Borescope Inspections

General

The gas turbine incorporates provisions in both turbine and compressor casings for visual inspection of an intermediate compressor rotor stage or stages, first and second stage turbine buckets and nozzle partitions by means of the optical borescope.

These provisions, consisting of radially aligned holes through the casings and internal stationary turbine shrouds, are designed to allow the penetration of an optical borescope into the gas or air-flow path regions of a non-operating gas turbine. Optical borescopes are utilized to provide visual inspection of the rotating and stationary parts without removing the upper compressor and turbine casings.

Areas of Inspection

In the hands of a qualified technician, the borescope allows rapid inspection of the following areas with minimum outage time, manpower and loss of production.

1. Turbine section
2. Axial flow compressor
3. Combustion system

Note: The primary zones and fuel nozzles for chambers 2, 3, 11, 12, 13 and 14 can be inspected by removing spark plugs and flame detectors.

Table 4-1 lists the inspection criteria for these areas of inspection. Table 4-2 lists the access hole location and number of holes in each location.

Figure 4-1 locates the borescope access holes for the various locations.

Equipment Required

A rigid borescope with high-quality rigid lens system plus a flexible fiber bundle to introduce light at the borescope tip from an external light projector is the basic equipment needed for visual inspection of the turbine and compressor. The combustion system, including the transition pieces, can only be inspected using a flexible fiber-optic borescope.

A qualified technician using this equipment can make visual observation and record the observed details.

Additional auxiliary equipment desirable to supplement the basic equipment may include a borescope support mount or fixture, camera attachments, camera and a television camera with recording capability and playback monitor.

Borescope Inspection Programming

A planned borescope inspection program results in opening a turbine unit only when necessary to repair or replace parts. It should be recognized that inspection intervals are based on average unit operating modes. Adjustment of these intervals may be made based on experience and the individual unit

mode of operation and the fuels used. Refer to Table 1-1, Special Inspections, in the Introduction, Section 1, in this inspection and maintenance manual.

The borescope inspection program should include

1. Baseline inspection and recording of conditions, both written and photographic, at the time of startup
2. Periodic inspection and recording of the results

The application of a monitoring program, utilizing the borescope, will allow scheduling outages and pre-planning of parts requirements resulting in lower maintenance costs, higher availability and reliability of the gas turbine.

Service Support for Borescope Inspections

Your GE Company Field Service Representative can quote and supply technicians and equipment to assist in setting up a program for monitoring machine condition.

Such service support also includes engineering evaluation of data and correlation of data with other units in similar application.

Inspection Procedure

1. Preparation of Gas Turbine for Borescope Inspection

   a. The gas turbine must be shutdown and the turbine wheelspace temperatures no greater than 180°F (82°C) before the borescope is inserted.

Note: Exposure of the borescope to higher temperatures may permanently damage the internal glass fiber bundle.

   b. For the location of borescope inspection access locations, see Figure 4–1. If a normal borescope inspection is to be done, remove the closing plugs only from those access holes (marked BS on turbine cases, which are defined as primary inspection access – normal inspection. See Figure 4–1.

Note: All casing holes on the MS-7001FA have an inner plug beneath the threaded plug in the casings. Both plugs must be removed to gain access. Ensure that inner plugs are correctly replaced after completing inspection.

   c. When inspecting compressor blades and turbine buckets, it is necessary to rotate the rotor incrementally to bring each bucket into the field of view of the borescope. Withdraw the borescope slightly while turning the rotor to prevent damage to the equipment.

CAUTION

A lube oil supply to the rotor bearings must be maintained during the borescope inspection.

d. A "zero" datum should be established for the rotor by marking the load coupling. This will provide the necessary reference to determine one revolution or intermediate angular positions.

e. With the access holes open the borescope can now be inserted, the light switched ON and the light intensity adjusted. It is recommended that the inspection commence with the compressor and proceed through each turbine stage.

f. The procedure should consist of visually inspecting all visible stationary parts (compressor stators and turbine nozzles) and each bucket/blade at each visible stage from root to tip, including platforms and tip seals. For inspection criteria see Table 4-1.

Note: **For purposes of physical orientation the objective lens at the borescope tip is displaced 180 degrees from the light connector beneath the eyepiece.**

g. Upon completion of the inspection ensure that all sealing plugs at borescope access holes are replaced and tightened.

h. If the turbine internal parts are abnormally dirty (ingested dirt or oil vapors), the turbine should be cleaned before proceeding with the borescope inspection. For compressor cleaning, see the Water Wash and Cleaning section of this Service Manual.

Note: **Your GE Company Field Service Representative can supply borescope technicians if assistance is needed in operation of the borescope equipment.**

TABLE 4-1

MS-7001FA

BORESCOPE INSPECTION CRITERIA

ACCESS AREA	INSPECT FOR
Compressor blades	Foreign object damage Dirt buildup Corrosion Tip erosion Trailing edge thinning Stator blade root erosion Tip clearance
Combustion (Liner and transition piece)	Carbon buildup Hot spots Cracking Bulging Wear Missing metal or thermal barrier coating
Turbine nozzles	Foreign object damage Corrosion Blocked cooling holes Cracks Trailing edge bowing Erosion Burning
Turbine buckets	Foreign object damage Corrosion Blisters Erosion Cracks Tip clearance Missing metal

TABLE 4-2

MS-7001FA

BORESCOPE ACCESS HOLE LOCATIONS

Identification	Location	No. of Holes
"0" stage compressor	0.25" (0.635 cm) aft from forward flange face of the mid compressor, case	2
First-stage compressor	12.56" (31.9 cm) aft from forward flange face of the mid compressor, case	2
Second-stage compressor	24.06" (61.1 cm) aft from forward flange face of mid compressor, case	2
Third-stage compressor	32.06" (81.4 cm) aft from forward flange face of mid compressor, case	2
Fourth-stage compressor	41.23" (104.7 cm) aft from forward flange face of the mid compressor, case	2
Fifth-stage compressor	48.46" (123 cm) aft from forward flange face of mid compressor, case	2
Sixth-stage compressor	54.80" (139.2 cm) aft from forward flange face of mid compressor, case	2
Fifteenth-stage compressor	8.152" (20.7 cm) aft from forward flange face of the compressor discharge casing	2
Sixteenth-stage compressor	12.171" (30.9 cm) aft from forward flange face of the compressor discharge casing	2
Seventeenth–stage compressor	16.301" (41.4 cm) aft from forward flange face of the compressor discharge casing	2
First-stage nozzle trailing edge and first-stage bucket leading edge	41.480" (105.4 cm) aft from forward flange face of the turbine casing	2
First-stage bucket trailing edge and second-stage nozzle leading edge	47.760" (121.3 cm) aft from forward flange face of the turbine casing	1
Second-stage bucket leading edge and second-stage nozzle trailing edge	59.400" (150.9 cm) aft from forward flange face of the turbine casing	2
Second-stage bucket trailing and third-stage nozzle leading edge	62.880" (159.7 cm) aft from forward flange face of the turbine casing	1
Third-stage bucket leading and third-stage nozzle trailing edge	76.250" (193.7 cm) aft from forward flange face of the turbine casing	3

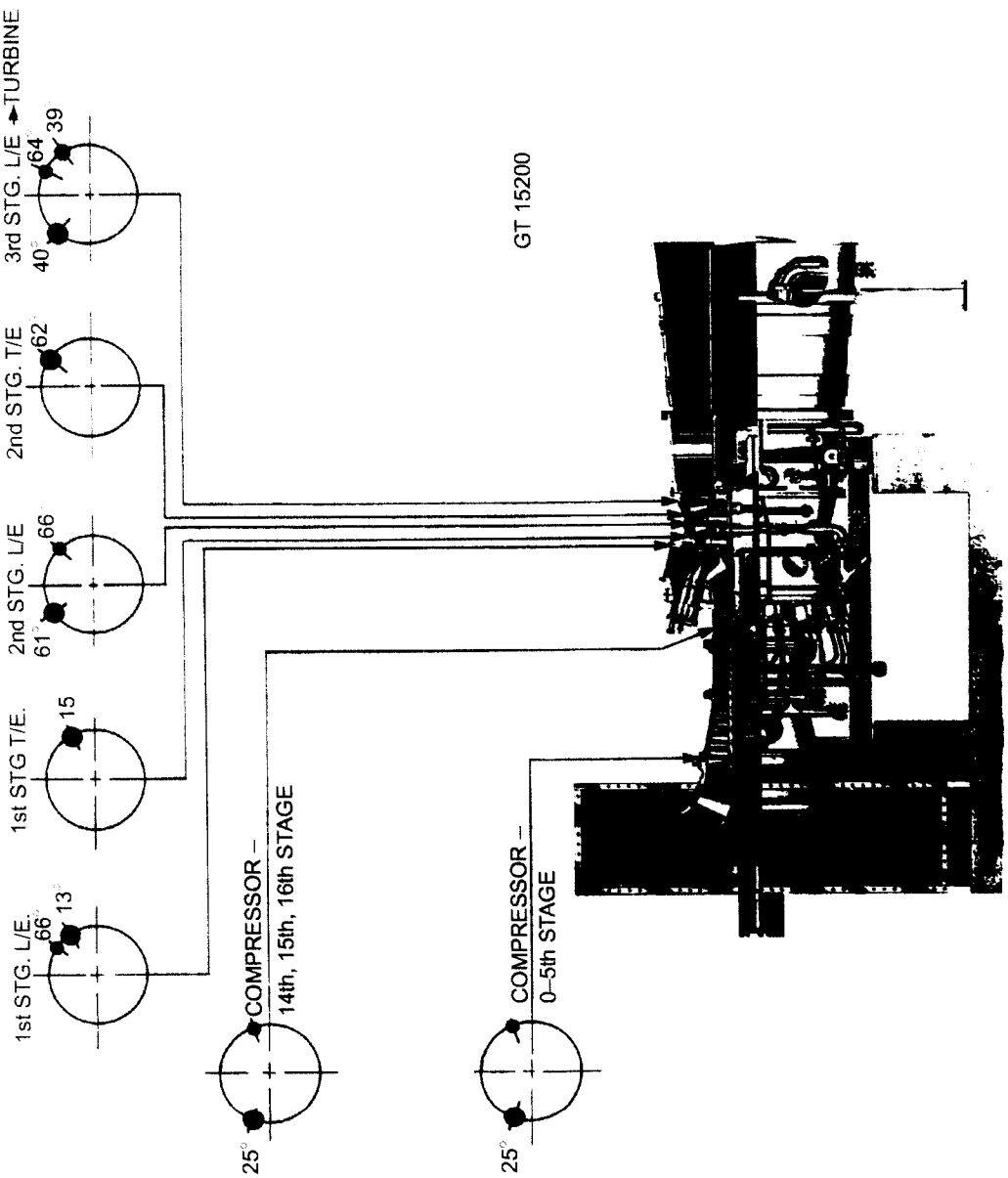

Figure 4–1. Borescope Hole Access Locations.