



# TURBOMACHINERY TRAINING SEMINAR



## “Compressors and Their Drivers”

Centrifugal Compressors, Gas Turbines and Steam Turbines..

**Flexware**<sup>®</sup> [www.flexwareinc.com](http://www.flexwareinc.com)

**Bahrain**

**February 13, 14, 15 & 16, 2024**



### Field & Shop Performance Analysis, Case Studies, Troubleshooting & Problem Resolution

- Optimize Your Condition Based Equipment Reliability Program
- Maximize Plant Production & Reliability
- Confirm OEM Performance Guarantee
- Optimize Equipment Utilization

**TAKE ADVANTAGE OF THIS EXCELLENT OPPORTUNITY TO LEARN COMPRESSOR & TURBINE THEORY AND EASY, PRACTICAL METHODS TO TROUBLESHOOT TURBOMACHINERY.**

*“Good Seminar. Improves my analytical knowledge. Will save the company money & time.” Sheridan Suleiman, Sarawak Shell*

### People Who Should Attend This Seminar

The people attending the course should be technical personnel interested in better understanding turbomachinery (operators, engineers & technicians, reliability specialists, project engineers, equipment specialists and planning engineers).

*“Difficult subject made easy to understand – Excellent work!”  
Showkath Ali K. C., Qatar Petrochemical Co.*

**FOR THE SEASONED ENGINEER AS WELL AS THOSE NEW TO THE SUBJECT OF TURBOMACHINERY.**

### Course Objective

Basic turbomachinery operation and maintenance and easy, practical methods to troubleshoot turbomachinery problems. Improving plant production and reducing maintenance costs.

**Course Materials:** “Compressor Performance”, access to training slides and other printed material.

### Time Schedule

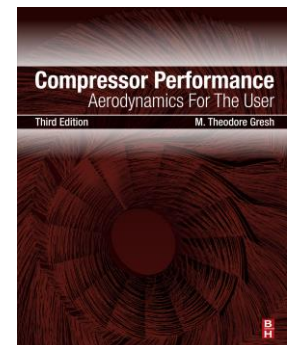
Seminar duration: 3 ½ days from 8:30 AM to 4:00 PM with lunch break from 12 to 1:00 PM and two 15 minute coffee breaks: one in the morning and one in the afternoon.

*“Notes, book & software are excellent. I still use the notes and text from your course regularly in my work.”  
Hosam Hassan, Praxair, Toronto*

### Program

Following subject areas are covered over a three and ½ day program. A tentative schedule is shown below.

*“...All in all the course is excellent with a lot of valuable information being transmitted.”  
Scott Schultz, Chart Energy & Chemicals, The Woodlands, Texas*



#### 1) - Compressor Aerodynamics

**Introduction to Turbocompressors:** Definition of compressor. Types of compressors. Relative comparisons of various compressor types.

**Aerodynamic Components:** Axial compressors. Centrifugal compressors. Impellers, diaphragms, guide vanes. Interstage seals. Balance piston seal. Impeller thrust. Internal compressor configuration: Straight thru, double flow, back to back, multi-stage iso-cool, side-load.

**Compressor Characteristics:** Centrifugal compressors. Slope. Stonewall. Surge. Off-design operation. Influence of the different operating variables: suction pressure, suction temperature, molecular weight changes, rotational speed, etc.

**Compressor Design & Construction:** Casing, impellers, diaphragms & rotors.

**Compressor Performance:** Head & efficiency evaluation

**Equipment Selection:** Considerations for selecting new equipment and rerating existing.

## 2) - Steam Turbines

**Introduction to Steam Turbines:** Blade designs, trip & throttle valves, integral rotor forgings, electronic speed control & trip, Rankine cycle, reaction & impulse turbines, back pressure and condensing turbines.

**Casing & Rotors:** Casing, steam chest, inlet valves, diaphragms, extraction valves, nozzle ring solid rotors, built-up rotors.

**Auxiliary Systems:** Speed control, overspeed trip, gland seal systems, condensers

## 3) – Flex Live Software & AWM

**Performance Monitoring:** Using of Flexware for performance evaluation and monitoring

**Off Design Evaluation:** Using of Flexware for off-design evaluation

**Examples:** Example of Flexware performance monitoring for selected equipment.

## 4) -General

**Driver Selection:** Motors, steam turbines & gas turbines. The best driver for the application.

**Compressor & Turbine Performance – Evaluation & Troubleshooting:** Performance analysis techniques, Head & efficiency evaluation, performance problems, solutions and troubleshooting techniques. Motors, backpressure turbine analysis, condensing turbine analysis, gas turbine analysis.

**Troubleshooting & Case Studies:** Aerodynamic problems, iso-cooled compressors, refrigeration compressors, shop & field problems.

**Compressor and Turbine Operation:** Commissioning. Start-up procedure of compressors for different types of drivers: steam turbines, gas turbines and electric motors. Operational cares. Avoiding liquid ingestion. Possible problems when operating outside the OEM performance curve.

**Ethylene Plants:** Process schematic, Refrigeration system, cracked gas train.

**Refinery:** Process schematic, FCC air compressors, wet gas, hydrogen recycle.

**Propane Dehydrogenation:** Process schematic, Compressor & driver types used for this service. How compressor operation affects plant operation.

**Q & A:** Review in detail questions about aerodynamic issues and go over specific questions and problems brought to the training seminar.

*“I learned a lot!” Jasmin Tremblay, Ultramar (Valero), St. Romuald, Quebec*

*“..overall good job.” Damien Parson, Occidental Chemical, Geismar, Louisiana*

*“Nice lecture & content. Helpful to my future work.” Frank Yuan, Chart Energy & Chemicals, The Woodlands, Texas*

### **Instructor: Ron Stewart**

Ronald Stewart is currently Director, Technology Flexware, Inc., Grapeville, PA, USA where he assists with software development, does application engineering for rerates, and assists with sales, service calls & marketing. Mr. Stewart developed the original GasFlex® gas properties software which is the calculation engine for Flex Live® software.

Extensive worldwide sales and service career to global engineering firms and energy companies. Strong knowledge of complex turbomachinery systems (centrifugal gas compressors, axial air compressors, mechanical drive steam turbines, steam turbine generators & hot gas expanders) and how they integrate into end user's systems.

Ronald Stewart received a Bachelor of Science - Marine Engineering at The University of Michigan - Ann Arbor, MI, USA in 1964.

*“Thank you for the heat balance methodology for condensing turbines. I can save some money for Shell with that.” Clay Crook, Sarawak Shell Berhad*

**Client Listing:** AdvanSix, Aramco, British Petroleum, Chart Energy & Chemicals, ConocoPhillips, Consumer Coop Refineries, Canadian Natural Resources, Dakota Gasification, Dibran GmbH, ExxonMobil, Foster Wheeler, Full System Engineering, GE Oil & Gas, John Crane, Hess Oil, Kop-Flex, Linde Engineering, Meco, Motiva, Nalco, Occidental Chemical, Orinoco Iron, Petro-Canada, PDVSA, Praxair, PTT Exploration & Production Co., Qatar Petrochemical Co., RasGas, Sadara Chemical, Shell Chemical, Sherritt Metals, Sinclair Oil, Sincor, Sunoco, Syncrude Canada, Tata Chemicals, Valero

## Registration Form #2302b

**Flexware, Inc.**, P.O. Box 110, Grapeville, PA 15634-0110, U. S. A.

Ph (1) 724-493-7906, [sales@flexwareinc.com](mailto:sales@flexwareinc.com), [www.flexwareinc.com](http://www.flexwareinc.com)

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<u>#</u>	<u>Item &amp; Description</u>	<u>Price Each</u>	<u>Quantity</u>	<u>Total Price</u>
	<b>“Compressors and Their Drivers” February 13, 14, 15 &amp; 16, 2024</b>	\$3,495 USD		
	Flex Live XK, one year License	No Charge		
	<b>subtotal</b>			
	<b>6% Sales Tax (Pennsylvania Locations only)</b> Credit card payment is preferred.			
	<b>Total Amount Due</b>			

**Credit Card:** Number \_\_\_\_\_ Expiration Date: \_\_\_\_\_

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