CONCEPT

Fired Heaters and Furnaces: Combustion Control, Burner Safety and Tube Integrity

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Introduction:

Fired heaters and industrial furnaces consume a large share of a plant's fuel, and a single burner flameout, flame impingement or overheated tube can end in a firebox explosion, a tube rupture or an unplanned shutdown. Many units still run with high excess air, unstable draft and tube metal temperatures nobody trends. This Core Concept course trains operators and engineers to run heaters within a safe operating window, tune combustion and draft, follow purge and light-off sequences, spot coking and tube damage early and raise thermal efficiency. Participants produce a Fired Heater Operating Window and Health Check Pack.

Course Objectives:

- Identify the radiant, convection, burner, stack and damper components of a fired heater and explain how each affects heat transfer and safe operation
- Adjust excess air, fuel pressure and draft to hold stable flame patterns and correct oxygen and arch draft readings
- Apply purge, light-off, normal shutdown and trip sequences for burner management systems as API 556 and NFPA 86 describe them
- Monitor tube metal temperatures and process indicators to detect coking, flame impingement, creep and other tube damage mechanisms
- Calculate heater thermal efficiency from flue gas data and rank losses, NOx reduction measures and fuel saving actions
- Plan turnaround inspection of tubes, supports, refractory and burners and record findings against acceptance criteria

Target Audience:

- Panel and field operators who light, adjust and monitor burners and heater controls on shift
- Shift supervisors responsible for heater start-up, shutdown and response to trips and upsets
- Process engineers who set heater operating limits, firing rates and efficiency targets
- Inspection and integrity engineers who assess heater tubes, supports and refractory during turnarounds
- Maintenance technicians who service burners, dampers, sootblowers and flame detection equipment

Course Outline:

Day 1: Fired Heater Types, Components and Current Operating Picture

- Cabin, Box and Vertical Cylindrical Heater Configurations Compared
- Radiant Section, Shield Tubes and Finned Convection Coil Heat Duty Split
- Burner, Air Register, Stack Damper and Sootblower Functions
- Refractory Linings: Firebrick, Castable and Ceramic Fibre Selection
- Heater Operating Data Baseline Sheet for the Participant Unit

Day 2: Combustion Fundamentals, Draft and Heater Standards

- Combustion Stoichiometry, Excess Air and Flue Gas Oxygen and CO Readings
- Natural, Forced and Induced Draft Profiles From Floor to Stack
- API 560 Scope: Fired Heaters for General Refinery Service
- API 556 and NFPA 86 Scope: Burner Management and Protective Systems
- API 530 Scope: Heater Tube Thickness and Design Life Basis

Day 3: Burner Operation, Combustion Control and Safe Sequences

- Flame Pattern Assessment: Length, Colour, Lift-Off and Impingement Checks
- Gas and Liquid Fuel Burner Tuning With Atomising Steam and Pilot Stability
- Oxygen Trim and Arch Draft Control Using Damper and Fan Adjustment
- Firebox Purge, Pilot and Main Burner Light-Off Sequence Checklist
- Normal Shutdown, Burner Trip and Fuel Isolation Response Steps

Day 4: Tube Integrity, Emissions, Efficiency and Troubleshooting

- Tube Metal Temperature Monitoring With Skin Thermocouples and Infrared Thermography
- Coking, Creep, Carburisation and Oxidation Tube Failure Mechanisms
- Low NOx Burners, Flue Gas Recirculation and Staged Combustion Options
- Thermal Efficiency Calculation From Stack Temperature and Flue Gas Analysis
- Troubleshooting Matrix: Positive Pressure, Afterburning, Flame Instability and Uneven Pass Flow

Day 5: Heater Walkthrough Practice and Health Check Pack

- Refinery Crude Heater Case: Firebox Walkthrough and Flame Inspection Findings
- Petrochemical Cracking Furnace Case: Decoking Decision From Tube Temperature Trends
- Turnaround Inspection Plan for Tubes, Hangers, Refractory and Burner Tips
- Operating Window Limits Table and Efficiency Improvement Action List
- Fired Heater Operating Window and Health Check Pack Peer Review

Skills You Will Gain:

- Heater Component Recognition
- Combustion Tuning
- Draft Profile Control
- Burner Management Sequencing
- Tube Temperature Surveillance
- Tube Damage Diagnosis
- Flue Gas Efficiency Analysis
- Heater Turnaround Inspection

Why Attend This Course:

- Return with a Fired Heater Operating Window and Health Check Pack prepared for a heater from your own site
- Cut fuel use by recognising when excess air, stack temperature or fouled convection tubes are wasting heat
- Act with confidence during light-off, trips and upsets because each sequence step is understood and rehearsed
- Compare heater practice with operators and engineers from refining, petrochemicals, gas processing, steel and power

Conclusion:

Fired heaters stay safe and efficient only when combustion, draft, burner sequences and tube condition are watched together rather than one at a time. The course moves from heater configurations and components, through combustion, draft and the scope of the main heater standards, to burner tuning, safe light-off and shutdown, tube temperature surveillance, damage mechanisms, NOx control, efficiency and troubleshooting. The final day applies these methods in walkthrough cases and produces a Fired Heater Operating Window and Health Check Pack ready for use on site.