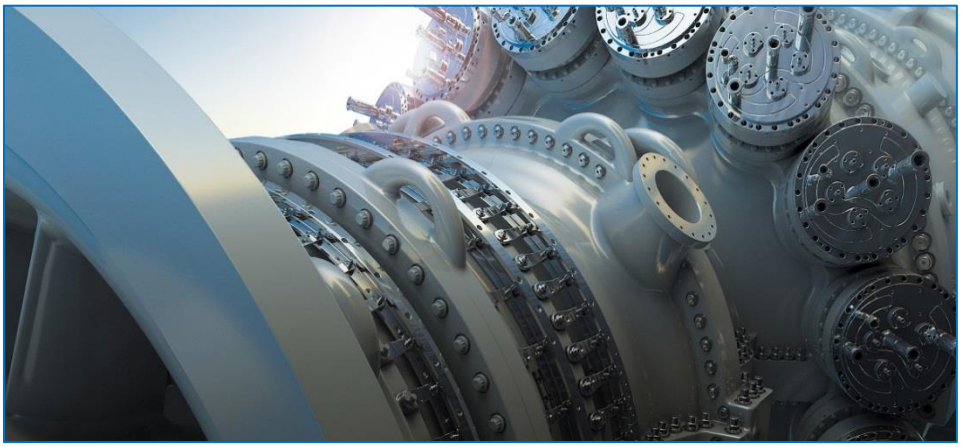
Tel No:+97126654546 | Fax No:+97126654182 | Email: training@cmc-me.com | www.cmc-me.com



MU165:
Repair and Manufacturing of Gas Turbine Components

Training Description:

The gas turbine is one of the most technologically advanced energy conversion devices. The first working models were introduced in 1939 in both aviation and in electric power production and had turbine inlet temperatures on the order of 1100 F and employed uncooled, heat resisting steel turbine blades. Today turbine inlet temperatures are in the range of 2700 F (1500 C) for the G & H class utility combustion turbines and in excess of 3000 F (1650 C) for commercial flight engines. These remarkable increases in the gas turbine firing temperature have been made possible in part by substantial advances in hot section airfoil materials, coatings and manufacturing technology during the past seventy years.

This course will discuss the development history, manufacturing processes, application and refurbishment of the high temperature materials and coatings used in gas turbine engines with particular emphasis on hot section superalloy component manufacture and refurbishment. The metallurgy of nickel and cobalt based superalloys will be discussed and the many steps involved in investment casting manufacture, from wax pattern & ceramic core production, shell build, equiaxed, DS or single crystal vacuum casting and post cast operations will be reviewed. This will include review of advances in cooling configurations, casting imperfections, inspection methods and general acceptance criteria. Specific challenges related to making large F, G & H-class components and sophisticated air cooled, single crystal aero-engine airfoils will be noted. The widespread use of thermal barrier coatings has brought great focus to the issue of coating selection. The various types of gas turbine hot section coatings, their selection criteria and manufacturing method used will be discussed.

The benefits of repair and refurbishment of engine run parts are well established. The increased complexity and high replacement cost of hot section components has placed greater importance on the development of innovative component repair schemes. Participants will learn methods of assessing component damage experienced from service exposure, typical degradation modes observed, and the techniques used to analyze the remaining life of components removed from service. The various component repair technologies utilized to restore components will be discussed in detail (ie dimensional checks, coating removal techniques, HIP and rejuvenation heat treatments, weld repair, diffusion brazing processes and component re-coating) as will quality assurance methods and procedures to verify the refurbished components meet industry standards. The course includes many case study examples of component refurbishment, and the last section is devoted to a workshop where attendees develop component repair solutions. Participants are encouraged to submit questions in advance regarding repair issues faced in their jobs.

Training Objectives:

By the end of the training, participants will be able to explain:

- ✓ What makes superalloys especially suited for gas turbine components
- ✓ Understanding of the distinction between conventional casting and directional solidification
- ✓ How different damage mechanisms (oxidation, corrosion, erosion) affect the component
- ✓ Advantages & disadvantages of the many types of protective coatings
- ✓ How high cycle fatigue & low cycle fatigue damage is caused, prevented, and repaired
- ✓ Various heat treatments used in repairs, and why they are important
- ✓ Critical quality control steps in component manufacture and repair
- ✓ How to reliably extend the service life of valuable components

Tel No:+97126654546 | Fax No:+97126654182 | Email: training@cmc-me.com | www.cmc-me.com

Training Designed for:

This course is intended for Technical Staff, Engineers and Technicians responsible for various aspects of gas turbine components design, upgrade, manufacture, repair, analysis, operations, or maintenance will attend. A must for GT repair shop personnel, insurance companies, coatings suppliers, GT OEM Designers and Technical Staff.

Training Requirement:

"Hand's on practical sessions, equipment and software will be applied during the course if required and as per the client's request."

Contents can be adapted to your specific wishes. It is therefore possible to focus on specific modules of the training course as per client's learning needs and objectives. Further, it should be forwarded to us a month prior to the course dates.

Training Program:

DAY ONE:

- PRE-TEST
- GAS TURBINE OVERVIEW
  - Gas Turbine Engine Designs
  - Typical Gas Turbine Components, Materials and Coatings
  - Gas Turbine Airfoil Materials, Coatings and Airfoil Design Trends
- MATERIALS AND METALLURGY
  - Superalloy Metallurgy
  - Evolution of Superalloy Materials Technology
  - Production of Superalloys
  - Investment Casting of Equiax, DS and Single Crystal Airfoils
  - NDT Inspection Criteria and Acceptance Standards

DAY TWO:

- GAS TURBINE COATINGS
  - Superalloy Surface Stability
  - Comparison of Oxidation/Corrosion protection
  - Manufacturing Methods and Requirements
  - Diffusion vs. Overlay Coatings
  - Thermal Barrier Coatings
- DEGRADATION OF GAS TURBINE COMPONENTS
  - Metallurgical Effects of Service
  - Creep
  - High Cycle Fatigue
  - Low Cycle Fatigue
  - Environmental Degradation

DAY THREE:

- WHY REPAIR AND REFURBISH PARTS?
  - Cost Benefit of Repairs

- Repair Market Trends
- The Future for Industrial Frame GT Repairs

❖ COMPONENT EVALUATION: THE EVALUATION OF USED COMPONENTS AND DETERMINATION OF THE REPAIR/REFURBISHMENT PROCESS WILL BE DISCUSSED

- Timing and selection of components for analysis
- Micro structural analysis
- Mechanical testing –Stress Rupture bars
- Coating Evaluation
- Hot Corrosion Attack
- Failure Analysis
- Component Management Program
- Determine Damage Mechanisms, the Extent of Damage, Root Cause of Damage, and Corrective/Preventive Action

DAY FOUR:

❖ REFURBISHMENT & REPAIR PROCESSES: PROCEDURES AND TECHNIQUES USED TO RESTORE COMPONENTS TO INDUSTRY STANDARDS

- Typical Damage
- Coating Stripping
- Dimensional Checks
- Re-Coating Selection and Processes
- HIP and Rejuvenation Heat Treatments
- Superalloy Weld Processes
- Diffusion Brazing

DAY FIVE:

❖ QUALITY ASSURANCE: METHODS AND PROCEDURES TO VERIFY COMPONENTS MEET INDUSTRY STANDARDS

- QA Certification
- Quality Plan
- QA Inspections
- NDE Defect Criteria
- Dimensional Specification
- NDE Inspections

❖ CASE STUDIES & PROBLEM SOLVING

- Case studies presented by the instructors to illustrate the process of component repair & refurbishment. The class will then be divided into teams and given components for which they will determine the best process
- Round table discussion regarding the latest repair trends

❖ Course Conclusion

❖ POST-ASSESSMENT and EVALUATION

Training Certificate(s):

CMCT Internationally recognized certificate(s) will be issued to each participant who completed the course.

Training Methodology:

This interactive training course includes the following training methodologies as a percentage of the total tuition hours:

- 30% Lectures, Concepts, Role Play
- 70% Workshops & Work Presentations, Techniques, Based on Case Studies & Practical Exercises, Gamification, Software & General Discussions
- Pre and Post Test

Training Fees:

TBA as per the course location - This rate includes participant's manual, hand-outs, buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

Note: The 5% VAT (Value Added Tax), will be effective starting 01st of January 2018 as per the new regulation from the UAE Government. The VAT applies for all quotation both for local and abroad.

Training Timings:

Daily Timings:

07:45 - 08:00	Morning Coffee / Tea
08:00 - 10:00	First Session
10:00 - 10:20	Recess (Coffee/Tea/Snacks)
10:20 - 12:20	Second Session
12:20 - 13:00	Recess (Prayer Break & Lunch)
13:00 - 14:00	Last Session

For training registrations or in-house enquiries, please contact:
Aisha Relativo - Training & Career Development Manager
aisha@cmc-me.com / training@cmc-me.com
Tel.: +971 2 665 3945 or +971 2 643 6653 | Mob.: +971 52 2954615