Engineering Standard

SAES-J-700 6 September 2011

Control Valves

Document Responsibility: Instrumentation Standards Committee

Saudi Aramco DeskTop Standards

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1 Scope

This standard prescribes the minimum mandatory requirements governing the design, specification, sizing, selection and installation of control valves and regulators. This standard does not cover on/off valves.

Commentary Note:

Some control valves are used in on/off service or interlock applications. Such valves are part of the scope of this standard.

2 Conflicts and Deviations

2.1 Any conflicts between this standard and other applicable Saudi Aramco Engineering Standards (SAESs), Materials System Specifications (SAMSSs), or industry standards, codes, and forms shall be resolved in writing by the Company or Buyer Representative through the Manager, Process & Control Systems Department of Saudi Aramco, Dhahran.

2.2 Direct all requests to deviate from this standard in writing to the Company or Buyer Representative, who shall follow internal company procedure SAEP-302 and forward such requests to the Manager, Process & Control Systems Department of Saudi Aramco, Dhahran.

3 References

The selection of material and equipment, and the design, construction, maintenance, and repair of equipment and facilities covered by this standard shall comply with the latest edition of the references listed below, unless otherwise noted.

3.1 Saudi Aramco References

Saudi Aramco Engineering Procedure

SAEP-302	*Instructions for Obtaining a Waiver of a Mandatory Saudi Aramco Engineering Requirement*

Saudi Aramco Materials System Specification

34-SAMSS-711	*Control Valves*

Saudi Aramco Engineering Standards

SAES-A-102	*Ambient Air Quality and Source Emissions Standards*

SAES-A-105	*Noise Control*
SAES-B-006	*Fireproofing for Plants*
SAES-B-058	*Emergency Shutdown, Isolation and Depressuring*
SAES-B-061	*Protective Shields for High Health Hazard Piping and Equipment*
SAES-B-068	*Electrical Area Classification*
SAES-J-002	*Technically Acceptable Instrument Manufacturers*
SAES-J-005	*Instrumentation Drawings and Forms*
SAES-J-601	*Emergency Shutdown and Isolation Systems*
SAES-J-902	*Electrical Systems for Instrumentation*
SAES-J-904	*FOUNDATION™ Fieldbus (FF) Systems*
SAES-J-905	*Instrument Asset Management Systems*
SAES-L-108	*Selection of Valves*
SAES-L-132	*Materials Selection for Piping Systems*

Saudi Aramco Standard Drawings

AC-036404	*Flame Impingement Shield for Flangeless Valves*
AD-036634	*Details of Large Size Welding Neck Flanges and Blind Flanges Class 150 RF*
AD-036673	*Details of Large Size Welding Neck Flanges and Blind Flanges Class 600 RF*
AD-036698	*Details of Large Size Welding Neck Flanges and Blind Flanges Class 400 RF*
AD-036991	*Details of Large Size Welding Neck Flanges and Blind Flanges Class 300 RF*
AB-036764	*Temporary Suction Screen - Gas Compressors*

Saudi Aramco Forms and Data Sheets

2787-ENG	*ISS - Pressure Regulators*
8020-711-ENG	*ISS - Globe/Angle Control Valves*
8020-712-ENG	*ISS - Ball Control Valves*
8020-713-ENG	*ISS - Butterfly/ Rotary Plug Control Valves*

Saudi Aramco Best Practices

SABP-J-711	*Selection of Recycle Valves for Salt Water Disposal Pumps*

3.2 Industry Codes and Standards

American Petroleum Institute

API STD 609	*Butterfly Valves: Double Flanged, Lug- and Wafer-Type*

American Society of Mechanical Engineers

ASME B1.20.1	*Pipe Threads, General Purpose (Inch)*
ASME B16.5	*Pipe Flanges and Flanged Fittings*
ASME B16.20	*Metallic Gaskets for Pipe Flanges Ring-Joint, Spiral Wound and Jacketed*
ASME B46.1	*Surface Texture (Surface Roughness, Waviness and Lay)*
ASME VIII D1	*Rules for Construction of Pressure Vessels*

American Society for Testing and Materials

ASTM A105	*Standard Specification for Carbon Steel Forgings for Piping Applications*
ASTM A193	*Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature or High Pressure Service and other Special Purpose Applications*
ASTM A194	*Standard Specification for Carbon and Alloy-Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both*
ASTM A216	*Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High Temperature Service*
ASTM A217/A217M	*Standard Specification for Steel Castings, Martensitic Stainless and Alloy, for Pressure-Containing Parts, Suitable for High-Temperature Service*
ASTM A320	*Standard Specification for Alloy-Steel Bolting Materials for Low-Temperature Service*

ASTM A351	*Standard Specification for Castings, Austenitic, for Pressure-Containing Parts*
ASTM A352	*Standard Specification for Steel Castings, Ferritic and Martensitic for Pressure-Containing Parts, Suitable for Low-Temperature Service*
ASTM A743	*Specification for Castings, Iron Chromium, Iron Chromium Nickel, and Nickel Base Corrosion Resistant for General Application*

Fluid Control Institute

ANSI/FCI 70-2	*Control Valve Seat Leakage*

The Instrumentation, Systems and Automation Society

Commentary Note:

IEC standards equivalent to the ISA standards referenced herein are also acceptable.

ANSI/ISA 51.1	*Process Instrumentation Terminology*
ANSI/ISA 75.01.01	*Flow Equations for Sizing Control Valves*
ANSI/ISA 75.05.01	*Control Valve Terminology*
ANSI/ISA 75.11.01	*Inherent Flow Characteristic and Rangeability of Control Valves*
ANSI/ISA RP75.23	*Considerations for Evaluating Control Valve Cavitation*
ANSI/ISA TR75.25.02	*Control Valve Response Measurement from Step Inputs*
ANSI/ISA 75.19.01	*Hydrostatic Testing of Control Valves*

International Electrotechnical Commission

IEC 60534-2-5	*Industrial Process Control Valves, Part 2-5: "Flow Capacity – Sizing Equations for Fluid Flow through Multistage Control Valves with Inter-Stage Recovery"*
IEC 60534-8-3	*Industrial Process Control Valves, Part 8-3: Noise Considerations: Control Valves Aerodynamic Noise Prediction Method*
IEC 60534-8-4	*Industrial Process Control Valves, Part 8-4: Noise Considerations: Prediction of Noise Generated by Hydrodynamic Flow*

International Organization for Standardization

NACE MR0175/ ISO 15156	*Petroleum and Natural Gas Industries, Materials for Use in H_2S-Containing Environments in Oil and Gas Production*

National Fire Protection Association

NFPA 70	*National Electrical Code*

3.3 Terminology

The terminology and nomenclature used in ANSI/ISA 51.1 and ANSI/ISA 75.05.01 apply to this standard.

4 Design

Control valves shall not be used as emergency shutdown valves (ZVs), or as emergency isolation valves (EIVs). Control valves may be used as Emergency Vapor Depressurizing valves and may also be used in process interlock systems.

4.1 General

All control valves shall be selected from the manufacturers listed in SAES-J-002, "*Technically Acceptable Instrument Manufacturers*" and SAP system.

4.1.1 Minimum Rating

a) The flange rating for control valve bodies shall be minimum Class 150.

b) The body rating shall never be lower than the flange rating.

4.1.2 End Connections

a) Control valve sizes 24" and smaller shall be integrally flanged. Flanged connections shall comply with ASME B16.5.

Raised-face (RF) flanges shall be used for lines rated up to and including Class 600 and up to a design temperature of 480°C.

Ring-joint (RJ) flanges shall be used for lines rated Class 900 and above, and for design temperature conditions exceeding 480°C. Ring grooves shall comply with ASME B16.20.

Separable flanges, flanges with tag welds, or flanges with partial penetration welding are not acceptable.

Dimensions of flanges larger than 24" size shall comply with one of the following Standard Drawings:

AD-036634, *AD-036991*, *AD-036698*, *AD-036673*

Class 400 carbon steel flanges for sizes smaller than 30-inch shall not be used.

b) Flangeless sliding stem control valves shall not be used. Flangeless rotary control valves may only be applied when a flanged body is not available for the selected type of control valve.

Flangeless rotary control valves shall not be used in:

- hydrogen services
- thermal cycling services
- fire-safe services
- systems rated above Class 600
- services with design temperatures above 480°C.
- services being part of a Leak Detection and Repair (LDAR) program for components in Volatile Organic Compounds (VOC) service and components that are in Hazardous Air Pollutant service, as defined by SAES-A-102.

For design temperatures above 205°C, bolting material for flangeless control valves shall have the same nominal coefficient of thermal expansion as the body and adjacent flanges. Flangeless control valves shall have centering means (e.g., lugs, holes, bolting, or equal) to ensure proper alignment of the control valve, gasket, and piping flange. Wafer-type butterfly control valves shall not be used.

Refer to paragraph 9.3 for flame impingement shield requirements for flangeless rotary control valves.

c) Threaded control valves shall not be used.

4.1.3 Face-to-Face Dimensions

Face-to-face dimensions of control valves shall conform to one of the standards listed in 34-SAMSS-711.

4.1.4 Gasket Contact Surface Finish

The gasket contact surface of raised-face flanged valves, and flangeless

control valves, up to and including Class 600 ratings shall be smooth machine-finished between 3.2 to 6.4 micrometers Ra conform to ASME B46.1. For hydrogen or hydrogen effluent service, the gasket contact surface finish shall not exceed 3.2 micrometers Ra.

4.1.5 Materials

The appropriate ANSI/ASTM specifications to which the valve bodies and bonnets need to be manufactured from shall be specified on the Instrument Specification Sheet (ISS).

The maximum system pressure and temperature shall be specified on the ISS. All materials used in the valve shall be compatible with the specified process conditions.

As a minimum, control valve body materials shall meet the requirements of SAES-L-108, "Selection of Valves," for the subject piping class.

Commentary Note:

Specific corrosive and erosive fluid applications, including flashing services, cavitation services, black powder services, steam, potable water, raw water, process water and sea water services commonly require more resistant body materials than the minimum requirements of SAES-L-108.

For steam and boiler feedwater services over 400°C and for flashing water services the body material shall be minimum ASTM A217/A217M grade WC9.

Bronze, aluminum, plastic, cast iron and ductile iron bodies are not acceptable.

Downstream temperature conditions shall be calculated and specified on the Instrument Specification Sheet (ISS) for all control valves in gas pressure letdown services where the downstream temperature conditions may be reduced to below 0°C due to the Joule-Thompson effect. Body and trim materials shall meet the lowest temperature requirements. Standard carbon steel materials (e.g., ASTM A216, ASTM A105, WCB, WCC, etc.) shall not be used below 0°C service temperatures. ASTM A352 grade LCB or LCC shall be specified for temperatures from 0°C to -46°C. ASTM A351 or ASTM A743 grade CF8 shall be selected for temperatures below -46°C.

NACE MR0175/ISO 15156, *"Petroleum and Natural Gas Industries Materials for Use in H_2S-Containing Environments in Oil and Gas Production"* shall be applied for all materials in sour fluid services.

Trim materials shall be selected to withstand corrosion, erosion and wear. Trim material combinations shall not be susceptible to galling. AISI 300- and 400- series stainless steel shall be used as a minimum.

Hard faced trims, or solid Stellite or Colmonoy type trims shall be used in erosive, cavitating and flashing type services, including steam, wet gas and water applications with pressure drop conditions exceeding 350 kPa (51 psi), other applications with pressure drop conditions exceeding 4000 kPa (580 psi) and as per manufacturer's recommendation. Such hard or hardened trims shall have a hardness of at least 38 HRC (hardness Rockwell C).

For black powder services, solid trim materials shall be specified.
A complete package for trim details (such as material selection, cladding or material deposits specification, sleeve or insert dimensions…etc) for every component of the trim, shall be submitted for evaluation and approval before proceeding with order placement. The package shall be submitted to the proponent and the General Supervisor, Process Automation Systems Division, Process and Control Systems Department of Saudi Aramco, Dhahran.

Monel, nickel, titanium and Hastelloy trim materials shall be considered in very corrosive type services to ensure acceptable service life.

Valve actuator springs shall be minimum carbon steel with standard factory applied corrosion resistant coating or be hot oil dipped. Alloy springs shall be considered for near shore and offshore locations.

4.1.6 Packing Systems

4.1.6.1 General

Control valve packing systems shall enable plant operations to effectively maintain minimum leakage and travel performance within the inaccuracy limits specified in paragraph 7.1.
All proposed packing systems and bellows seals shall be field proven for a minimum of 3 years and references of other users shall be made available upon request.

Specific cyclic, thermal cyclic operations of control valves or valves in auto ignition services shall be specified to the control valve manufacturer in the Request for Quotation (RFQ) and Purchase Order (PO).

Packing systems shall not require lubrication.

4.1.6.2 Fugitive Emissions Considerations

For new facilities, all control valves in Environmental Services (ES) shall be defined and shall be included in the master list of components that have the potential to leak under the Fugitive Emission Monitoring (FEM) plan as required by SAES-A-102.

4.1.6.3 Low Emission Packing Systems for Environmental Services

Low Emission Packing (LEP) systems shall be provided for control valves in Environmental Services (ES). The LEP systems shall limit fugitive emission below 500 ppmv (parts per million volume) or below the applicable government limit for the particular ES, whichever is lower.

4.1.7 Gaskets

Body gaskets shall be fully retained 316 SST, or other appropriate alloy, spiral wound, with PTFE or graphite compound fillers.

4.1.8 Bonnet

Bolts, studs and nuts shall meet the applicable ASTM A193, ASTM A194 or ASTM A320 specifications.

Threaded connections shall be NPT and comply with ASME B1.20.1.

For cryogenic services, an extended bonnet shall be used. The minimum required length of the bonnet shall be specified in the purchase order. The packing arrangements shall be on the top of the bonnet.

4.1.9 Seat Leakage

Seat leakage classification shall be in accordance with ANSI/FCI 70-2. The leakage class shall be determined by the service and valve-type used.

Tight-Shut-Off (TSO) control valves shall be identified on the Process & Instrument Diagrams (P&ID's) as "TSO". TSO control valves shall be class V or better. The TSO class and maximum differential pressure under shut-off conditions shall be specified on the ISS.

In order to minimize product loss or to maximize energy conservation and to minimize seat erosion Leakage Class V, or better, metal-to-metal TSO shall be applied for:

- Compressor anti-surge and spill-back services and for gas to flare pressure letdown services

- vapor, wet gas, steam and water services with shut-off pressure drop exceeding 2500 kPa (363 psi)
- cavitating services where the valve size is 8" or more or when shut-off pressure drop exceeding 2500 kPa (363 psi).
- black powder applications

Soft-seated shut-off trim designs shall not be applied in services with design temperature conditions over 230°C nor in flashing liquid or other erosive type services.

If pipe provisions allow, TSO control valves shall be tested at site for acceptable leakage with water containing a corrosion inhibitor. Class V shutoff shall be tested at the shutoff pressure conditions specified on the ISS.

4.1.10 Hydrostatic Testing

New control valves are hydro-tested at the factory and there is no need to hydro-test them in the field.

For control valves in existing facilities, hydrostatic testing of the valve body shall be done without trim parts per ANSI/ISA 75.19.01.

4.2 Sliding Stem Type Control Valves

Bottom flanges on globe type control valves shall not be used unless they are justified and approved by the proponent.

Split type bodies shall not be used unless they are justified and approved by the proponent.

Three-way diverting or mixing type control valve bodies shall not be used and these requirements shall be accomplished by using two standard control valves.

Exception:

This does not apply to de-superheaters, licensed process designs or other special control valve applications.

Axial body design shall be used for recycle valves in salt water disposal pump applications per SABP-J-711, "Selection of Recycle Valves for Salt Water Disposal Pumps." Body or trim material deviations shall be submitted for approval to Supervisor, Instrumentation Unit, Process Automation Systems Division, Process & Control Systems Department, Dhahran.

4.3 Rotary Motion Control Valves

The shaft design shall prevent excessive shaft deflection for the process conditions specified on the ISS. The shaft design shall eliminate the possibility of blowout.

Conventional flat disk/vane type butterfly valves shall be sized for a maximum travel of 60° opening. Travel in excess of 60° opening may only be applied when the butterfly disk/vane is specifically designed for stable control services above 60° opening under low dynamic torques. Butterfly valve trims enabling stable control beyond 60° opening include a fishtail disk/vane, angular offset disk/vane, cambered disk/vane, fluted disk/vane and S-DISK designs.

Clearance requirements for the disk shall be sufficient and meet API STD 609 to eliminate any interference between the disk and the heavy wall piping.

4.4 Trim Design

To prevent damage on cage type trims and to minimize body erosion through direct particle impingement, the flow outwards configuration (or flowing from the inner diameter to the outer diameter of the cage) shall not be used for fluids containing sand, pipe scaling, or other particulate matter. Anti-cavitation type trims and low noise type trims used in fluid services with entrained particulate matter shall be of solid cage type design (i.e., multi-plate, labyrinth or disk stack type trims shall not be used in fluid services containing dirt, debris or other particulate matter).

4.5 Regulators

The use of all self-acting regulating type valves including pressure regulators, level regulators, temperature regulators, pump minimum flow regulators, etc, shall be approved by the proponent.

Self-acting regulating valves may be used only for services where setpoint adjustments are not required, where limited rangeability is acceptable and where control performance within ±20% is acceptable. Self-acting regulating valves shall not be used in applications where any failure, or plugging, of the sensing element or actuating system can result in unsafe operating conditions. Regulators shall not be used in sour gas, toxic gas, cavitating, flashing, high noise and erosive services. Venting type regulators shall not be used where the vented combustible gas can create hazardous conditions.

A strainer or filter shall be used for regulators that are susceptible to plugging.

Actuator systems for self-acting regulating valves shall be capable of withstanding 150% of the maximum upstream design pressure. Pilot-operated regulators may only be used in clean fluid applications. All sensing element and actuator system

materials shall be fully compatible for the process fluid application. The correct gain and operating range shall be provided for self-acting regulating valves through proper selection of the diaphragm, spring or pilot system.

5 Specification

5.1 Instrument Specification Sheets

Individual control valve calculation and specification requirements shall be covered on one of the following Instrument Specification Sheets:

8020-711-ENG	*ISS - Globe Control Valves*
8020-712-ENG	*ISS - Ball Control Valves*
8020-713-ENG	*ISS - Butterfly/Rotary Plug/Disk Control Valves*
2787-ENG	*ISS - Pressure Regulators*

Other types of control valves shall also be specified on one of these ISSs (e.g., angle and axial flow type valves on 8020-711-ENG, non-symmetrical and/or segmented ball type valves on 8020-712-ENG, eccentric and/or cammed disk type valves on 8020-713-ENG, etc.).

The specification and process data for the ISSs shall be maintained in both hard copy and soft copy (electronic) format conforming to SAES-J-005, "Instrumentation Drawings and Forms."

5.2 Process Data Specification

5.2.1 Process Data Operating Window

For each control valve, the process data for the following three flow conditions shall be specified as a minimum:

- Normal Flow Rate
- Maximum Flow Rate
- Minimum Flow Rate

5.2.2 Process Data for Flashing and Two-Phase Flow

For flashing services the downstream vapor phase shall be specified on the ISS in percentage (%) weight together with the average MW.

For two-phase flow services the upstream and downstream vapor phase shall be specified on the ISS in percentage (%) weight together with the average MW.

5.3 Segregation Requirement

34-SAMSS-711, "Control Valves," with associated ISSs, shall be used as a minimum basis for the specification and requisitioning of all control valves. Control valves for non-general service applications, as defined in paragraph 5.5, shall be specified and requisitioned separately from control valves in general service applications.

5.4 General Service Applications

34-SAMSS-711 is the basis for specifying general service control valves. The contractor shall issue a technical specification supplement for any technical requirement not covered by 34-SAMSS-711.

5.5 Non-General Service Applications

For Project Purchasing, Control valves for non-general service applications, as defined in the following paragraphs, shall be specified and requisitioned separately from the general service control valves.

If 34-SAMSS-711 is not sufficient to address the requirements of control valves in a non-general application, the contractor shall issue a technical specification supplement for all technical requirements not covered by 34-SAMSS-711. Such supplement shall incorporate clearly defined technical requirements for meeting the more difficult process application(s). The specification shall cover all technical requirements to facilitate accurate, conscious and objective technical evaluation of the bids.

Control valves in non-general services include the following:

5.5.1 All Fluids

- wellhead flow line applications
- oxygen services
- compressor anti-surge control valves
- erosive fluid applications including fluids with black powder
- de-superheater (steam conditioning) applications
- temperature cycling applications
- all applications considered special, difficult, or severe by the proponent

5.5.2 Dry Gas and Superheated Steam

- control valve body outlet velocities greater than 0.4 Mach
- all services with a pressure ratio greater than 15 (P1/P2 > 15, pressures expressed in absolute pressure units)

5.5.3 Wet Vapor and Saturated Steam

- control valve body outlet velocities in greater than 0.3 Mach
- all services with a pressure ratio greater than 10 (P1/P2 > 10; pressures expressed in absolute pressure units)

5.5.4 Gas or Vapor with Entrained Particulates (including the black powder)

- control valve body outlet velocities greater than 0.2 Mach (for black powder greater than 0.15 Mach)
- all services with a pressure ratio in greater than 3 (P1/P2 > 3; pressures expressed in absolute pressure units)

5.5.5 Liquids

- flashing services with downstream vapor content exceeding 10% weight
- cavitating services, where more than a two stage let-down trim is required to meet the noise limits without application of path-treatment
- two-phase flow services with downstream vapor content exceeding 10% weight
- water injection services
- boiler feed water services
- entrained solid or particulate services

5.6 Control Valve Acceptance

Prior to placing the order, the Contractor shall submit a technical proposal for each control valve for acceptance to Saudi Aramco. The technical proposal shall include a completed ISS, vendor capacity and noise calculation, complete technical specification of the proposed control valve covering all material selections and trim performance data.

For control valves in non-general service conditions, as defined in paragraph 5.5, the complete technical proposals shall be submitted for review and approval to the

General Supervisor, Process Automation Systems Division, Process and Control Systems Department of Saudi Aramco, Dhahran.

6 Engineering

6.1 Sizing

Control valve sizing shall be based on ANSI/ISA 75.01.01 and IEC 60534-2-5. Manufacturer may deviate from the standard formulas provided that the reason and the formulas used are detailed in the technical quotation. Proposed deviations from these standards shall be submitted for approval to Supervisor, Instrumentation Unit, Process Automation Systems Division, Process & Control Systems Department, Dhahran.

The manufacturer shall be provided with all data necessary to select and size the control valve and actuator assembly and to accurately evaluate the minimum trim performance requirements.

All factors used in sizing per ANSI/ISA 75.01.01 shall be presented on sheet 2 of the ISS. These include Reynolds Number Factor F_R, piping geometry factor F_P, calculated F_{LP} and/or X_{TP} factors and manufacturer's correction factors.

Control valve noise calculations shall be in accordance with the IEC 60534-8-3 and IEC 60534-8-4. The Contractor is responsible to meet the requirements of SAES-A-105. Capacity and noise level calculations for all operating conditions shall be specified on sheet 2 of the ISS. The calculation basis and results shall be shown for manual or computer calculations. The calculated Cv capacities for the minimum, normal and maximum flow conditions and the highest calculated noise level shall also be specified on sheet 1 of the ISS.

6.2 Selection

6.2.1 Minimum Body Size

The minimum control valve nominal body size shall be 1". The control valve nominal body size shall not be smaller than half of the upstream nominal line size.

Control valve bodies with reduced trims shall be considered for the following applications:

a) Pressure drop application in excess of 5170 kPa (750 psi)

b) Choked flow service

c) Flashing service exceeding 10 % weight of liquid being vaporized

d) Erosive service

e) Services where future capacity increase is anticipated

Nominal body sizes 1¼ inch, 2½ inch, 3½ inch, 5 inch or higher odd numbers shall not be used.

6.2.2 Minimum Cv Capacity (Cv Required)

The selected control valve trim capacity (Cv selected) shall meet the following:

a) An equal percentage trim shall operate below 93% travel at maximum flow condition. If no maximum flow condition is specified on the ISS, then the trim shall operate below 85% travel at normal flow condition.

b) A linear trim and quick opening trim shall operate below 90% travel at maximum flow condition. If no maximum flow condition is specified on the ISS, then the trim shall operate below 75% travel at normal flow condition. Anti-surge control valves shall operate below 55% travel at maximum flow condition.

c) A modified parabolic trim shall operate below 90% travel at maximum flow condition. If no maximum flow condition is specified on the ISS, then the trim shall operate below 80% travel at normal flow condition.

Commentary Note:

The specified percentage (%) travel positions are for sliding stem type valves and need to be converted to degrees opening for rotary type control valves.

A control valve affecting the load of a downstream safety/relief valve system can only be reduced in capacity by using a smaller valve or a reduced trim.

When the capacity of a control valve affects the load of a safety/relief valve system, then the following shall be specified on the ISS: “Valve Trim Size Affects Safety/Relief Valve System Load.” The bypass of this control valve shall be "car-sealed closed".

6.2.3 Minimum Rangeability

The installed rangeability of each control valve shall meet all flow conditions specified on the ISS. The specified minimum flow condition shall operate above 10% travel for globe, angle and axial flow type control

valves, 5 degrees for ball and segmented ball type control valves and 10 degrees for butterfly, rotary plug/disk and cammed type control valves.

When the minimum required rangeability can not be met with one control valve, two or more parallel runs of control valves with split range control shall be provided.

6.2.4 Flow Characteristics

Manufacturer's control valve characteristics shall conform to ANSI/ISA 75.11.01.

The control valve flow characteristics shall be selected based on the following:

a) linear flow characteristic

- when the ratio of differential pressure across the control valve at minimum flow over the differential pressure across the control valve at maximum flow is equal to or less than 1.5
- when the differential pressure conditions across the control valve under all specified flow conditions are more than ⅔ of the differential pressure across the control valve in the closed condition
- when two control valves are used in pairs as a 3-way valve
- for compressor recycle (spill-back) applications
- for compressor anti-surge control valves
- for centrifugal pump minimum flow bypass applications

b) equal percentage flow characteristic

- for all other modulating control applications, except for those under a), c) and d)

c) modified parabolic flow characteristic

- may only be substituted for equal percentage trim applications, provided that the smaller inherent rangeability is acceptable for the subject application

d) quick opening flow characteristic

- on/off control applications

Permissible deviations between actual and manufacturer-stated inherent flow characteristics shall not exceed the limits specified in ANSI/ISA 75.11.01.

If necessary, the contractor shall modify the installed control valve flow characteristic in the positioner to obtain constant controller gain over the required flow range. The installed flow characteristic shall provide stable process control for all specified operating conditions without the need to change controller tuning parameters.

6.2.5 Minimum Flow Capacity

Permanently welded mechanical limit stops may be used for minimum flow requirements in, e.g., furnace/boiler feed system, burner fuel system, heat exchanger bypass, etc.

Limit stops on compressor suction control valves shall be made permanent with either a disc undercut or a complete valve/disc weld. Jam-nut arrangements (either inside the valve or the actuator) or tack welding arrangements are not acceptable.

When limit stops are used on a control valve, the signal from the control system shall be limited to the same travel values.

Valves with limit stops shall be marked accordingly in the P&IDs and on the valve name plate at the field.

6.3 Compressor Anti-Surge Control Valves

Anti-surge control valves shall have a very fast and stable control capability. The control valve opening stroke time in control mode from closed to fully open shall be less than 2 seconds including dead time. Overshoot shall be less than 110% of the input step change. The valve dead time of the seat shall be less than 0.5 seconds. In order to stabilize the compressor flow after surge conditions the closing response time shall be delayed to approximately three times the opening response time. Closure time shall be user configurable. The maximum deadband for control valves in anti-surge applications shall not exceed 2%.

Anti-surge control valves for compressors rated at 20,000 HP or more shall incorporate a multi-stage trim design to effectively dissipate the required energy during any surge condition (i.e. single stage trims, such as a simple drilled hole cage design, shall not be used).

Anti-surge control valves shall have linear flow characteristics unless recommended otherwise by compressor vendor. Anti-surge control valves shall operate below 55% travel for any surge condition.

Anti-surge control valves shall be TSO to class V or better.

6.4 Critical Downstream Pressure Conditions

The downstream pressure conditions of the control valve shall be accurately calculated and specified on the ISS for each flow condition. To determine the worst-case service conditions, considerations shall be given to the different downstream pressures that can exist under various operating conditions.

6.5 Cavitation, Choked Flow and Flashing

ANSI/ISA 75.01.01 and ANSI/ISA RP75.23, together with the manufacturer's valve cavitation index data, shall be used for determining the severity of cavitation, choked flow or flashing conditions in a control valve.

If cavitation cannot be eliminated completely, (e.g., by providing more downstream pressure through relocating the valve in the piping system) then a special control valve shall be selected with a high liquid pressure recovery coefficient F_L and/or low anti-cavitation index σ that will provide maximum lifetime for the valve and piping system. Noise and piping vibration levels shall not exceed the limits defined in paragraph 6.6.

Control valves in potentially cavitating service conditions shall be analyzed in detail to ensure that the intensity, or degree, of cavitation of the selected trim is acceptable based on the recommendations of ANSI/ISA RP75.23. This requires the valve manufacturer to provide a recommended sigma (σ_{mr}) for the specific valve and a scaled and adjusted proposed sigma (σ_p). These factors shall be stated on sheet 2 of the ISS.

Contingencies on the minimum required control valve cavitation index shall be applied to compensate for inaccuracies in process data and inaccuracies in manufacturer's control valve cavitation index data.

The location and piping installation of a control valve in flashing services shall be designed to limit the outlet velocity in order to minimize erosion in the control valve outlet area and downstream piping section.

6.6 Noise and Vibration

6.6.1 Noise Limits

The maximum noise level emission measured 1 m (3 ft) downstream of the valve and 1 m (3 ft) away from the valve including noise contributions from the piping system, piping elbows and reducers, is not allowed to exceed:

a) 85 dB(A) for all services at offshore plant facilities and for continuous services at onshore plant facilities for any specified operating condition and for any other operating condition between the specified minimum and maximum flow conditions.

b) 90 dB(A) for intermittent services at onshore plant facilities for any specified operating condition and for any other operating condition between the specified minimum and maximum flow conditions. Intermittent services include compressor anti-surge and spill back services.

c) 95 dB(A) for infrequent services at onshore plant facilities in which the control valves are normally closed. Infrequent services include vent or gas-to-flare valves where the downstream pressures fall below 100 kPag (14.5 psig).

These maximum noise levels are specified in terms of equivalent continuous A-weighted Sound Pressure Levels (SPL) with a maximum inaccuracy of ±5 dB(A).

Manufacturers shall be required to include inaccuracies of their quoted noise levels and shall be requested to guarantee that the noise emission from the proposed control valve in the specific piping system shall not exceed above stated limit. Contingencies need to be included in the design to ensure that the actual noise levels will be not be exceeded.

For control valves in potential noise and vibrating type service conditions, the Contractor shall provide piping layout information (e.g., piping isometric drawings) with the Request for Quotation to the bidding control valve vendors.

Overall plant noise emission limits shall conform to SAES-A-105, "Noise Control."

Control valve noise shall be treated at the source through the provision of low-noise multipath trim designs. To ensure that excessive noise and piping vibration problems will not occur, a contingency in trim performance shall be provided in high energy dissipating type services (example highly cavitating services, high pressure letdown services…etc.)

When the noise limit can not be met by source treatment alone, application of diffusers, baffle plates and silencers may be considered, subject to approval by the Supervisor, Instrumentation Unit, Process Automation Systems Division, Process & Control Systems Department.

Acoustic or thermal insulation shall not be used for control valves in continuous or intermittent services.

6.6.2 Vibration Limits

The maximum vibration levels of the control valve, manifold and piping system shall be less than 12.5 mm/sec Root Mean Square (0.5 inch/sec RMS) under all specified operating conditions.

Proper control valve selection shall ensure that the required energy can be dissipated without exceeding the maximum vibration levels in the piping system. The control valve manifold piping layout and piping support design shall facilitate maximum reduction of control valve induced vibration.

6.6.3 Noise and Vibration Test

A control valve noise and vibration test shall be conducted for each control valve with a calculated noise level in excess of 85 dB(A) (e.g., as part of a plant performance test). Any new control valve installation exceeding a measured SPL of 85 dB(A) shall be reported in writing to the Environmental Compliance Division, Environmental Protection department in conformance with SAES-A-105.

6.7 Outlet Velocity Limits

Body outlet velocity, defined as the fluid velocity at the discharge flange of a control valve, shall be limited to:

- 0.15 Mach for gas containing black powder
- 0.2 Mach for gas, vapor and steam services containing any particulate matter
- 0.3 Mach for wet gas, vapor and saturated steam services
- 0.4 Mach for dry clean gas and superheated steam services
- 0.5 Mach for dry clean gas in infrequent services. Infrequent services include vent or gas-to-flare valves where the downstream pressures fall below 100kPag (14.5 psig).

6.8 Emergency Vapor Depressurizing Control Valves

Remote operated emergency vapor depressurizing control valves (if specified) shall be provided in accordance with SAES-B-058 and SAES-J-601.

7 Actuators and Positioners

7.1 General

Actuators, positioners and other accessories shall be procured as part of the control valve purchase order. The control valve manufacturer shall be responsible for packaging and guaranteeing the whole control valve assembly.

The control valve manufacturer shall be responsible for correctly sizing the actuators based on the technical specification(s) and the data specified on the ISS.

The bench set (spring range) of actuators shall be specified on the ISS's. Actuator sizing shall be based on a minimum available instrument air pressure of 415 kPag (60 psig), including worst-case requirements for maximum force/torque. Maximum air supply system design pressure conditions are generally 862 kPag (125 psig) at 82°C, or less. Actuator systems shall be suitable for non-lubricated air. A regulator/filter (with adequate capacity) shall be used to provide a constant air supply pressure under all operating conditions. A regulator is not required for pneumatic piston type actuators with design pressure conditions in excess of 862 kPag (125 psig).

The total maximum inaccuracy of the valve travel position due to any limitation (e.g., repeatability, dead band, resolution, hysteresis, non-linearity, etc.) shall be:

	Valve with a positioner	**Valve without a positioner**
Valve size <12”	1.5%	3%
Valve sizes 12” & 16”	2.5%	4%
Valve size >16”	3%	4.5%

Actuator force/torque requirements shall be specified for the worst case condition. Type and size of actuator system shall develop minimum 110% of the required seat load to meet the leakage class and the shut-off pressure drop specified on the ISS.

The maximum shut-off differential pressure shall always be calculated and specified on the ISS. For TSO applications, actuator load calculations shall be made and shown on sheet 2 of the ISS.

7.2 Positioners

7.2.1 Digital positioners shall be applied for all new control valves, unless otherwise specified.

7.2.2 A double acting positioner shall be used for double acting type actuators (i.e., it is not acceptable to use a single acting positioner with a reversing relay).

7.2.3 Digital positioners and their associated software shall include valve diagnostic capability in accordance to requirements detailed in SAES-J-905.

7.3 Pneumatic Diaphragm Actuators

Spring-return pneumatic diaphragm actuators are preferred and shall be used whenever feasible.

7.4 Pneumatic Piston Actuators

Air failure position shall be accomplished without the aid of process pressure conditions. Air failure position shall be testable during inspection and during plant commissioning when piping systems are de-pressurized.

When the "air failure open" (AFO) or "air failure close" (AFC) action mode of a piston-operated actuator system can not be accomplished due to insufficient spring force, then a volume tank with fail-safe trip valves shall be provided (refer to paragraph 8.4 for volume tank requirements). Air failure mode movement of the control valve shall be prompt in the event of air supply failure.

When "air failure lock" (AFL) action mode is required, also referred to as "air failure steady" (AFS), for any critical valve operation, lock-up valves and if so required, a volume tank shall be provided to lock the actuator in the last operating position upon air supply failure for a minimum period of 30 minutes.

7.5 Actuator Systems other than Pneumatic Air Operated

Control valve actuator systems other than pneumatic may be applied if access to instrument air is impractical. Application of actuator systems other than pneumatic air requires prior written approval of the Supervisor, Instrumentation Unit, Process Automation Systems Division, Process and Control Systems Department of Saudi Aramco, Dhahran.

- Process Gas as Actuating Medium

  For applications where instrument air supply cannot practically be made available, sweet, clean, dry process gas may be considered as the actuating medium. Sour gas shall never be used. Process gas operated actuator systems shall never be used at an indoor location or enclosed area. Electronic, smart or any positioners with potential ignition sources, shall not be used for such applications.

Actuator and positioner materials, specifically the elastomer seals, shall be suitable for the particular process gas application. All materials in the actuator and control instrumentation shall be certified for the particular process gas services.

The gas shall be properly conditioned through a fully redundant gas supply system each with a dedicated inlet and outlet block valve (e.g., dual regulators, dual liquid knock-out pots with drain valves, dual filtering systems, over-pressure relief valves, etc.) connected to a ring header to enable on-line maintenance on one system at the time.

The gas supply ring header piping shall be sloping, without pockets, towards the knock-out pots installed at the lowest point. The liquid knock-out system design shall be over designed such to ensure trouble-free operation even during upset conditions of the process.

Sweet gas venting shall be kept to a minimum (i.e., selecting instruments with the lowest venting rates available, minimizing the number of venting instruments, etc.). The area around a combustible gas venting instrument that discharges gas continuously or for long periods of time shall be classified as per SAES-B-068. Sweet gas venting shall be elevated to direct the gas away from the immediate area around the control valve. Consideration shall be given to connecting individual instrument vents to a common vent manifold which is subsequently connected to an elevated vent stack.

All enclosures shall be metallic (i.e., non-metallic actuator systems shall not be used in sweet gas services). Grounding of the complete system shall be in accordance with SAES-J-902, "Electrical Systems for Instrumentation."

7.6 Actuator Stroke Speed Requirements

For minimum control performance requirements, the minimum stroke speed in modulating modes of process operation shall be:

- 0.75 inch per second for time-critical gas/vapor control applications, including but not limited steam pressure, fuel gas pressure, etc.
- 0.15 inch per second for general control applications.

  For example: The maximum stroke times in control mode, for a valve with a 6"stem travel, are:

  - 8 sec's at a stroke speed of 0.75 inch per second and
  - 40 sec's at a stroke speed of 0.15 inch per second

Note: *Anti-surge applications are specified in paragraph 6.3.*

All applications need to be verified for the actual stroke speed requirements by the contractor. The required stroke time shall be specified on the ISS for each control valve.

Stroke times shall be tested on a 50% control signal step change (i.e., on a 50% step change the resulting change in valve travel needs to be performed within 50% of the required stroke time) without the aid of process pressure conditions. Stroke times shall be tested during manufacturer's inspection and during plant commissioning when piping systems are de-pressurized. Boosters may be applied to meet stroke time requirements, but stroke movements shall remain stable at 20%, 50% and 80% control signal step changes (i.e., overshoot to be less than 120% of the input step change and be dampening as defined in ANSI/ISA 51.1, and ANSI/ISA TR75.25.02).

Fast-stroke time requirements under air failure conditions shall be separately specified on the ISS (e.g., stroke times faster than the manufacturer's standard; piston-type actuators may have prolonged stroke times under air failure conditions). Typical applications requiring fast stroke times on air failure conditions include vent and flare dump valves to prevent safety/relief valves from being lifted. Quick-exhaust valves may be used, provided that they do not interfere with the normal control operation of the actuator system.

Exception:

Prolonged stroke times shall be applied for control valves in liquid lines, when required to prevent hydraulic surge conditions to exceed the pipeline Maximum Allowable Surge Pressure (MASP). When the stroke time of a control valve affects the pipeline MASP, or the load of a surge relief valve system, then the following note shall be specified on the ISS: "Valve Stroke Time Affects Pipeline MASP or Surge Relief Valve System Load". Typical applications may include pipelines, loading lines, tankage transfer lines, etc.

7.7 FOUNDATION™ Fieldbus (FF) Systems

FF digital positioners shall meet the minimum device requirements detailed in SAES-J-904.

7.8 Control Valve Maintenance Support System

The control valve maintenance support system shall be integrated into the Instrument Asset Management System and shall follow the requirements in SAES-J-905.

8 Accessories

8.1 Handwheels

A handwheel shall be provided on valves when local manual control is required by the Proponent. Handwheel installations shall meet the following requirements:

a) Neutral position shall be clearly indicated.

b) Handwheel mechanism shall not add friction to the actuator.

c) Handwheel shall not be used as travel stops.

d) Handwheel shall be fully accessible for operation.

8.2 Limit Switches

Limit switches shall be actuated by proximity sensors. Limit switch enclosures shall be hermetically sealed. Switch contact outputs shall be at minimum, Single-Pole, Double-Throw (SPDT). Contact rating shall be at minimum, 0.5 Amp inductive at 125 VDC.

8.3 Solenoid Valves

Requirements for solenoid valves shall be specified on the subject control valve ISS. Solenoid valves shall be selected from approved manufacturers per SAES-J-002 and SAP. High temperature class "H" coil insulation rated for continuous duty shall be used with viton elastomers. Class "F" coil insulation is acceptable for low power (<2 watt) solenoid valves. Solenoid valves shall not be used for in-process service applications.

8.4 Volume Tanks

Volume tanks shall be mechanically designed to withstand a maximum pressure of 862 kPag (125 psig) at 82°C. Volume tanks shall be manufactured in accordance with ASME VIII D1 (stamped UM) or PED requirements. Volume tanks shall have a minimum capacity for two complete stroke operation of the control valve at the minimum available instrument air pressure of 415 kPag (60 psig). When specified on the ISS, the volume tank shall be equipped with all required accessories to ensure that the control valve fails in the safe position.

Commentary Note:

The two strokes consist of the failure mode movement plus one movement in the opposite direction. So, if the control valve is AFC, the volume tank will be sized to move the valve from open to close and then from close to open.

8.5 Mechanical Limit Stops

When mechanical limit stops are required, they shall be of a permanently welded type. Screwed type, if seal-welding at the locking nuts, is acceptable.

Limit stop arrangements through: hand wheel mechanism, jam-nut arrangement, tack welding arrangement or positioner configuration, are not acceptable.

8.6 Position Indication

8.6.1 Valve Position Indicator

Each control valve shall be provided with a valve position indicator. The indicating pointer shall be directly connected to the stem or shaft. The valve position shall be indicated on a reversible scale, with clearly graduated markings at the 0%, 25%, 50%, 75% and 100% valve opening position and open and/or closed indication at the valve travel limits.

8.6.2 Valve Position Transmitter

For safety related applications, a dedicated electronic travel position transmitter, providing a proportional valve stem or shaft position signal, shall be specified for remote valve position indication.

8.7 Marking and Identification

8.7.1 Marking

The direction of flow shall be cast or steel-stamped on the valve body, or alternatively a stainless steel arrow shall be permanently fixed to the body by rivets, for all appropriate valves which have been designed or selected for a specific flow direction.

For butterfly valves and other rotary valves, the vane, disk, cam or ball position shall be indicated by an engraved marking on the shaft end.

8.7.2 Identification

Name plates shall be provided for all control valves. Name plates shall be made of 316SS and permanently fastened to the valve (i.e., adhesive fastening is not acceptable).

9 Installation

9.1 General

Control valves shall be installed in horizontal lines.

Control valves shall be installed such that they can easily be removed for maintenance (i.e., if necessary a piping spool shall be installed to prevent the need to remove major piping).

Control valves and their actuating systems shall be mounted such that all adjustments are accessible (and all indicators/gauges are readable) from grade, permanent platform, walkway or fixed ladder. Portable platforms and portable ladders shall not be used. Sufficient clearances shall be provided for the removal of any part of the control valve or actuator assembly. Access space for lifting equipment shall be provided for valve and actuator assemblies weighing over 50 kg.

Control valve actuating systems and cabling shall not be located in close proximity to high temperature sources. Thermal shielding shall be applied from surfaces exceeding 260°C (500°F) when less clearance than 1000 mm (40 inches) is provided.

To avoid damage on control valve trims during flushing and hydrotesting of the piping system all control valves shall be removed from the piping system (e.g., blind flanges or spool pieces can be used to close the piping system). If the valve cannot be removed during flushing and hydrotesting, a temporary spool-mounted strainer of adequate strength shall be installed upstream of control valves with a high performance type trim (e.g., multi-stage low noise type trims, anti-cavitation type trims, etc.). A strainer in accordance with Standard Drawing AB-036764 may also be used.

A permanent, spool-mounted strainer of adequate strength shall be installed upstream of control valves in dirty and erosive services.

Electrical installation shall conform to SAES-J-902, "Electrical Systems for Instrumentation." The electrical area classification of the control valve location shall be specified on the ISS. Electrical installation shall comply with NFPA 70, National Electrical Code (NEC).

9.2 Manifold

9.2.1 Block and bypass valves shall be provided as standard for each control valve installation. However, the block valves and bypass valve arrangement are not mandatory for control valves installed in:

- identical pieces of equipment installed in parallel (e.g., pumps, compressors, heat exchangers, etc.) with one piece of equipment used for standby, spare or redundant capacity (e.g., one duty and one standby, two duty and one standby, etc.), enabling on-line maintenance of any one control valve at any one time without affecting the required capacity
- identical process systems installed in parallel (e.g., trains, modules, units, boilers, furnaces, etc.) with one process system used for spare or redundant capacity, enabling on-line maintenance of any one control valve at any one time without affecting the required capacity
- process or equipment which is only intermittently operated in association with a continuous process (e.g., during start-up, regeneration, etc.)
- control valves which are only intermittently operated including compressor anti-surge, compressor spill-back, pump minimum flow, emergency vent, etc.
- non-critical equipment which may be shut down without affecting the operation of the main process
- applications where, for safety reasons, a block and bypass valves arrangement is not desirable (e.g., to reduce leakage sources of hazardous fluids, such as hydrogen, phenol, hydrofluoric acid, etc.)
- applications where, for safety reasons, manual operation by means of the bypass valve is not desirable (e.g., turbine speed control, fuel control to boilers and process heaters, etc.)
- applications, for which the proponent specifically does not require block and bypass valves to be installed

Bypass manifolds shall be designed to prevent the accumulation of dirt or other solids or formation of sluggish materials in stagnant lines.

The capacity impact (i.e., friction losses) of the manifold need to be verified during detailed design of the control valve system. This is especially important for high-recovery-type control valves operating under low-pressure drop conditions.

9.2.2 Manifold Piping

The manifold piping shall be arranged to provide flexibility for removing control valves for maintenance (e.g., particularly where ring joint flanges are used).

The piping around control valves shall be self-supporting or shall be permanently supported so that when the control valve is removed, the lines will remain in place without the need for temporary supports. If required, a support directly under the control valve body shall be provided where the weight of the control valve will add significant stress to the piping system.

Sizes of main line piping and branch piping shall be selected to conform to the fluid velocity limitations governed by SAES-L-132, "Materials Selections for Piping Systems." These fluid velocity limitations may only be exceeded for piping installed between the control valve and reducers provided that one schedule heavier piping is used for this piping than the schedule required by the piping code.

For control valve applications with body outlet velocities in excess of 0.2 Mach, a straight piece of piping shall be installed over a length of at least 2D upstream and 10D downstream of the control valve before any fitting (e.g., elbow, tee, thermowell, etc.) where D is the nominal size of the piping. Additionally, the angle of the reducer and expander shall be smaller than 30° ($\theta < 30°$).

Control valves in flashing services shall be located as close as practically possible to the downstream vessel.

When heavier schedule piping is installed for noise reduction, it shall be installed over a minimum length of 10 D upstream and 20 D downstream of the control valve before any fitting (e.g., elbows, tee, or reducer), where D is the nominal size of the piping.

Requirements for non-standard reducers and heavier wall piping shall be specified on the Piping & Instrument Diagrams.

9.2.3 Bypass Valve

Bypass valves shall meet the minimum requirements of SAES-L-108 applicable for the subject piping class.

The bypass valve shall be manually operable and have a correct trim and control characteristic suitable for meeting the service requirements without excessive noise or piping vibration, on a temporary basis. Additionally, the bypass valve shall have a capacity at least equal to the required Cv of the control valve, but not greater than twice the selected Cv of the control valve. When the line may be required to handle larger flows at a later date, the bypass valve capacity shall be selected to accommodate the future flow rate.

For applications where it is impractical, or unsafe to operate the process on a manual bypass valve, a control valve with an actuator system shall be installed as a bypass valve. A pneumatic valve arrangement shall then be provided to allow smooth transfer of the control signal between the main control valve and the bypass control valve. Alternatively, two smaller redundant control valves, each having 50% of the required flow capacity, may be provided. Such applications include, but are not limited to quench flow control and temperature control on an exothermic reactor, pressure control requirements above 80% of the PZV set pressure, boiler feed water control, steam drum pressure control, etc.

For applications requiring control valve body sizes in excess of 12", multiple parallel arrangements of identical smaller body size valves may be considered. A duplicate control valve, installed in between block valves, shall then be provided as a common bypass valve for any one control valve (e.g., the same type of control valve with a handwheel, but without an actuator). Alternatively, a duplicate control valve with switch arrangements may be provided such that it can replace anyone of the control valves.

For applications where the bypass valve must be able to remain in service for an extended period of time (including those where control valves with special low-noise and anti-cavitation-type trims are installed), a duplicate control valve, installed in between block valves, shall be provided as a bypass valve (e.g., the same type of control valve with a handwheel, but without an actuator). Alternatively, a duplicate control valve with switch arrangements may be provided such that it can replace anyone of the control valves.

9.2.4 Block Valves

Block valves shall conform to SAES-L-108 for the subject piping class. Block valves shall generally be the same size as the line size and shall be full capacity type valves.

Inlet block valves shall be installed upstream (before inlet reducers). Outlet block valves shall be installed downstream (after outlet expanders).

9.2.5 Drain and Vent Valves

Both sides of a control valve in a manifold shall be provided with a drain valve, unless otherwise specified by the proponent. Drain valves shall be installed on the bottom of each spool piece between the control valve and the block valves.

Control valve installations without block and bypass valves shall also be provided with a drain valve on each side of the control valve.

The size of drain valve shall be large enough to drain the enclosed liquid within 2 hours under atmospheric conditions, but be ¾" minimum.

Vent valves shall be provided where required. Size of vent valve shall be ¾" minimum.

The type of drain and vent valve shall be suitable for the selected piping class, conforming to SAES-L-108. Drain and vent valves shall be plugged or blinded per SAES-L-108.

9.3 Protective Shields and Flame Impingement Shields

Protective shields, to prevent injury to personnel, shall be installed on valves handling dangerous or flammable liquids, in accordance with SAES-B-061. Protective shields shall be of a type that can be removed while the equipment is in service.

Flame impingement shields, to protect flangeless control valves in fire-hazardous zone services as defined in SAES-B-006, shall be installed in accordance with Standard Drawing AC-036404. This requirement is applicable for all onshore, near-shore and offshore facilities.

9.4 Anti-Static Devices

Control valve designs shall be evaluated for the presence of electrically isolated metal parts when used in non-conductive fluid services.

Anti-static devices shall be provided to ensure electric continuity between all isolated parts and the valve body. These shall fulfill the following requirements:

a) Provide a discharge path with an electrical resistance of not greater than 10 ohms.

b) Be of such a design that the valve cannot be assembled, or reassembled, without the device.

Revision Summary

6 September 2011 Major revision