

## COMPRESSORS: DESIGN, OPERATION AND MAINTENANCE

Enhancing compressor uptime and reducing operating costs through best practices and effective maintenance

**Presenter:** Fred Geitner

### ABOUT THE PRESENTER: FRED GEITNER P.ENG



Mr. Geitner is presently the principal engineer of PMES (Process Machinery Engineering Services), an independent consultant and expert litigation witness in the area of process machinery reliability. He has over 40 years experience in the design, operation, maintenance and troubleshooting of compressors used in process plant and transmission pipeline applications. He is a registered professional engineer in the Province of Ontario, Canada.

He has given depositions as an expert witness, has conducted plant site reliability audits and also presented courses and seminars covering process machinery design, operation, maintenance and reliability issues in Canada, United States, South America, Europe, Pakistan and the Middle East.

Together with H.P. Bloch he co-authored several books on process machinery management and reliability assurance.

#### Co-author:

- Machinery Failure Analysis and Troubleshooting (4th Ed., 2012)
- Machinery Component Maintenance and Repair (2nd Ed., 2001)
- Maximizing Machinery Uptime (2nd Ed., 2006)
- Compressors - How to Achieve High Reliability & Availability (1st Ed., 2012)

**Number of days:** 4

**Cost:** \$2950

## WHY YOU CANNOT MISS THIS COURSE

Compressors can be one of the most mechanically complex pieces of machinery. The industry is currently struggling with various issues, ranging from selection, operation, and high maintenance expenditures to production stoppages caused by compressor downtime. In addition, due to the rising energy costs, there is an increased demand to reduce energy wastage and greenhouse emission in compressor operation.

The experience gained from compressor maintenance and troubleshooting will help you select the right compressor based on your operating or design conditions. It will also enhance the life cycle of your compressors, increase energy efficiency, reduce ongoing maintenance costs and prevent failures.

The practical insights delivered at this training will assist in troubleshooting issues and challenges in compressor operation and maintenance along with exposure to key techniques and predictive maintenance tools that will help you significantly increase its performance, reliability and availability. Compressor failures can cause significant problems from delays in production to the possible shutdown of the whole plant.

However, good compressor operation and maintenance can cost-effectively maximize compressor life expectancy; while improving its reliability and availability to meet output requirements

This hands-on course will give a practical introduction to control, operation, maintenance and troubleshooting of centrifugal and positive displacement compressors.

The key issues which will be addressed in this training are: How to maximize compressor output, increase its life cycle and minimize downtime.

## WHO MUST ATTEND

Mechanical Engineers, Maintenance Engineers, Reliability Engineers, Electrical Engineers, Professional Engineers, Operations Managers, Maintenance Managers, Project Managers, Contract Managers, Asset Managers, Technical Managers

From Industries such as:

Oil & Gas, Mining, Energy & Utilities, Chemicals & Petrochemicals, Food & Beverage Manufacturing, Agriculture

## AIM OF THE COURSE

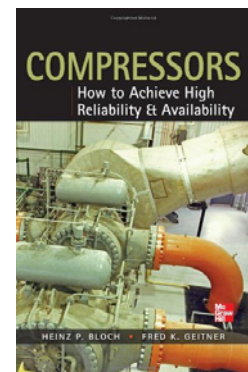
- Evaluating and augmenting the efficiency of compressor operation resulting in reduced energy consumption
- Improving the knowledge of best practices and troubleshooting techniques to avoid and mitigate compressor failures
- Defining the technical features and vulnerabilities of dynamic and positive displacement compressors
- Identifying the criteria that can assist in cost-effective compressor selection
- Using appropriate maintenance technologies to maximize compressor reliability and availability
- Benchmarking compressor performance against industry standards

## YOU WILL RECEIVE:

**Included in the seminar** is the book  
Compressors: How to Achieve High Reliability & Availability  
written by **Heinz P. Bloch** and **Fred K. Geitner**

Practical techniques for optimizing compressor performance

Written by experts with more than 100 combined years of industry experience in machinery failure avoidance, this book offers proven solutions to a pervasive and expensive problem in modern industry--compressor failure. This succinct, on-the-job guide addresses elusive causes of compressor failure and clearly maps out permanent remedies you can put to use right away. With a focus on centrifugal and reciprocating compressors, this accessible reference is based on real-world processes and procedures used by successful global companies.





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## COURSE OUTLINE

### DAY 1

#### Session One

##### Introduction to Compressors

- Principles of operation, configurations, classifications, ranges of applications, vulnerabilities and limitations of: 1)Ejectors / 2)Dynamic compressors: Radial, axial, single-shaft and multi-shaft turbocompressors

#### Session Two

##### Introduction to Compressors (continued)

- Principles of operation, configurations, classifications, ranges of applications, vulnerabilities and limitations of:
- Displacement compressors: Rotary, screw, sliding vane, liquidating, reciprocating compressors
- Non-lubricated process compressors
- Determining compressor life cycle costs (LCC) to identify the most cost-effective way of compressing gas & air

#### Session Three

##### Mechanical Design of Centrifugal Compressors

- Side streams
- Rotors
- Impellers
- Balancing
- Rotor dynamics
- Casings
- Bearings
- Seals
- Couplings
- Performance controls

#### Session Four

##### Review

- Skill test and assessment
- Review, summary and Q&A

In this session the course director will review and summarize learning's of the day and answer delegates' questions.

### DAY 2

#### Session One

##### Design and Materials of Reciprocating Compressor Components

- Crank case/frame
- Main bearings
- Cylinders
- Piston and rings/bands
- Valves
- Packing
- Seals

#### Session Two

##### Design and Materials of Reciprocating Compressor Components (continued)

- Traditional lubrication vs. mini-lube concepts
- Auxiliaries: Cooling principles / Cooling systems / Pulsation vessels and piping
- Controls
- Unloaders
- Protection Philosophies

#### Session Three

##### Compressor Characteristics and Selection Criteria

- Understanding key compressor parameters such as thermodynamics, capacity, power, efficiencies, gas properties and intercooling as they apply to various compressor types
- Selection criteria of dynamic and displacement compressors:
- Characteristic curves and their significance to the operator
- Stability issues and solutions
- Calculation and sizing methods using examples

#### Session Four

- Skill test and assessment
- Turbo Compressor Group Discussion: What approaches to problems are being used at your facility?
- Reciprocating Compressor Group Discussion: What are our most urgent problems at your facility and how do you address them?



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## COURSE OUTLINE

### Day 3

#### Session One

##### Compressor Maintenance Strategies, Tactics and Procedures

- Predictive vs. Preventive Maintenance (PdM vs.PM):
- PM, PdM, CBM explained as they apply to different compressor types
- When to apply difference maintenance strategies

#### Session Two

##### Applying and determining the frequency of condition based maintenance tactics such as:

- Performance monitoring
- Condition monitoring
- Vibration analysis
- Oil analysis
- Ultra sound inspection/analysis
- Infrared imaging tools

#### Session Three

- Operation and Maintenance – Turbocompressors
- Start-up and shutdown
- Surveillance and monitoring
- Safety and emergency shut-down devices (ESD)
- Compressor train operation inspection, maintenance, overhaul and repair (IMO&R)
- Planning and execution of IMO&R
- Why IMO&Rs campaigns are not always successful
- Troubleshooting turbocompressor trains

#### Session Four

##### Operation and Maintenance – Reciprocating Compressors

- Start-up and shutdown
- Surveillance and monitoring
- Safety and ESDs
- IMO&R planning and implementation
- Selecting the right program
- Alignment and piston rod run-out checks
- General suitability of valve materials
- Valve constraints
- Valve testing
- Packing maintenance
- Foundations
- Inspection and inspection forms
- Reports and clearance assurance

### Day 4

#### Session One

- Operation and Maintenance -Displacement Compressors
- Troubleshooting and failure analysis
- Troubleshooting matrices applied: Typical problems and solutions diagnostic tests / Compressed air system evaluation
- Learning from recent compressor failure incidents examples to prevent functional failures in your compressor operation

#### Session Two

##### Implementing Root Cause Failure Analysis (RCFA) to Prevent Recurrence of Compressor Problems

- Structured problem solving principles: Situation Analysis / Cause Analysis / Action Generation
- A practical guide to root cause failure analysis (RCFA)
- Examples and discussions of attendees' experiences

#### Session Three

##### Repairs and Spares Assessment

- Extending compressor life: Upgrading, conversion, re-rating, revamping, reapplication and remanufacturing
- Key principles of repair or replacement decisions:
- Insurance spares vs. wear & tear parts
- Vendors' (OEM) recommended spare parts vs. experience based spare parts lists
- Comparing scientific vs. experience based approaches to establish requisite spares stock levels

#### Session Four

- Skill test & assessment
- Review, summary and Q&A

In this session the course director will encourage delegates to share experiences in relation to the compressor challenges faced at their individual workplace with the aim of finding a suitable solutions.

Possible Topics:

- Exchange of Reliability and Availability Statistics
- Turbo Compressors: Fouling Problems / Gas Seals / Couplings
- Reciprocating and other displacement compressors:





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### About 2KG Training

Leading engineering training firm 2KG Training has provided expert training to South African industry for almost a decade. Drawing on our international network of experienced professionals, 2KG Training provides training to the most exacting requirements in an exacting field.

2KG Training launched in 2005 with a focus on pumps, valves, and related systems. After establishing our presence in the field, we expanded our core offering of courses in order to meet demand from clients looking for our expert training in other aspects of the mechanical engineering discipline.

Managing Director Harry Rosen is a past chairman of the South African Institution of Mechanical Engineering (SAIMechE) and an internationally-recognised expert on UNIDO Energy Efficiency projects. Mr Rosen embodies 2KG Training's insistence on experience and expertise in all aspects of our business.

### About Oryx Engineering Solutions

Oryx Engineering Solutions (Oryx) is a progressive and newly established Qatari engineering services provider located in Ras Laffan Industrial City. Through Oryx's state-of-the-art facility or on-site teams they provide expertise in a number of technology areas: rotating & static equipment including pumps & valves, seals, welding and fabrication, and machining.

Oryx works directly or through a number of strategic joint ventures and partnerships with leading companies, including: ABB Oryx Motors & Generators Service – motors and generators, Aesseal Oryx for mechanical seals, Stork Oryx Turbo Machinery Services for turbines, gearboxes, control systems and the supply of associated auxiliary parts, and Furmanite for leak-sealing and on-site machining. Through this breadth of work Oryx recognises the importance of achieving maximum reliability and efficiency in the operation of these systems. This extends to the need for highest quality training and development for the industry.

### Our Training Offering

In striving to deliver new value to the industry in Qatar, Oryx has now partnered with 2KG Training to bring world class engineering training to the country.

Our reputation for comprehensive expertise is due to the stringent evaluation criteria used in selecting our trainers. Trainers are picked from a field of international experts, all of whom have at least twenty years of relevant experience. All our expert trainers have published books and journal articles in their disciplines, are affiliated with the relevant international associations and are actively involved with the standards committees.

We currently offer the following accredited courses:

- Pump Operation and Maintenance
- Pump Efficiency Workshop
- Pumping Systems
- ASME B31.3 Process Piping
- ASME B31.1 Power Piping
- ASME Section VIII Div 1 Design, Fabrication, Inspection and Repairs of Pressure Vessels,
- ASME Section VIII Div 2 Design and Fabrication of Pressure Vessels
- ASME Section IX Welding and Brazing Qualifications
- Valves, Selection, Installation and Operations
- Piping Systems
- Compressors: Design, Operation and Maintenance
- Electricity for Mechanicals
- Bearings
- Mechanical Seals
- Flow Control Measurement
- API Advanced Storage Tanks: API650 & API653 Design, Maintenance and Inspection
- API 579-1 ASME FFS1 Fitness for Service
- Power Generation: Steam and Gas Turbines
- Variable Speed Drives
- Vibration Analysis 1
- Condition Monitoring and Reliability

**Number of days: 4**  
**Cost: \$2950**

### How to register for the course:

1. Complete this registration form and fax it to Grace Villamar: Tel: +974 4015 9809 Fax: +974 4015-9899  
Email: [Grace.Villamar@oes.com.qa](mailto:Grace.Villamar@oes.com.qa)
2. Acknowledgement will be emailed to you.
3. Final confirmation and details will be faxed or emailed to you approximately 7 days before the commencement of the seminar.

### Conditions of entry:

1. Cancellations are accepted in writing and without penalty, up to 14 working days prior to commencement of the seminar.
2. Cancellations in writing less than 14 working days prior to the seminar will be liable to pay 50% cancellation fee.
3. Less than 7 days, defaulter will be liable to pay 100% cancellation fee.
4. In case of insufficient applications for the workshop 2KG/Oryx Engineering reserves the right to cancel the seminar. Applicants will be informed and all fees will be refunded immediately.

### Delegate information:

Title: \_\_\_\_\_ Surname: \_\_\_\_\_ Name: \_\_\_\_\_

Full Company name: \_\_\_\_\_ Job Title: \_\_\_\_\_

Postal Address (to which invoice must be sent): \_\_\_\_\_

Code: \_\_\_\_\_ VAT number: \_\_\_\_\_

Tel: ( ) \_\_\_\_\_ fax: ( ) \_\_\_\_\_

Cell: \_\_\_\_\_ Email: \_\_\_\_\_

### Contact/ Accounts information:

Title: \_\_\_\_\_ Surname: \_\_\_\_\_ Name: \_\_\_\_\_

Tel: ( ) \_\_\_\_\_ fax: ( ) \_\_\_\_\_

Cell: \_\_\_\_\_ Email: \_\_\_\_\_

**Dietary Requirements:**  Normal  Vegetarian  Halaal

**Accommodation Requirements:**  Yes  No

Please tick the course that you would like to attend:

30 November - 03 December 2014  
Qatar, Ras Laffan

I have read and agreed to all the conditions of registration as stipulated in this brochure.

Signature

Date

For more info and to register contact Grace Villamar on tel: +974 40159-888 Ext : 809 and email: [Grace.Villamar@oes.com.qa](mailto:Grace.Villamar@oes.com.qa)