

The background of the cover is a photograph of industrial machinery. It features a large, weathered metal component with a circular flange and several bolts. A horizontal pipe with a red and white striped section is visible in the foreground. In the background, there are yellow structural beams and red pipes against a clear blue sky.

PetroSkills[®]

2017 Mechanical Engineering Training Guide

OGCI[®]

John M. Campbell

RDC



Course Progression Map

The Mechanical discipline covers equipment and systems that are key to any facility engineer or those that are pursuing a deeper rotating equipment role within their company.

The Intermediate level opportunities involve specific sessions focused into key areas such as piping, pressure vessels, pumps and compression. In addition, a deeper focus into reliability and optimization is a key theme in the mechanical discipline as this is commonly an industry benchmark. Our specialized courses are designed for engineers with more than a few years of experience whereby the participant can focus on solutions to real world problems.

The following instructors have been selected and approved by the PetroSkills Curriculum Network:

- MR. JOHN CURRY
- MR. WOLFGANG FOERG
- MR. RON FREND
- MR. JOSH GILAD
- MR. GERALD GUIDROZ
- MR. ROBERT HUBBARD
- MR. KEN LUNSFORD
- DR. MAHMOOD MOSHFEGHIAN
- DR. CARLOS PALACIOS
- MR. PAUL VERRILL
- MR. STUART WATSON

	Oil and Gas Processing			Process Safety	Instrumentation, Controls & Electrical		Offshore & Subsea
	Gas	Oil / Water	General Processing		Electrical	Instrumentation & Controls	
Specialized			CO ₂ Surface Facilities – PF81				
Intermediate	Gas Treating and Sulfur Recovery – G6 Practical Computer Simulation Applications in Gas Processing – G5 Onshore Gas Gathering Systems: Design & Operation – PF45		Separation Equipment - Selection & Sizing – PF42	Relief and Flare Systems – PF44		Practical PID Control and Loop Tuning – IC74 Flow and Level Custody Measurement – IC73 Valve and Actuator Technologies – IC72 PLC and SCADA Technologies – IC71	Flow Assurance for Offshore Production – FAOP
Foundation		Fundamental and Practical Aspects of Produced Water Treating – PF23 Applied Water Technology in Oil and Gas Production – PF21		Process Safety Engineering – PS4 Risk Based Process Safety Management – HS45 Fundamentals of Process Safety – PS2	Electrical Engineering Fundamentals for Facilities Engineers – E3	Instrumentation and Controls Fundamentals for Facilities Engineers – IC3	Fundamentals of Offshore Systems: Design and Construction – OS4 Offshore and Cons... Corrosion Management Processing Operati...
Basic	Gas Conditioning and Processing - LNG Emphasis – G4LNG						
	Gas Conditioning and Processing – G4 (Virtual/Blended option for first week coming s...						
	Oil Production and Processing Facilities – PF4						
Basic	LNG Short Course: Technology and the LNG Chain – G29 Overview of Gas Processing – G2 Introduction to Oil and Gas Production Facilities – PF2		Concept Selection and Specification of Production Facilities in Field Development Projects – PF3	Process Safety Engineering Principles – PSE Virtual/Blended Course			Overview of Subsea Systems – SS2 Overview of Offshore Systems – OS21

Course Progression Map

Pipeline Engineering	Mechanical Engineering			Operations & Maintenance		Project Mgmt.	Procurement/ Supply Chain Management
	Non-Rotating	Rotating	Reliability	O&M Management	Operator Training		
		Compressor Systems - Mechanical Design and Specification - ME46 p.4	Turbomachinery Monitoring and Problem Analysis - ME62 p.4			Advanced Project Management II - FPM63 Advanced Project Management - FPM62	
	Mechanical Specification of Pressure Vessels and Heat Exchangers - ME43 p.3 Piping Systems - Mechanical Design and Specification - ME41 p.3	Fundamentals of Pump and Compressor Systems - ME44 p.3	Risk Based Inspection - REL61 p.4 Process Plant Reliability and Maintenance Strategies - REL5 p.4	Turnaround, Shutdown, and Outage Management - TSOM		Managing Brownfield Projects - FPM42 Project Management for Engineering and Construction - FPM22 Project Cost Scheduling - PCS Petroleum Project Management: Principles and Practices - PPM	Cost/Price Analysis and Total Cost Concepts in Supply Management - SC64 Supplier Relationship Management - SC63 Strategic Procurement and Supply Management in the Oil and Gas Industry - SC62 Inside Procurement in Oil & Gas - SC61
Terminals and Storage Facilities - PL44 Onshore Pipeline Facilities: Design, Construction and Operations - PL42 Pipeline Design Construction - PL43 Management in Production/ Operations - PF22 p.3					Crude Oil Pipeline Operations - OT50		Effective Materials Management - SC42
				Maintenance Planning and Work Control - OM41	LNG Facilities for Operations & Maintenance - OT43	Introduction to Project Management - IPM	Contracts and Tenders Fundamentals - SC41
Pipeline Systems Overview - PL22				Applied Maintenance Management - OM21	Oil & Gas Processing Facilities for Operations & Maintenance - OT1		



Corrosion Management in Production/ Processing Operations

– PF22

FOUNDATION 5-DAY

This course will cover the main causes of corrosion in upstream oil and gas operations, as well as monitoring and mitigation methods. The various corrosion mechanisms give rise to a number of different forms of corrosion damage, which will all be considered. Participants will estimate the corrosivity of a given environment through analysis of the chemical and physical characteristics of the system; review approaches to selecting materials and coatings for corrosion resistance for different conditions and applications (including the use of NACE MR0175/ISO 15156); and be introduced to cathodic protection (CP) surveys, selecting the CP system type, estimating current requirements, and the design principles of simple cathodic protection systems. The participant will learn how to select and utilize corrosion inhibitors for different systems, and how to select and apply corrosion monitoring techniques to create an integrated monitoring program. The course content is based on a field facilities engineering point of view, as opposed to a more narrowly-specialized corrosion engineering or chemistry viewpoint. It provides an appropriate balance of necessary theory and practical applications to solve/mitigate corrosion-related problems.

DESIGNED FOR

Managers, engineers, chemists, and operators who need to understand corrosion and its control management in oil and gas production and processing.

YOU WILL LEARN

- The basics of corrosion chemistry
- The main corrosion mechanisms occurring in oil and gas production/processing systems
- The different types of damage caused by corrosion
- Materials selection for corrosion prevention
- Some methods for conducting cathodic protection (CP) surveys
- Items to consider in corrosion inhibitor selection
- Key advantages and disadvantages of the various corrosion monitoring methods
- Where the main locations of corrosion concern occur within oil production systems, gas processing facilities (including amine units), and water injection systems

COURSE CONTENT

Fundamentals of corrosion theory • Major causes of corrosion (O₂, CO₂, H₂S, microbologically influenced corrosion) • Forms of corrosion damage • Materials selection • Protective coatings and linings • Cathodic protection • Corrosion inhibitors • Corrosion monitoring and inspection • Corrosion in gas processing facilities • Corrosion in water injection systems • Corrosion management strategy and life-cycle costs

2017 Schedule and Tuition (USD)

HOUSTON, US	28 AUG-1 SEP	\$4150
MIDLAND, US	31 JUL-4 AUG	\$4110
ORLANDO, US	6-10 NOV	\$4210
THE HAGUE, NLD	23-27 OCT	\$4780

Piping Systems - Mechanical Design and Specification – ME41

INTERMEDIATE 5-DAY

This 5-day, intermediate level course for engineers and piping system designers reviews the key areas associated with the design of piping systems for oil and gas facilities. The course is focused on four areas: codes and standards, pipe materials and manufacture, piping components, and piping layout and design. Applicable piping codes for oil and gas facilities (ISO, B31.3, B31.4, B31.8, etc.), pipe sizing calculations, pipe installation, and materials selection are an integral part of the course. The emphasis is on proper material selection and specification of piping systems.

DESIGNED FOR

This PetroSkills training course is ideal for mechanical, facilities, plant, or pipeline engineers and piping system designers who are involved in the design of in-plant piping systems for oil and gas facilities.

YOU WILL LEARN

- To apply piping system codes and standards
- About line sizing and layout of piping systems in various types of facilities
- How to specify proper components for process and utility applications
- To compare alternative materials of construction
- The process of steelmaking, pipe manufacturing, and material specifications
- Joining methods and inspection techniques
- Key considerations for flare and vent systems, including PSV sizing

COURSE CONTENT

Piping codes and standards (ANSI/ASME, API, ISO) • Pipe materials and manufacturing • Basic pipe stress analysis methods • Valves and actuators • Welding and non-destructive testing • Line sizing basics (single-phase and multiphase flow) • Pipe and valve material selection • Piping layout and design • Manifolds, headers, and flare/vent systems • Non-metallic piping systems • Operations and maintenance considerations of facilities and pipelines

2017 Schedule and Tuition (USD)

DENVER, US	17-21 JUL	\$4160
DUBAI, UAE	5-9 NOV	\$5190
HOUSTON, US	11-15 DEC	\$4150
MIDLAND, US	21-25 AUG	\$4,110

Mechanical Specification of Pressure Vessels and Heat Exchangers – ME43

INTERMEDIATE 5-DAY

FIELD TRIP

This 5-day, intermediate level course for facility engineers and project engineers reviews the key areas associated with the mechanical design of pressure vessels and heat exchangers for oil and gas facilities. The course is focused on vessels, heat exchangers built in accordance to ASME VIII Div 1, considering material selection, key design calculations, and manufacturing processes. The course is not aimed at process engineers sizing equipment (PF-42 covers these elements), although a brief review of the sizing correlations is included. The course is delivered from the perspective of a vessel fabricator to better understand the dos and don'ts of ideal mechanical specification of pressurized equipment by owner/operators, in order to optimize material utilization and minimize construction costs. The Houston session features an afternoon field trip to a large pressure vessel fabricator.

DESIGNED FOR

Mechanical, facilities, construction, or project engineers and plant piping/vessel designers who are involved in the specification and purchasing of pressure vessels, heat exchangers, and other pressure-containing equipment for oil and gas facilities.

YOU WILL LEARN

- About ASME B&PV code and the commonly used sections relevant to oil and gas equipment
- To specify correct and commonly used materials according to ASME II
- How to design vessel shells, heads, nozzles, and heat exchanger details
- How to provide accurate equipment specification documents and review documentation for code compliance
- Key fabrication processes used in the workshop and how to simplify construction through correct vessel specification
- About welding processes and inspection requirements per ASME IX

COURSE CONTENT

Vessel codes and standards (ASME B&PV Code, TEMA, API) • Vessel material selection, corrosion mechanisms, heat treatment, and basic metallurgy • Essential design calculations for vessels and heat exchangers • Welding process overview and inspection requirements • Constructability and operability considerations • Vessel integrity, evaluation, and re-purposing of pressure-containing equipment according to API/ASME

2017 Schedule and Tuition (USD)

HOUSTON, US †	28 AUG-1 SEP	\$4325
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† includes field trip

Fundamentals of Pump and Compressor Systems – ME44

INTERMEDIATE 5-DAY

This is an intensive 5-day course providing a comprehensive overview of pumps and compressor systems. The focus is on equipment selection; type, unit, and station configuration; and integration of these units in the process scheme and control strategy in upstream and midstream oil and gas facilities. The material of the course is applicable to field production facilities, pipelines, gas plants, and offshore systems.

DESIGNED FOR

Engineers, senior technicians, and system operators designing, operating, and maintaining pump and compressor systems in oil and gas facilities.

YOU WILL LEARN

- Selecting the appropriate integrated pump and compressors units (drivers, pumps, compressors, and auxiliary systems)
- Integrating the pump or compressor units with the upstream and downstream piping and process equipment
- Evaluating pump and compressor units and their drivers in multiple train configurations, parallel and series
- Identifying the key local and remote control elements of pumps and compressors as well as their drivers
- Defining the major life-cycle events, such as changes in flows, fluid composition, and operating conditions that can affect equipment selection and operating strategies
- Assessing the key pump hydraulics and compressor thermodynamics, and their effect on selection and operations
- Identifying significant operating conditioning monitoring parameters and troubleshooting techniques

COURSE CONTENT

Types of pumps, compressors, and drivers, and their common applications and range of operations • Evaluation and selection of pumps and compressors, and their drivers for long-term efficient operations • Unit and station configuration including multiple trains in series and/or parallel operations • Integration with upstream and downstream process equipment, local and remote control systems, and facilities utilities • Key auxiliary systems including monitoring equipment, heat exchangers, lube and seal systems, and fuel/power systems • Major design, installation, operating, troubleshooting, and maintenance considerations

2017 Schedule and Tuition (USD)

COVINGTON, US	18-22 SEP	\$4110
DENVER, US	24-28 JUL	\$4160
DUBAI, UAE	12-16 NOV	\$5190
KUALA LUMPUR, MYS	20-24 NOV	\$5460
MIDLAND, US	4-8 DEC	\$4,110



Compressor Systems - Mechanical Design and Specification – ME46

SPECIALIZED 5-DAY

This 5-day, specialized level course is for facility design engineers, operations engineers, and technicians seeking an in-depth understanding of centrifugal, reciprocating, and screw compressors. This course provides basic knowledge of compressor types and associated auxiliary systems, mechanical design of equipment, operating and performance characteristics, control and monitoring systems, maintenance practices, and codes and standards.

DESIGNED FOR

Mechanical, facilities, plant, or pipeline engineers and technicians needing an in-depth understanding of the different types of compressors.

YOU WILL LEARN

- How to apply thermodynamics to compressor performance and operating characteristics
- How to size, specify, and select compressors
- Compressor auxiliary systems
- Series and parallel application of compressors
- How to integrate compressor systems into process facilities used in the oil and gas industry
- How to use state-of-the-art monitor and control devices in the operation, maintenance, and troubleshooting of compression systems
- How to apply maintenance practices to improve compressor reliability
- Shop and field performance testing
- Compressor economics including OPEX vs. CAPEX considerations

COURSE CONTENT

Types and application of compressors • Selection criteria of dynamic and positive displacement compressors • Compressor thermodynamics and operating characteristics • Performance curves and off-design evaluations • Key compressor components and other auxiliary systems • Equipment specifications • Compressor controls and monitoring devices • Driver and gear involvement • Installation, operation, maintenance practices, and troubleshooting • Economic considerations

Turbomachinery Monitoring and Problem Analysis – ME62

SPECIALIZED 5-DAY

This 5-day course is an intensive, specialized level program for experienced mechanical equipment engineers to develop and expand their capabilities in monitoring and problem analysis of turbomachinery. This course focuses on defining the systems and subsystems that form the turbomachinery, the potential problems with these systems and subsystems, monitoring techniques for early detection of problems, and methods to analyze the monitored variables to detect potential problems or reconstruct reasons for failures. Case studies are used throughout the course.

DESIGNED FOR

Experienced mechanical or facilities engineers and senior technicians needing an understanding of monitoring and troubleshooting turbomachinery.

YOU WILL LEARN HOW TO

- Evaluate turbine performance during startup and operation
- Identify turbomachinery system components
- Define and use appropriate monitoring techniques and tools
- Utilize effective operation and shutdown procedures
- Analyze common turbomachinery problems, such as vibration, temp/pressure operation, and surge
- Solve instrumentation and control problems
- Understand the inter-relationships of drivers, couplings, gearboxes, and driven equipment
- Evaluate installation techniques, equipment failures, and different maintenance practices
- Evaluate economic considerations

COURSE CONTENT

Gas turbine machinery - general description • Operating principles of gas turbines • Key performance variables and means to monitor • Major components of axial flow compressors: rotors, blades, shafts, combustion chambers, nozzles, etc. • Auxiliary systems: lube oil, seal oil, fuel, start-up, etc. • Evaluation of turbine performance parameters during start-up and normal operation • Troubleshooting control systems for gas turbines: start-up, speed and temperature controls, vibration • Principles of operation and general components of compressors: rotors, seals, diaphragms, etc. • Operating characteristics curves • Surging phenomenon • Choking phenomenon • Compressor instrumentation: various control loops, anti-surge control loops • Compressor safety interlock and trip systems • Gas turbine and compressor systems start-up procedures • Normal operation - monitoring of parameters • Shutdown procedures • Logging of monitoring checks • Vibration monitoring • Troubleshooting

Process Plant Reliability and Maintenance Strategies – REL5

INTERMEDIATE 5-DAY

This course is designed to teach reliability engineering skills as they apply to improving process system reliability and developing maintenance strategies. You will use modern software and analysis methods to perform statistical analysis of failures and model system performance, plus develop maintenance and reengineering strategies to improve overall performance.

DESIGNED FOR

Maintenance, engineering, and operations personnel involved in improving reliability, availability, condition monitoring, and maintainability of process equipment and systems. Participants should have foundation skills in statistical analysis and reliability techniques for equipment.

YOU WILL LEARN

- Improving reliability in new facilities/systems
- Reliability design for maintainability
- Developing initial maintenance strategies
- Virtual equipment walk-down; criticality using simulation and modeling; developing baseline condition monitoring programs; developing lubrication programs; and developing process-specific maintenance strategies with reliability-centered maintenance (RCM)
- Improving reliability in existing facilities/systems
- Analyzing process reliability plots to determine the amount of opportunity
- Continuous improvement through failure reporting, analysis, and corrective action systems (FRACAS)
- Developing policies and procedures; developing failure reporting codes; statistical analysis of failures using Weibull; and developing root cause analysis (RCA) programs (triggers for RCA and analyzing recommendations)
- Developing maintenance strategies with condition monitoring
- Identifying applicable condition monitoring methods; using criticality to determine level of condition monitoring application; and reporting asset health
- Developing maintenance strategies with RCM
- Developing policies and procedures; identifying systems for analysis; analyzing recommendations with simulation and modeling; and implementing recommendations
- Monitoring results
- Understanding the true purpose of key performance indicators (KPIs)
- Developing appropriate reliability and maintainability KPIs

COURSE CONTENT

Criticality analysis • Availability simulation and modeling • Statistical analysis of failures using Weibull • Maintenance strategy development; condition monitoring; reliability-centered maintenance; and essential care • Process reliability analysis • Root cause analysis • Failure reporting, analysis, and corrective action systems • Key performance indicators • Reliability definitions

Risk Based Inspection – REL61

INTERMEDIATE 5-DAY

The risk-based approach requires a systematic and integrated use of expertise from the different disciplines that impact plant integrity. These include design, materials selection, operating parameters and scenarios, and understanding of the current and future degradation mechanisms and risks involved. Risk-based methodologies enable the assessment of the likelihood and potential consequences of equipment failures. Risk-Based Inspection (RBI) provides companies the opportunity to prioritize their equipment for inspection; optimize inspection methods, frequencies, and resources; and develop specific equipment inspection plans. This results in improved safety, lower failure risk, fewer forced shutdowns, and reduced operational costs.

DESIGNED FOR

Inspection maintenance, production, and other plant engineers and technicians responsible for the safe on-going operation of pressure-containing equipment in oil and gas facilities.

YOU WILL LEARN

- To apply fundamental principles of risk analysis, using practical application through case histories and a step-by-step evaluation process for each type of damage mechanism
- To quantitatively determine probability of failure of pressure equipment, analyze consequences of failure, and develop an appropriate inspection plan
- About the fundamental principles of component integrity, application of the API rules, material properties of strength and toughness, and the introduction to stress and fracture mechanics
- How to assess the integrity of equipment and make projections about remaining useful life
- Assessment of existing static equipment to increase the equipment capacity and to extend service life; API 579-1/ASME FFS-1
- To apply and use API RP 580 and API RP 581 recommended practices; for pressurized components (e.g. pressure vessels and piping), these assessments can be used to determine optimum inspection intervals through the considered application of ASME section V NDE techniques

COURSE CONTENT

RBI philosophy based on API RP 580 • Risk-based decision making fundamentals and tools • Technical integrity and mechanical properties of pressure equipment • Understanding and managing risk • Fires, vapor cloud explosions (VCE), and boiling liquid expanding vapor explosions (BLEVE) • API risk-based inspection methodology • Damage mechanisms affecting pressure equipment in the oil and gas industry • Non-destructive examination techniques (NDE and NDT) • API RP 581 Part 1, Part 2, and Part 3 • Fitness for service assessments using API 579-1/ASME FFS-1 • Inspection plan development and implementation • RBI rollout and management

2017 Schedule and Tuition (USD)

HOUSTON, US 18-22 SEP \$4150

See website for dates and locations

See website for dates and locations

See website for dates and locations



TO VIEW OUR COURSES IN OTHER DISCIPLINES, VISIT:

Subsurface

- Introductory and Multi-Discipline
- Geology
- Geophysics
- Petrophysics
- Reservoir Engineering
- Well Construction/Drilling
- Production and Completions Engineering
- Unconventional Resources
- Integrated - Heavy Oil
- Petroleum Data Management

Facilities

- Gas Processing
- Process Facilities
- Offshore & Subsea
- Pipeline Engineering
- Instrumentation, Controls & Electrical
- Reliability Engineering
- Procurement/Supply Chain Management
- Refining

Operations & Maintenance

Health, Safety, Environment

Petroleum Business and Professional Development

- Petroleum Professional Development
- Petroleum Business
- Project Management

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