

## COURSE OVERVIEW ME0960-4D

### Combustion Techniques & Burners in Furnaces, Boilers & Unit Efficiencies

**Course Title**

Combustion Techniques & Burners in Furnaces, Boilers & Unit Efficiencies

**Course Reference**

ME0960-4D

**Course Duration/Credits**

Four days/2.4 CEUs/24 PDHs

**Course Date/Venue**

Session(s)	Date	Venue
1	January 29-February 01, 2024	Boardroom 1, Elite Byblos Hotel Al Barsha, Sheikh Zayed Road, Dubai, UAE
2	March 04-07, 2024	Jubail Hall, Signature Al Khobar Hotel, Al Khobar, KSA
3	June 08-11, 2024	Ajman Meeting Room, Grand Millennium Al Wahda Hotel, Abu Dhabi, UAE
4	September 23-26, 2024	Business Center, Concorde Hotel Doha, Doha Qatar



**Course Description**



*This practical and highly-interactive course includes real-life case studies and exercises where participants will be engaged in a series of interactive small groups and class workshops.*



Power generation and most processes are dependent on combustion of fuels. The effectiveness of the combustion process has a major influence on plant efficiency, reliability, safety and emissions. This course will improve your understanding of combustion and heat transfer and assist you to obtain the best out of your plant.



This course focuses on recent developments in burner design for process heating applications including boilers, furnaces, refinery operations, power plant and process plant. Particular emphasis is given to combustion aerodynamics and its influence on burner design, low NO<sub>x</sub> burner design and emission reduction techniques including reburn, SNCR, SCR and NO<sub>x</sub> storage techniques. These aspects are examined in relation to large natural gas burners, refinery burners, heavy fuel oil burners, flameless combustion, waste and bio-fuel firing, oxy-fuel firing and fluidized bed combustion. Large scale testing and the role of CFD in burner design are also covered.



This course is particularly concerned with improving the energy and environmental performance and design of gas and oil-fired, high-temperature furnaces and boilers. The main aim of the course is to provide greater understanding of the principles and practices associated with efficient design and operation of this type of plant. Lectures will be presented initially on the appropriate fundamental and practical aspects of combustion and heat transfer which are necessary to provide an understanding of the thermal behaviour of fuel-fired furnaces and boilers. Recent concerns on the harmful effects of global climate change have highlighted the need for energy conservation so that efficient burner operation is a major feature of the course. It is also necessary to minimise pollutant emissions (particularly NO<sub>x</sub>) from combustion processes so that this topic is covered in the presentations. Furnace design and control is still often based on tradition and experience despite the recent development of theoretical and experimental techniques which can assist in the prediction of furnace performance. Consequently, furnace modelling is a further major theme of the course.

Further, the course will provide a comprehensive insight into understanding the safety functions involved with ensuring a safe combustion process in boilers, furnaces, heaters and other fired process units. The concepts of Safety-Instrumented Burner Management Systems (SI-BMS) will be presented as the methodology to design a BMS to be compliant with latest codes and standards including NFPA 85, NFPA 86, FM 7605, ANSI/ISA 84, and IEC 61508, API 556, API 14C & BLRBAC.

### Course Objectives

Upon the successful completion of this course, each participant will be able to:-

- Apply proper techniques of combustion and burners in furnaces, fired-process heaters and boilers and reach the maximum efficiency
- Identify the types of industrial burners available and how they are applied for efficient operation
- Discuss supply and control of the fuel and air for these systems including piping design and valve selection
- Identify flame safety requirements of combustion systems
- Explain process and ratio controls with exposure to microprocessor equipment, furnace pressure controls for operation and efficiency improvements and preheated combustion air and furnace recuperators
- Discuss NO<sub>x</sub> & other emissions as well as what causes them and how to minimize them
- Determine combustion hazards and safety functions, BMS design considerations, combustion codes & standards and combustion control applications

### Exclusive Smart Training Kit - H-STK®



Participants of this course will receive the exclusive “Haward Smart Training Kit” (H-STK®). The H-STK® consists of a comprehensive set of technical content which includes **electronic version** of the course materials, sample video clips of the instructor’s actual lectures & practical sessions during the course conveniently saved in a **Tablet PC**.





**Who Should Attend**

This course provides an overview of all significant aspects and considerations of combustion techniques and burners in furnaces, boilers and unit efficiencies for those who are responsible for furnace or boiler operation and design especially engineers working with combustion systems such as:-

- Power station engineers
- Process engineers in fuel using industries such as: alumina, cement, glass making, lime, petrochemicals, pulp and paper, steel making, metals processing, etc.
- Furnace, boiler and burner designers, refractory manufacturers and suppliers, etc.

Further, this course is suitable for environmental professionals and regulatory bodies.

**Training Methodology**

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

- 30% Lectures
- 20% Workshops & Work Presentations
- 30% Case Studies & Practical Exercises
- 20% Software, Simulators & Videos

In an unlikely event, the course instructor may modify the above training methodology before or during the course for technical reasons.

**Course Fee**

Abu Dhabi	<b>US\$ 4,500</b> per Delegate + <b>VAT</b> . This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.
Al Khobar	<b>US\$ 4,500</b> per Delegate + <b>VAT</b> . This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.
Doha	<b>US\$ 4,500</b> per Delegate. This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.
Dubai	<b>US\$ 4,500</b> per Delegate + <b>VAT</b> . This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

**Accommodation**

Accommodation is not included in the course fees. However, any accommodation required can be arranged at the time of booking.



**Course Certificate(s)**

Internationally recognized certificates will be issued to all participants of the course who completed a minimum of 80% of the total tuition hours.

**Certificate Accreditations**

Certificates are accredited by the following international accreditation organizations: -


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The International Accreditors for Continuing Education and Training (IACET - USA)

Haward Technology is an Authorized Training Provider by the International Accreditors for Continuing Education and Training (IACET), 2201 Cooperative Way, Suite 600, Herndon, VA 20171, USA. In obtaining this authority, Haward Technology has demonstrated that it complies with the **ANSI/IACET 2018-1 Standard** which is widely recognized as the standard of good practice internationally. As a result of our Authorized Provider membership status, Haward Technology is authorized to offer IACET CEUs for its programs that qualify under the **ANSI/IACET 2018-1 Standard**.

Haward Technology’s courses meet the professional certification and continuing education requirements for participants seeking **Continuing Education Units (CEUs)** in accordance with the rules & regulations of the International Accreditors for Continuing Education & Training (IACET). IACET is an international authority that evaluates programs according to strict, research-based criteria and guidelines. The CEU is an internationally accepted uniform unit of measurement in qualified courses of continuing education.

Haward Technology Middle East will award **2.4 CEUs** (Continuing Education Units) or **24 PDHs** (Professional Development Hours) for participants who completed the total tuition hours of this program. One CEU is equivalent to ten Professional Development Hours (PDHs) or ten contact hours of the participation in and completion of Haward Technology programs. A permanent record of a participant’s involvement and awarding of CEU will be maintained by Haward Technology. Haward Technology will provide a copy of the participant’s CEU and PDH Transcript of Records upon request.

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British Accreditation Council (BAC)

Haward Technology is accredited by the **British Accreditation Council** for **Independent Further and Higher Education** as an **International Centre**. BAC is the British accrediting body responsible for setting standards within independent further and higher education sector in the UK and overseas. As a BAC-accredited international centre, Haward Technology meets all of the international higher education criteria and standards set by BAC.





**Course Instructor(s)**

This course will be conducted by the following instructor(s). However, we have the right to change the course instructor(s) prior to the course date and inform participants accordingly:



**Mr. Den Bazley, PE, BSc, is a Senior Mechanical Engineer with over 30 years of industrial experience in Oil, Gas, Refinery, Petrochemical, Power and Utilities industries. His wide expertise includes Pumps & Compressors Maintenance & Troubleshooting, Centrifugal Pump Design, Hydraulic Turbines, Axial Flow Compressor, Centrifugal Pump Installation & Operation, Centrifugal Pump Maintenance & Troubleshooting, Centrifugal & Positive Displacement Pump Technology, Pumps & Valves Operation, Bearings, Seals & Couplings, Compressors & Turbines Maintenance & Troubleshooting, Gas Turbine Design & Maintenance, Gas Turbine Troubleshooting, Pressure Vessel Design, Fabrication & Testing, Tank & Tank Farms, Heat Exchangers Operation & Maintenance, Boilers & Steam System Management, Re-tubing & Tube Expanding Technology, Propylene Compressor & Turbine, Valve Installation & Repair, Safety Relief Valve Sizing & Troubleshooting, Dry Gas Seal Operation, Mechanical Seal Installation & Maintenance, Industrial Equipment & Turbomachinery, Pumps, Compressors, Turbines & Motors, Boiler & Steam System Management, Tune-Up, Heat Recovery & Optimization, Bearing & Lubrication, Installation & Failure Analysis, Boiler Operation & Maintenance, Process Control Valves, Steam Turbine Operation, Bearing Mounting/Dismounting, Valve Types, Troubleshooting & Repair Procedure, Pressure Vessels & Heat Exchangers, Corrosion Inspection, PSV Maintenance & Testing, Pump Maintenance, Machinery Troubleshooting, Valves, Safety Relief Valves, Strainers & Steam Traps, Pipeline Rules of Thumb, Analytical Prevention of Mechanical Failure, Gear Boxes Troubleshooting & Repair, Piping & Pipeline Design & Inspection, Pigging & Integrity Assessment, Process Piping Design, Pipeline Operation & Maintenance, Welding & Fabrication, Brazing, Fitness-for-Service (FFS), Process Plant Equipment, Pressure Vessels, Piping & Storage Facilities, Layout of Piping Systems & Process Equipment, Pipe Work Design & Fabrication, Mechanical Integrity & Reliability, Mechanical Rotating Equipment & Turbomachinery, Motors & Variable Speed Drives, Mechanical Engineering Design, Process Plant Shutdown, Turnaround & Troubleshooting, Mechanical Alignment, Laser & Dial-Indicator Techniques, Material Cataloguing, Condition Based Monitoring, Maintenance Management, Reliability Management, Reliability Centred Maintenance (RCM), Total Plant Maintenance (TPM) and Reliability-Availability-Maintainability (RAM), Engineering Drawings, Codes & Standards, P&ID Reading, Interpretation & Developing, Maintenance & Reliability Best Practices, Maintenance Auditing, Benchmarking & Performance Improvement, Excellence in Maintenance & Reliability Management, Preventive & Predictive Maintenance & Machinery Failure Analysis (RCFA), Total Plant Reliability Centered Maintenance (RCM), Rotating Equipment Reliability Optimization, Machinery Failure Analysis, Prevention & Troubleshooting, Maintenance Planning, Scheduling & Work Control and Maintenance Planning & Cost Estimation.**

During his career life, Mr. Bazley has gained his practical and field experience through his various significant positions and dedication as the **General Manager, Branch Manager, Refinery Chairman, Engineering Manager, Maintenance Engineer, Construction Engineer, Project Engineer, Mechanical Engineer, Associate Engineer, Oil Process Engineer, Mechanical Services Superintendent, Quality Coordinator, Planning Coordinator, Consultant/Instructor, Lecturer/Trainer and Public Relations Officer** for numerous international companies like **ESSO, FFS Refinery, Dorbyl Heavy Engineering (VECOR), Vandenbergh Foods (Unilever), Engen Petroleum, Royle Trust and Pepsi-Cola.**

Mr. Bazley is a **Registered Professional Engineer** and has a **Bachelor** degree in **Mechanical Engineering**. Further, he is a **Certified Engineer** (Government Certificate of Competency GCC Mechanical Pretoria), a **Certified Instructor/Trainer**, a **Certified Internal Verifier/Assessor/Trainer** by the **Institute of Leadership and Management (ILM)**, an active member of the **Institute of Mechanical Engineers (IMechE)** and has delivered numerous trainings, courses, seminars and workshops internationally.





**Course Program**

The following program is planned for this course. However, the course instructor(s) may modify this program before or during the course for technical reasons with no prior notice to participants. Nevertheless, the course objectives will always be met:

**Day 1**

0730 – 0800	Registration & Coffee
0800 – 0815	Welcome & Introduction
0815 – 0830	<b>PRE-TEST</b>
0830 – 0930	<b>Fundamentals of Combustion</b> Terminology • Combustion Chemistry • Characteristics of Different Fuels and How They Burn • Proper Fuel/Air Ratio • Combustion Limits • Flame Temperature • Flame Geometry • Operational Applications
0930 – 0945	Break
0945 – 1045	<b>Burners &amp; Flame Retention</b> Discussion of Nozzle Mix and Premix Burners • Burner Performance
1045 – 1230	<b>Combustion Air Blowers/Fluid Flow</b> Blower Types, • Construction • Performance • Fan Laws •, Sizing and Selection • Fluid Flow in Combustion Systems
1230 – 1245	Break
1245 – 1420	<b>Radiant Tube Burner Technology &amp; Application</b> <b>Fuel/Air Ratio Control</b> Atmospheric Pre-Mix (Proportional, Mechanical I & II) • Ratio Regulator • Linked Valves & Control
1420 – 1430	<b>Recap</b>
1430	Lunch & End of Day One

**Day2**

0730 - 0900	<b>Flame Safety &amp; Sequence Control</b> Flame Monitoring Equipment • Flame Detection •Flame Safety Equipment
0900 – 0915	Break
0915 – 1045	<b>Combustion System Safety</b> Requirements of the Various Regulating Bodies (i.e., IRL, FM, NFPA) • Hardware & Alternative System Design Considerations • Applications & Case Histories Analysis
1045 – 1230	<b>Workshop Problem &amp; Solution</b> Typical Combustion Sizing Problem
1230 – 1245	Break
1245 – 1420	<b>Enhanced Combustion Efficiency</b> Descriptions of Equipment • Recuperative & Regenerative Systems for Thermal Processes
1420 – 1430	<b>Recap</b>
1430	Lunch & End of Day Two

**Day 3**

0730 – 0900	<b>Oxygen Enriched Combustion</b> Efficiencies & Fuel Savings • Hardware & System Design Considerations
0900 – 0915	Break
0915 – 1045	<b>Furnace &amp; Process Controls</b> Application of Process Controls-Furnace & Combustion System





1045 - 1230	<b>Optimizing Combustion Systems Performance</b> Melting, Heating & Heat Treating Furnaces & Boilers • Furnace & Department • Overall Impact on NO <sub>x</sub> & CO <sub>2</sub> Emissions
1230 - 1245	Break
1245 - 1330	<b>Heat Application - Low Temperature</b> Combustion Systems
1330 - 1400	<b>Heat Application - High Temperature</b> Optimizing Heat Transfer - Furnace Combustion System • Burner Types & Resultant Flames - Industrial Heating Configurations
1400 - 1420	<b>Combustion Systems &amp; NO<sub>x</sub></b> Mechanisms & Variables • Flame Temperature • Combustion Control • Burner Design • Process Variables • Post Combustion Control of Emissions
1420 - 1430	<b>Recap</b>
1430	Lunch & End of Day Three

**Day 4**

0730 - 08000	<b>Round Table Discussion, Combustion System Maintenance</b>
0800 - 0830	<b>Understanding Combustion Hazards</b> Causes of Combustion Incidents
0830 - 0900	<b>Identifying Combustion Safety Functions</b> Risk Analysis & Ranking Techniques • SIF Identification • SIL Determination
0900 - 0915	Break
0915 - 1045	<b>BMS Design Considerations</b> Applying Cost/Benefit Ratio Principals to System Design • Transmitters versus Switches • Logic Solver Technology Selection • SIL Verification • Functional Testing Requirements
1045 - 1200	<b>Requirements for Code &amp; Standard Conformance</b> Prescriptive vs. Performance Considerations • What Applies to your System
1200 - 1215	Break
1215 - 1345	<b>Combustion Control Implications</b> Separation of BMS & CCS • Communications Between Systems
1345 - 1400	<b>Course Conclusion</b>
1400 - 1415	<b>POST-TEST</b>
1415 - 1430	Presentation of Course Certificates
1430	Lunch & End of Course





**Practical Sessions**

This practical and highly-interactive course includes real-life case studies and exercises: -



**Course Coordinator**

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