# COURSE OVERVIEW ME0960
# Combustion Techniques

**Course Title**
Combustion Techniques


**Course Date/Venue**
November 25-29, 2024/Fujairah Meeting Room,
Grand Millennium Al Wahda Hotel, Abu Dhabi, UAE

**Course Reference**
ME0960

**Course Duration/Credits**
Five days/3.0 CEUs/30 PDHs

**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 $NO_x$ burner design and emission reduction techniques including reburn, SNCR, SCR and $NO_x$ 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 $NO_x$) 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 $NO_x$ & 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**.*

## Training Methodology

All our Courses are including **Hands-on Practical Sessions** using equipment, State-of-the-Art Simulators, Drawings, Case Studies, Videos and Exercises. The courses include the following training methodologies as a percentage of the total tuition hours:-

30% Lectures
20% Practical Workshops & Work Presentations
30% Hands-on Practical Exercises & Case Studies
20% Simulators (Hardware & Software) & Videos

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

## 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
20% Case Studies & Practical Exercises
30% Videos, Software & Simulators

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

## Course Fee

**US$ 5,500** per Delegate + **VAT**. 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: -

- 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 **3.0 CEUs** (Continuing Education Units) or **30 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.

- 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:*** ***Monday, 25th of November 2024***

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| *0730 – 0800* | *Registration & Coffee* |
| *0800 – 0815* | *Welcome & Introduction* |
| *0815 – 0830* | ***PRE-TEST*** |
| *0830 – 0930* | ***Fundamentals of Combustion***<br>*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* | ***Burners & Flame Retention***<br>*Discussion of Nozzle Mix and Premix Burners ● Burner Performance* |
| *1045 – 1230* | ***Combustion Air Blowers/Fluid Flow***<br>*Blower Types, ● Construction ● Performance ● Fan Laws ●, Sizing and Selection ● Fluid Flow in Combustion Systems* |
| *1230 – 1245* | *Break* |
| *1245 – 1420* | ***Radiant Tube Burner Technology & Application***<br>***Fuel/Air Ratio Control***<br>*Atmospheric Pre-Mix (Proportional, Mechanical I & II) ● Ratio Regulator ● Linked Valves & Control* |
| *1420 – 1430* | ***Recap*** |
| *1430* | *Lunch & End of Day One* |

***Day 2:*** ***Tuesday, 26th of November 2024***

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

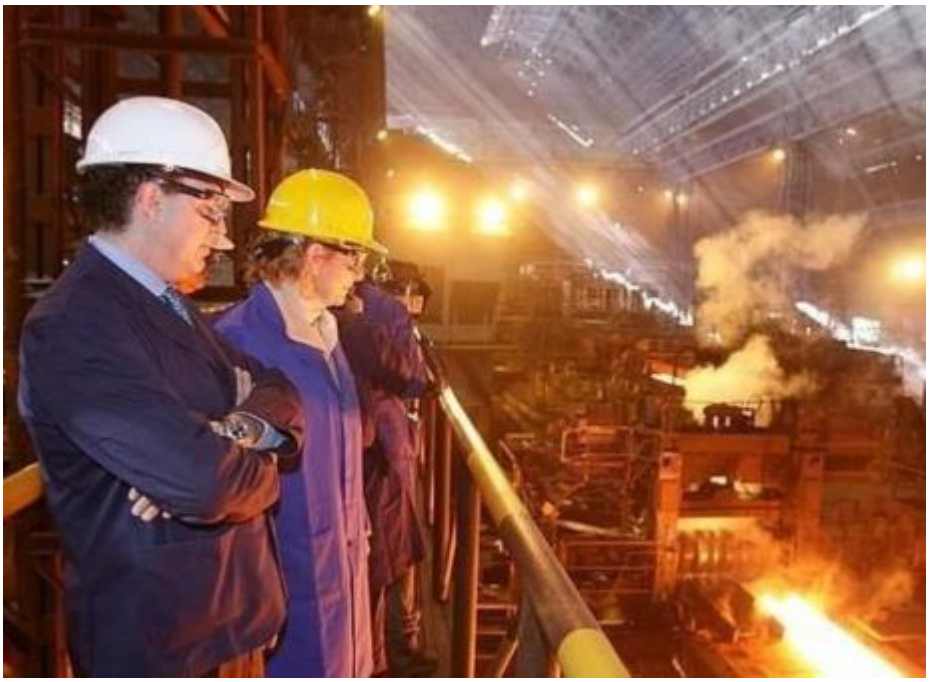
| Day 3: | Wednesday, 27th of November 2024 |
|---|---|
| 0730 – 0900 | ***Oxygen Enriched Combustion***<br>*Efficiencies & Fuel Savings ● Hardware & System Design Considerations* |
| 0900 – 0915 | *Break* |
| 0915 – 1045 | ***Furnace & Process Controls***<br>*Application of Process Controls-Furnace & Combustion System* |
| 1045 – 1230 | ***Optimizing Combustion Systems Performance***<br>*Melting, Heating & Heat Treating Furnaces & Boilers ● Furnace & Department ● Overall Impact on $NO_x$ & $CO_2$ Emissions* |
| 1230 – 1245 | *Break* |
| 1245 – 1420 | ***Heat Application – Low Temperature***<br>*Combustion Systems* |
| 1420 – 1430 | ***Recap*** |
| 1430 | *Lunch & End of Day Three* |

| Day 4: | Thursday, 28th of November 2024 |
|---|---|
| 0730 – 0900 | ***Heat Application – High Temperature***<br>*Optimizing Heat Transfer - Furnace Combustion System ● Burner Types & Resultant Flames - Industrial Heating Configurations* |
| 0900 – 0915 | *Break* |
| 0915 – 1045 | ***Combustion Systems & $NO_x$***<br>*Mechanisms & Variables ● Flame Temperature ● Combustion Control ● Burner Design ● Process Variables ● Post Combustion Control of Emissions* |
| 1045 – 1230 | ***Round Table Discussion, Combustion System Maintenance*** |
| 1230 – 1245 | *Break* |
| 1245 – 1420 | ***Understanding Combustion Hazards***<br>*Causes of Combustion Incidents* |
| 1420 – 1430 | ***Recap*** |
| 1430 | *Lunch & End of Day Four* |

| Day 5: | Friday, 29th of November 2024 |
|---|---|
| 0730 – 0900 | ***Identifying Combustion Safety Functions***<br>*Risk Analysis & Ranking Techniques ● SIF Identification ● SIL Determination* |
| 0900 – 0915 | *Break* |
| 0915 – 1045 | ***BMS Design Considerations***<br>*Applying Cost/Benefit Ratio Principals to System Design ● Transmitters versus Switches ● Logic Solver Technology Selection ● SIL Verification ● Functional Testing Requirements* |
| 1045 – 1200 | ***Requirements for Code & Standard Conformance***<br>*Prescriptive vs. Performance Considerations ● What Applies to your System* |
| 1200 – 1215 | *Break* |
| 1215 – 1345 | ***Combustion Control Implications***<br>*Separation of BMS & CCS*<br>***Communications between Systems*** |
| 1345 – 1400 | ***Course Conclusion*** |
| 1400 – 1415 | ***POST-TEST*** |
| 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**

Mari Nakintu, Tel: +971 2 30 91 714, Email: mari1@haward.org