



## Testing and Quality Control TQLC-SA-07

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**COEN-SA-07-01**

**QUALITY CONTROL AND MECHANICAL TESTING OF  
ENGINEERING MATERIALS**

This course gives an overview of the methods of mechanical testing to personnel involved in quality control, design, production, purchasing and selling of a wide range of engineering materials. Practical experiments and industrial case studies are emphasized.

*Course Outline*

- **Quality control techniques and standard specifications**
- **Acceptance tests and analysis of test results and report writing**
- **Case studies**
- **Tension and compression tests**
- **Hardness tests**
- **Shear and torsion tests**
- **Creep and stress rupture tests**
- **Ductility and formability tests**
- **Fatigue tests and fracture and impact tests**
- **Instrumentation and calibration of testing equipment**

**COEN-SA-07-02**

**WELDING DESIGN**

The main objective of this course is to introduce welding engineers to the subject of welding design. Many factors have to be considered in this issue. These factors include: customer requirement, technical specifications, and environmental and economical constraints

*Course Outline*

- **Types of welded joints**
- **Welding Accessibility and Inspection**
- **Economical Analysis**
- **Design information**
- **Welding symbols**
- **Case studies**
- **Materials properties related to welding**
- **Welding process selection**



The objective of this course is to introduce engineers to the different welding codes, to discuss the methods of developing welding procedures and measuring performance of welding personnel.

*Course Outline*

- Welding processes and symbols
- Welding defects and quality control
- Destructive testing of welded joints
- API 1104 standard for welding pipelines and related facilities
- AWS D1.1 structural welding code
- ASME boiler and pressure vessel code
- Welding procedure specification and qualification
- Performance qualification
- Case studies

Once a quality assurance program has been developed and implemented, the only possible way an organization can verify its effectiveness is to carry out regular audits. Having established procedures to cover all activities and functions of a company, the only way to assure that all these procedures are being properly adhered to be to perform a compliance audit. This course is designed to familiarize engineers, inspectors and QA/QC specialists with the concept, methodology and application of quality assurance and program auditing.

*Course Outline*

- Preparation for auditing (objective - scope - checklists)
- Audit execution (document review - interview)
- Audit reporting (oral - written)
- Follow up
- Qualification and certification of auditors
- Case studies.
- Guidelines for auditing quality systems (ISO-10011)



**COEN-SA-07-05**

**NON-DESTRUCTIVE TESTING: FUNDAMENTALS, TECHNIQUES AND APPLICATIONS**

**This course is designed to give engineers an overview of the field of nondestructive testing NDT. The course has three main objectives: a) to familiarize engineers and scientists with the different NDT methods and outline their advantages and limitations, b) to demonstrate the techniques used to interpret results of the different NDT methods, and c) to illustrate the selection of the appropriate NDT method for a given application.**

*Course Outline*

- **Nondestructive testing principles**
- **Ultrasonic, radiography**
- **Magnetic particle inspection**
- **Liquid penetrates, Eddy current**
- **Acoustic emission**
- **Case studies**

**COEN-SA-07-06**

**WELDING, CUTTING AND JOINING PROCESSES**

**The course familiarized engineers with various aspects related to welding and cutting techniques and procedures in industry. The course introduces the participants to the different welding techniques, advanced joining technologies and cutting processes for engineers or scientists.**

*Course Outline*

- **Non-conventional and advanced joining processes**
- **Power for welding**
- **Physics of arc welding**
- **Survey of welding processes**
- **Conventional welding processes**
- **Cutting processes**



**This course introduces engineers to the metallurgy of welding for various types of industrial alloys. It helps in understanding of micro-structural changes “hence property changes” during welding. It gives also the principles of preheat calculations, PWHT requirements and electrode selection criteria.**

*Course Outline*

- **Metallurgy of carbon and low alloy steels**
- **Microstructure changes during welding of carbon and low alloy steel**
- **Pre-weld heat treatment calculations: effect of carbon equivalent (alloying elements), heat input, thickness**
- **PWHT or stress relief heat treatment**
- **Welding of various types of stainless steels**
- **Welding of various types if cast iron**
- **Welding of non ferrous alloys: solid solution alloys, precipitation hardenable alloys**
- **Principles of filler metals selection for various welding techniques**
- **Case studies.**



**COEN-SA-07-08**

**INSPECTION OF PRESSURE VESSELS ACCORDING TO API REQUIREMENTS**

The objective of this course is to give orientation information for those who are involved in pressure vessels' inspection, maintenance and repair. Such information includes types of pressure vessels, materials used in their structure, their uses and maintenance inspection techniques used. The course is prepared according to the requirements of the American Petroleum Institute Codes and Standards (API 510 and API RP 572).

*Course Outline*

- Introduction and overview of the applied codes and standards
- Types of pressure vessels: columns, towers, drums, heat exchangers, condensers, etc
- Materials and methods of construction; carbon steel, low-alloy steel, austenitic steels and Ni-based alloys.
- Reasons for periodic inspection: safety, continuity, efficiency and reliability.
- Causes of degradation and deterioration in the materials of pressure vessels: corrosion, erosion, metallurgical changes, thermal stresses, mechanical stresses, faulty material and or fabrication techniques.
- External Inspection of pressure vessels: supports and bolts, insulation and coatings, metallic parts, evidence of corrosion, etc.
- Internal Inspection: visual inspection, metallic lining and non-metallic lining.
- Special methods for Inspection: Thickness measurements, in-situ metal analysis, hammer testing, pressure and leak tests.
- Records and reports
- Case study

**COEN-SA-07-09**

**HEAT TREATMENT OF INDUSTRIAL ALLOYS AND WELDED JOINTS**

The course is deigned to introduce candidates with information related to various heat treatments of ferrous and non-ferrous alloys used in various industries including petroleum, petrochemical and chemical industries. A specific emphasis is given to the heat treatment of welded joints.

*Course Outline*

- Heat treatment of carbon and low alloy steels: quenching, normalizing, isothermal heat treatment
- Preheat and Post-Weld Heat Treatment of carbon and low alloy steels



- **Types of stainless steels: grain boundary precipitation during welding of stainless steels**
- **Solution heat treatment of stainless steels of stainless steels**
- **Nonferrous alloys: work-hardening, stress relief, grain growth and recrystallization**
- **Precipitation hardening of nonferrous alloys**
- **Welding of non ferrous alloys, heat input and heat treatment of hardenable and non-hardenable alloys**
- **Case studies.**

**COEN-SA-07-10**

**FUNDAMENTALS OF WELDING TECHNOLOGY: PROCESSES, INSPECTION AND QUALITY CONTROL**

**The main objective of this course is to familiarize engineers and inspectors to various aspects related to welding techniques, inspection and quality procedures in welding industry. The course is designed for engineers or scientists with no or little experience in the welding field.**

#### ***Course Outline***

- **Welding processes: Shielded metal Arc welding, Gas metal Arc welding, Gas tungsten Arc welding, Submerged Arc welding, Oxyfuel welding and electric resistance**
- **Cutting processes: Oxygen cutting, plasma cutting and laser cutting**
- **Inspection of weldments: Nondestructive testing of weldments (RT, UT, MT, PT), Mechanical testing of weldments (tensile, bending, impact)**
- **Principals of QA and QC in Welding: Codes, standards, welding procedure & welder qualification.**



**COEN-SA-07-11**

**ADVANCED WELDING TECHNOLOGY: WELDING METALLURGY AND ELECTRODE SELECTION**

This course introduces engineers to the metallurgy of welding for various types of industrial alloys. It helps in understanding of microstructural changes "hence properties changes" during welding. It gives also the principals of preheat calculations PWHT requirements and electrode selection criteria. The course is to be attended by engineers with some experience in welding or those who attended the Fundamentals Welding Technology Course (part 1 of this series of courses).

*Course Outline*

- Case studies.
- Metallurgy of carbon and low alloy steels
- Microstructure changes during welding of carbon and low alloy steel
- Pre-weld heat treatment calculations: effect of: carbon equivalent (Alloying elements), heat input, thickness
- PWHT or stress relief heat treatment
- Welding of various types of stainless steels
- Welding of various types of cast iron
- Welding of non ferrous alloys
- Principal of filler metals selection of various welding technique

**COEN-SA-07-12**

**ADVANCED WELDING TECHNOLOGY: CODES, STANDARDS & QUALITY ASSURANCE**

The course is offered to engineers who are familiarized with Welding principals and are willing to create documents for qualification of welding procedures, welders and welding operators. Also the course explains in details procedures to prepare a complete set of documents for a quality assurance system in welding industry.

*Course Outline*

- Introduction : history of codes and standards in welding
- ASME Boiler and Pressure Vessel Code
- American Petroleum Institute Standard No. API 1 104 for welding petroleum pipelines



- American Welding Society Steel Structure Code (AWS D1.1)
- Qualification of Welding Procedures (WPS and PQR)
- Qualification of Welders and Welding Operators
- European Standards for Qualification EN 188
- European Standards for Quality Assurance in Welding Industry (EN 297 parts 1, 11 and 111)
- Case studies.

**COEN-SA-07-13**

**INDUSTRIAL QUALITY MANAGEMENT: PLANNING, ANALYSIS AND CONTROL**

**The objectives of this course are: a) to familiarize engineers with basic quality control concepts, b) to discuss the applications of statistical models to production and c) to illustrate construction of control charts and the development of sampling plans for receiving and for shipping departments.**

*Course Outline*

- **Role of statistics in industry, data collection, classification and statistical analysis**
- **Analysis of production data Control charts: X and R charts; The P,C,U charts**
- **Acceptance sampling: OC curves, MIL standards, Dodge Rooming standards**
- **Microcomputer software applications**
- **Case studies**