

# Furnace Maintenance / Troubleshooting

## Furnace Maintenance and Troubleshooting for all Industrial Plant Assets

2018

### Major Benefits of Attending

- **APPRECIATE** the fundamentals of Industrial Furnace design
- **BE MADE AWARE** of innovative technologies designed to reduce outages
- **UNDERSTAND** how to dramatically reduce the time required to prepare Furnaces for inspection and repair
- **CONSIDER** the application of Non-Destructive Examination to assess the condition of your Furnaces
- **ADDRESS** the decisions to be made when optimising your in-service storage life-cycle against the Repair Plan
- **EVALUATE** the scope of mechanical repairs
- **COMPARE** the value of upgrading your Furnaces
- **LEARN** the major elements of Furnaces for maintenance and troubleshooting to bring back efficiently into service.

### Why you Should Attend?

Industrial furnaces do a great deal of work each day, and if they are working properly, they are going to see some normal wear and tear. There is not much to be done about that. However, with regular maintenance and preventative care, any industrial furnace can be kept functioning properly and efficiently, which minimizes downtime for major repairs and improves productivity.

### Who Should Attend?

This training is highly recommended for Managers and Engineers involved in the following capacities:

- ✓ Furnace Degradation (Fouling) Control
- ✓ Health, Safety and Environment
- ✓ Inspection
- ✓ Loss Prevention
- ✓ Operations and Maintenance
- ✓ Technical and Mechanical
- ✓ Plant
- ✓ Production and Process
- ✓ Project Planning
- ✓ Furnace Design
- ✓ Furnace Repair

It is also crucial for personnel involved in the operation and maintenance of Furnaces within these industries:

- ✓ Chemical and Petrochemical
- ✓ Oil and Gas
- ✓ Refineries
- ✓ Steel Mills
- ✓ All Industrial Assets

Organized by: \_\_\_\_\_

## ▶ Workshop Overview

Anyone working on or associated with Industrial Plants - heat transfer systems, as the '**Aim**' of this course is to provide you with the knowledge and practical skills necessary to inspect, assess, trouble shoot and maintain the Plant Furnace Systems. The '**Objectives**' by the end of the course you will be able to:

- Understand the fundamentals of Furnaces
- Have an understanding of Furnace Construction and Operating Conditions.
- Demonstrate good Inspection and Maintenance practices.
- Demonstrate fault finding through practical experience.

## Outline

### DAY 1

#### SESSION 1 – FURNACE FUNDAMENTALS

- **Heat transfer** to the tube coil: control parameters. Impact of internal or external fouling.
- **Heat control:** process fluid outlet temperature, fuel flowrate control
- **Furnace temperature and constraints:** skin temperature, bridgewall temperature, limits and risk of overcoming.
- **Furnace temperature profile** and heat recovery distribution as a function of fuel burned and combustion air excess.
- **Furnace operations:** monitoring of combustion and heating. Modifying operating conditions. Analysis of disturbances. Key points for safe operation.

#### SESSION 2 – FUNDAMENTALS OF COMBUSTION AND HEAT TRANSFER

- **Combustion;** Theory
- **Thermodynamics**
- **Steam;** Tables

#### SESSION 3 – FURNACE CONSTRUCTION AND OPERATING CONDITIONS

- **Types;** Furnace & Operating conditions, Gas Train, Oil Train, Standard Burner, High Turndown Burner, Burner Controls.
- **Scope and Limitations;** improving furnace efficiency.
- **Construction of heat exchange areas and refractory materials:** tube bundle arrangement, insulation, type of material used and operating limits.

#### SESSION 4 – COMBUSTION BURNERS

- **Combustion conditions:** liquid and gas fuel characteristics, liquid spray.
- **Burners:** fuel and air supply and mixture. Conventional and low NOx burners operation.
- **Combustion quality:** analysis of the oxygen and the unburned material in the flue gases, control of combustion air flow rate and air/fuel ratio.
- **Combustion safety:** flame detection, control and safety devices.
- **Air and flue gas circulation:** natural draft, forced draft, pressure differential control, automatic safety devices. Damper or Induced draft fan role.
- **Natural and forced draft:** pressure profile drawing. Review of draft constraints.
- **Different types:** burners and spraying systems.

#### Day 1 - CASE STUDIES:

Fired Heater – Combustion Air Control. Optimised air control and complete combustion, control of air with O<sub>2</sub> Analysers, absolute combustion as a variable.

## DAY 2

### SESSION 5 – HEAT TRANSFER & FURNACE OPERATION.

- **Heat transfer to the tube coil:** control parameters. Impact of internal or external fouling.
- **Heat control:** process fluid outlet temperature, fuel flowrate control.
- **Most important furnace temperature and constraints:** skin temperature, bridgewall temperature, limits and risk of overcoming.
- **Application:** furnace temperature profile and heat recovery distribution as a function of fuel burned and combustion air excess.
- **On-stream furnace operations:** monitoring of combustion and heating. Modifying operating conditions. Analysis of disturbances. Key points for safe operation.

### SESSION 6 – FURNACE INSPECTION

- **Inspections of:** the windbox. Burner Registers and the Burners
- **Problems:** commonly associated with furnaces.
- **Breaching sections.**
- **Convection sections.**
- **Radiant Section.**
- **Coil Arrangements:** Condition assessments.

### SESSION 7 – FURNACE MAINTENANCE

- **Air flow:** balanced by adjusting the burner registers.
- **Adjusting:** burner tilts.
- **Identify:** common burner problems and describe how they can be recognized.
- **Annual:** Furnace Cleaning.
- **Mechanical Design Conditions:** API Standard 560, Third Edition, May 2001

### SESSION 8 – START-UP AND TROUBLESHOOTING

- **Start-up and shutdown:** preparation, safe ignition procedures, ignition after a short shutdown, normal shutdown, emergency shutdown.
- **Incidents:** explosive atmosphere in the radiant section, tube rupture, unbalancing of the heat, etc.
- **Diagnostic facilities:** troubleshooting: Burner, Controls and additional.
- **Case study of furnace accidents.**
- **Start-up procedure study.**

**Day 2 - CASE STUDIES: Sizewell 'A' Nuclear Pressure Envelope Boilers Repairs** – Engineering papers of intent, repair evaluations for scoping and preparing ITT proposal BOQ (Bill of Quantities), proposal repair methodology. Technical repair bid evaluations, planning and scheduling the repairs, repair methodologies, contractor mobilisation, repair workforce and supervision.

### CLOSE OUT

- Methods
- Troubleshooting
- Furnace start-up

#### program schedule

08:30	Registration
09:00	Morning Session Begins
10:40 - 11:00	Refreshments & Networking Break
12:45	Luncheon
14:00	Afternoon Session begins
15:30 - 15:50	Refreshments & Networking Break
17:00	Course Ends



**Robin Dargavel**

**Key Expert – Engineering, Construction and Maintenance Training  
DARGAVEL ENGINEERING LIMITED**

**Robin Dargavel** is a versatile and highly skilled, BEng (Hons) Degree Qualified Engineer - Project Manager, Senior Facilities Engineer, Chief Surveyor, Consulting Engineer and founder at Dargavel Engineering Ltd. Robin has over 25 years experience in Oil & Gas, Petrochemical, Process and Nuclear Power Generation industries. That experience includes Engineering, Project Management, Independent Expert Witness/ Adviser on Engineering Issues, positions with responsibility for the engineering, design, procurement, construction, commissioning, and start-up of a variety of projects both in the UK and worldwide. In recent years, Robin has been working extensively in Aberdeen, Scotland on North Sea offshore and associated onshore assets as a consulting Senior Facilities Engineer for major oil and gas operators, since returning to the U.K. after twenty years of working overseas for oil companies in mechanical/ process disciplines in Yemen, Kazakhstan, Vietnam, most of West Africa, Libya, Israel, Qatar, U.S.A. (and others). Robin is an active member of an assortment of Engineering Institutes within the U.K.

Experienced in Furnace Preventative Maintenance and Maintenance / Troubleshooting and Repairs;

- Mechanical Inspections
- Refractory Inspections
- Electrical Inspections
- Instrumentation & Controls
- Calibrations
- Surveys
- Burner Tuning
- Cleaning
- Filter Changes
- Lubrication
- Start-up and shutdown

**Industry Sectors Experience:**

- ✓ Oil & Gas
- ✓ Fuel Storage and Distribution
- ✓ Chemical & Petrochemical
- ✓ Renewable Energy
- ✓ Environmental
- ✓ Power Generation & Utilities
- ✓ Pipelines and Facilities

## ▶ Professional Memberships: MIPlantE, MIET, MWeldI, MInstNDT, SOE, EWI

Industry	Action	Results
Oil and Gas - LNG Plant	Developed a more efficient system to renew LNG Storage Tank Bund Pearlite.	Highly effective reduction in Plant Shutdown durations.
Oil and Gas – Offshore Production	Established a Maintenance Project Costs Control Procedure.	Improved project efficiencies for offshore production projects.
Oil and Gas - Pipelines	Established an Evaluation system for Technical Bid Proposals.	Highly effective Technical Bid Evaluations.
Oil and Gas – Refinery	Developed Oil Storage Tank Repair Engineering Procedures and Method Statements.	Improved repair efficiencies, reduced production shutdown.

## ▶ Partial List of Clients

- ✓ BP
- ✓ Dietsmann
- ✓ DUSUP
- ✓ ENI
- ✓ Jacobs
- ✓ Lloyd's Register
- ✓ Parsons Brinkerhoff
- ✓ Penspen
- ✓ Qatar Petroleum
- ✓ Saipem
- ✓ TOTAL
- ✓ Yemen LNG Company
- ✓ Zuetina Oil Company

## ▶ Testimonials

"Robin's training on Pipeline Maintenance was extremely appreciated by my team, very knowledgeable." **Andy Band, Director, Band Consulting Ltd.**

"Robin's method of training is from hands-on experience, specifically regarding Oil and Gas Flow Fiscal metering."

**Daniel Delahaye, Consultant Pipeline Engineer, Delahaye Engineering Ltd.**