

DEP SPECIFICATION

CONTROL VALVES - SELECTION, SIZING, AND SPECIFICATION

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DESIGN AND ENGINEERING PRACTICE

DEM1



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1. INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and gives recommendations for the selection and specification of control valves, their actuators and accessories, using the latest industry practices and international standards where applicable. It includes self-acting regulators and the use of control valves as a final element for certain protective functions.

Outside the scope of this DEP are on/off valves solely intended for switching or protective functions.

This DEP is primarily intended for:

- Engineers who are involved in selection and specification of control valves as well as trouble shooting, adding new and replacing existing control valves;
- Engineering consultants and system integrators (Contractors) who are preparing requisitions and evaluating technical proposals on behalf of their Principal;
- Control valve vendors (Manufacturers/Suppliers) involved in the preparation of technical quotations, calculations and providing technical support to sites.

This DEP contains mandatory requirements to mitigate process safety risks in accordance with Design Engineering Manual DEM 1 – Application of Technical Standards

This DEP is a revision of the DEP of the same title and number dated April 2003; see (1.5) regarding the changes.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by Shell GSI, the distribution of this DEP is confined to Shell companies and, where necessary, to Contractors and Manufacturers/Suppliers nominated by them. Any authorised access to DEPs does not for that reason constitute an authorization to any documents, data or information to which the DEPs may refer.

This DEP is intended for use in facilities related to oil and gas production, gas handling, oil refining, chemical processing, gasification, distribution and supply/marketing. This DEP may also be applied in other similar facilities.

When DEPs are applied, a Management of Change (MOC) process should be implemented; this is of particular importance when existing facilities are to be modified.

If national and/or local regulations exist in which some of the requirements could be more stringent than in this DEP, the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable with regards to the safety, environmental, economic and legal aspects. In all cases the Contractor shall inform the Principal of any deviation from the requirements of this DEP which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned, the objective being to obtain agreement to follow this DEP as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

The **Contractor** is the party that carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project or operation of a facility. The Principal may undertake all or part of the duties of the Contractor.

The **Manufacturer** is the party that manufactures equipment to perform the duties specified by the Contractor.

The **Supplier** is the Manufacturer or third party which is ultimately responsible for achieving the goods meeting the performance specification.

The **Principal** is the party that initiates the project and ultimately pays for it. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

Process Safety is the management of hazards that can give rise to major accidents involving the release of potentially dangerous materials, release of energy (such as fire or explosion) or both.

The word **shall** indicates a requirement.

The capitalised term **SHALL [PS]** indicates a process safety requirement.

The word **should** indicates a recommendation.

1.3.2 Specific definitions and abbreviations

For control valve terminology and related terms, IEC 60534-1 applies, with the following amendments:

- *Section 4.1 Nominal size, add:*
Valve sizes may also be expressed in inches.
- *Section 4.2 Nominal pressure, add:*
Valve pressure rating may also be expressed in ASME classes.

For definitions regarding control valve sizing, see (Appendix 1).

For the purposes of this DEP, the following definitions apply:

FF	Foundation™ Fieldbus
HART	Highway Addressable Remote Transducer is a standard for sending and receiving digital information across analogue wires between smart devices and control or monitoring system
HP	High Pressure
IPF	Instrumented Protective Function: A function comprising one (1) or more Initiators, a Logic Solver and one (1) or more Final Elements whose purpose is to prevent or mitigate hazardous situations An IPF is intended to achieve or maintain a safe state for the process, in respect of a specific hazardous event In IEC 61508/61511 an IPF is referred to as a Safety Instrumented Function (SIF)
Maximum Operating Pressure (MOP)	The maximum pressure allowed in a device or system. The design pressure (DP) is 110% of the MOP
NPS	Nominal Pipe Size
NPT	National pipe thread is a U.S. standard for tapered threads used on threaded pipes and fittings
On/off	Changing to an open, closed or predetermined state when required, for example, by an instrumented protective system, through the use of a solenoid-operated valve
PAS	Process Automation System
PEFS	Process Engineering Flow Scheme(s)

SPI SmartPlant Instrumentation – an instrument index complete with device specification sheets

Throttling control Continuously manipulating the stem/shaft of a control valve in order to obtain a desired process condition. This is usually done through a valve positioner

1.4 CROSS-REFERENCES

Where cross references to other parts of this DEP are made, the referenced section number is shown in brackets. Other documents referenced in this DEP are listed in (15).

1.5 SUMMARY OF MAIN CHANGES

This DEP is a revision of the DEP of the same number dated April 2003.

This has been a major rewrite and it is impractical to summarise the changes here.

Content of the previous version that was background information, explanation, and guidance, and therefore not required to be communicated to the Contractor, has been removed.

1.6 COMMENTS ON THIS DEP

Comments on this DEP may be sent to the Administrator at standards@shell.com, using the DEP Feedback Form. The DEP Feedback Form can be found on the main page of “DEPs on the Web”, available through the Global Technical Standards web portal <http://www.shell.com/standards> and on the main page of the DEPs DVD-ROM.

1.7 DUAL UNITS

**Amended per
Circular 06/12**

Dual units have been incorporated throughout this DEP.

This DEP contains both the International System (SI) units, as well as the corresponding US Customary (USC) units, which are given following the SI units in brackets. When agreed by the Principal, the indicated USC values/units may be used.

2. GENERAL

2.1 FUNCTION

When a control valve is used as a final element of a protective function, it shall be equipped with a solenoid-operated valve between the valve positioner and the actuator. The primary purpose of the valve remains throttling control. The optional use of a control valve as a final element in a protective function does not make that valve an on/off valve. In case the control valve requires a bypass for operational reasons that bypass shall normally be closed and locked with a chain / padlock.

Throughout this document, use of a control valve as a final element of a protective function only affects the requirement for a solenoid-operated valve. It does not affect other requirements such as material selection, stroking time and allowable leak rate.

3. SELECTION OF CONTROL VALVES

The information listed in (12.3) shall be provided with the requisition for each control valve. This document is aligned with IEC 60534 and uses the standard control valve data sheet as included in IEC 60534-7:2010 Clause 8.3. Many of the required parameters for the specification of a control valve are described there. Throughout this document, reference is made to the standard control valve data sheet line numbers.

Note that if an instrument index (e.g.: SmartPlant Instrumentation) is used for the project, the valve specifications sheets supplied with that instrument index shall be used. In this scenario, the IEC valve data sheet shall be used as a reference for information that shall be provided in the specification and purchase of a control valve.

The selection of control valves is done in a number of steps:

- Determine the basic process conditions and other details for the application (IEC 60534-7:2010, lines 1-25);
 - o During normal operating modes, at minimum, normal and maximum flow rate for each operating case;
 - o During abnormal operating modes, start-up, commissioning, test and emergency operations;
- Qualify the process conditions of the application as either 'General Service' or 'Severe Service' (3.1);
- For severe service, gather additional information such as:
 - o Pump curves, compressor anti-surge requirements;
Note: The vendor of the anti-surge system and vendor of compressor shall be consulted for all compressor anti-surge valve requirements.
 - o Piping details, line losses, elevations as shown in Appendix 1.

This data will influence the controllability of the control valve and relates to the choice of trim characteristic for all services.

- Determine, based on the piping classes, whether the application requires any special valve designs (3.2) or end connections;
- Selection of valve type and category within project list of equipment suppliers (3.4).

The next steps will be the specification of the valve body (4), valve trim (5), actuator (8) and accessories (9).

Valves with special designs are covered in (6). Valves for special services are covered in (7).

3.1 QUALIFICATION OF SEVERE SERVICE CONDITIONS

In the early phases of a project limited information may be available and often a certain degree of uncertainty is associated to that knowledge.

However, the following information is generally reasonably known when the control valve selection is performed:

- Fluid state (liquid, gas, steam, slurries)
- Flow rate at max, normal and min conditions (Q) for each operating case
- Upstream pressure at max, normal and min conditions (P1)
- Differential pressure at max, normal and min conditions (P1-P2) or (dP)
- Vapour pressure for liquids (Pv)
- Upstream temperature (T1)

- Valve size (D), for this purpose taken as being one (1) size smaller than the line size.

With this information a number of qualifiers can be calculated which will determine if a severe service condition exists for that control valve. It should be noted that the limits indicated in the table below are not very sharp but are merely indicating whether a potential for severity exist in the service conditions. The worst case may not necessarily exist at maximum conditions; often it is a combination of pressure drops and flow rates that may cause problems. It is required to calculate these qualifiers at least at minimum, normal and maximum conditions.

The severe service conditions need to be verified during detailed design through the use of computer programs that can model the piping and equipment around the valve and determine the behaviour of the control valve in the overall process. These programs will allow calculations to be performed at any flow rate, not just at minimum, normal and maximum flow and thus provide opportunities for trouble shooting and optimisation.

Severe Service Condition	Calculation	Limit	Notes
Cavitating service	$dP/(P_1 - P_v)$	>0.38	Only for liquids
Flashing service	P_2/P_v	<1.0	Only for liquids
High pressure drop ratio (choked flow)	dP/P_1	>0.6	
High turn-down ratio	Q_{max}/Q_{min}	>10	
High power conversion	$dP(Pa) \times Q$	>30 Kw (40 HP)	
High noise	Noise > 85 dB	> 85 dB	
Erosive applications			Entrained solids

Table 1 Qualification of severe service conditions (all pressures in kPa (psi))

Theoretical sound level production has not been included in this table because many valve-specific factors determine the sound level.

If any of these conditions violate the limits in the Table 1, the application shall be considered as a 'severe service application' which requires the selection of control valves which have been specifically selected and qualified for severe service applications.

In addition to these criteria, severe service conditions always apply to:

- Compressor anti-surge/spillback valves;
- Minimum flow recycle valves;
- Choke valves for the control of well fluids;
- Liquid drain valves on HP separators and knock-out vessels;
- Boiler feed-water valves
- Valves that experience heavy out gassing (release of gases absorbed or dissolved in pressurised liquids).

If none of the above conditions apply (including start-up, commissioning and emergency conditions) the application can be met by a general service valve.

When it has been established that an application is qualified as severe service, this condition shall be indicated in the requisition (IEC 60534-7:2010, line 26) and additional process information shall be provided. Refer to Appendix 1.

The following service descriptions shall be used when selecting the control valve service:

3.1.1 Cavitating service

Cavitation potential exists when the pressure in the vena contracta of a control valve reaches the vapour pressure of the liquid based on the parameter $dP/(P_1 - P_v)$. Special measures are required to avoid material damage to the valve and downstream piping and equipment as well as noise and vibration. In case cavitation potential exists, a valve with a high numeric valve recovery coefficient (F_v) shall be required. This is considered a severe service application.

3.1.2 Flashing service

In a flashing application, vapour will always be present downstream of the vena contracta of a control valve ($P_v \geq P_2$). The fraction of the vapour depends on many factors. Flashing is actually the first stage of cavitation but not all vapour returns to liquid. Control valves in a flashing application may also show material damage over time due to high valve outlet velocities however in most cases this can be handled by selecting special hardened alloys.

3.1.3 High pressure drop ratio (choked flow)

Above a certain pressure drop ratio (dP/P_1) the flow rate does not depend on the downstream pressure anymore as the fluid velocity in the vena contracta reaches the velocity of sound. It only depends on valve opening and upstream pressure. This is called 'choked flow'. In certain applications it is desirable to have the flow rate independent of downstream conditions. Choked flow in itself is not necessarily a problem but the effects associated to the very high velocities inside and at the outlet of the valve may require a severe service valve for these applications.

3.1.4 Turn-down ratio

The turn-down ratio of an application is the ratio between the maximum flow rate to the minimum flow rate that can be properly controlled by the control valve. This includes the effects of other devices in the flow path and is not the same as rangeability, which is a characteristic of a particular control valve.

3.1.5 High power conversion

The differential pressure across a control valve multiplied with the volumetric flow rate (equals velocity) provides an indication for the power conversion that takes place inside the valve. This energy conversion will be mostly from potential energy into thermal energy (heat), kinetic energy (velocity) and acoustic energy (noise). It is clear that this figure is an indicator for the intensity of the conversion that takes place inside the control valve. Examples of high power conversion valves are depressuring valves, recycle valves, wellhead choke valves etcetera.

3.1.6 High noise

A control valve with high noise is an indication of a large dissipation of energy (conversion of potential energy to acoustic energy). These valves shall be closely reviewed to ensure the appropriate valve design has been selected.

3.2 DETERMINATION OF SPECIAL VALVE DESIGN REQUIREMENTS

The first step in determining whether a control valve requires a special design is to determine the required piping class. Based on that, either a special valve design is required or the control valve can be considered as a standard valve.

3.2.1 Piping classes

A piping class is a collection of piping components, suitable for a defined service and design limits in a piping system. Piping classes are compiled in DEP 31.38.01.12 Gen. and DEP 31.38.01.15 Gen.

Although it should be recognised that Manufacturers generally do not have access to piping class details, reference to the applicable piping class shall be in the requisition (IEC 60534-7:2010, line 6) will help consistency and avoid confusion and errors.

Control valves and self-acting regulators shall be selected in accordance with the requirements of the piping class. Based on those requirements, decide on the options for the following valve properties which shall be included in the requisition:

- Pressure class;
- Mechanical design limits, indicating the pressure ratings at coincident temperatures;
- Material selection of valve body (trim material shall be based on the application requirements and verified with the Manufacturer);
- Flange type and facing, end gasket type;
- Fugitive Emissions Class (IEC 60534-7:2010, line 56).

Providing a certain choice of the trim materials in the requisition (IEC 60534-7:2010, line 50) allows the Manufacturer to be able to advise the most suitable material for the valve trim.

3.2.2 Selection process

Figure 1 illustrates the flow chart of the special design selection process. It is typical only and may be amended by the Principal for a particular Manufacturer. The purpose of Figure 1 is to enable an early selection in order to focus attention on valves that need special designs. Any special design requirements shall be indicated in the requisition (IEC 60534-7:2010, line 44).

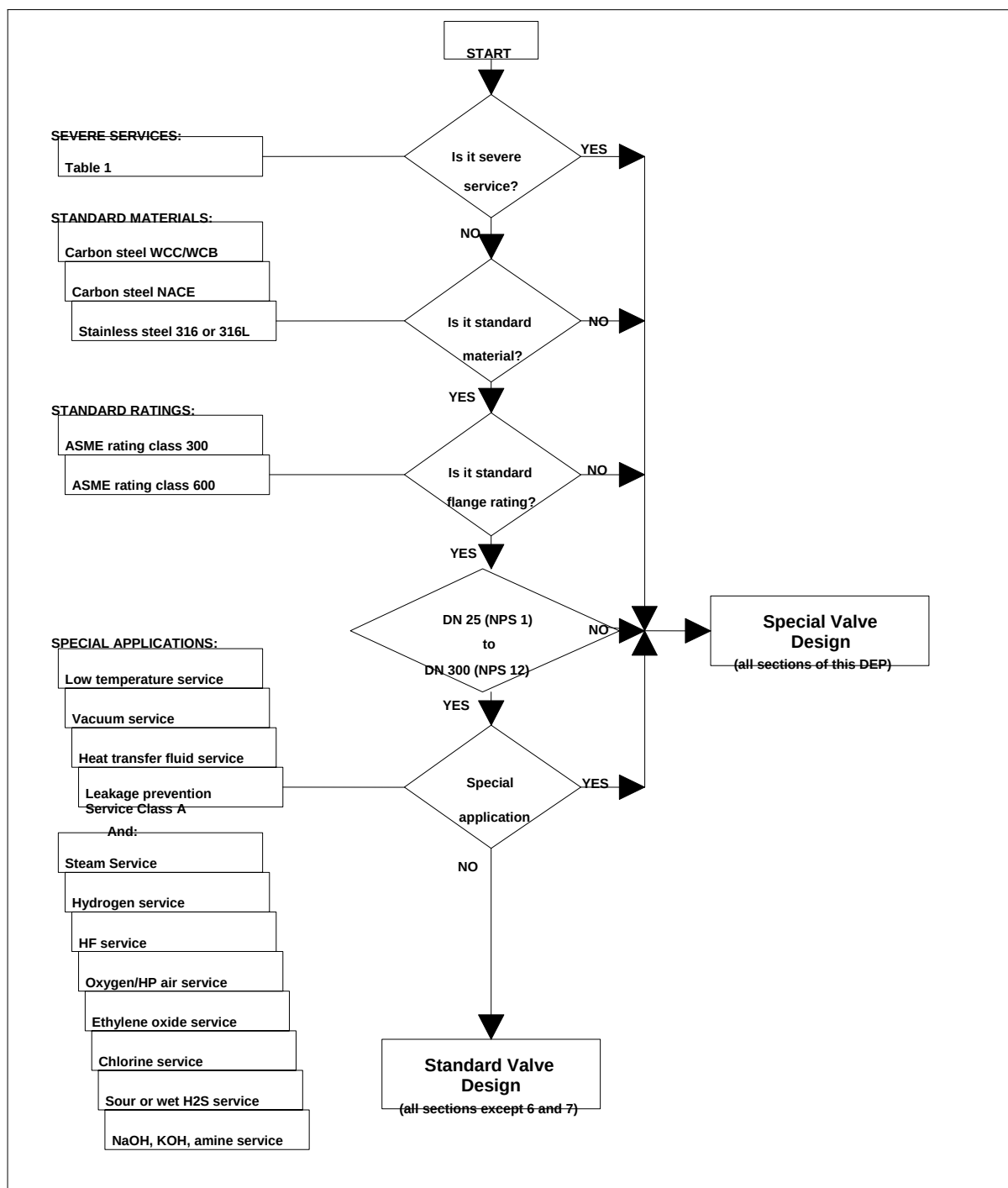


Figure 1 Selection process for special valve designs

3.3 SELECTION OF CONTROL VALVE TYPE

IEC 60534 splits control valve types by the motion of the valve stem and this is the first choice in the selection of a control valve. This choice is influenced by technical as well as economic reasons. The selection of valves for severe service applications shall be based on proven applications experience.

3.4 LINK OF THIS STANDARD ACCEPTED PRODUCTS AND SUPPLIERS.

Products shall be technically qualified to the satisfaction of the Principal and shall be sourced from Manufacturers acceptable to the Principal.

IEC 60534-1:2005 Clause 3.1 provides a framework for different types of control valves which is depicted in Table 2. Use of this table provides selection of types of valves that are acceptable to be used for a particular severe service condition. It should be understood that this selection is not 'absolute'. Local site experience should also be considered when selecting control valve types. The category of valve to be used for the tender shall be indicated in the requisition (IEC 60534-7:2010, line 26).

Only valve types from the same category shall be tendered in the same requisition.

Note: For this purpose Shell Companies may use the list of Technically Acceptable Manufacturers and Products maintained by Shell."

Table 2 Valve type selection table (a X indicates an allowed use of that valve type)

Sub-Group	Valve Sub-Sub-Group	General Service	Severe Service						
			Cavita- ting	Flashing	Hi-dP	Choked flow	Turn-down ratio	High Power	Erosive, solids,
Control Valve - Linear Motion	Diaphragm (IEC 60534-1:2005 Clause 3.1.1.1)	X							On/off only
	Gate (IEC 60534-1:2005 Clause 3.1.1.2)	X							
	Globe (IEC 60534-1:2005 Clause 3.1.1.3) Two-way post guided valve			X	X	X Note 1	X	X	X
	Two-way cage guided valve		X	X	X	X Note 1	X	X	
	Three-way valve	X							
	Axial flow valve			X	X	X Note 1	X	X	X
	Globe Angle (IEC 60534-1:2005 Clause 3.1.1.3)		X	X	X	X	X	X	X
Control Valve - Rotary Motion	Ball (IEC 60534-1:2005 Clause 3.1.2.1)	X	X Note 3						X
	Segmented Ball (IEC 60534-1:2005 Clause 3.1.2.2)	X	X Note 3	X			X	X	
	Butterfly (IEC 60534-1:2005 Clause 3.1.2.3)	X	X Note 2						
	Plug (IEC 60534-1:2005 Clause 3.1.2.4)								X
	Eccentric Plug (IEC 60534-1:2005 Clause 3.1.2.5)	X	X Note 3	X					
Control Valve - Self-Acting	Pressure, Self-Acting	X							
	Temperature, Self-Acting	X							

	Tank blanketing / venting	X							
Control Chokes	Gas or liquid service	X			X	X		X	X

Note 1) Not for wellhead chokes

Note 2) Only as triple-eccentric with anti-cavitation trim

Note 3) To be specified with anti-cavitation trim

3.5 LINEAR MOTION VALVES

The sections below follow the structure and nomenclature of IEC 60534-1:2005 Clause 3.1.1. For certain valve types, qualifiers for service conditions have been added to the text which may differ from those used to qualify severe services. The users of this document may amend these figures based on site-specific experience.

3.5.1 DIAPHRAGM VALVES IEC 60534-1:2005 Clause 3.1.1.1

The use of diaphragm valves is common in waste water (water treatment) service. Use in any other service requires the approval of the Principal. These types of valves are not further covered in this document.

3.5.2 GATE VALVES IEC 60534-1:2005 Clause 3.1.1.2

These types of valve are not further covered in this document.

3.5.3 GLOBE VALVES IEC 60534-1:2005 Clause 3.1.1.3

Globe valves for throttling control shall only be considered if:

- Leakage Class $\leq V$ for dirty general service applications (Leakage Class VI is possible for clean service)
- Leakage Class $< V$ for severe service applications.

3.5.3.1 Two-way globe valves

Post guided valves:

Top guided parabolic plugs in modern "light weight" valves shall be selected with care to avoid stem vibration in sizes greater than DN 25 (NPS 1).

Cage guided valves:

Cage guided valves and balanced type valves, with the exception of double seated control valves, shall not be used in service where coke may form, where solids are present or where gluing effects may be present.

Balanced-type control valves shall only be used in clean services where Leakage class less than or equal to Class V applies. In case there is any potential for scaling, corrosion or contaminants, balanced-type control valves shall not be used.

3.5.3.2 Three-way globe valves

If the two (2) inlet streams are of different temperatures, it shall be confirmed that the resulting temperature stress is within the capabilities of the three-way globe valve. All process conditions shall be considered (start-up, shutdown, etc.) when confirming the temperature stress scenarios.

3.5.3.3 Axial flow valves

Axial flow valves shall be considered for anti surge application, this to ensure smooth control, fast acting and to avoid unnecessary boosters (which affect and limit the control margin) to speed up the response.

3.5.4 ANGLE VALVES IEC 60534-1:2005 Clause 3.1.1.3

Angle valves for throttling control shall only be considered if one (1) or more of the following conditions are met:

- Hydrocarbon services where coke may form;
- Erosive services, e.g. slurries and solids carried in suspension;
- Severe flashing service;
- Cavitating services;

- Applications where solid contaminants might settle in the body of a globe valve, for instance vessel bottoms services;
- Liquid service with high differential pressures;
- Compressor antisurge;
- Vent or blowdown valves;
- High temperature/desuperheating;
- Two (2) phase/multi phase flows;
- Wellhead fluid chokes.

3.6 ROTARY MOTION VALVES

The sections below follow the structure and nomenclature of IEC 60534-1:2005 Clause 3.1.2.

Cryogenic applications shall be reviewed for the requirement of a gas lock under the gland packing.

3.6.1 BALL VALVES IEC 60534-1:2005 Clause 3.1.2.1

Ball valves for throttling control shall only be considered if all of the following conditions are met:

- Cavitating potential <0.6
- Non flashing service
- Pressure drop $dP < 1000$ kPa (145 psi)
- Pressure drop ratio $dP/P_1 < 0.6$
- Turn down ratio <5
- Power conversion <20 kW (27 HP)

The controllability (installed characteristic) shall be checked over the whole range of the valve, to ensure smooth control.

Ball valves without internals that are specially designed for throttling control require the approval of the Principal.

3.6.2 SEGMENTED BALL IEC 60534-1:2005 Clause 3.1.2.2

Segmented ball valves for throttling control shall only be considered if all of the following conditions are met (all pressures are in kPa (psi)):

- Cavitating potential <0.8
- Mild or non-flashing service
- Pressure drop $dP < 1000$ kPa (145 psi)
- Pressure drop ratio $dP/P_1 < 0.6$
- Turn down ratio <10
- Power conversion <30 kW (40 HP)

3.6.3 BUTTERFLY VALVES IEC 60534-1:2005 Clause 3.1.2.3

Butterfly valves for throttling control shall only be considered if all of the following conditions are met (all pressures are in kPa):

- Valve size > 101.5 mm (4 in)
- Pressure drop ratio $dP/P_1 < 0.1$
- Turn down ratio <5

- Pressure drop $dP < 500$ kPa (75 psi)
- Leakage Class $<V$,
- Non-erosive fluids.

3.6.4 PLUG VALVES IEC 60534-1:2005 Clause 3.1.2.4

Contractor shall specify plug valves in accordance with MESC SPE 77/107 which is an amendment of API 599.

3.6.5 VALVES WITH ECCENTRIC PLUG IEC 60534-1:2005 Clause 3.1.2.5

Eccentric plug valves for throttling control shall only be considered if all of the following conditions are met (all pressures are in kPa (psi)):

- Cavitating potential <0.8
- Pressure drop $dP < 1000$ kPa (145 psi)
- Pressure drop ratio $dP/P_1 < 0.6$
- Turn down ratio <10
- Power conversion <20 kW (27 HP)
- $\Delta p_{100}/\Delta p_0 > 0,15$

3.7 SELF-ACTING REGULATORS

Self-acting regulators shall only be used in clean fluid services and only in applications that need no operator intervention, like the changing of a set point or manual operations. All self-acting regulators shall meet local pressure code requirements.

The use of self-acting regulators requires the approval of the Principal.

3.7.1 Self-acting pressure-reducing regulators

Pressure reducing regulators in gas blanketing service shall not be provided with an internal self-relieving function because that would cause a constant bleed of gas. All components downstream of the pressure-reducing regulator shall be rated for the maximum upstream protected pressure or suitable pressure protection shall be provided.

3.7.2 Self-acting back-pressure regulators

All components downstream of the back-pressure regulator shall be rated for the maximum upstream protected pressure or suitable pressure protection shall be provided.

3.7.3 Self-acting differential-pressure regulators

The pressure containing components of the differential-pressure regulator shall be rated for the maximum upstream and downstream protected pressures or suitable pressure protection shall be provided. Protected pressure is the maximum pressure allowed by a mechanical pressure protection device (e.g. relief valve, rupture disk).

3.7.4 Self-acting temperature regulators

Self-acting temperature regulators shall only be considered for simple heating applications where utilities (e.g. instrument air or gas) are not available.

4. SPECIFICATION OF BODY CONSTRUCTION AND MATERIALS

4.1 VALVE BODY

In general, valve body sizes are smaller than the piping size. However, the valve body size shall not be smaller than half the adjacent pipe size or two (2) nominal pipe sizes smaller, whichever is larger without approval from the Principal. Valves smaller than half the pipe size may require isolation from transmitted pipe stresses.

Oversized bodies (up to the size of the adjacent piping) with reduced trim sizes may be considered for economic reasons (e.g. to allow for foreseen capacity increase in the future) or may for instance be required to reduce the fluid outlet velocity.

The nominal sizes of control valve bodies should be selected from the following series:

DN 25, DN 40, DN 50, DN 80, DN 100, DN 150, DN 200, DN 250, DN 300 and larger (NPS 1, NPS 1 ½, NPS 2, NPS 3, NPS 4, NPS 6, NPS 8, NPS 10, NPS 12 and larger).

The use of body sizes smaller than DN 25 (NPS 1) shall only be used with the approval of the Principal.

The pressure class and the flange rating of flanged control valves shall be at least PN40 (ASME class 300). This requirement may be waived by the Principal for projects where it can be established that it is not justified. It shall not be waived on an individual basis.

Control valve bodies shall not be fitted with bottom drain plugs or other process-wetted threaded connections.

Split-body globe valves shall only be used with the approval of the Principal.

Control valves shall be installed free of pipe stresses.

All pressure containing components shall meet the regulatory pressure registration requirements in compliance with local codes.

4.2 END CONNECTIONS

Control valves in hydrocarbon service SHALL [PS] be provided with either process flanges or welded ends. Any deviation from this requires approval of the Principal.

Threaded connections shall not be used for control valves. Separable flanges are not allowed.

Wafer type valves on hydrocarbon service shall not be used. Wafer type valves clamped between flanges with long bolts or tie rods SHALL [PS] not be used in hydrocarbon service.

The use of lug type valves on non-hydrocarbon service shall only be used if the bolt holes are threaded and individual stud bolts are used on each end. In case stud bolts are not possible at locations adjacent to the stem drive and tail ends, tapped holes shall be used on those locations only.

Contractor shall specify flanges (including review of the suitability of the valve bottom flange gasket material) and flange gasket contact surface finish in accordance with the piping class and this shall be indicated in the requisition (IEC 60534-7:2010, line 11).

4.3 FACE-TO-FACE AND END-TO-END DIMENSIONS

Face-to-face dimensions for control valves shall be in accordance with IEC 60534-3 as follows:

- IEC 60534-3-1 Face-to-face dimensions for two-way, globe type, straight pattern and centre to face dimensions for two-way, globe type angle pattern control valves.
- IEC 60534-3-2 Face-to-face dimensions for rotary control valves except butterfly valves (which means segmented ball and eccentric rotary control valves with or without flanges).