FACT SHEET

Online Master of Piping Systems Engineering

Online Master of Piping Systems Engineering for Industrial Plants, Power Plants, and Oil & Gas Plants

Who Should Attend?

This program is designed for a wide range of professionals such as technicians, designers, and engineers involved in the **calculation, design, selection, manufacturing, safety, quality control, and maintenance of piping systems and equipment** in industrial plants.

Prerequisites: prior knowledge in piping design, a degree in engineering, or verifiable experience.

Master Objectives

The main objective is to provide participants with a **solid base of theoretical knowledge and practical abilities based on professional experience and best practices** of engineering, essential for engineering projects. Students will be taught the competencies necessary to face **current and future challenges** in the professional field.

What to Expect?

Participants will acquire both fundamental, as well as advanced abilities for the **design, calculation, modelling, and support of piping systems in industrial plants**. Upon completion of the program, participants will demonstrate a **solid knowledge and a comprehensive understanding of piping systems**, from piping **fundamentals**, **sound engineering practices and lessons learned** from several engineering projects. This knowledge will allow participants to develop **safe and economical designs** to be applied in the majority of industrial plants.

Duration of the Master

The master has been designed to be completed with an average dedication of 510 hours over 51 weeks.

Methodology

Self-guided Hands-On

Available 24/7

"Learn by doing" concept.

No scheduled sessions

Specialist Instructor available throughout the course

Included in the program

- Study Notes
- Summary Videos
- Progress Quizzes
- Case Studies
- Design & calculation sheets

Part I: Introduction to Piping Systems in Industrial Plants (20 hr)

L1. Industrial projects

Introduction

Projects

Project life cycle

Phases of a project over time

General organization within the projects

Project execution schedule

Responsibility within projects

Project management according to PMI

Exercises & Case Studies

- *Vocabulary and terminology*
- *Project organization*
- *Project life cycle*

L2. Relationship between disciplines

Introduction

Engineering sequence

Engineering and its collaborators

Main deliverables developed by each discipline

Direct communication and through products

Interdisciplinary meetings

Verification and quality control

Internal and external audits

Exercises & Case Studies

- *Vocabulary and terminology*
- *Discipline deliverables*
- *QA*

L3. Workflow, documents, and plans

Introduction

Pipeline specialty overview

Base documentation for the development of products in the pipe specialty

Pipeline Specialty Workflow

Importance of the design of piping systems in projects

Exercises & Case Studies

- *Vocabulary and terminology*
- *Workflow*
- *Vision of the piping discipline*

Part II: Fundamentals of Piping Systems (80 hr)

L1. Codes & Design Criteria

Applicable Codes

ANSI Code

ASTM Code

ASME B31 Code

Design Loads

Sustained Loads

Displacement Loads

Occasional Loads

Exercises & Case Studies

- *Assimilation test*

L2. Diameter & Pressure Loss

Flow of fluids in pipes

Properties of fluids

Flow of fluids

Energy conservation law

Pressure loss

Pressure loss in straight runs

Pressure loss in fittings

Exercises & Case Studies

- *Assimilation test*
- *Case Study No.1: Energy Conservation – Bernoulli*
- *Case Study No.2: Diameter and Pressure Loss Calculation*

L3. Material Selection

Material selection

Corrosion types

Corrosion Allowance

Essential properties of materials

Allowable stress

Material designation

Most used materials

General requirements

Exercises & Case Studies

- *Assimilation test*
- *Case Study No.1: Material Selection*

L4. Piping Insulation

Purpose of insulation

Selection parameters

Insulation Calculation

Effective thickness

Cold & hot piping insulation

Thickness selection

Insulation installation

Exercises & Case Studies

- *Assimilation test*
- *Case Study No.1: Insulation material properties*
- *Case Study No.2: Heat transfer equation*
- *Case Study No.3: Effective thickness*
- *Case Study No.4: Insulation specification*

L5. Thickness Calculation

Stresses in cylindrical shells

Thin-walled cylinders

Thickness calculation procedure

ASME B31.1 Formulae: Power Piping

ASME B31.3 Formulae: Process Piping

ASME B31.4 Formulae: Pipeline Transportation

ASME B31.8 Formulae: Gas Transport

Commercial thickness selection

Exercises & Case Studies

- *Assimilation test*
- *Case Study N.1: Thickness Calculation ASME B31.1*
- *Case Study N.2: Thickness Calculation ASME B31.3*
- *Case Study N.3: Thickness Calculation ASME B31.4*
- *Case Study N.4: Thickness Calculation ASME B31.8*

L6. External Pressure Design

Applicable Codes

Failure Mechanisms

Moment of Inertia of the System

Support Lines

System verification

Wall thickness and Stiffening rings

Best Practices

Exercises & Case Studies

- *Assimilation test*
- *Case Study No.1: Pipe Thickness*
- *Case Study No.2: Separation between support lines*
- *Case Study No.3: Stiffening rings*

L7. Buried Piping Design

Introduction

Design Codes

Terrain Importance

Design Considerations

Loads Definition

Stress Verification

Failure Modes

Installation

Exercises & Case Studies

- *Assimilation test*
- *Case Study No.1: Buried Piping Design*

Part III: Piping Class Specification (40 hr)

L1. Piping systems

Piping System Design

Applicable Codes

Reference Standards

Components of a System

Jointing Methods

Nomenclature and Terminology

Exercises & Case Studies

- *Vocabulary and terminology*
- *Assimilation test*
- *Identification of components*
- *Identification of joining methods*

L2. Facility Services

Industrial Facility Services

Identification of plant services

Grouping of similar services

Materials

Allowable Corrosion

Coding of pipe specifications

Pressure and temperature range

Operating conditions

Design conditions

Exercises & Case Studies

- *Assimilation test*
- *Service grouping*
- *System coding*
- *Pressure and temperature range*

L3. Component Specification

Component Specification

Piping Selection

Calculating Required Thicknesses

Selection of Nominal Thicknesses

Component Selection

Elbows | Tees | Caps

Eccentric reducers | Concentric reducers | Concentric reducers Flanges | Gaskets | Nuts and bolts

Valves: Gate | Globe | Check | Check valves

Schedule Pipe and Calibrated Pipe

Exercises & Case Studies

- *Assimilation test*
- *Piping Calculations*
- *Fittings Selection*
- *Flange Selection*

L4. Branch Table

Pipe-Tube Connection Joints (Grafts)

Calculation of reinforcements

O'let Fittings

Tee | Reducing Tee | Couplings (sleeves)

Exercises & Case Studies

- *Assimilation test*
- *Reinforcements calculation*
- *Selection of O'let fittings*
- *Selection of couplings*

Part IV: Design, Modelling and Drafting of piping systems (120 hr)

L1. Documentation for routing

Introduction

Initial documentation required for pipeline route development

Project bases and criteria

PFD, PID diagrams

Line List, Equipment List

Data sheets, schematics, equipment plans

Piping Specifications and Criteria

Exercises & Case Studies

- *Vocabulary and terminology*
- *Assimilation test*
- *PFD Diagram Exercises | PI&D*

L2. Interpretation of a PFD | P&ID

Introduction

Main diagram types

Symbology, lines

Equipment and instruments

Entries, exits, continued

Line thicknesses.

Notes and their importance

Revisions and clouds

Master document. Importance

Exercises & Case Studies

- *Assimilation test*
- *Symbology exercises*
- *Interpretation of diagrams*

L3. Plot Plan & other important docs

Introduction

General considerations for preparation

Location of equipment, main structures, roads and accesses

Predominant wind directions and their importance

Minimum information required, symbols

Key implementation plans

Super piping schemes, purpose

Exercises & Case Studies

- *Assimilation test*
- *Case study: equipment location*
- *Symbology exercises*

L4. Orthographic routing plans (Layout)

Introduction

Scales, paper size, useful space, layout

Elemental symbology for diagramming pipe routes on plans

Single line and double line representation

Minimum information required, dimensions, elevations, etc.

Most important criteria to apply in the development of route plans

Instruments in lines and their considerations in pipeline routes

Exercises & Case Studies

- *Assimilation test*
- *Case study: examples of pipe routing*
- *Symbology concepts*

L5. Isometrics

Introduction

Basic documents for development

Isometric work planes, orientations

Marks, names of equipment nozzles, coordinates, and elevations.

Flow direction and sizing

Development of isometrics, paper size, useful space

Elemental symbology for product layout

Material list

Exercises & Case Studies

- *Assimilation test*
- *Case study: isometric symbology*
- *Bill of materials exercises*

L6. Equipment interconnection

Introduction

Generalizations, types of equipment

Main codes for static and rotating equipment

Considerations for the development of pipeline routes in relation to the type of equipment

Data sheets, schematics, manufacturers drawings, specifications

Interconnection between pipes and equipment

Shells and nozzles in space

Exercises & Case Studies

- *Assimilation test*
- *Case study: best practices*
- *Minimum distances*

L7. Piping modelling (2D & 3D)

Introduction

Evolution from the physical model to the electronic model

Generalities of 3D work tools

Work philosophy (Workflow)

Database, types

Disciplines that intervene in the execution of the 3D model

Usefulness of 3D models in engineering phases

Exercises & Case Studies

- *Assimilation test*
- *Case study: interpretation of models*
- *Interference analysis*

L8. Modelling & Design tools

Introduction

Tools for modelling 2D piping

Tools for modelling 3D piping

Specific knowledge for the implementation of a 3D tool

2D and 3D viewers, scope, usefulness

3D commercial software

Exercises & Case Studies

- *Assimilation test*
- *Case study: 3D model examples*
- *Model visualization*

Part V: Stress and Flexibility Analysis (120 hr)

L1. Mechanics of materials

What is the mechanics of materials?

Basic concepts

Definition of loads and their types

Definition of stresses

Materials mechanics

Deformation

Stiffness

Hooke's law

Exercises & Case studies

- *Assimilation test*

L2. Stress/strain fundamentals

Stress-strain

Engineering stress-strain vs. true stress-strain

Properties obtained by means of a stress-strain curve

Types of stresses

Failure modes

Stress concentrators

Photoelasticity and Thermoelasticity

Exercises & Case studies

- *Assimilation test*

L3. Introduction to stress analysis

Piping systems

Classification of piping systems

Dimensional characteristics of pipes

Common joining methods

Piping Materials

Main piping organizations and codes

Differences between piping codes

Stress and flexibility analysis in piping systems

Challenges of piping stress analysis

Why a stress and flexibility analysis in piping systems?

Stresses in piping systems

Primary, secondary, tertiary stresses in piping systems

Stress intensification factors in piping systems

In plane and Out plane

Criteria for estimating stresses in piping systems

Stress limits in piping systems according to codes

Combination of loads and stresses in piping systems

Exercises & Case studies

- *Assimilation test*

L4. Stress & flexibility analysis

Stress and flexibility analysis in piping systems

How do you increase flexibility in a piping system?

Stages in a stress and flexibility analysis

Thermal expansion in pipes

Force induced by thermal expansion

Induced stresses and strains

Allowable stresses according to codes

Simplified analytical calculations

Stress and flexibility analysis with computers

Exercises & Case studies

- *Assimilation test*

L5. Considerations for the analysis

Modelling considerations when performing stress and flexibility analysis

Degrees of freedom

Restrictions

Mathematical and physical considerations of a calculation software

Boundary conditions used in analysis

Numerical methods

Types of elements used in mathematical type simulations

Exercises & Case studies

- *Assimilation test*

L6. Stress analysis with computers

Stress and flexibility analysis with computers

Commercial software

Considerations regarding the use of software

Complementary calculations to stress and flexibility analysis

Other software or tools used

Exercises & Case studies

- *Assimilation test*

L7. Introduction to Software

Introduction to Software

Software overview

Main codes contained

Loading the main inputs in the software

Definition of operating scenarios and load cases

Analysis and visualization of results

Exercises & Case studies

- *Assimilation test*
- *Case study*

L8. Loads, stiffness, and flexibility

Introduction

Loads and deformation

Flexibility in piping systems

Gain flexibility or decrease stiffness

Exercises & Case studies

- *Assimilation test*
- *Case studies to increase flexibility in piping systems*

L9. Movement, stiffness, & loads

Introduction

Different load types in piping systems

Movements at terminal points (Edge/border)

Stiffness and associated movements in boundary conditions

Exercises & Case studies

- *Assimilation test*
- *Case studies: evaluation of stress levels of different piping systems*

L10. Nozzle displacements

Introduction

Displacement, local and global stiffness, rigid elements

Other types of stiffness

Exercises & Case studies

- *Assimilation test*
- *Case studies: evaluation of loads in a centrifugal pump*

L11. Additional considerations

Introduction

Unexpected or underestimated movements

Simulation of characteristic rigid elements

Special considerations for restrictions in elbows

Local stresses at trunnions

Exercises & Case studies

- *Assimilation test*
- *Case studies for improving stress levels in piping systems*

Part VI: Design and Selection of Supports (50 hr)

L1. Purpose & classification

Supports design

Information gathering

Purpose of piping supports

Supports classification

As per the attachment to piping

As per the construction method

Exercises & Case Studies

- *Assimilation test*

L2. Stress analysis & restraints

Stress analysis

Thermal expansion of piping

Design loads

Piping systems restraints

Symbology, types of restraints

Stress isometric

Exercises & Case Studies

- *Assimilation test*
- *Suggested Case Study No. 1/2/3*

L3. Rigid supports

Types of rigid supports

Rest supports, guide

Stops, anchors

Hangers, Trunnions and pedestals

Materials of supports

Supports standard

Exercises & Case Studies

- *Proposed Case Study No. 1: Commercial supports*
- *Proposed Case Study No. 2: Standard of supports*

L4. Spring supports

Variable loads spring

Purpose and characteristics

Selection procedure

Constant loads spring

Purpose and characteristics

Selection procedure

Exercises & Case Studies

- *Assimilation test*
- *Proposed Case No. 1/2: Variable load springs*
- *Proposed Case No. 3/4: Constant Load Piers*

L5. Location & calculation

Location in the piping system

Maximum span between supports

Structural calculation

Stresses, deformations

Calculation tools, examples

Exercises & Case Studies

- *Assimilation test*
- *Proposed Case No. 1: Support spacing*
- *Proposed Case No. 2: Structural supports*

L6. Special supports

Types of special supports

Rigid strut, Snubber, Sway brace

Supports for vibrating systems

Supports for structures and equipment

Supports for cryogenic systems

Exercises & Case Studies

- *Assimilation test*

Part VII: Master's Final Project (80 hr)

Master's Final Project

The final project of this master consists of the design and calculation of the pumping system, conditioning, storage and injection system of demineralized water in gas turbines of a power generation plant.

To carry out the project, participants will have to:

- Size piping systems according to the required flow
- Calculate system head losses
- Select the thermal insulation of the system
- Carry out the layout of the piping system (plot plan, isometric, etc.)
- Develop the piping class of the system
- Carry out the stress and flexibility study
- Select and calculate system supports
- Perform the MTO of the systems involved

Instructor

Senior Mechanical Engineer and Master in Business Administration (MBA). **More than 20 years of experience in design, calculation and fabrication of pressure vessels, heat exchangers, storage tanks, piping systems and structures in general.**

Duties of the above-mentioned positions cover the entire cycle of an equipment, **from the very conception, drawings, design and calculation, technical specifications, technical requisitions, vendor drawings, to the manufacturing phase and installation assistance**. Among the developed projects, clients such as SHELL, EXXON, REPSOL, CHEVRON, GALP, CEPSA, TUPRAS and SAUDI ARAMCO can be found.

Vast experience providing specific training sessions in both classroom and online approaches. More than 75 training courses carried out in different institutions and in-company, courses oriented to graduates, designers, engineers and experienced professionals.

Tailored Training

The most effective training is one that satisfies the needs of each company's business focus and deliverables. **We adapt our training programs to each specific requirement, offering bespoke solutions for each need.** The result, 100% tailored programs, developed to maximize the time investment and deliver tangible and intangible returns to the work teams.

After an assessment phase, a tailored training plan is designed jointly with the client. This plan is specifically tailored to meet the client's needs, focusing on effectively enhancing the capabilities of the work team. **We provide practical, dynamic and hands-on training,** making available the best instructors in each subject.

Arveng Training

Arveng Training has developed effective and practical solutions for today's industrial challenges by delivering specific, high-quality engineering courses utilizing three different approaches: classroom, online, and tailored training. We are proud to have imparted more than 250 classroom courses, 1200 online courses, and over 65 in-company sessions. Our training activities have benefitted over 4500 professionals, our greatest accomplishment of all.

We consider our students' time to be of utmost importance. For this reason, all our courses have been designed with the main objective of quickly improving the professional skills of the participants through our expert instructors in different disciplines. **We stimulate creativity, innovation, and initiative to make the participants inquisitive, bringing good engineering practices and lessons learned to the field, that benefits their professional lives in the long term.**

Our Company

Arveng Training & Engineering SL is a leading company providing Training and Engineering services based in Madrid, Spain. Our mission and vision are to be a leading training and engineering services company, providing our clients with the best in the sector. We are a team of highly motivated, talented, highly qualified professionals with over 20 years of experience. We aim to exceed expectations by offering efficient, innovative, cost-effective, and transparent services.

Established in July 2010, mainly oriented to the industrial sector, from the very beginning Arveng has always worked with closeness, responsibility, and commitment in all areas of activity.

Through experience gained by partaking in multidisciplinary engineering projects in sectors such as Petrochemical, Energy Generation, and Industrial, we provide answers and solutions to concrete requirements, making the effort to build long-lasting and mutually beneficial relationships.