# COMBUSTION INSPECTION

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## 1. Disassembly Procedures for MS-6001FA+e Combustion System

**Operation 1— How to Remove the Flame Detectors**

1. The flame detector is mounted on the side of the combustion chamber (See Figure 7 and Figure 8). Prior to disconnecting and removing the flame detectors mark them with the combustion chamber number.

2. Disconnect the wiring going to each of the flame detectors. This will ensure against any possibility of energizing the flame detectors.

3. Remove the flame detectors from combustion chambers 1, 2 and 6 (2 flame detectors in can # 6). Discard all gaskets.

**Operation 2— How to Remove the Spark Plugs** (See Figure 9)

1. Prior to disconnecting and removing the spark plugs, mark the combustion chamber number on each plug.

2. Disconnect the spark plug leads.

3. Unbolt each spark plug assembly from the casing flanges on combustion chamber numbers 4 and 5 by removing the four bolts on the spark plug flange.

4. Lift spark plugs out. Discard all gaskets.

5. Remove old anti-seize compound from all bolts; bag and identify for reassembly. Clean matching flange surfaces.

**CAUTION**

Handle carefully to prevent breaking the internal ceramic parts.

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**Operation 3— How to Remove the Gas Fuel and Purge Flex Hoses**

1. Prior to disconnecting and removing the gas fuel flex hoses, the hoses must be match marked with the combustion chamber number as well as whether it is PM 1, PM 2, PM 3 or diffusion hose.

**CAUTION**

The gas fuel hoses must be installed in a low stress state. Avoid excessive single plane bends, multiple bend planes, kinks, and squirm in the hoses. Avoid excessive hose tension or compression by reinstalling in the hose in the original bending plane. Match marking the hose components prior to removal can assist in reassembly and can help obtain a low stress installation.

2. Starting at cover number 3 and working both clockwise and counterclockwise up to cover number 6, remove all flex hoses to each combustion cover.

**CAUTION**

Do not use the gas fuel flex hoses as climbing aids or footholds. Proper rigging and scaffolding shall be used.

3. Keep gas fuel flex hoses free from dirt, oil, water, or other contaminants. Store the removed hoses in a weather-protected area with temporary flange covers installed.

4. Install temporary flange covers over the exposed gas fuel manifold flanges.

**NOTE**

The gas fuel manifolds do not require disassembly for a typical combustion inspection.

**Operation 4— How to Remove the False Start Drain Piping**

1. Prior to disconnecting the combustion chamber false start drain piping, the pipe spools must be match marked with a waterproof marker.

2. Mark the pipe spools connecting to Cans 2, 3 and 4. Match mark the pipe end that connects to the combustion can. Mark the other end to the drain flex hose. Mark each hose with the chamber number.

3. Remove the drain piping spools and the corresponding flex hoses starting at can 2 and work counter clockwise towards can 4.

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4. Store the removed pipe and flex hoses in a weather-protected area. Temporarily cover exposed drain manifold flanges.

**Operation 5— How to Remove Other Fuel Nozzle Flex Hoses**

1. Unbolt the nozzle flex hoses from the combustion can end covers.

2. Temporarily move the free end of the flex hoses away from the end cover to gain access to other end cover bolting.

**NOTE**

Complete removal of the flex assembly is not usually required to remove the fuel nozzle assembly.

**Operation 6— How to Remove the Fuel Nozzle/Cover and Case Assembly (Forward Combustor Module)**

1. Prior to removing the cover and casing assembly, mark both parts with the chamber number.

2. Install lifting bracket provided to the end cover and eyebolts to the downstream casing flange of #6 chamber. Rig a set of slings so that the assembly can be removed axially from the downstream combustion casing.

**CAUTION**

The cover and casing assembly weighs approximately 800lb (360 kg). A crane or other lifting device must be used for removal and installation.

Do not attempt to remove cover from forward combustor module casing while installed on unit. Damage to fuel nozzle or cap assembly may result. Cover and cap assembly should be removed from forward case by qualified Gas Turbine Service Center ONLY. Damage to mechanical seal between cap assembly and fuel nozzle components may result.

3. Make sure the three guide pins are in place and that the retaining nuts are tight.

4. Raise the crane hook to support the assembly.

5. Remove the bolts from the flange between the forward combustion casing and the aft combustion casing. The assembly is now supported by the guide pins.

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6. Attempt to slide the cover and casing axially on the guide pins.

7. Use the jacking bolts to move the assembly axially until the spring seal on the cap assembly clears the combustion liner (approximately 2.5 in. [6.5 cm]).

8. Slide the assembly axially until the guide pins clear the casing flange.

9. The cover and casing assembly can be moved away and lifted clear of the turbine.

10.A special cart has been designed to support and transport cover/casing assembly.

**CAUTION**

| |
|---|
| If the special cart is not available, the assembly may be set down on the down-stream flange using blocks large enough (minimum 3in. (8 cm))to prevent the cap assembly from touching. |

11.The remaining cover-casing assemblies can be removed in the same way. Some of the lower assemblies will require special rigging to control swing.

12.Remove and scrap casing gaskets. Do not reuse.

**Operation 7— How to Remove the Combustion Liners and Crossfire Tubes**

1. Remove the combustion liners by first pulling all crossfire tube retainers away from the crossfire tube collars (two retainers per crossfire tube). Tag all retainer clamps and identify according to chamber position and side.

2. To remove the combustion liner, telescope both crossfire tubes toward the adjacent chamber until they are clear of the combustion liner. If crossfire tube tends to fall into the liner being removed, employ a long-bladed screwdriver or one of the retainers to hold the crossfire tube in the retracted position.

**CAUTION**

| |
|---|
| Be sure that crossfire tubes are disengaged from liner collars before attempting to move liner or damage will occur. |

3. Remove two liner anti-withdrawal stops from the flow sleeve mounting flange.

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4. Pull liner straight out taking care not to snag the spring seals on the liner locating stops in the flow sleeve [each liner weighs approximately 60lb (27 kg)]. Place liners on plywood to prevent damage and cover to keep dirt out.

**NOTE**

Exercise caution when removing liners to ensure that aft spring seal leaves and crossfire tube collars do not snag over liner stops or retainer ramp assemblies on the flow sleeve.

5. Identify each liner according to chamber position (See Figure 15).

**NOTE**

Refer to the Standard Practices section in this maintenance instruction for marking of nickel-base alloys.

6. Retrieve both crossfire tube ends previously pushed into adjacent chambers by pulling each back through the empty chamber. Identify and tag each end with respect to its combustion chamber location and side.

7. Remove the remaining combustion liners and crossfire tubes in the same manner, identifying and tagging each.

**Operation 8— How to Remove the Flow Sleeves**

1. Remove four cap screws in flange of flow sleeve.

2. Remove flow sleeve and mark with combustion chamber number.

3. Remove remaining flow sleeves in the same manner, identifying each.

**NOTE**

Operations 9, 10 and 11 are required only if transition piece removal and inspection are required.

**NOTE**

Exercise caution when removing flow sleeves to ensure that aft spring seal leaves do not snag over crossfire, flame detector, or spark plug bosses on ID of aft combustion casing.



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**9— How to Remove the Outer Crossfire Tubes**

1. Remove the bolts from each sealing ring flange on the outer crossfire tube flanges. Remove the split ring retaining washers, identify them and store for reuse.

2. Back off each sealing ring in turn and chisel out a section of each packing ring to loosen them. Push the outer crossfire tube through the remains of the packing rings into the adjacent combustion chamber and remove it.

3. Identify the tube with the combustion chamber numbers and store for reuse.

4. Clean out the remains of the packing rings.

**Operation 10 — How to Remove the Aft Combustion Casings**

1. Starting with Chamber 6, remove all but four flange bolts. Rig a sling around the casing and raise the crane hook to pick up the weight of the casing before removing the last four bolts.

2. Pick up the casing and set it down on plywood. Mark location and store until needed.

**Operation 11 — How to Remove Transition Pieces**

1. Remove covers from the combustion access ports on the turbine casing.

2. Remove the bolts from the side seals of the Number 6 combustion transition piece. Remove the side seal retainer blocks and the side seals, identify and store.

3. Wrap a flat sling around the transition piece body upstream of the aft mount. Raise the crane hook to pick up some of the transition piece weight.

4. Remove the two aft bracket bolts and Lock plates. Move the transition piece upstream until the inner and outer seals disengage [approximately 3/8 inch (0.952 cm)]. Continue to move the transition piece upstream until the forward mount “bat wing” blocks clear the forward (bullhorn) support clamp and the aft mount guide pin clears the nozzle retaining ring.

5. The transition piece may be rotated and removed through the compressor discharge casing.

**NOTE**

All transition pieces must be removed through the openings in the compressor

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discharge casing man way cover location. Removal through these ports requires rotating the transition piece during removal, to 90 on the axial axis whilst continuously extracting through CDC.

6. Transition pieces should be marked and set aside for inspection and reuse. Care must be taken to avoid damage to the floating seals and the thermal barrier coating during handling.

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## 2. Inspection Procedures for MS-6001FA+e Combustion System

**NOTE**

Inspection information should be recorded on the appropriate form, which can be obtained by contacting your GE Technical advisor or local GE office.

**Operation 12 — Fuel Nozzle Inspection**

**CAUTION**

It is critical that disassembly of the cap, fuel nozzle cover, and fuel nozzles from the forward combustor module casing be performed by a qualified GE Gas Turbine Service Center ONLY. Damage to cap assembly mechanical seal and/or fuel nozzle components may result. Any fuel nozzle disassembly, cleaning, inspection, re-assembly, testing and reinstallation to the forward combustor module casing must be performed by a qualified Gas Turbine Service Center.

Your local General Electric Company Field Service Representative can assist you in material return procedures to send the fuel nozzles to a qualified Gas Turbine Service Center.

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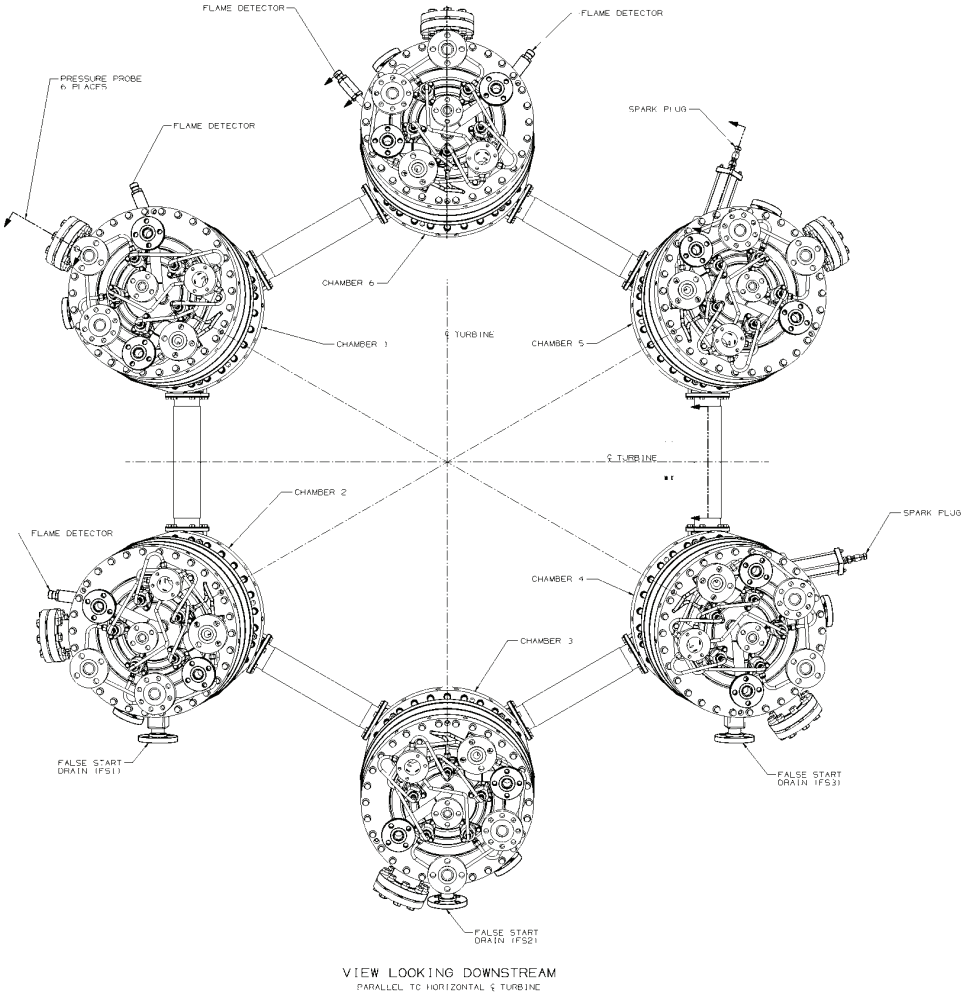



**Figure 1. MS6001FA+E Combustion System Arrangement**

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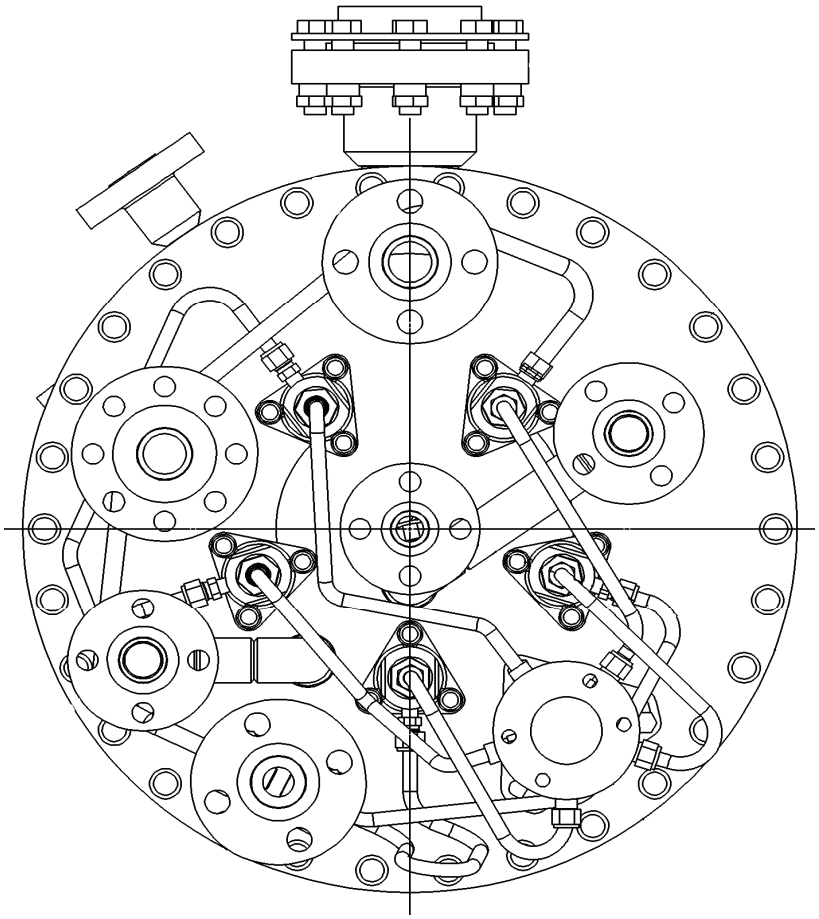


**Figure 2. Fuel Nozzle Arrangement – Complete Tubing**

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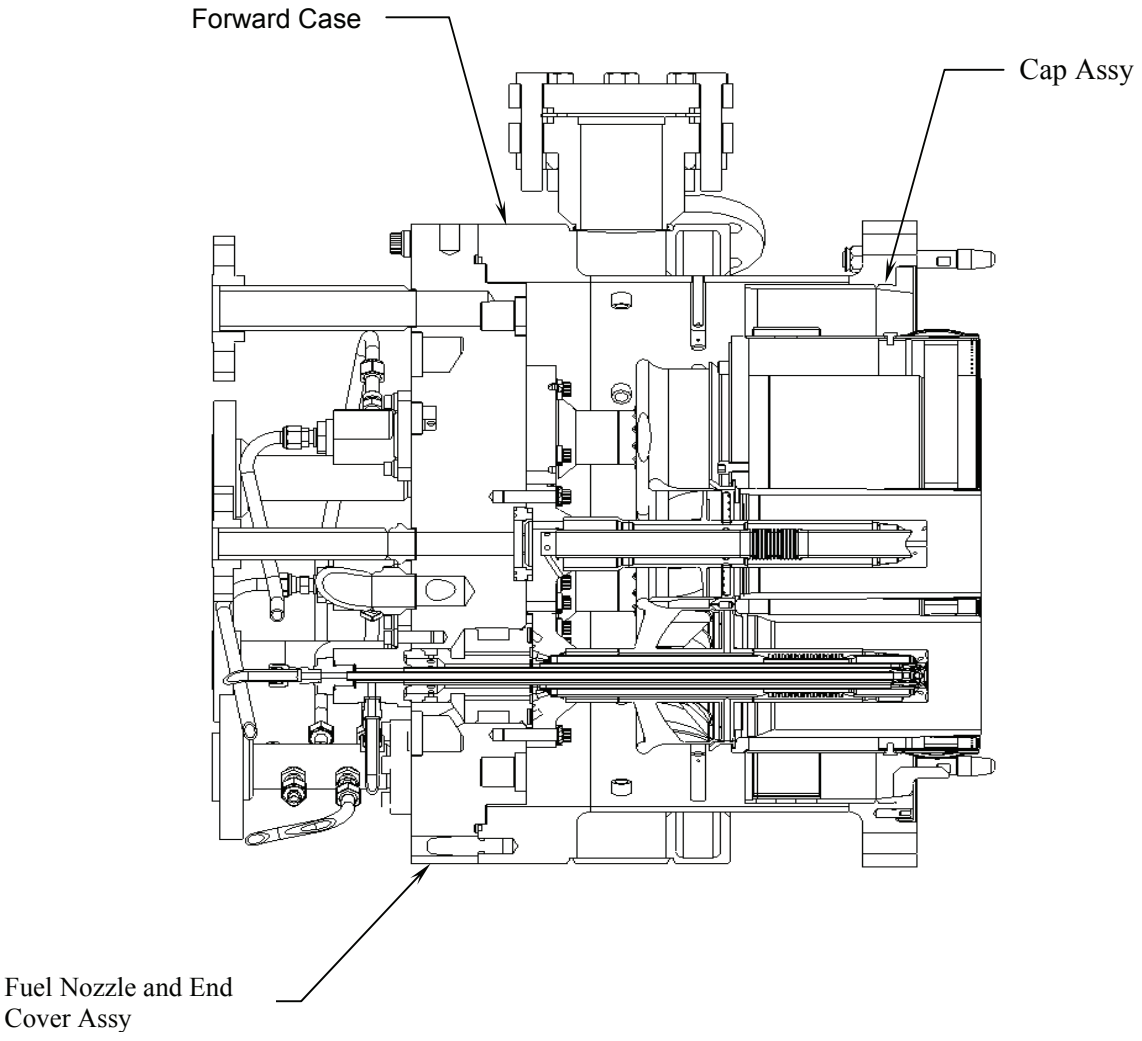



**Figure 3. Fuel Nozzle Assembly, with case and cap**

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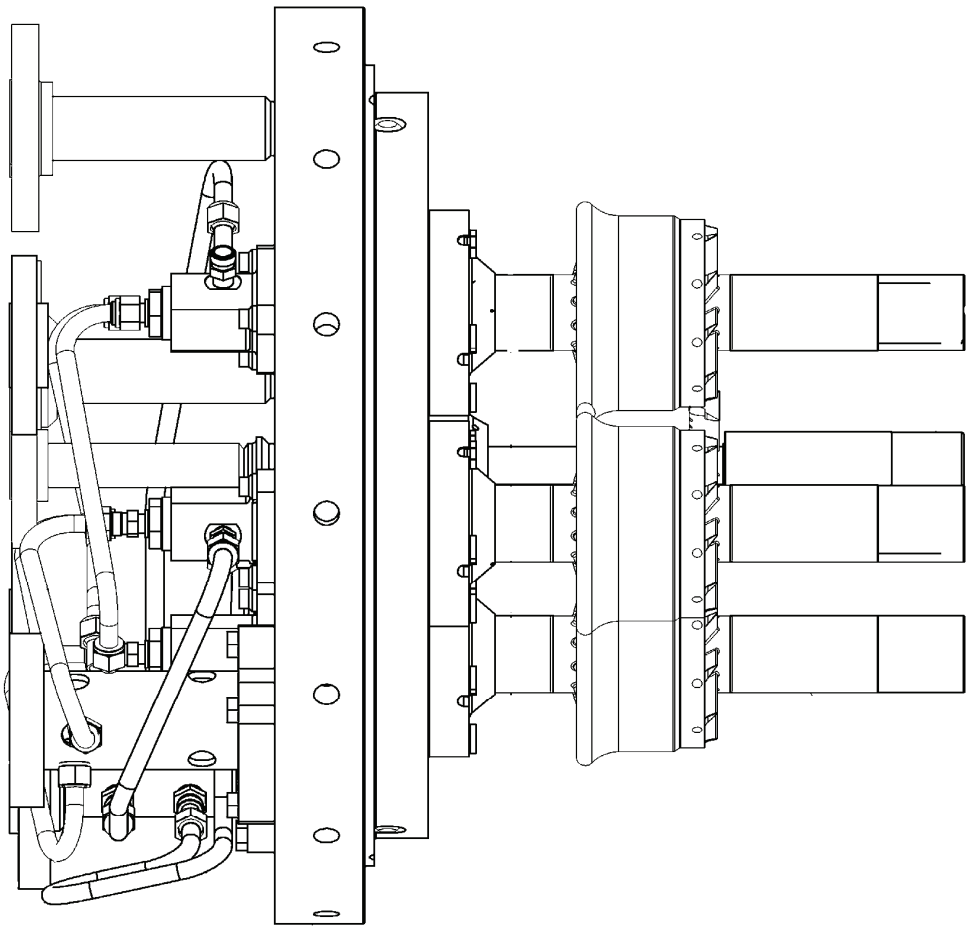


**Figure 4. Fuel Nozzle Assembly, without case or cap**

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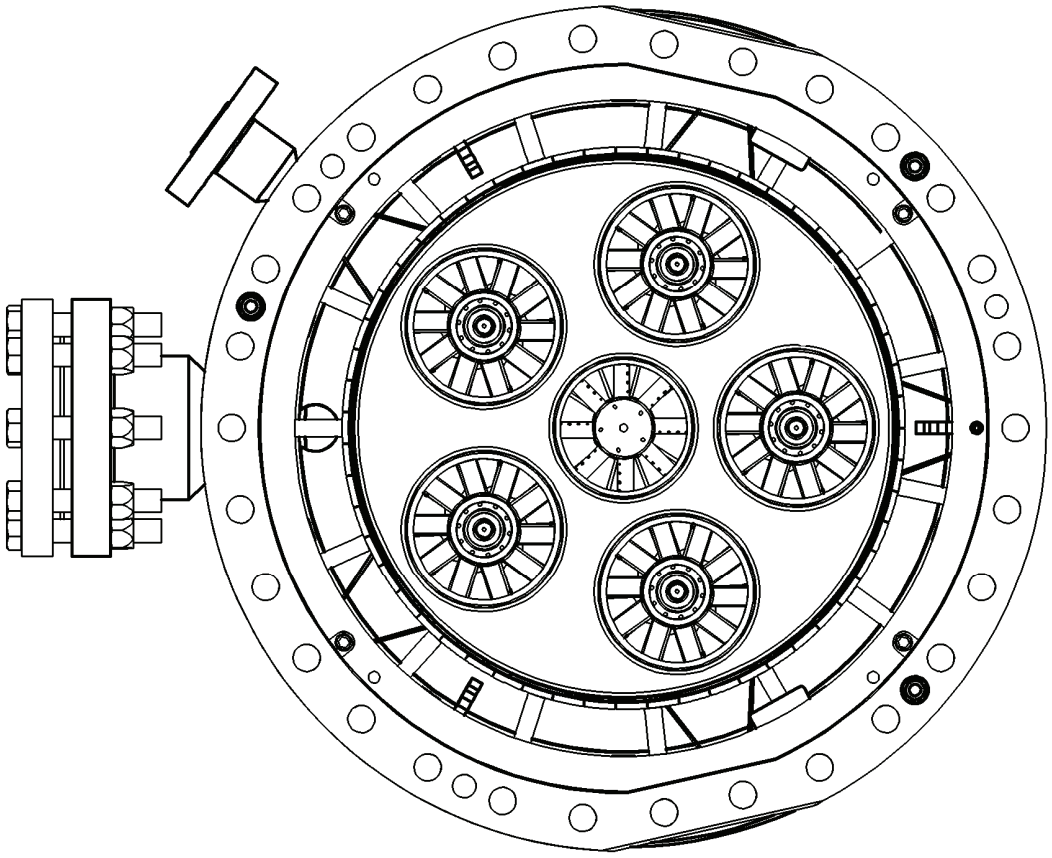


**Figure 5. Fuel Nozzle Arrangement**

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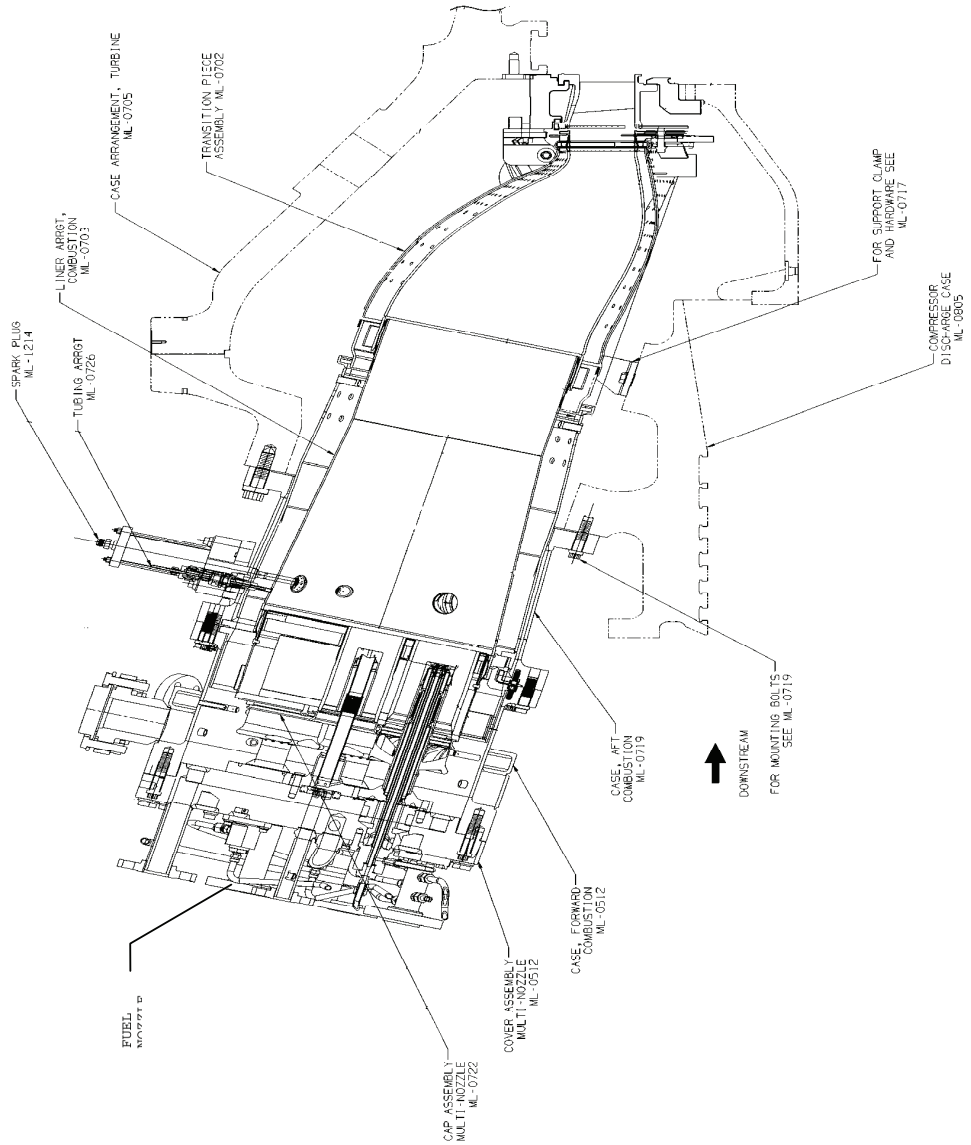
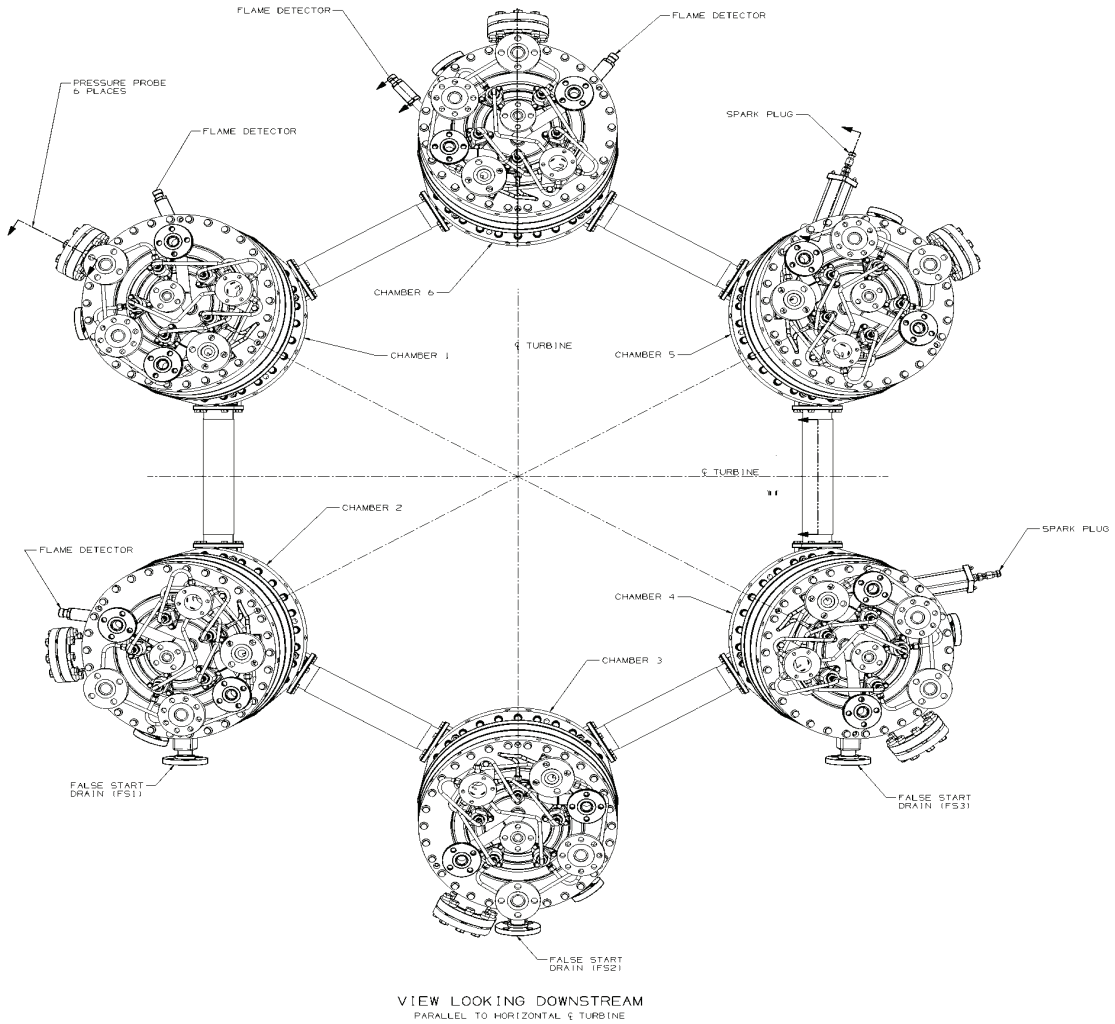



**Figure 6. MS-6001FA+E DLN 2.6 Combustion Arrangement**

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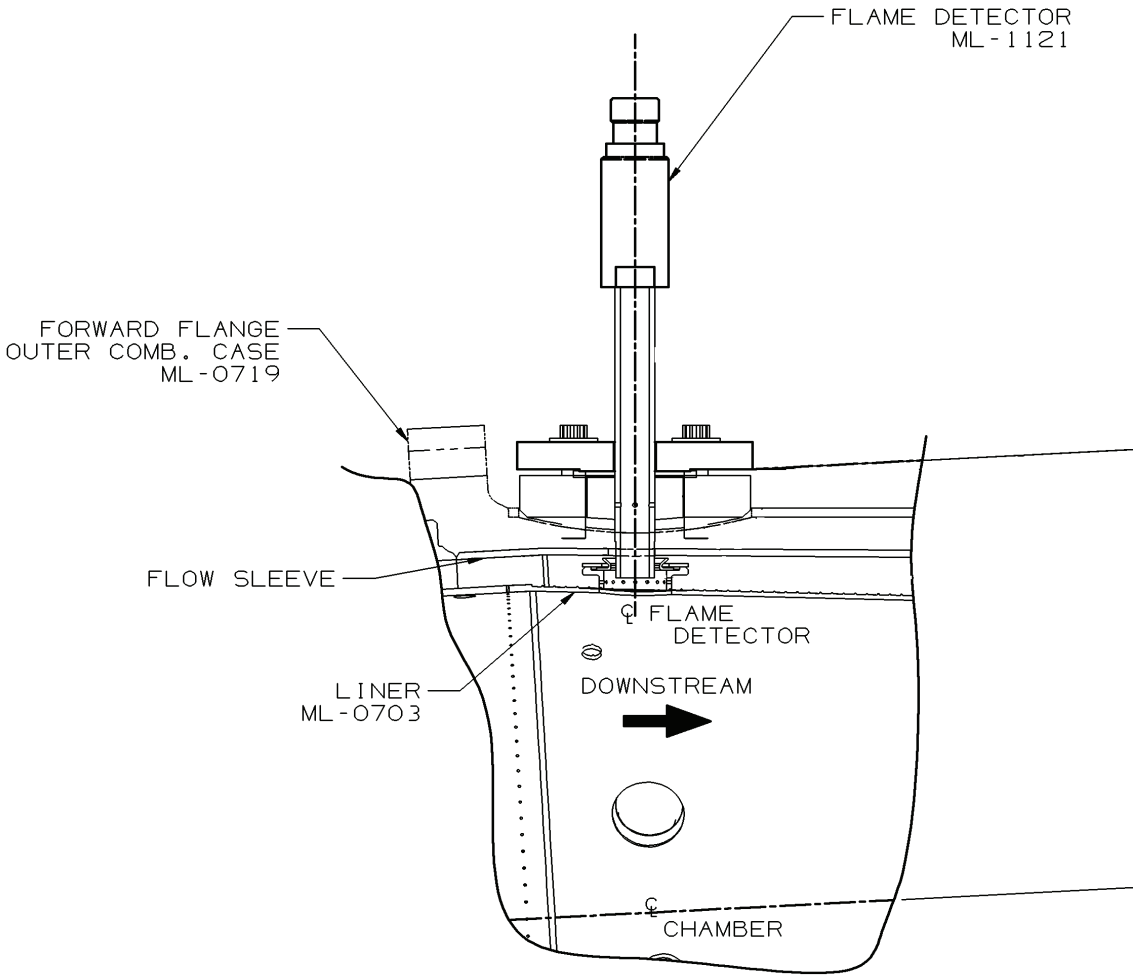



**Figure 8. Flame Detector Assembly**

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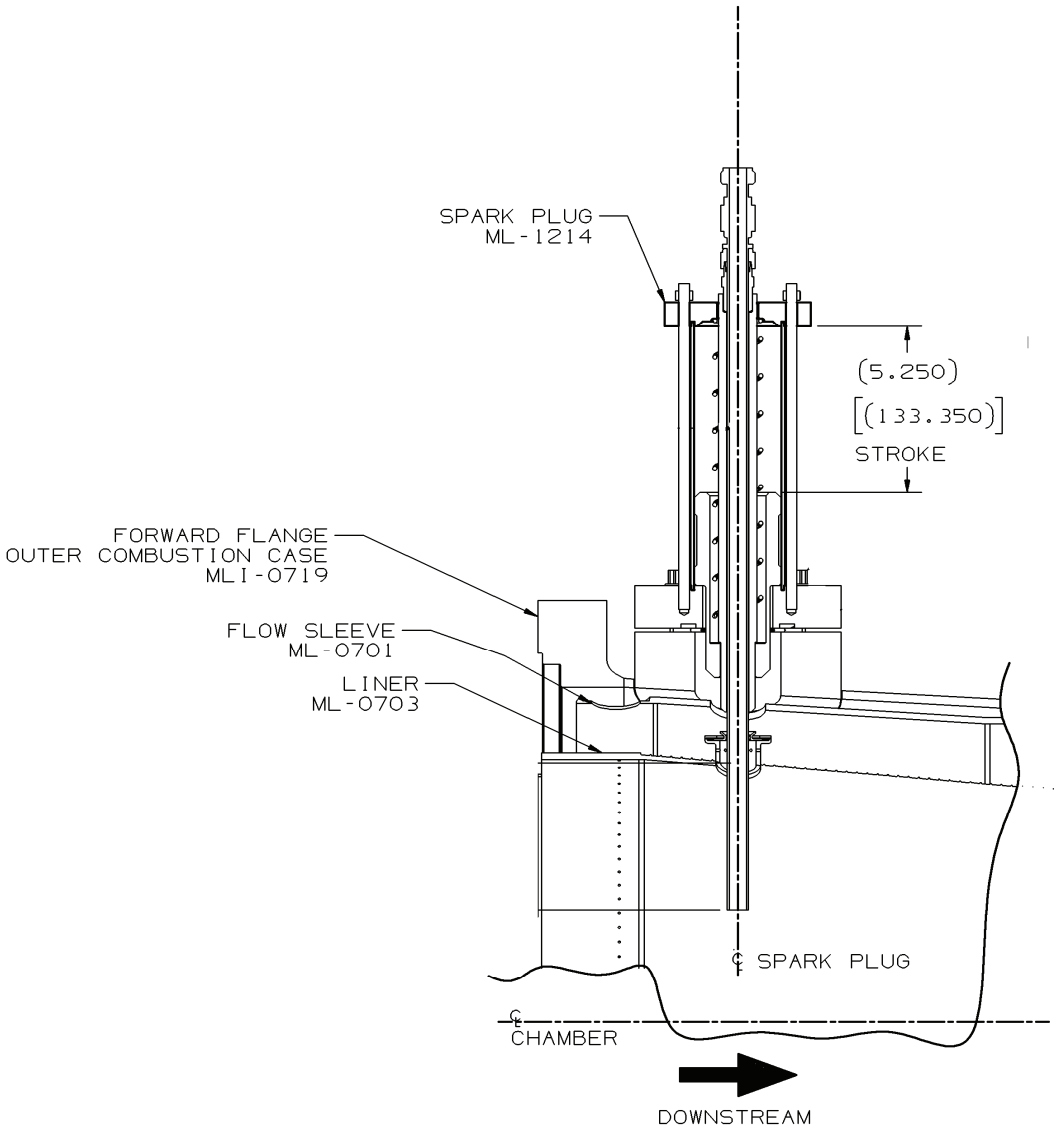



**Figure 9. Spark Plug Assembly**

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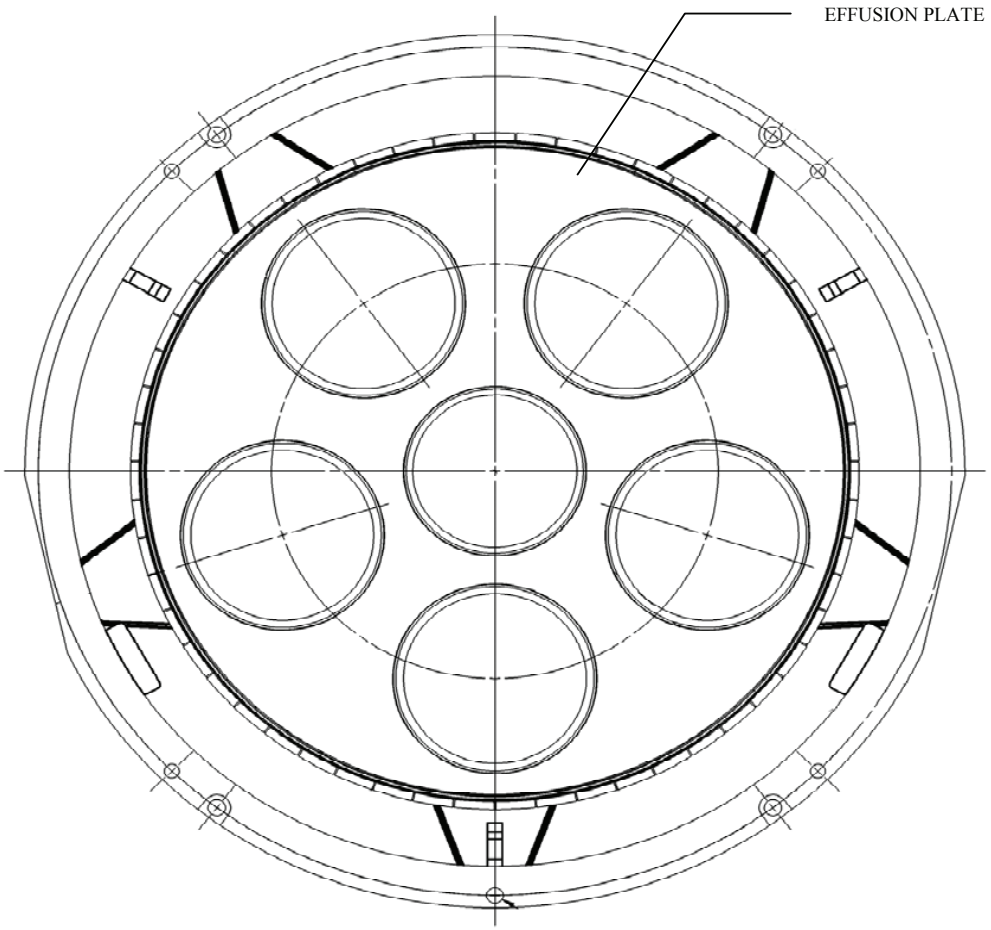



**Figure 10 Cap Assembly – View from Downstream**

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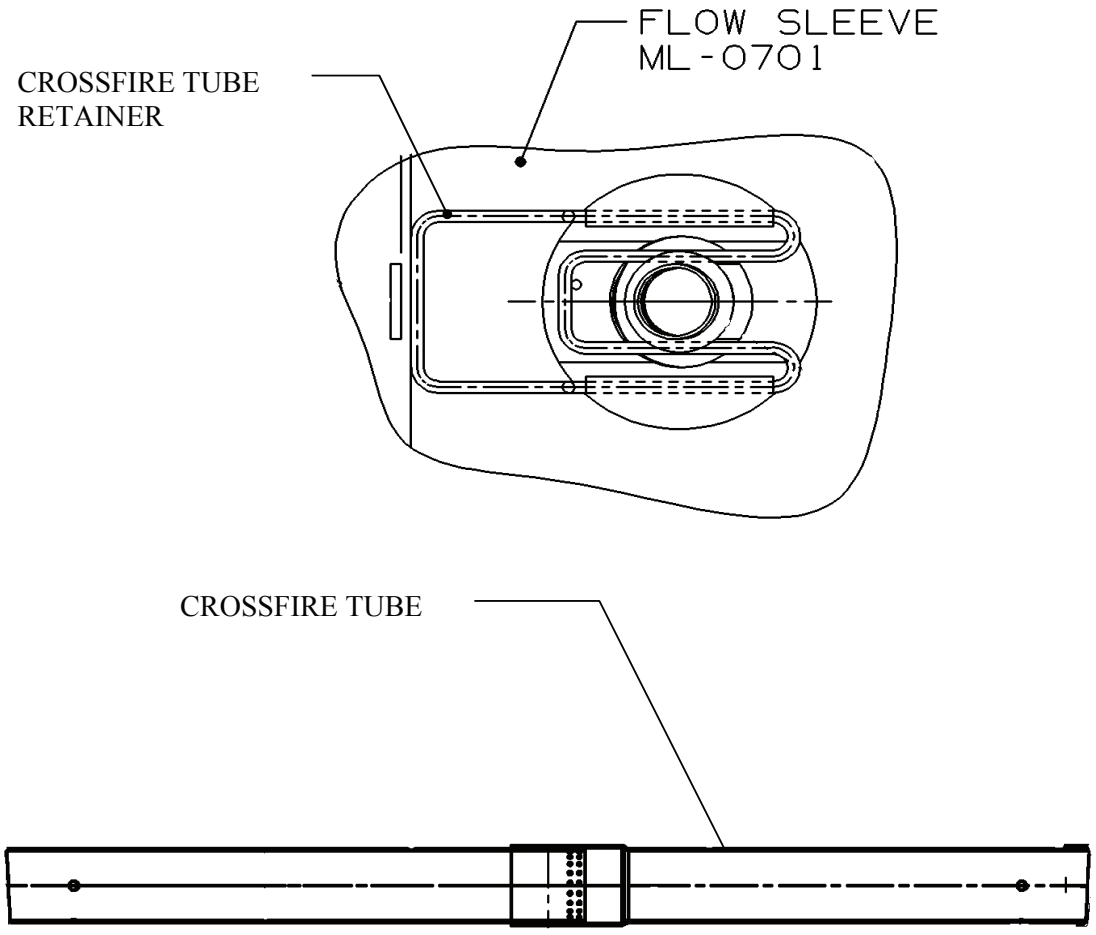



**Figure 11. Crossfire Tube and Retainer Assembly**

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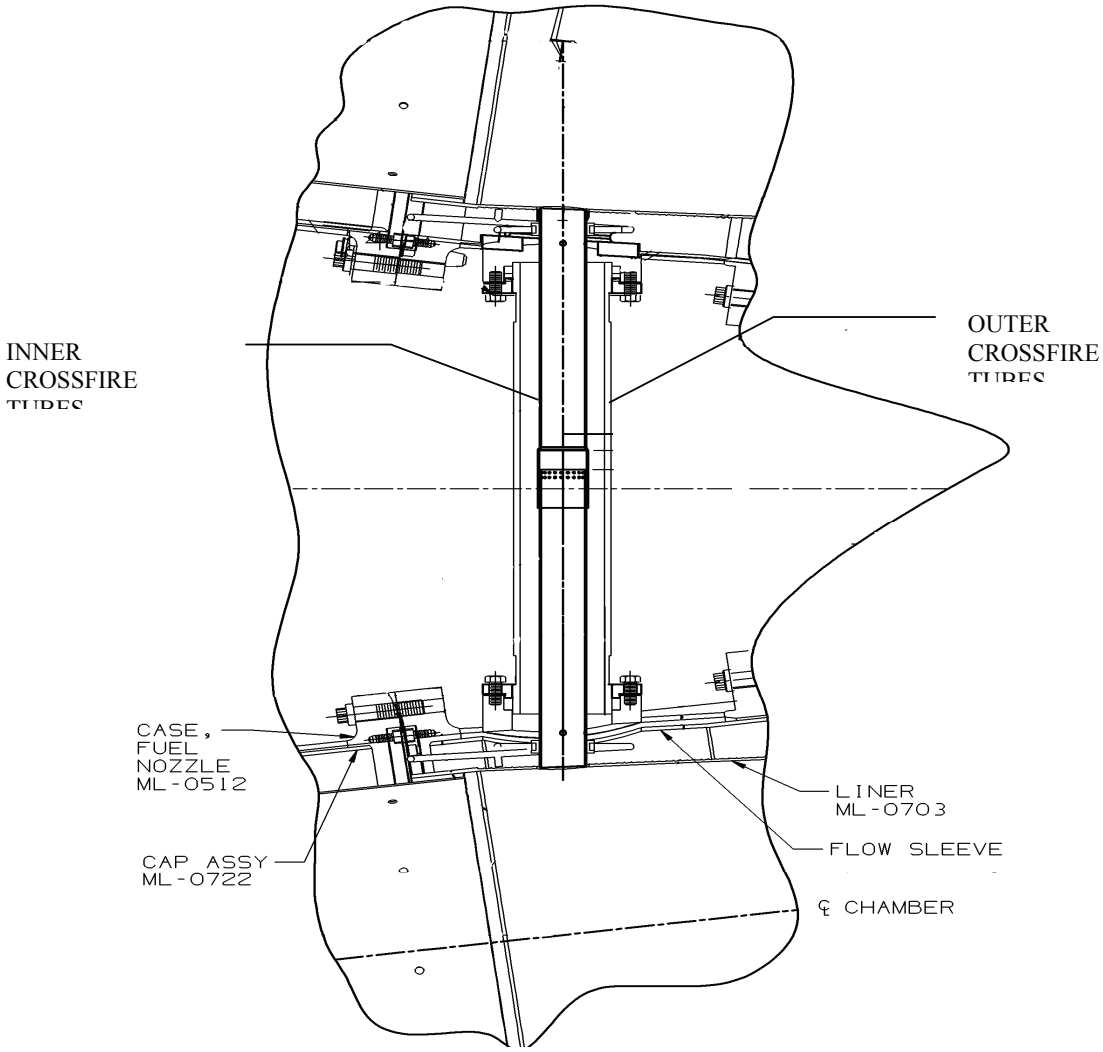



**Figure 12. Crossfire Tube Assembly**

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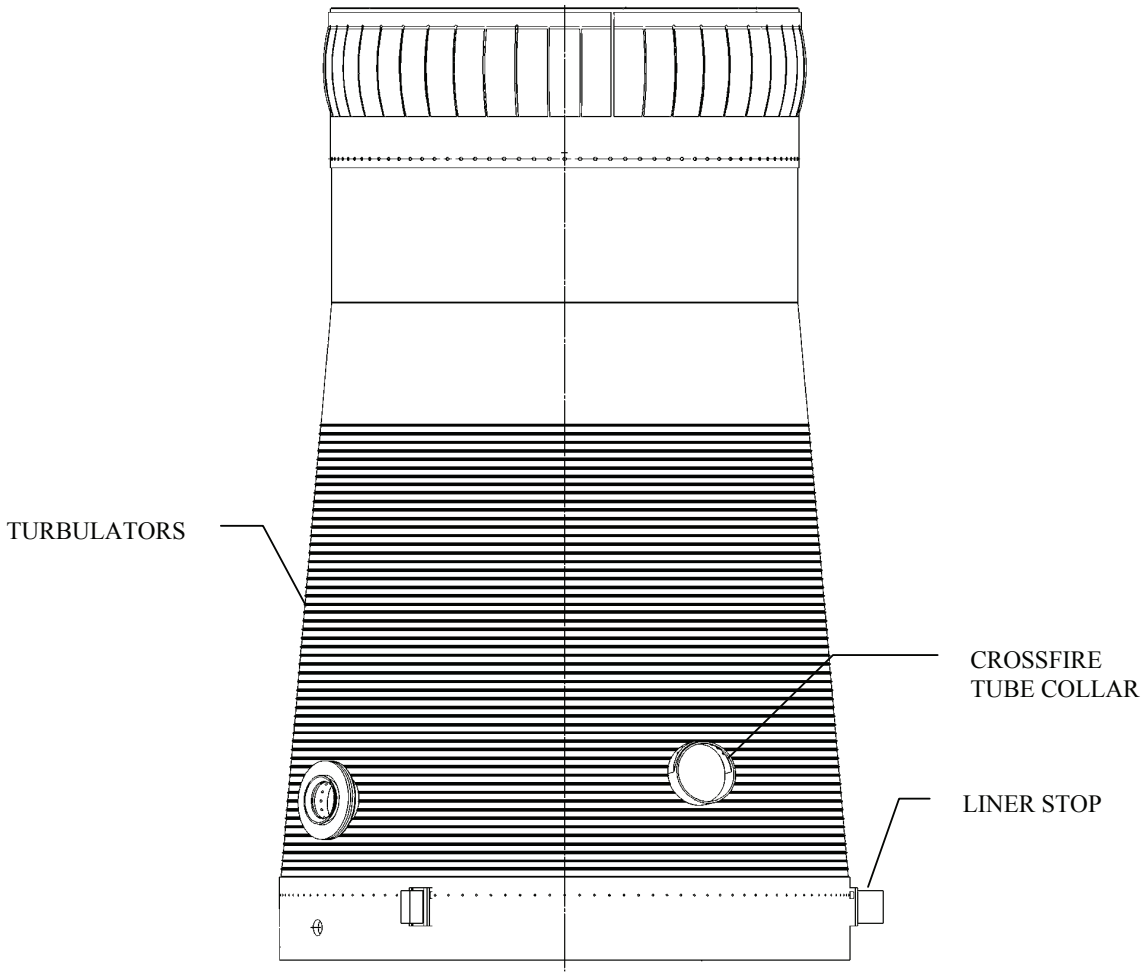



**Figure 13. Combustion Liner Assembly**

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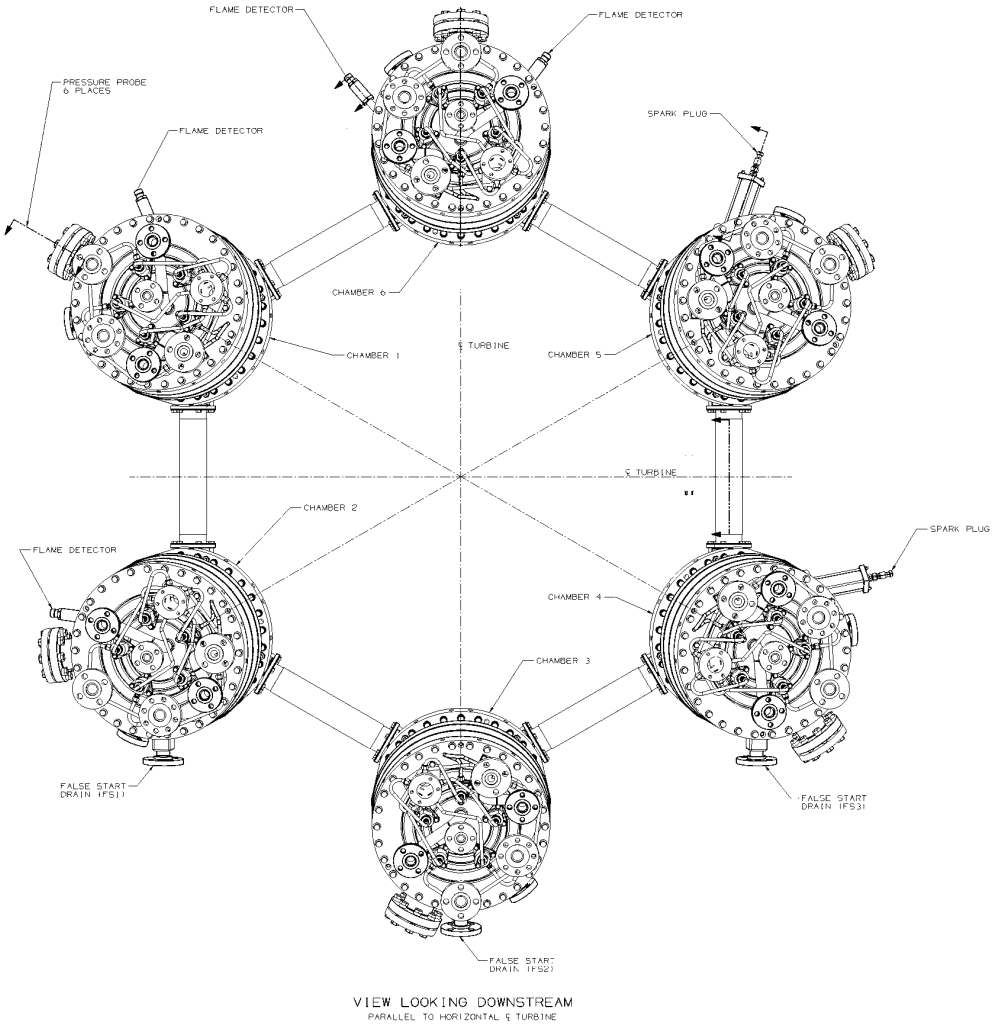



**Figure 14. MS-6001FA+E Combustion System Arrangement**

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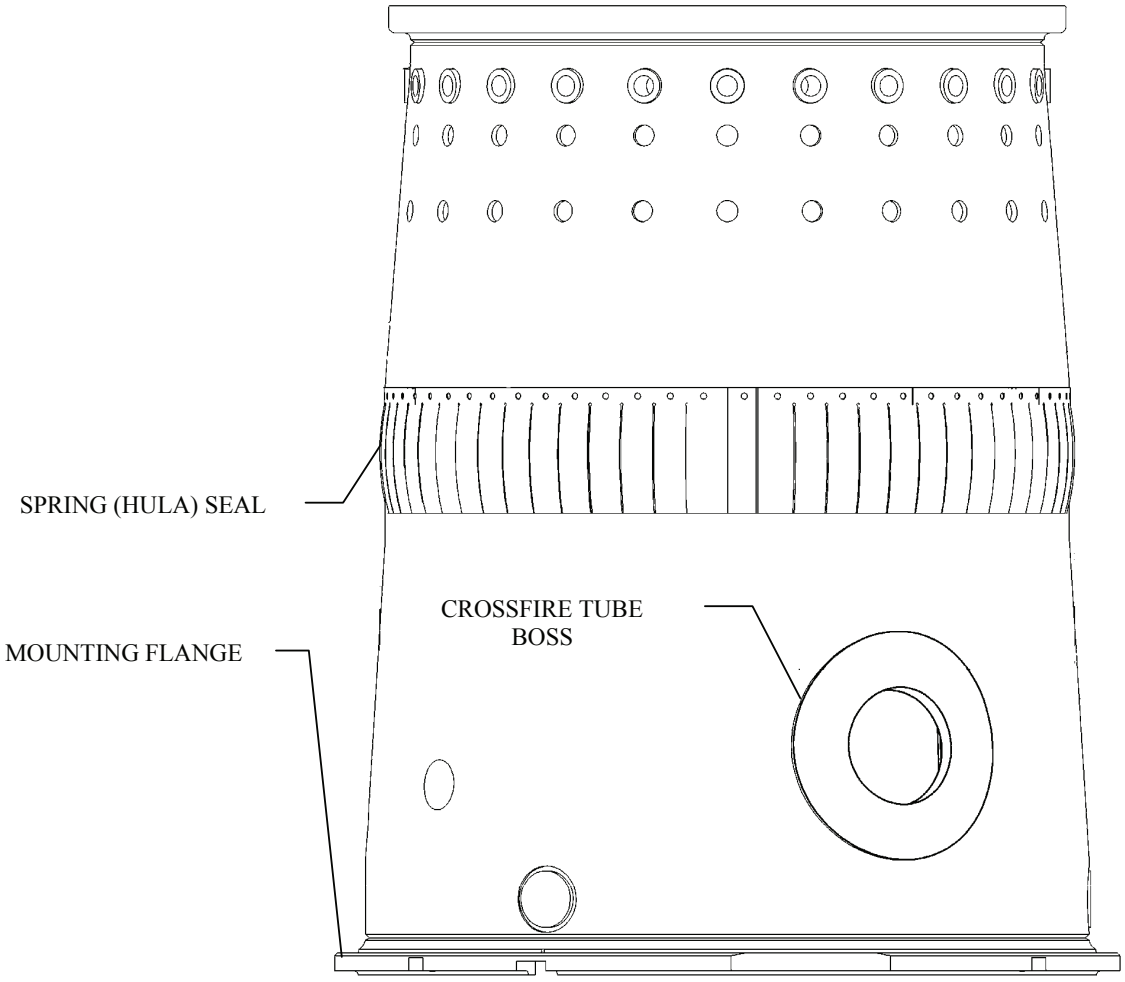



**Figure 15. Flow Sleeve Assembly**

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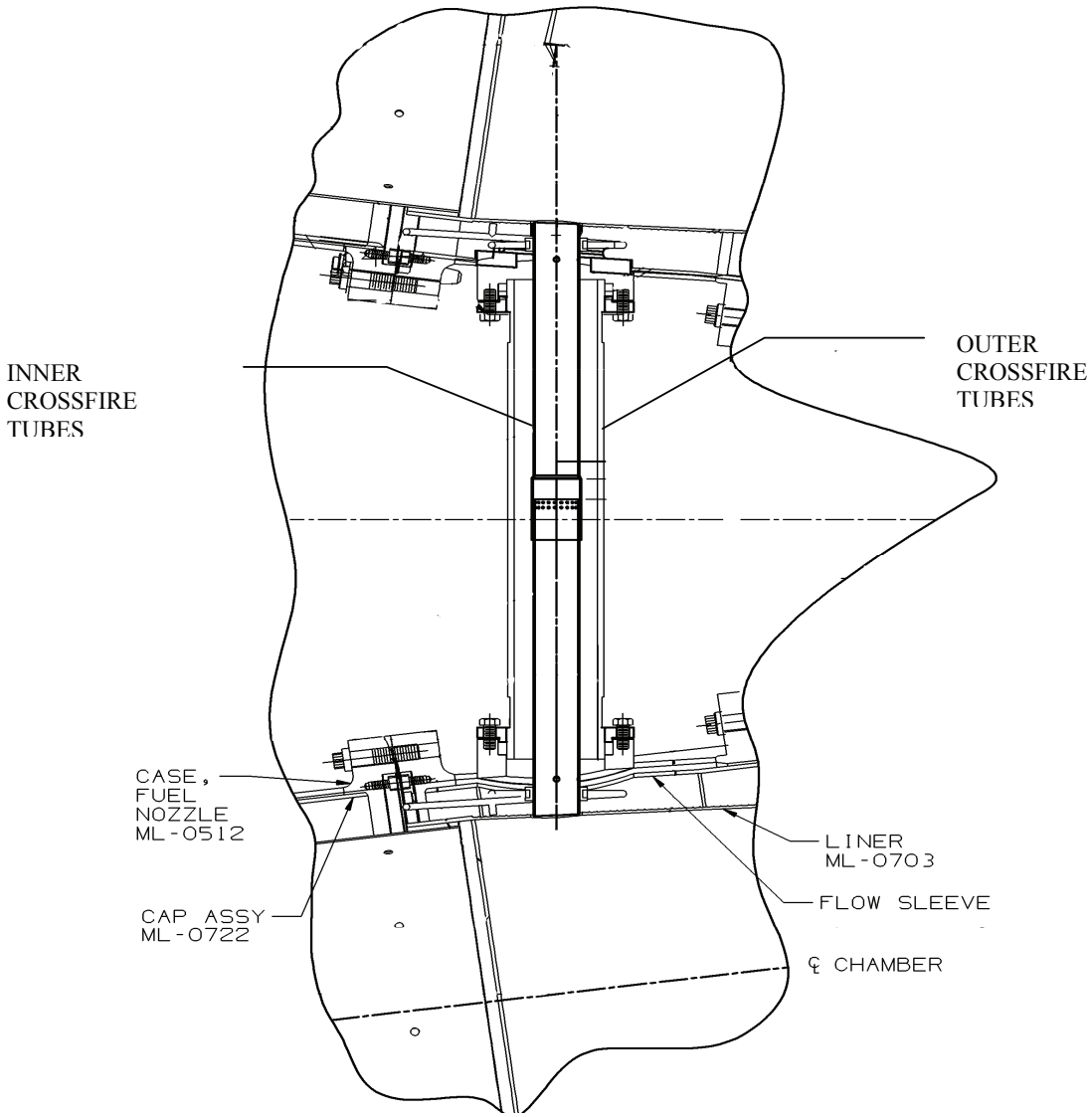



**Figure 16. Crossfire Tube Assembly**

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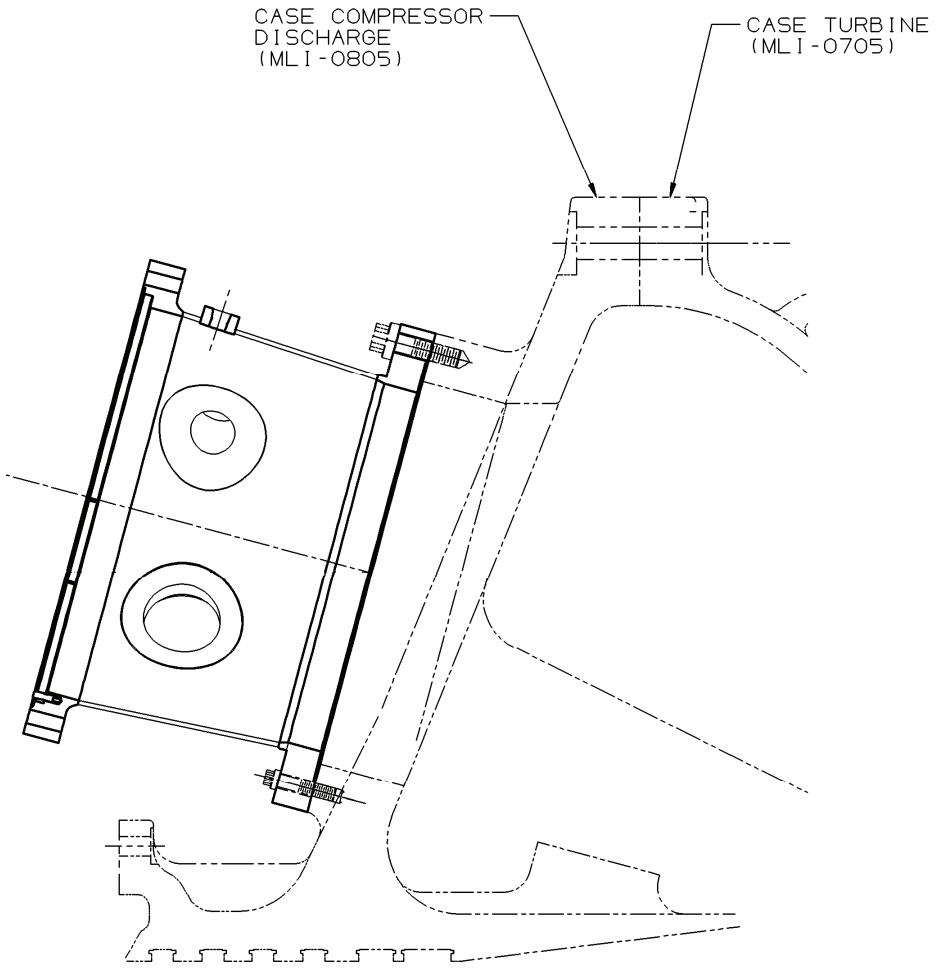



**Figure 17. Combustion Aft Casing**

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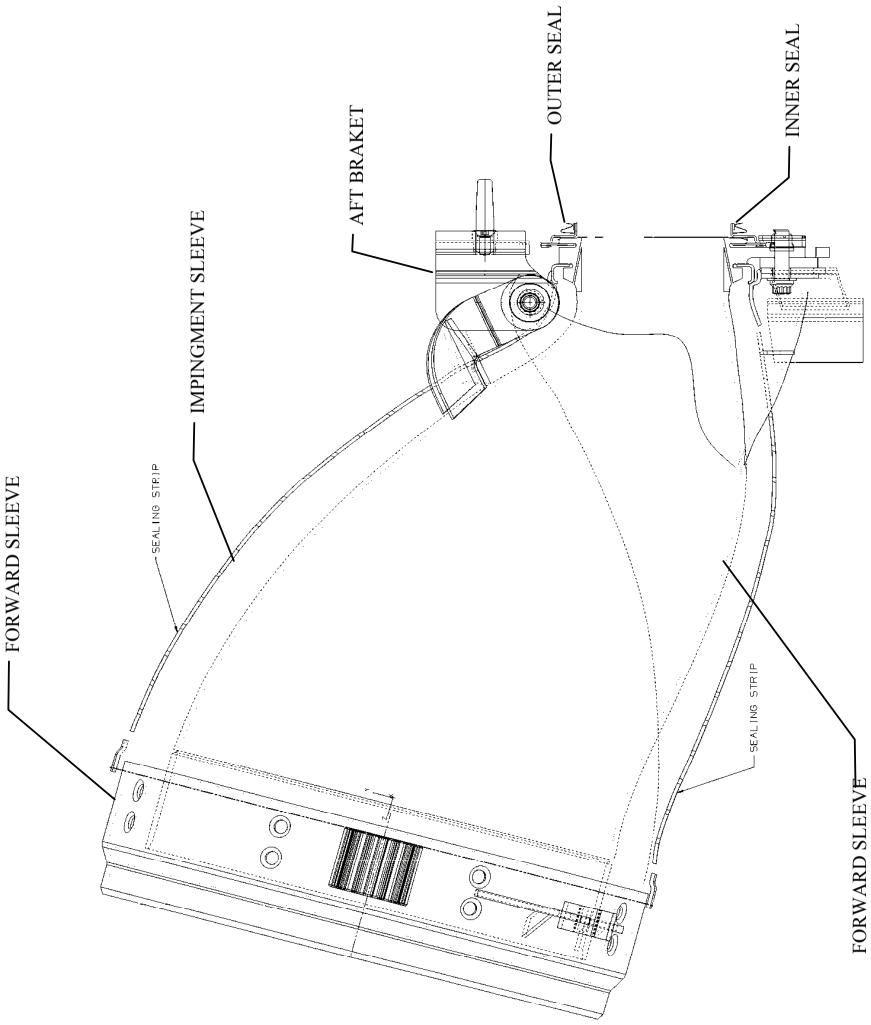



**Figure 18. Transition Piece Assembly**

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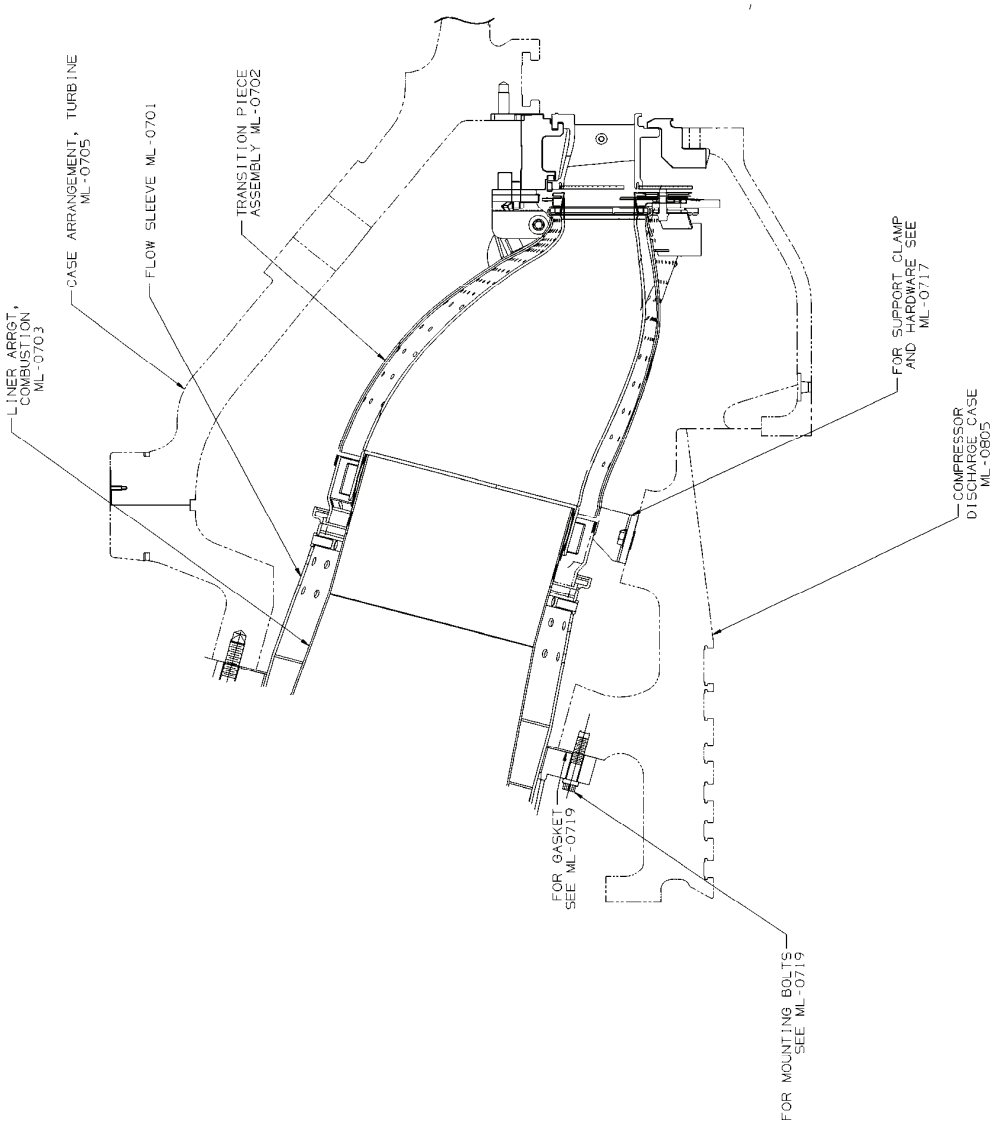



**Figure 19. Transition Piece Installed**

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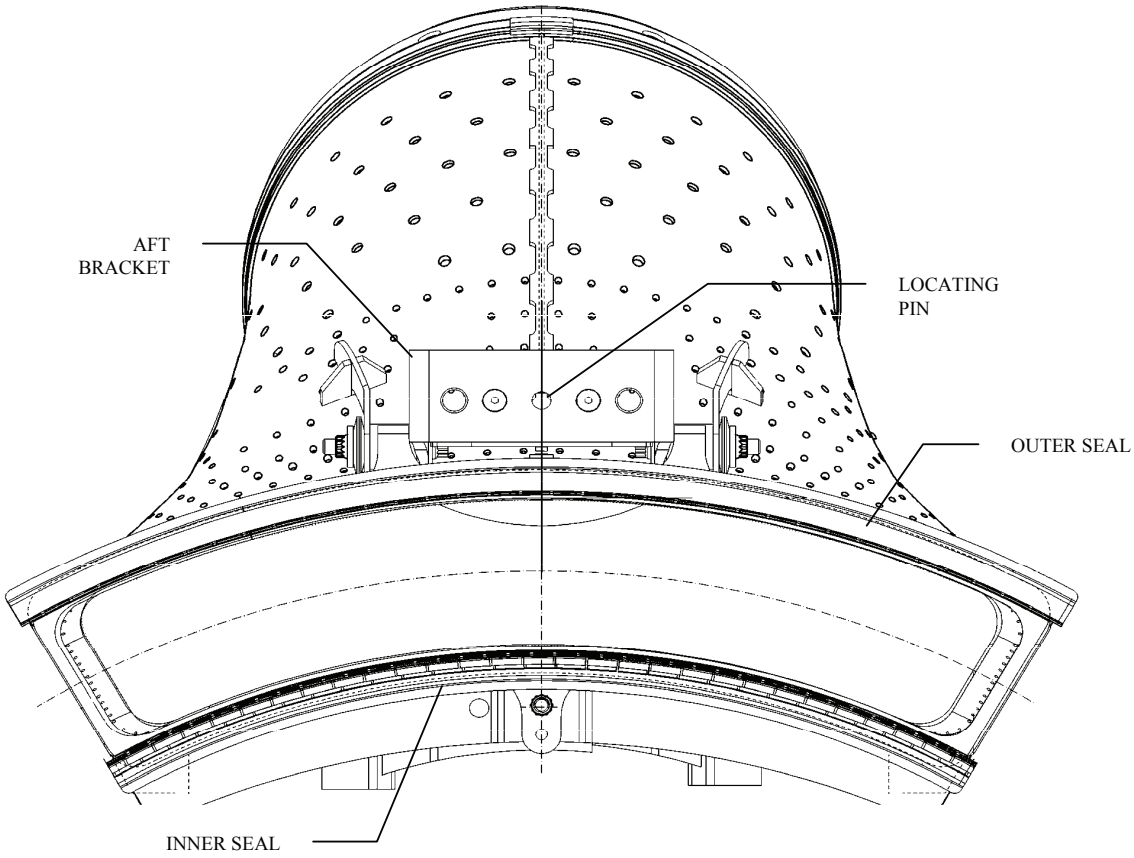



**Figure 20. Transition Piece End View**

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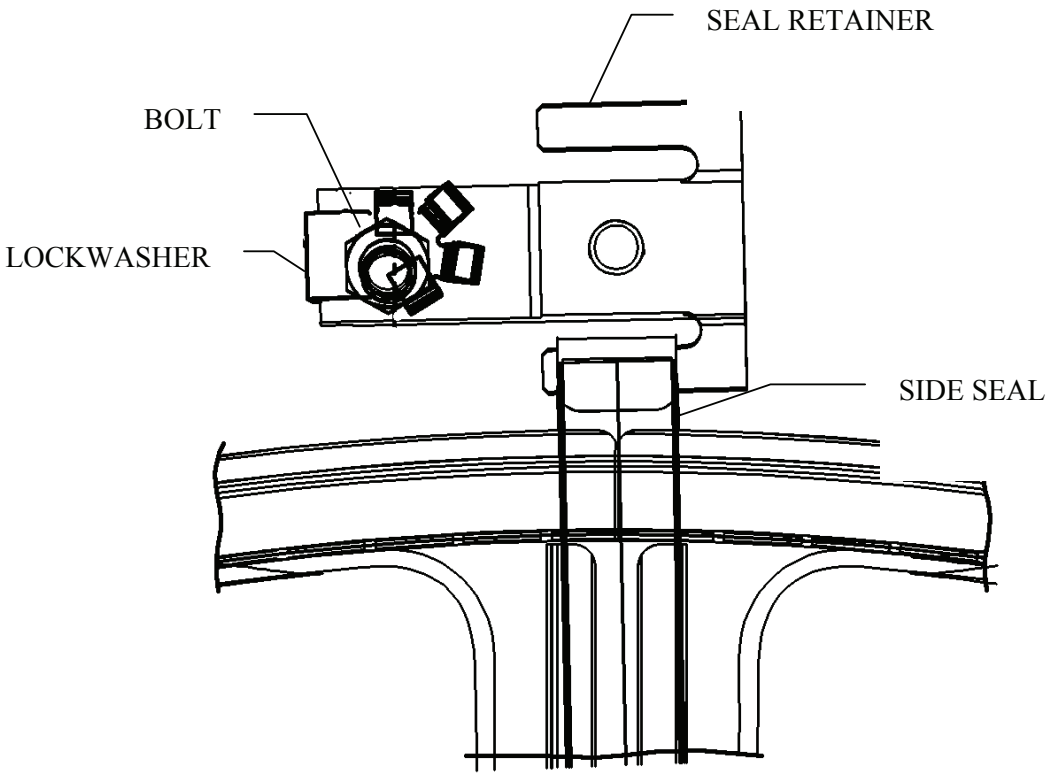



**Figure 21. Transition Piece Side Seal Details**

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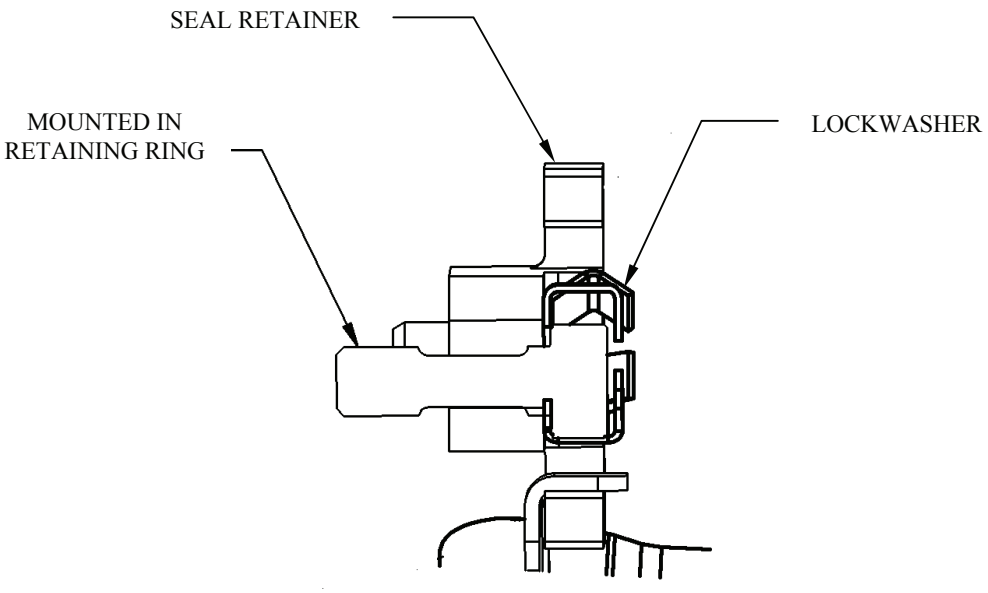



**Figure 22. Transition Piece Side Seal Retainer Block Detail**

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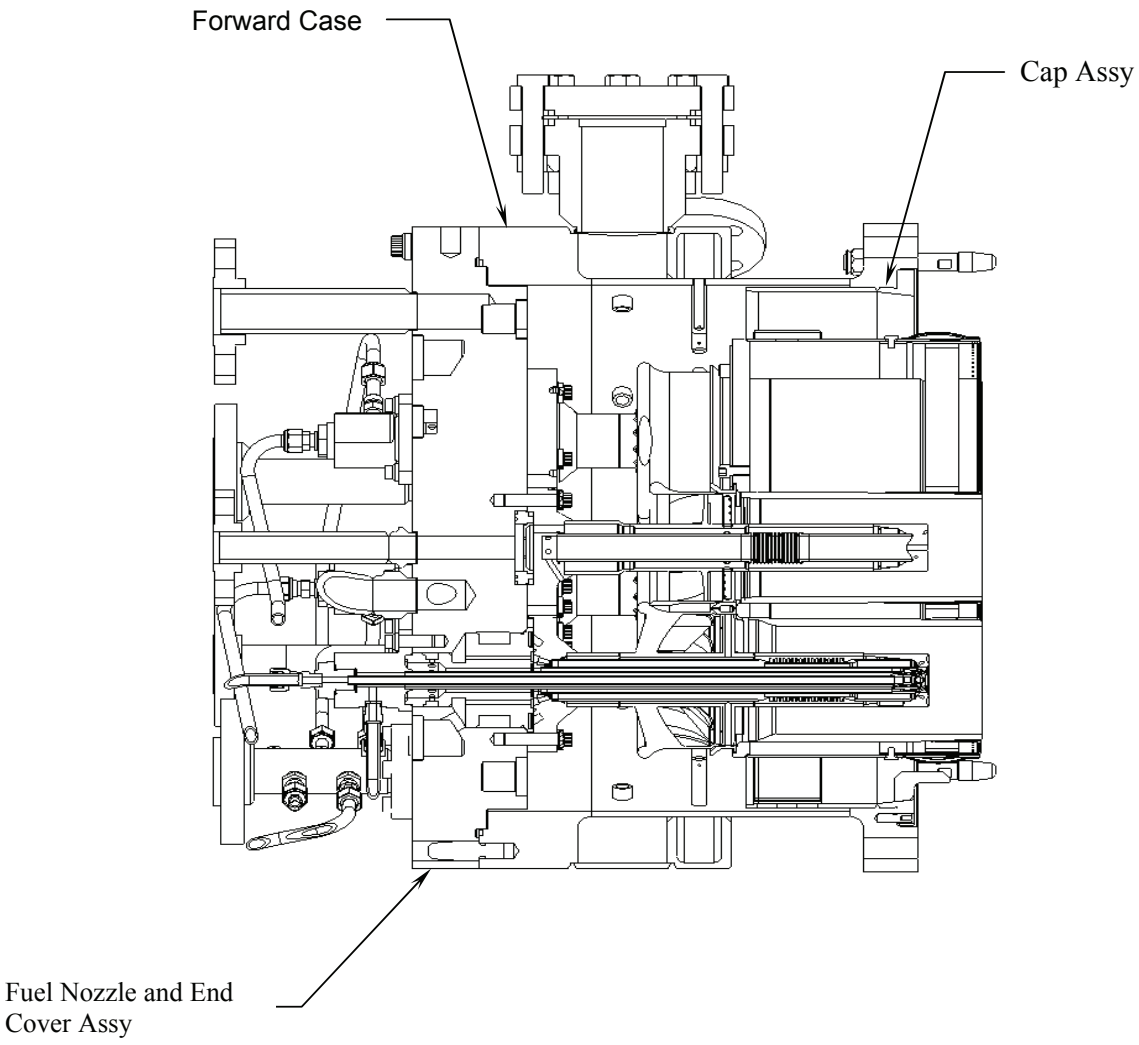



**Figure 23. Fuel Nozzle Assembly, with case and cap**

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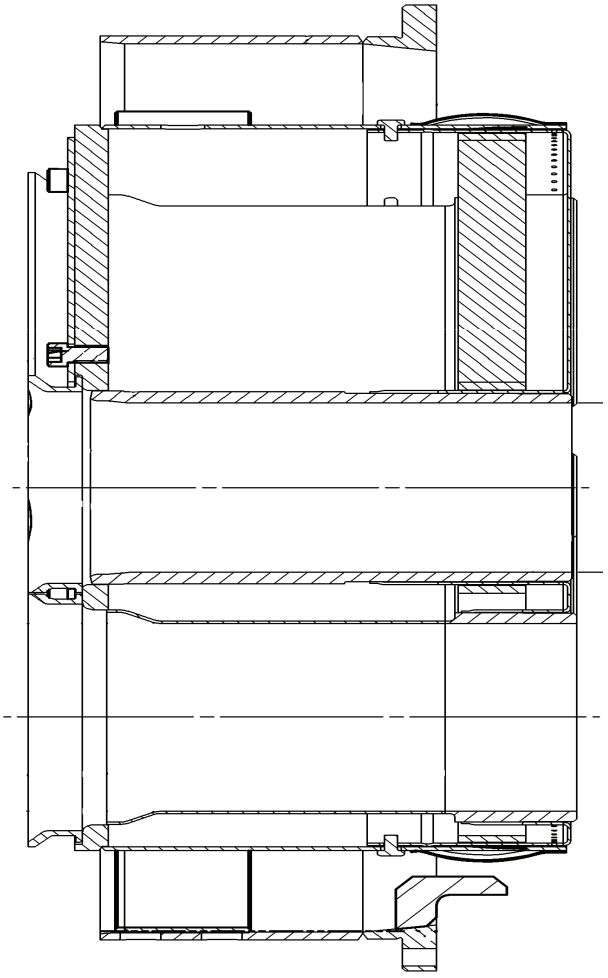


**Figure 24. Cap Assembly Cutaway**

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**Operation 13 — How to Inspect and Test Spark Plugs**

**NOTE**

The possibility exists that the electrical components, porcelain core and ceramic rod may be found damaged during disassembly of spark plug tip, or broken while handling. Therefore, spare parts should always be available for this possibility.

1. Inspect the spark plug assembly for binding, galling, arcing, tip/piston weld cracks, ceramic insulator cracks and damaged threads on electrical lead connection. See Table 1 for inspection criteria.

2. Check the movement of the spark plug piston by pulling on the lead end of the piston. If any evidence of binding exists, the cylinder assembly must be disassembled and the binding eliminated. To disassemble the cylinder assembly, remove the four bolts from the top of the cylinder, then remove the top of the cylinder and the piston.

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**Table 1. MS-6001FA+e Spark Plug Inspection Limits**

| **CAUTION**<br>The inspection criteria in this table apply to GE Company supplied spark plugs only. | | |
|---|---|---|
| Inspect | Maximum Acceptable Limits | Disposition (For Parts Beyond Max. Limits) |
| **1. Spark Plugs** | | |
| a. Binding | None | Disassemble and clean. |
| b. Galling | None | Polish with fine abrasive cloth. |
| c. Terminal extension cracks | None | Replace. |
| d. Core assembly cracks | None | Replace. |
| e. Ceramic insulator crack | None | Replace. |
| f. Bad threads on electrical connection | None | Replace. |
| g. Test firing | None | Replace insulator. |

**CAUTION**

Take care not to lose or damage the nickel sealing ring at the top of the cylinder.

Remove all foreign material, such as dust, dirt or chips, from the cylinder and piston assemblies. Remove all oxidation and galling marks and correct the cause of galling.

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3. The igniter needs to be replaced if it has been damaged at the hot end, or fails to fire properly when tested. To remove the igniter from the piston assembly, unscrew the igniter's retaining nut at the cold end. The igniter may then be slid out of the piston assembly. It should be replaced with a new igniter including a new retaining nut and ferrule. Slide the igniter assembly into the piston until the retainer nut is against the fitting and the stop collar is against the retainer nut. Then tighten the retaining nut 1 ¼ turns to set the ferrule.

*****WARNING*****

**DO NOT TEST IGNITORS IN OR NEAR AN AREA WITH AN EXPLOSIVE ATMOSPHERE.**

Reconnect the spark plug lead, with the spark plug removed from the turbine. Rest the body of the spark plug against the turbine shell (or other grounded metal). Make sure the electrode end of the spark plug is not grounded.

*****WARNING*****

**BE CAREFUL OF HIGH VOLTAGE.**

Energize the ignition circuit and check the spark of the spark plug for approximately two minutes. If heating occurs at any point along the length of the igniter or if the spark is weak or erratic replace the igniter.

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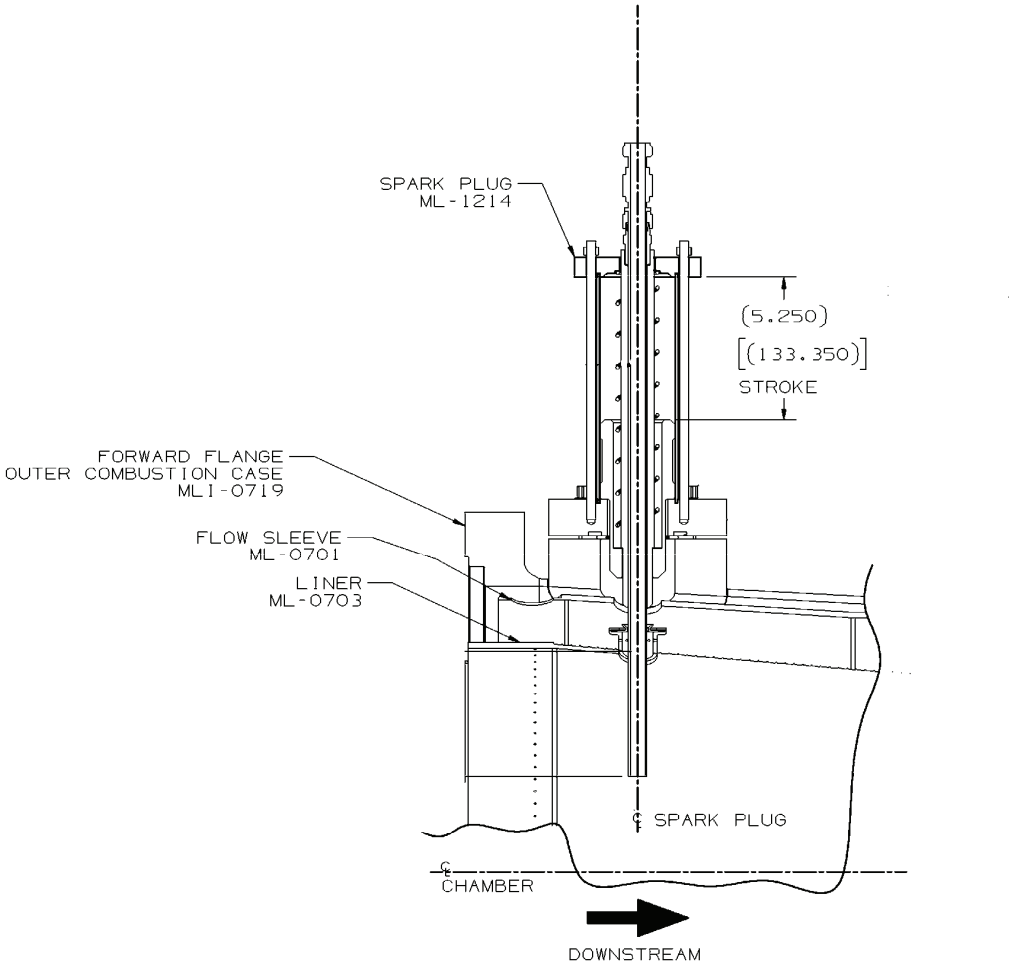



**Figure 25. Spark Plug Assembly for Multi-Nozzle Combustion System**

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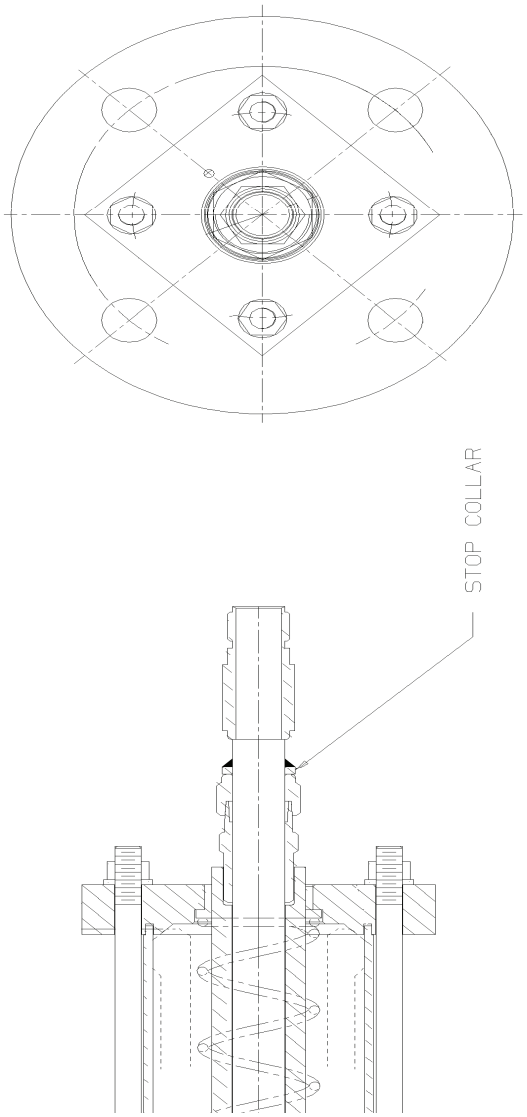



**Figure 26. Spark Plug Locking Procedure**

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**OPERATION 14 — How to Inspect and Test Flame Detectors**

1. The combustion system has four flame detectors. They are mounted on the combustion casings looking across the upstream end of the reaction zone.

**NOTE**

The flame detector tube is contained in the flame sensor sub-assembly. Combined with the body and window subassembly, the two subassemblies form the ultraviolet flame sensor. Either of these sub-assemblies are field replaceable, but neither sub-assembly is field repairable (except for cleaning), and it must be returned to the manufacturer for repair or replacement.

2. Clean the scanner lenses. Reconnect flame detector wiring and energize the control panel. With power on the control panel, check that FL-1 and FL-2 indicating lights are out.

**CAUTION**

| |
|---|
| Sensor is polarity sensitive and will be damaged if connected with reverse polarity. Black lead of sensor is positive. |

3. Using a match or candle, check to assure that each flame detector picks up and drops out when the light source is placed in front of the sensor and removed. The unit should be capable of detecting the match or candle at approximately 18 inches (45.7 centimeters).

**OPERATION 15 — How to Inspect Combustion Caps and Liners**

1. Record combustion liner inspection results on Inspection Forms.

**NOTE**

Combustion chamber parts will not be dealt with by any specific drawing number. It is generally recommended that repairs concerning the replacement of caps, liner sleeves, and hula seals be performed by qualified General Electric Company personnel. Deterioration less than maximum allowable limits indicates that reuse may be permissible based on the premise that consideration has been given to the operating hours and firing conditions experienced by the liners to date, and the subsequent operations expected from the liners.

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2. Inspect Multi-Nozzle Caps and Liners (see Figure 27, Figure 28 and Figure 29).

a. Table 2 is a guide to aid in decision-making on re-use or replacement of combustion caps and Table 3 is a guide in decision on reuse or replacement of combustion liners.

b. Figure 27 and Figure 28 should be used to identify areas of the combustion caps called for on Table 2.

c. Figure 29 should be used to identify areas of the combustion liners called for on Table 3.

d. Weld cracks shall be detected using fluorescent penetrant. Zyglo ZL-22 is acceptable, using the *spot* method.

e. Parts that have thermal barrier coating should be inspected with a bright light and a 10x glass. Do not allow any of the Zyglo materials to contaminate the thermal barrier coating.

f. Figure 30 shows the row of cooling holes near the downstream end of the combustion liner.
(1) Inspect for cracks emanating from the cooling holes.

(2) The cooling ring overhang should be inspected to detect cracks or warpage.

g. Inspect the liner spring seals (Hula seals) for axial cracks, circumferential cracks, distortion (flattening), wear, missing leaves, bent leaves or spot weld cracks. See Table 3 for inspection criteria.

h. If any spring seals are reshaped, ensure the leaf curvature height is similar to adjacent leaves and “PI” tape dimension is satisfied.

i Fluorescent penetrant check any spring seal leaves that have been reshaped.

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**Table 2. MS-6001FA+e Combustion Cap Inspection Limits**

| | Inspect | Maximum Acceptable Limits | Disposition (For Parts Beyond Max. Limits) |
|---|---|---|---|
| **1.** | **Cap Assembly** | | |
| | a. Perforated plate cracks | None | Replace* |
| | b. Warpage of perforated plate | 0.060 in. locally | Replace* |
| | c. Burn through or loss of material | None | Replace* |
| | d. Liner stop | 0.080 in. metal loss | Repair |
| | e. Perforated plate assembly loosens in cap assembly | None | Repair |
| | f. Premixing tube cracks | None | Repair |
| **2.** | **Cap Assembly Spring Seal** | | |
| | a. Axial cracks | None | Repair |
| | b. Circumferential cracks | None | Repair |
| | c. Distortion (flattening) Pi tape OD | None | Repair |
| | d. Wear | 50% material loss at slots | Repair |
| | e. Missing leaves | None | Repair |
| | f. Spot weld cracks | Four per cap, no more than two adjacent | Repair |
| | g. Fillet weld cracks | None | Repair |
| | h. Bent leaves | Any number | Straighten and penetrant check |
| | i. Loss of elasticity | Seal leaves must be tight to cap sleeve, no clearance | Repair |

* “Replace” does not mean cap must be scrapped – this part can be repaired by qualified General Electric Company personnel.

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**Table 3. MS-6001FA+e Combustion Liner Inspection Limits**

| | Inspect | Maximum Acceptable Limits | Disposition (For Parts Beyond Max. Limits) |
|---|---|---|---|
| **1.** | **Liner Sleeve** | | |
| | a. Cracks | None | Repair |
| | b. Burn through (missing metal) | None | Repair |
| | c. Out-of-roundness (up stream) | (Dia. Max – Dia. Min.)= ¼ in. | Repair |
| | d. Out-of-roundness (down stream) | (Dia. Max – Dia. Min.)= ¼ in. | Repair |
| | e. Liner wear beneath spring seal | 40% material thickness beneath seal | Repair |
| **2.** | **Liner Downstream Cooling System** | | |
| | a. Axial cracks | None | Repair |
| | b. Weld cracks | None | Repair |
| | c. Circumferential cracks | None | Repair |
| | d. Burn through (missing metal) | None | Repair |
| | e. Thermal barrier coating | Isolated patches separated by at least 1.0 in. Total lost area 2 $in^2$. | Repair |
| **3.** | **Liner Spring Seal** | | |
| | a. Axial cracks | None | Repair |
| | b. Circular cracks | None | Repair |
| | c. Flattened leaves | None | Repair |
| | d. Wear | Min. thickness – 0.030 in. | Repair |
| | e. Missing leaves | None | Repair |

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**Table 3. MS-6001FA+e Combustion Liner Inspection Limits (Cont'd)**

| | Inspect | Maximum Acceptable Limits | Disposition (For Parts Beyond Max. Limits) |
|---|---|---|---|
| | f. Weld cracks | None | Repair |
| | g. Bent leaves | Any number | Straighten and penetrant check |
| | h. Raised leaves | Seal leaves must be tight to liner, no gap allowed | Adjust or replace |
| **4.** | **Crossfire Tube Collars** | | |
| | a. Cracks | None | Repair |
| | b. Wear | 0.030 in. material remaining | Repair |
| | c. Distortion | 1.98 in. minimum ID | Reform with hand tools |
| | d. Burning of collar | None | Repair |
| **5.** | **Liner Stops** | | |
| | a. Wear on down stream end | 0.060 in. | Repair |
| | b. Wear on up stream end | 0.060 in. | Repair |
| | c. Wear on sides | 0.030 in. | Repair |
| | d. Cracks (weld or parent metal) | None | Repair |
| | **Floating Collars, Spark Plug, Flame Detector, and P.C.B.** | | |
| **6.** | **Probe** | | |
| | a. Through hole wear | 0.050 in. from original diameter | Repair |
| | b. Collar sliding wear | 0.020 in. material remaining | Repair |
| | c. Retainer cracks (weld or parent metal) | None | Repair |
| | d. Collar Deformation | No visible deformation | Repair |

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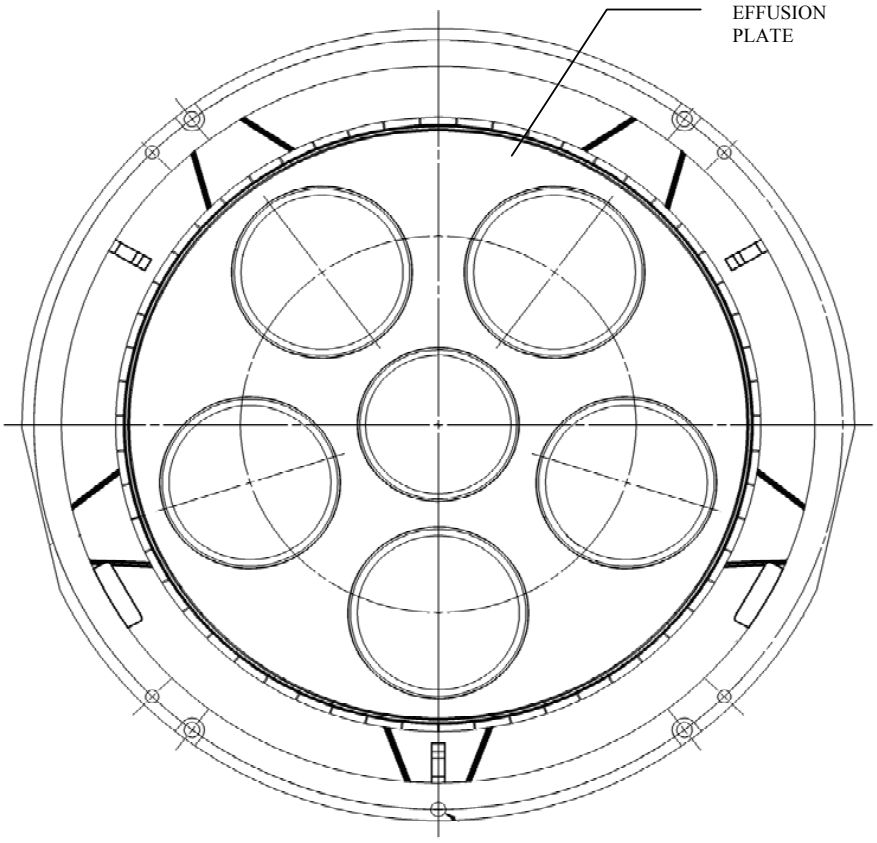



**Figure 27. Cap Assembly – View from Downstream Effusion Plate Detail Not Shown**

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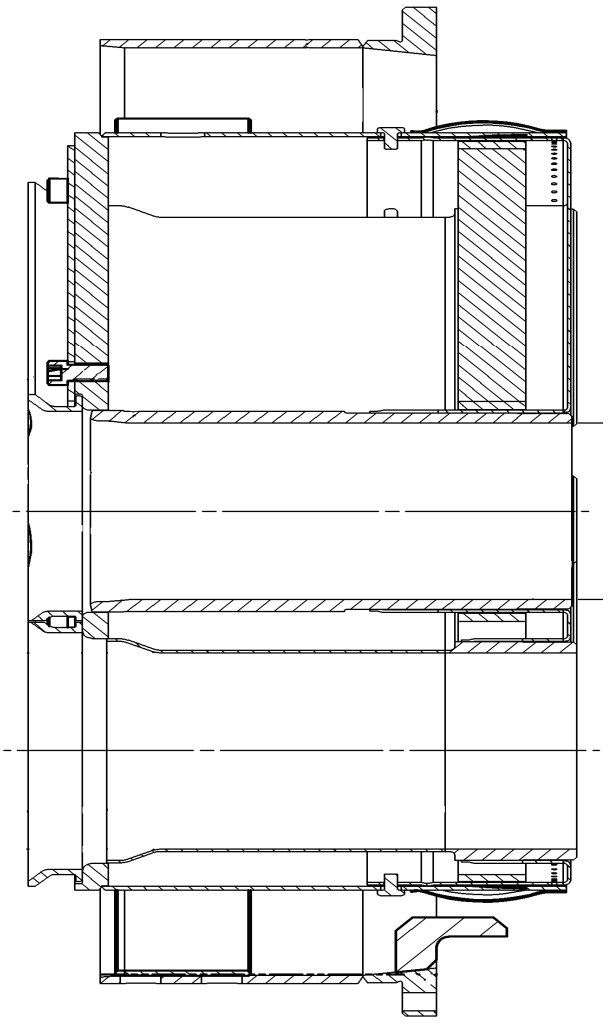


**Figure 28. Cap Assembly Cutaway**

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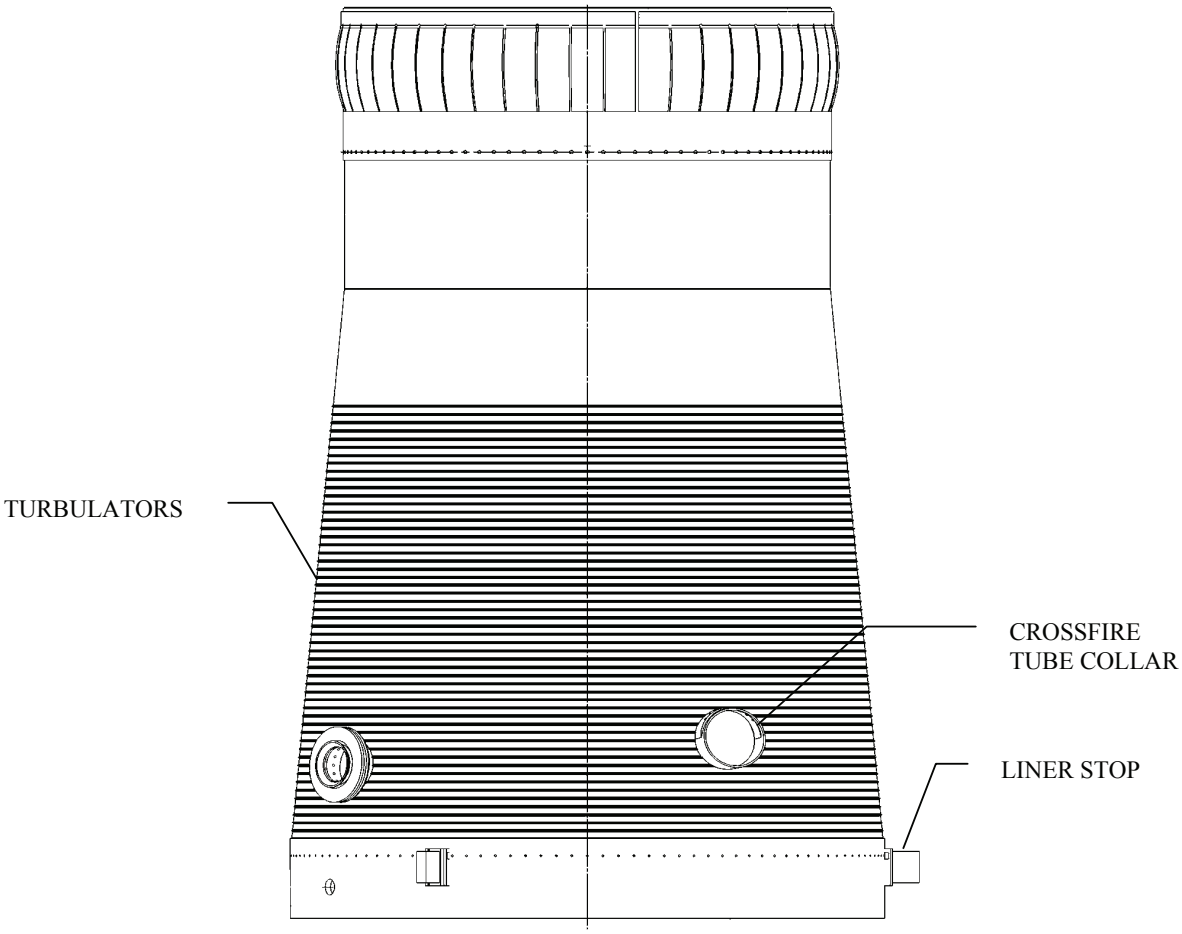



**Figure 29. Combustion Liner Assembly**

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**Operation 16 — How to Inspect Crossfire Tubes and Retainers**

1. Inspect crossfire tubes for evidence of distortion, cracks, missing metal, burn-through and wear. Use Table 4 for inspection criteria.

2. Inspect crossfire tube retainers for wear and evidence of bending. Use Table 4 for inspection criteria.

3. Record inspection results on appropriate Inspection Form.

**Table 4. Inspection Limits, Crossfire Tubes and Retainers**

**CAUTION**

The inspection criteria in this table applies to General Electric Company supplied crossfire tubes and retainers.

| Inspect | Maximum Acceptable Limits | Disposition (For Parts Beyond Max. Limits) |
|---|---|---|
| **1. Crossfire Tubes** | | |
| a. Burn through; missing metal | None | Replace |
| b. Distortion | None | Replace |
| c. Wear | 50% of original material | Replace |
| **2. Crossfire Tube Spring Retainers** | | |
| a. Wear | Wear coating breached | Replace |
| b. Evidence of distortion | None | Straighten* |

**NOTE**

* Retainers are bowed 0.23” for spring locking tubes 5.25” from open end. *DO NOT* straighten this bend.

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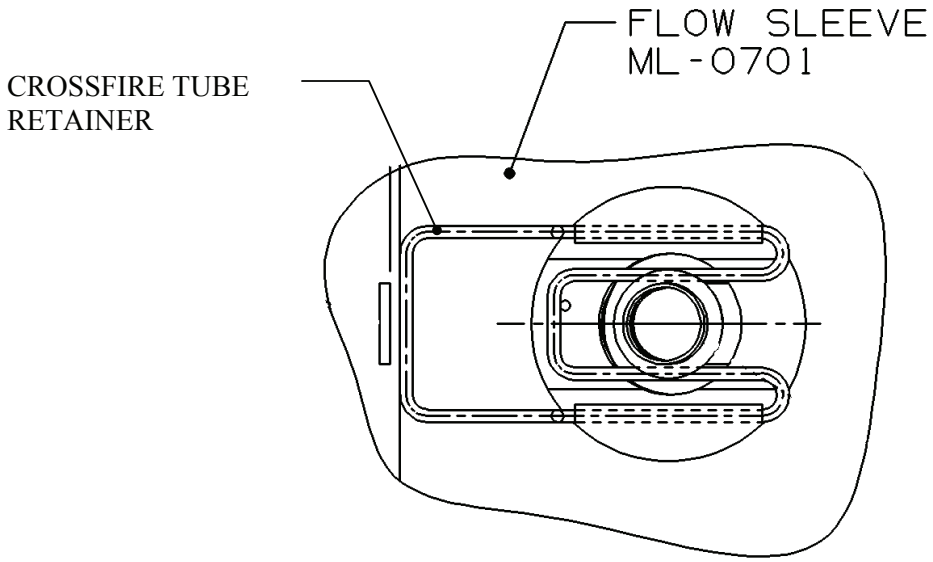



**Figure 30. Crossfire Tube Parts**

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**Operation 17 — How to Inspect Combustion Chamber Flow Sleeve**

1. Using a bright light and a 10 x power magnifying glass, inspect the combustion chamber flow sleeve.

2. Use Figure 31 for identification of parts and Table 5 for inspection limits. Record all inspection results on Inspection Form.

a. Inspect the sleeve for body or weld cracks, out-of-roundness, burn-through, missing metal.

b. Inspect forward flange to body weld for cracks or cracks in the flange.

c. Inspect liner stops for wear, and also body and stop weld cracks.

d. Inspect crossfire tube retainer bracket for weld cracks or bracket cracks.

e. Inspect floating seal at aft end for excessive wear on ring or retainers.

f. Inspect the spring seals at mid length for axial cracks, circumferential cracks, distortion (flattening), wear, missing leaves, bent leaves or spot weld cracks. See Table 5 for inspection criteria.

g. If any spring seals are reshaped, ensure the leaf curvature height is similar to adjacent leaves and “PI” tape dimension is satisfied.

h. Fluorescent penetrant check any spring seal leaves that have been reshaped.

i. Record inspection results on Inspection Forms.

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**Table 5. Inspection Limits for Flow Sleeves**

**CAUTION**

The inspection criteria in this Table applies to General Electric Company supplied flow sleeves.

| Inspect | | Maximum Acceptable Limits | Disposition (For Parts Beyond Max. Limits) |
|---|---|---|---|
| **1.** | **Sleeve** | | |
| | a. Body or wed cracks | 0.250” (0.635 cm) long | Replace* |
| | b. Out-of-roundness | 0.250” (0.635 cm) from original contour | Replace* |
| | c. Local Distortion | 0.190” (0.481cm) from original contour with no cracks | Replace* |
| | d. Burn-through (missing metal) | None | Replace* |
| **2.** | **Forward Flange** | | |
| | a. Flange to body weld crack | None | Replace* |
| | b. Cracks | None | Replace* |
| **3.** | **Liner Stops** | | |
| | a. Wear | 0.020” (0.051cm) from original mat’l | Replace* |
| | b. Body stop weld cracks | None | Replace* |
| **4.** | **Floating Seal Ring** | | |
| | a. Cracks | None | Replace Ring |
| | b. Wear | 0.120” (0.31 cm) radial | Replace Ring |
| **5.** | **Floating Seal Retainer** | | |
| | a. Cracks | None | Replace |
| | b. Wear | 0.06” (0.15 cm) | Replace |
| **6.** | **Crossfire Tube Retainer Bracket** | | |
| | a. Weld Cracks | 0.130” (0.33 cm) long | Replace |
| | b. Cracks | None | Replace |
| **7.** | **Spring Seal** | | |
| | a. Axial Cracks | None | Replace Seal |
| | b. Circular Cracks | None | Replace Seal |

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**Table 5. Inspection Limits for Flow Sleeves (Cont'd)**

**CAUTION**

The inspection criteria in this Table applies to General Electric Company supplied flow sleeves.

| Inspect | Maximum Acceptable Limits | Disposition (For Parts Beyond Max. Limits) |
|---|---|---|
| | None | Replace Seal |
| c. Distortion (flattening) | 0.219-0.239" (5.56-6.07 mm) height | Replace Seal |
| d. Wear | 50% material removal at slots | Replace Seal |
| e. Missing Leaves | None<br>Four per flow sleeve, no more than two | Replace Section of Seal |
| f. Spot Weld Cracks | Adjacent | Replace Section of Seal |
| g. Bent Leaves | Any number | Straighten and penetrant check |

* "Replace" does not mean flow sleeve must be scrapped- this part can be repaired by qualified General Electric Company personnel.

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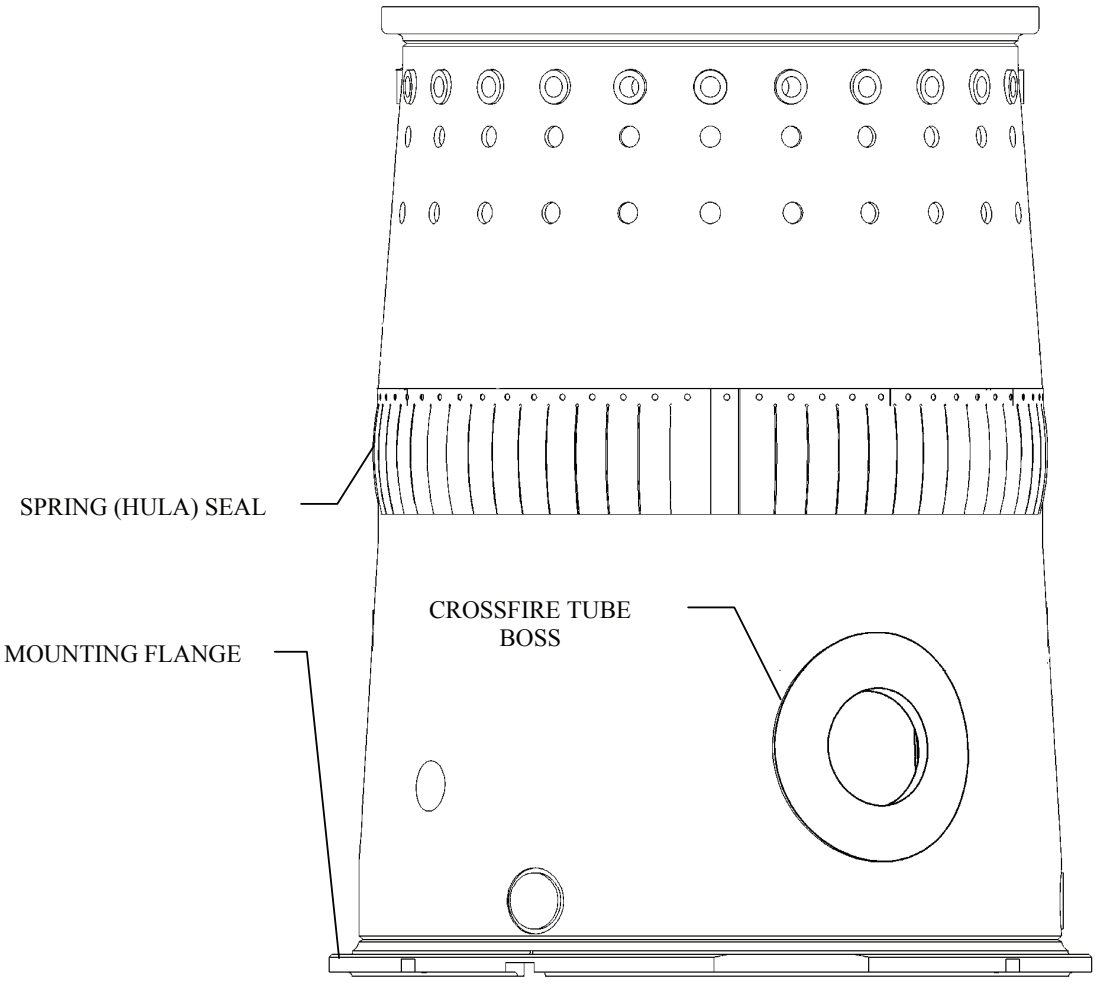



**Figure 31. Flow Sleeve Assembly**

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**Operation 18 — How to Inspect Fuel Nozzle (Forward) Combustion Casing**

1. Inspect the outside of the casing for cracks, bulging, buckling or signs of overheating and corrosion.

2. Check all Helicoil inserts in upstream flange. Replace if unserviceable.

3. Record inspection results on appropriate Inspection Form. (See Figure 32)

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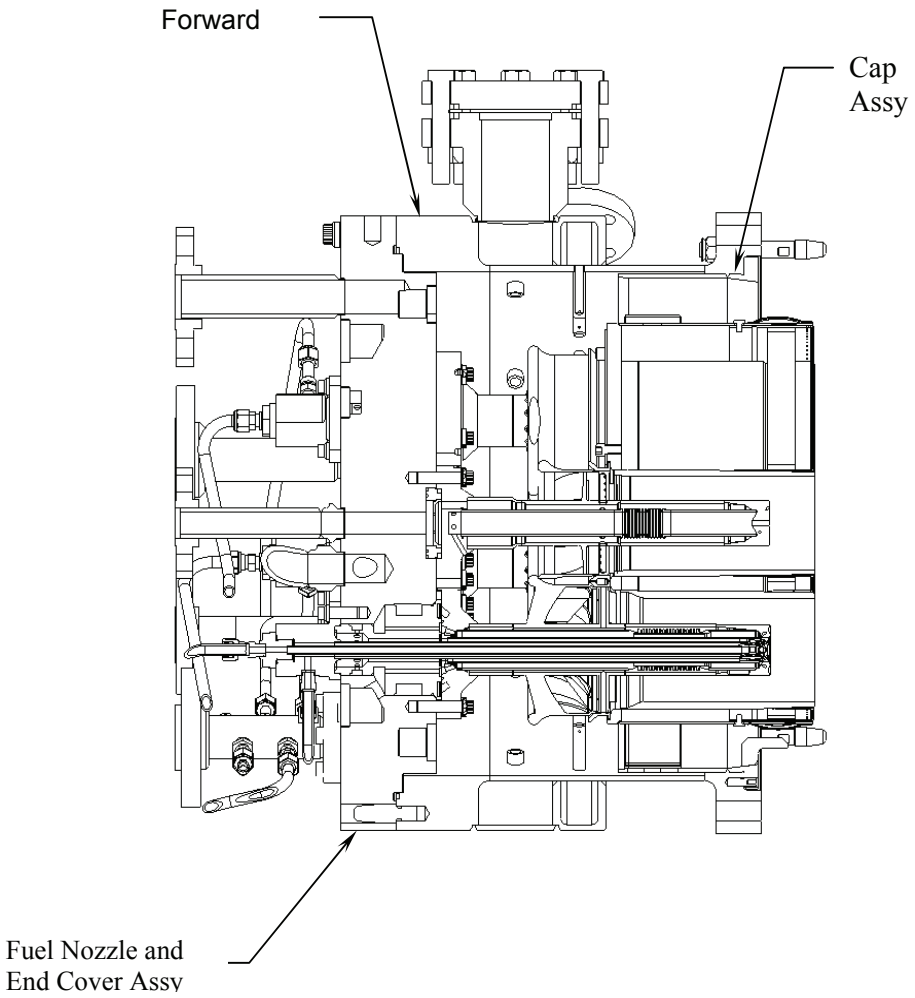



**Figure 32. Fuel Nozzle Assembly, with case and cap**

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**Operation 19 — How to Inspect Aft Combustion Outer Casings**

1. Inspect inside and outside of combustion casings for cracks, bulging, buckling, signs of overheating and corrosion.

2. Inspect each combustion outer casing for foreign objects.

3. Check Heli-Coil inserts in flange at upstream end of casing. Replace if unserviceable. (See Figure 33)

4. Record inspection results on appropriate Inspection Form.

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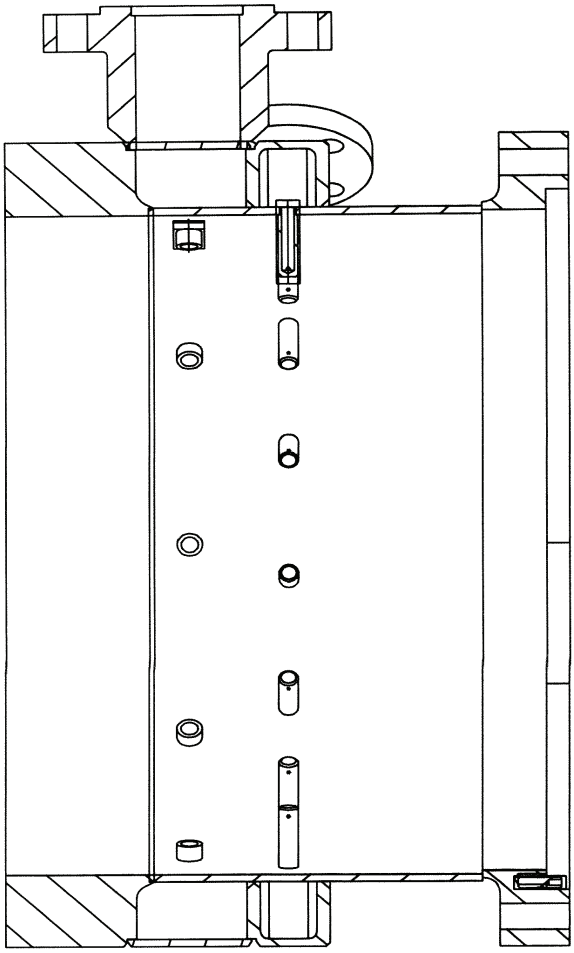


**Figure 33. Combustion Outer Casing**

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**Operation 20 — How to Inspect Transition Pieces**

1. For inspection guidelines, see Table 6. Clean and fluorescent penetrant check the aft (rectangular) body end. Use the Zyglo with the “spot” method after a general inspection with a bright light and a 10 power glass. Do not allow any of the Zyglo materials to contaminate the thermal barrier coating. If there is reason, based upon inspection of the inside surface of the transition piece, for removal of the impingement sleeve, it should be done at a qualified GE Service Center. Reinstallation of an impingement sleeve requires special fixtures. Record all inspection results on appropriate Inspection Form. See Figures 34-37.

a. Aft bracket for weld or body cracks on inside surface of transition piece.

b. Aft picture frame/body corners for weld or body cracks, or cracks in wear inserts.

c. Forward support ring for weld or body cracks on inside and outside surface.

d. Inspect outside of forward support ring for wear from floating ring seal in flow sleeve.

e. Floating seal retainers for weld or retainer cracks.

f. Check floating seals for cracks and worn surfaces.

g. Check aft side seal spots for cracks, or breached wear coating.

h. Check transition piece body for body and weld cracks.

i. Inspect inside of transition piece for loss of thermal barrier coating.

j. Check forward “bat wing” bracket for cracks.

k. Check forward support clamp (bullhorn) for cracks and slot wear.

2. Repair welding procedures.

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**NOTE**

Welding repair procedures will not be described except to note that Gas Tungsten Arc Welding is the only authorized welding repair procedure allowed on MS-6001FA+e transition pieces. It is generally recommended that transition pieces requiring repairs be done by qualified General Electric Company personnel. The transition pieces require heat treatment after weld repairs.

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**Table 6. MS-6001FA+e Transition Piece Assembly Inspection Limits**

**CAUTION**

The inspection criteria in this Table applies to General Electric Company supplied transition pieces.

| Inspect | | Maximum Acceptable Limits | Disposition (For Parts Beyond Max. Limits) |
|---|---|---|---|
| **1.** | **Aft Side Seal Slot Wear Inserts** | | |
| | a. Wear | 0.030” (0.76 cm) deep | Replace* |
| | b. Cracks | None | Replace* |
| **2.** | **Body** | | |
| | a. Body or weld cracks | 0.250” (0.635 cm) long | Replace* |
| | b. Out-of-roundness | 0.080” (0.020 cm) from original contour | Replace* |
| | c. Wear from liner seal | 0.060” (0.152 cm) reduction of original material thickness | * Weld buildup and grind smooth |
| | d. Corrosion | 0.030” (0.076 cm) reduction of original material thickness | Replace* |
| | e. Deposits | 0.030” (0.076 cm) thick | Remove* |
| | f. Loss of thermal barrier coating | 0.75 x 0.75 $in^2$ (1.9 x 1.9 $cm^2$) isolated patches | Replace* |
| **3.** | **Forward Support** | | |
| | a. Cracks | None | Replace* |
| | b. Wear | 0.060” (0.152 cm) from original material | Weld buildup* |
| **4.** | **Forward Support Ring** | | |
| | a. Wear from flow seal ring | 0.040” (0.102 cm) | Replace* |
| | b. Cracks in bracket welds between transition piece body and forward support ring | None | Replace* |
| | c. Cracks in ring | None | Replace* |
| **5.** | **Aft Bracket** | | |
| | a. Weld or body cracks | None | Replace* |
| | b. Pivot Torque (must be within this range) | 40-160 ft-lbs (54.2-216.8 N-m) | Replace* |

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**Table 6. MS-6001FA+e Transition Piece Assembly Inspection Limits (Cont'd)**

**CAUTION**

The inspection criteria in this table applies to General Electric Company supplied flow sleeves.

| Inspect | Maximum Acceptable Limits | Disposition (For Parts Beyond Max. Limits) |
|---|---|---|
| **6. Aft Frame/Body Corners** | | |
| a. Weld or body cracks | None | Replace* |
| **7. Floating Seals** | | |
| a. Wear | 50% of original cloth thickness | Replace* |
| b. Cracks | None | Replace* |
| c. Radial movement | 0.080" (0.020 cm) min. from nom. Dim. | Replace* |
| **8. Impingement Sleeve** | | |
| a. Cracks at bracket | None | Replace* |
| b. Cracks from impingement holes | None | Replace* |

* "Replace" does not mean transition piece must be scrapped- this part can be repaired by qualified General Electric Company personnel.

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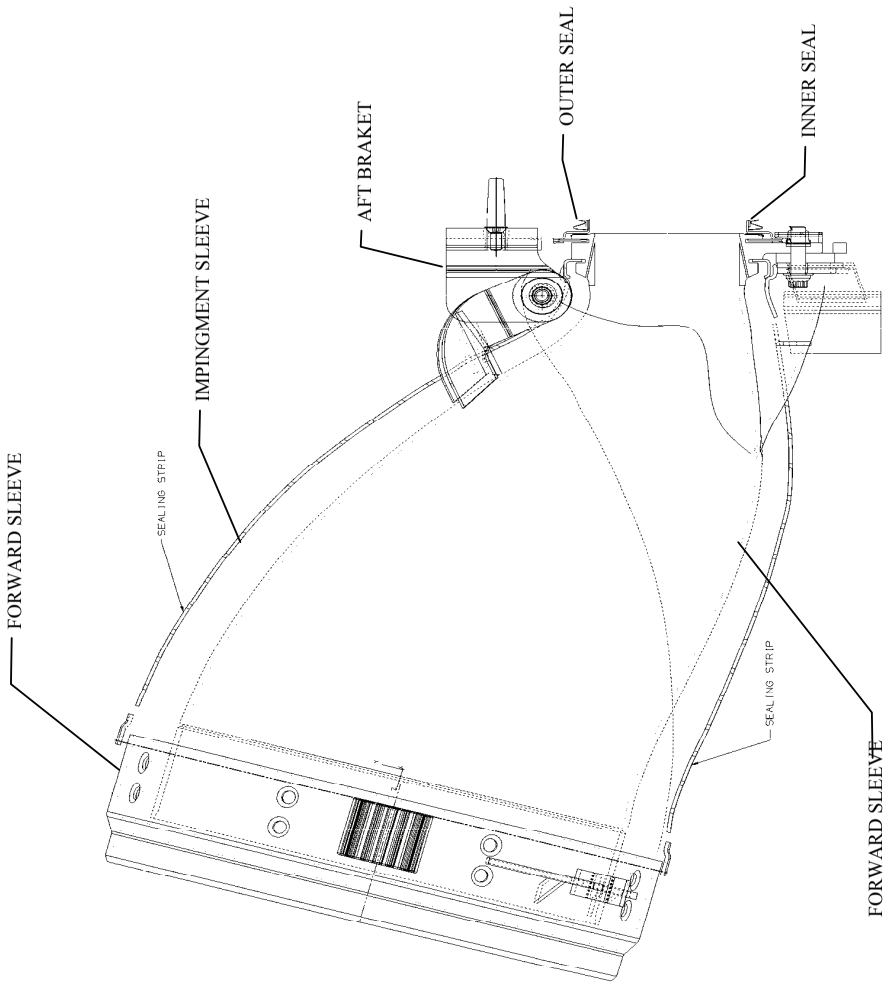



**Figure 34. Transition Piece Assembly**

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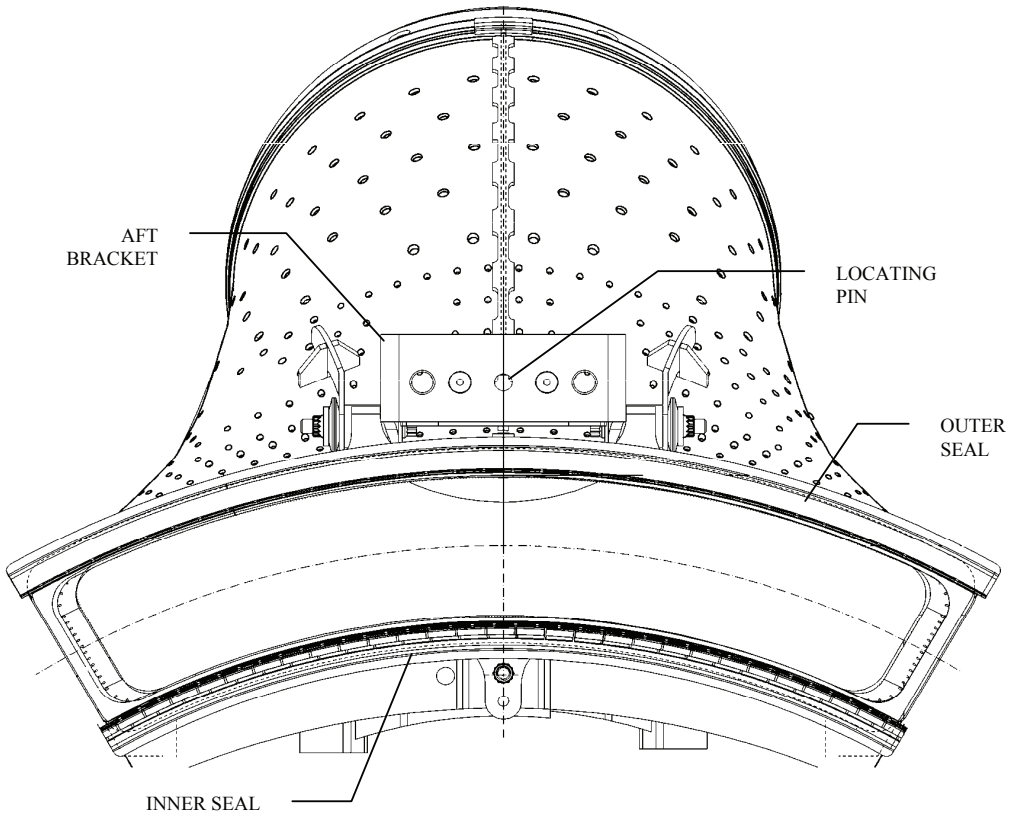



**Figure 35. Transition Piece End View**

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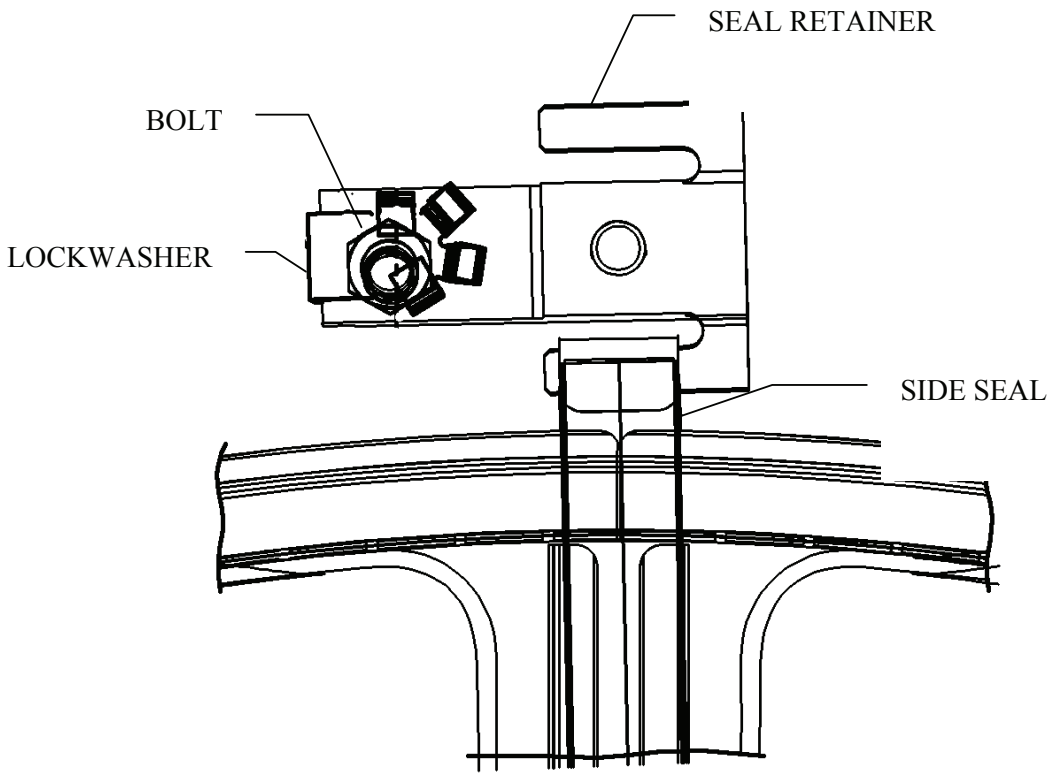



**Figure 36. Transition Piece Side Seal Details**

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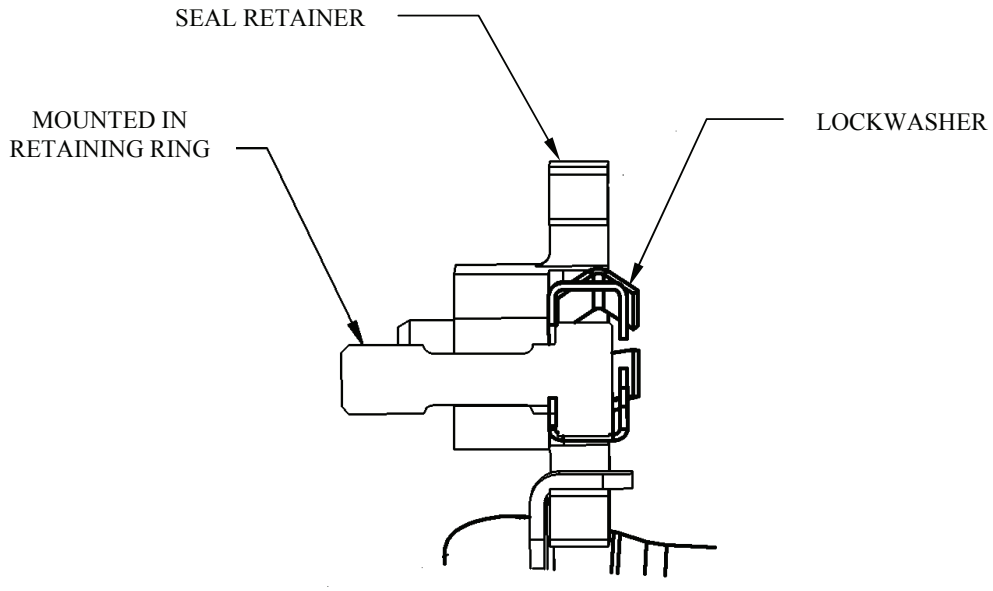



**Figure 37. Transition Piece Side Seal Retainer Block Detail**

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## 3. Reassembly Procedures for MS-6001FA+e Combustion Inspection

**<u>Operation 21</u> - How to Install Transition Pieces**

**Pre-assembly Inspection and Checks**

1. Prior to installation, inspect transition pieces for obvious handling or transportation damage such as deformed floating seals. Trial fit end seals onto transition piece before installing the transition piece into the machine.

**NOTE**

If a spare first-stage nozzle is available or if the first-stage nozzle for the unit is out of the unit, it is recommended that the transition pieces be trial fitted into the nozzle retaining ring and that the bolt hole alignment and the end seal fit be checked prior to trying the parts in the unit.

2. Trial fit, using hand force only, each support clamp to its respective transition piece prior to installing the transition piece into the machine.

3. Inspect first-stage nozzle segments for axial displacement (steps) between adjoining segments. Displacement greater than 0.030 inch (0.076 cm) should be reseated with a 5-pound rawhide mallet. *Do Not* Use Metal Hammer.

4. Inspect first-stage nozzle seal strips for extension into floating seal slots. Grind seals back to bottom of the slot if required.

5. Inspect all tapped holes for dirt, chips, rust or damaged threads. Re-tap damaged threads; re-machine for heli-coil insert if threads are elongated or stripped.

6. Inspect all heli-coils for cross threading, elongation, stripping or insert backing out. Remove and replace all damaged heli-coils.

7. To minimize handling and adjustments inside the combustion wrapper, set the positions of the inner and outer floating seals as shown in Figure 38. *Do Not* Use Metal Hammer to Position Seals.

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**Assembly Procedure**

**NOTE**

Prior to and at reinstallation of transition pieces, verify and record information called for on Inspection Report Form.

**CAUTION**

| |
|---|
| All new bolts and lock plates must be used at reassembly without exceptions. |

**NOTE**

When installing transition pieces, start with the No. 3 position, then proceed to install around each side of the turbine to the top. The final transition piece installed is at the No. 6 position.

1. Lift transition piece into the opening in the compressor discharge casing (through man way cover opening). Rig a line inside the turbine casing to support the weight of the transition piece. At the bottom of the turbine, a sideline will be needed to bring the transition piece over to its position.

2. It may be easier to align the transition piece seals if it is done without the presence of the front support.

3. Move the transition piece aft until the alignment pin in the aft bracket engages the hole in the nozzle retaining ring.

4. Move the transition piece further aft making sure the inner and outer floating seals line up with the slots in the first-stage nozzle.

5. After the seals have entered the slots in the nozzle, the transition piece should be moved aft until the aft bracket face contacts the retaining ring.

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6. Install aft bracket bolt and lock plate. Tighten to first-stage nozzle retaining ring. Prior to torquing bolt, check for proper floating seal engagement. Torquing aft bracket bolt with floating seal out of its slot will result in damage. Torque bolt to figures identified in GE specification. Do not bend lock plate tabs at this time. (Figure 39)

7. To assure proper seating of the transition piece, the aft mounting bolt must be torqued, loosened and re-torqued to the correct load.

8. Slide the front support into place engaging the blocks on the transition piece. Install the front support bracket bolts and lock plate but do not torque bolts or bend lock plate tabs. Adjust support clamp by sliding on block until at least one bearing surface on each side of support clamp makes contact when transition piece is loaded toward turbine centerline.

9. Torque the support clamp bolts and check the “B” and “C” dimensions between the nozzle sidewall and the transition piece end frame. These dimensions must agree with the values given in the Transition Piece Arrangement drawing. Note that the values must be achieved both for the clearance and the values on adjacent transition pieces so that it is possible to assemble side seals. (See MLI 0717.)

If the “C” dimension is less than the dimension given in MLI 0717, up to two lock plates may be used as shims between the support clamp and the block.

When the “C” dimension meets the drawing requirements, bend up the lock plate tabs on the support clamp and the transition piece aft bracket.

10.Install the side seals after the adjacent transition pieces have been installed. Slide in side seal, the side seal retainer, the lock plate, and the bolt. (See Figure 41 and Figure 42.)

11.Torque end seal bolt to correct load and bend lock plate tabs.

12.Follow the same procedure for each transition piece until the last one is installed in Position # 6.

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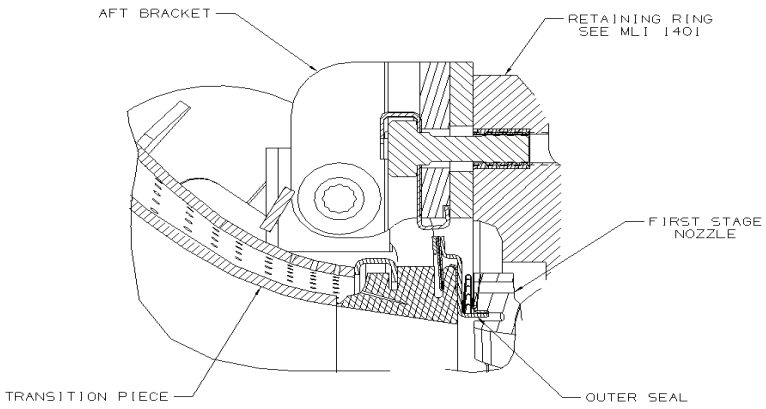
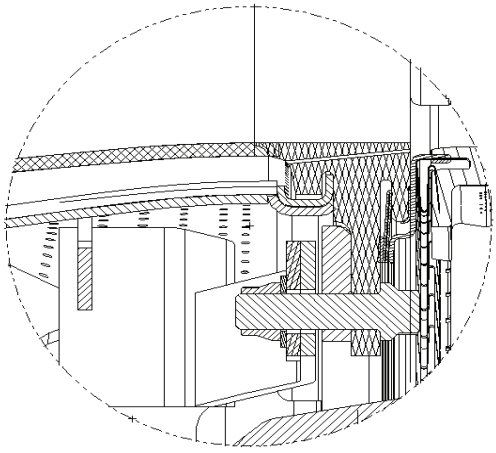



**Figure 38. Floating Seal Position for Assembly**



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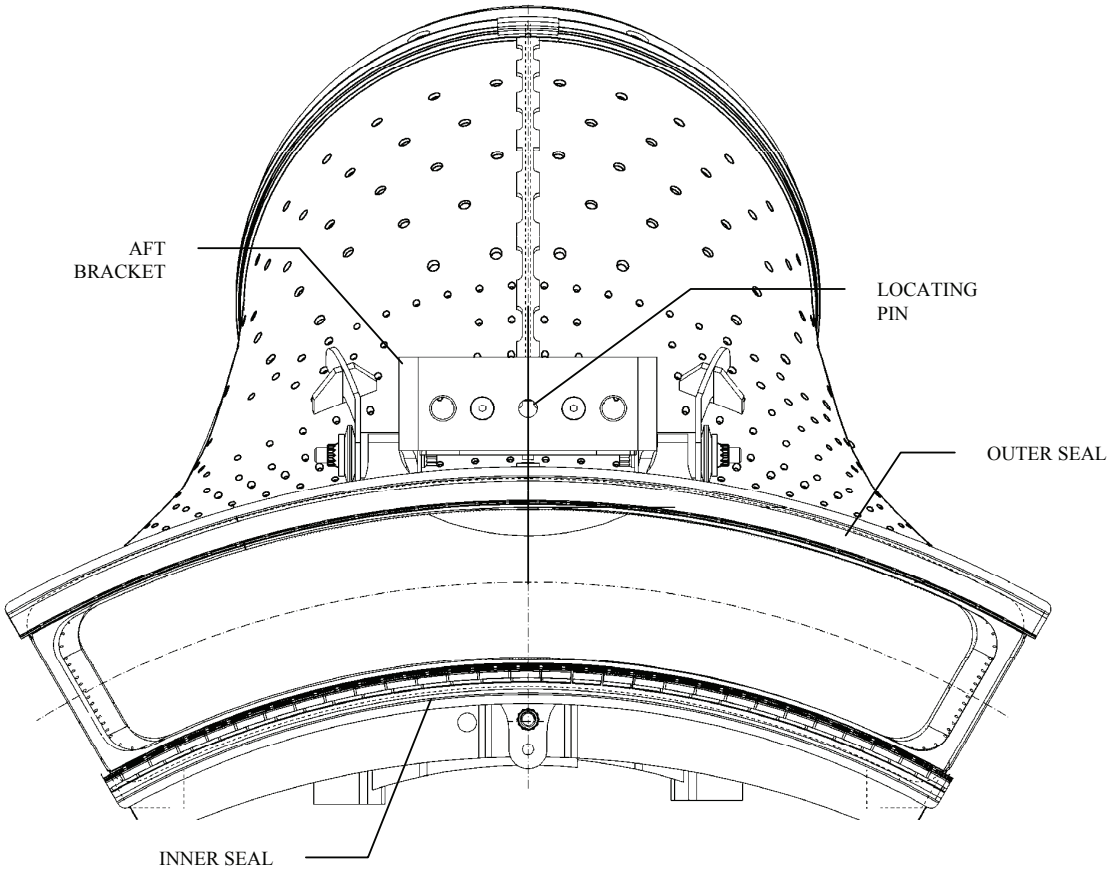



**Figure 39. Transition Piece End View**

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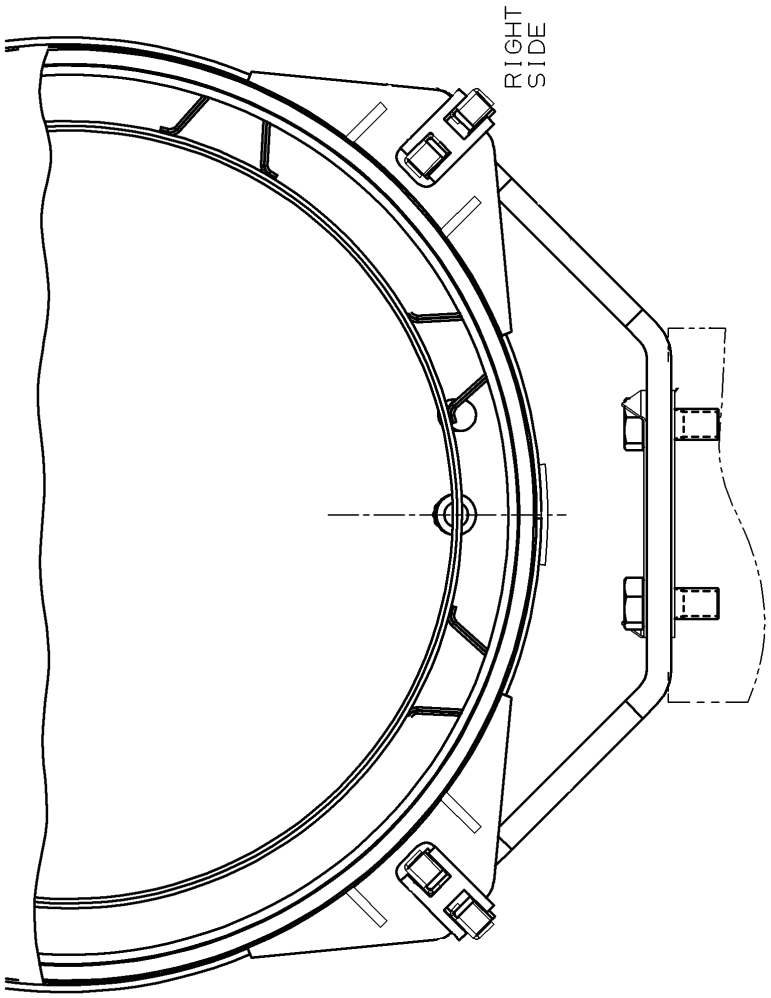



**Figure 40. Transition Piece Front Support Alignment**

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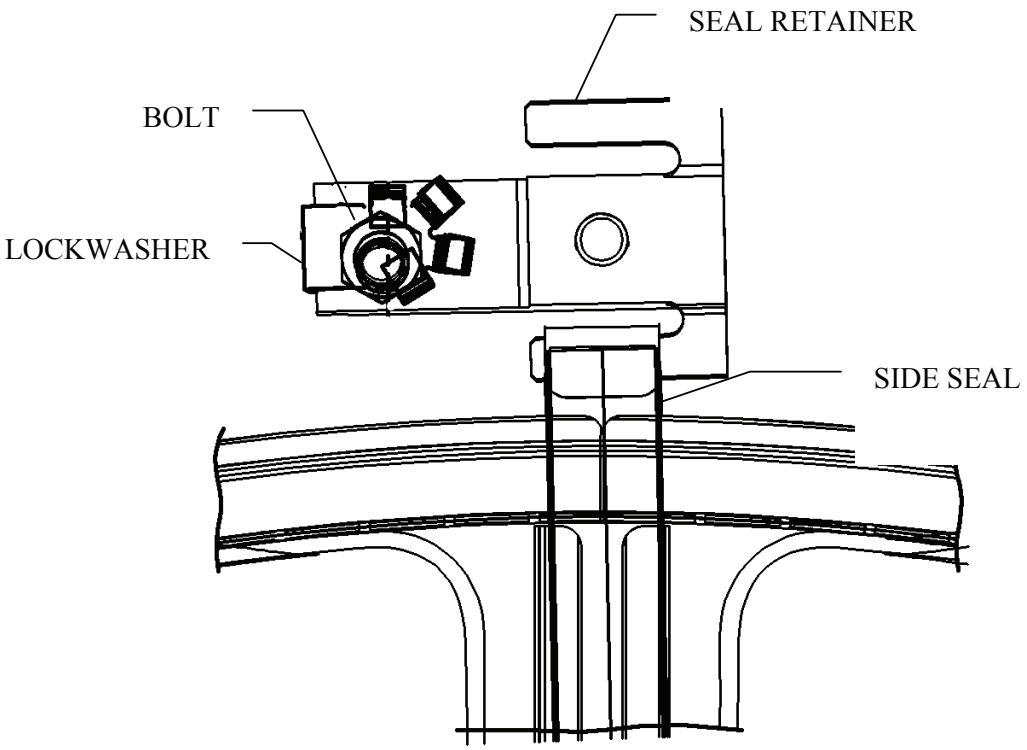



**Figure 41. Transition Piece Side Seal Details**

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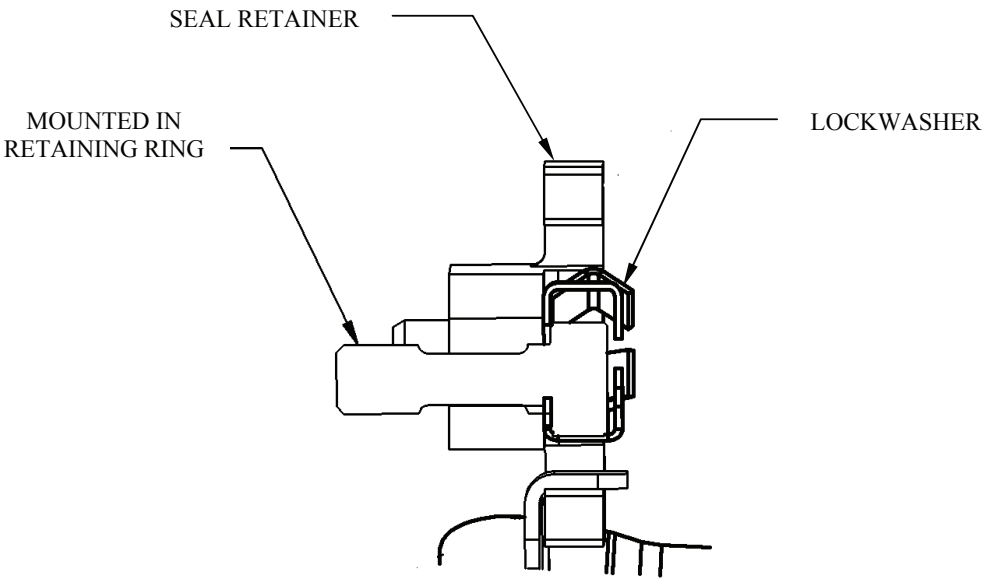



**Figure 42. Transition Piece Side Seal Retainer Block Detail**

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**Operation 22 — How to Install Aft Combustion Casing and Outer Crossfire Tubes**
(See Figure 43)

**NOTE**

Begin by installing the outer casing on Chamber No. 9 and work up to the top of the turbine.

1. Apply a light coating of approved anti-seize compound to all mating parts and bolts.

2. Install a new spiral wound gasket into groove in the downstream flange of the outer combustion chamber.

3. Rig a support sling and lift the aft combustion casing into place.

**CAUTION**

| |
|---|
| The weight of the aft casing is approximately 400 pounds (181.4 kg). |

4. Install two locating pins in the compressor discharge casing in the two bolt holes at the line connecting the centerlines of adjacent combustors (see MLI 0701).

5. Raise aft casing and engage the locating pins. Install all other bolts and torque to about 50% of final value and then remove alignment pins and replace with bolts.

6. Tighten the combustion casing flange to compressor discharge casing flange bolts. Tighten bolts 180~ apart and work around the flange bolting circle in this sequence until all bolts are tight.

7. Continue to install aft casings until all are in place and properly torqued.

8. Inspect sealing surface of outer crossfire tube to be sure it is free of nicks or burrs.

9. Install new packing rings in each end.

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10. Slide outer crossfire tube from inside one aft casing through the crossfire flange and into the adjacent casing. Thread on the packing rings and the sealing ring flanges to the outer tube in the appropriate order.

11. Install the split ring retaining washers and bolts to compress the packing hand tight.

12. Center the outer tube between the two outer casings and use the bolts to compress the packing to the dimension given in MLI 0701.

13. Repeat the process until all outer crossfire tubes are in place and the packings are compressed.

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14.

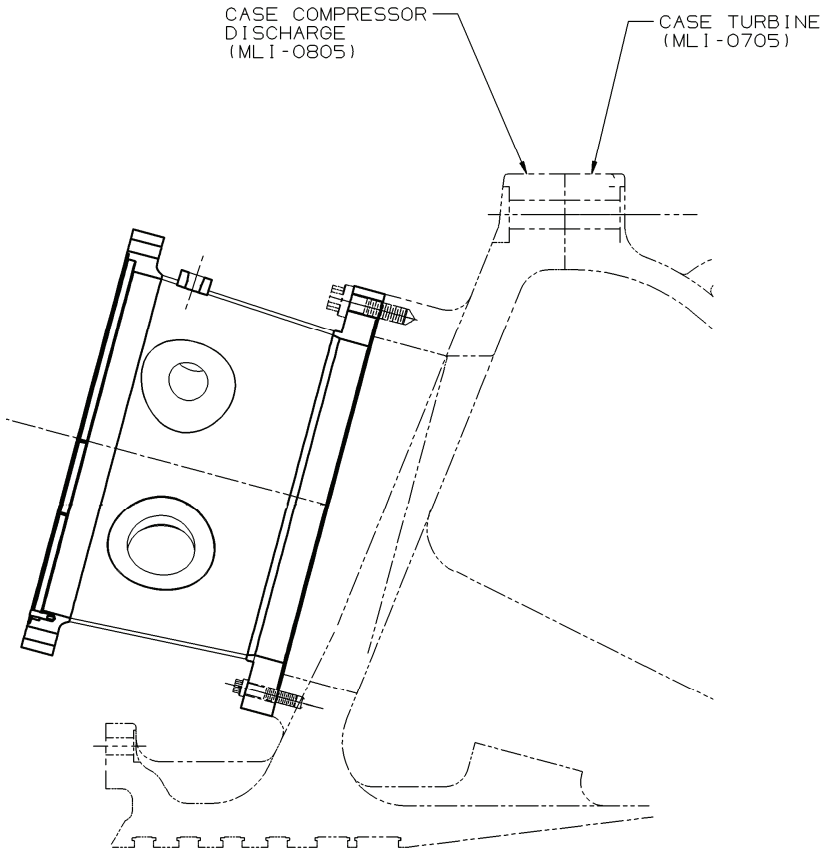



**Figure 43. Combustion Aft Casing**

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**Operation 23 - How to Install Flow Sleeves, Crossfire Tubes, and Combustion Liner Assemblies**

1. Use a wood or aluminum rod to expand the piston ring at the downstream end of the flow sleeve to allow the ring to slide over the end of the transition piece.

**NOTE**

Secure the rod with a line to allow easy retrieval and to prevent the rod from falling into the turbine.

2. Slide the flow sleeve into the outer casing until the piston ring slides over the transition piece impingement sleeve. When the piston ring is in place, the rod holding the ring open will be dislodged, allowing the ring to spring back into contact with the impingement sleeve.

3. Push the flow sleeve downstream until the flange at the upstream end is seated in the recess in the aft casing flange.

4. Install the four socket head cap screws through the flange in the flow sleeve and tighten them to secure the flow sleeve in its proper position.

5. After each flow sleeve is installed, insert the two inner crossfire tube parts before installing the next flow sleeve. Install the two crossfire tube halves so that the male end is at the clockwise end of the crossfire tube assembly.

6. Use the crossfire tube retainers to lock the inner crossfire tube parts away from the combustor centerline to allow assembly of the liner assemblies.

7. Slide the liner assembly into the flow sleeve until the downstream end begins to enter the transition piece. Before proceeding, be sure that the liner stops are aligned with the correct brackets in the flow sleeve. Then push the liner aft until the liner stops are against the brackets and the spring seal is in the transition piece.

8. Install the two liner anti-withdrawal stops into the flow sleeve flange.

9. Insert the crossfire tube into the collar in the combustion liner and lock it in position with the crossfire tube retainer.

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10.Continue to install liner assemblies and crossfire tubes until all are installed.

**Operation 24 - How to Install Spark Plugs**

1. Install new gaskets and spark plug assembly in combustion chambers 4 and 5. Be sure that spark plug tip enters the hole in the flow sleeve and the hole in the cap and liner assembly.

2. Coat bolts with anti-seize compound and bolt the spark plug assembly to flange.

3. Check to see that spark plug electrode moves freely.

**Operation 25 - How to Assemble the Forward Combustion Casing to the Aft Combustion Casing**

1. Check to be sure that the three alignment pins in the aft flange of the fuel nozzle casing are in place and tight.

2. Install eye bolts in the flanges of the fuel nozzle cover and casing and rig so that the assembly will be in proper alignment for its combustion casing.

3. Place a new gasket in the recess of the combustion casing.

4. Lift the casing assembly and move it to the combustion casing. Move it axially until the alignment pins engage the flange of the casing.

5. Move the case axially until the spring seal on the cap enters the combustion liner. Three or more flange bolts may be used to draw the flanges together.

6. Install the rest of the flange bolts, tighten and torque them.

7. Continue to assemble until all 6 assemblies are complete.

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**Operation 26 - How to Install Fuel Nozzle Flex Hose Lines**

1. For gas only turbines , the fuel nozzle flex hose connects from the flanged connection on the block located on the radial inside of the aft combustion casing to the atomizing air flange on the cover. This line may be connected using new gaskets at this time.

**Operation 27 - How to Install Diffusion, PM1, PM2 and PM3 Gas Fuel Lines**

1. Using new gaskets, connect the flexible gas fuel lines between the fuel nozzle flange and the manifold flange.

2. The order of installation of these flexible gas lines is generally from the bottom of the turbine to the top, and from the radial inside to the radial outside.

3. Tighten bolts in a criss-cross pattern to give uniform gasket compression.

**Operation 28 — How to Install Flame Detectors**

1. Install new gasket.

2. Coat bolts with approved anti-seize compound, being careful not to get any of the compound into the hot gas path.

3. Install flame detectors on chambers 1, 2 and 6 (there are 2 flame detectors located in can # 6).

4. Reconnect wiring to flame detectors.

5. Reenergize power supply to flame detectors by reinstalling the flame detector cards.

**Operation 29 - How to Install False Start Drain Piping**

1. Install new gaskets at all flanges.

2. Match marks and numbers on pipe spool pieces and flex hose flanges to the appropriate combustion cans (2 - 4).

3. Tighten bolts in a cross-cross pattern to give uniform gasket compression.

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## 4. Startup Checks for MS-6001FA+e Combustion Inspection

**<u>Operation 30</u> – Clean up, Visual Inspection, Pre-start/Startup Checks**

1. Clean up all lube oil and water spills.

2. Make a visual inspection of the unit and check to ensure that the following has been completed.

a. Check that all removed piping has been replaced.

b. Check that all removed conduit has been replaced and electrical connections made. Confirm function of all devices.

c. Inspect inlet and exhaust plenums.

3. Reconnect power to all systems disabled at start of job.

4. Perform pre-cranking checks as follows:

a. Record all panel counter readings.

b. Check operation of cool down/emergency lube pumps.

c. Check operation of auxiliary hydraulic pump.

d. Make visual inspection to see if oil is flowing in bearing drains.

e. Block out excitation and generator breaker equipment.

f. Place unit on turning gear and observe for leaks, rubs, and control deficiencies.

5. Perform cranking checks as follows:

a. Observe pickup RPM of speed sensors versus time.

b. Inspect for casing air leaks.

c. Observe and record vibration channel outputs.

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d. Observe and record crank speed.

e. Check starting means for proper operation.

f. Listen for rubbing noises.

g. Check temperature of lube oil in bearing drains or at the bearing header and tank.

h. Observe all panel and hydraulic manifold pressure gauge readings for abnormalities.

i. Trip the unit using the emergency trip and listen for abnormal noises from gas turbine and associated equipment during coast down.

j. Observe proper dropout RPM of speed sensors.

6. Initiate a start and perform the zero to full speed, no load firing checks as follows:

a. Observe applicable firing check parameters, relay sequences, exhaust temperature, vibration and speed.

b. Check spark plugs and flame detectors.

c. Observe and record acceleration rates.

d. Record full set of vibration readings.

e. Observe and record temperature suppression set point.

f. Note and record pick-up time of all appropriate electrical speed relays.

g. Check full-speed-no-load RPM.

h. Check digital set point.

i. Take a complete set of running data. See Running Inspection section of this instruction.

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j. Check for air, oil, gas and water leaks.

7. Perform load checks (if applicable) as follows:

a. Take a full set of load data, including the staging times from diffusion to piloted premix and from to piloted premix to premix. This can be done automatically by the control system.

b. Check for air, oil, gas and water leaks.

8. Observe normal unloading and shutdown as follows:

a. The times and loads for transition from premix through piloted premix and from piloted premix through diffusion should be recorded during the unloading period.

b. Note and record coast down time.

c. Listen for abnormal noises from gas turbine and associated equipment during coast down.

d. Observe unit vibration readings during coast down.

Complete preparation of all inspection, startup and operation data report

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