Professional Development Courses from SigmaTech

Course Duration: 3 days

1. COURSE TITLE

Valve Design Principles and Procedures

2. COURSE DESCRIPTION

Valves have been called the “work horses” or “muscles” of any automatic control system. And, with the rapid changes occurring in the process industries, there is a constant need for the design, development, and testing of new and better valves. Defining a need, identifying a new application, designing new valves, improving valve design, replacing old designs, and offering less expensive options are all part of the valve designer’s environment.

A methodology of valve design is presented with an in-depth look at the design of various valve components, actuator selection and its valve interface, materials of construction, as well as latest machining practices and manufacturing processes. A close look at prototyping, industry standards, and testing requirements is also included. The instructor uses multiple examples of various valve types to present a systematic design methodology, which the valve designer will find very useful for designing any type of valve.

3. COURSE TOPICS

- Defining a need
- Establishing basic parameters
- Review of Industry Standards
- Design of Valve Body
- Valve Seat and Closure
- Valve Trim
- Actuator Selection
- Valve Actuator Interface
- Selection of Construction Material
- Coatings and Platings
- Valve Assembly and Testing
- Developing Prototype
- Developing Catalog Information
- Machining Practices and Manufacturing Processes

You will learn to apply these techniques to design, prototype, test, and manufacture valves for your application at the optimum cost. Discussing actual problems from your job experience is encouraged.
4. **SPECIAL FEATURES AND BENEFITS**

Participants will receive comprehensive notes based on the course presentation.

5. **WHO SHOULD ATTEND?**

This course was developed for engineers and other individuals involved with the design, specification, and maintenance of industrial valves & actuators. Valve specialists and those with some valve experience will come away with valuable information from this course. Participants should have some technical background and job related experience. Please bring calculators to the class.

6. **COURSE OUTLINE**

**DAY 1: Module Description**

I. **Course Introduction**
   A. **Course Overview**
      1. Course objectives
      2. Use of course materials
      3. Organization and sequence
   B. **Introduction of Course Participants**

II. **Prelude to the Control Valve Design**
   A. **Defining Valve Needs/Applications**
      1. Satisfying a new application
      2. Improving existing valve performance
      3. Cost reduction of existing valve
      4. Joining competition
   B. **Establishing basic design parameters (Phase 1)**
      1. Line medium
      2. Pressure-temperature of medium
      3. Type of valve-rising stem, rotary, etc.
      4. End connections
      5. Valve sizes
      6. Mode of valve operation
      7. Cost
      8. Write Phase 1.
   C. **Investigation of competitive Designs**
      1. Investigating similar valves on market
      2. Conducting patent search
         a. Where to find the information
         b. Things to watch out for
      3. Defining applicable industry & regulatory codes
   D. **Writing Project Description**
      1. Involvement of applicable company departments
      2. Seeking top management’s commitment
      3. To go ahead or not?
      4. Writing Phase 2
      5. Establishing schedules and milestones
a. Design time
b. Prototype manufacture
c. Prototype testing
d. Production release
e. Follow-up

III. Review of applicable valve industry standards/codes
A. ANSI B16.5
B. ANSI B16.34
C. ANSI B16.22
D. MSS Standards
E. API Standards
F. NACE Standards
G. Fire-Safe Standards

IV. Nuclear and Military Requirements
A. Military specs and standards
B. ASME standards and code cases

V. The Valve Design
A. Where to start?
   1. Establish a conceptual design
   2. Filing patent of proposed innovation
   3. Understanding three basic valve elements:
      a. Body
      b. Trim and seat
   4. Interdependency of one element on another
B. Establish priorities among elements
C. Criterion for materials selection
   1. Corrosion
   2. Strength
   3. Wear, galling
   4. Ambient, high, low temperature service
   5. Materials for seat
   6. Materials for gasketing and packing
   7. Materials for bolting
   8. Radiation tolerance for nuclear applications

VI. Material Selection
A. Material selection for corrosion
B. Material selection for strength
C. Material selection for high temperature
D. Material selection for low temperature
E. Material selection for radiation/nuclear
F. Material selection for weldability
G. Material selection for NACE requirements

DAY 2: Module Description

I. Review of Quarter-Turn Valves
A. Butterfly valves
B. Ball valves
C. Plug valves

III. Review of Rising Stem Valves
A. Globe valves
B. Gate valves

IV. Diaphragm Operated Valves
   A. Needle type
   B. Ball valve

V. High Temperature Services

VI. Design of H.P. Butterfly Valves
   A. Valve Body
      1. Establish end-to-end dimensions:
         ANSI, MILSPEC
      2. Flanged construction, Lug/Wafer:
         ANSI, API, MSS, MIL
      3. Flange surface finish
      4. Casting or flame cut plate
      5. Establish body bore and seat diameters
      6. Calculate disc/pipe
      7. Establishing minimum wall thickness
   B. Valve trim
      1. Calculate valve operating torque
      2. Establishing stem diameter
      3. Establish stuffing box dimensions
         a. Chevron packing
         b. Braided TFE
         c. Laminated graphite
         d. Live loaded packing design
      4. Sizing packing gland bolting/thread engagement
      5. Valve disc design
      6. Stem-to-disc connection
      7. O-ring sealing/gasket sealing
   C. Valve seat
      1. Establish through seat leakage
      2. Criteria for soft seat design
      3. Criteria for metal seat design
      4. Fire-safe seat
   D. Valve-actuator interface
      1. Manual or automatic
      2. Sizing mounting bolts based on ISO design
      3. Mounting bracket design
      4. Manual lever or actuator handwheel design

VII. Design of Ball Valves
   A. Valve body
      1. Side entry, top entry, three piece design
      2. End-to-end dimension
      3. End connections
      4. Bonnet and bolting design
   B. Valve trim
      1. Standard, full, or reduced port
      2. Trim grounding

VIII. Design of Plug Valves

DAY 3: Module Description
I. Rising Stem Valves
   (Diaphragm Operated Globe Valves)
   A. Valve body design
      1. Establishing body bore
      2. Establishing end-to-end dimensions
      3. Establishing end connections
      4. Minimum wall thickness
   B. Valve trim design
      1. Establishing disc lift
      2. Flow over disc
      3. Flow under disc
      4. Stem diameter selection
      5. Valve seat design
      6. Compression spring calculations
   C. Valve Diaphragm design
      1. Elastomer and reinforcement
      2. Diaphragm strength and style
   D. Manual over-ride design
II. Diaphragm Operated Check Valve
   A. Body
   B. Check valve
   C. Calculations for opening and closing pressures
   D. Speed control of check valve operation
III. Quick-Closing Globe Style valve Design
   A. Body
   B. Trim
      1. Dampening and quick closing
      2. Spring calculations
IV. Selection of Valve Operator (Actuator)
   A. Hydrodynamic torque
   B. Lifting and closing forces
   C. Handwheel/lever design
   D. Electric operators
   E. Pneumatic operators
   F. Manual gear operators
V. Establishing Cv (Flow Coefficient) of Valve
   A. Experimental
   B. Estimating via interpolation
VI. Coatings and Platings
   A. Coatings on valve body
      1. Corrosion resistant coatings
      2. Abrasion resistant coatings
   B. Coatings on stem and disc
      1. Hard and soft chrome
      2. Electroless nickel
      3. Nickel-Boron
      4. Dry film
   C. Coatings on Fasteners
      1. Lock-tite
      2. Never-seize
VII. Bill of Materials
   A. Format
VIII. Drawing Notes
A. General
B. Marking, name plate information

IX. Valve Assembly and Testing
A. Sequence of assembly
B. Shell Test
   1. Hydrostatic
   2. Air under water
C. Seat test
   1. Visual
   2. Pressure decay
D. Torque test

X. Developing Prototype Procurement and Testing
A. Which sizes to test
B. First article testing
C. Vendor selection
D. Incorporating precious lessons

XI. Developing Catalog Information
A. Role of marketing
B. What information to include and what not to?
C. Extrapolating information with minimum risk

XII. Special Consideration for Unusual Applications
A. Chlorine
B. Steam
C. Boiler blow down valves
D. Oxygen
E. Vacuum

XIII. Machining Practices and Manufacturing Processes
A. Weldability of materials
B. Heat treatment
C. Brazing: furnace, stick
D. Casting versus forging versus plate
E. Sand versus allowances and their cost impact
F. Surface finishes
G. Domestic versus overseas production

XIV. Case Histories
A. Patent infringement: success and failure stories
B. Unsafe valve design: stem ejection
C. Reverse engineering

7. COURSE INSTRUCTORS

Mr. Vinod Bhasin, founder and Principal at SigmaTech, a consulting engineering company, has over 25 years of professional experience in the design, application, and manufacturing of piping, valves, and actuators for several companies including Hills McCanna Company, Rockwell International, and Westinghouse Electric Corporation. He served as Chief Engineer at Hills McCanna Company and Rockwell International. He is an alumnus of Illinois Institute of Technology (IIT), Chicago, Illinois. A registered PE, he holds BSME, MSME, and MSIE degrees. He has published numerous papers in Chemical Engineering, Chemical Processing, Chemical Processing International (UK), and the Journal of Naval Engineering related to piping, valves, and actuators. Mr. Bhasin has taught professional development courses on valves and actuators for the Instrument Society of America (ISA), and Navy's Life Cycle managers. He has also taught undergraduate courses in Solid Mechanics, and Machine Design at IIT. Mr. Bhasin is a member of ASME
B16 committee and is currently chairing several valve and actuator technical committees on ships and marine technology under ASTM F25.

**Mr. Russell P. Kok** is a Principal at Kok & Associates, Inc., a Nondestructive Evaluation consulting and services company. Mr. Kok has over 20 years of experience in the nondestructive evaluation field with several companies including Westinghouse Electric Corporation, Newport News Shipbuilding, and MQS Inspection. He holds a B.S. in Mechanical Engineering from the State University of New York at Buffalo and is currently completing his M.S. in Metallurgical Engineering at the University of Pittsburgh. He has published numerous papers involving the nondestructive evaluation of ship components and structures. Mr. Kok is certified by American Society for Nondestructive Testing as Level III in ultrasonics, eddy current, radiography, magnetic particle, liquid penetrant, and leak testing and is also qualified by the Electric Power Research Institute in ultrasonic sizing of intergranular stress-corrosion cracking. He is the Secretary of the Marine Committee of the American Society for Nondestructive Testing and the Chairman of several subcommittees of the American Society for Testing and Materials Committee E-7 on Nondestructive Testing.

8. **UNCONDITIONAL MONEY-BACK GUARANTEE**

If for any reason you are not satisfied with the course, we will refund your money.
REGISTRATION AND FEES

Course fee is $1175 per person, payable in advance. Class size will be limited to ensure optimum interaction among participants. The course will be reviewed two weeks prior to course start date and SigmaTech reserves the right to cancel the course if the minimum enrollment has not reached. We may slightly modify the course content or substitute instructors due to unforeseen circumstances.

The course fee is payable in advance and includes the cost of classroom materials. The fee does not include expenses for hotel accommodations. Please make check payable to SigmaTech. The course program is all day sessions from 8:00 am to 4:30 pm.

Cancellation Policy: All cancellations must be in writing, postmarked 14 days prior to the course date to receive a full refund. Those postmarked less than 14 days prior to the class will be subject to a service charge of $250. After the 14 days cancellation period, no refund is given. You may send a substitute.

Course Dates: To be determined (TBD)

Course Hotel Location and Accommodations:
Course location is to be determined. (TBD)
Hotel accommodations must be arranged directly with the hotel.

Registration Form – Valve Design Principles & Procedures

Name ________________________Organization ___________________________
Title ______________________________Code_____________________________
Phone (____)____________Fax (____) ____________ E-mail__________________
Address ____________________________________________________________
City _______________________________ State ______________Zip ___________

Method of payment: Circle one

Check Enclosed            Purchase Order Enclosed

Make check or purchase order payable to “SigmaTech” and mail with registration form to: SigmaTech, 601 Wyndham Crossings, Creve, St. Louis, MO 63131.
Phone: (636) 346-7594  Fax: (314) 821-3386  E-mail: info@sigmatechconsulting.com

Please visit the following WEB site for downloading the course content and any changes: http://www.sigmatechconsulting.com/coursetraining/coursetraining.htm