

Turbine Section Repair Kit

Overview

The **GTR-TURB-MAJOR-003 Turbine Section Repair Kit** is a complete maintenance package designed for major hot-section overhauls. With a total weight of **720 pounds** and a standard lead time of **14–16 weeks**, this kit provides all critical components required to restore turbine efficiency, durability, and performance in high-temperature, high-stress operating conditions.

Critical Components

Primary Turbine Elements

At the core of the turbine section are **First-Stage Blades (TB-BLD-001)** — 92 precision-cast units manufactured from **René 80 nickel-based superalloy**. Each blade undergoes investment casting with directional solidification, followed by solution heat treatment at **2,050°F for 4 hours** and aging at **1,600°F for 32 hours**. A **plasma-sprayed thermal barrier coating (TBC)** provides oxidation and hot corrosion resistance.

Supporting airflow are **First-Stage Nozzles (TB-NZL-001)**, with 46 segments cast from **CMSX-4 single-crystal superalloy**. These nozzles are produced by vacuum investment casting, heat-treated at **2,300°F for 3 hours**, and coated with an **electron-beam physical vapor deposition (EB-PVD) ceramic layer** to ensure high creep strength and thermal stability.

Rotor Support System

The rotor assembly includes **Second-Stage Turbine Disks (TB-DSK-001)**, forged from **Inconel 718**. The disks undergo hot-die forging, followed by solution treatment at **1,750°F for 8 hours** and double-aging at **1,325°F for 8 hours** and **1,150°F for 10 hours**. Final machining ensures dimensional accuracy for blade and shaft integration.

The kit also provides **96 Fir-Tree Blade Retainers (TB-RTN-001)** manufactured from **Inconel X-750** through precision machining and shot peening, ensuring fatigue resistance under cyclic loading conditions.

Cooling and Thermal Management

Cooling Hardware

The high-performance turbine relies on advanced cooling passages. The kit contains **92 Cooling Inserts (TB-CLN-001)** fabricated from **Hastelloy X sheet stock**, shaped via hydroforming, and brazed with nickel-based filler metal for durability under thermal cycling.

Sealing Systems

Gas path sealing is achieved with **48 Turbine Seal Segments (TB-SEA-001)** made from **Inconel 625** with honeycomb structures brazed onto backing strips. These seals undergo vacuum brazing at **1,975°F** with post-braze heat treatment to ensure bond strength and wear resistance.

Important Support Components

Thermal Protection Systems

Hot-section thermal shielding is provided by **18 Turbine Shrouds (TB-SHR-001)**, manufactured from **Haynes 230** superalloy with TBC coatings. These shrouds are hot-rolled, solution-treated, and coated with **yttria-stabilized zirconia** for maximum high-temperature capability.

The kit also includes **24 Insulation Seals (TB-INS-001)** fabricated from **alumina-silicate fiber mats**, needle-punched for mechanical integrity, with refractory coatings applied to withstand continuous exposure up to **2,400°F**.

Monitoring and Instrumentation

Critical temperature measurement is supported by **6 Thermocouple Probes (TB-TCP-001)**, constructed from Type K thermocouple wire sheathed in Inconel 600. Each probe undergoes calibration and passivation, ensuring accurate high-temperature monitoring inside the turbine casing.

Standard Assembly Materials

Joining and Sealing Materials

To support assembly, the kit provides **3 pounds of Braze Alloy (TB-BZE-001)**, consisting of **BNi-5 composition (Ni-19Cr-10Si-3B)** in atomized powder form, ensuring reliable brazed joints in extreme turbine environments.

Sealing operations are completed with **10 cartridges of High-Temperature Sealant (TB-HTS-001)**, an alumina-silicate-based compound supplied as a paste. The sealant is cured at **1,500°F**, providing reliable joint integrity under thermal cycling.

Manufacturing and Quality Standards

All turbine section components are manufactured under **aerospace-grade and industrial gas turbine standards**, with stringent inspection and testing. Precision casting, forging, and heat-treatment processes ensure creep resistance, fatigue durability, and oxidation protection. The **14–16 week lead time** reflects the complexity of superalloy processing and quality control required for turbine hot-section hardware.