



Applications of Industrial Valves

(Types and Characteristics, Selection, Operation and Maintenance)

Introduction:

Valves are very essential parts of industrial pipelines or hydraulic or pneumatic circuits. Because flow area through valves can be changed, valves are therefore the final control elements in pipelines control systems. Today's spectrum of available valves extends from simple water faucets to large control valves equipped with micro-processors to provide single-loop control of the process. Valves are assemblies of many parts made of different materials as per the design requirements, efficient performance and safe operation conditions. There are many major types of valves. Each type includes various designs and range of sizes to meet all flow applications in pipe lines. The most common types are gate, plug, globe, ball, butterfly, check, bench, diaphragm and needle valves. The valve's inherent control and pressure loss characteristics are greatly function of its type and internal design.

Many different manual or automatic operation methods of valves are used. Positioners and valves automatic actuation methods include electro-mechanical gear system, electro-hydraulic, Pneumatic, Servo-motor, ON/OFF or proportional solenoid, ..etc. Valves are used to control several important flow parameters such as: control the of flow rate (i.e., from 0 to 100% value); pressure control valves (including regulation, safety and pressure relief valves); Directional Control Valves which divert the flow from one path to another; ...etc. The effect of selection and proper operation of valves are also very important factors for Water Hammer Protection and Surge Control Systems. Valves are constructed to withstand specific design and operation ranges of flow rate, fluid temperature, pressure, corrosion, and applied mechanical stresses. Emergency and pressure relief valves and ruptured disks are practically the key elements in the safe operation of any high pressure and high temperature process. The correct selection and application of valves as well as the safe operation and maintenance requirements of those critical components shall affect greatly cost optimisation, plant availability, personnel and equipment safety as well as internal and external fluid leakage and many other related environmental issues.

Finally, valves are considered a major part in the design process of any piping system. Types and characteristics of valves, selection, operation and maintenance as well are in fact one of the very important practices of most engineers and technicians. Availability, efficiency and extended reliable performance of power plants, pumping and fluid handling stations and all similar facilities are greatly influenced by accurate design, selection, efficient operation and proper maintenance of valves. The mechanical power engineer must therefore have the essential knowledge and skills to deal with valves as they are important and crucial elements of any pipe line system.

Course Objectives:

This Training Course has been designed to give the participants a wide range of knowledge & practical skills to:

- Understand the basics and fundamentals of hydraulic considerations regarding the differences between fluid flow in valves as compared to fluid flow in pipes/ducts and other pipe line fittings.
- Understand how various types of valves are included in the design process of industrial pipe lines and networks.
- Full examination of how to calculate pressure/head losses at different valve's openings or operation conditions.
- Recognize all major types of available industrial valves including their basic functions in flow control process.
- Understand types of manual, automatic control and check valves as essential parts of pipelines. This includes various functions, materials, sizes, geometry considerations & the most essential flow characteristics of each type.
- Full examination of pressure drop relations and flow coefficient calculations for each valve type.
- Investigation of effects due to cavitations and flashing problems in valves and how to do correction procedures.
- How to do sizing process to select the proper valve size for a given flow is also considered.
- Investigate various international standards for valve design, rating, classes and material selection for internal parts.
- Full examination of various types of the essential emergency and pressure relief valves and ruptured disks.
- Full examination of various types of automatic control valves and water hammer protection valves including different methods of actuation and positioning devices.
- Understand some of valve's operation problems and some maintenance requirements and procedures.



The ILO's (Intended Learning Outcomes) of the Course:

a) Knowledge and Understanding:

Having successfully completed this course, the participants should have knowledge and understanding of:

- ✓ Fundamental aspects of valves, major types and their internal parts and geometric symbols of valves.
- ✓ Fluid flow, Hydraulic considerations and calculations of pressure/head Losses in various types of valves.
- ✓ Using Computer Software & numerical calculation methods in design & analysis of valves.
- ✓ Types of industrial valves (including functions, selections, operation considerations, construction, ratings, materials, sizing of valves, design facts/parameters related to Manual Valves.
- ✓ Basics & types of hydraulic/pneumatic automatic control valves (safety, pressure control, directional, check, ..etc).
- ✓ Water Hammer and surge control valves.

b) Intellectual Skills:

Having successfully completed this course, the participants should have the ability to:

- ✓ Select and apply appropriate technical and optimum method in doing design and analysis of valves problems.
- ✓ Searching for scientific information and adopting self-E-learning capabilities.
- ✓ Analyze & compare component effects, performance, and efficiency of different valves.

c) Professional and Practical Skills:

Having successfully completed this course, the participants should have the ability to do:

- ✓ Identify several types of valves which are essential for the design and safe operation of mechanical power systems and energy transfer processes.
- ✓ Perform professional design and modelling for using valves in pipe line systems and networks.
- ✓ Suggest possible alternative valves for various types of pipe line systems and networks.
- ✓ Diagnose efficiency and performance of different types of automatic control valves in pipe lines and networks.
- ✓ Perform engineering assembly of different valves in hydraulic/pneumatic automatic control circuits.
- ✓ Identify practical problems and compare between different technologies used for various valves.
- ✓ Apply concept of using software for design, simulation, analysis, diagnostics & operation of various types of valves.
- ✓ Compare between various types of valves in pipe line systems and networks.
- ✓ Apply scientific and engineering analysis for valves in pipe line systems and networks.

d) General and Transferable Skills:

Having successfully completed this course, the participants should have the ability to do:

- ✓ Transfer knowledge, Work in group and Communicate in written and oral forms, in English.
- ✓ Use IT & evolutionary technological tools & PC applications.
- ✓ Prepare & write reports, Manipulate & sort data, Think logically, and continuous self-E-learning.
- ✓ Organise and manage time & resources effectively; for short-term and longer-term commitments.

Who Should Attend:

Engineers and Field Personnel involved with design, maintenance, operation, selection installation and maintenance as well as plant reliability, condition monitoring and for the day to day servicing and operational efficiency. Also plant and maintenance engineers, process engineers and maintenance managers. It is also be invaluable to supervisors who are involved in pump and compressor maintenance activities.

The Instructor:

Dr. Mohsen Soliman is an Associate professor of fluid mechanics group in Mechanical Power Engineering Department – Cairo university. He has a Ph.D. degree, 1987 from university of California, Irvine and has a long teaching and research experience in the area of fluid flow, turbo machines, and gas dynamics and has many research papers published at international conferences and journals. Dr. Soliman has had many years' experience in organizing and lecturing training courses for engineers inside and outside Egypt. The courses cover design pipe lines, valve technology, water hammer and fire fighting systems. Currently, Dr. Soliman is the manager of the Automatic Control Lab, ACC, and the administrator of the Automatic Control Post Graduate Diploma at Mech. Power Engineering Dept. FECU. See the ACC site: www.acc-vlab.cu.edu.eg



Course Contents:

Chapter [1] : Introduction & Basic Concepts:

Fundamental Aspects of Fluid Flow in valves & piping Systems, Types and components of valves, Review of Hydraulic considerations, Minor pressure/head Losses in valves, Solved Examples.

Chapter [2] : Design Calculations for valves (Solved Practical Cases)

Chapter [3] : Using Computer Software in the design of valves.

Chapter [4] : Types of Valves (basic functions, selections:

Hydraulic considerations, construction, ratings, materials, Flow through valves, pressure losses, design facts / parameters
- Manual Valves (types, selection, connections, operation) - Check Valves (types, selection, design and installation factors) - Reducing and Pressure Relief Valves (direct acting, characteristics) - Automatic Control Valves (spool types, single/multi-stage controls) - Valve Maintenance - Examples for automatic Valves & movies

Chapter [5] : Types of Hydraulic and Pneumatic valves in Control Circuits

Daily Course Program

Day one:

9:00 – 9:30	Registration	
9:30 – 11:00	Lecture 1	Introduction to Fluid flow in pipe lines and valves+ movie.
11:00 – 11:30	Coffee break	
11:30 – 13:00	Lecture 2	Fundamentals of valves (major types, basic main functions, selection).
13:00 – 13:30	Lunch break	
13:30 – 15:00	Lecture 3	Hydraulic considerations, construction, Classes or valves ratings, Materials, standards for valves, standards for different valve parts.

Day Two:

9:00 – 10:30	Lecture 4	Design of valves (calculation of pressure/head losses) + practical movies.
10:30 – 11:00	Coffee break	
11:00 – 12:30	Lecture 5	Valve sizing parameters, cavitations, fluid-tightness, solved example on sizing.
12:30 – 13:00	Lunch break	
13:00 – 14:30	Lecture 6	Operation of Manual Valves (types, selection, connections and operation)

Day Three:

9:00 – 10:30	Lecture 7	Non-manual Valves: Check Valves (types, selection, design and installation factors, examples) + a movie
10:30 – 11:00	Coffee break	
11:00 – 12:30	Lecture 8	Control Valves: Pressure Relief/Safety Valves (direct acting, characteristics).
12:30 – 13:00	Lunch break	
13:00 – 14:30	Lecture 9	Electric Valves (spool types, single/multi-stage controls)

Day Four:

9:00 – 10:30	Lecture 10	Water Hammer and Surge Control Valves
10:30 – 11:00	Coffee break	
11:00 – 12:30	Lecture 11	Problems of Valves, Cavitations & flashing (some movies)
12:30 – 13:00	Lunch break	
13:00 – 14:30	Lecture 12	Special Types of valves (in Hydraulic or Pneumatic Control Circuits)

Day Five:

9:00 – 10:30	Lecture 13	Valve testing and Maintenance
10:30 – 11:00	Coffee break	
11:00 – 12:30	Lecture 14	Electro-Hydraulic and Servo-Valves + Movies
12:30 – 13:00	Lunch break	
13:00 – 14:30	Lecture 15	Course Review and Course Evaluation.

أ.م/ محسن سيد سليمان

مدير معمل التحكم ACC ومسئول إدارة دبلوم التحكم الأتوماتيكي - مدير وحدة ضمان الجودة سابقاً ومرشداً أكاديمي د.ع في قسم ميكانيكا قوى