

API 936: REFRACTORY INSPECTION CODE: INSTALLATION, INSPECTION, TESTING & REPAIR (API EXAM PREPARATION TRAINING)

Introduction:

This course discusses the design, installation, inspection, and repair of refractory systems for processing & power generation applications in pressure vessels, piping systems, and fired equipment. The discussions include practical examples of refractory systems in demanding applications (such as FCCU's, Fluid Cokers, process vessels, fired heaters and steam generation equipment) and are illustrated by photos and a video. The course will present these topics in the context of API Recommended Practice 936 Guidelines for Refractory Installation Quality Control. Attendees will be well prepared to challenge the API 936 Inspector certification exam upon completion of this course.

Objectives:

- To familiarize participants with technical terms and definitions.
- Understand Physical Property Requirements
- Know about the laboratory testing procedures,
- Know about the Material Qualification
- Understand surface preparation requirements,
- Installation methods (e.g., gunning, casting, ramming, and hand packing)
- Know Environmental conditions required for curing.
- Do's and Don'ts for Curing and dry out procedures
- Know Sampling and sample preparation procedures
- Understand Post Installation inspections
- Identify the acceptance and rejection criteria
- How to Score very well in API 936 examination



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Training Methodology:

This is an interactive course. There will be open question and answer sessions, regular group exercises and activities, videos, case studies and presentations on best practice. Participants will have the opportunity to share with the facilitator and other participants on what works well and not so well for them, as well as work on issues from their own organizations.

Who Should Attend?

This course is intended for individuals who are responsible for the design, installation, inspection, or repair of refractory systems in refinery, power generation and petrochemical applications

Course Outline:

API 936 Overview

- What Are Refractory?
- Definition
- Functions
- Insulation
- Corrosion Resistance
- Erosion Resistance

Types of Refractories

- Ramming Mixes
- Plastics
- Gunning Mixes



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- Castables
- Trowelling Mixes and Mortars
- Brick
- Ceramic Fiber
- Block Insulation

Raw Materials

- Aggregate
- Bonding Mechanism
- Phosphate (Acid) Bond
- Cement (Hydraulic) Bond
- Clay
- Sodium Silicate
- Curing & Drying

Physical Properties of Refractory Materials and Test Procedures

- Bulk Density
- Compressive Strength
- Tensile Strength (Modulus of Rupture)
- Erosion Resistance
- Heat Resistance
- Thermal Conductivity (How to Use K-Stick)
- Thermal Expansion

Refractory Failure Mechanisms

- Erosion
- Corrosion
- Thermal Shock
- Mechanical Abuse



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- Overheating
- Atmospheric Reaction/Chemical Attack

Factors Affecting Refractory Performance

- Product Quality
- Anchoring Design
- Installed Quality
- Installation Procedures
- Unit Operation
- Material Specification
- Experience of Applicator/Crew

Benefits of Using Metal Fiber Reinforcement

- Randomized Cracking
- Holding Lining in Place, if Cracking Occurs

Refractory Linings for Miscellaneous Equipment

- Sulfur Recovery Unit
- Tail Gas Cleanup Unit
- Feed Fired Heater
- Flue Gas Cooler & Stack
- Fluid Coker
- Hydrogen Furnace
- FCCU
- Concrete/Gunite Lined Drums

Introduction to the API RP 936

- Documentation (2.1)
- Material Qualification (2.2)
- Applicator Qualification (2.3)



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- Installation Monitoring (2.4)
- As-installed Testing (3.1)
- Pre-dryout Inspection
- Dryout Monitoring (4.2)

Pre-Turnaround Planning (At least 6 Months Prior to Turnaround)

- Review of Past Inspection Reports, Repairs, Quality Control Records and Recommended Future Repair Priority Areas.
- Review of Unit Operation since the Last Major Turnaround.
- Review of Refractory Material Types Needed for Unit Repairs.
- Review of a Thermographic Survey from the Beginning of Operation as compared with One of Current Operation.
- Formulation of Plan.
- The Benefits of Component Replacements Compared to Insitu Repairs.
- Selection of Refractory Products for Shutdown Needs
- Selection of Refractory Contractor to Perform Work During Unit Shutdown
- Estimating Refractory Quantities Needed for Planned Maintenance Work

Advance Preparation of Refractory Lining Repair Procedures

- Scheduling Access
- Scaffolding Needs
- Refractory Removal Procedure
- Formwork Manufacture Plans
- Determining How Repair Lining Installations will be Done in Various Portions of the Unit
- Qualifying Installation Personnel
- Procedure for Expediting as Installed Quality Control Test Sample Preparation
- Developing a Good Work Flow Plan
- Turnaround Inspection/Repair Decisions



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- Lining Repair
- Lining Curing/Startup Procedures
- Post Turnaround Reporting