9. Rigid Tube Inspection and Installation

CAUTION: TORQUE PAINT (SLIPPAGE MARKS) MUST BE APPLIED TO ALL THE RIGID TUBE B-NUTS IN ACCORDANCE WITH THE RIGID TUBE INSTALLATION PROCEDURES. THE TORQUE PAINT MUST BE REMOVED AND REAPPLIED EACH TIME THE B-NUT IS LOOSENED AND TIGHTENED. DAMAGE TO THE ENGINE CAN OCCUR.

When a component to which rigid tube assemblies are attached is replaced, remove all interfering tube assemblies to permit easy removal and reinstallation of the component. This precaution will prevent subsequent damage to the tube assemblies. Tube-to-fitting alignment should be checked for proper fit, as described in Flared Tubes and Flanged Tubes, para 9.B. and 9.C., this section, anytime such a component is installed.

A. Inspection

Inspect fuel, control air, and oil tubes as follows:

(1) Inspect tubes for dents, chafing or cracks.

(2) Reject tubes with cracks (FPI) in all areas.

(3) Reject tubes having dents or chafing on the flared ends or on the retention clamps.

(4) Reject tubes with dents exceeding 0.125 in. (3 mm) depth or having a sharp radius.

ENGINE FUEL AND CONTROL SYSTEM - MAINTENANCE PRACTICES

1. General

WARNING: WATER OR CONTAMINATION IN THE FUEL CAN CAUSE FLAMEOUT OR POWER LOSS.

WARNING: AIR LEAKS IN THE FUEL SYSTEM OR THE PNEUMATIC SENSING SYSTEM CAN CAUSE FLAMEOUTS, POWER LOSS OR OVERSPEED.

WARNING: PROPER TIGHTENING OF ENGINE TUBING CONNECTIONS IS CRITICAL TO FLIGHT SAFETY. CORRECT TORQUE VALUES MUST BE USED AT ALL TIMES. EXCESSIVE TORQUE ON PNEUMATIC SENSING SYSTEM CONNECTIONS RESULTS IN CRACKING OF THE FLARE CAUSING AN AIR LEAK WHICH CAN CAUSE FLAMEOUT, POWER LOSS, OR OVERSPEED.

NOTE: Performance of vacuum check of the fuel system lines and components is recommended anytime a fuel system component is removed or replaced to ensure no engine or airframe fuel system leaks are present.

A. Fuel System Maintenance

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

The components of both the Bendix and the Chandler Evans (CECO) fuel systems are included in the fuel system maintenance paragraphs. Maintenance includes purging the fuel system, cleaning the Pc filter and fuel control and governor airflow restrictors; inspecting, cleaning, and/or replacing the fuel system filters; adjusting the gas producer fuel control; replacing the fuel control, power turbine governor, fuel pump and filter assembly; inspecting and cleaning the fuel nozzle; and inspecting and cleaning the accumulators. Proper maintenance of the fuel and control air system includes the correct installation of tubes, unions, fittings, and clamping systems employed on each engine. Illustration of the location of these items is provided in Figures 201, 202 and 203 of this section.

B. Fuel System Air Leaks

The two principal reasons for fuel system air leaks are loose lines and damaged or impaired fittings.

NOTE: Loose lines can develop from improperly tightened B-nuts. Damaged fittings are the result of incorrect handling or improper installation procedures. Insufficient tightening of the B-nut allows wear of the fitting through normal operating vibrations applied to a loose flare.

(1) When a loose line is detected, proceed as follows:

(a) Remove the line and check the flares for wear, bends, dents, feathered edges or other deformities.

(b) Inspect nipple portion of fitting for damage, grooves or wear. Detect grooves in the mating surface by placing a small metal straight edge on the beveled surface and viewing for gaps.

(c) Determine the cause of irregularities and take steps to correct the situation.

1 Tube clamping should be in accordance with the M250-C20 Series Parts Catalog (Pub. No. 10W4).

2 If a tube requires replacement, the fitting to which it mates should also be replaced.

(d) For detailed installation instructions, refer to Rigid Tube Inspection and Installation, para 9., 72-00-00, Engine-Servicing.

Rolls-Royce Property - Uncontrolled Printed Copy

(3) Install in reverse of removal.

CAUTION: MAKE SURE THE PROCEDURES AND PRECAUTIONS OF RIGID TUBE INSPECTION AND INSTALLATION, PARA 9., 72-00-00, ENGINE-SERVICING, ARE OBSERVED WHEN INSTALLING FUEL SYSTEM TUBES.

CAUTION: HOLD FUEL CONTROL FITTINGS WITH ONE WRENCH WHILE TIGHTENING "B" NUT TO FITTING WITH ANOTHER WRENCH.

(4) Tighten mount pad nuts to 70-85 lb in. (7.9-9.6 N·m).

(5) Tighten fuel inlet and bypass lines coupling nuts to 150-200 lb in. (17-23 N·m).

(6) Tighten fuel outlet line coupling nut to 80-120 lb in. (9.0-13.6 N·m)

(7) Tighten fuel control air line coupling nuts to 80-120 lb in. (9.0-13.6 N·m).

(a) If necessary, use wrench 23083893 to help tighten the PC air tube coupling nuts.

(8) Tighten elbow jam nut 55-80 lb in. (6.2-9.0 N·m).

(9) Attach aircraft linkage to the fuel control lever.

(10) Check the fuel control lever travel using the cockpit control. The lever stop arm on the fuel control must bottom out on the maximum and minimum speed stops. (Refer to Rigging Check, para 3.C., this section.)

NOTE: During rigging of the linkage, the primary points of significance are the 30-degree mark and full travel, minimum stop to maximum stop. Ground Idle position is established with the pointer at the 30-degree mark on the quadrant.

CAUTION: OVERTIGHTENING CAUSES BINDING OF THE LEVER SHAFT.

(11) If the gas producer lever requires repositioning--loosen the nut, reposition, then tighten the nut to 40-50 lb in. (4.5-5.6 N·m).

(12) After the gas producer fuel control has been replaced, bleed air from the fuel system. (Refer to Purging the Fuel System, para 2.D., 73-00-00.)

(13) Check the pneumatic portion of the fuel control system for leaks. (Refer to Fuel Control System Pneumatic Leak Check, para 2.B., 73-00-00.)

(14) Check run the engine after fuel control replacement. (Refer to Check Run, para 1., 72-00-00, Engine-Adjustment/Test.)

NOTE: After the fuel control has been changed, if a false start is encountered or a start is not completed in one minute, return the throttle to FUEL OFF. Motor the engine without ignition for 10 seconds before attempting another start.

(15) Make a fuel control operational check. (Refer to Fuel Control Operational Checks, para 3.A., this section.)

(16) Make appropriate entry relative to fuel control replacement in the Engine Log.

3. Adjustment/Test

The adjustments that can be made on the fuel control are idle speed, maximum speed and start derichment. Also, on 6899262 (Bendix 2524644-9) or later fuel controls, there is a start/acceleration fuel flow schedule adjustment and a wide range start derichment adjustment.

A. Fuel Control Operational Checks

Ground check the control system and associated linkage by making a deceleration check (para 3.B., this section). Corrective action for an improper deceleration rate must be as follows:

NOTE: Perform the steps of the corrective action in the sequence listed. Recheck the deceleration rate after each step to determine if there is a need for further correction. Replace the fuel control if the deceleration rate is still unsatisfactory after all steps of the corrective action have been completed.

Rolls-Royce Property - Uncontrolled Printed Copy

LIST OF WARNINGS (CONT)

OPERATORS MUST MAINTAIN THE ENGINE MAGNETIC DRAIN PLUGS AND INDICATING SYSTEM IN OPERATING ORDER AND COMPLY WITH THE AIRCRAFT FLIGHT MANUAL AND ENGINE OPERATION AND MAINTENANCE MANUAL INSTRUCTIONS WHEN AN INDICATION IS RECEIVED. NEVER ALLOW AN ACCEPTABLE SPECTROGRAPHIC OIL ANALYSIS PROGRAM (SOAP) READING TO OVERRIDE MAGNETIC DRAIN PLUG INDICATIONS.

FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN THE FUEL, OIL, AIR FITTINGS, AND TUBES COULD RESULT IN AN ENGINE FAILURE.

MINERAL SPIRITS IS TOXIC. PROVIDE ADEQUATE VENTILATION FOR PERSONNEL USING IT.

FAILURE TO PROPERLY SHIM THE COMPRESSOR AT INSTALLATION CAN CAUSE THE SPUR ADAPTER GEARSHAFT TO FAIL, RESULTING IN SUDDEN ENGINE STOPPAGE.

CORROSION OR EROSION WILL CAUSE DAMAGE TO COMPRESSOR BLADES AND VANES WHICH CAN RESULT IN ENGINE FAILURE.

MAKE SURE THAT THE IGNITION SWITCH IS OFF BEFORE REMOVING THE SPARK IGNITER OR SPARK IGNITER LEAD ASSEMBLY, AS DANGEROUS HIGH VOLTAGES MAY BE PRESENT. ALLOW FIVE MINUTES AFTER OPERATION FOR ELECTRICAL DISSIPATION BEFORE DISASSEMBLY.

AIR LEAKAGE ACROSS THE METALLIC SEAL WILL RESULT IN PRESSURIZATION OF THE NUMBER 8 BEARING SUMP. PRESSURIZATION OF THE NUMBER 8 SUMP WILL CAUSE A FLOW REVERSAL ACROSS THE NUMBER 8 LABYRINTH SEAL. THIS LEAKAGE CAN RESULT IN AN ENGINE FIRE AND SUBSEQUENT TURBINE WHEEL RIM FAILURE.

WATER OR CONTAMINATION IN THE FUEL CAN CAUSE FLAMEOUT OR POWER LOSS.

AIR LEAKS IN THE FUEL SYSTEM OR THE PNEUMATIC SENSING SYSTEM CAN CAUSE FLAMEOUTS, POWER LOSS OR OVERSPEED.

THE FUEL/AIR DISCHARGE DURING PURGING IS IRRITATING TO THE EYES AND HIGHLY FLAMMABLE. MECHANICS MUST TAKE SUITABLE MEASURES TO PROTECT THEIR EYES AND PREVENT FIRE.

THE FUEL/AIR DISCHARGE DURING THIS CHECK IS IRRITATING TO THE EYES AND HIGHLY FLAMMABLE. TAKE SUITABLE MEASURES TO PROTECT EYES AND PREVENT FIRE.

MAKE SURE THAT THE AIRCRAFT IS ADEQUATELY GROUNDED WHEN PURGING THE FUEL SYSTEM. (SEE AIRCRAFT MANUFACTURER'S INSTRUCTIONS FOR PROPER GROUNDING PROCEDURES.)

AVOID FUEL ACCUMULATION IN THE ENGINE COMPARTMENT BY PROVIDING A SUITABLE CONTAINER TO COLLECT FUEL DISCHARGED FROM THE TYGON TUBE ATTACHED TO THE AF PRESSURE PORT.

SULPHURIC ACID CAUSES SEVERE BURNS. DO NOT GET IN EYES, ON SKIN, OR ON CLOTHING. DO NOT ADD WATER TO ACID WHILE IN A CONTAINER BECAUSE OF VIOLENT REACTION. IN THE EVENT OF CONTACT WITH SULPHURIC ACID, IMMEDIATELY FLOOD EXPOSED SKIN OR CLOTHING WITH WATER. FOR EYES, FLUSH HEAVILY WITH WATER AND OBTAIN IMMEDIATE MEDICAL ATTENTION.

PERCHLORETHYLENE IS TOXIC AND MUST BE USED WITH EXTREME CAUTION. MAKE SURE ADEQUATE VENTILATION IS PRoVIDED. REPEATED OR PROLONGED CONTACT WITH THE SKIN SHOULD BE AVOIDED.

Rolls-Royce Property - Uncontrolled Printed Copy

LIST OF WARNINGS (CONT)

DURING THE ACCELERATION CHECK, THE AIRCRAFT MAY REACT OR BECOME LIGHT ON ITS SKIDS. DO NOT SNAP THE TWIST GRIP TO THE FULL THROTTLE POSITION.

FAILURE TO PROPERLY REMOVE OR INSTALL PC AIR LINES MAY DAMAGE LINES, FITTINGS, AND/OR FILTER ASSEMBLY WHICH CAN RESULT IN SUDDEN UNINTENDED ENGINE POWER LOSS.

SODIUM HYDROXIDE CAN CAUSE SEVERE BURNS. DO NOT GET IN EYES, ON SKIN OR ON CLOTHING. IN THE EVENT OF CONTACT WITH SODIUM HYDROXIDE, IMMEDIATELY FLOOD EXPOSED SKIN OR CLOTHING WITH WATER. FOR EYES, FLUSH HEAVILY WITH WATER AND OBTAIN IMMEDIATE MEDICAL ATTENTION.

POTASSIUM PERMANGANATE CAN BE VERY DANGEROUS IF IMPROPERLY HANDLED. CONTACT WITH ORGANIC MATERIALS (OIL, GREASE) CAN CAUSE FIRE.

PERCHLORETHYLENE IS TOXIC AND MUST BE USED WITH EXTREME CAUTION. MAKE SURE ADEQUATE VENTILATION IS PROVIDED. REPEATED OR PROLONGED CONTACT WITH THE SKIN SHOULD BE AVOIDED.

TO PREVENT ELECTRICAL SHOCK DURING INSTALLATION OF THE SPARK IGNITER AND THE LEAD, ALLOW FIVE MINUTES FOR ELECTRICAL DISSIPATION FOLLOWING IGNITION OPERATION OR TEST.

ANTI-ICING AIR IS HOT ENOUGH TO CAUSE SEVERE BURNS. DO NOT CHECK AIR FLOW BY FEEL.

FAILURE OF A COMPRESSOR BLADE OR VANE CAN CAUSE RUBBING CONTACT BETWEEN THE TIPS OF THE FIRST- AND SECOND-STAGE TURBINE BLADES AND THE SECOND-STAGE TURBINE NOZZLE OUTER RING. THIS RUBBING CONTACT MAY INDUCE STRESSES IN THE BLADES WHICH CAN CONTRIBUTE TO A FATIGUE FAILURE OF THE BLADES IF THE TURBINE WHEEL IS RETURNED TO SERVICE. TO PRECLUDE THIS POSSIBILITY OF SUBSEQUENT TURBINE BLADE FAILURE, 1ST- AND 2ND-STAGE TURBINE WHEELS WHICH HAVE BEEN OPERATED IN ENGINES THAT HAVE EXPERIENCED A COMPRESSOR BLADE AND/OR VANE FAILURE SHALL BE REMOVED FROM SERVICE IF THE TIPS OF ANY OF THE BLADES OF THESE WHEELS SHOW EVIDENCE OF RUBBING CONTACT.

IT IS VERY IMPORTANT THAT THE ENTIRE AIRCRAFT AND ENGINE FUEL SYSTEM BE MAINTAINED TO THE HIGHEST STANDARDS OF CLEANLINESS. ROLLS-ROYCE HAS CONDUCTED TESTING OF APPLE JELLY TYPE CONTAMINATION WHICH SHOWS IT BEHAVES DIFFERENTLY THAN A SOLID CONTAMINANT. IT CAN PASS THROUGH VARIOUS AIRFRAME AND ENGINE FUEL FILTERS UNDETECTED WITHOUT ACTUATING THE IMPENDING BYPASS INDICATOR, AND IT CAN CAUSE PARTIAL OR COMPLETE BLOCKAGE OF THE FUEL NOZZLE SCREEN RESULTING IN REDUCED ENGINE PERFORMANCE OR FLAMEOUT. SHOULD THIS GEL-LIKE MATERIAL BE DETECTED AT ANY POINT IN THE AIRCRAFT OR ENGINE FUEL SYSTEM, THE ENTIRE AIRFRAME AND ENGINE FUEL SYSTEM SHOULD BE INSPECTED.

DO NOT LET THE HOT PART TOUCH YOUR SKIN. THE HOT PART WILL BURN YOUR SKIN. WEAR INSULATED GLOVES. IF THE HOT PART BURNS YOUR SKIN, GET MEDICAL AID.

DO NOT BREATHE THE FUMES FROM SYNTHETIC LUBRICATING OIL. IT CAN CONTAIN TRICRESYL PHOSPHATE. USE IN AN AREA WITH CONTINUOUS AIRFLOW. KEEP AWAY FROM HEAT, SPARKS, AND OPEN FLAMES. DO NOT GET IT ON YOUR SKIN OR IN YOUR EYES. WEAR GOGGLES, CHEMICAL-RESISTANT GLOVES, AND SAFETY CLOTHING. IF YOU GET IT ON YOUR SKIN, CLEAN WITH SOAP AND WATER. IF YOU GET IT IN YOUR EYES, FLUSH WITH WATER. GET MEDICAL AID.

HAZARDOUS MATERIALS MUST BE HANDLED AND DISPOSED OF IN ACCORDANCE WITH ALL APPLICABLE ENVIRONMENTAL LAW. FOR PURPOSES OF THIS REQUIREMENT, “ENVIRONMENTAL LAW” REFERS TO ANY LAW OR ORDER RELATING TO (I) HUMAN OR OCCUPATIONAL HEALTH AND SAFETY, (II) PROTECTION OF THE ENVIRONMENT, OR (III) EXPOSURE TO, OR USE, GENERATION, TREATMENT, RECYCLING, STORAGE, DISPOSAL, TRANSPORT, LABELING, PRESENCE, HANDLING, RELEASE, OR THREATENED RELEASE OF, ANY HAZARDOUS MATERIAL. “HAZARDOUS MATERIAL” MEANS ANY CHEMICAL, MATERIAL, SUBSTANCE, OR WASTE THAT IS NOW OR HEREAFTER LIMITED OR REGULATED BY ANY GOVERNMENTAL OR REGULATORY AUTHORITY.