أدنـوك
ADNOC

ADNOC GROUP PROJECTS AND ENGINEERING

CONTROL VALVE SPECIFICATION

Specification

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EFFECTIVE DATE:

AGES-SP-04-002

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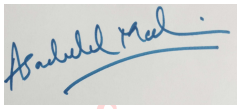
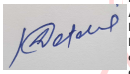
Abu Dhabi National Oil Company

GROUP PROJECTS & ENGINEERING / PT&CS DIRECTORATE

CUSTODIAN	Group Projects & Engineering / PT&CS
ADNOC	Specification applicable to ADNOC & ADNOC Group Companies

REVISION HISTORY

DATE	REV. NO	PREPARED BY (Designation / Initial)	REVIEWED BY (Designation / Initial)	ENDORSED BY (Designation / Initial)	ENDORSED BY (Designation / Initial)
1 June 2020	1	Asadullah Malik / Sr. Engineer, I&C, TE.  Digitally signed by Asadullah Malik DN: cn=Asadullah Malik, o=ADNOC, ou=AGP, email=asadullahm@adnoc.ae, c=AE Date: 2020.06.24 11:11:29 +04'00'	Ashwani Kumar Kataria/ A/MES,TC-Eng  Digitally signed by Ashwani Kumar Kataria DN: cn=Ashwani Kumar Kataria, o=ADNOC Onshore, ou=ADNOC Onshore, email=akataria@adnoc.ae, c=AE Date: 2020.06.24 13:52:23 +04'00' Reuben Yagambaram/ SPM-GPE Reuben Yagambaram Digitally signed by Reuben Yagambaram DN: cn=Reuben Yagambaram, o=ADNOC HQ, ou=ADNOC GPE, email=ryagambaram@adnoc.ae, c=AE Date: 2020.06.24 14:14:34 +04'00' Adobe Acrobat version: 2017.008.30051	Abdulla Al Shaiba/ VP-GPE  Digitally signed by Abdulla Al Shaiba Date: 2020.06.24 22:46:17 +04'00'	Zaher Salem/ SVP-GPE Zaher Salem Digitally signed by Zaher Salem Date: 2020.06.30 10:52:28 +04'00'

Group Projects & Engineering is the owner of this Specification and responsible for its custody, maintenance and periodic update.

In addition, Group Projects & Engineering is responsible for communication and distribution of any changes to this Specification and its version control.

This specification will be reviewed and updated in case of any changes affecting the activities described in this document.

INTER-RELATIONSHIPS AND STAKEHOLDERS

a) The following are inter-relationships for implementation of this Specification:

   i. ADNOC Upstream and ADNOC Downstream Directorates and

   ii. ADNOC Onshore, ADNOC Offshore, ADNOC Sour Gas, ADNOG Gas Processing. ADNOC LNG, ADNOC Refining, ADNOC Fertilisers, Borouge, Al Dhafra Petroleum, Al Yasat

b) The following are stakeholders for the purpose of this Specification:

   ADNOC PT&CS Directorate.

c) This Specification has been approved by the ADNOC PT&CS is to be implemented by each ADNOC Group company included above subject to and in accordance with their Delegation of Authority and other governance-related processes in order to ensure compliance

d) Each ADNOC Group company must establish/nominate a Technical Authority responsible for compliance with this Specification.

DEFINED TERMS / ABBREVIATIONS / REFERENCES

"**ADNOC**" means Abu Dhabi National Oil Company.

"**ADNOC Group**" means ADNOC together with each company in which ADNOC, directly or indirectly, controls fifty percent (50%) or more of the share capital.

"**Approving Authority**" means the decision-making body or employee with the required authority to approve Policies & Procedures or any changes to it.

"**Business Line Directorates**" or "**BLD**" means a directorate of ADNOC which is responsible for one or more Group Companies reporting to, or operating within the same line of business as, such directorate.

"**Business Support Directorates and Functions**" or "**Non- BLD**" means all the ADNOC functions and the remaining directorates, which are not ADNOC Business Line Directorates.

"**CEO**" means chief executive officer.

"**Group Company**" means any company within the ADNOC Group other than ADNOC.

"Specification" means this Control Valve Specification.

TABLE OF CONTENTS

GENERAL

1 PURPOSE

This specification describes the methodology and requirements for selection and sizing of control valves and accessories for general and severe service.

The purpose of this specification is to ensure consistency in selection and sizing of control valves for all ADNOC group businesses and stakeholders and reduce duplication of effort by others in developing control valve specifications for different projects.

Unless otherwise stated in this specification control valves shall in general comply with the requirements of IEC 60534 (all parts). Where a requirement is not covered in IEC 60534 then reference can be made to the listed standards included in section 4.1.

2 SCOPE

This specification shall generally apply to:

i. Control valves with pneumatic, electric and hydraulic actuators
ii. Severe service valves
iii. Valve accessories

This specification provides the general requirements for control valves but shall be read in conjunction with the valve data sheets and purchase order requisition provided at the time of enquiry.

This specification excludes actuated on/off valves (ESD and EDP) and subsea control valves.

3 DEFINED TERMS / ABBREVIATIONS / REFERENCES

Abbreviations	
Cv	Flow coefficient for sizing of a control valve
dBA	Decibel A-Weighted (Instrument Measured Sound Levels)
DCS	Distributed Control System
DCA	Design Change Authorization
DN	Nominal Diameter (metric)
EDP	Emergency De-Pressurisation
EPC	Engineering Procurement and Construction
ESD	Emergency Shutdown System

Abbreviations	
FAT	Factory Acceptance Test
HART	Highway Addressable Remote Transducer
IAMS	Instrument Asset Management System
ICSS	Integrated Control and Safety System
IEC	International Electrotechnical Commission
IP	Ingress Protection
ITP	Inspection and Test plan
LVDT	Linear Variable Differential Transformer
MOV	Motor Operated Valve
NACE	National Association of Corrosion Engineers
NDE	Non-Destructive Examination
NPS	Nominal Pipe Size
NPT	National Pipe Thread
PCS	Process Control System
PMI	Positive Material Identification
RF	Raised Face
RTJ	Ring Type Joint
SAT	Site Acceptance Test
SMART	Single Modular Auto-ranging Remote
TPI	Third Party Inspector
TSO	Tight Shut Off

References
ADNOC Group Companies Control Valve documents forming part of Control Valve Purchase Order shall be referred to for design and supply of equipment.

SECTION A

4 NORMATIVE REFERENCES

4.1 International Code(s) and Standards

The following codes and standards, to the extent specified herein, form a part of this specification. They have been rationalized to avoid duplication between the many regulatory organisations. When an edition date is not indicated for a code or standard, the latest edition in force at the time of VENDOR'S proposal submittal shall apply.

Standard	Description
American Petroleum Institute (API)	
API STD 598	Valve Inspection and Testing
API STD 599	Metal Plug Valves-Flanged, Threaded and Welding Ends
API STD 609	Butterfly Valves: Double Flanged, Lug- and Wafer-Type
API STD 622	Type Testing of Process Valve Packing for Fugitive Emissions
API SPEC 6D	Specification for Pipeline and Piping Valves
API RP 553	Refinery Valves and Accessories for Control and Safety Instrumented Systems
API RP 941	Steels for Hydrogen Service at Elevated Temperatures and Pressures in Petroleum Refineries and Petrochemical Plants
American Society of Mechanical Engineers (ASME)	
ASME B16.5	Pipe Flanges and Flanged Fittings NPS ½ through NPS 24 Metric/Inch Standard
ASME B16.10	Face-to-Face and End-to–End Dimensions of Valves
ASME B16.34	Valves – Flanged, Threaded and Welded End
ASME B16.47	Large Diameter Steel Flanges NPS 26 through NPS 60 Metric/Inch Standard
ASME B46.1	Surface Texture (Surface Roughness, Waviness and Lay)

Standard	Description
ASME Section VIII	Boiler and Pressure Code, Div. I
ASTM International	
ASTM G93	Standard Practice for Cleaning Methods and Cleanliness Levels for Material and Equipment Used in Oxygen Enriched Environments
ASTM A240l240M	Standard Specification for Chromium and Chromium Nickel Stainless Steel Plate. Sheet. and Strip for Pressure Vessels and for General Applications
ASTM A269/269M	Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
Fluid Control Institute (FCI)	
ANSI/FCI 70.2	Control Valve Seat Leakage
ANSI/FCI 70.3	Regulator Seat Leakage
International Society of Automation (ISA)	
ANSI/ISA 75.01.01	Industrial-Process Control Valves – Part 2-1: Flow Capacity – Sizing Equations for Fluid Flow under Installed Conditions
ANSI/ISA 75.02.01	Control Valve Capacity Test Procedure
ANSI/ISA 75.05.01	Control Valves Terminology
ANSI/ISA 75.08.01	Face-to-Face Dimensions for Integral Flanged Globe Style Control Valves Bodies (Classes 125, 150, 250, 300 and 600)
ANSI/ISA 75.08.02	Face-to-Face Dimensions for Flanged and Flangeless Rotary Control Valves (Classes 150, 300 and 600 and PN 10, PN 16, PN 25, PN 40, PN 63 and PN 100)
ANSI/ISA 75.08.06	Face-to-Face Dimensions for Flanged Globe-Style Control Valve Bodies (Classes 900, 1500 and 2500)
ANSI/ISA 75.08.08	Face-to-Centerline Dimensions for Flanged Globe-Style Angle Control Valve Bodies (Classes 150, 300 and 600)

Standard	Description
ANSI/ISA 75.11.01	Inherent Flow Characteristics and Rangeability of Control Valves
ANSI/ISA 75.19.01	Hydrostatic Testing of Control Valves
ANSI/ISA 75.17	Control Valve Aerodynamic Noise Prediction
ISA-RP75-23	Consideration for Evaluating Control Valve Cavitation
National Association of Corrosion Engineers (NACE)	
ANSI/ NACE MR 0175/ISO 15156	Petroleum and Natural Gas Industries – Materials for use in H2S-containing environments in Oil and Gas Production
ANSI/NACE MR0103/ISO 17945	Metallic Materials resistant to Sulfide Stress Cracking in corrosive petroleum refining environments
NACE TM0177	Laboratory Testing of metals for resistance to sulfide stress cracking and stress corrosion cracking in H2S environments
Manufacturer's Standardization Society of Valve and Fittings Industry (MSS)	
ANSI/MSS SP-55	Quality Standard for Steel Castings for Valves, Flanges, Fittings and Other Piping Components - Visual Method for Evaluation of Surface Irregularities
International Electrotechnical Commission (IEC)	
IEC 60079-0	Explosive atmospheres – Part 0: Equipment – General Requirements
IEC 60079-1	Electrical Apparatus for Explosive Atmospheres Part 1: Equipment protection by Flameproof Enclosures "d"
IEC 60079-7	Electrical Apparatus for Explosive Atmospheres Part 7: Equipment protection by Increased Safety "e"
IEC 60079-11	Explosive atmospheres. Explosive Atmospheres Part 11 Equipment protection by Intrinsic Safety "i"
IEC 60529	Degrees of Protection Provided by Enclosures (IP Code)
IEC 60534 (All parts)	Industrial-process control valves

Standard	Description
IEC 60947-5-2	Low-voltage switchgear and controlgear - Control circuit devices and switching elements - Proximity switches
IEC 61000 (All parts)	Electromagnetic compatibility (EMC)
European Committee for Electrotechnical Standardization	
CENELEC EN 60947-5-6	Low-Voltage Switchgear and Control gear Part 5-6: Control Circuit Devices and Switching Elements DC Interface for Proximity Sensors and Switching Amplifiers (NAMUR)
EN 10204	Metallic Products – Types of inspection documents
International Organization for Standardization (ISO)	
ISO 9001	Quality Management Systems - Requirements.
ISO 19011	Guidelines for Auditing Management Systems
ISO 15848-1	Industrial valves Measurement, test and qualification procedures for fugitive emissions Part 1: Classification system and qualification procedures for type testing of valves.
ISO 15848-2	Industrial valves Measurement, test and qualification procedures for fugitive emissions Part 1: Classification system and qualification procedures for type testing of valves.
ISO 14313	Petroleum and Natural Gas Industries – Pipeline Transportation Systems – Pipeline Valves.
ISO 28921-1/2	Isolating Valves for Low-Temperature Applications.
ISO 27895	Vacuum Technology Valves Leak Test

4.2 ADNOC Specifications

Document Number	Title
AGES-SP-04-005	Emergency Shutdown and On/Off Valve Specification
AGES-SP-04-001	Process Control System Specification
AGES-SP-09-002	Piping Material Specification Index
AGES-SP-09-003	Piping & Pipeline Valves Specification

5 REFERENCE DOCUMENTS

5.1 Standard Drawings

Valve Data Sheet IEC 60534-7 Control Valve Data Sheet

5.2 Other References

Not Applicable

6 DOCUMENTS PRECEDENCE

The Codes and Standards referred to in this specification shall, unless stated otherwise, be the latest approved issue at the time of Purchase Order placement.

It shall be the VENDOR'S and CONTRACTORS'S responsibility to be, or to become, knowledgeable of the requirements of the referenced Codes and Standards.

The VENDOR/CONTRACTOR shall notify the COMPANY of any apparent conflict between this specification, the related data sheets, the Codes and Standards and any other specifications noted herein.

Resolution and/or interpretation precedence shall be obtained from the COMPANY in writing before proceeding with the design/manufacture.

In case of conflict, the order of document precedence shall be:

1. UAE Statutory requirements
2. ADNOC Codes of Practice
3. Equipment datasheets and drawings
4. Project Specifications and standard drawings
5. Company Specifications
6. National/International Standards

7 SPECIFICATION DEVIATION/CONCESSION CONTROL

Deviations from this specification are only acceptable where the VENDOR has listed in his quotation the requirements he cannot, or does not wish to comply with, and COMPANY/CONTRACTOR has accepted in writing the deviations before the order is placed.

In the absence of a list of deviations, it will be assumed that the VENDOR complies fully with this specification.

Any technical deviations to the Purchase Order and its attachments including, but not limited to, the Data Sheets and Narrative Specifications shall be sought by the VENDOR only through Concession Request Format. Concession requests require CONTRACTOR'S and COMPANY'S review/approval, prior to the proposed technical changes being implemented. Technical changes implemented prior to COMPANY approval are subject to rejection.

8 PROCESS SAFETY REQUIREMENTS

SR. No.	Description
1	Failure action of control valves shall be reviewed during HAZOP

9 DESIGN CONSIDERATIONS /MINIMUM DESIGN REQUIREMENTS

9.1.1 Design Basis

Control valves shall have a design life of 30 years and be suitable for continuous service in the environment specified.

SECTION B

10 CONTROL VALVE TECHNICAL REQUIREMENTS

10.1 Types of Control Valves and their application

10.1.1 General

Unless otherwise specified in the instrument data sheets or dictated by its application, the selection of valve type should be in the following order of preference:

1. Globe valve (linear motion) or rotary valve (eccentric plug or segmented ball)
1. Ball valve
2. Butterfly valve
3. Other types

The total life cycle cost including reliability factors will be considered in comparative evaluation of bids but will not be quantified. Data should include:

a. Failure rate for each Failure Mode
b. Repair time
c. Cost of spares for the given failure mode
d. Logistics data

As these factors are not fully quantifiable at time of purchase, their influence on purchasing decisions shall remain the responsibility of the evaluating engineer(s).

Predictive maintenance will be utilized to optimise and reduce operating costs.

All control valve bodies for Hydrocarbon or other critical services shall have flange or hub connections at both ends unless it is required to weld the valve into the process pipe. Flangeless bodies shall not be used in these services.

Flanges for Hydrocarbon or critical services shall be integrally cast type. No slip-on, weld-on flanges or wafer type valves shall be permitted in these services.

The materials and rating of a control valve shall be in accordance with the piping class for all sizes. All identification and/or instruction plates on the valve, actuator and accessories shall be of stainless steel and be attached with screws or rivets.

Cadmium plating or galvanizing shall not be used for any component of the control valve assembly or its accessories.

10.1.2 Sizing

The Cv value shall be calculated in accordance with IEC 60534-2-1 Industrial-Process Control Valves – Part 2-1: Flow- Capacity Sizing Equations for Fluid Flow under Installed Conditions. Calculation based on ISA 75.01.01 Part 2-1 is also acceptable.

Control valves shall be sized for a minimum fully open capacity of 110% of maximum flow. The selected valve shall normally be less than 90% open for maximum flow and more than 10% open at minimum flow, or shall be within the VENDOR'S minimum throttling Cv recommendation.

Butterfly valves shall be sized for a maximum flow at 60° angular opening, except for a characterized vane valve (such as the “Fishtail”) which may be sized at 90° angular opening. Three-way valves shall be sized to pass maximum flow through either port with minimum available pressure drop through the same port.

10.1.3 Noise

The noise level is defined in IEC 60534-7 as the sound pressure level outside the pipe, typically 1m downstream of the valve or expander and 1m from the pipe wall.

The limit for noise generated by control valves shall be 85dBA or less, as measured at 1 meter from the valve for any flow condition.

The valve VENDOR shall calculate the noise levels in accordance with IEC 60534-8-3 and IEC 60534-8-4 based on the specified downstream pipe material, wall thickness and type and thickness of insulation.

The noise levels shall be calculated at different flow rates (including minimum, normal, maximum flow rates as well as start-up and shut-down) to determine the worst-case conditions. Where the valve differential pressure changes significantly with flow-rate, a noise calculation shall be made at the rate at which the product of mass flow and differential pressure is maximum.

The valve VENDOR may propose an alternative to IEC 60534-8-3 and IEC 60534-8-4 for calculation of the noise levels; subject to approval by COMPANY.

If the calculated noise level of a standard control valve exceeds the allowable limit, a control valve with special low-noise internals (such as velocity control trim) should be selected. If, for technical (process conditions prevent) or economic reasons, low noise valves are not practical, acoustic containment techniques such as diffuser or silencer may be applied if approved by COMPANY (Note: no other methods shall be considered):

Where noise attenuation is achieved in contaminated of potentially contaminated streams by using valves or diffusers with small flow passages, strainers shall be used to avoid plugging these passages. In these cases, provision shall be included for cleaning the strainers.

For control valves with calculated noise levels higher than the allowed limit, the VENDOR should quote on a standard version valve and a low noise valve. Both calculated noise levels shall be stated in the quotation.

Noise prediction calculation and testing shall be in accordance with IEC 60534-8-3.

Control valve operation above 100 dBA for any time period shall be avoided. For valves in infrequent intermittent service/events (EDP or flaring) higher noise levels may be tolerated if accepted by COMPANY.

In extreme noise conditions VENDOR shall provide technical recommendations to COMPANY.

10.1.4 Control Valve Characteristics

The required control valve characteristic may be obtained through a characterized trim.

Two main characteristics are commonly applied, linear and equal percentage. There are different guidelines and different rules of thumb that can be used for selecting valve characteristics.

If the total process gain is more or less constant (does not change much with flow) linear valve trim should be used. An equal percentage control valve should be used when the pressure differential across the valve decreases with increases in flow rate. Also, equal percentage control valves should be used in control loops of which the process gain decreases with increases in flow rate.

Valve Characteristic selection guide.

Service	Valve (Δp max/Δp min) Under 2:1	Valve (Δp max/Δp min) Over 2:1 but Under 5:1
Flow	Linear	Equal Percentage
Level	Linear	Equal Percentage
Gas Pressure	Linear	Equal Percentage
Liquid Pressure	Equal Percentage	Equal Percentage
Temperature	Equal Percentage	Equal Percentage

Due to the unavailability of an equal percentage characteristic for the miniature type of control valve, these types of control valves may have a linear characteristic in all cases.

Unless specified for special applications, quick opening valves shall be avoided. A quick opening valve produces a large increase in flow for a small initial change in valve travel.

10.1.5 Globe Valves

Globe valves to IEC 60534-1 (linear motion, rotary/eccentric plug or rotary/segmented ball) shall be used for general service applications.

Cage guided globe valves and balanced type valves, exception of double seated globe valves, shall not be used on services with a tendency towards coking.

Cage guided globe valves shall not be used for fluids that contain solid particles.

Cage trim globe valves should be considered for severe service applications where anti-cavitation or noise reduction properties are required.

Throttling globe valves with Metal-Metal seating can achieve Class V or Class VI shutoff (as per IEC 60534-4). Requirements for shut-off tighter than Class IV shall be given special consideration and review of the process/safety requirement. If tighter shut off is required for example to ISO 5208 Rate A then an associated in line shut off valve may be required

Split-body globe valves shall not be used in hydrocarbon or toxic services. In other services (utilities or nontoxic) they shall require COMPANY approval.

For special requirements related to globe valves in severe service, see section 10.3.

10.1.6 Angle Valves

Angle valves to IEC 60534-1 should be considered for:

i. Very high pressure drop service (e.g. wellhead choke)
ii. Hydrocarbon services, having a tendency of coking
iii. Cavitation service
iv. Erosive services (slurries or solids carried in suspension).
v. Steam service with excessive noise

vi. Applications where solids contaminants might settle in the body of a standard globe valve
vii. Flashing Service

Angle vales are generally applied in severe or demanding applications. For application requirements, see section 10.3

10.1.7 Butterfly Valves

Butterfly valves to IEC 60534-1 shall comply with the piping class. For Hydrocarbon or other critical services, butterfly valves shall have bodies flanged at both ends. Butterfly valves can be considered for the following circumstances:

i. If the required size (any low pressure-drop where tight closure isn't needed) would make it economically attractive or if it is impossible to apply globe valves.
ii. For corrosive services, where body lining of globe valves becomes economically unattractive.
iii. Only flanged butterfly valves will be permitted.

Valve disks shall be positively located on shafts, with double pinned attachment as minimum (friction or clamped fit is not permitted).

Special butterfly valves (known as "high performance butterfly valves") are available. These butterfly valves can handle high temperatures, high differential pressures and can have a Class V (with metal seat) or Class VI (with soft seat) shutoff class. Double or Triple offset designs are recommended. Low noise and anti-cavitation options are available.

For valves in high-temperature service or handling aggressive material that would be likely to lead to rapid bearing deterioration, bearings shall be located outside the valve pressure boundary.

10.1.8 Ball Valves

Segmented or contoured V-notch ball valves may be considered for throttling service with slurries and abrasive service. The V-notch ball provides positive shearing action and produces an inherent equal percentage flow characteristic.

Ball valves in throttling service shall not be used without the approval of COMPANY.

10.1.9 Diaphragm Valves

Diaphragm valves to IEC 60534 should only be considered for on/off applications in slurry/waste water service. The use of diaphragm valves requires the approval of COMPANY.

10.1.10 Plug Valves

Plug valves to IEC 60534 should be considered for special applications, such as throttling control in slurry service. The use of plug valves requires the approval of COMPANY.

Eccentric plug valves inherent self-cleaning properties are best suited for dirty liquids, sludge and slurries.

10.1.11 Self-Acting Regulators

In all cases VENDOR will provide analysis in the form of a table with valve failures positions verses defined failures such as main diaphragm ruptures or main spring breaks. They shall only be used with approval of COMPANY.

10.1.11.1 Self-Acting Pressure-Reducing Regulators

Self-acting pressure-reducing regulators shall only be applied on simple clean applications, such as for reducing instrument supply pressure.

Special attention shall be given to the application of self-acting regulators, with internal, self-relieving capability. For details of tank blanketing, refer to API STD 2000, “Venting of atmospheric and low-pressure storage tanks”.

10.1.11.2 Self-Acting Back Pressure Regulators

Self-acting back-pressure regulators shall only be considered for clean fluids in simple applications, such as for maintaining a uniform back pressure in utility (e.g. nitrogen) distribution systems.

The application of self-acting back-pressure regulators requires the approval of COMPANY.

10.1.11.3 Self-Acting Differential-Pressure Regulators

Self-acting differential-pressure regulators shall only be considered for clean fluids in simple applications, such as for secured instrument air systems or for compressor bearing sealing services.

The pressure retaining components of the differential-pressure regulator shall be rated for the upper design pressure of the upstream and downstream piping, whichever is the highest.

The application of self-acting differential-pressure regulators requires the approval of COMPANY.

10.1.11.4 Self-Acting Temperature Regulators

Self-acting temperature regulators shall only be considered for simple, non-safety critical heating applications, where utilities (e.g. instrument air or gas) are not available and based on VENDOR’S recommendation and proven in service references.

The application of self-acting temperature regulators requires the approval of COMPANY.

10.1.12 Three Way Globe Valves

Three-way globe valves shall only be applied for splitting and blending of flows in applications such as temperature control where there is economic advantage to be gained. Use of three-way valves shall require approval by COMPANY.

When selecting three-way globe valves, each flow path Cv shall be sized separately. Design of three-way valves shall be such that the total Cv of the open paths at any time is not less than the fully open Cv of the smaller path.

Three-way valves shall clearly indicate the common inlet or common outlet port by a permanent mark stamped on the flange.

The application of three-way globe valves requires the approval of COMPANY.

10.2 Requisitioning

The VENDOR shall:

i. Calculate the required Cv and thoroughly review the valve data sheet and associated “General requirement sheet” and offer a suitable valve. For a preliminary enquiry COMPANY may agree on a reduced level of information. In this instance the applicable lines of the data sheet will be identified. Control valve sizing and selection will be specified on the data sheets only as an initial basis for design.
ii. Consider all the “cases” detailed in the provided process data.
iii. Identify to CONTRACTOR/COMPANY any element of the specification which they believe to be unsuitable for the required service.
iv. Quote/supply a Cv-value for each valve in the fully open position.

v. Provide a data sheet in the format defined by IEC 60534-7. Identical control valves can be grouped on the same data sheet.
vi. Quote for control valves complying with all the requirements of the data sheet including body and trim material specification.
vii. Inform CONTRACTOR of any irregularities found in the relevant purchase order.
viii. Perform noise prediction calculations for all valves at all of the operating conditions provided on the data sheets (including minimum, normal, maximum flow rates as well as start-up and shut-down) to determine the worst-case conditions.
ix. Include torque figures for bolting all parts of valve assembly in maintenance manuals.

The VENDOR is responsible for the design and construction of the supplied control valve(s) for service(s) and condition(s) as specified in the requisition and data sheet.

Control valves and actuators, including all accessories, shall be provided by the control valve VENDOR who shall be responsible for ensuring that the control valve assembly (control valve plus actuator, mountings and accessories) meets the specific requirements detailed on the data sheets.

VENDOR shall have single point responsibility for all aspects of the control valve and actuator assembly.

Control valves, actuators and all accessories shall be fully integrated at the factory and be supplied as one assembly with all components mounted, fully tubed and cabled.

If a control valve is provided with an actuator and/or accessories from another source but supplied as part of the control valve purchase order, the responsibility of the overall valve assembly (valve complete with actuator and/or accessories) shall be remain with the VENDOR.

The VENDOR will provide guarantee and warranty services as defined in section 24.

All provided accessories shall be as specified on the data sheet.

The variety of types and sizes of control valves and supplied accessories ordered under the purchase order shall be minimized.

To enable process line cleaning, butt-weld end control valves shall be supplied with a blind bonnet flange, together with bonnet gasket(s) sufficient for three changes. The blind bonnet flange shall be of carbon steel and have the same rating as the body. Alternative methods are subject to the approval of COMPANY.

10.3 Special Designs

10.3.1 Cavitation/Flashing Service

Cavitation is the formation and collapse of vapour bubbles (cavities) in the liquid flow streams due to the Bernoulli effect pressure changes as a stream is accelerated and then slowed down as it passes through a trim. If the vena contracta pressure drops below the liquid vapour pressure, bubble formation results. The negative effects of uncontrolled cavitation in control valves are; high noise, excessive vibration, material damage and deterioration of flow effectiveness. Physical damage of valve trim is characterised by rough pitted appearance

Flashing is the process whereby the liquid in the stream changes phase to vapour when its pressure drops below its vapour pressure. In the case of flashing, the vapour remains in that state, producing two-phase flow downstream of the valve.

In mild cases, flashing and cavitation may be mitigated by changing the location of the valve to increase the fluid pressure, either by moving it to a lower elevation, or by moving it upstream to take advantage of the system pressure profile.

In most cases, it will not be possible to eliminate flashing and cavitation by relocating the valve. Flashing will always happen if the pressure/temperature conditions at the stream arrival point result in vapour formation; relocation of the valve simply moves the flashing from the valve to the pipe.

Cavitation may be avoided if the valve can be relocated to have a high enough static pressure in the stream that the minimum vena contracts pressure remains above the process vapour pressure. The extent can also be minimised by choosing valves with smooth flow profiles to avoid the creation of bubbles by vortices.

In most case, however, these measures will be impractical or insufficient and specialised trims will be required.

There are two main approaches used for handling cavitation in valve trims. The first, usually known as 'velocity control', drops pressure in multiple steps so that the trim velocity never increases to a point where the cavitation pressure is reached. Velocity control trims can prevent cavitation, but not flashing.

The second option is to use single cage-type trims, usually described as 'cavitation control' or similar terms, that direct the fluid stream in jets that impinge on each other in the middle of the trim. In this case both cavitation and flashing can occur but the main destructive processes take place in the middle of the liquid body rather than against the valve metal.

Hardened trim materials (also Section 10.5.3.2) shall be used for construction of velocity control and anti-cavitation trims.

For applications where, anti-cavitation trims are not available, an angle valve or two valves in series may also be considered, if approved by COMPANY.

The applications of restriction orifices downstream of the control valve requires the approval of COMPANY.

10.3.2 Steam Desuperheating Valves

Special control valves, with internal water injection for desuperheating purposes, may be used for high pressure steam reducing services. Body is constructed from Forged materials to permit higher design stresses and improved grain structure and material integrity is superior to cast valve bodies. The make and type of steam conditioning valve is subject to the approval of COMPANY.

10.3.3 Choke Valves

Choke valves are typically applied in oil and gas production facilities to control the flow of well fluids being produced and where the process fluid is erosive with high sand contamination.

10.3.3.1 High Pressure Gas Choke Valves

High pressure gas choke valves shall be able to withstand very high pressures, up to the maximum closed-in well pressure, and shall be capable of delivering the desired maximum and minimum flowrates at varying well pressures. The process fluid is wet gas, and may include liquid slugs and solid particles, which makes the valve subject to erosion and/or impact damage.

The following are the preferred minimum requirements for high pressure gas choke valves:

i. The body should be sized, to limit the gas velocity and consequently the noise and the erosion. The additional space in the oversized valves may be combined with noise reducing inserts in the inlet and outlet of the valve.
ii. The valve shall be leakage class V or class VI in accordance with IEC 60534-4, standard for control valve leakage classification (Note 1)
iii. Hard materials plug and trim design to meet flowing fluid conditions.

Note 1: For valves in erosive service with tungsten carbide trims (e.g. surface chokes), this may not be achievable with normal maintenance procedures. IEC 60534-4 designates a Class IV-S1 that is 20 times more stringent than Class IV but not as tight as Class V

10.3.3.2 Liquid Choke Valves

For special applications, such as the draining of high-pressure separators, a “liquid” choke valve should be considered.

This valve shall be designed for liquids containing solid particles such as grit, sand and scale. There shall be no requirement for leakage class greater than Class V on this valve. If a tight shut off is required, a separate on/off valve shall be installed.

The trim of the valve consists of two discs, one fixed in the valve body and one that can be rotated by the actuator. Each disc has one or more eccentric holes and throttling is created by rotating the upper disc in such a way that the holes partly overlap each other. A bean, provided downstream of the fixed disc, takes the major part of the pressure drop. A built-in filter upstream of the rotating disc shall be fitted to protect the discs against large solid particles in the process fluid.

The following are the minimum requirements:

i. The valve shall be made up of several modular subassemblies, such as internals, bonnet, yoke, actuator and coupling.
ii. To replace any of the subassemblies, it shall not be necessary to remove the valve body from the process line.
iii. The materials for the discs and beam shall be tungsten carbide.

10.3.4 Anti-Surge Valves

The following characteristics and guidelines shall apply:

I. Fast response time with opening times in the region of 0.5 to 2 seconds utilizing accessories such as boosters.
II. Capable to withstand high vibration applications.
III. Appropriate low noise trim.
IV. Leakage class V or class VI.
V. Linear or bi-linear characteristic will be the norm.
VI. Installation of Handwheels is prohibited on anti-surge valves.
VII. The performance of the valve shall be demonstrated by VENDOR and witnessed by COMPANY.
VIII. Digital Smart Valve positioners for online tuning and diagnostics.
IX. Position transmitters should be installed.

Sizing and design of anti-surge valves will be done in conjunction with compressor VENDOR. The design shall incorporate the requirements of severe service valves and shall typically incorporate multi-stage tortuous path trim to minimise generated aero-dynamic noise and vibration. Suitability of drilled hole cage type design shall be verified in case of potential deposits likely to occur over the operating envelope.

For the actuator design (especially in the case of double acting) VENDOR shall ensure that the fail-safe condition is achieved by any of the accessories or component failure. This shall be demonstrated during FAT.

An electronic valve position transmitter shall be supplied with the valve because the valve speed deteriorates with age and the stroking time is too fast to be quantitatively measured with a stopwatch. The position transmitter output should be compared with the surge controller output on a high-speed recorder or data logger. The plot or log should be checked for the ability of the valve to respond precisely and quickly to small changes in controller output.

It is absolutely essential that the throttling speed and precision requirement be emphasized on the control valve specification, that the installation details of accessories be reviewed prior to assembly, and that the valve be throttle-tested and witnessed by the COMPANY before shipment.

10.4 Body Construction and Materials

10.4.1 General

Control valves for Hydrocarbon or other critical services shall be provided with process flanges or hub connections at both ends. Wafer or lug type bodies are not permitted in these services.

Split-body globe valves may only be applied with the approval of COMPANY.

Control Valves with Welded ends can only be considered with prior approval of COMPANY.

Control valve bodies shall not be fitted with bottom drain plugs. A bottom flange shall be provided for valves that require bottom access for trim removal.

Valve bonnets shall be of bolted construction with fully retained gaskets.

10.4.2 Body Size

The body size of a control valve in throttling service should have the same size as the calculated trim size, but oversized bodies may be required up to the size of the adjacent piping (to reduce the outlet velocity or to cater for future capacity/expansion).

Valve body size shall not be less than half the size or two sizes (see below) less than line size, whichever is larger.

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

i. 1-inch
ii. 1-1/2-inch
iii. 2-inch
iv. 4-inch
v. 6-inch
vi. 8-inch
vii. 10-inch
viii. 12-inch and higher sizes

For application of body sizes smaller than 1-inch, use reduced size inner valve trim.

10.4.3 End Connection

The flange ANSI rating class shall be in accordance with the piping class unless otherwise specified.

In general end flanges shall be raised-face and depending on size in accordance with:

i. ASME B16.5 for sizes through DN 600 (through NPS 24)
ii. ASME B16.47 Series A flanges for sizes DN 650 through DN 1500 (NPS 26 through NPS 60).

Depending on the application Ring Type Joint (RTJ) or Flat Face may be considered. Butt Weld ends can be considered for high pressure applications or for hazardous service where no leakage can be tolerated. Socket weld ends for control valves are not permitted.

Flange finish shall comply with the requirements of ANSI B16.5.

10.4.4 Face-to-Face Dimensions

The face-to-face dimensions of flanged control valves of body size 1-inch to 16-inch and ANSI rating class 150, 300 and 600 shall be in accordance with ANSI B16-10.

10.4.5 Materials

Material selection shall comply with the appropriate Piping material requirements listed in ADNOC Piping Material Specification (see Piping Material Specification Index AGES-SP-09-002):

Specific approval of COMPANY is required for use of types of steel with a specified minimum tensile strength exceeding 480N/mm2.

The material selection of the body (including bonnet and/or bottom flange), external bolts, studs and nuts, shall be in accordance with the project piping class and material spec. Valve bodies specified as 316 shall be 316/316L dual certified stainless steel minimum. Carbon steel, low alloy steel and stainless steel bodies shall be externally painted. Refer to section 0.

External, uninsulated bolts and nuts shall be shop coated with TAKECOAT-1000 from Takenada Seisakusho Co., Osaka, Japan or equivalent. Insulated bolts shall also be coated if the service temperature is less than 200°C. All bolting installation requirements from the coating VENDOR shall be followed in addition to installation requirements from COMPANY.

Additional requirements for special applications are given in section 10.6

10.4.5.1 Lining

If approved by COMPANY, internal lining may be used for protection against corrosion or erosion as an alternative to resistant base materials.

Internal lining of the fluid impact area with hardfacing may be required for:

i. Fluids containing erosive particle (slurries).
ii. Ported plugs for wet gas or wet steam service with a pressure drop across the valve above 10 kg/cm2.
iii. Other services if the pressure drop is above 40 kg/cm2.

Internal lining of the entire body with rubber, epoxy or other non-metallic materials shall be considered for valves in sea water services.

10.4.5.2 Cladding

The VENDOR may propose cladding of the valve body as protection against erosion and/or corrosion. The wetted surfaces will have the corrosion resistance of the clad material with an overall cost closer to the base material. Valve types and sizes where this can be proposed will be agreed with COMPANY and VENDOR will provide references of projects where cladded valves have been provided.

10.4.5.3 Welding

No welding is allowed on 316 stainless steel material. If welding is required in valve manufacture use dual certified 316/316L stainless steel.

10.4.6 Stuffing Box and Packing

10.4.6.1 General

Packing materials should be:

i. PTFE-based for packing temperatures below 200°C
ii. Graphite-based, metal-reinforced, for packing temperatures between 200°C and 600°C

Grafoil form GTA (uninhibited) shall not be used on any project that requires suitability for sour services (accelerated corrosion with stainless steel and low pH fluids).

Asbestos is prohibited and shall not be used as packing.

External lubricators or grease nipples shall not apply, only where service conditions prohibit PTFE packing.

The VENDOR shall propose a packing solution that meets fugitive emissions endurance classes defined in ISO 15848.

Live loading valve packing can be considered for thermal cycling, pressure cycling and high vibration service.

Depending upon the design of the valve, an extended bonnet may be required to keep the temperature at the stuffing box at an acceptable value for the applied packing.

An extended bonnet shall be used for process temperatures below 0°C and above 200°C. For services below -100°C, cryogenic bonnets shall be provided.

An extended bonnet may also be required if the operating differential pressure across the valve could otherwise cause freezing of the stuffing box/packing and/or ice formation on the trim. For example, this may be the case for compressor recycle (antisurge) valves.

For valves in cryogenic service that are intended for installation inside a “cold box”, an extended bonnet shall be applied for bringing the stuffing box outside the cold box. The minimum required length shall be specified on the data sheet. The stuffing box shall be on top of the extended bonnet.

The stuffing box shall be provided with an adjustable, bolted gland flange and gland follower. The valve gland shall be properly adjusted by the valve VENDOR. If, for technical reasons, the valves will be delivered with a loose gland, this shall be clearly indicated on the appropriate valve with a warning sign.

For valves in vacuum service, special attention should be paid to the type of stem packing/sealing facilities as well as to the stem surface finish. The packing box shall be suitable for vacuum service

10.4.6.2 Bellows-Sealed Valves

Bellows-sealed bonnets shall be applied for special applications involving toxic or hazardous service, or if specified by COMPANY.

Bellows seals for control valves shall conform to ISO 15848-1 endurance class AM.

The bellows for services which do not contain chlorides shall be of AISI 316 type stainless steel, unless otherwise specified in the data sheet.

As an alternative to a bellows seal, special double packings with a leak-off connection between the sets or a special environmental packing may be applied if approved by COMPANY.

Bellows-sealed bonnets shall not be applied above ANSI rating class 300 without the approval of COMPANY.

10.4.7 Gaskets

Body-to-bonnet and, if required, body-to-bottom flange gaskets shall be of the spiral wound type. Unless otherwise dictated by the process conditions, the gasket material shall be AISI 316 type stainless steel, graphite filled.

The filler material shall be expanded graphite with the following specifications:

i. Maximum 1% ash content
ii. Maximum 50 mg/kg chloride content
iii. Density range 0.7 to 1.8 g/cm3

Other types of gasket require the approval of COMPANY.

10.4.8 Torque Figures

The torque figures for bolting the body/bonnet and body bottom connection shall be indicated in the relevant manuals by the VENDOR.

10.5 Valve Trim and Seat Ring

10.5.1 Seat Leakage and Flow Direction

Throttling control applications with unbalanced valves, the direction should be “flow-tending-to-open” to avoid a very large unstable force in the nearly closed position. For angle valves, the direction should be “flow-tending-to-close” (over the plug flow) to avoid high velocity and turbulence in the valve body.

Valve flow direction shall either be cast or engraved on the valve body or by means of a plate permanently attached to the valve body.

Shutoff requirements shall be specified on the purchase order. The shutoff direction (one or both directions) shall be stated on the data sheet.

For minimum requirements, refer to section 17.8, Seal Leakage Test.

Cage-guided valves or balanced-type valves shall not be used for fluids that contain solid particles (e.g. coke). Balanced-type control valves shall be used only in clean services and only with the approval of COMPANY”

PTFE seating shall not be used for process fluid temperatures above 200° C and for corrosive / severe service above 120° C, or if PTFE is incompatible with the process fluid.

10.5.2 Construction

10.5.2.1 Globe Valves and Angle Valves

The trim and particularly the seat ring(s) shall be of the easy/quick replaceable type.

On butt-welded-end control valves, the entire assembly of trim and seat shall be removable from the top.

The clearances between the plug and guide bushings and, for cage type trims, the clearances between the plug and cage and guide bushings, shall be designed such that sticking cannot occur at minimum and maximum operating temperatures.

If specified by COMPANY, the design shall also be suitable for services that can cause coking.

For trims which are not of the one-piece plug and stem type, the plug and stem construction shall be provided with a locking device to prevent accidental separation. The locking device may be either a special fluted pin, driven through a hole which is simultaneously drilled in the plug guide section and stem, or it may be of a welded construction.

The stem of the control valve shall be retained even if the actuator is removed.

The seat-ring(s) should be clamped or backed-up via a seat ring retainer. Special attention shall be paid to fixing of the seat ring in order to prevent loosening due to vibration. Adhesive compounds shall not be used for the locking of seat rings.

The connection of the valve stem to the actuator stem shall be adjustable and shall allow positive locking of the adjustment.

If required, the valve stem part that is exposed to the surrounding atmosphere shall be completely covered by a protection bellows. This protection bellows shall be of a hydrocarbon and environment resistant material.

10.5.3 Materials

10.5.3.1 General Trim

The control valve trim (Internal components of a valve consisting of plug, seat rings and stem) shall be corrosion resistant and of the grade specified in the data sheet. Minimum requirement is 316 stainless steel.

For fluids that become corrosive when in contact with the atmosphere, i.e. sulphuric acid, suitable valve stem and trim materials with increased Nickel content shall be considered, or precautions shall be taken to prevent contact with air.

Where soft (resilient) inserts are required for meeting the specified leakage rate, the inserts should be of glass-fibre-filled or graphite-filled PTFE; the selection shall be based on the suitability for the specified process conditions.

The resilient insert shall be properly clamped between metal parts and/or locked in position to prevent blowout in the closed position.

For globe valves, soft seats can deteriorate quickly and should be avoided as far as possible (Section 10.1.5).

10.5.3.2 Hardened Trim

Hardened (e.g. Stellite-coated or Colmonoy-coated) or solid Stellite closure member and seat rings either coated or solid shall be selected for the following applications:

i. Erosive services
ii. Choked flow
iii. Cavitating or flashing service
iv. Wet gas or steam service with a pressure drop greater than 5 kg/cm2
v. Other services in which the pressure drop is greater than 10 kg/cm2 at design conditions

Solid hard plugs are the preferred choice but for larger valve sizes material overlay (usually a cobalt alloy) is more cost effective.

Choke valves and valves in other extremely erosive services, special materials like tungsten carbide and ceramics may be applied.

Angle valves for erosive services (e.g. choke valves) should be equipped with a chrome plated venturi seat ring, unless other materials are required for the process conditions.

10.6 Control Valves for Special Applications

10.6.1 Oxygen Service

Only valves especially made for oxygen service and that have proved to be reliable in service shall be used. Particular care will be taken in selection of materials based on their resistance to ignition and rate of reaction.

Conform to ASTM G93 for special cleaning (degreasing). Valves for oxygen service shall be clearly marked and shall be packed separately from other valves

Valves for oxygen service shall generally have Monel bodies and trim. Monel linings shall be permissible for valve sizes >8”. Other valve material shall be approved by COMPANY.

Throttling valves may cause considerable turbulence. Therefore, in oxygen service carbon steel systems, a pipe section of 10 D length downstream of the throttling valve should be made of the material specified for higher velocities (usually the same material as the valve body). Only globe valves and needle valves (including angle and Y types) shall be used for throttling.

Control valves in oxygen service shall not have handwheels unless specified by COMPANY.

All valves and instruments shall bear the warning:

"OXYGEN! KEEP FREE FROM OIL AND GREASE!"

If lubrication would nevertheless be required, a fluorocarbon lubricant suitable for oxygen service may be used, provided this is agreed with COMPANY.

10.6.2 Hydrofluoric Acid Service

Stress relieved Monel bellows seal shall be applied. All pressure-containing carbon steel welds shall be stress-relieved before bellows installation.

Viton shall be used as sealing/seating material.

The stem material shall be Hastelloy-C or Monel K500. All pressure-retaining steel bolting shall be ASTM A 193 B7M with ASTM A 194 2HM nuts.

10.6.3 Sour Service NACE Requirements

If sour service is specified, NACE MR0175/ISO 15156 and NACE MR0103 sour service design and material shall apply to the valve (but not to the gaskets). Carbon steel flanges shall be normalized.

Pressure-retaining bolting (even if not directly exposed to the process fluid) shall comply with NACE MR0175.

The trim for wet sour systems shall be made of Incoloy 825 or Monel K 500. If other hardness material is considered by the valve manufacturer, it shall be subject to COMPANY approval.

10.6.4 Low Temperature, Liquefied Gas and Lethal Services

For control valves in the following services:

a. Low-temperature service (below -15ºC).
b. Liquefied gas and LPG.
c. Lethal service such as hydrofluoric acid (HF), chlorine and streams containing greater than 1000 ppm of H2S.

Carbon steel body material shall meet A 352 LCB. See ADNOC Group Specification Welding, NDE and Prevention of Brittle Fracture of Piping.

10.6.5 Hydrogen Service

Packing should be high performance suitable for Hydrogen service as per API STD 622, ISO 15848 Class BH.

Fugitive emissions testing shall be conducted using helium test gas.

10.6.6 Steam Service

Elastomers should be suitable for high temperature steam as per process requirements.

10.6.7 UREA Service

UREA process is characterised by severe service conditions with high pressures, high temperatures and aggressive process fluids. UREA control valves must be of robust and rugged design with appropriate material selection.

Control valves designed for Urea service shall comply with the following additional requirements:

a. Be compliant with the UREA licenser specification
b. Be streamlined without dead zone/space to prevent crystallisation
c. Features to prevent UREA crystals from damaging valve packing
d. Option of heating jacket to prevent crystallisation
e. Globe and angle valves shall have top guide
f. Angle valves shall have split-body
g. Stem of H.P. valve shall have uniform diameter with integral plug
h. Valve packing assembly (flange, follower and bolts) shall have the same material of valve body.
i. Valves with balanced trim, cage trim or similar devices shall be avoided.

VENDOR shall provide reference for supplying control valves for UREA service projects and confirm compliance to UREA licensor specification.

10.6.8 Sulphur Service

Valves for sulphur service shall be provided with temperature-controllable heating jackets. Jackets shall generally be heated by steam but other methods may be used if approved by COMPANY.

10.7 Control Valve Actuator

10.7.1 General

Instrument air shall be the primary choice for motive power for control valve actuators.

The action on loss of supply energy or motive power shall be specified on the data sheet. These actions can be:

a. Fail to open
b. Fail to close
c. Fail last (as is) with drift direction to be specified

The actuator shall function properly under the minimum, normal and maximum instrument air supply pressures as specified in the data sheet.

The actual bench setting (spring range) shall be indicated on the valve tag plate.

Piston actuators shall be designed for a minimum instrument air pressure of 4.5 kg/cm2, unless otherwise required. Actuators requiring an instrument air supply pressure above 4.5 kg/cm2 shall not be used unless approved by COMPANY.

Actuators shall be direct acting spring return pneumatic diaphragm or piston type unless otherwise specified on the data sheets or proposed by VENDOR and agreed by COMPANY.

If process or operating conditions preclude the use of spring return pneumatic actuators, use of alternative power media (hydraulic fluid or electric power) and other types of actuators (electric or hydraulic) will be stated on data sheets.

Double acting actuators do not have an inherent fail-safe action and should not be used for control valves with a predetermined fail action.

If process conditions dictate the use of double acting actuators such as high torque loads in both its working directions, then fail safe double acting actuators with an accumulator to provide at least three strokes of the control valve in the event of motive power loss can be considered.

Piston-type actuator, if specified, should be of the spring-opposed diaphragm or of the spring-opposed short-stroke type.

Long-stroke springless piston actuators shall be opposed via a secured instrument air system or provided with lock-up valves to achieve the required action in the event of instrument air failure.

To prevent tampering, the rotary intermediate linkages between a butterfly valve and its actuator shall be of the integral type, enclosed in a protective metal housing

Cylinder actuators shall be provided with adjustable end-limit travel stops in both directions. Bolt adjustment type limit stops shall be applied with a locking facility, e.g. a locking nut, to prevent tampering.

Construction shall be leak-tight, with seal gaskets.

Piston or cylinder actuators shall have O-ring sealing and shall be designed to minimize shaft and piston friction.

Actuators shall be equipped with a direct coupled adjustable travel or position indicator for local status indication. The position shall be indicated by a permanent mark on a reversible scale with the words “open” and “closed” at the travel limits, or by unambiguous symbols.

10.7.2 Actuator Material

The actuator case or housing material shall be steel based.

Aluminium shall not be used under any circumstances.

The pressure retaining parts of the actuator are normally carbon steel.

The yoke shall be of the open type to allow access for adjustment of the packing gland follower.

The diaphragm material shall be nylon-reinforced neoprene or Buna N rubber.

The actuator spring shall be fully enclosed in a metal housing and treated with VENDORS standard enamel paint or epoxy coating to resist atmospheric corrosion.

10.7.3 Actuator Sizing

Actuators are selected and sized by matching the force required to stroke the valve with an actuator that can supply the force plus a percentage safety factor. For rotary valves a similar process matches the torque required to stroke the valve with an actuator that will supply that torque. The same process is used for pneumatic, electric and electro-hydraulic actuators.

For globe valves actuator sizing shall consider the following:

a. Force to overcome static unbalance of the valve plug
b. Force to provide a seat load
c. Force to overcome packing friction (stem load)
d. Additional forces required for certain specific applications or considerations to stroke the valve. These include bellows stiffness, friction forces resulting from seals or special seating forces for example soft metal seals.

For rotary valves the determining factors are the torque required to open and close the valve and the torque output of the actuator. VENDOR will also state the Maximum Allowable Stem Torque (MAST) for each valve.

Attention shall be paid to unbalanced dynamic forces on the valve plug.

For flow-tending-to-close valves the actuator shall be capable of opening the valve against the full upstream pressure, and for flow-tending-to-open valves the actuator shall be capable of closing the valve against the full-upstream pressure.

VENDOR will provide actuator sizing calculations for each actuator and state the safety margin that has been added or included in their calculation.

10.7.4 Stroking Time

Unless other stroking times are indicated on the data sheet, the following maximum stroking times for both directions shall not be exceeded:

Body Size	Maximum Stroking Time
≤ DN 50/NPS 2	10 Seconds
DN 80/NPS 3	15 Seconds
DN 100/NPS 4	15 Seconds
DN 150/NPS 6	20 Seconds
DN 200/NPS 8	25 Seconds
DN 250/NPS 10	35 Seconds
≥ DN300/NPS 12	45 Seconds

The stroking times are applicable to throttling control valves and should not exceed 2 seconds/inch of valve diameter. Special care shall be taken for compressor antisurge valves which should be in the region of 0.5 to 2 seconds.

Stroking times shall as far as possible be achieved by correct actuator sizing and without the use of external accessories.

10.7.5 Actuator Colour Coding

If a coating other than the manufacturer's standard colour and paint specification is required, COMPANY shall specify the colour and paint specification on the data sheet. For any additional requirements reference will be made to respective ADNOC group painting specification.

10.7.6 Actuators for Dampers

The actuator shall be sized to provide sufficient torque to overcome both the static and dynamic torque in the damper.

The actuator should be sized with an appropriate safety factor based on its and the damper's functionality. Clean air and on/off applications can operate successfully with 25% to 30% margins of safety. For modulating and dirty air applications, safety factors of 50% and upwards should be considered. VENDOR will clearly indicate what safety factor has been included for each application.

If the damper is specified with a fail-safe position, then a spring return type actuator will be specified. Double acting actuators will not be considered. Modulating dampers will be provided with a positioner.

The operating time of the damper will be specified on the data sheet. If the damper service is for safety isolation faster closing times will be required.

Communication protocol for the positioner will be specified on the data sheet.

In addition, actuators will be provided with:

I. Facilities for manual actuation. For smaller actuators a lever would be adequate. For larger actuators a hand wheel with gear reduction may be required.
II. A manual actuation locking device
III. A weatherproof enclosure around the positioner and manual actuation excluding operating handles and links.
IV. Flexible hoses to connect the air supply to the damper actuator and positioner.
V. Turn-buckles on connecting linkages to allow length adjustment on site.
VI. Safety guards.
VII. Mechanical stop mechanisms, strong enough to withstand the actuating force in the failsafe position.
VIII. Visual indicator

10.7.7 Fire Safe Enclosures

Fire Safe enclosures shall only be provided if specified by COMPANY. Refer to Fire & Gas Detection & Fire Protection System Philosophy AGES-PH-03-002.

10.8 Actuators for Special Applications

10.8.1 Electrical Actuators

Electrical actuators may be considered for remote locations where no pneumatic or hydraulic supply is available and for control valves where a standard pneumatic actuator is unsuitable. Electrical actuators for on/off valves are outside the scope of this specification.

If the application requires a predetermined fail-safe function, the use of electric actuators shall be subject to approval of COMPANY.

Electric actuators may be part turn / rotary or linear, dependent on the application, and shall be suitable for closed loop modulating duty (S9 operating mode to IEC 60034-1)

Electric actuators shall be SMART or intelligent type with "non-intrusive" setting of actuator parameters. Remote control will be hard wired or serial communication protocol and will be specified on the data sheet.

A minimum of two intrinsically safe hand-held setting tools will be provided. Any requirement for additional units will be stated in the data sheet.

Functionality shall include diagnostics to monitor the status and health of the actuator with on-board data logging for analysis and service data.

Electric motor actuators for throttling control valves shall be self-contained units comprising:

I. Electric motor and motor starter
II. Gearbox
III. Handwheel
IV. Heater (if specified)
V. Local position indicator
VI. Position Limit Switches
VII. Analogue Position Transmitter (if specified).

Electric motor actuators shall be designed so the motor is above the gearbox when the control valve is installed.

For cost saving a group of MOV's in a specific plant area may be connected to a "Master Station" which in turn will be networked to the PCS. Connectivity will be specified by COMPANY. Typical signals would include:

I. Opened control valve status from limit switch.
II. Closed control valve status from limit switch.
III. Fault status (due to phase fault, power supply, over load or over torque).
IV. Control valve position accurate to 0.1% or VENDOR'S maximum resolution.
V. Open valve control.
VI. Closed valve control.
VII. Local / Remote Status

10.8.2 Hydraulic Actuators

The use of hydraulic actuators for throttling control valves shall only be considered if no pneumatic supply is available and will be subject to approval by COMPANY.

Hydraulic quarter-turn, linear, spring return and double acting actuators shall consist of hydraulic cylinder(s) or equivalent, a hydraulic accumulator (to achieve failure action), appropriate gearing and travel stops.

Internal actuator parts and lubricants shall be compatible with the hydraulic fluid specification defined in the data sheets.

If the application requires a predetermined fail-safe function, the use of hydraulic actuators shall be subject to approval of COMPANY.

10.8.3 Electro-Hydraulic Actuators

Electro-hydraulic actuators shall consist of a hydraulic actuator and integral power pack including the following items:

i. Electrically powered hydraulic pump.
ii. Hydraulic accumulators if control valve is defined as having a predetermined fail-safe position.
iii. Fluid reservoir
iv. Control system.

This includes compact electro-hydraulic actuators if the configuration is agreed by COMPANY.

The actuator can be configured for remote control of a valve or damper in two position or modulating control applications. Manual local push button control or remote PCS control hardwired or networked will be specified.

10.9 Accessories

10.9.1 General

All accessories shall be provided by the VENDOR and shall be installed on the valve on a stainless-steel mounting plate. Accessories will be tubed with 316L tubing and 316 SS compression fittings. However, in some critical application especially in Sulphur plant or Toxic H2S environment, Alloy 825 tubing material and SS316L double ferrule compression fittings shall be used. For Offshore applications 6Mo alloy shall be considered as minimum.

COMPANY shall specify the manufacturer of compression fittings for standardisation.

The execution of tubing between the air filter regulator and accessories and actuator shall be as follows:

i. The control valve VENDOR shall determine the tubing diameter; however, with a minimum size of 6 mm OD, with larger sizes of 10 mm, 12mm and 16 mm as required.
ii. The compression fittings shall be of the make, type and composition as specified in the data sheet. All parts of the fittings shall be made by the same manufacturer. The fittings and tubing shall be installed by skilled personnel and strictly in accordance with the compression fitting manufacturer's instructions.

Off-valve mounting of accessories can be considered with COMPANY approval due to high temperature or vibration service.

To aid maintenance, each accessory shall be capable of being maintained or replaced without removing any other part.

Control valves shall have a position indicator to indicate control valve position and the indicator shall not be obscured by any part of the control valve, actuator or handwheel.

External earths on valve positioners and solenoid coil enclosures will be bonded to plant earth structure. Exception will be pipeline valves as possible interaction with cathodic protection systems.

Sunshade shall be provided for valve positioner to protect from direct sunlight. Material shall be UV resistant GRP with low flammability and antistatic to avoid electrostatic charges.

10.9.2 Valve Positioners

Digital "Smart" control valve positioners with HART Communications are to be supplied as standard, use of other types such as Analogue I/P (electro-pneumatic) or pneumatic positioners will require prior approval of COMPANY and will only be considered if digital positioners are not available for the given application.

Bypass selector for maintenance of positioner is applicable to pneumatic positioners only and will be specified by COMPANY if required.

Valve positioners shall be direct acting mode. Correct direction of control action will be configured in the DCS.

The device shall utilize two-wire, 4-20 mA HART, 24VDC loop-powered unit, powered from the DCS section of the plant ICSS or FOUNDATION Fieldbus (FF).

Electrical classification for Hazardous area will be specified on the data sheet and positioner housing will be rated to IP66.

The device shall provide self-diagnostics for the positioner and control valve. Digital information from positioner (HART / Fieldbus) shall be provided to the Instrument Asset Management System (IAMS. Strong preference is given to systems that allow calibration, configuration and on-line diagnostics to take place in the DCS, i.e. an integrated system not a stand-alone platform. COMPANY will inform VENDOR as to the

supplier of the DCS and the IAMS software requirements so that the provided positioner will be able to integrate and provide full diagnostic capabilities to the plant ICSS. VENDOR will confirm if the following diagnostic functions are available.

i. Predictive diagnostic function providing advance warning of a malfunction with a condition indicator “dashboard” and focused alerts.
ii. Operating data logging to record valve position against time.

VENDOR will also provide a valve signature benchmark of the assembled valve’s performance prior to shipping. This benchmark provides a starting point for future data comparison, so the operating condition of the valve can be tracked to optimise valve performance.

VENDOR standard pressure gauges as required and calibrated as per units and range specified on the data sheet will be provided. VENDOR will state air supply requirements and air flow capacity of positioner.

10.9.3 Handwheels

Handwheels on control valves should only be provided if they are required for operational or safety requirements and specified on the P&ID or project design documents. The requirement and orientation will be shown on the data sheet. The consequences of inappropriate use of handwheels should be carefully considered. For Electrical actuator handwheels refer to section 10.8.1

If a handwheel is required, the following are the minimum requirements:

i. Operation of the handwheel shall be limited by any mechanical limit or travel stops on the valve.
ii. Be engageable in any position
iii. The operating force shall not exceed 360 N force on the rim of the handwheel
iv. Shall be of a fire safe design
v. The handwheel should be yoke mounted and of the non-declutchable type.
vi. The handwheel for butterfly valves shall be shaft mounted instead of yoke mount.
vii. Indicate direction of opening or closing.
viii. Neutral position should be clearly indicated.
ix. Be unaffected by vibration.

10.9.4 Limit Stops

Limit or travel stops shall be fitted only if shown on the P&IDs and included on the data sheet.

Limit stops shall be mechanical devices mounted on the actuator, but they shall not form part of the handwheel mechanism (if provided). Bolts screwed in the body shall not be used as a limit stop.

Screwed bolt-type limit stops, e.g. on the control valve stem, adjustable over the full length of the stroke shall be applied if requested.

To prevent tampering, the limit stops shall be fitted with a locking facility, e.g. a locking nut.

The limit stops shall be adequately protected against unintentional adjustments.

The VENDOR shall set the limit/travel stops at the required minimum or maximum valve opening as specified on the data sheet and shall be checked during FAT.

The application of non-mechanical limit stops requires the approval of COMPANY.

10.9.5 Air Lock-Up Valves

Air lock-up valves shall be specified for the following applications:

I. All services requiring the control valve to remain in the position immediately prior to a complete failure of the instrument air supply.
II. All shutoff control valves requiring an air supply pressure higher than the guaranteed minimum instrument air pressure.

The lock-up valves shall have a bolt adjustment provided with a locking facility, e.g. a locking nut, to prevent unintentional adjustments.

A separate name plate shall be provided to indicate the range and the set values.

The lock-up valves shall be set at 0.5 kg/cm2 above the required control valve air supply pressure unless some other set value is required for a specific actuator.

The lock-up valves shall be properly adjusted by the valve VENDOR.

For control valves with a valve positioner, the lock-up valve shall be installed between the positioner output and the actuator. If lock-up valves are applied on valves operated by a solenoid valve, this solenoid valve shall be installed between the lock-up valve and the actuator.

10.9.6 Limit Switches

“Open” and/or “closed” limit switches shall be fitted only if indicated on the P&IDs and specified in the data sheet. Limit switches shall be of the inductive proximity type.

Limit switches shall be provided with mechanical protection.

Limit switches shall operate within 3% of the control valve travel from respective open and closed limits.

If not armoured, the flying leads shall be protected by a flexible conduit.

If applied, the external linkage between the actuator stem or the rotary spindle and the initiator shall be protected against unintentional damage.

The mounting instructions supplied by the limit switch VENDOR shall be applied by the valve VENDOR. The limit switches shall be properly adjusted by the valve VENDOR. The method of mounting will be approved by COMPANY.

Proximity type limit switches shall be adjustable and autonomous to their function, e.g. one switch for the “fully open” position and a separate switch for the “fully closed” position.

Failure of limit switches either by broken communication or failure to activate will be alarmed. Execution of limit switch will be failsafe.

10.9.7 Position Transmitter

The requirement for a position transmitter will be specified in the valve data sheet. It shall be:

I. Provided by a 4 to 20 mA signal from a proven in service LVDT position transmitter with 4-20 mA + HART, secondary 4 to 20 mA signal from positioner or HART signal directly from positioner.
II. Suitable for area classification and IP66 rated.
III. Based on feedback from actual valve stem or shaft position and not inferred position.
IV. Accurate to .25%.

10.9.8 Air Lubricators

When required, air lubricators shall be of the oil-mist type and the oil flow shall be externally adjustable. The oil buffer capacity shall be sufficient for continuous operation for one month.

In addition, the lubricator shall have facilities for oil refilling under pressure, shall have oil level indication and shall be suitable for installing on a mounting plate.

Where air lubricators are applied for valves operated by a solenoid valve, the lubricator shall be installed upstream of the solenoid valve.

Air lubricators shall be considered for pneumatic long-stroke cylinder actuators.

Spherical glass (bowl type) air lubricators shall not be used.

VENDOR will make a recommendation to COMPANY if VENDOR's proposed valves require an air lubricator.

10.9.9 Filter Regulators

Combined air filter regulator unit shall be installed in the instrument air supply lines to the actuator and/or positioner or individual instruments, in order to regulate the instrument air supply pressure. The make of filter regulator shall be as specified in the data sheet.

The air filter regulators shall be of the reducing-relief valve type, with drainage facility and bolt adjustment provided with a locking facility, e.g. a locking nut, to prevent tampering.

The air filter cartridges shall be of the rigid structure type to resist channelling, rupturing, shrinkage or distortion and shall have a maximum mesh size of 40 µm.

The capability, e.g. output capacity and required spring range, of the filter-regulator shall be checked against the instrument air requirement of the particular positioner and/or actuator or pneumatic instrument.

A 50mm pressure gauge shall be installed on the downstream side of the pressure regulator. Units, range and case material will be specified by COMPANY. Body connection style and size shall be 1/2" or 1/4" NPT.

Filter regulators shall be 316 SS (painted) with overpressure (soft seat internal relief) protection. Manual or Automatic water draining can be specified.

Filter regulators shall be mounted in the vertical position so that they can easily be drained manually.

Glass or polyacrylate (bowl-type) filter regulators shall not be used.

10.9.10 Filters

Air filters may be considered instead of air filter regulators in instrument air supply lines to long-stroke cylinder actuators that can withstand the maximum air pressure.

If applied, the air filter shall be provided with a manual drainage facility and a filter cartridge of the rigid structure type, to resist channelling, rupturing, shrinkage or distortion, having a maximum mesh size of 40 µm Glass or polyacrylate (bowl type) filters shall not be used.

Air filters shall be fitted with small pressure gauges indicating the incoming instrument air supply pressure and delivery pressure to the actuator and/or its components.

10.9.11 Quick Exhaust Valves

In general valve stroking time should be achieved by correct actuator design and without external speed controlling accessories.

Quick exhaust valves may be provided for services which require the control valve to move to its designated failure position faster than specified in section 10.7.4, Stroking Time.

Pilot-operated, quick-exhaust valves shall not be used.

The minimum port size in the quick exhaust valve shall be verified and considered for stroking time calculation.

Silencers might be required on certain applications. In particular on valves that are frequently switching. The noise level generated during operation of the silencer shall not exceed the maximum allowable noise level specified for the control valve trim.

Quick exhaust valves shall have Bug Screens to prevent blockage from insects.

Quick exhaust valves shall be fitted directly to the port of the actuator.

10.9.12 Volume Boosters

Volume boosters shall be provided if needed to achieve the stroking times specified. Volume boosters for pneumatic actuators shall be of the high capacity type with fast throttling facilities to control the required capacity.

Volume boosters shall be fitted directly on the actuator and be provided with a separate pneumatic supply connection, not sharing the same filter regulator. The response of the volume booster shall be adjustable by means of an adjustment screw to match the loop requirements and can be locked in position or permanently sealed.

The temperature rating of the device including the “O” rings shall be suitable for the site ambient temperature. Material of construction to be stainless steel.

10.9.13 Restrictors

If a requirement for slow opening and/or slow closing of a valve exists, this should be achieved within the DCS or other remote electronic system (Smart Valve Positioner). The use of mechanical instrument air restrictors should be avoided and must approved by COMPANY.

If its use is unavoidable, then the mechanical flow restrictor shall be provided with a lockable, variable restriction adjustment facility. The direction(s) of restricted flow shall be indicated by a permanent mark on the body. The capacity of the flow restrictor shall be sized (and tested) for a normal air supply pressure. Restrictors’ material of construction will be stainless steel with NPT connections.

11 PAINTING

Painting shall be to VENDOR standard who shall provide their standard painting procedure for approval prior to shipment for approval. VENDOR shall ensure paint specification is suitable for the environment the valve shall be mounted. The paint colours for the valve and actuator shall be approved by COMPANY. VENDOR may be referred to ADNOC Group painting specification for alinement.

Corrosion due to condensation inside the actuator housing power unit and spring module shall be prevented by using protective coatings and compounds or corrosion resistant materials.

12 VALVE IDENTIFICATION

The control valve shall be provided with a permanently attached stainless steel identification plate, showing the mandatory and supplementary markings as described in IEC 60534-5:2004. Markings shall be permanent and shall be visible after thermal insulation of the valve. For small valves where insufficient space is available on the identification plate, supplementary markings may be provided on a separate identification plate securely fixed to the control valve.

In addition, each control valve shall be provided with a stainless-steel tag plate which shall be fixed to the control valve with a stainless-steel wire. This plate shall be marked with the valve tag number as stated in the data sheet.

Control valve flanges shall be marked in accordance with the applicable design code.

The direction of flow and where applicable, the shutoff direction(s) shall be clearly indicated by a permanent mark cast in or stamped on the valve body or by a riveted stainless-steel plate attached to the valve body or bonnet flange. It shall not be painted. Three-way valves shall clearly indicate the common inlet or common outlet port by a permanent mark stamped on the flange.

The language used for valve markings will be “English”.

Control valves for oxygen services shall be marked:

“SUITABLE FOR OXYGEN SERVICE”

Control valves for HF service shall be tagged:

“SUITABLE FOR HF ACID SERVICE”

Valves in oxygen of Hydrofluoric acid service shall be fitted with warning plates with text as follows:

For Oxygen Service:

WARNING – OXYGEN SERVICE

KEEP FREE FROM OIL AND GREASE

For Hydrofluoric Acid Service:

WARNING – HF ACID

Where a control valve trim size affects the loading on relief headers or a furnace, the valve shall be fitted with a warning plate. The plates shall carry text as follows:

WARNING — TRIM SIZE AFFECTS RELIEF VALVE CAPACITY

or

WARNING — TRIM SIZE AFFECTS FIRING OF FURNACE

Warning plates shall be 3-layer (red-white-red) material, with engraved text, fixed by screws or rivets.

Warning text shall be white letters, with a minimum text height of 6 mm, on a red background.

13 ADDITIONAL SPECIFIC REQUIREMENTS

None

SECTION C

14 SCOPE OF SUPPLY

The VENDOR will supply control valves and accessories as stated in the purchase order and detailed in the data sheets. The provided equipment will meet the technical requirements of this specification.

The VENDOR's scope of supply will include and not be limited to:

i. Control Valves and accessories as stated in the purchase order.
ii. Data sheets and sizing calculations
iii. Noise calculations
iv. Fugitive emissions testing
v. Actuator functional test
vi. Valve stroking time test
vii. List of exceptions and non-compliance
viii. Catalogue details of provided equipment
ix. Manufactures Record Book and material certificates
x. Operation and maintenance manuals
xi. Inspection and Test plan
xii. FAT and all required test services at VENDOR's facility
xiii. Valve signatures for benchmarking valve performance
xiv. Spare parts as detailed in the purchase order
xv. Special test equipment such as HART communicator and communicator for MOV
xvi. Packing and preservation
xvii. Weights and dimensions of cases for shipping
xviii. Warranty and guarantee

15 QUALITY CONTROL AND ASSURANCE

Equipment shall only be purchased from Vendors approved by ADNOC Category Management. This approval indicates that the VENDOR has an approved Quality management system and a proven track record in supply of this equipment type.

COMPANY reserves the right to inspect materials and workmanship at all stages of manufacture and to witness any or all tests.

VENDOR shall comply to Criticality Rating for Equipment outlined in respective ADNOC Group Company's Quality System Specifications for requirements of production checks, shop inspection, testing and material certification.

The VENDOR shall provide equipment inspection and test reports as per approved Inspection and Test Plan.

16 CERTIFICATIONS

VENDOR shall provide hazardous area certificates for all provided valves.

Unless otherwise specified in the Purchase Order, Material test certificates (Mill test reports) shall be provided as set out in section 17.2

17 INSPECTION & TESTING REQUIREMENTS

17.1 General

Prior to the start of valve manufacture, an Inspection and Test Plan) ITP shall be submitted for approval by COMPANY.

The ITP shall include all inspection and test activities to be performed, including those at SUBVENDORS works.

17.2 Materials

Material test certificates in accordance with EN 10204 shall be provided as follows:

Components	Certificate Type
Other wetted parts and bolting	2.2
Body, Bonnet, Stem and Closure Members for General Service valves	3.1
Body, Bonnet, Stem and Closure Members for Critical Service valves (Note 1)	3.2

Note 1: Critical Service is defined as: highly sour and sour with chlorides as well as valves that have been rated functionally critical.

Documents shall be validated in accordance with EN 10204.

17.3 Shop Inspection Access

COMPANY and COMPANY/CONTRACTOR appointed TPI shall at all times have access to the VENDOR and any SUBVENDOR facility engaged in providing material or supplying equipment in the scope of this purchase order for the purpose of inspecting the materials and equipment.

17.4 Factory Acceptance Test

The FAT will evaluate each fully assembled control valve to verify that it is built and operating as per the technical requirements of this specification. The FAT procedure will be provided by VENDOR and approved by COMPANY.

All control valves together with accessories shall be subjected to the following checks and tests as a minimum:

i. Dimensional and flange face finish check
ii. Visual inspection
iii. Hydrostatic test
iv. Performance and mechanical operation test

The following tests will be executed if specified in the purchase order.

i. Seat leakage test
ii. Capacity test
iii. Low temperature or cryogenic test
iv. Vacuum test
v. Fugitive emissions leakage test

17.5 Dimensional and Flange Face Finish Check

The face-to-face dimensions of flanged globe-body control valves shall be as given in the relevant standard ASME B16.10 and IEC 60534-3-2

All dimensions (including overall height) shall be as shown on the VENDOR'S drawings.

The flange face finish shall be in accordance with ASME B16.5 or as specified by COMPANY.

17.6 Visual Inspection

The visual inspection is a mandatory test which shall be performed on all control valves. It is intended to ensure that all accessories are assembled and identified correctly. The paint finish is also checked.

17.7 Hydrostatic Test

Control valves shall be hydrostatically tested in accordance with IEC 60534-4. Valves shall be flushed and drained immediately after testing and thoroughly dried with compressed air immediately after draining.

The water quality shall be clean potable water of a natural pH value, clear and free of sulphides. Water containing up to 200 mg/kg chlorides, temperature not to exceed 50ºC, may be used for the pressure test with the following exceptions:

For austenitic and duplex stainless steel valves and valves made of 9 wt% nickel alloy, the test fluid shall be clean water with a chloride content of 50 mg/kg (50 ppmw) or less. For valves with stainless steel bellows, the test fluid shall be demineralised water that has a chloride content of 2 mg/kg (2 ppmw) or less.

The valves shall be flushed with condensate or demineralised water (chloride content of < 2 mg/kg (2 ppmw)) immediately after the hydro test.

The duration of the hydrostatic test shall be based on Table 2 in IEC 60534-4 unless alternative durations are advised by COMPANY.

17.8 Seat Leakage

The seat leakage test shall be in accordance with ANSI/FCI 70.2 and IEC-60534-4, Standard for control valve leakage.

The seat leakage test procedures shall be executed for all control valves of Class V or VI. Unless otherwise specified, the leakage rate of a single-seated control valve shall not exceed the limits of Class III. For a double-seated control valve, the leakage rate shall not exceed the limits of Class II.

IEC-60534-4, Test Procedure #1 should be used for "flow-tending-to-open" control valves, whereas Test Procedure #2 should be used for "flow-tending-to-close" control valves.

For each control valve, in the shutoff position, the VENDOR shall perform a leakage calculation at the test conditions (as defined in the test procedure) and at operating conditions with the specified fluid.

The control valve shall be completely assembled and tested under the thrust or torque applied by the actuator, with the signal pressure that will be available to close the valve, e.g. 0.2 kg/cm2 or 0.2 to 1.0 kg/cm2 bench setting as required.

For fail open valves the seat leakage test shall be done with the pneumatic supply pressure to the control valve set at the minimum supply pressure.

For each valve tested, the VENDOR will state the following data:

i. Flow direction;
ii. Test medium;
iii. Test differential pressure;
iv. Duration of test;
v. Seat leakage flow rate measured;
vi. Allowable seat leakage flow rate; and
vii. Seat leakage class (if applicable).

During the seat leakage test no adjustments shall be made to the actuator/body/bonnet. After the seat leakage test no adjustments shall be made to the actuator/body/bonnet unless the valve is to be retested.

17.9 Packing Test

The packing test is a mandatory test and shall be done in accordance with IEC 60534-4:2006. However, if the control valve will be subject to fugitive emissions testing (ISO 15848-2), the packing test is not required. Refer to section 17.16 for fugitive emission testing.

After the packing test is completed, the packing shall not be adjusted before shipment.

17.10 Performance and Mechanical Operation

The control valve shall be completely assembled and fitted with all accessories. The packing box shall be correctly packed to the tightness as needed for the hydrostatic test (if necessary, packing shall be renewed after testing).

The performance and mechanical test shall include a hysteresis test, a dead band test and a stroking time test.

For definitions and test procedures refer to IEC 60534-1 and 60534-4, control valve terminology, inspection and testing.

The actuating medium for the tests shall be clean, dry air or nitrogen.

The Hysteresis Test shall consist of measuring the valve stem position for the following sequence of input signals: 50%, 75%, 100%, 75%, 50%, 25%, 0%, 25% and 50%. Hysteresis shall not exceed 0.5% of maximum valve stroke.

The Dead Band Test is expressed in percentage of the input span and shall be measured at 5%, 50% and 95% of the input span. The maximum dead band found shall not exceed 1% of rated input signal.

For each valve, if not otherwise specified, the stroking time at the specified air pressures shall comply with section 10.7.4.

Testing shall be performed under atmospheric conditions (at zero differential pressure and ambient temperature) and with the minimum specified air supply pressure.

The above test results should be recorded on an X-Y recorder.

If the control valve is equipped with a handwheel, the fully open and closed position of the valve shall be achieved with handwheel operation, taking over from actuator starting at mid-position.

If the control valve is equipped with limit switches, they shall be checked for functional operation with a proximity tester.

17.11 Capacity Test

If specified, the actual Cv value shall be demonstrated by a test in accordance with IEC 60534-2-3, Flow capacity, test procedures (control valves).

During the flow capacity test the actual flow capacity shall be demonstrated.

If the VENDOR submits test results and demonstrates the supplied valve matches the prototype, then the flow capacity test may be waived with approval of COMPANY. Flow capacity testing can be expensive and time-consuming.

Computational fluid dynamic modelling may be used to calculate the flow capacity, subject to approval of COMPANY.

17.12 Vacuum Test

A vacuum test shall be made on COMPANY selected control valves used in vacuum service. The test shall hall be in accordance with ISO 27895.

17.13 Non-Destructive Testing and Material Inspection

Requirements for ND, PMI and material certification will be based on AGES-SP-09-003 Piping & Pipeline Valve specification.

17.14 Impact Tests

Impact testing requirements of carbon and low alloy steels and is applicable to valves with low temperature services -101°C (-150°F) and will be based on AGES-SP-09-003 Piping & Pipeline Valve specification.

17.15 NACE

NACE requirements are defined in the Manual Valve specification and will be in compliance of NACE MR0103 or NACE MR0175.

17.16 Fugitive Emission Test

Fugitive emissions seal leakage for control valves and choke valves in hydrocarbon service shall be certified as per ISO 15848. Where fugitive emission tests are specified in the data sheets, valves shall be subjected

to type tests and production tests in accordance with ISO 15848 Part 1 and Part 2 respectively and test reports shall be provided for all valves and shall meet:

i. Class AM for bellows seal valves
ii. Class BM for quarter turn valves
iii. Class CM for rising stem valves

Fugitive emission test procedure shall be submitted for COMPANY review/approval.

COMPANY can specify different fugitive emissions specification depending on local UAE regulations.

Refer to section 17.9 for valve packing test.

17.17 Cryogenic Service Test

VENDOR will provide test procedure and details of proposed test facility for cryogenic testing of control valves. As a minimum, tests will include leakage, torques (opening/closing) and cycling under specified cryogenic service conditions.

18 SUBCONTRACTORS/SUBVENDORS

The VENDOR shall assume full responsibility and overall guarantee for the equipment package and associated equipment.

The VENDOR shall transmit all relevant purchase order documents including specifications to his SUBVENDORS and SUBCONTRACTORS.

It is the VENDOR'S responsibility to enforce all Purchase Order and Specification requirements on his SUBVENDORS and SUBCONTRACTORS.

The VENDOR shall submit all relevant SUBVENDOR and SUBCONTRACTOR drawings and engineering data to the CONTRACTOR.

The VENDOR shall obtain and transmit all SUBVENDOR and SUBCONTRACTORS warranties to the CONTRACTOR/COMPANY, in addition to the system warranty.

19 SPARE PARTS

A listing of recommended spare parts for Construction, Start-up/Commissioning and for two years operations shall be provided by the VENDOR and will be detailed in the purchase order.

Any spare parts for the Control Valves used during the Warranty Period shall be replenished at the VENDOR’S expense.

The time scale and procedure for repair and/or replacement of parts shall be stated in the VENDOR’S proposal. The VENDOR shall provide ordering information to order consumable and spare parts as required. Information required is:

I. Description of item
i. VENDOR’S reference and part number
ii. Standard quantities recommended for start-up and normal operation
iii. SPIR (Spare parts Interchangeability record)

VENDOR shall provide a list of all required testing, maintenance and calibration equipment. COMPANY will decide which items shall be supplied to avoid duplication.

20 PRESERVATION & SHIPMENT

20.1 Packing and Shipping

Preparation for shipment shall be in accordance with purchase order Preservation and Export Packing requirements. VENDOR shall be solely responsible for the adequacy of the preparation for shipment provisions with respect to materials and application, and to provide equipment at the destination in ex-works condition when handled by commercial carriers. Adequate protection shall be provided to prevent mechanical damage and atmospheric corrosion in transit and at the jobsite. Preparation for shipment and packing will be subject to inspection and rejection by COMPANY'S inspectors. All costs occasioned by such rejection shall be to the account of the VENDOR. Equipment shall be packed and securely anchored Bracing, supports, and rigging connections shall be provided to prevent damage during transit, lifting, or unloading. Separate, loose, and spare parts shall be completely boxed. Pieces of equipment and spare parts shall be identified by item number and service and marked with CONTRACTOR'S order number, tag number, and weight, both inside and outside of each individual package or container. A bill of material shall be enclosed in each package or container of parts. One complete set of the installation, operation, and maintenance instructions shall be packed in the boxes or crates with equipment. This is in addition to the number called for in the Purchase Order.

20.2 Preservation and Storage

Equipment and materials shall be protected to withstand ocean transit and extended period of storage at the jobsite for a minimum period of 18 months. Equipment shall be protected to safeguard against all adverse environments, such as humidity, moisture, rain, dust, dirt, sand, mud, salt air, salt spray, and seawater. All equipment and material shall be preserved, and export packed in accordance with project specifications.

21 COMMISSIONING

21.1 Installation

If required VENDOR shall provide supervision assistance for installation and commissioning of control valves at site.

21.2 Long Term Support

VENDOR must provide assurances that supplied equipment will not be obsolete in the next 15 years. In the belief that equipment will eventually be withdrawn from sale, a firm commitment by the VENDOR that for his standard products there will be either repair capability or equivalent parts and/or products available for a minimum of 15 years from the withdrawal date is required. VENDOR may be requested to provide a “roadmap” of equipment obsolescence.

VENDOR shall include comprehensive details of his support facilities for Abu Dhabi as part of the proposal. This shall include the location of support facilities, number and capabilities of service personnel, quantities and types of spare parts kept in inventory and the approximate turnaround time for repair of defective parts together with call out options.

22 TRAINING

VENDOR shall quote an option for training.

23 DOCUMENTATION/MANUFACTURER DATA RECORDS

VENDOR shall submit the type and quantity of drawings and documentation for COMPANY authorization or information as listed in the individual Requisitions and Purchase Orders.

Mutual agreement on scheduled submittal of drawings and engineering data shall be an integral part of any formal Purchase Order.

All drawings, documents, information, correspondence, test reports, operating and maintenance instructions and like items shall be in the English language and metric Units.

All documents and drawings issued by the VENDOR shall be produced in an electronic format compatible with recent and standard office computer software. VENDOR shall provide final documentation on DVD-ROM with search and retrieval capabilities.

Comments made by COMPANY on drawing submittal shall not relieve VENDOR or SUBVENDORS of any responsibility in meeting the requirements of the specifications. Such comments shall not be construed as permission to deviate from requirements of the Purchase Order unless specific and mutual agreement is reached and confirmed in writing.

Each drawing shall be provided with a block in the bottom right-hand corner incorporating the following information:

i. Official trade name of the VENDOR.
ii. VENDOR'S drawing number.
iii. Drawing title giving the description of contents whereby the drawing can be identified.
iv. A symbol or letter indicating the latest issue or revision.
v. PO number and item tag numbers.

Revisions to drawing shall be identified with symbols adjacent to the alterations, a brief description in tabular form of each revision shall be given, and if applicable, the authority and date of the revision shall be listed. The term "Latest Revision" shall not be used.

The below list of documents required is intended to define the minimum technical documents to be provided by the VEDNOR. This list is not exhaustive and additional documentation necessary for the work execution shall be provided by VENDOR.

i. Calculations of control valve capacity
ii. Noise calculation
iii. Seat leakage test report
iv. Details of selected actuator
v. Electrical drawings and schematics for electrical actuators
vi. Control drawings and schematics for hydraulic actuators
vii. Pneumatic and electrical schematics for all accessories
viii. Dimensions and construction drawings of the control valve, including accessories and air lines
ix. Construction drawings of the buffer vessel (if supplied).
x. Bill of materials
xi. Valve datasheets
xii. Production testing and inspection certificates
xiii. Shell Pressure test results

xiv. NDE results
xv. PMI results
xvi. Hazardous area certificates
xvii. Inspection and Test Plan (ITP)
xviii. QA/QC procedure
xix. Internal Test reports and internal punch lists
xx. Catalogue sheets for all furnished items
xxi. FAT procedure
xxii. List of spare parts, tools and test equipment
xxiii. Packing Marking and Shipping Procedure
xxiv. Preservation and Site Storage Procedure
xxv. Operations and Maintenance Manuals
xxvi. Third Party Manuals

24 GUARANTEES & WARRANTY

The VENDOR shall guarantee, in accordance with the general conditions, that the provided equipment shall meet the performance conditions specified in this specification, the purchase order, associated documents and Data Sheets.

The VENDOR will provide warranty services for a minimum period of 18 months from purchase date or 12 months after has been installed, whichever is later. The warranty services shall comprise any diagnostic services, on-site repairs or replacements, and technical support required to ensure that the control valves operate as specified during the defined warranty period and shall be provided at no additional cost to COMPANY.

SECTION D

25 DATA SHEETS TEMPLATES

Data sheets shall be prepared in the format defined by IEC 60534-7 “Industrial-process control valves; Part 7: Control valve data sheet”

26 STANDARD DRAWINGS

None.

SECTION E

None.