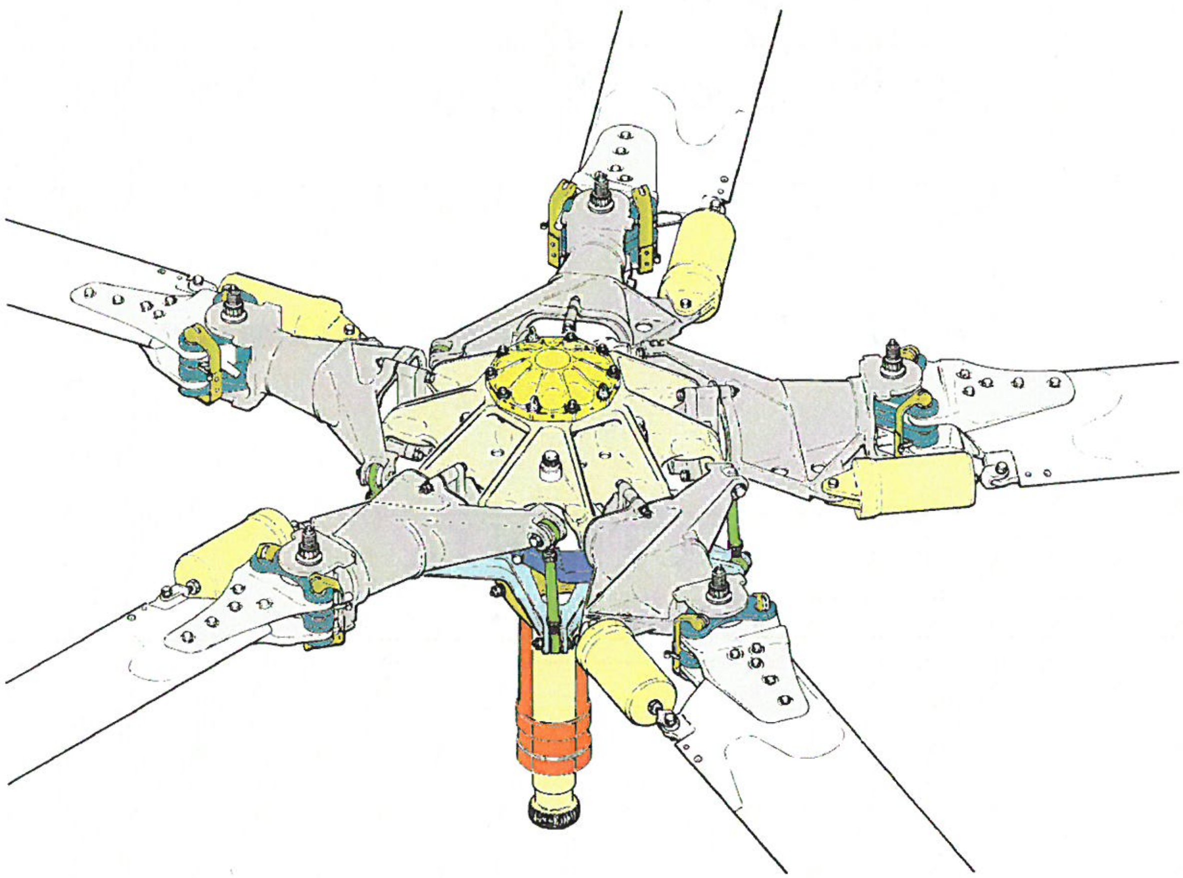

Figure 9–1. Main Rotor Assembly

9-1. MAIN ROTOR

Description

The helicopter utilizes a five bladed, fully articulated main rotor assembly with unique features. While contemporary helicopters use straps in lieu of thrust bearing stacks to contain blade centrifugal loading and allow feathering, the strap arrangement goes three steps further:

First, the strap configuration (while secured firmly to the hub by bolts) actually allows the centrifugal load exerted by one blade to be reacted by the opposite two blades. Thus, very light centrifugal loads are sensed by the hub.

Second, the V-legs of the strap packs rotate as driving members to turn the blades. In other words, the straps act as the spokes of the wheel to impart the rotating movement to a point outboard of the hub, which, instead of a wheel rim happen to be the rotor blades.

Finally, the straps are configured to allow flapping and feathering of the blades. Utilization of the blade restraining straps as just described allows a weight reduction of approximately 100 pounds.

NOTES:

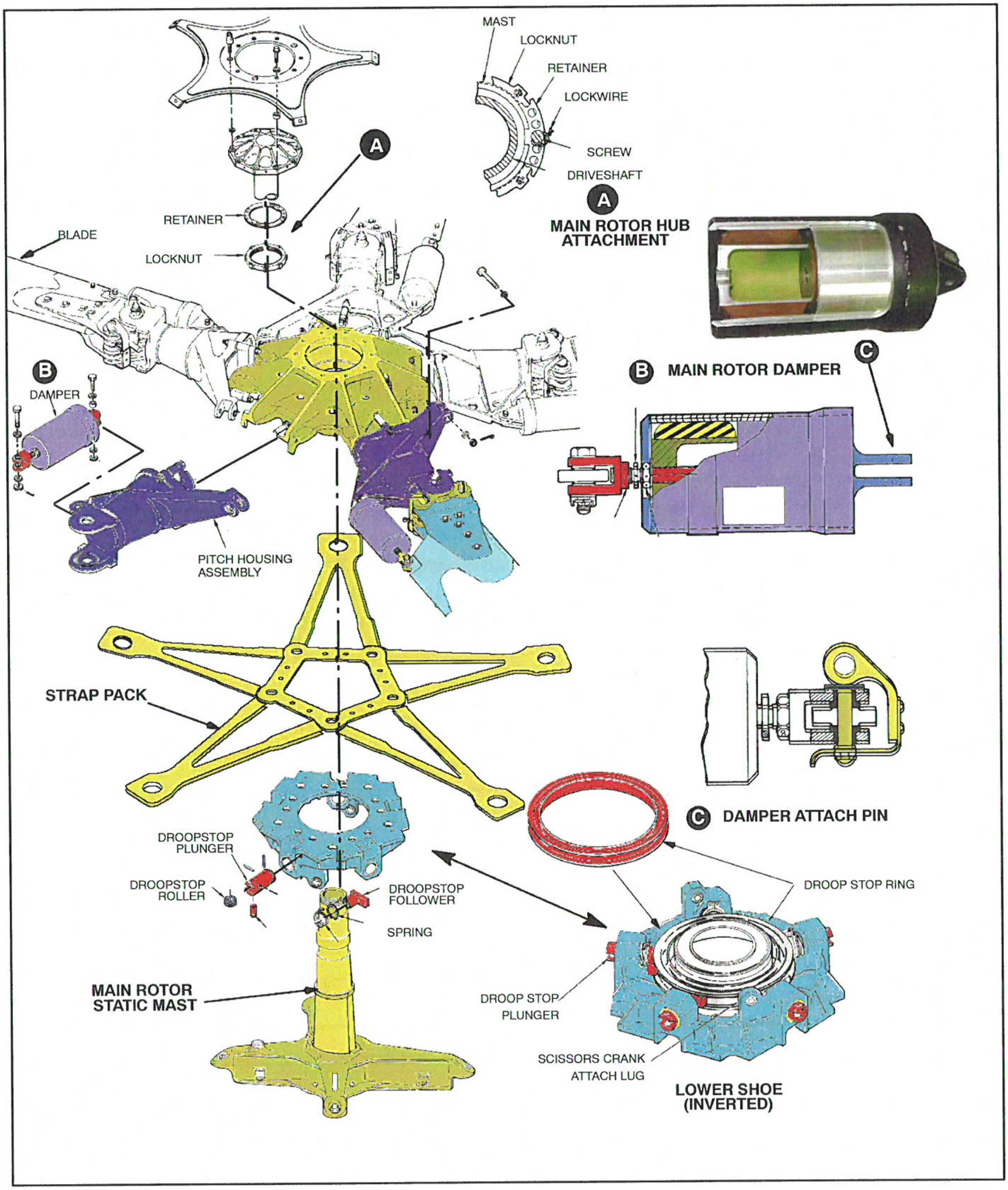

Figure 9-2. Main Rotor Hub

9-2. MAIN ROTOR HUB

Components and Construction

The hub, an aluminum alloy forging machined to its final configuration.

Lower shoe, also a machined aluminum alloy forging.

Five pitch housings (also aluminum alloy)

Five pitch bearing assemblies attached to the pitch housing assemblies.

Riding between the hub and lower shoe and out through the pitch housing, is the strap pack assembly.

The lead-lag link assemblies are secured to the outer extremities of the strap pack.

Attached to the pitch housing are the five main rotor dampers.

Completing the assembly is the droop stop ring, which is a maraging-steel ring, and five follower assemblies.

Attachment

The rotor hub is interconnected to the static mast by two opposed tapered roller bearings. The bearings are hand packed with grease. The grease is retained in the bearings by three lip seals.

The bearing arrangement is locked together and the hub is secured to the static mast by a locknut and retainer used in conjunction with two screws.

Hub assemblies are dynamically balanced. Balance bolts and weights are added to the hollow lead-lag bolt as necessary.

Elastomeric Dampers

There are five elastomeric type main rotor dampers, each attached to the aft side of the applicable pitch housing and to the trailing edge of each blade. The purpose of the dampers, as their name implies, is to dampen the lead-lag of hunting moments of the main rotor blades. The dampers are essential to rotorcraft equipped with fully articulated rotor heads. When operating normally, they space the blades so that no lateral vibration is felt in the aircraft.

The dampers consist of an aluminum cylinder and two assemblies filled with a rubber-like material, and a clevis attachment point at each end. The housing clevis is nonadjustable and attaches to the pitch housing . The adjustable turnbuckle clevis attaches to the trailing edge of the main rotor blade, and is interconnected with the rubber-like material within the cylinder. The dampers operate on the principle of hysteresis. When a shear load is applied to the rubber-like material, it is slow in returning to its original shape.

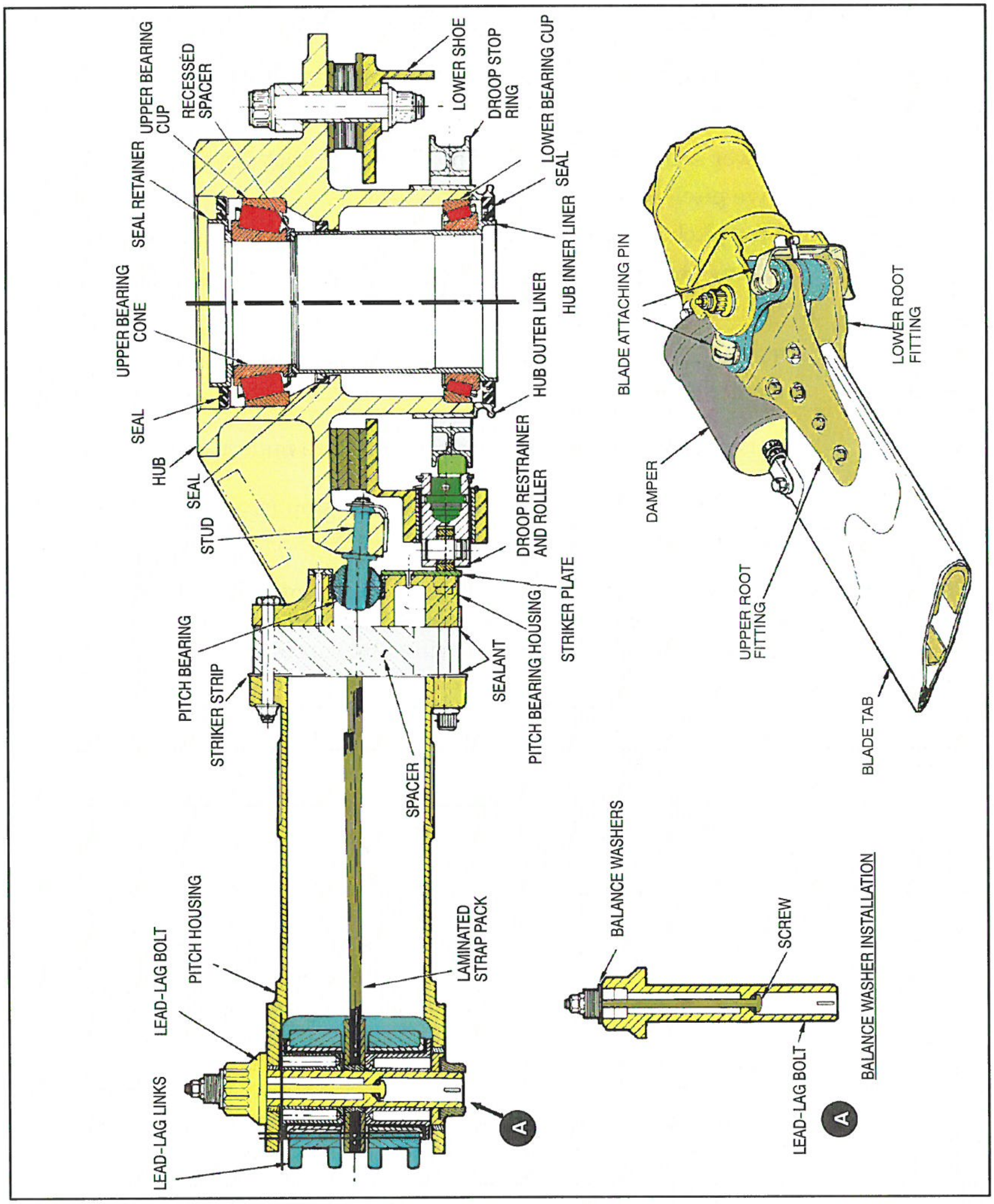

Figure 9-3. Main Rotor Hub Cross Section

9-3. PITCH HOUSING

Description and Construction

The pitch housing is a hollow aluminum casting. The pitch bearing assembly consists of a steel striker plate that is attached to the forged aluminum pitch bearing housing by nuts and screws. The pitch bearing is inserted into the housing and captured by the striker plate. This is a Teflon-lined spherical bearing. The spacer, an aluminum extrusion, completes the stack up. The entire bearing assembly is secured to the pitch housing by three bolts. The stud is a nitrited steel unit situated in the hub and secured by a self-locking nut. All five pitch housings are assembled and mated to the hub in the same manner.

Lead-Lag Assembly

The lead-lag bearings are a press fit in the links. These bearings have Teflon-lined shoulders and bores. Situated in the link bearings are steel bushings that bear against the Teflon surfaces of the link bearings. Torque on the lead-lag bolt tightly clamps the strap pack end, at the same time the lead-lab links are free to rotate. The lead-lag links are situated between the outboard ears of the pitch housings. The links are aluminum forgings; there are two links per pitch housing. The lead-lag links are secured by a special bolt. This bolt, which is hollow, has a shank held to within 0.0005 inch. It is machined from high-nickel steel, heat treated and cadmium plated. This bolt is a serialized item and has a finite life.

NOTES: ____

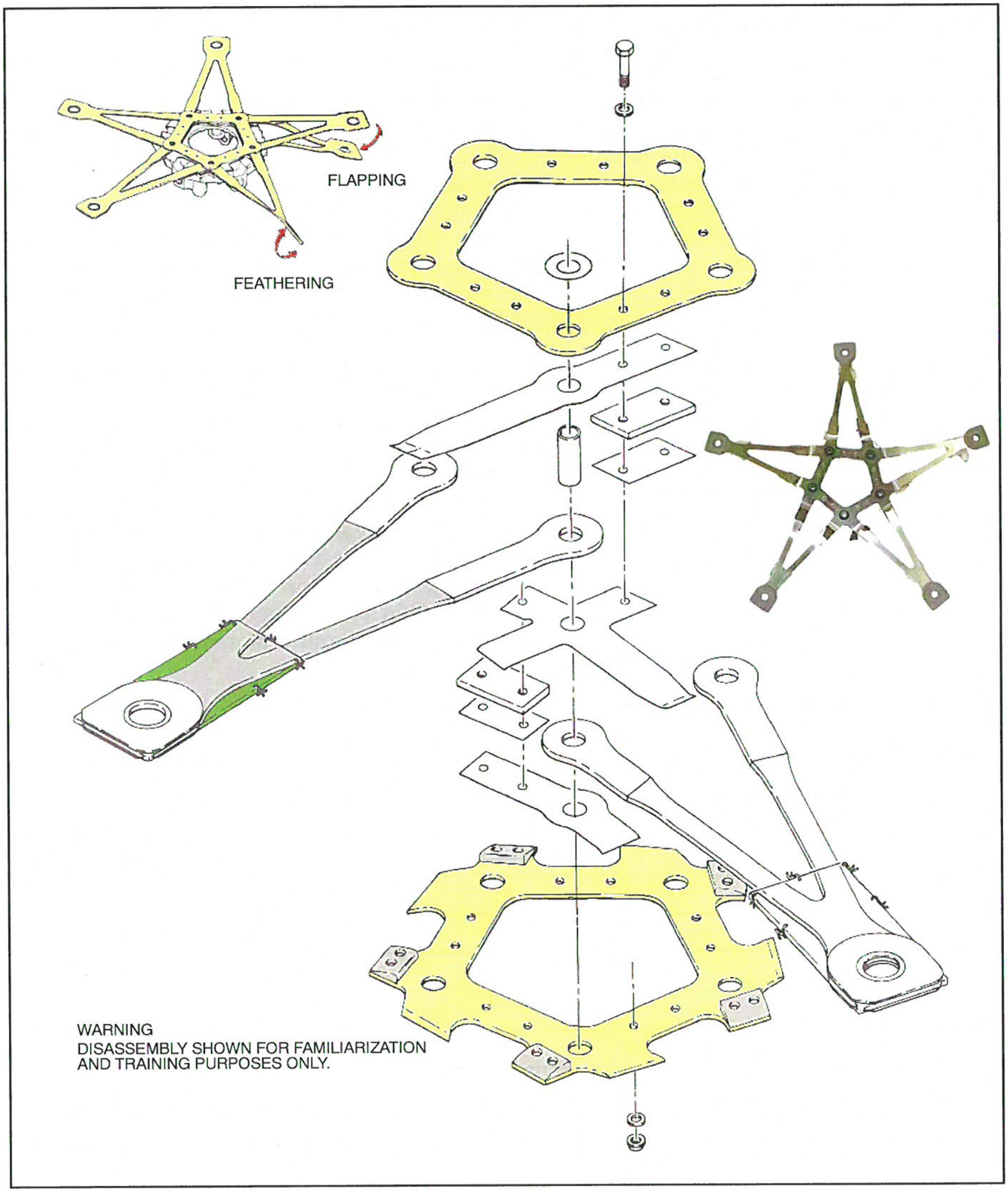

Figure 9–4. Strap Pack

9-4. STRAP PACK

Description The most significant fail-safe features of the MD500 series helicopter are found in the main rotor system. The straight through strap retention system transfers all major centrifugal, propulsion, and thrust forces from a lag hinge of each rotor blade directly through the pitch housing to the center plates; then to the lag hinges of the two opposite rotor blades. The V-configuration supports both steady and cyclic forces in the rotor plane at the lag hinge. Blade collective and cyclic pitch motions are provided by warpage of the strap assembly about the feathering axis. The straps are unique items and are the key to the rotor head's simplicity and light weight. They react to the centrifugal loads of the main rotor blades and replace the flapping and feathering hinge arrangement found in conventional fully articulated rotor heads.

The strap packs are sandwiched between two steel plates before installation into the hub assembly. The upper and lower plates have five large diameter holes for hub-to-strap attachment and ten smaller holes for bolts securing the strap pack laminates. Each strap assembly has 16 straps. Each strap is 0.009 inch stainless steel, so machined that its grain structure lies parallel to the line between the blade attachment points. This is parallel to the centrifugal load path. Teflon impregnated cloth strips are bonded under each strap where the straps bear between the upper and lower plates. The outer straps of each pack have the Teflon cloth bonded to their upper sides also. The teflon eliminates fretting corrosion.

NOTES: ____________________

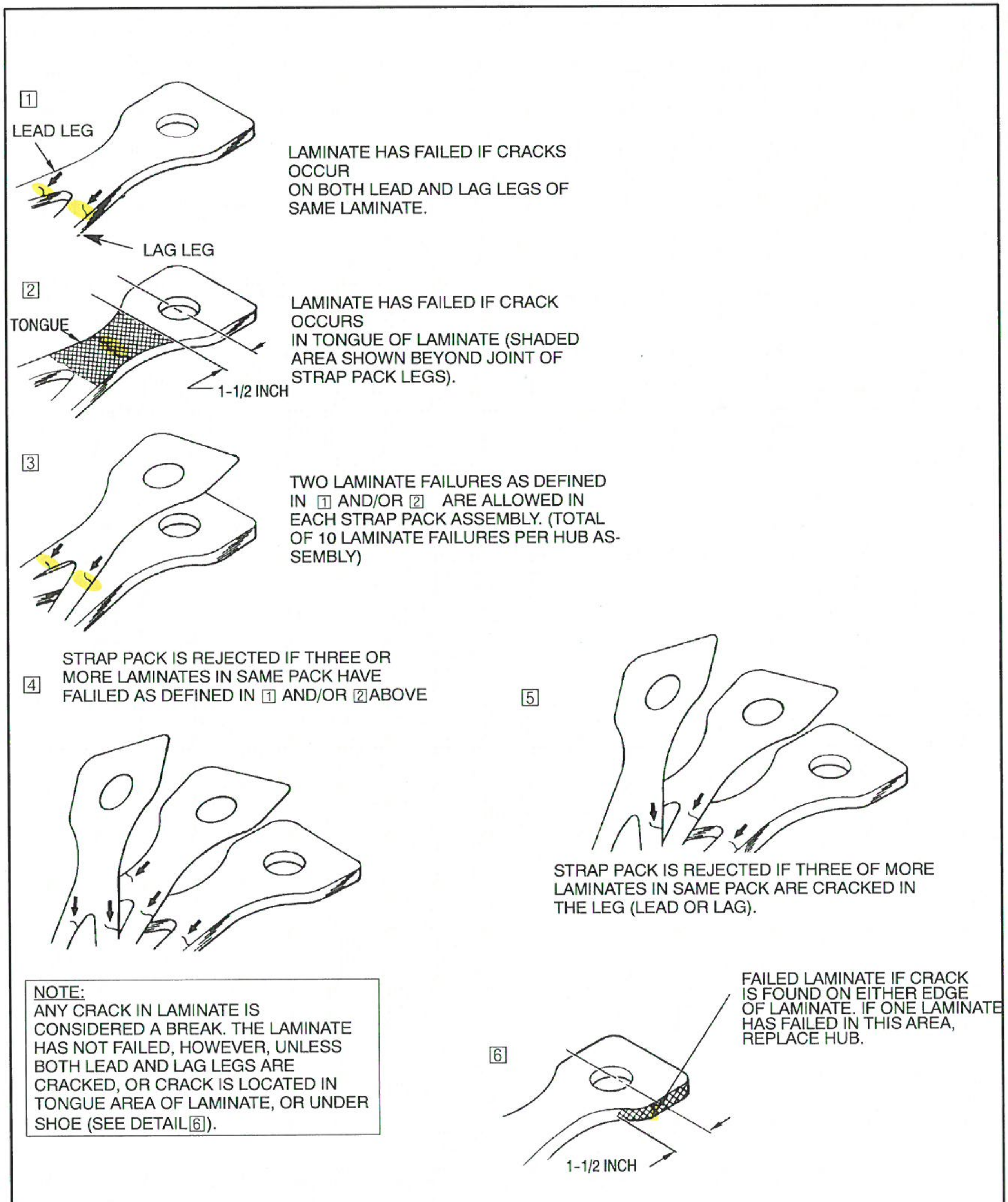

Figure 9–5. Main Rotor Strap Pack Checks

NOTES:

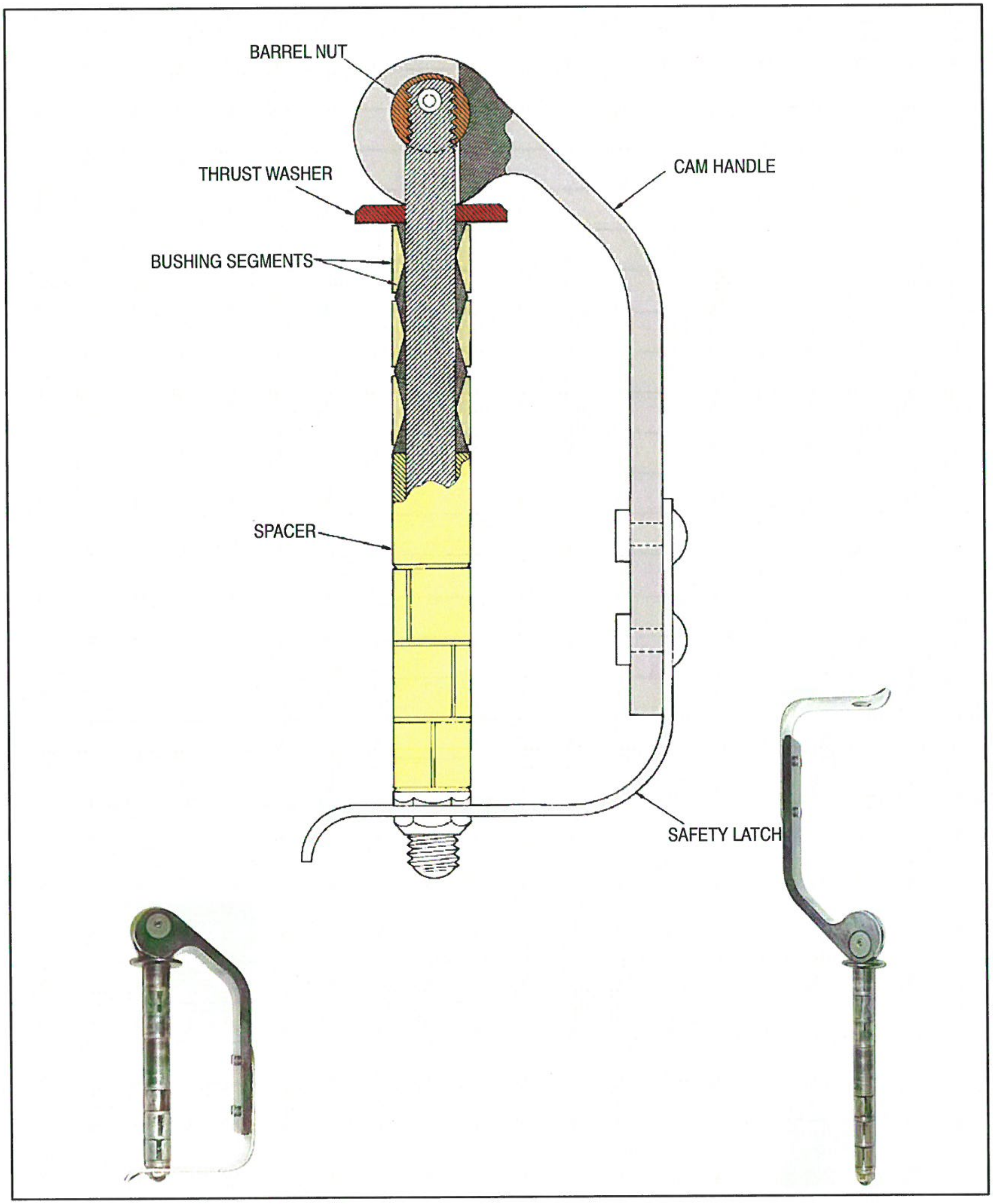

Figure 9–6. Blade Attaching Pins

9-5. BLADE ATTACHMENT

Description Blade attachment is accomplished by blade attaching pins that are designed for quick installation and removal. There are two blade attaching pins per pitch housing. The pins are threaded on both ends. The upper end has a roll pin-secured barrel nut and the lower end has an adjustable hex nut. Assembled on the bolt is a series of bushings, a spacer, a thrust washer, and a handle which is designed to work as a cam. The pin is installed, and the adjustment nut tightened against the expandable bushing until the desired fit is achieved. The handle cam is closed and secures the adjusting nut. Releasing the handle cam allows removal of the pins without altering adjustment.

PREFLIGHT CHECKS

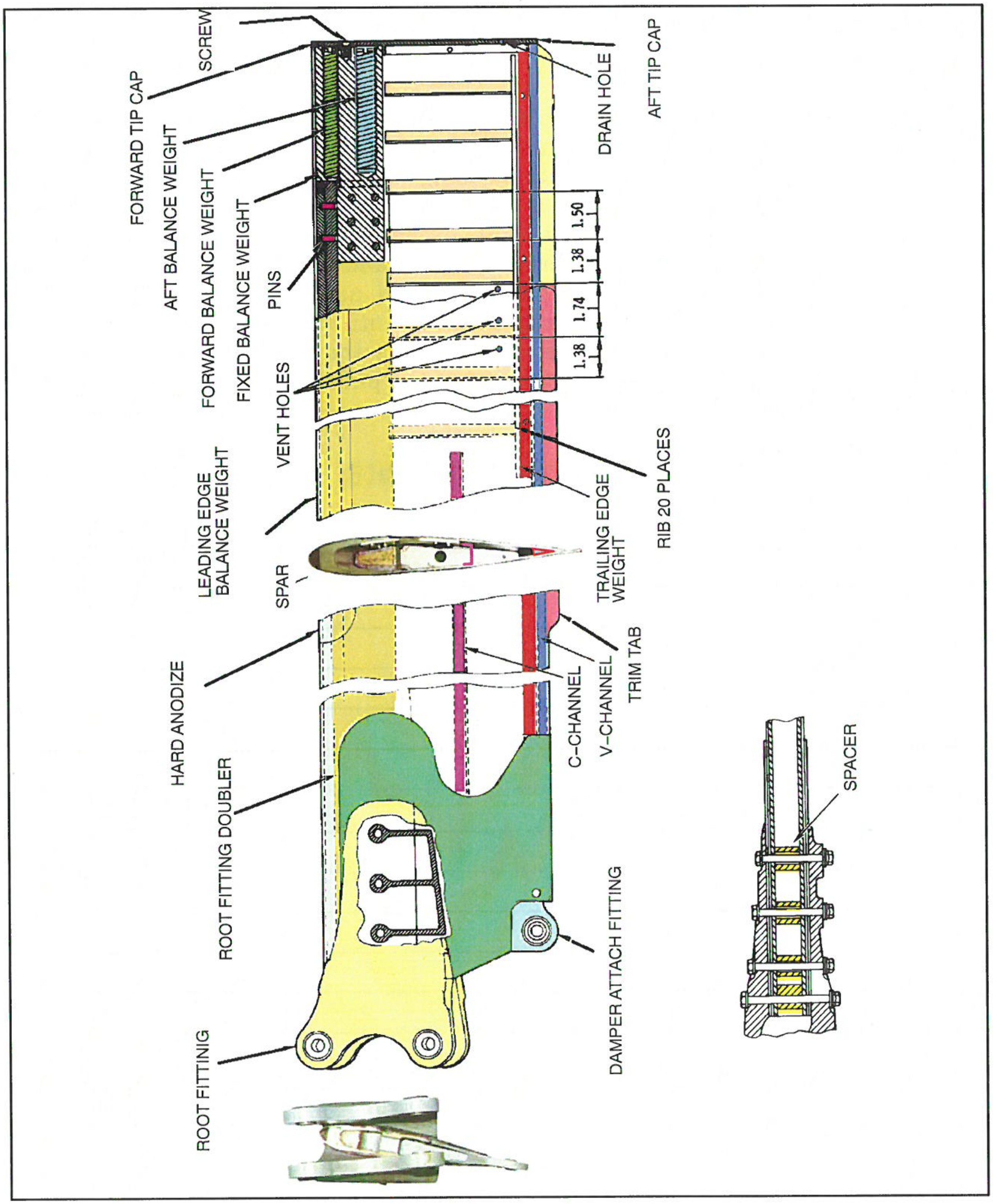

Figure 9–7. Main Rotor Blade

9-6. MAIN ROTOR BLADE

General Each main rotor blade is a balanced airfoil with adjustable trim tabs. The main rotor blade contains a U-shaped aluminum extrusion, machined to its final configuration, which forms the spar. An approximate 8 degree negative twist is refined into the spar between its root end and its tip end.

NOTE: Another angular relationship of interest exists. The attachment of the blade root end to the rotor head, when compared with the blade root chordline, is found to be offset by a negative 13 degree 43 minute angle. The reasoning for such an arrangement is based on the strap pack V-configuration. The straps "want" to turn in a flat state, and actually resist pitch changes from the flat or neutral pack position. To obtain optimum life and low feedback, the flight controls, rotor hub, and blades are designed to allow the strap packs to remain at or near a neutral position during cruise modes of operation.

Construction The leading edge of the spar is flat. A naval brass extrusion, conforming to the blade's airfoil requirements, is bonded to the leading edge of the spar. It is called the leading edge balance weight. Wrapped around the spar and forming the airfoil is a one piece, aluminum skin. It is twisted to conform to the negative twist of the spar and bonded to the spar. An aluminum V-strip bonded in place secures the trailing edges of the airfoil envelope together. The skin has a section that extends beyond the actual trailing edge to form the trim tab section, and is used for blade tracking adjustments in the field. An aluminum channel forms a spanwise support to reinforce the skin section. The channel is bonded to the skin.

Twenty aluminum ribs, equally spaced and bonded in place, are located in the blade tip. The leading edges of the ribs slip into the lips of the spar. The trailing edges of the ribs extend back to the trailing edge weight, which is a brass extrusion. The trailing edge weight is bonded to the skins and secured with rivets. At the inboard end of each blade, there is a three-fingered cast aluminum spacer that takes the compression of three of the root fitting attach bolts. The spacer is bonded in place. A forged aluminum unit forms the damper attach fitting. The fitting sits chordwise in the spar and forms a solid mounting surface for the two remaining bolts of the root fitting. The bearing that forms the damper clevis attach point is swaged in position, and is replaceable.

Doublers are situated on the top and bottom sides of the airfoil under the root fittings. The root fittings are designed to give the blade positive pitch while the fittings and the strap pack remain at or near a neutral position.

9–7. MAIN ROTOR BLADE RETIREMENT INDEX NUMBER (RIN)

A Retirement Index Number (RIN) is a number that accounts for different usage spectra in assigning the retirement time for a component.

The RIN is calculated as the sum of an adjustment factor times flight hours plus another adjustment factor times Torque Events.

When a component reaches 1,000,000 RIN's, it has reached it's maximum life and is to be scrapped.

Torque Event A Torque Event (TE) is defined as:

- The transition to a hover from forward flight.
- Any external lift operation.
- All autorotations including power recoveries.

NOTE: An external lift can either be on the cargo hook, external hoist or in external baskets.

- For external lift operators, an external load is recorded as two (2) TE's (pick-up and drop-off).
- Hover taxi with no external load will typically result in no TEs.

External Lift and Torque Event (TE) The 369D/E/F/FF - 500/600N helicopters are multi-use helicopters. If the helicopter is used primarily for external lifts or training flights (high TE flights), there may be a reduction in inspection intervals of some components.

CAUTION **For safe operation of the helicopter, the total number of TE's for a day's flight must be recorded in the Rotorcraft Log Book following the last flight of the day. Each external lift will be recorded as two (2) TE's.**

HELICOPTERS

MD 500 Pilot Transition Training Manual

SECTION X
FLIGHT CONTROLS

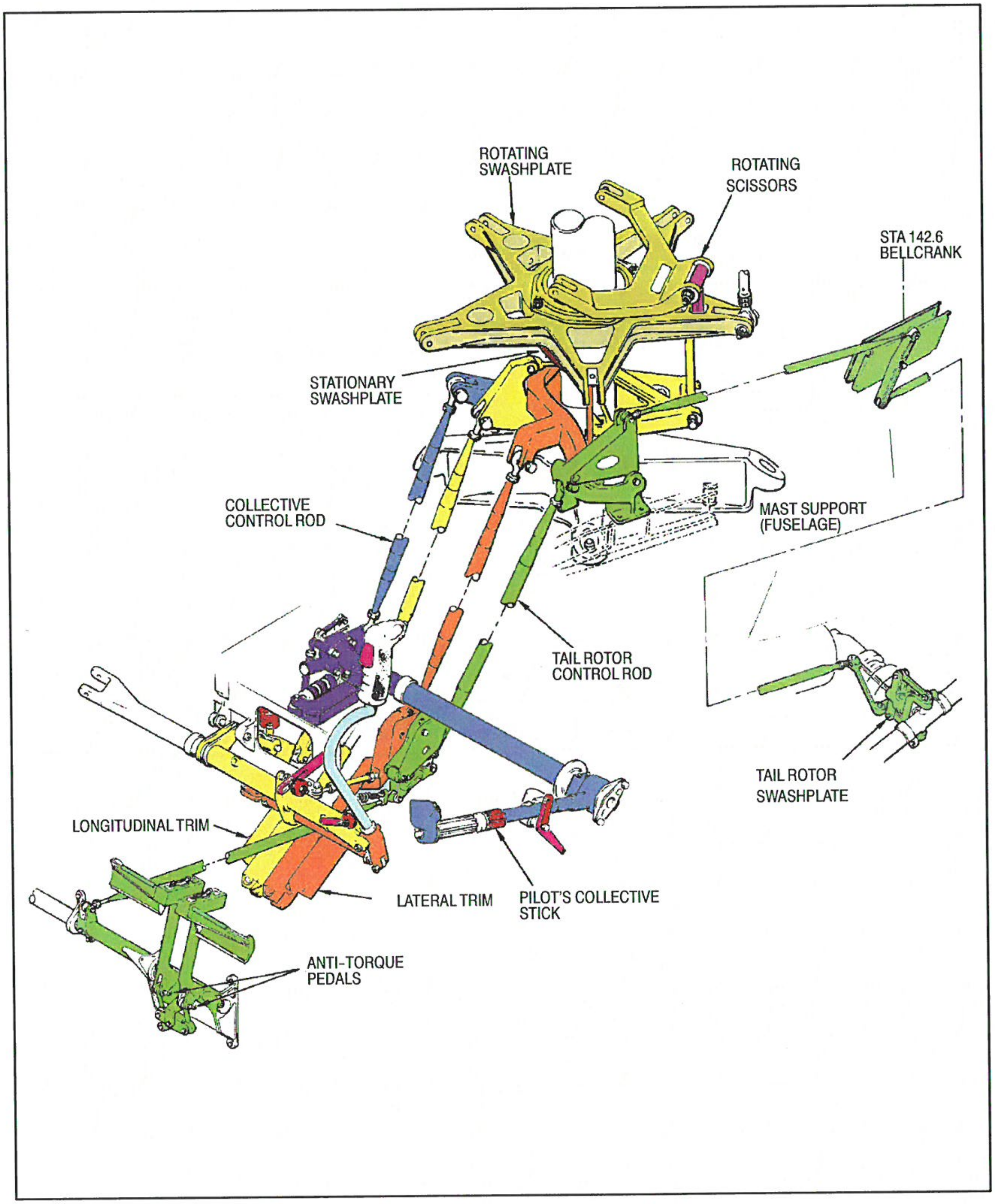

Figure 10–1. Flight Control System

10-1. FLIGHT CONTROLS

General The flight control system is of the conventional helicopter controls systems design for collective, cyclic, and tail rotor control. Flight control simplicity was achieved as a result of the design philosophy to keep all systems as uncomplicated as possible. Control forces are light and do not require the complexity of hydraulic boost. Single flight controls on the MD 500 series helicopter are mounted on the left side, allowing three people to be seated in the forward compartment.

Dual controls installation equips the helicopter with flight control for the copilot's seat (right position). The dual controls are essentially the same as those provided for the pilot (left position), except the longitudinal and lateral cyclic friction controls are not duplicated, collective friction is preset and not adjustable by the copilot, and there is no landing light switch or engine starting switch on the collective pitch stick.

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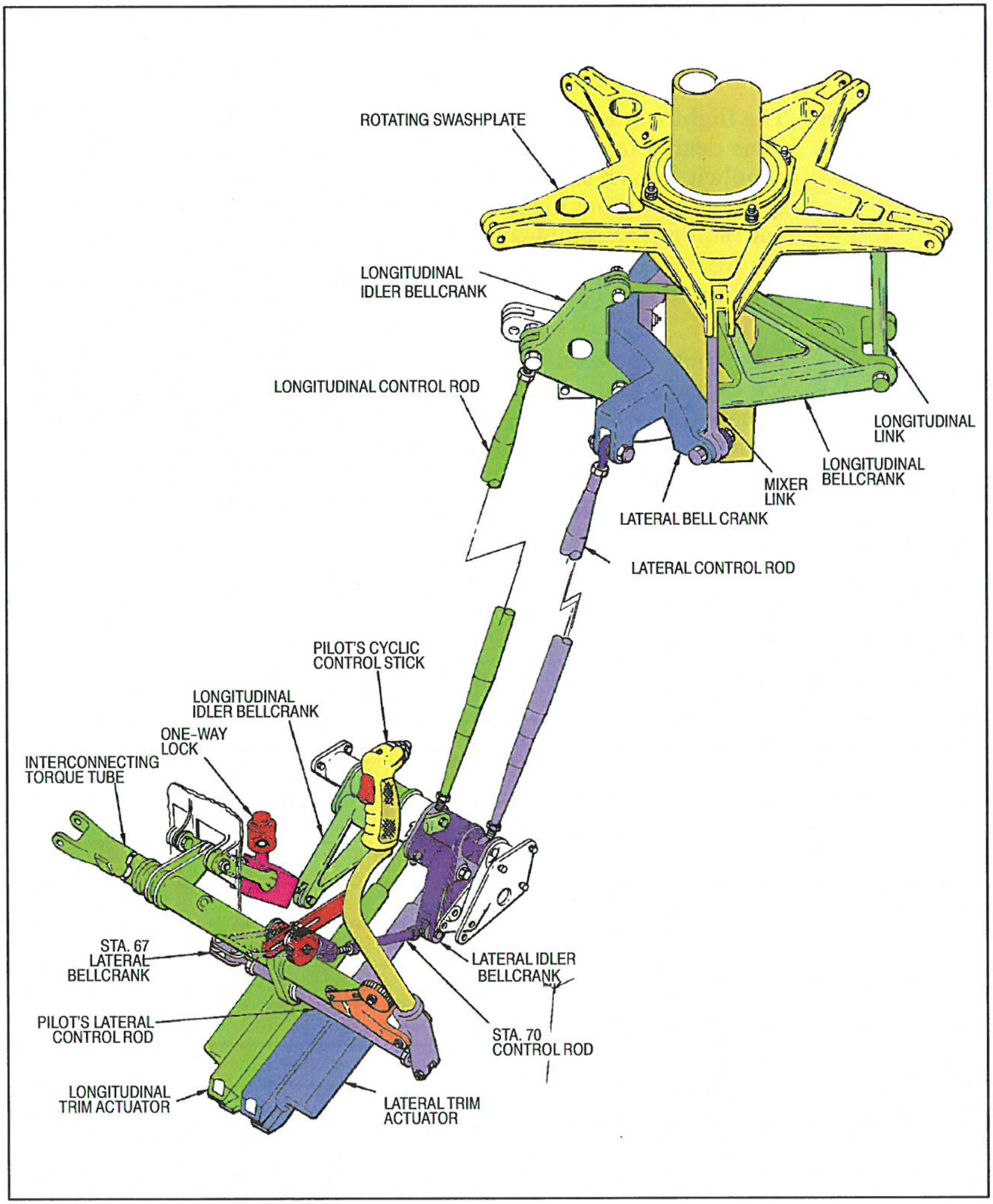

Figure 10–2. Cyclic Controls

10-2.CYCLIC CONTROLS

Control Function

The cyclic control stick may be moved in any direction of the azimuth. The cyclic control system passes that input through the mixer assembly to the swashplate. Tilting of the swashplate results from cyclic stick displacement from the stick neutral position. Stick movements may be broken down into two basic components. These are lateral movements and longitudinal movements and any combination thereof. The cyclic stick is attached to the cyclic interconnecting torque tube. The torque tube provides pivot for lateral stick movements and for longitudinal stick movements.

Lateral stick movements are coordinated by two rods interconnecting the cyclic sticks to the lateral cyclic bellcrank. The bellcrank is pivoted by lateral stick movements which in turn moves the lateral idler bellcrank through an interconnecting rod. The idler changes direction of input to coincide with the station 78.50 rod which in turn pivots the lateral pitch mixer bellcrank of the mixer assembly. Pivoting the double ended lateral pitch mixer bellcrank causes one end of the bellcrank to go up and the other end to go down and the swashplate to tilt accordingly.

Longitudinal stick movements cause the interconnecting torque tube to pivot. The torque tube has an integral crank which attaches to a one-way lock and when the torque tube is pivoted, motion is fed through the one-way lock to the longitudinal idler bellcrank to the tunnel rod. The tunnel rod positions the longitudinal idler of the mixer assembly which in turn positions the mixer link, the longitudinal mixer bellcrank, and the longitudinal link which is attached to the swashplate assembly; thus, longitudinal stick movements are fed to the swashplate which tilts accordingly.

NOTES: ____

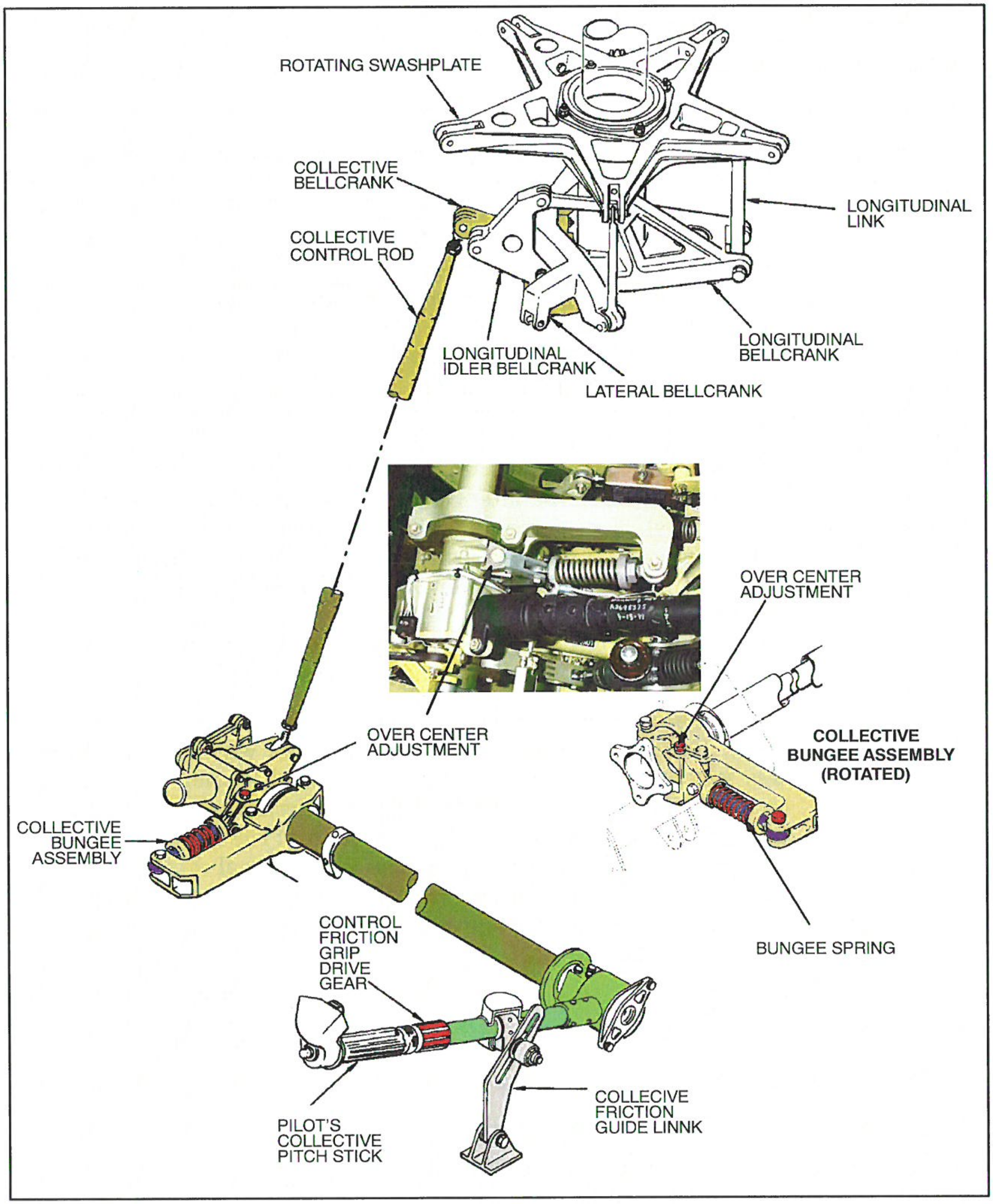

Figure 10–3. Single Collective Pitch Control

10-3. COLLECTIVE CONTROL

Control Function

Total travel of the collective pitch stick is 30 degrees. Movement of the collective stick is transmitted through a control rod to the collective mixer bellcrank which in turn rotates the lateral mixer bellcrank. The outer ears of the lateral bellcrank are attached to the stationary swashplate by two links. As the lateral bellcrank rotates, the stationary swashplate raises equally on both sides. The longitudinal bellcrank is attached to the aft end of the collective bellcrank and raises as the collective bellcrank is raised. The longitudinal link connects the longitudinal bellcrank with the swashplate and acts as the stationary scissors.

Collective Bungee

An important feature of the collective control is the collective bungee/ over-center device that controls collective loads while the helicopter is on the ground (flat pitch, operating RPM), at a hover and at high speed cruise ("heavy" or "light" collective).

The collective bungee is an overcenter spring arrangement in parallel with the collective control path to provide a mechanical force to counteract the strap pack's resistance to twist. The bungee is a strong compressed spring that is trapped between a fixed point on the bungee bracket and a moving point determined by the position of the overcenter fitting. If the spring and two restraining points are in a straight line (a condition that is adjusted to occur at the no-twist position of the strap packs), no bungee force is added to the control system. However, as the collective sticks are moved from the strap pack no-twist position, the spring can exert a force on the overcenter fitting that increases in accordance with the amount of displacement.

The collective bungee consists of a male bearing assembly, female bearing assembly, spring, and retainer. This unit attaches between the bungee fitting and bungee bracket of the collective interconnecting torque tube. The purpose of the adjustable bungee and the overcenter bracket attachment is to counteract these forces so that collective stick loads are relatively constant throughout the full range of travel. There are two adjustments available to establish or correct collective flight loads. Adjustment of the collective bungee spring will correct a variation in collective load from low pitch to high pitch. Adjustment of the overcenter bolt to raise or lower the bungee fitting will cause an overall reduction or increase of collective forces in both low pitch and high pitch.

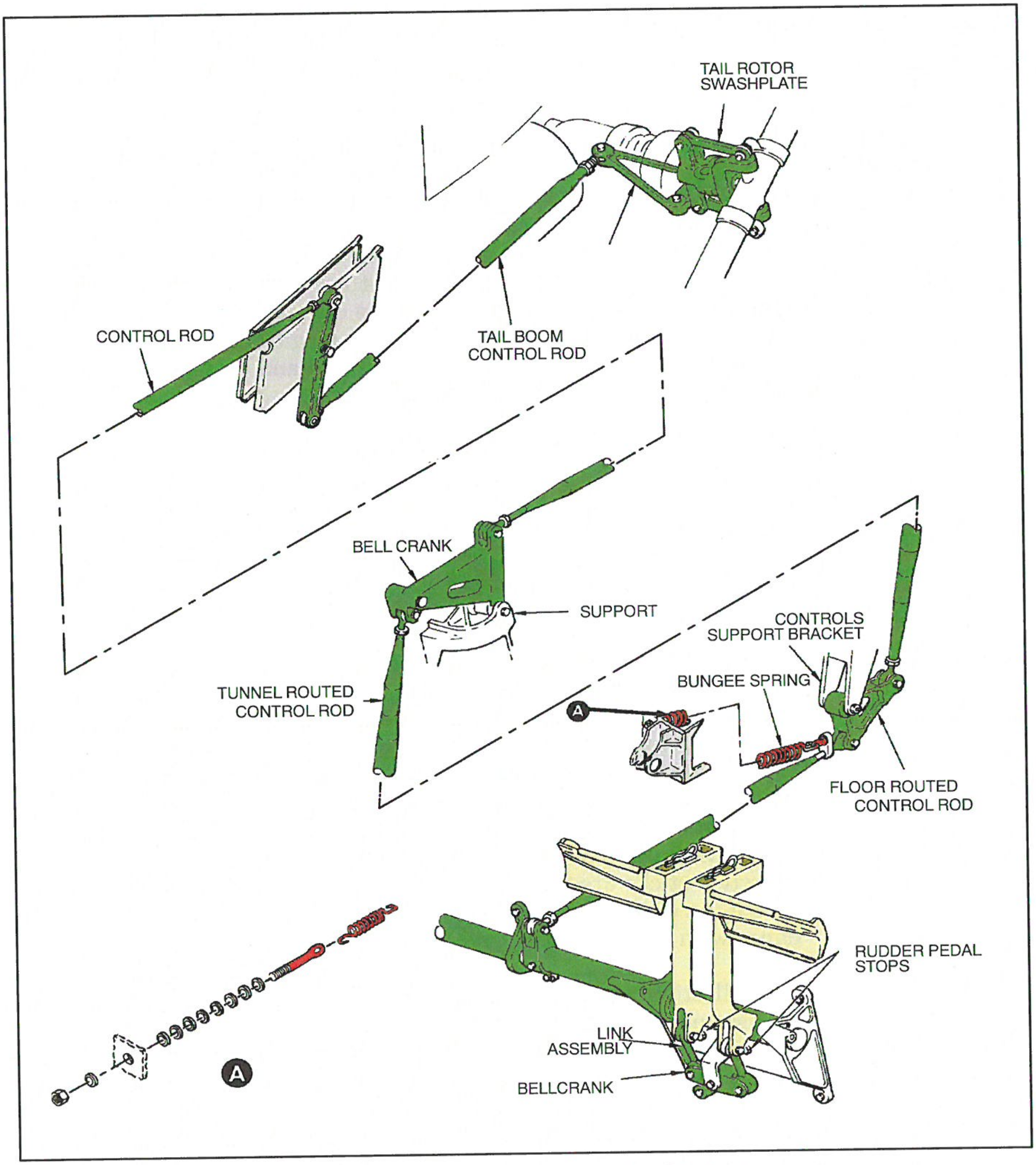

Figure 10–4. Tail Rotor Control System

10-4. TAIL ROTOR CONTROL SYSTEM

Description and Operation

The tail rotor pedals in the cockpit control the blade angle of the tail rotor pedal assemblies. The pedals are secured in position by lockpins.

The right hand pedal is a floating pedal, whereas the left hand pedal is the working or driving pedal. A torque tube interconnects the pilot's and copilot's pedals and transfers their control function to a control rod running under the flight compartment floor. The torque tube is a precision ground aluminum tube, hard anodized and polished to a fine surface finish. The support brackets are machined magnesium castings bolted to the structure at fuselage station 44.65. The bearings pressed into these brackets are lifetime lubricated ball bearings expressly designed for torque tube application. The torque tube slips into the support brackets and accepts the left hand and right hand pedal arms, which are fitted with Teflon-lined bushings. The pedals are then secured to the torque tube by bushing assemblies. The right hand pedal is free to rotate about the torque tube, while any movement of the left hand pedal will cause a corresponding movement of the torque tube.

Tail Rotor Bungee Spring

The tail rotor control bungee spring is designed to reduce pilot work load when operating under high gross weight conditions or when cruising at high power settings.

It is normal to require some right pedal in cruise flight. The lighter the aircraft gross weight, the more pronounced the requirement to hold right pedal. This is due to the low engine power requirements to maintain cruise flight, therefore less left pedal is required for anti-torque compensation. It should be stressed to pilots complaining of the pedal characteristics that under high gross weights they will need the left pedal reserve (created by the bungee spring) now built into the controls to correct the high power setting and increased anti-torque requirements.

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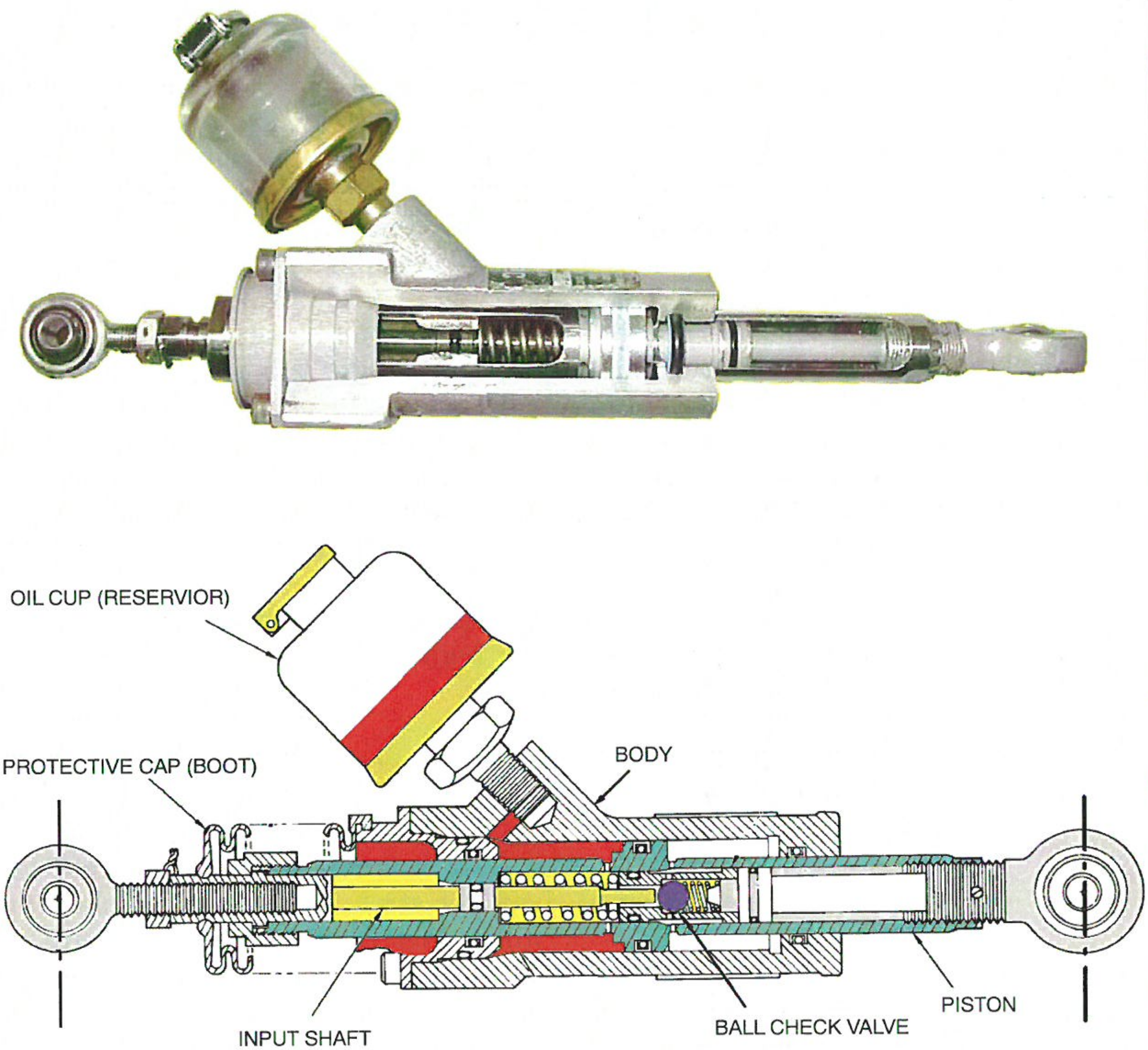

Figure 10–5. One Way Lock

10–5. ONE–WAY LOCK

Description and Operation The one–way lock assembly is a self-contained hydraulic unit connected in series with the longitudinal control system.

The one–way lock assembly functions as a control rod during longitudinal movement of the cyclic control stick. The piston of the assembly connects to the longitudinal idler bellcrank on the control support bracket and the input shaft connects to the cyclic interconnection torque tube. It mounts in the aircraft at an angle. The one–way lock assembly consists of a piston, a shaft, a spring loaded ball check valve, and a spring loaded relief sleeve. The piston is inside a housing assembly serves as a hydraulic chamber supplied by the reservoir.

Function The one–way lock prevents aft rotor system feedback forces from moving the cyclic control stick aft. Any tendency to pull the piston aft by a force acting on the lower rod end bearing will be resisted by a hydraulic lock formed by the ball check valve and hydraulic fluid trapped in the aft chamber. During forward control inputs, the piston acts as a simple control rod. Fluid is displaced around the ball check valve as pressure differentials warrant.

When an aft cyclic control input is applied to the forward rod end bearing and shaft, the shoulder of the shaft will travel aft to the limit of free play set by the nut before any pressure is exerted on the shaft. This travel of the shaft allows its plunger to unseat the ball check as long as aft control input is maintained. When control input is removed, a force still remains (feedback in an aft direction from the main rotor head), which will cause the ball check valve to reseat itself and "lock out" this unwanted feedback force.

Rotor head forces up to 200 ±25 pounds that exert an aft motion to the cyclic control stick are hydraulically locked out of the control path. A relief mechanism built into the one–way lock assembly relieves the hydraulic lock at forces above the design limit.

MALFUNCTIONS

Indications Aft feedback in the cyclic at high airspeed and/or during pull ups from high airspeed; or, higher than normal forces required to move the cyclic longitudinally.

NOTE: If the one–way lock has a push rod shaft or check valve seizure in the closed valve position, a pull of _______ to _______ pounds will be necessary to open the hydraulic relief valve and bypass the check valve. This additional pull will be required for each subsequent longitudinal movement of the cyclic stick. Temporary forces as high as _______ pounds may be experienced when flying in turbulence.

Recommended airspeed with a one–way lock failure is _______ knots or less. Limit cyclic movement to those movements required to safely fly the helicopter. Abnormal or extreme control inputs are not not necessary.

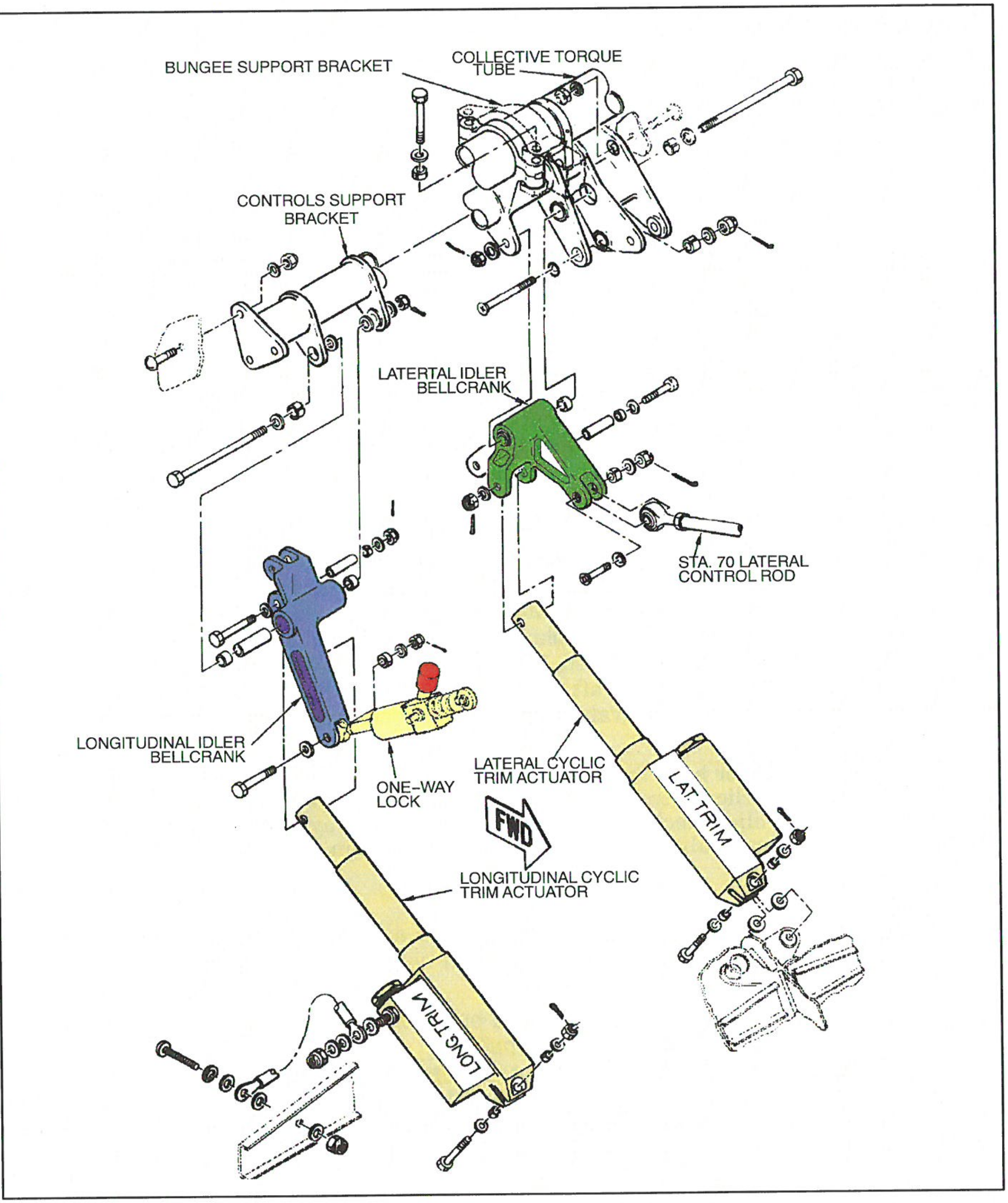

Figure 10-6. Cyclic Trim Actuator

10-6. CYCLIC TRIM

Description and Operation

Cyclic trim is controlled by the cyclic trim switch located on the cyclic stick grip. The cyclic trim switch has five positions: normally OFF at the center, and momentary FORWARD, AFT, LEFT, and RIGHT. When the trim switch is moved off center to any of the four trim positions, one of the trim motors operates to provide trim spring force in the desired direction. Two linear actuator assemblies are installed in parallel with the longitudinal and lateral control paths. The actuator moves a spring assembly to counteract feedback forces from the main rotor to the cyclic control sticks. The actuator assemblies are secured to brackets, which are part of the center beam, and to the lateral and longitudinal idler bellcranks mounted on the controls support bracket.

Construction

Each of the two cyclic trim actuators consists of an actuator, housing support, trim tube and spring assembly. The actuator is essentially a motor-driven, variable length shaft that moves a spring assembly, counteracting feedback force from the main rotor and compensating for imbalance conditions such as those imposed by crosswinds or unevenly distributed cargo.

TRIM ACTUATOR CHECKS

NOTES:

MALFUNCTIONS

Indications Cyclic trim failure is indicated by an inability to reduce cyclic forces with the cyclic trim switch. The failure will be one of the following types:

Inoperative Trim The trim motor fails to respond to application of the cyclic trim switch in one or more directions.

Recommended Action:

Establish a safe flight condition that produces the least cyclic control force. Normally straight and level at the last trimmed airspeed.

Actuate the trim switch thru all positions in an attempt to restore trim capability and determine the extent of trim failure. If restored, trim to a near neutral position and land as soon as practical avoiding further trimming.

If trim failure is determined to be in all directions, and control of the helicopter can be maintained safely, check/reset TRIM circuit breaker.

Land as soon as practical if unable to re establish full cyclic trim control with the pilot's cyclic.

Runaway Trim An uncommanded longitudinal or lateral cyclic trim actuation. The cyclic may move to a full travel position or some intermediate position resulting in cyclic forces up to the maximum. Uncommanded movement can occur after cyclic trim switch actuation or as a result of an electrical short.

NOTE: Runaway cyclic trim failures can produce cyclic stick forces of approximately ______ pounds in the direction of the runaway. Although the forces required to move the cyclic will be higher than normal, the helicopter will respond normally to all cyclic inputs by the pilot.

Recommended Action:

Establish a safe flight condition that produces the least cyclic control force.

NOTE: If a forward longitudinal runaway trim failure is experienced, it may be possible to reduce cyclic stick forces by maintaining higher airspeeds. Cyclic stick forces may be reduced if an aft longitudinal runaway trim failure is experienced by maintaining slower airspeeds. Lateral runaway trim forces cannot be reduced by adjusting flight conditions.

Utilize left hand and legs, as necessary, to apply pressure against the cyclic stick to relieve the right hand loads and conserve strength for landing. Use collective friction to prevent unwanted collective movement and associated power change. Be prepared to respond to any emergency requiring the use of collective pitch.

Actuate the trim switch thru all positions, several times if necessary, as this will generally re-establish trimming capability. When restored, trim to a near neutral position and land as soon as practical avoiding further trimming.

If trim runaway is to the full forward position, accomplish landing into the wind and do not hover downwind.

WARNING: **Control of the helicopter is the primary consideration of a pilot confronted with any type of trim motor or switch malfunction. The pilot–in–command should land the helicopter immediately if the pilot's physical condition, strength, or threshold of fatigue, would compromise their ability to safely control the helicopter in continued flight.**

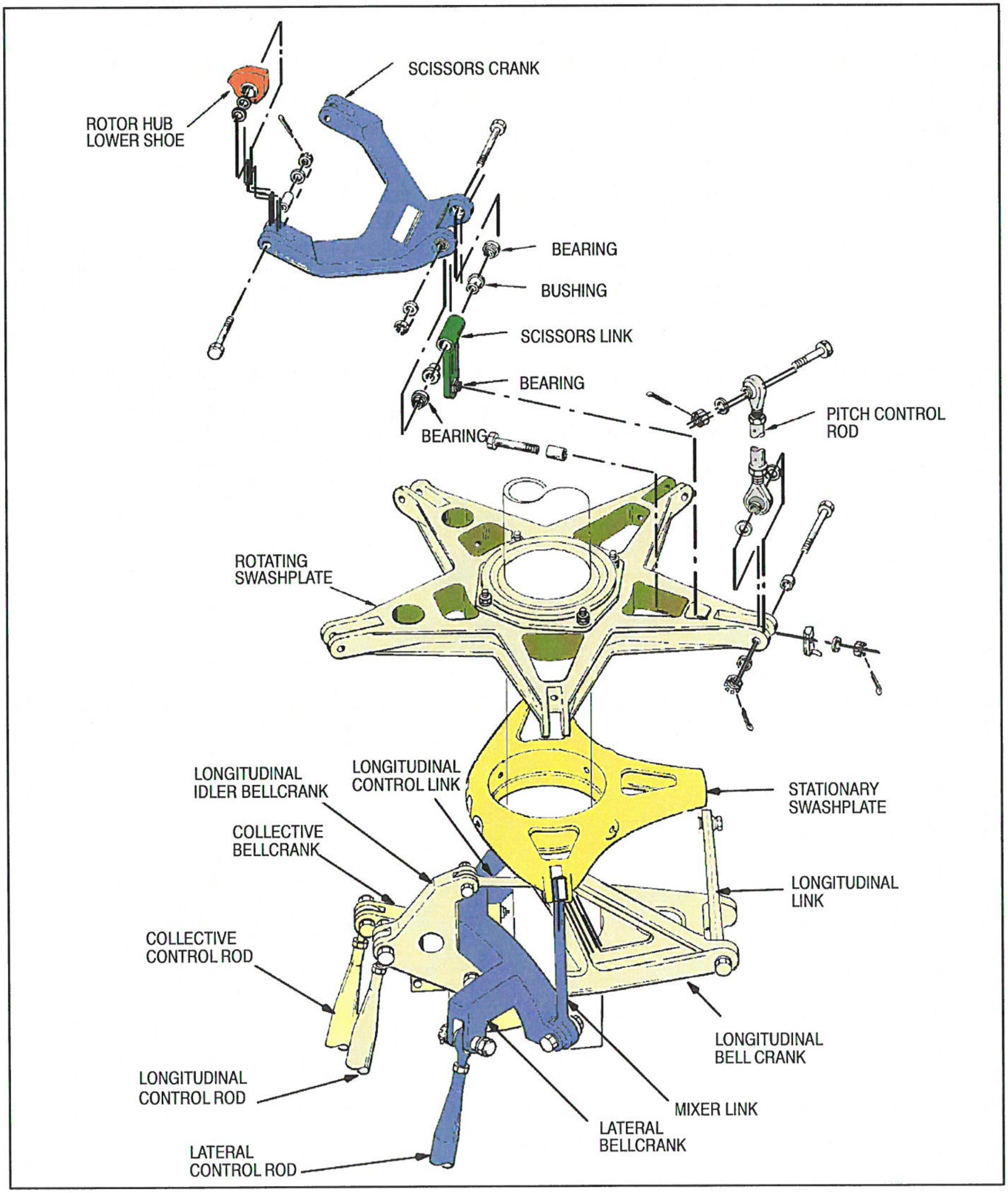

Figure 10-7. Main Rotor Swashplate Assembly

10–7.MAIN ROTOR SWASHPLATE ASSEMBLY

Description and Operation

The control action from the mixer controls is fed to the swashplate at two lateral inputs (located directly opposite each other) and one longitudinal input. The purpose of the swashplate is to transmit linear control inputs from the flight controls to the rotor blades. The swashplate assembly accomplishes its function through a stationary member (Stationary Swashplate) linked to the flight controls and a rotating (Rotating Swashplate) member linked to the rotor blades. The two units are joined by a double row ball bearing.

There are two types of control inputs fed to the swashplate. One is collective control, where the swashplate must transmit simultaneous control input of the same degree to all five blades. To do this, the rotating and stationary swashplates must be raised or lowered as a unit. The other control input is cyclic control, where the swashplate must transmit to the rotor blades a differential control input for each blade. To accomplish this, the entire swashplate is attached to a ball and socket. During collective action, the two act as a single unit and slide up or down on a polished journal on the stationary mast. During cyclic action, the ball remains stationary, serving as the inner race of the socket. The socket pivots about the ball to any position within the limits of the flight controls.

Scissors Assembly

The rotating swashplate is driven by a rotating scissors assembly which attaches to the lower shoe of the rotor hub assembly.

NOTES: ______________________________

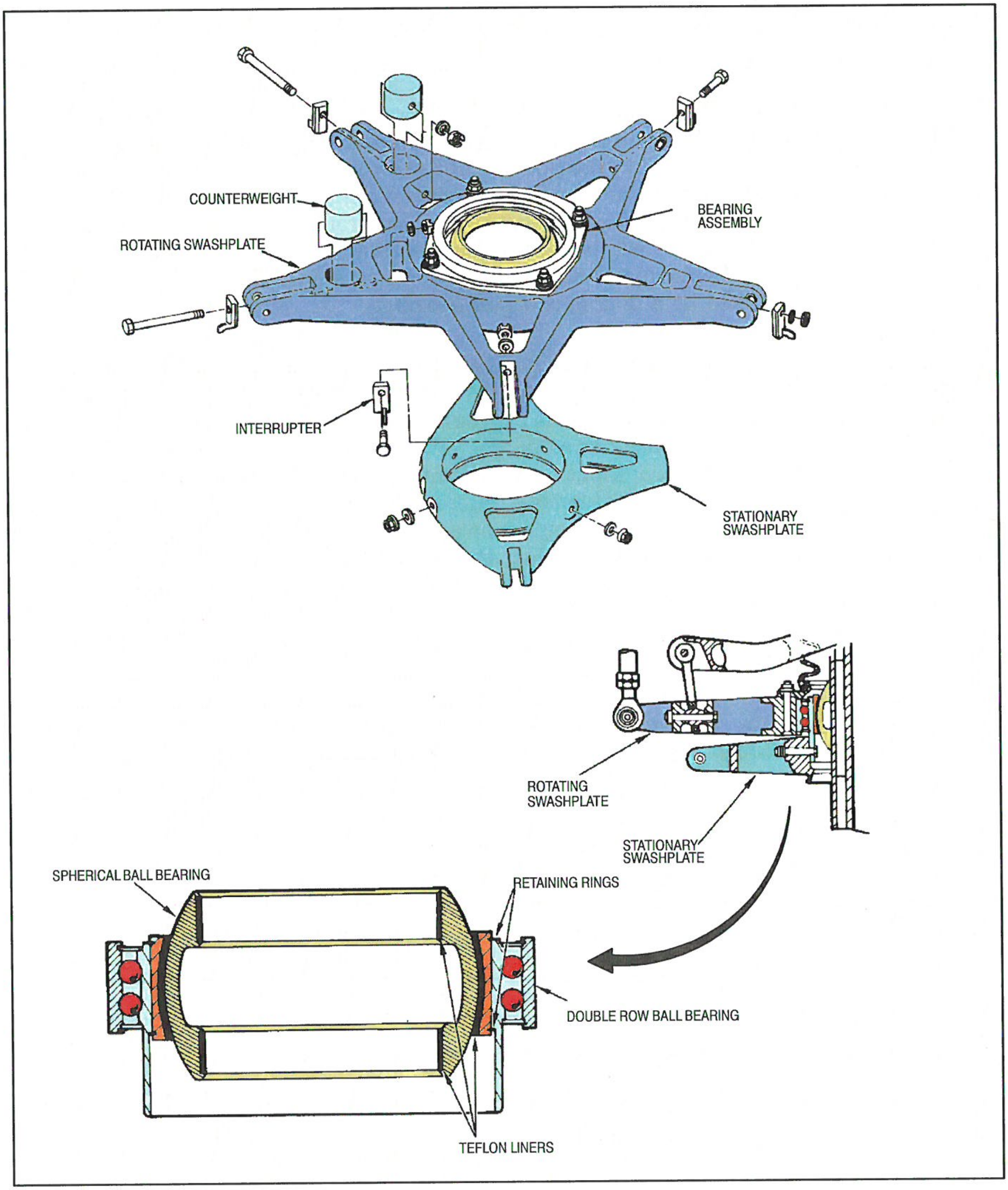

Figure 10-8. Swashplates and Swashplate Bearing Uniball

10–8. STATIONARY SWASHPLATE

Description The stationary swashplate is secured by bolts to the extended inner race of the double row of ball bearings. The outer bearing race is pressed into the rotating swashplate and secured by a retaining ring bolted to the rotating swashplate. The rotating swashplate forging. Situated in the bore of the inner bearing race is the outer socket of the "uniball." The socket is secured to the bearing by two spiral locks. The "uniball" consists of a ball and socket. The ID's of the ball and socket have heavy reinforced Teflon liners bonded in position.

NOTES:

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MD™ HELICOPTERS

MD 500 Pilot Transition Training Manual

SECTION XI
ANTI-TORQUE SYSTEM

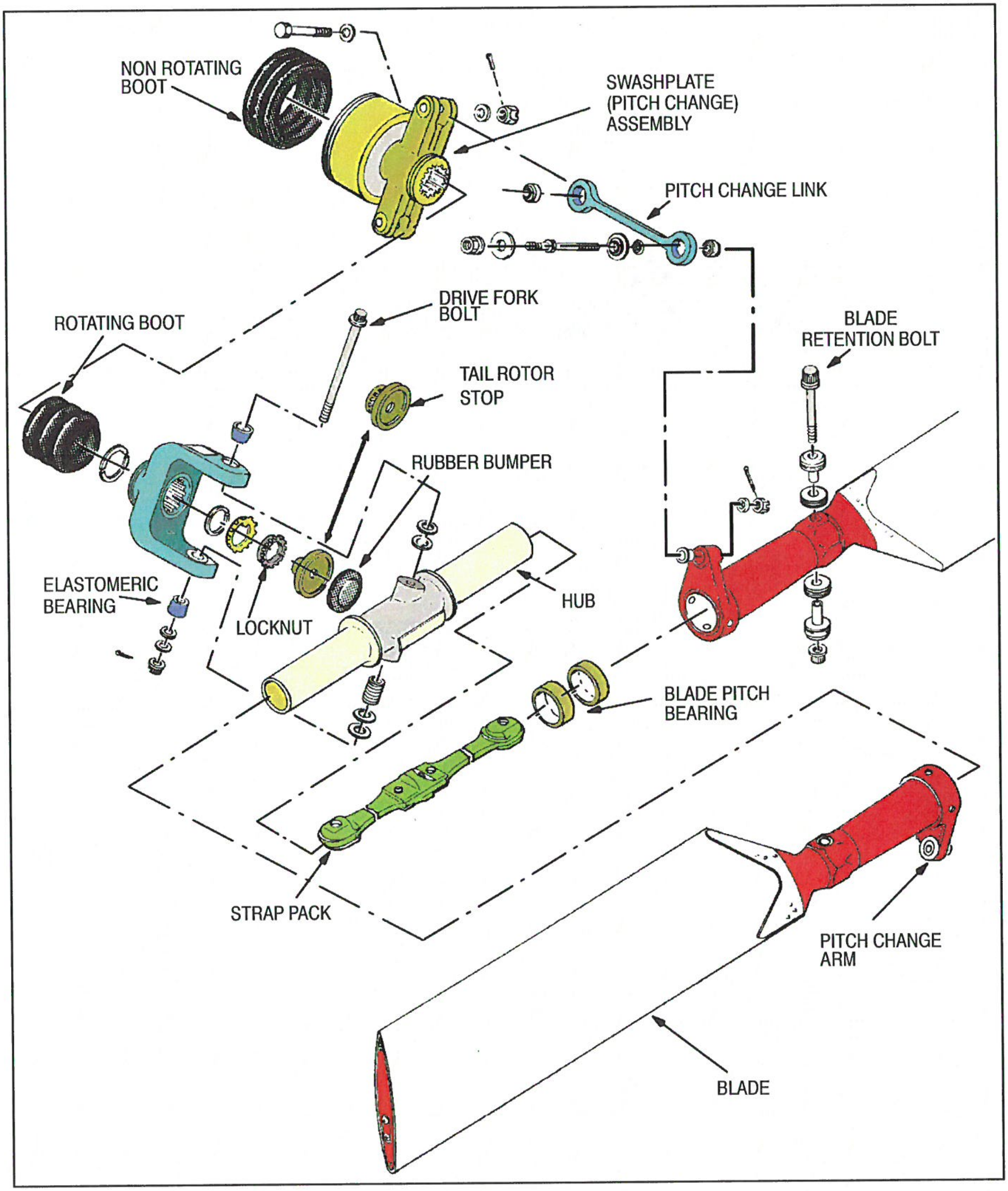

Figure 11-1. Tail Rotor Installation

11–1. TAIL ROTOR INSTALLATION

Description and Operation

The tail rotor installation consists of a pitch control assembly, a drive fork assembly, two pitch control link assemblies, and two blade assemblies telescoped over a hub and bolted to an interconnecting tension-torsion strap assembly located inside the hub.

Pitch is controlled collectively by the pitch control assembly, which consists of link assemblies connecting the pitch control arms to a swashplate that slides axially on the tail rotor output shaft.

Movement of the swash plate is controlled through a series of bell cranks and rod assemblies connected to the pedal installation.

Rotation of the blades is effected through the tail rotor transmission splined output shaft, tail rotor drive fork assembly, and hub.

The tail rotor has a coning angle toward the tailboom and is designed to relieve bending stress when thrust loads are applied.

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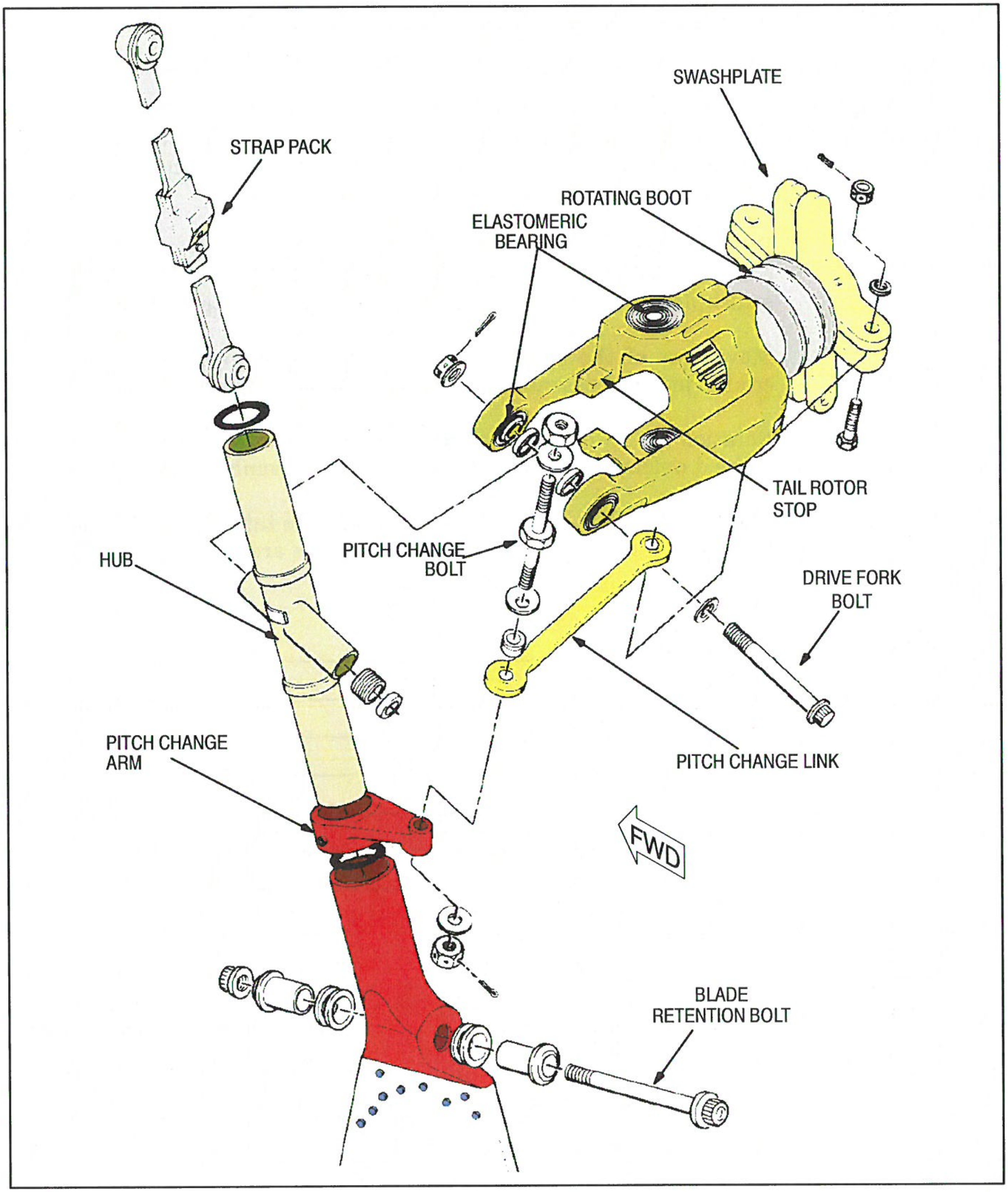

Figure 11-2. Four-Bladed Tail Rotor Installation

11-2. FOUR-BLADED TAIL ROTOR INSTALLATION

NOTE: The installation of Four-bladed Tail Rotor Kit affects certain Flight Manual data for Limitations (Section II), Emergency and Malfunction Procedures (Section III), Normal Procedures (Section IV), Performance Data (Section V), and Weight and Balance (Section VI). Pilots operating aircraft with this kit must refer to the Section IX for 4-Bladed Tail Rotor operating instructions.

Description

The McDonnell Douglas 369D292500 Four-Bladed Tail Rotor Kit has been developed to reduce the external noise signature of the helicopter. It consists of two principal assemblies, the 369D21610 Tail Rotor, and the 369D25300 Gearbox. The pedal bungee has been changed to compensate for tail rotor produced loads. The push rod length and the bellcrank at the tail rotor have been changed to increase the blade angle range.

The four-bladed tail rotor turns at reduced RPM thus substantially reducing the external noise signature which is a function of rotor tip speed.

Application

This kit may be refitted to any 500D/E helicopter by removing the existing two-bladed tail rotor assembly and gearbox, and replacing them with the kit components. This modification may be accomplished at the operator's facilities by licensed A&P mechanics. There is a weight increase of 9.4 pounds which will cause an aft C.G. shift of 0.6 to 0.9 inch depending on gross weight. The exact shift must be determined by individual helicopter weight and balance.

NOTE: Description of the various components of the 4-Bladed Tail Rotor assembly are similar to that of the 2-Bladed Tail Rotor.

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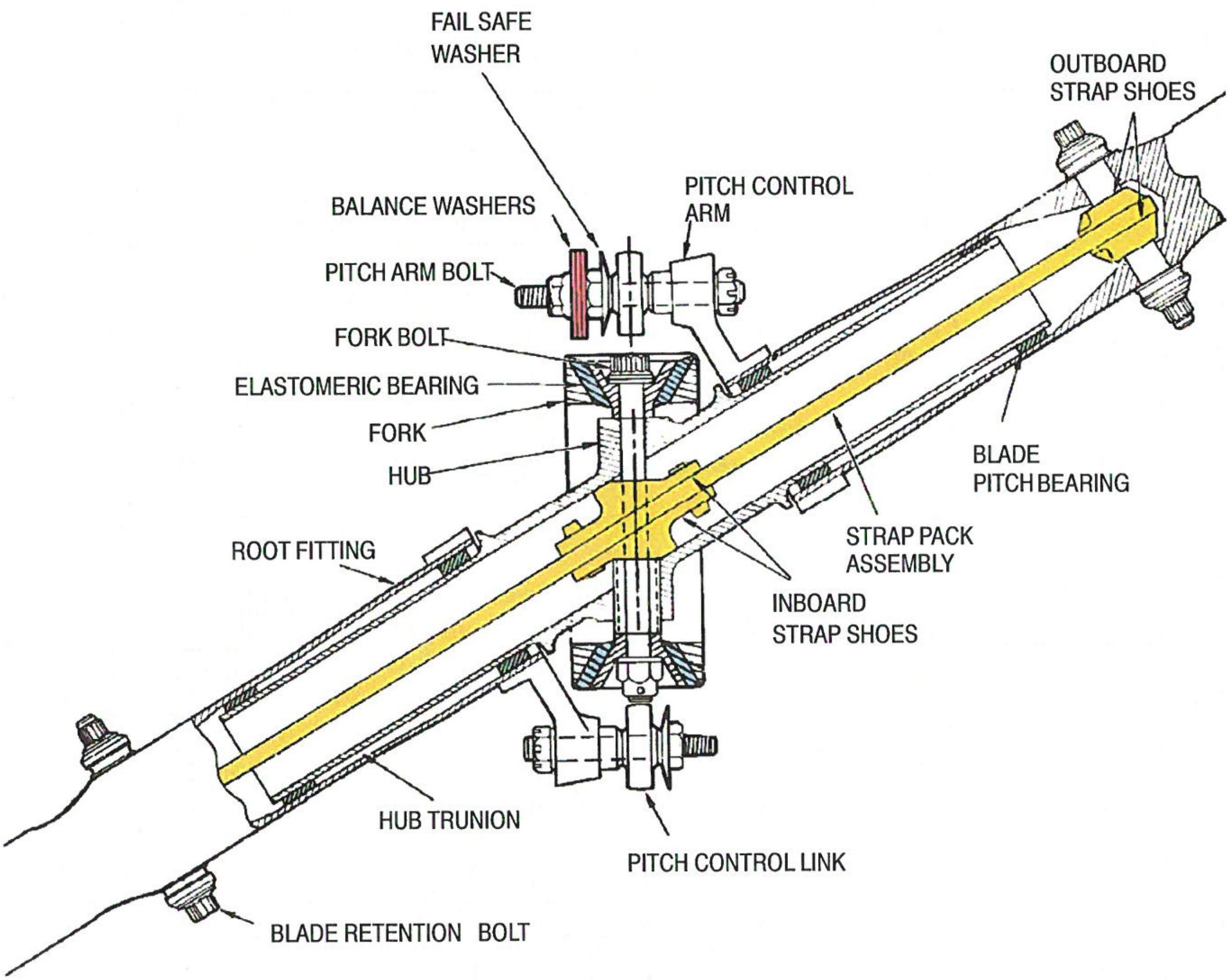

Figure 11–3. Tail Rotor Hub

11–3. TAIL ROTOR HUB

Description The tail rotor hub installation consists of a drive fork, teetering bearings, strap pack, hub, flap retainer and attachment hardware.

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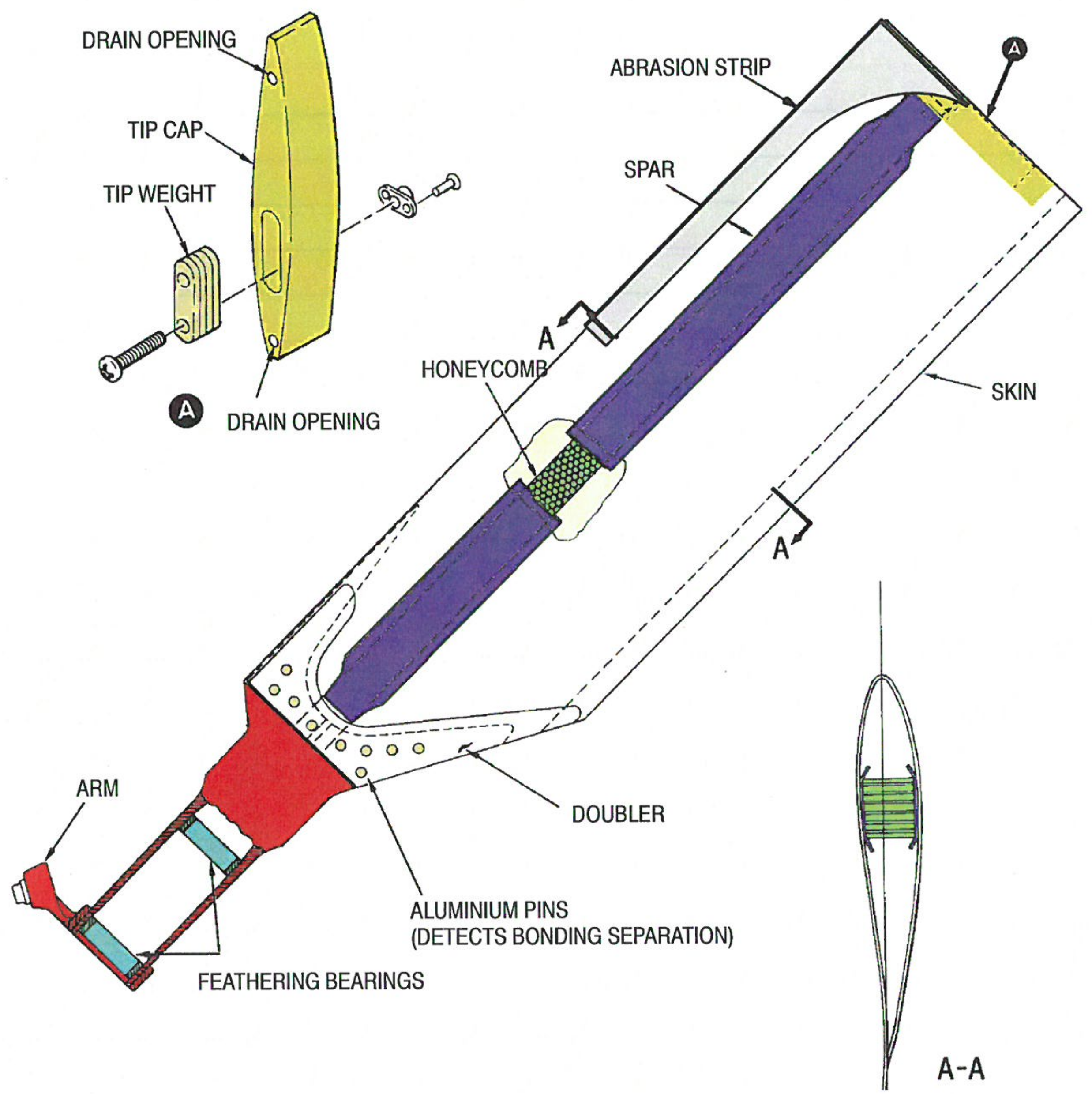

Figure 11-4. Tail Rotor Blade

11–4. TAIL ROTOR BLADE

Construction Each tail rotor blade consists of an aluminum honeycomb spar, skin, root fitting with pitch change arm, and tip cap that are all structurally bonded together. In addition, a stainless steel abrasion strip is bonded and riveted to the leading edge of each tail rotor blade.

Root Fitting The root fitting is a forging contoured to the airfoil shape. The internal bore is machined in two places to receive feathering bearings. The pitch change arm is stress relieved and attached to the root fitting.

Spar An aluminum honeycomb spar is bonded to stiffeners. The stiffeners are then bonded to the root fitting and the tip cap. The assembly is completed with a wraparound skin bonded to the root fitting, spar, and tip cap and closed at the trimming edge. Doublers are bonded in place and aluminium pins are installed through the blade doublers to detect a possible bonding separation.

Attachment Each blade attaches to the strap pack by a single bolt with two bushings and crushable washers. This arrangement allows the bushings to clamp against the strap pack while having a minimum amount of squeeze on the root fitting. The crushable washers allow the bushings to extend through the root fitting equally during torquing of the bolt.

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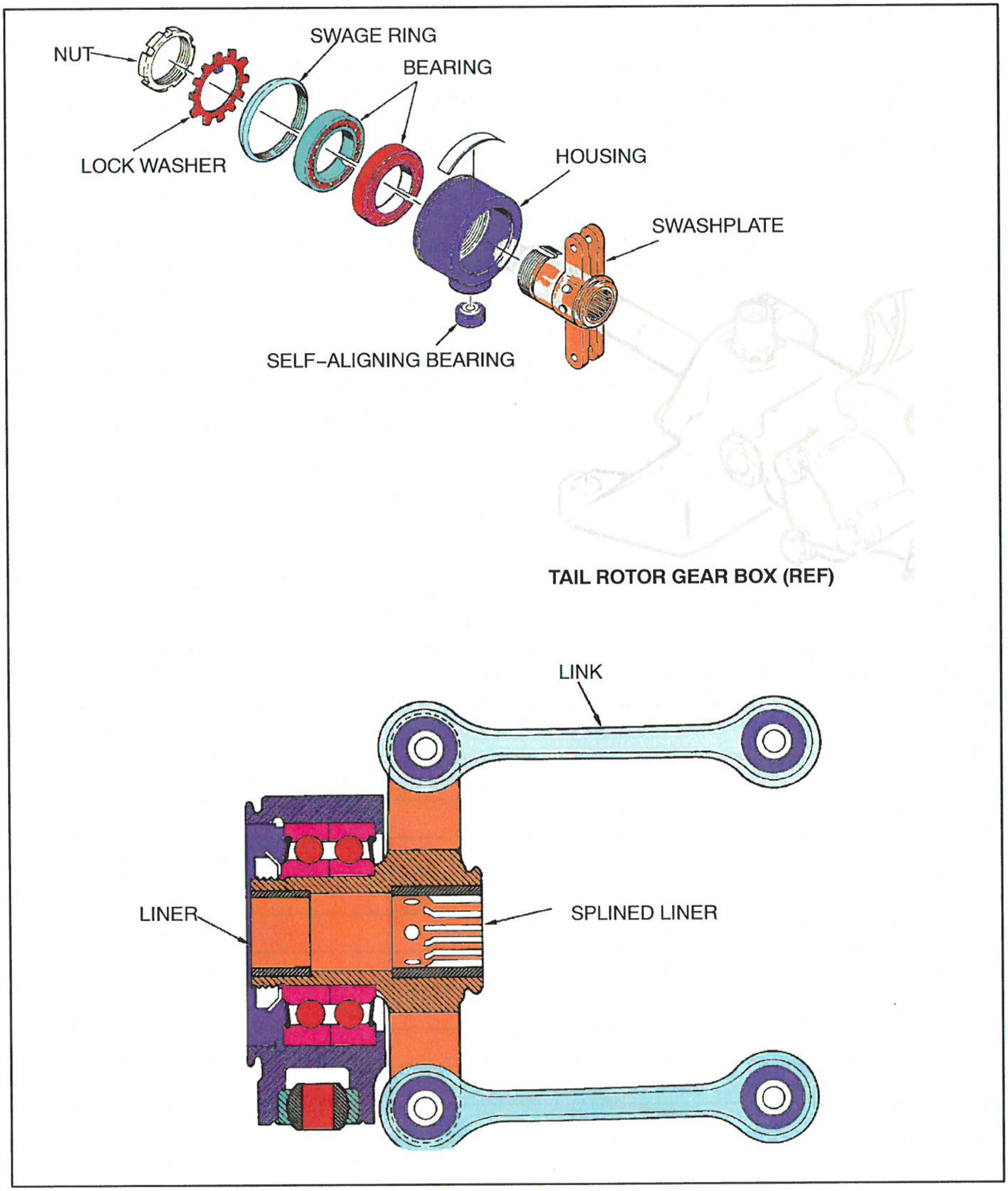

Figure 11–5. Tail Rotor Pitch Control Assembly

11-5. TAIL ROTOR PITCH CONTROL ASSEMBLY

Description and Construction

The pitch control assembly consists of a rotating swashplate and pitch control housing. The housing is a casting fitted with two bearings. The outer race is secured in the housing by a swage ring. A spherical bearing is pressed into a bore of the housing and is the attach point for the pitch control bellcrank that provides control input to the swashplate assembly. The machined swashplate slides into the two bearings in the pitch control housing and is held by a locknut. Two liners are situated in the swashplate, one splined, the other smooth. The splined liner rides in the outboard splined portion of the tall rotor gearbox output shaft and provides the driving force for the swashplate. The unsplined inboard liner is roll staked and serves as a second bearing surface for the swashplate on the output shaft.

The pitch control links are forgings with spherical bearings swaged in place. The tail rotor assembly is statically balanced at the factory. Chordwise balance is achieved by adding balance washers to the balance bolts at the pitch link and arm attach points. Spanwise balance is accomplished using weights at the blade tips.

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HELICOPTERS

MD 500 Pilot Transition Training Manual

SECTION XII
ELECTRICAL SYSTEM

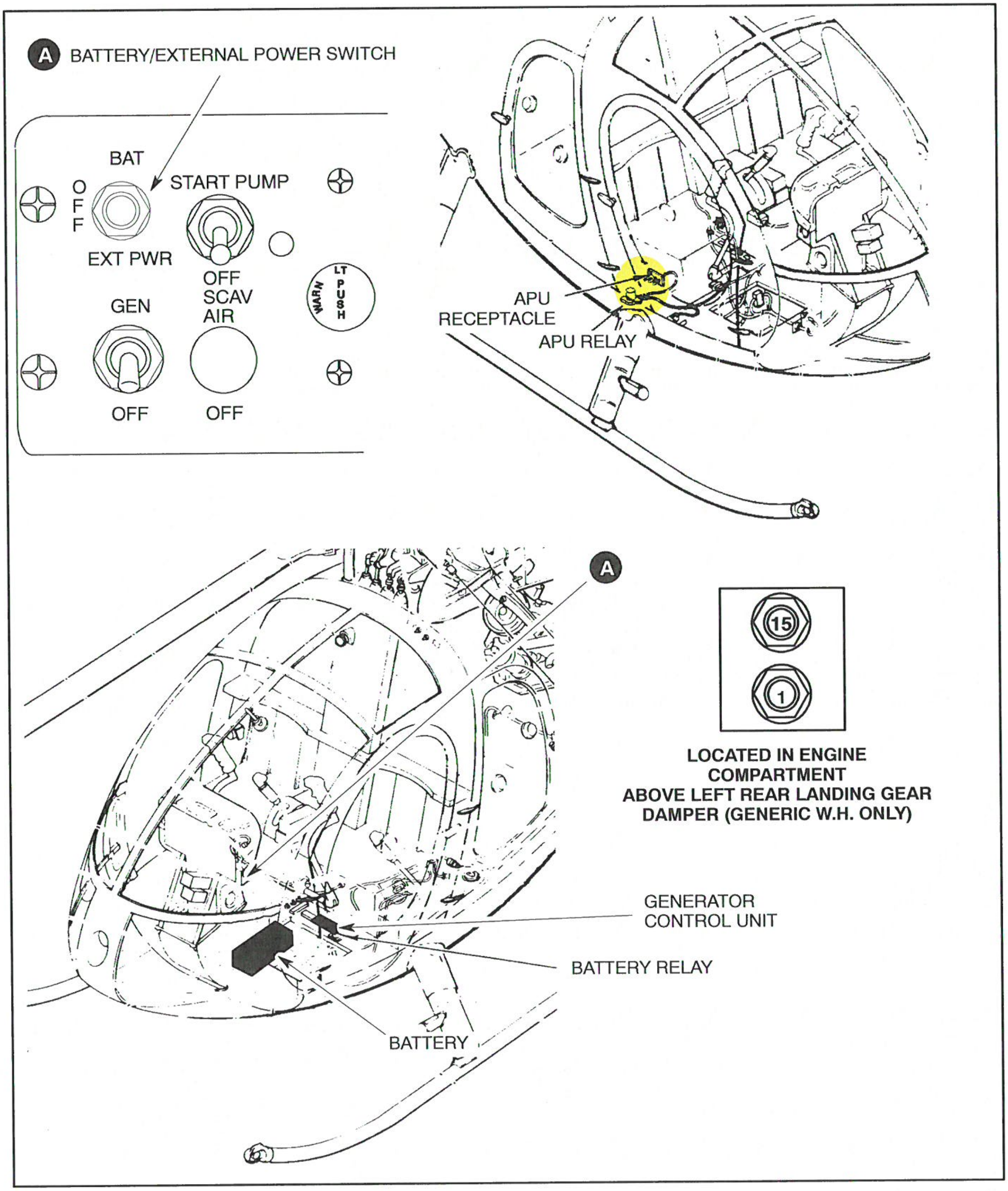

Figure 12-1. Basic Electrical Components

12-1.ELECTRICAL SYSTEM

General Description

Many of the components of the electrical system may be familiar to you, as the aircraft has a basic DC system. However, since solid state units have replaced some older type rotary or electro-mechanical devices (giving the electrical system much more reliable components than older type systems), a general review will be presented here. The basic electrical source is direct current as supplied by a battery and a combination starter-generator. The battery and generating system are protected by the reverse current relay, and an overvoltage relay is incorporated as well as a circuit breaker in the generator field cuprite to provide a protection against system malfunctions.

System Control

Control of the electrical system, not including the optional intercom system, is provided by switches and circuit breakers located on the instrument panel. All circuits of the electrical or units or components that produce electromagnetic energy are bonded to adjacent structures to ensure a negligible radio interference. Bonding jumpers are also used throughout to ensure static ground.

Power Sources

Direct current prime power can be obtained from three sources; the battery, the external power receptacle, and the generator function of the starter-generator. Battery or external power selection is accomplished with the power selector switch (battery switch). With the DC bus energized, the starter function of the starter-generator can be utilized by operation of the start switch. The start switch operates the start relay, which in turn connects the DC bus to the starter. When the start switch is released, the start relay opens and the starter function is de-energized.

As soon as the starter function is released, the voltage regulator brings the generator output up to approximately 28 volts regulated voltage. However, the generator output is not connected to the DC bus until the generator switch is placed in the ON position and the reverse current relay senses an acceptable generator output.

The generator switch function in this system either connects or disconnects the already functioning generator output from the DC bus through generator switch control of the reverse current relay. This is the most unique feature of the system. The generator functions under control of the voltage regulator regardless of the generator switch position. The generator can only be disabled if the field strength rises to 15 amperes, at which time the circuit breaker in the generator field circuit trips open. Overvoltage protection is provided through a voltage regulator function that energizes the overvoltage relay. The overvoltage relay is in series with the generator switch circuit and actuates the reverse current relay in the same manner as the generator switch.

While the primary purpose of the reverse current relay (RCR) is to protect the battery from discharging by motorizing the generator, it is also used as a switching relay, as noted above. The generator switch and overvoltage relay actuates the RCR to connect or disconnect generator output with the DC bus.

When actuation of the reverse current relay main contact occurs to connect or disconnect the generator output in relation to the DC bus, a piggy back warning lamp switch operates the GEN OUT caution lamp. When the RCR disconnects the generator output, the caution lamp switch closes, and thereby completes the lamp circuit.

Summary

The power selector switch may be used to select battery power or external power, but not both at the same time.

During the engine starting sequence, the voltage regulator is disabled so that the generator function of the starter–generator cannot act.

At the end of a successful starting sequence, as soon as the starter is deenergized, the voltage regulator automatically functions to bring the output of the generator up to 28 volts.

The generator switch does not disable the generator function; it merely uses the RCR as a switching device to attach or disconnect the generator output from the DC bus. The overvoltage relay works in series with the generator switch and receives the signal from the voltage regulator.

NOTES: ______________________________

12-2.BASIC ELECTRICAL COMPONENTS

1. External Power Receptacle
2. Battery/External Power Switch
3. Voltage Regulator
4. Over Voltage Relay
5. Reverse Current Relay (RCR)
6. Start Relay
7. Starter-Generator
8. Nickle Cadmium Battery

External Power Receptacle

The external power receptacle is constructed of insulator material with three pins molded in place. The receptacle provides for utilization of external power for engine starting or maintenance purposes. The small pin is not used.

Battery/External Power Switch

The battery/external power switch is a three position switch located on the instrument panel lower left. It is wired in such a manner that you cannot connect the battery and external power to the bus at the same time. A battery and an external power relay are located in the battery compartment area and under the seat structure (Figure . The main power switch provides ground for the battery relay when the battery is selected and provides ground for the external power relay when it is selected. The wiring from the external power relay to the switch includes a diode to prevent relay energizing when the external power is of incorrect polarity. Select switch center position is OFF.

Voltage Regulator

The voltage regulator is a small solid-state unit and incorporates a circuit to control the overvoltage relay. It is mounted in the battery compartment. Regulation of voltage is adjustable between approximately 26 and 30 volts.

Overvoltage Relay

The overvoltage relay is a small unit weighing approximately 7/10 ounce. This relay is controlled by a circuit in the voltage regulator. The relay contains two sets of contact points.

Reverse Current Relay (RCR)

In order to protect the generator from battery voltage, and to prevent the battery from discharging through the generator, it is necessary to provide a means for disconnecting the generator automatically whenever the generator voltage is lower than that of the battery. When the generator voltage reaches a value slightly above that of the battery, the voltage coil magnetizes its soft iron core sufficiently to overcome the spring tension that tends to hold the main contacts open.

If the generator output decreases to such an extent that the generator voltage is below the battery voltage, current will begin to flow from the battery to the generator. This current will be flowing in a direction opposite to the normal flow, thus reversing the polarity in the reverse current coil and causing the contacts to open, which disconnects the generator from the bus.

For the operator's control of the generator, a generator switch is incorporated into the system that will control the power applied to the reverse current relay switch terminal. The generator switch will apply or cut off the generator output that is applied to the switch terminal on the RCR, thus giving the operator control over the generator output application to the bus. The RCR is mounted on the landing gear damper support fitting at the right side of the engine compartment (Model 500D helicopters, serial nos. 0723D and prior) or on the left aft rib installation between stations 124.00 and 137.50 (Model 500D helicopters, serial nos. 0724D and subsequent helicopters and all Model 500E and 530F Plus helicopters).

Start Relay

The start relay, mounted aft of the RCR on the oleo support fitting at the right side of the engine compartment (Model 500D helicopters, serial nos. 0723D and prior, or on the left side of the engine compartment (Model 500D helicopters, serial nos. 0724D and subsequent helicopters and all Model500E and 530F Plus helicopters), is a single–pole, single–throw, normally open relay with enclosed contacts. The relay connects battery or external power to the starter when the START switch on the pilot's collective pitch stick is pressed. (For information on optional engine automatic reignition components that may be used with the start relay on Model 500D helicopters, serial nos. 0149D and prior, refer to CSP–003. Automatic reignition equipment is standard on helicopters, serial nos. 1150D and subs. and all Model 500E and 530F Plus helicopters.)

Starter–Generator

The starter–generator is a combined, self–cooled unit used to start the engine and provide primary DC power to the electrical system. It is mounted on the engine accessory case, clamped to the mounting flange and is held in alignment by a series of slots between the mounting flange and the starter-generator. The generator portion has a rating of 30 volts, 150 amperes, over a range of 7,200 to 13,000 RPM. A shear point is incorporated in the generator drive shaft to protect the engine drive from excessive torque loads. A radio frequency interference filter is located in the terminal block.

12-3. GENERIC WIRE HARNESS - 500E AND 530F PLUS HELICOPTER

Generic Wire Harness

In late 1989, our product line of MD500 Series helicopters were upgraded by the addition of a generic (common) wire harness. The new design became effective on

Models 384E and Subsequent and
FF076 and Subsequent

Beginning with aircraft serial number 384E the electrical system incorporated a generic electrical wire harness that is common with other current production MD500 series aircraft and includes wiring for common optional equipment kits and future growth.

Co-location of major power distribution components, increased size and isolation of main feeder lines, and the use of a single generator control unit (GCU) increases the reliability and performance of the helicopter's electrical system.

The early ("early generic") version of the generic system utilized an air/ground switch to disable the ENGINE OUT/low rotor audio warning while on the ground and a three position RE-IGN test switch that, in addition to testing the reignition system, also tested the ENGINE OUT/low rotor audio warning. This "early generic" version was delivered on aircraft serial numbers 384E through 508E.On aircraft serial numbers 509E and subsequent, a modified ("late generic") version of the system eliminated the air/ground switch, incorporated the ENGINE OUT/low rotor audio warning disable into the generator switch, and changed the RE-IGN test switch back to a two-position, momentary-type switch. In operating the reignition system and checking the ENGINE OUT/low rotor audio warning the "late generic" system functions almost identical to the "pre-generic" system.

Pilots should be aware that aircraft originally delivered with the "early generic" version of the system may have been modified in the field to the "late generic" version. Look at the RE-IGN test switch and it's labelling to determine which version of the system is installed in your particular helicopter. "Pre-generic" and "late generic" utilize a two-position, momentary-type switch, labelled OFF at the bottom and

TEST at the top. "Early generic" systems utilize a three–position switch labelled OFF at the bottom, FLT in the middle, and TEST GND at the top.

Major Electrical Components

1. External Power Receptacle
2. Battery/External Power Switch
3. Starter-Generator
4. Generator Control Unit
5. Nickle Cadmium Battery

External Power Receptacle

The external power receptacle is constructed of insulator material with three pins molded in place. The receptacle provides for utilization of external power for engine starting or maintenance purposes. The small pin is not used.

Battery/External Power Switch

The battery/external power switch is a three position switch located on the instrument panel lower left. It is wired in such a manner that you cannot connect the battery and external power to the bus at the same time. A battery and an external power relay are located in the battery compartment area and under the seat structure. The main power switch provides ground for the battery relay when the battery is selected and provides ground for the external power relay when it is selected. The wiring from the external power relay to the switch includes a diode to prevent relay energizing when the external power is of incorrect polarity. Select switch center position is OFF.

Starter-Generator

The starter-generator is a combined, self-cooled unit used to start the engine and provide primary DC power to the electrical system. It is mounted on the engine accessory case, clamped to the mounting flange and is held in alignment by a series of slots between the mounting flange and the starter-generator. The generator portion has a rating of 30 volts, 150 amperes, over a range of 7,200 to 13,000 RPM. A shear point is incorporated in the generator drive shaft to protect the engine drive from excessive torque loads. A radio frequency interference filter is located in the terminal block.

As soon as the starter function is released, the GCU brings the generator output up to approximately 28 volts regulated voltage. However, the generator output is not connected to the DC bus until the generator switch is placed in the ON position.

Generator Control Unit (GCU)

The GCU maintains constant generator output voltage under varying speeds and load conditions. An over voltage sensed by the GCU trips the GEN switch (**early GCU only**) removing power to the GCU and removing generator output voltage from the main dc power bus. The GCU reverse current circuitry prevents discharging of battery through generator circuits when generator output voltage is less than battery voltage. If generator output voltage is absent or excessively low, the reverse current circuit senses the same, tripping the GEN switch (**early GCU only**), removing power to GCU, and provides internal ground to illuminate GEN OUT lamp on the instrument panel.

With the early GCU the GEN switch will not enable the engine out warning and audible headset warning. (With the current GCU, placing the GEN-OFF switch to GEN, a ground is supplied that activates the engine power out warning horn.) A 15-ampere circuit breaker (located in the engine compartment above the left rear landing gear damper) protects the generator field circuit. During engine starting, the voltage regulator opens the generator field circuit when the START circuit is energized.

An improved GCU was incorporated in E509 and subs and FF092 and subs. The improved GCU is also available as a replacement for current GCU's.

Nickel Cadmium Battery

There are significant differences between lead acid batteries and nickel cadmium batteries. Unless these differences are recognized, improper servicing techniques could result. The electrolyte in a nickel cadmium battery is a solution of potassium hydroxide (KOH), which does not chemically react with the plate as the electrolyte does in a lead acid type of battery. Therefore, the plates do not deteriorate, nor does the specific gravity of the electrolyte appreciable change. However, the slightest acid contamination will deteriorate the nickel cadmium battery. The plates of the nickel cadmium battery are porous, absorbing the electrolyte while discharging and expelling it while charging.

Charging reaction: The active material of the negative plates in a nickel cadmium battery is cadmium oxide. The positive plates are nickel oxide. A solution of distilled water and potassium hydroxide (KOH) with a specific gravity of 1.24 to 1.30 is used as the electrolyte. The electrolyte is used only as a conductor and, therefore, the state of the battery charge cannot readily be determined by reading the specific gravity. During charging, the positive plates are brought to a higher state of oxidation by the charging current until both materials are completely converted, that is, all the oxygen is driven out of the cadmium oxide plates and only cadmium remains. The nickel oxide plates pickup the oxygen to form nickel dioxide. Toward the end of the charging process and during charging, the electrolyte will gas. Gassing is the result of electrolysis taking place in the electrolyte, The point of gassing is dependent upon the temperature and the charging voltage. A slight amount of gassing is necessary to completely charge the battery. The battery, therefore, will lose a certain amount of water.

Discharging reaction: During discharge, the reverse chemical action takes place. The negative plates gradually gain back the oxygen as the positive plates lose oxygen. Because of this interchange of oxygen, there is no gassing on normal discharge. In this way, the chemical energy of the plate; therefore, the electrolyte level cannot be determined on a discharged battery.

Restoring capacity: One Characteristic of a nickle cadmium battery is that after several hundred charge/discharge cycles, the battery may not deliver its rated capacity. The battery exhibits a loss of capacity. This loss may be as much as 35 percent of the rated capacity. Personnel accustomed to working with lead acid batteries could interpret the loss of capacity as a natural aging of the battery. This loss of capacity, due to cell voltage imbalance, is normal and must be corrected periodically. The battery has a fast recharge capability and can be recharged from zero voltage to full capacity in 1 hour.

Battery freezing: Lead acid batteries exposed to cold temperatures are subject to plate damage due to freezing of the electrolyte. A nickel cadmium battery is not as susceptible to damage due to freezing, because no appreciable chemical change takes place between the charged and discharged state. However, the electrolyte will freeze at approximately -75 degrees F.

GENERATOR MALFUNCTIONS

Indications Amber GEN OUT indicator-ON.

Ammeter indicating zero.

Generator (GEN) switch tripped to OFF. (Early Generic W/H only)

Procedures Check generator (GEN) circuit breaker ______ and return generator switch to ______ (if tripped OFF). (Generic W/H only)

If GEN OUT indicator remains ON or comes back ON, pull ____________ OUT and insure generator (GEN) switch is in the ______ position for the remainder of the flight.

NOTE: The generator (GEN) switch must be in the ON position to enable the Engine Out/Low Rotor audio warning to function as required.

BATTERY MALFUNCTIONS - NICAD

Battery Overtemperature 160°F and Above Red BAT TEMP 160°F indicator -ON.
Land as soon as possible.

NOTE: The battery HI TEMP relay automatically removes the battery from the DC electrical Bus (aircraft with the generic wire harness only) when the battery reaches 160°F

Procedure: ____

____

____

____

NOTE: Inspect battery in accordance with the manufacturer's instructions upon landing. No further flight is authorized until battery has been inspected.

Battery Overtemperature 140°F and Above

Amber BAT TEMP 140°F indicator-ON.

Procedure: ____________________

____

____

____

NOTE: The amber BAT TEMP 140°F light will go out after the battery has cooled to below 140°F.

Battery must remain off line during remainder of flight.

NOTE: Inspect battery in accordance with manufacturer's instructions upon landing. No further flights are authorized until battery is inspected and cause of overtemp corrected.

Starting: Generic Wire Harness

With electrical power applied to the main Bus, power is applied to the start circuit breaker.

- With the C.B. "SET", power can continue to the key switch.
- With the key switch "ON" power is applied to the start switch.
- Depressing the start button provides power to the FWD line contactor energizing the coil of K308 which closes the heavy contacts. This now allows a power path to the heavy contacts of the start relay K301.
- Another small wire from the start switch connects the start relay coil. This coil energizes and allows power through the heavy current carrying wires to the start terminal of the starter/generator.
- The ammeter will show maximum negative of 150A when the start initiates. As the current draw of the starter decreases the ammeter will move toward zero.

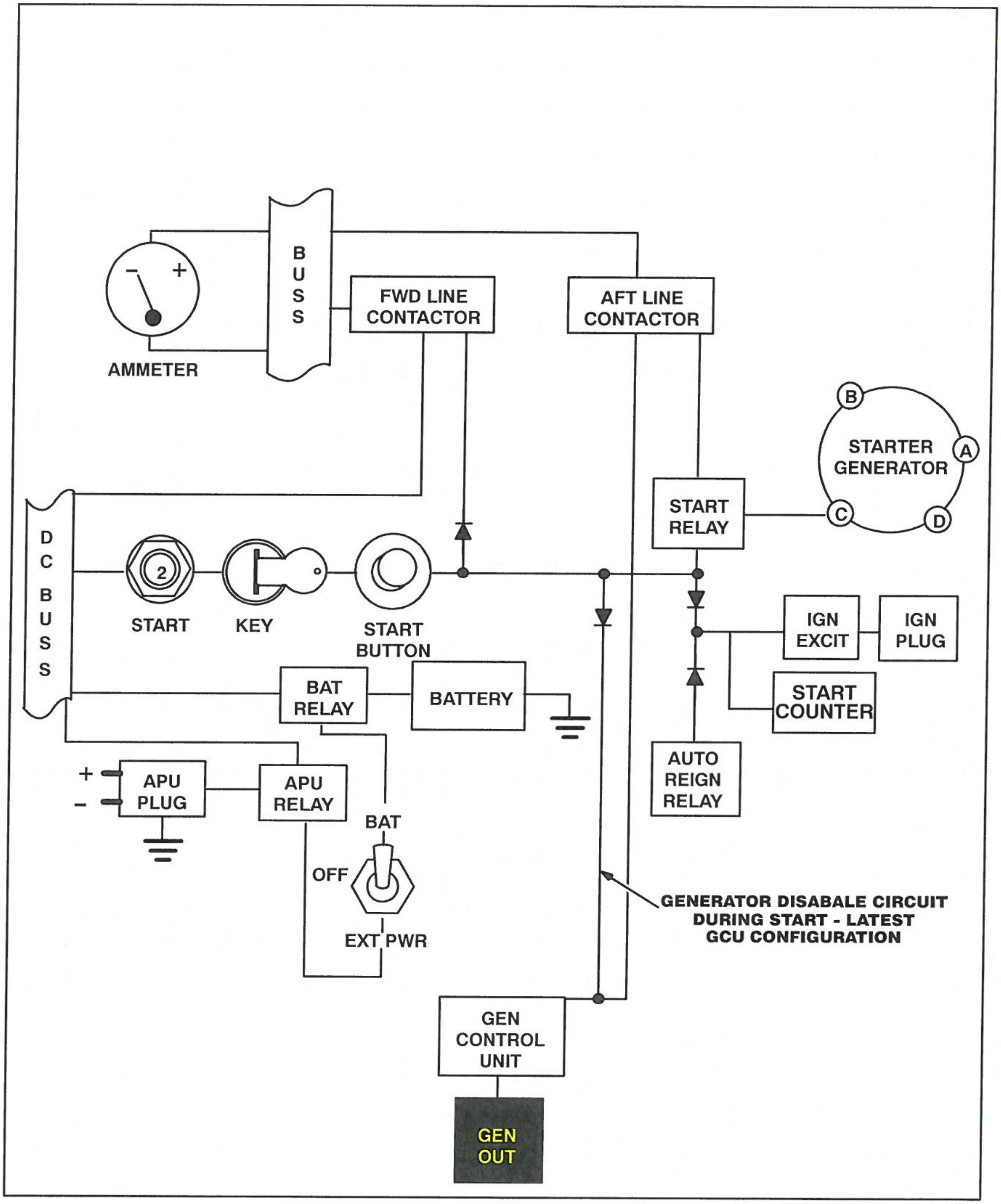

Figure 12-2. Starting Circuit - Generic Wiring Harness

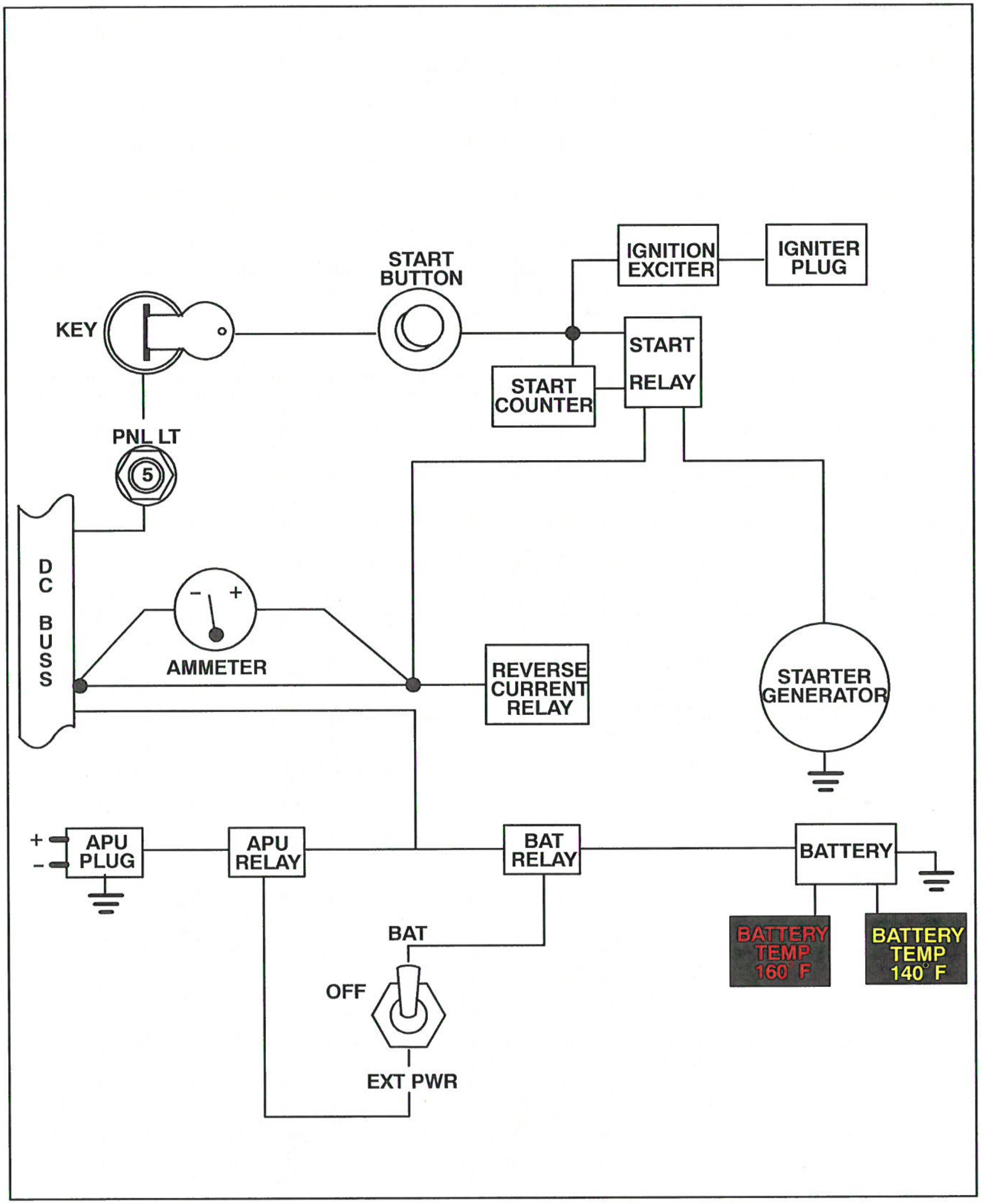

Figure 12–3. Starting Circuit – All Models – Non Generic Wiring Harness

12-4. START OPERATIONS GENERIC W/H

Description and Operation

With electrical power applied to the main Bus, power is applied to the start circuit breaker. With the C.B. IN, power can continue to the key switch. With the key switch "ON" power is applied to the start switch. Depressing the start switch provides power to the FWD line contactor which closes the heavy contacts. This now allows a power path to the heavy contacts of the start relay. A small wire from the start switch connects to the start relay coil. This coil energizes and allows power through the heavy current carrying wires to the start terminal of the starter/generator. The ammeter will show maximum negative of 150A when the start initiates. As the current draw of the starter decreases the ammeter will move toward zero. The generator switch must be in the "OFF" position or the generator will begin operating and create an additional load on the starter which will cause the start to stagnate. During start, ignition is provided by the ignition system firing as long as the start switch is depressed. The engine provided start counter is energized whenever the start switch is depressed.

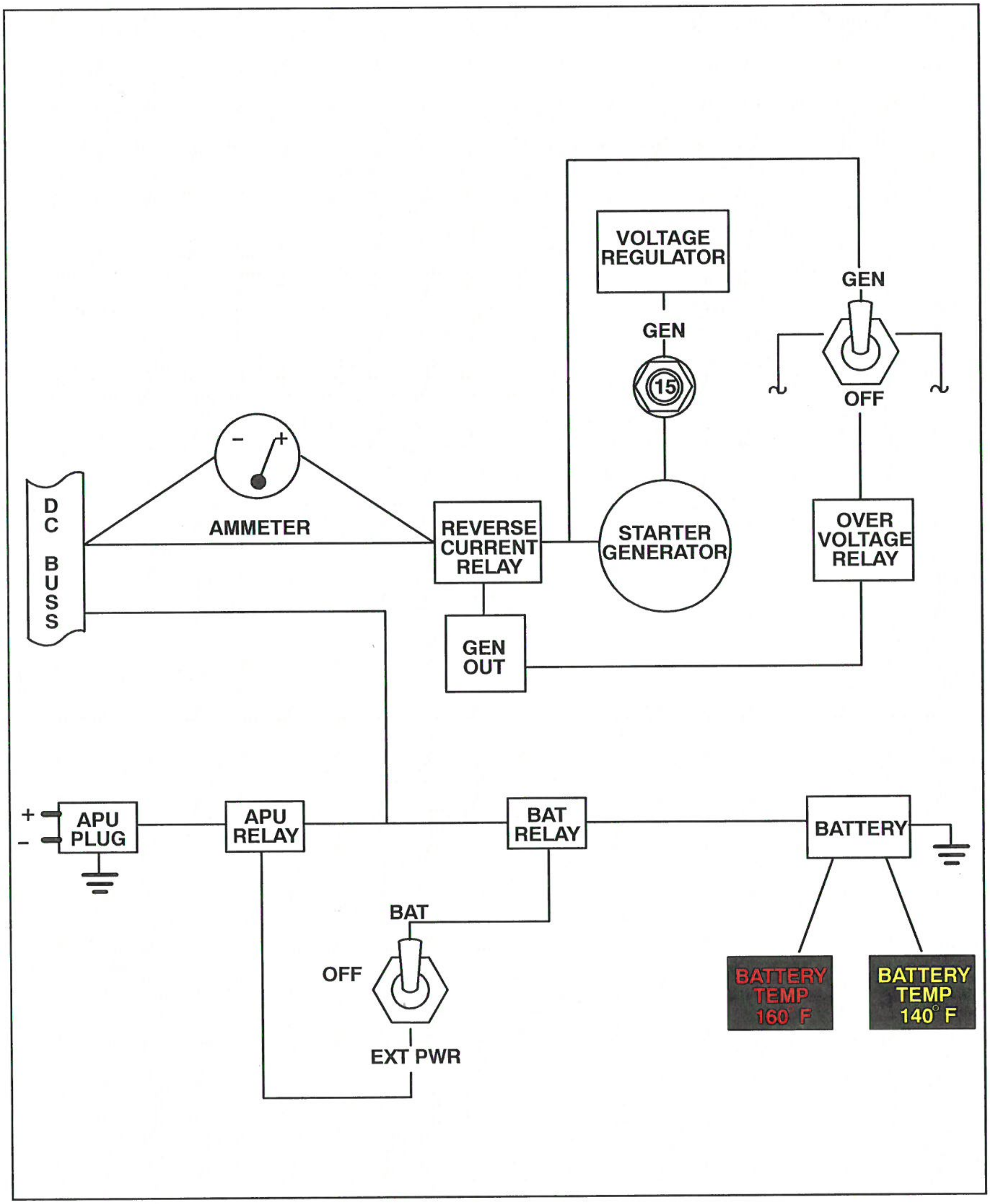

Figure 12–4. Generating Circuit – Models 500E/530F Plus – Non Generic Wiring Harness

NOTES:

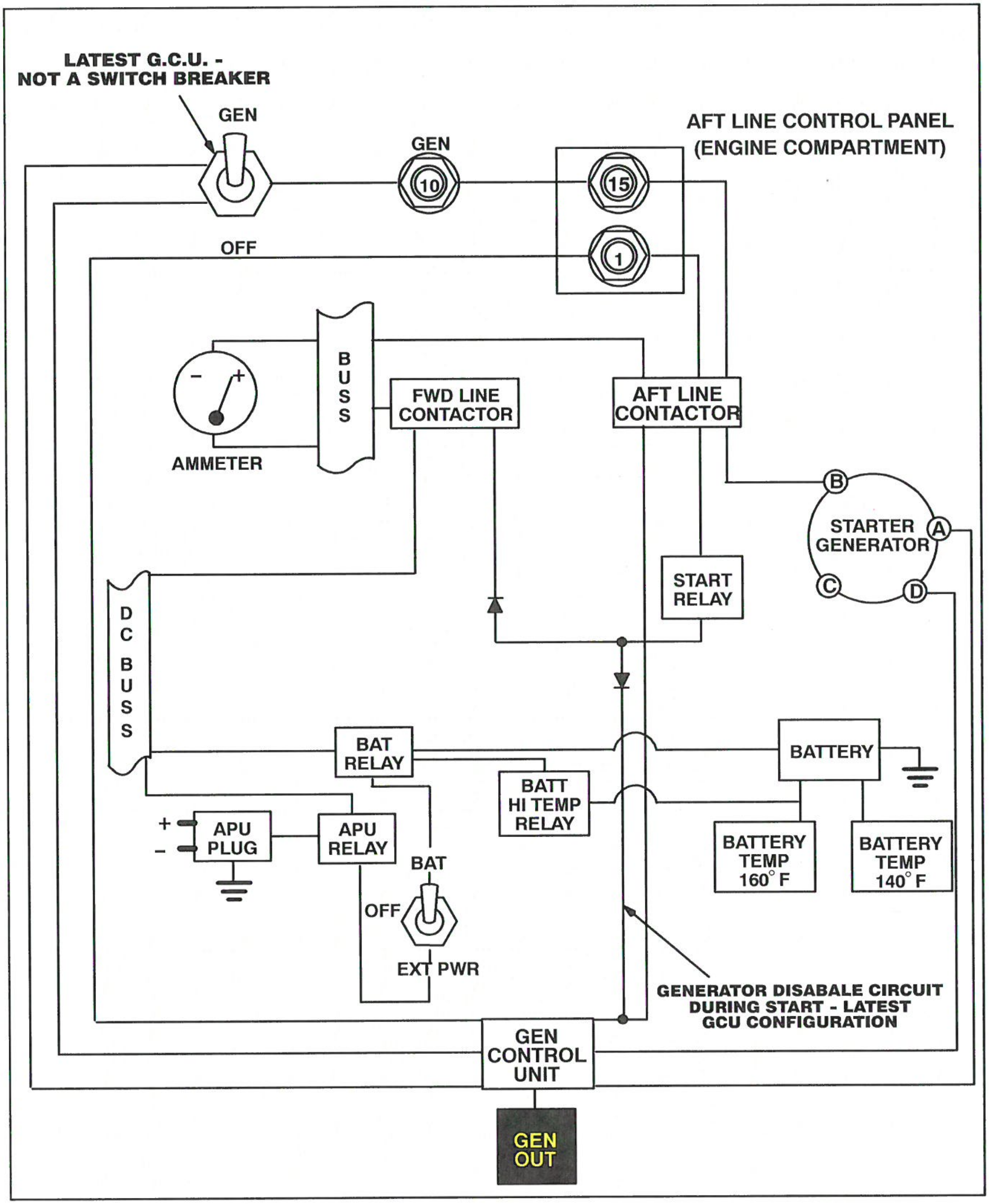

Figure 12–5. Generating Circuit – Generic Wiring Harness

12–5.GENERATING SYSTEM

Description and Operation

After the start is completed and the aircraft is at ground idle, the generator switch is positioned to "ON". This allows the generator residual output to be applied to the Generator Control Unit. The GCU at this time now acts as a voltage regulator, and by controlling the generator field strength, will increase the voltage to established voltage as preset by the adjustment. The voltage output of the generator is adjustable at the GCU.

When the GCU senses all parameters are normal, power will be provided to pin H. of the GCU connector. This power is applied to the coils of the FWD and AFT line contactors. Closing the contacts of the AFT contactor allows the generator output to go forward through the heavy current carrying wires to the FWD bus. When the AFT contactor was energized the FWD contactor was energized at the same time by the same GCU output. The generator output is now applied to the battery/ external power bus. The generator output now charges the battery and provides electrical power for all electrical systems in the aircraft.

The GCU controls the operation of the "GEN OUT" light. Under voltage, over voltage approximately, or excessive current will cause the GCU to trip the generator switch to OFF. With the power removed from the GCU the FWD and AFT contactor coils lose power, thereby removing the generator output from the wires at the generator end, minimizing electrical shorts to ground problems. The FWD contactor removes the generator from the battery/external bus. These conditions will cause the "GEN OUT" light to illuminate. The electrical system is now powered by the battery.

The system may be reset by returning the generator switch to "ON". If a problem should still exist, the generator switch will trip to "OFF".

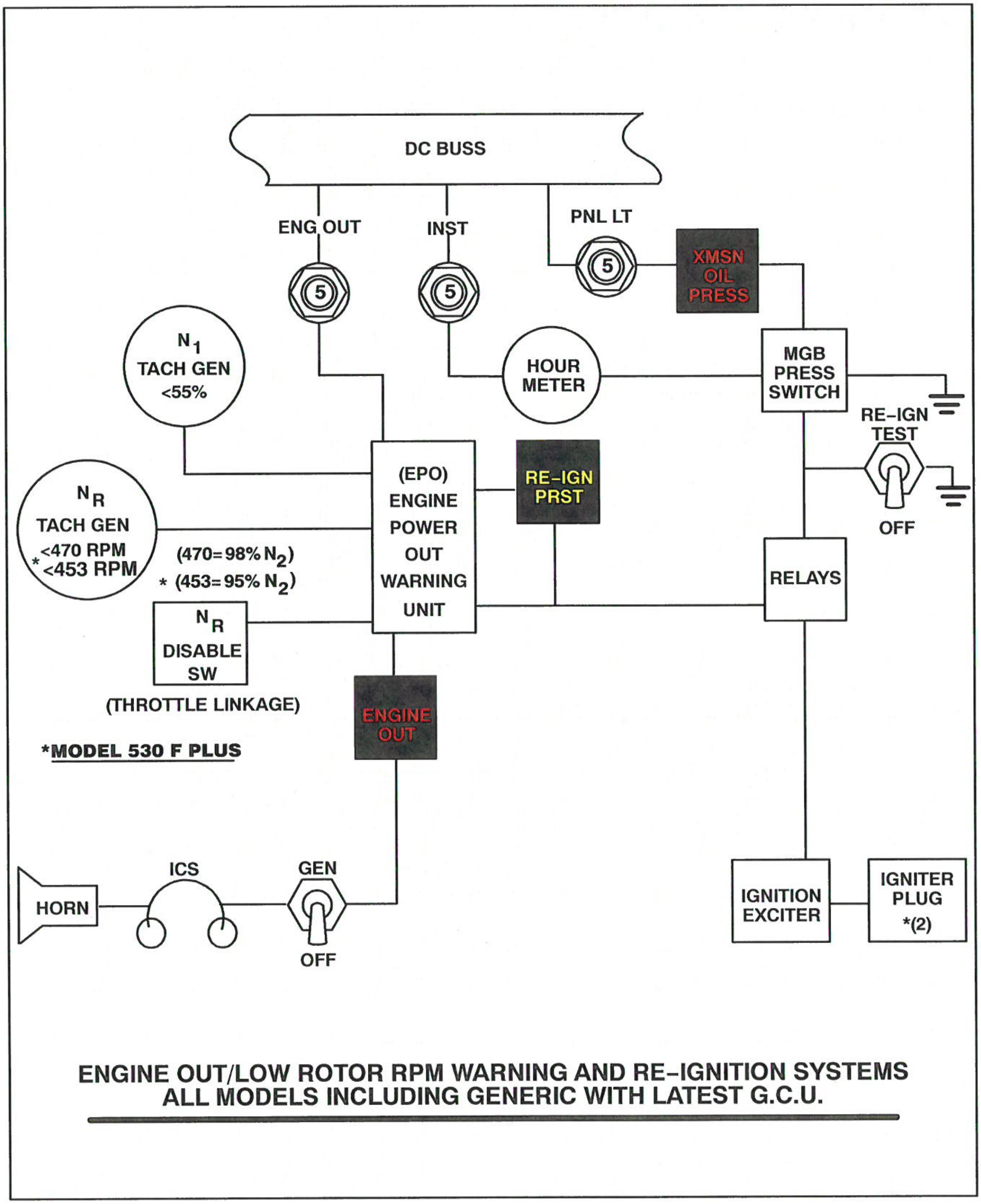

Figure 12-6. EPO, N_R, Automatic Reignition - All models (Sheet 1 of 2)

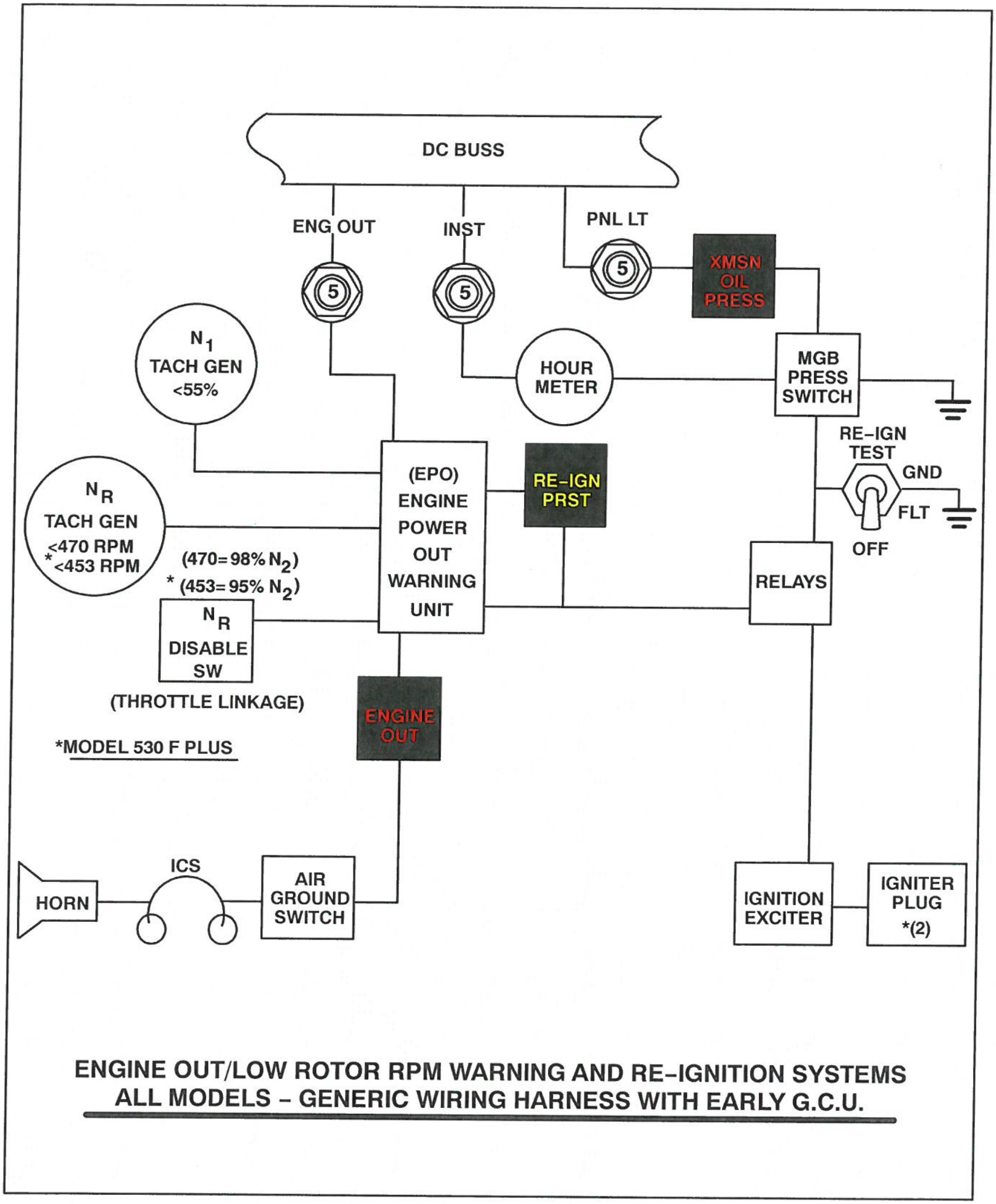

Figure 12-5. EPO, N_R, Automatic Reignition - Generic Wiring Harness (Sheet 2 of 2)

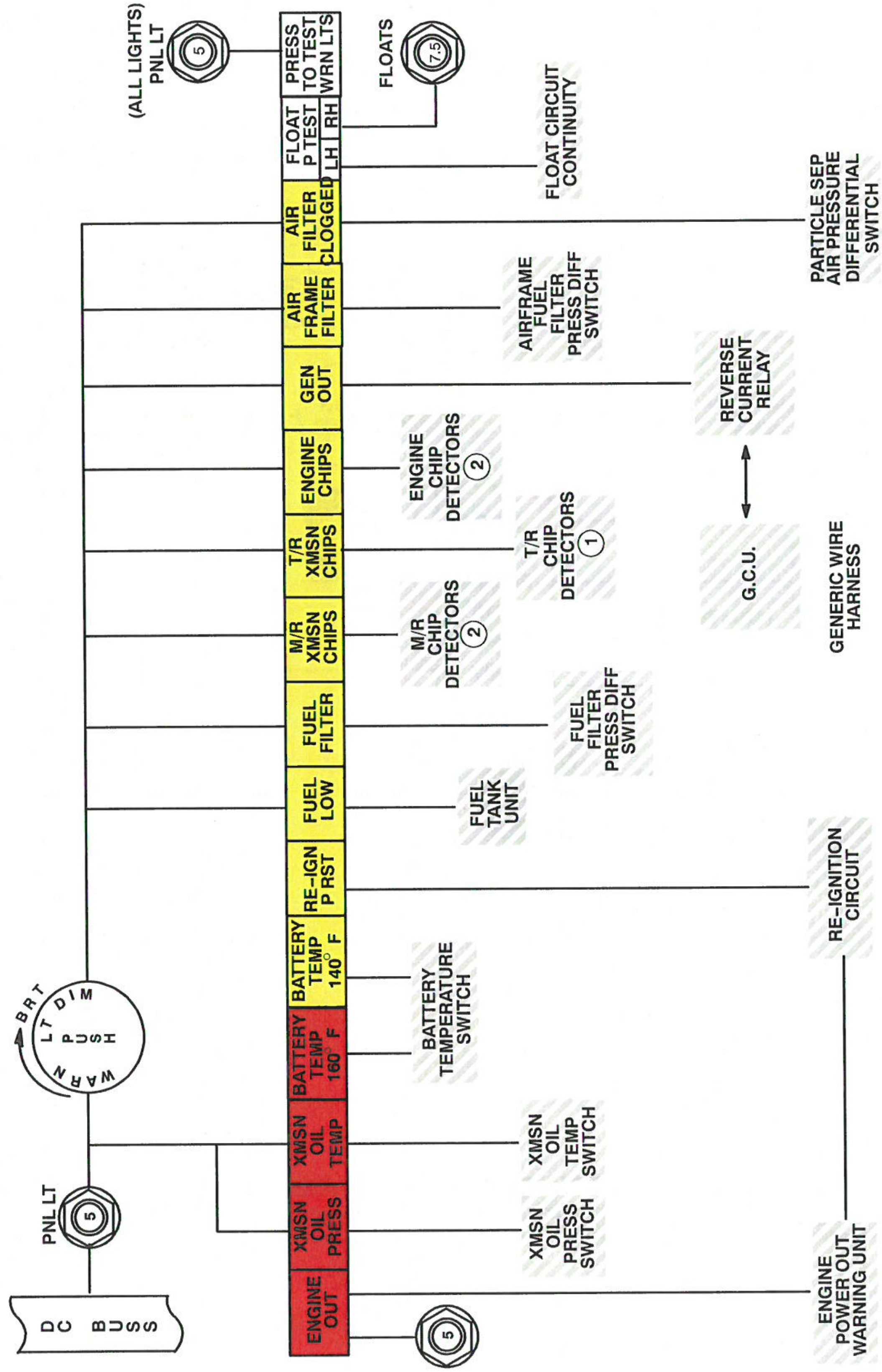

Figure 12–7. Caution and Warning Indicators – Model 500E

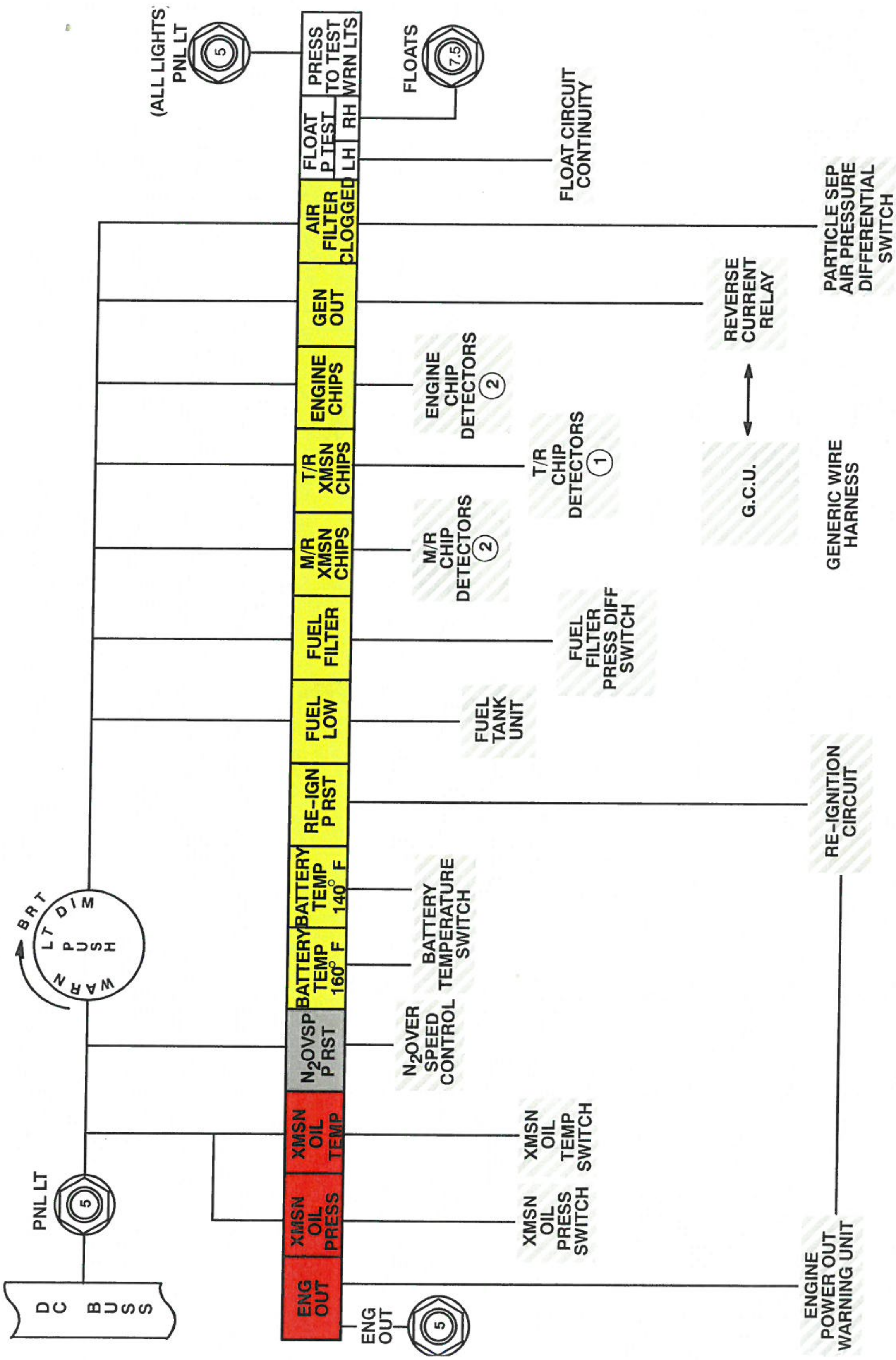

Figure 12–8. Caution and Warning Indicators – Model 530F Plus

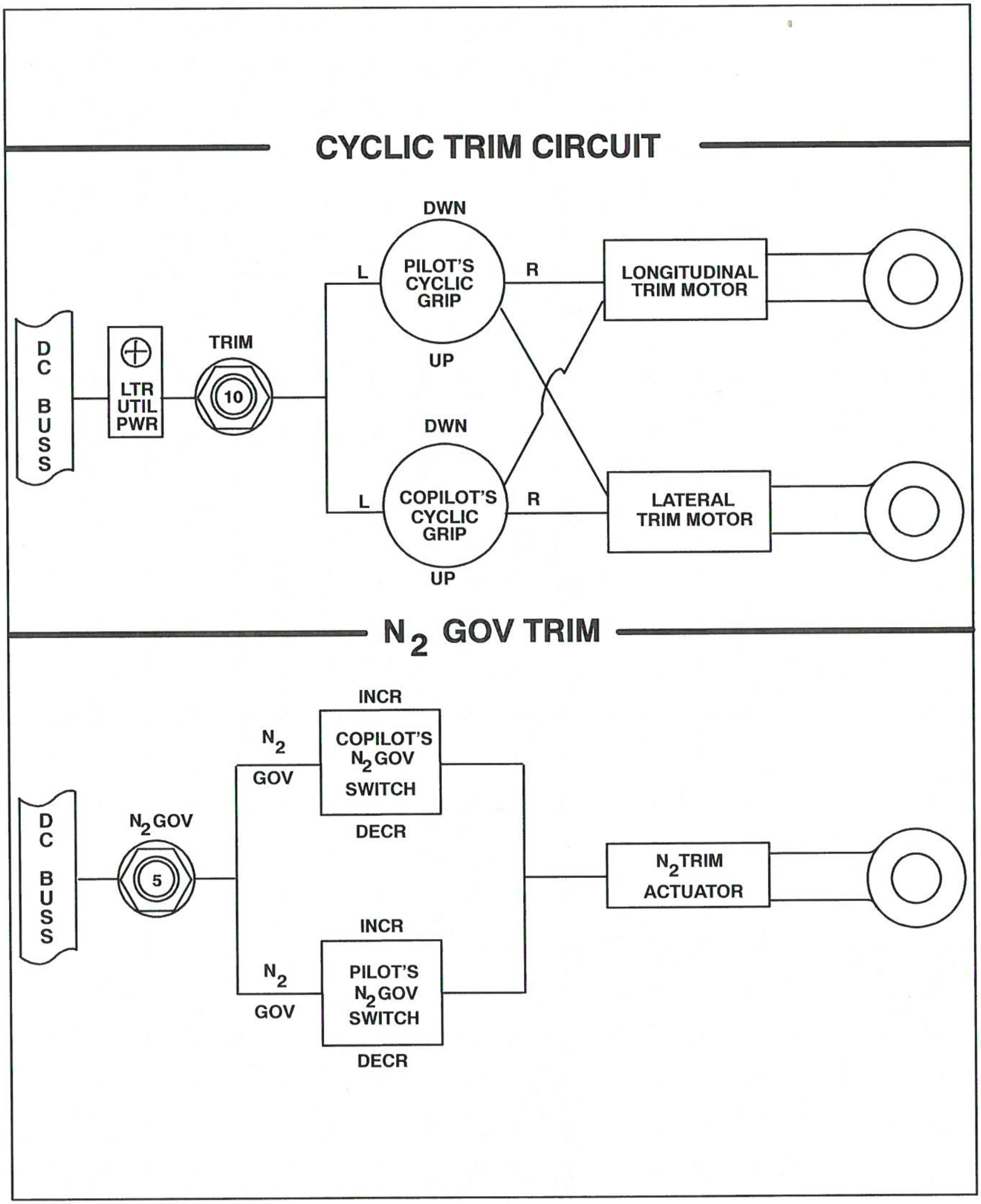

Figure 12-9. Cyclic Trim and N_2 Governor Circuits Model 500E and 530F Plus

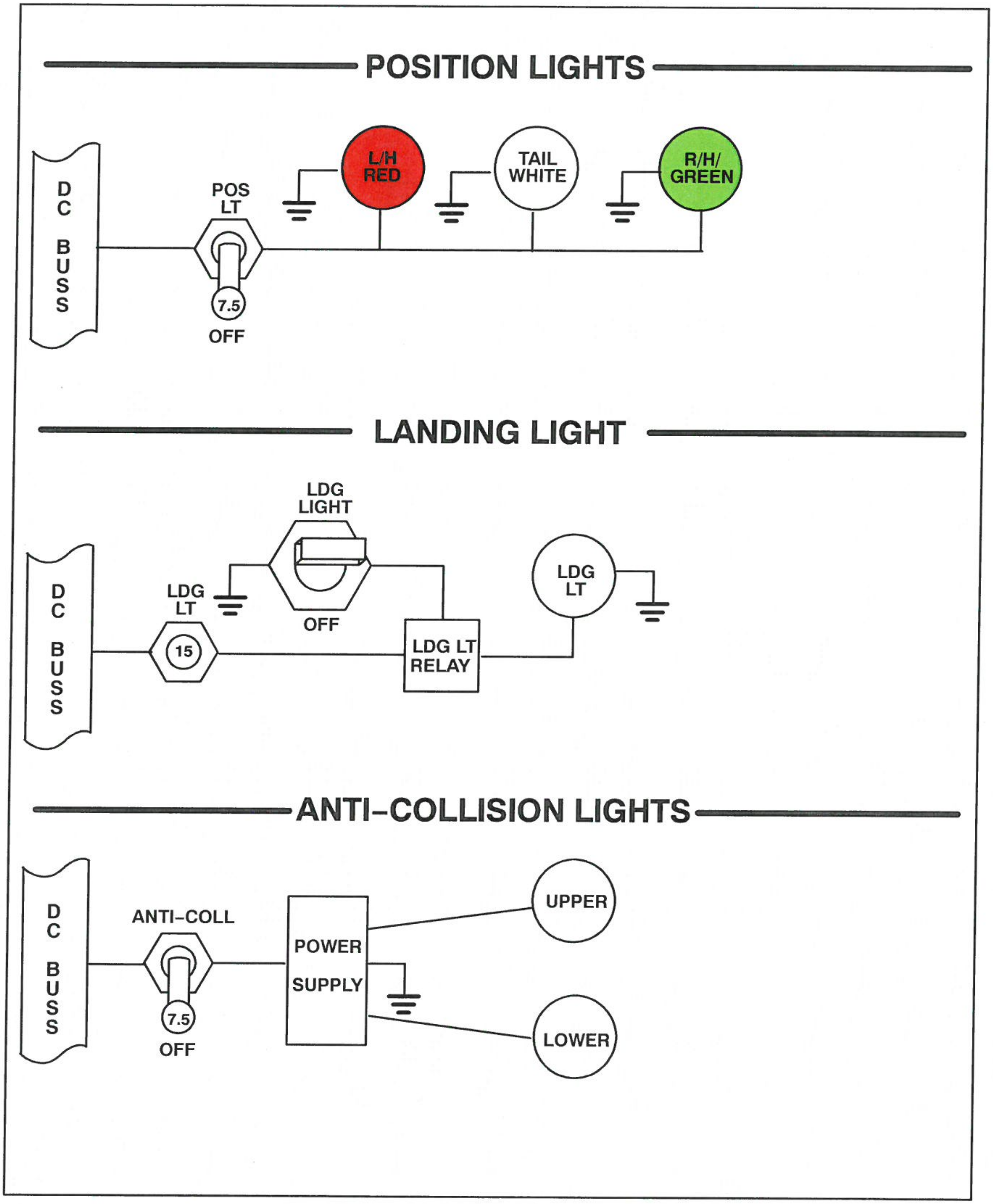

Figure 12–10. Position, Landing, and Anti-Collision Lights – All Models

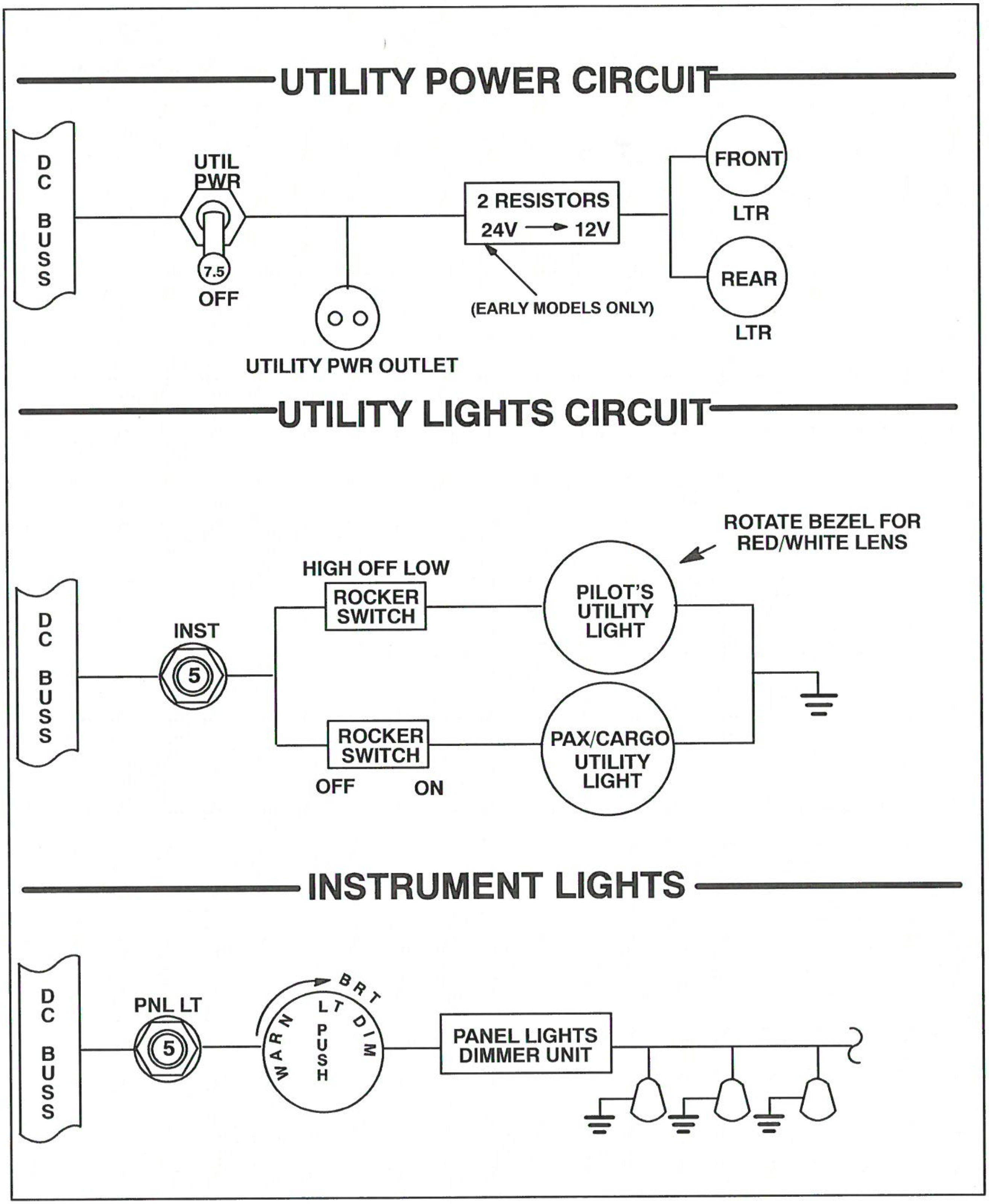

Figure 12-11. Utility Power, Utility/Instrument Lights – Model 500E and 530F Plus

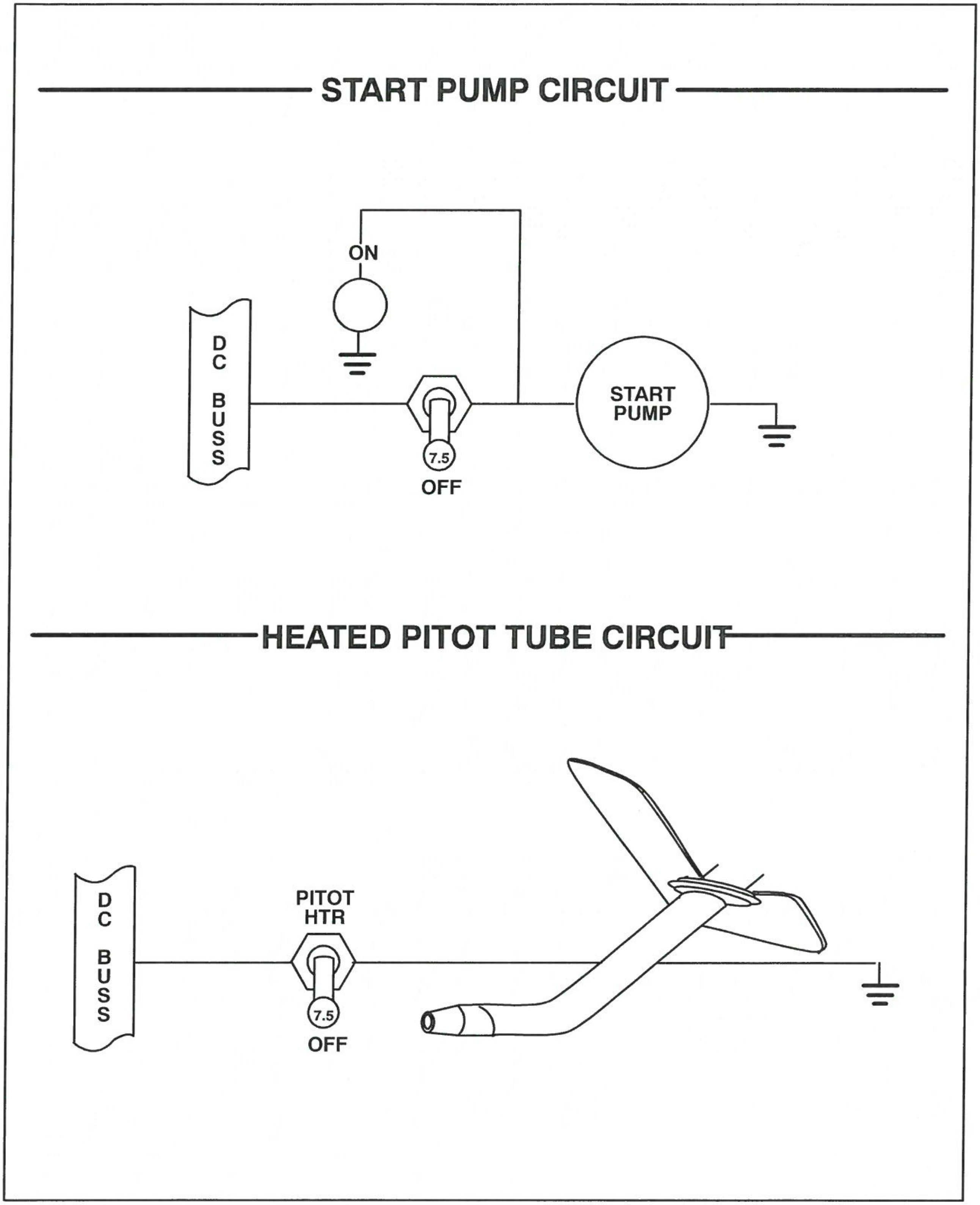

Figure 12–12. Start Pump and Pitot Tube Circuits – Model 500E and 530F Plus

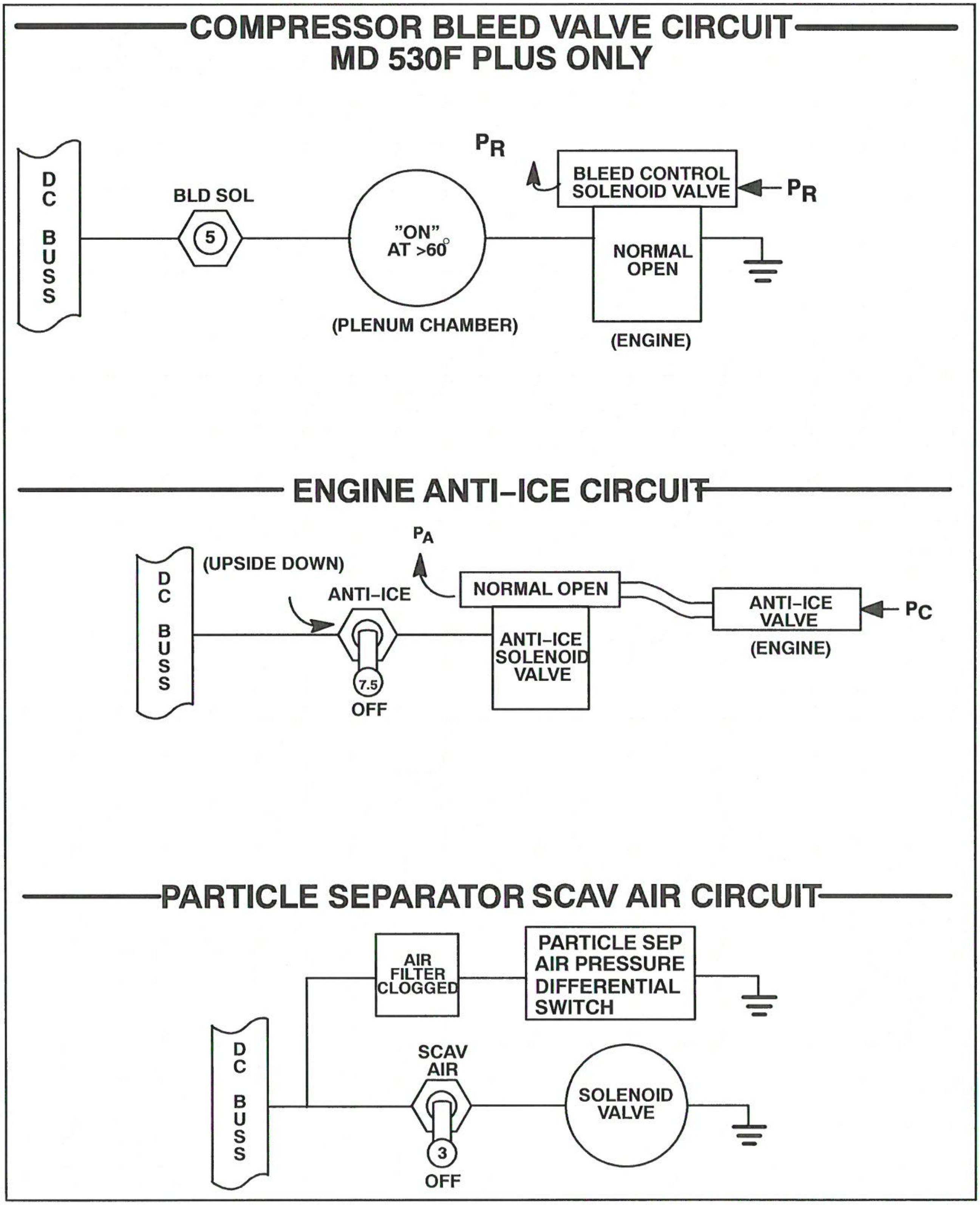

Figure 12–13. Compressor Bleed Valve, Engine Anti–Ice, and Particle Separator Scav–Air for Helicopters Equipped with Allison 250–C30 or C–20R/2 Engines

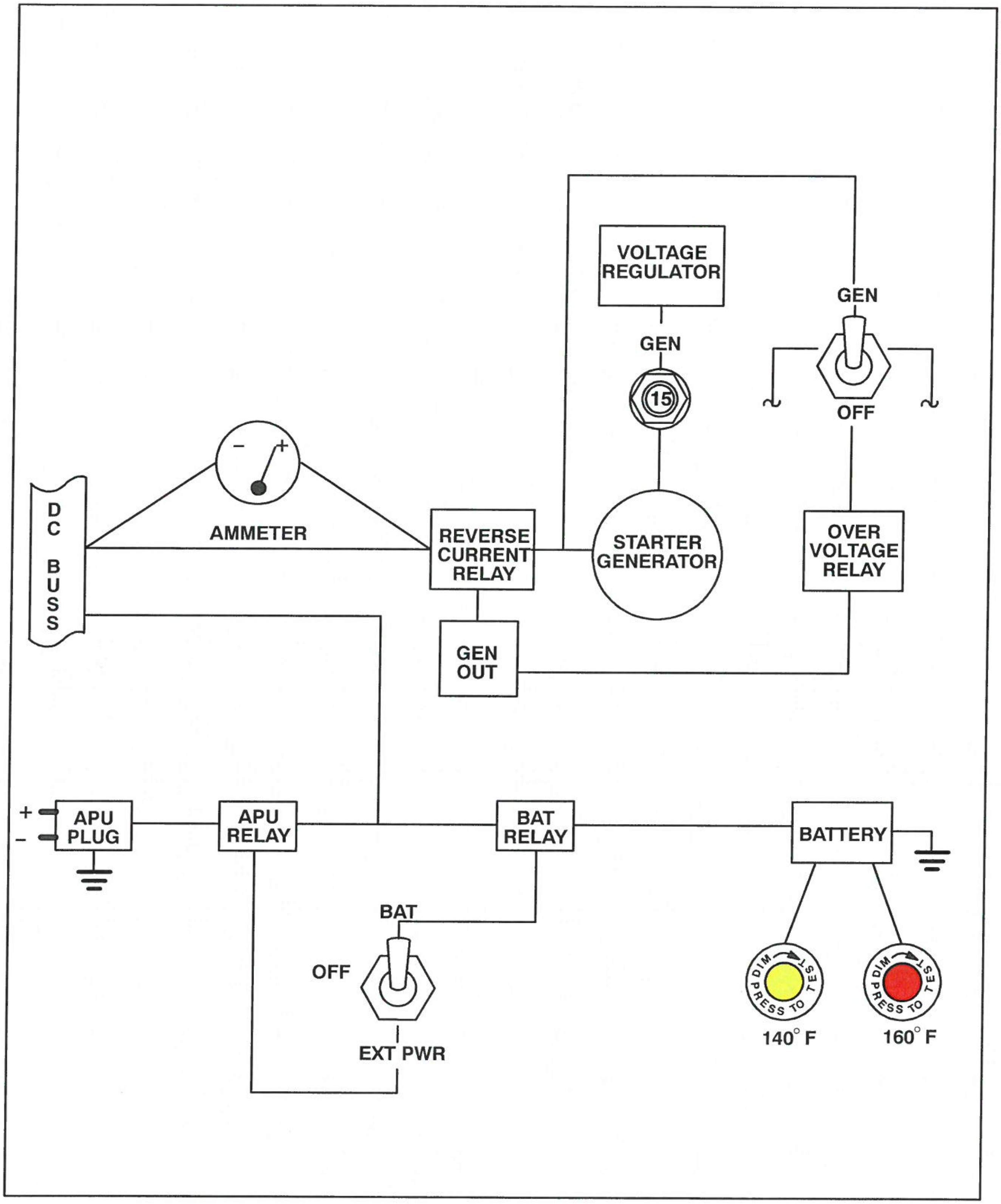

Figure 12–14. Generating Circuit – Model 500D

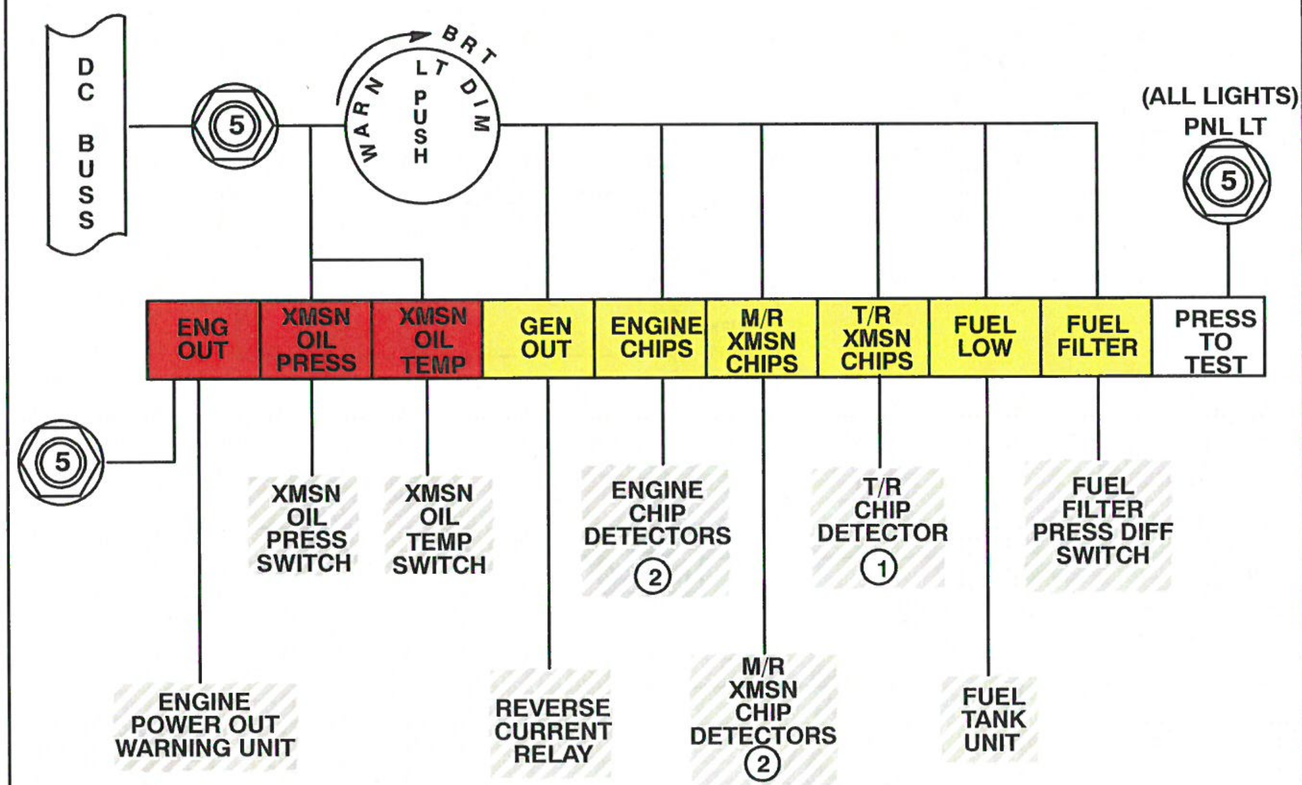

Figure 12-15. Caution and Warning Indicators – Model 500D

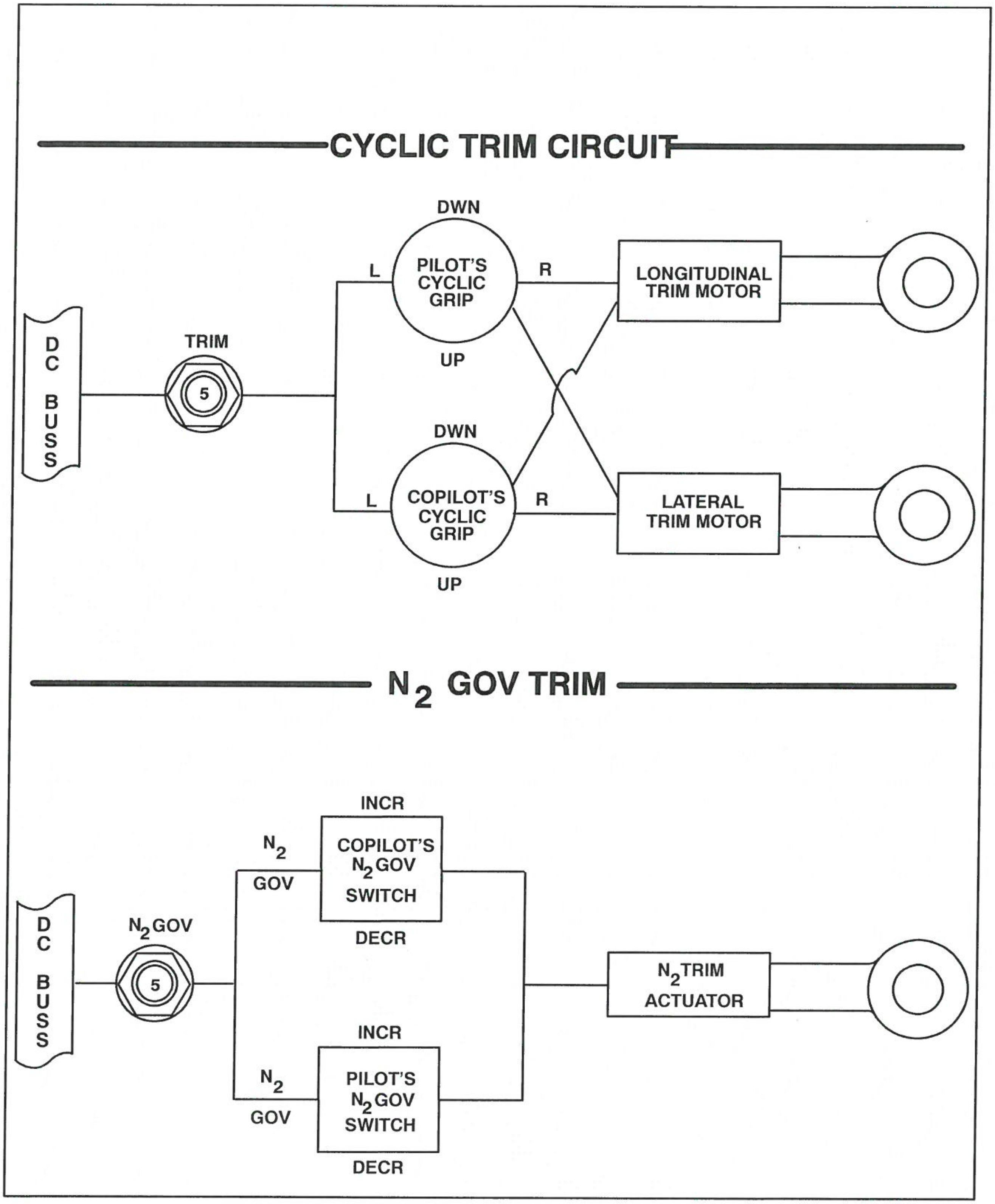

Figure 12–16. Cyclic and N_2 Governor Trim Circuits – Model 500D

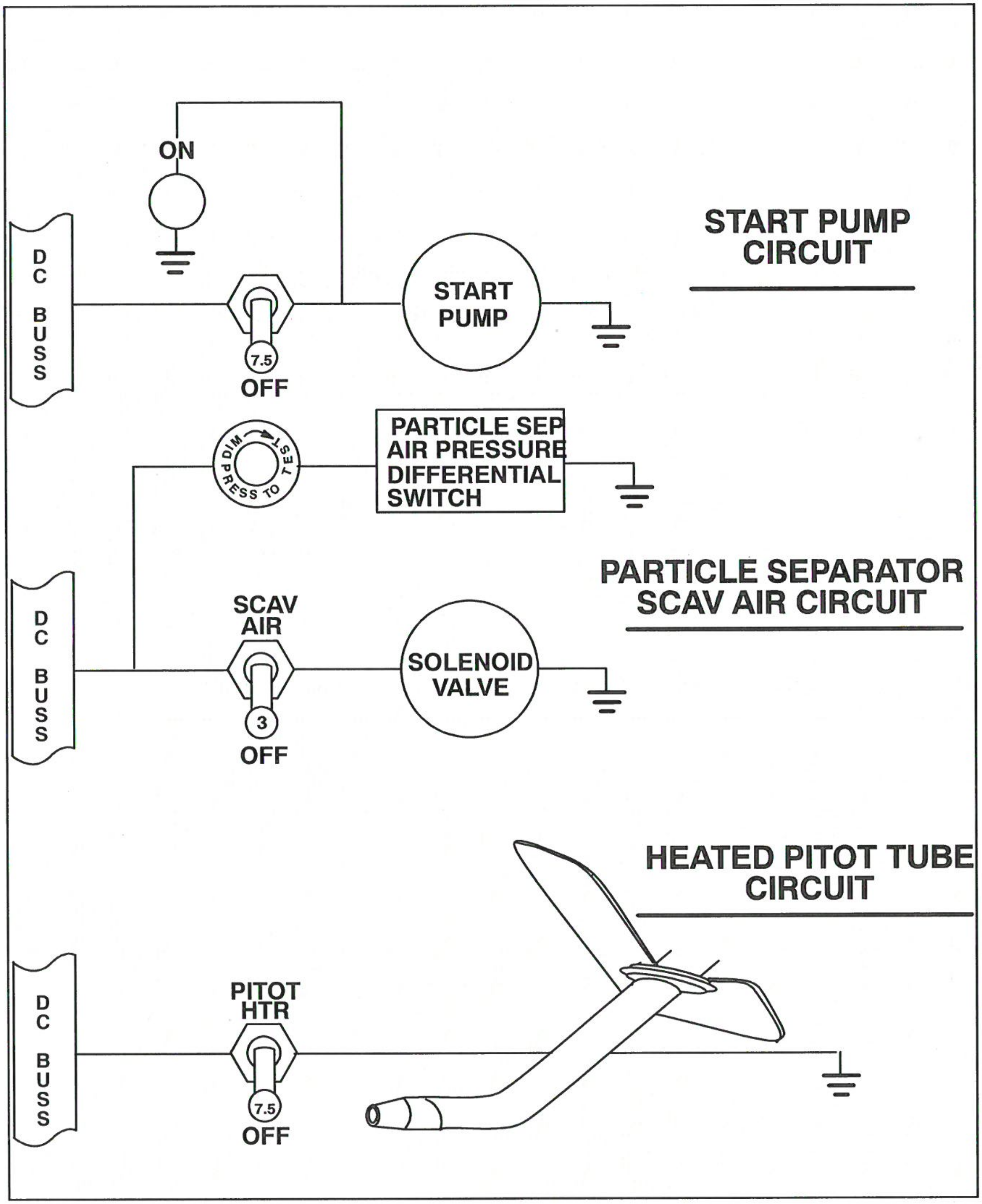

Figure 12–17. Start Pump, Particle Separator Scav–Air, and Pitot Tube Circuits for Model 500D

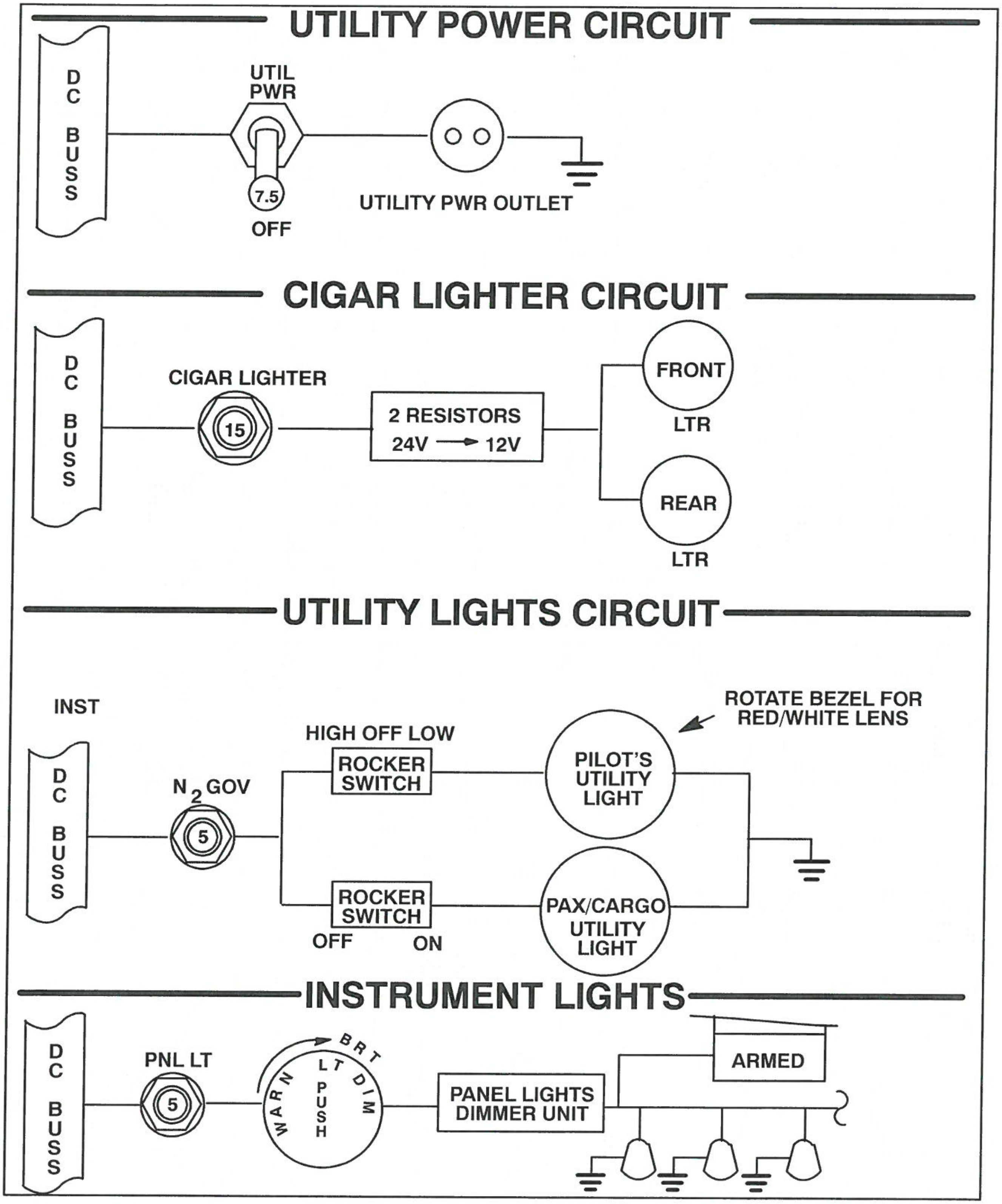

Figure 12–18. Utility Pwr, Cigar Ltr, Utility Inst Lts – Model 500D

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HELICOPTERS

MD 500 Pilot Transition Training Manual

SECTION XIII
ENVIRONMENTAL CONTROL

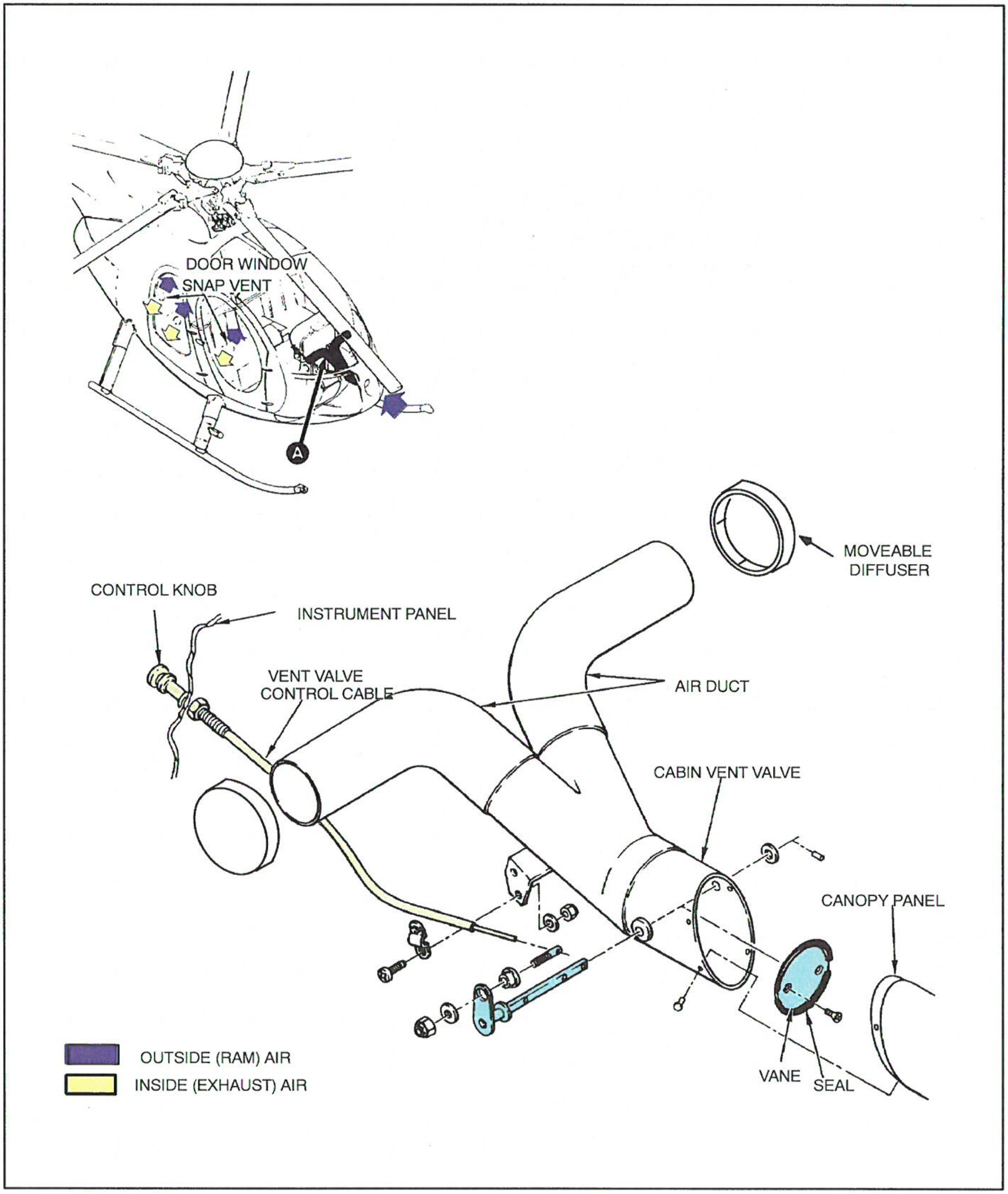

Figure 13-1. Cabin Ventilating System

13–1. VENTELATING SYSTEM

Description and Operation

A cable actuated vent control valve located at approximately center of the canopy, forward of the instrument panel, supplies fresh air to the helicopter interior.

The vent control valve allows ram air to enter an inlet and discharge through a diffuser which directs the air throughout the pilot and passenger cargo compartment.

Each pilot and cargo compartment door window contains an adjustable plastic ventilator which can be opened, closed, and positioned by rotation of the vent output to supplement fresh air intake, or can be positioned for exhaust as desired.

The vent control valve controls the amount of ram air allowed to enter the pilot and passenger cargo compartment. The valve is molded into the canopy center frame. The vent valve housing is made of polycarbonate plastic and incorporates a valve vane to control airflow. A wire cable and conduit assembly activates the valve door (vane).

NOTES: ____

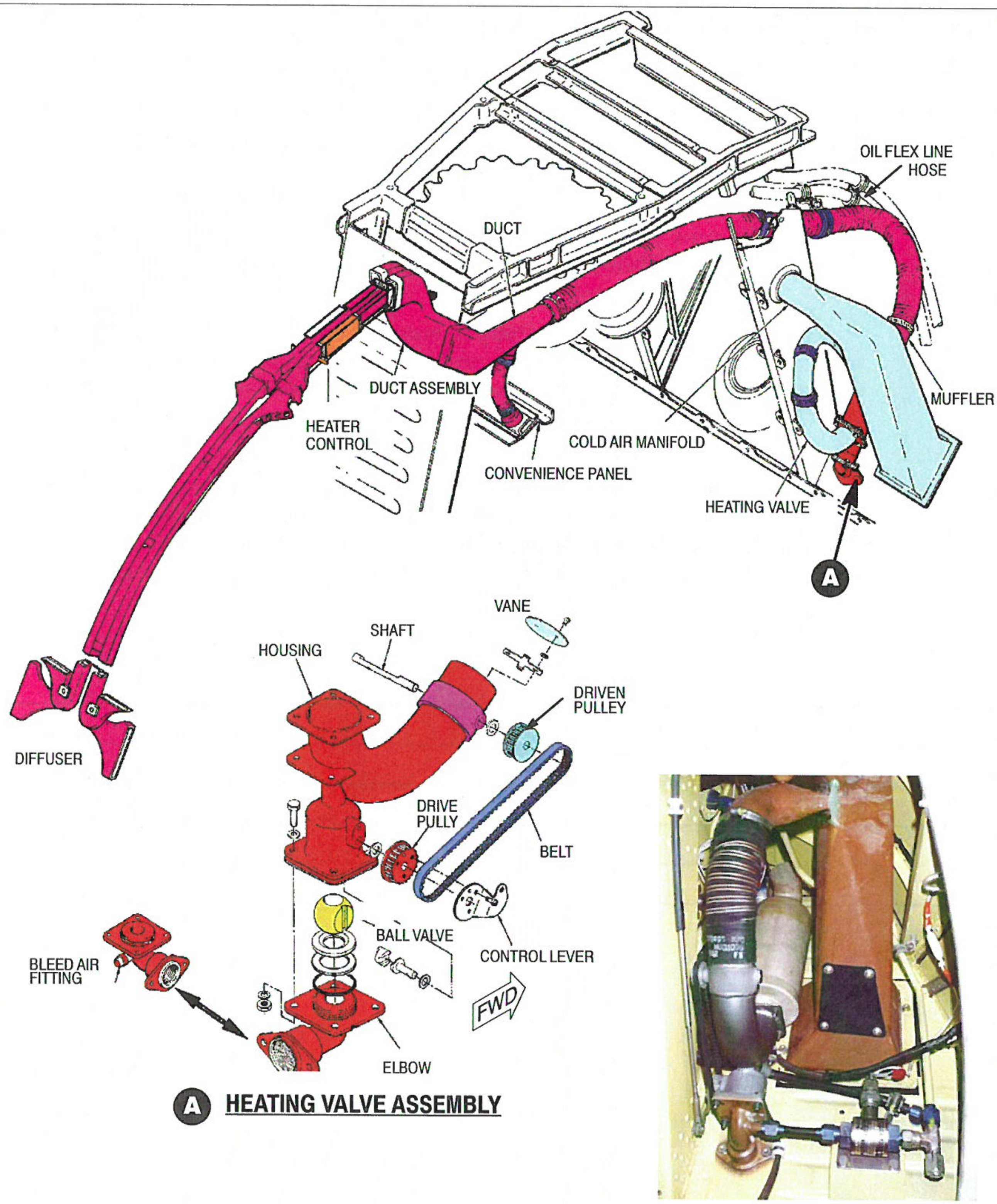

Figure 13–2. Heating System

13-2.HEATING AND DEFOGGING SYSTEM

Description and Operation

The heating and defogging system provides heat for pilot and passenger comfort in colder areas of operation and will provide fresh air for windshield defogging in humid areas of operation. This simple system requiring no combustion, electrical switches or sensing devices, or elaborate regulating units.

The heating and defogging system is an option and may not be installed in your aircraft.

Airflow is supplied by the engine oil cooler blower to one control valve port. Heated air is also supplied to another control valve port. The control valve then acts as a mixer to control air temperature discharge into the cabin area.

For heating and defogging, the helicopter uses some of the air that passes through the engine oil cooler blower assembly. The blower scroll has two outlets. The outlet on the right side of the scroll is ducted to the engine oil cooler. The outlet on the left is ducted to the transmission oil cooler and to the heating control valve.

The scroll left side outlet is equipped with a Y duct to supply air for cabin heating and defogging. The airflow is ducted to the heater control valve, and when open, the air will continue through ducting to the six fan shaped outlets in the cockpit and convenience panel outlet for cargo compartment heating.

The heated air is provided by bleed ports on the engine compressor discharge scroll. The heat generated by compression through seven stages of the engine compressor will average approximately 500°F at takeoff rpm. Heater operation effects hover capability. Refer to Section V of the flight manual when performing operations with cabin heat on.

The heated air is supplied by two bleed ports on the front side of the seventh stage centrifugal compressor scroll. The ports are located diametrically opposite one another to maintain a balance airflow through the compressor discharge tubes.

Bleed air is routed through tubing to a port on the heater control valve. The heater control valve when open acts as a "mixer" of heated bleed air with the engine oil cooler blower supplied ambient air. Temperature control of the cockpit and cargo compartment is a function of the cockpit control valve.

A large cylindrical muffler at the output of the heater control valve deadens airflow noises that may otherwise resonate through the ducting.

Heater Control Valve

The heater control valve assembly houses two valves, one to control the amount of engine bleed air (heated) and another to control passage of blower ambient air.

The inlet for engine air is controlled by rotating a ball valve. As the ball is rotated by cockpit control movement, the passage through the ball aligns with the valve ports to allow passage of heated air. The inlet from the blower scroll is controlled by a butterfly valve which has a drive pulley interconnected to the ball valve by means of a rubber belt.

When the ball valve is closed the butterfly valve is closed; consequently, neither heated nor blower air passes through the heater control valve. As the cockpit control is moved aft, the control valve ever is moved, rotating the ball valve and opening the butterfly valve. The first one inch of travel of the cockpit control rotates the ball valve, but not far enough to align the openings; however, the butterfly valve immediately opens allowing passage of blower air to pass to the outlets for defogging. Further movement of the control will open the ball valve proportionally for heater operation.

The drive belt has teeth along the inner diameter which engage in notches on both drive pulleys. The belt pulleys are of two different diameters, the one for the butterfly valve being the smaller. This is for a definite reason. If only heated air was allowed passage through the ducts without some dilution, the temperature could create softening of the canopy plexiglass. To prevent this from occurring, the butterfly valve continues to rotate to a point where it is 3/4 closed when the heated air ball valve is full open, to provide the necessary diluted but maximum heat to be discharged onto the plexiglass.

Heater Control Cable

The control handle, wire control, and conduit assembly are incorporated in the left side of a duct attached to the overhead canopy structure. Movement of the cable actuated control handle to the forward limit opens the heat control valve. Complete travel of the control handle is approximately 2–3/4 inches, from open to closed positions. Cable routing is along the left side of the main rotor mast support structure and then downward to the control valve on the firewall.