

NORSOK STANDARD

COMMON REQUIREMENTS
PROCESS DESIGN

P-CR-001
Rev. 1, December 1994

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1. FOREWORD

This standard has been developed by the NORSOK Standardisation Work Group.

Annex A is normative.

2. SCOPE

The scope of this standard is to provide design requirements and criteria for process design on offshore production facilities. The following main topics are included:

- Design Pressure and Temperature
- Line Sizing
- System and Equipment Isolation
- Insulation and Heat Tracing

These criteria are applicable for all process, process support, process utility and drilling systems.

3. NORMATIVE REFERENCES

NORSOK Standards:

P-DP-001	Operational Principles
S-DP-002	Working Environment

ISO 10418	Analysis, Design, Installation and Testing of Basic Surface
API RP 14 C	Systems for Offshore Production Platforms Replaces
API RP 14 E*	Recommended Practice for Design and Installation of Offshore
	Production Platform Piping Systems

British Standard:

BS MA 18	Salt water piping systems in ships
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* This subject will be covered in the new ISO standard 13703 which is now in preparation to replace API RP 14E. When issued, the ISO standard will replace API RP 14E as a guideline for calculation methods, etc.

4. DEFINITIONS AND ABBREVIATIONS

4.1 Definitions

Operating pressure	The pressure in the equipment when the plant operates at steady state condition, subject to normal variation in operating parameters.
Maximum operating pressure	The pressure predicted for deviations from normal operations, like start-up/shutdown, process flexibility, control requirements and process upsets.
Minimum operating pressure	The pressure predicted for deviations from normal operations, like process start-up and shutdown.
Design pressure	The maximum internal or external pressure to be used in determining the minimum permissible wall thickness of equipment and piping. Note that the minimum permissible wall thickness may be derived from a lower operating pressure, but higher operating temperature.
Operating temperature	The temperature in the equipment when the plant operates at steady state condition, subject to normal variation in operating parameters.
Maximum operating temperature	The temperature in the equipment when the plant operate at unstable conditions, like start-up/shutdown, control requirements, process flexibility and process upsets.
Minimum operating temperature	The temperature in the equipment when the plant operate at unstable conditions, like start-up, shutdown and depressurizing.
Maximum design temperature	The metal temperature representing the most severe condition of coincident pressure and temperature. The design temperature shall encompass the maximum operating temperature.
Minimum design temperature	The temperature which serves as a base for specifying the low temperature characteristics of the material. The design temperature shall encompass the minimum operating temperature.
Insulation	Use of a material with a low conductivity applied to equipment and piping in order to prevent energy flow (i.e. heat, noise).

Heat tracing	Use of heat from electrical cables for heat conservation or frost proofing.
Winterization	Use of insulation and heat tracing, or insulation only, for frost proofing.
Isolation	Isolation means a physical barrier (blind) or a tested barrier
	Double Block & Bleed Two barriers with a bleed between the barriers. Typical arrangement is two block valves with a bleed valve in the middle. Single valve with dual seats and bleed are <u>not</u> considered true double block & bleed.
	Single Block & Bleed One isolation and a bleed. The point to be isolated can be bled down by the bleeder, but there is only one barrier against the pressure side (f.ex. a valve).

4.2 Abbreviations

ESD	Emergency Shut Down
PSV	Pressure Safety Valve
HP	High Pressure
LP	Low Pressure
LO	Locked Open
LC	Locked Closed
RO	Reducing Orifice
NPSH	Net Positive Suction Head

5. DESIGN PRESSURE AND TEMPERATURE

5.1 Design Pressure Criteria

5.1.1 Design Pressure

The design pressure shall be calculated using the following procedures:

For pressurised equipment the criteria in Table 1. shall be applied.

Table 1.

Maximum operating pressure (barg)	Design pressure(barg)
0-35	Maximum operating pressure +3,5 bar
35-70	Maximum operating pressure +10%
70-	Maximum operating pressure +8,5% but minimum 7 bar

The design pressure at the discharge of positive displacement pumps shall be calculated in accordance with Table 1. Equipment not protected by PSV and located downstream of a pump or a compressor shall be designed for the shut-in pressure.

The design pressure for an injection pump shall be the same as for the system into which it injects. For flare knock out drums, it is acceptable that the design pressure should be equal to the maximum operating pressure.

Square or rectangular storage tanks operating at atmospheric pressure, shall be designed for an over-pressure of 0.07 bar. To give mechanical strength to the side and bottom plates, the liquid static pressure of a liquid filled vessel shall be added to the quoted pressure of 0.07 bar.

Equipment where condensing vapours or pump out may lead to less than atmospheric pressure, shall be designed for full vacuum, except for vessels where the design requirements for equipment operating below atmospheric pressure shall be used.

Design pressure for equipment operating below atmospheric pressure are as follows:

Operational pressure	Design pressure
0.35 bara	full vacuum
1.00 bara	the minimum operating pressure minus 0.1 bar, but maximum 0.5 bara

Equipment operating below atmospheric pressure shall also withstand an over-pressure of 3.5 bar (3.5 barg).

5.1.2 *Maximum operating pressure*

Maximum operating pressure for vessels is defined as follows:

- Separators; the highest pressure resulting in a trip
- Compression suction scrubber and coolers; settle-out pressure.

The maximum operating pressure must be lower than the design pressure and PSV set at design pressure.

The maximum operating pressure (shut-in pressure) for compressors shall, when accurate information is unavailable, be determined as:

- Maximum operating suction pressure +1.3 times the normal differential pressure developed by the compressor.

The maximum operating pressure (shut-in pressure) for centrifugal pumps shall, when accurate information is unavailable, be determined by choosing the greater of the two following criteria:

- Maximum operating suction pressure +1.25 times the normal differential pressure developed by the pump
- Maximum suction pressure at relieving conditions plus the normal differential pressure developed by the pump.

Care should be taken not to define higher pressure than required when it affects the selection of material and pressure class rating.

5.1.3 Piping

The design pressure of a piping system comprising pipes, fittings, flanges and valves shall be based on the design pressure of upstream and/or downstream equipment.

Static head, friction loss and surge pressures shall be taken into consideration.

5.2 Design Temperature

5.2.1 Maximum design temperature

Where the maximum operating temperature can be calculated accurately, this temperature shall be used as design temperature, without adding a safety margin.

Where the maximum operating temperature can not be calculated accurately, the design temperature is normally determined by adding 30⁰C to the operating temperature. For equipment operating at ambient conditions, the maximum design temperature is 50⁰C.

Compressor suction scrubber maximum design temperatures are defined as the higher of the following:

- Maximum operating temperature at the compressor suction in the event of cooling medium failure. Maximum operating temperature can be limited by a high temperature shutdown function.

- Maximum recycle temperature (maximum discharge minus Joule Thomsen drop across anti-surge valve) in the event of cooling medium failure. If a high temperature shutdown function is installed downstream the compressor, refer to the above.
- Maximum temperature due to settle out conditions.
- Operating temperature plus 10⁰C.

For all heat exchangers, both sides shall have a maximum design temperature determined by the hottest fluid.

Vessels subject to steam-out shall be designed to meet pressure and temperature during steam-out operation.

5.2.2 *Minimum design temperature*

The minimum design temperature shall be the more stringent of the following:

- Operating temperature (obtained during normal operation, start-up, shutdown or process upsets) minus 5⁰C.
- Minimum ambient temperature.
- Minimum temperature occurring during depressurizing.

5.3 Temperature and Pressure Protection

Protection of equipment and piping against pressure and temperature beyond those values designed for, shall for hydrocarbon systems be according to ISO 10418.

6. LINE SIZING CRITERIA

6.1 Design Basis

6.1.1 *Permissible pipe sizes*

A minimum size of DN50(2") shall in general be used for all process, process support and utility piping to ensure adequate mechanical integrity. Piping of diameter DN25 (1") can be used, where protection and/or support is provided for the following services:

- Instrument air;
- Chemical injection;
- Auxiliary services such as pump cooling

- Services where a minimum velocity is required
- Internal piping on equipment skids
- Sample connections
- Instrument connections.

Minimum size for the sewage and open drain header shall be DN100(4") and sub-headers DN80(3").

Overflow from atmospheric tanks shall as a minimum be equal to the largest inlet pipe.

6.1.2 *Maximum allowable velocities due to reaction forces*

If $\rho V^2 > 200,000$ the piping discipline shall be consulted in order to consider reaction forces. (ρ is fluid density in kg/m^3 and v is velocity in m/s)

This applies to all fluid services (gas, liquid, two-phase).

6.1.3 *Pipe roughness*

For all calculations of pressure drop, the following pipe roughness values should be used:

- | | |
|------------------------------------|----------|
| • Carbon Steel (CS) non-corroded | 0,05 mm |
| • Carbon Steel (CS) corroded | 0,5 mm |
| • Stainless Steel (SS) | 0,05 mm |
| • Titanium and Cu-Ni | |
| • Glassfiber Reinforced Pipe (GRP) | 0,02 mm |
| • Polyethylene, PVC | 0,005 mm |

Flexible hose: Vendor to be consulted. (As a rough estimation, ID/20 mm can be used (ID in inch) for steel carcass and 0.005 mm for plastic coating.)

6.2 *Sizing of Liquid Lines*

6.2.1 *Velocity limitations*

The velocities shall in general be kept low enough to prevent problems with erosion, waterhammer pressure surges, noise, vibration and reaction forces. In some cases a minimum velocity is required.

The acceptable pressure drop will in general be the governing criterion when:

- Flashing of liquid has to be avoided, eg. upstream control valves and in pump suction lines.
- The available pressure drop is limited.

A compromise between line size and pump power has to be taken.

Table 2. gives maximum velocities for sizing of liquid lines.

Table 2. Maximum velocities for sizing of liquid lines.

Fluid	Maximum velocities (m/s)			
	CS	SS	CuNi ⁴⁾	GRP
Liquids	7	Note 2	1,7	7
Liquids with sand ³⁾	5	5	N.A.	N.A.
Liquids with large quantities of mud or silt ³⁾	4	4	N.A.	N.A.
Untreated Seawater ¹⁾	3	Note 2	1,7	6
Deoxygenated Seawater	6	Note 2	1,7	6

- Notes: 1) For pipe less than DN200 (8"), see BS MA-18 for maximum velocity limitations.
- 2) For Stainless Steels and Titanium the maximum velocities is limited by system design (available pressure drop/reaction forces).
- 3) Minimum velocity shall normally be 0.8 m/s
- 4) Minimum velocity for Capronicked is 1,0 m/s

When the service is intermittent the velocity can be increased to 10 m/s.

With corrosion inhibited fluids in carbon steel piping, the velocity shall be limited by a wall shear stress of 40 N/m², with the corresponding maximum velocity:

$$V_{\max} = (80/(f \times \rho))^{1/2} \text{ (m/s)}$$

f = Fanning's friction factor

ρ = fluid density (kg/m³)

$$\text{With } f = 0.005 \quad V_{\max} = 126/\rho^{1/2} \text{ (m/s)}$$

6.2.2 Centrifugal pump suction and discharge lines

The suction piping shall be sized based on NPSH requirements. Maximum velocity from Table 2. and the following maximum pressure drops shall in general be used:

- Subcooled liquids: 0.25 bar/100 m
- Boiling liquids: 0.05 bar/100 m

The fluid temperature shall be at least 15°C below the fluid boiling point temperature to allow sizing based on the criterion for subcooled liquids.

The discharge piping shall be sized using the governing criterion of maximum velocity from Table 2. The pressure drop shall normally not be higher than 0.9 bar /100 m.

The overall pressure drop and pump power shall be considered before final line sizing.

6.2.3 Reciprocation pump suction and discharge lines

For reciprocating pumps, the suction piping shall be sized based on NPSH requirements. Recommended maximum velocities in reciprocating pump piping is given in Table 3.

Table 3. Recommended maximum velocity in reciprocating pump piping.

Speed (RPM)	Maximum velocity (m/s)	
	Suction	Discharge
< 250	0.6	1.8
250-300	0.5	1.4
> 300	0.3	0.9

The limits are for a single plunger pump, and the velocity is the average during several strokes. The discharge velocities can be increased if the number of plungers are increased, and/or if dampers are installed. (Ref. API RP 14E)

6.2.4 Control valve suction lines

Control valve suction lines shall be sized according to criteria for centrifugal pump suction lines.

6.2.5 Liquid flowing by gravity

Lines flowing by gravity includes tank overflows, drains (sanitary, closed and open drains), and other lines where the liquid flows due to gravity forces instead of pressure difference. Generally, a minimum downward slope of 1:100 shall be used. However, with mud and/or sand, the slope shall be at least 1:50.

Pipes that are running full, and do not require a minimum downward slope to avoid particle deposition, shall be sized according to the total available static pressure head, and the maximum allowable velocities for liquid lines.

Near horizontal pipes not running full shall be sized based on the maximum flow as given in Table 4.

Table 4. Flow Capacity - near horizontal pipes.

Diameter (mm (inch))	Liquid flow capacity		
	Entrance to pipe (m ³ /h)	Slope 1:50 (m ³ /h)	Slope 1:100 (m ³ /h)
50 (2)	1.8	3.0	2.5
100 (4)	8	20	15
150 (6)	20	60	35
200 (8)	50	240	170
250 (10)	80	440	310
300 (12)	130	620	440
350 (14)	200	710	500
400 (16)	280	890	630

Vertical gravity lines (such as liquids from sea water returns and produced water discharge) shall be designed such that the Froude number is less than 0.3 to avoid air entrainment.

$$\text{Froude number} = \frac{V^2}{Dg}$$

V = Velocity assuming full pipe (m/s)

D = pipe inner diameter (m)

G = gravity constant (m/s²)

Drainage of deluge water from drain boxes through vertical lines shall be sized on basis of 50% of the available head (assuming the pipe running full of liquid) and not Froude number.

6.2.6 Fire water

The line sizing of fire water lines shall be based on available system pressure and allowable flow velocities.

The pressure drop to the large deluge systems shall be calculated on basis of the most unfavourable pipe routing to those systems.

In the ring main pipework the flow velocity shall in general not exceed the velocity as given in Table 2. Upstream the deluge skids, the flow velocities shall normally not exceed 10 m/s. Some areas may require velocities higher than 10 m/s in order to hydraulically balance the systems, which is acceptable provided the reaction force within the system does not cause excessive stress in the pipe work or the supports.

6.2.7 Oily water systems

The lines for oily water to water treatment facilities, shall be sized in order to retain the size of oil droplets in the water. This can be achieved by providing low flow velocities. Typically the velocity should not exceed 3 m/s.

6.2.8 Drilling fluid systems

The minimum flowing velocity of drilling fluid shall not be lower than 0.8 m/s in order to avoid sand settling in pipes.

The maximum velocity in carbon steel should not exceed 4 m/s to avoid problems such as cavitation/erosion on bends and damage to inline equipment / vessels internals.

Line sizing criteria for drilling fluids are summarized in Table 5.

Table 5. Allowable pressure drop and velocity in drilling fluid systems.

Line Service	Max pressure drop [bar/100 m]	Velocity limits [m/s]	
		Min	Max
Pump Suction (and Gravity) flow (Carbon Steel pipes)	0.3	0.8	4.0

6.3 Sizing of Gas Lines

6.3.1 General

Gas lines shall generally be sized in order to not exceed the acceptable noise level at the platform.

Piping with gas at the dewpoint and/or with some droplets shall be designed as gas lines.

6.3.2 Maximum velocities

The gas shall not exceed the maximum velocities as given in Table 6:

Table 6. Maximum velocities in gas lines.

Diameter(mm(inch))	Maximum velocities (m/s)	
	Continuous flow	Intermittent flow
50-100(2-4)	20	30
150-200(6-8)	30	40
>200(>8)	40	60

For installations where high noise levels are not considered as a problem or if the noise level is reduced by insulation or other means, the maximum velocities for intermittent flow shall apply.

Antisurge recycle lines can be designed to a maximum velocity of 76 m/s during process upsets, if the noise level is acceptable. However, during normal recycle, the velocity shall be limited to figures for continuous flow in Table 6.

If solid particles exist, special attention shall be given to particle erosion.

6.3.3 Recommended pressure drops

Pressure drop in gas lines shall be considered in order to minimize the compression power.

Table 7. lists recommended pressure drops in gas lines. For lines where pressure drop is not considered critical for compression power, the lines should be sized based on maximum velocity only.

Table 7. Maximum pressure drop for single phase gas process lines.

Operating pressure (Barg)	Pressure drop (Bar/100 m)
0 - 35	0.001 - 0.11
35 - 138	0.11 - 0.27
Over 138	P/500 *

* P is operating pressure in bara.

6.4 Sizing of Gas/Liquid Two- or Multi-Phase Lines

Wellhead flowlines, production manifolds, process headers and other lines transporting gas and liquid in two- or multi- phase flow, shall be sized on the basis of flowing velocity.

The maximum velocity shall not exceed the lowest of $183/(\rho_{\text{mix}})^{1/2}$ and maximum velocity for single gas flow (ρ_{mix} = mixture density in kg/m³).

If the available pressure drop allows, the velocity shall in general be sufficiently high to ensure homogeneous flow. This prevents unstabilities due to liquid accumulations, and it allows simple pressure drop calculations. If lower velocities are required due to limited available pressure drop, problems with slugging and/or liquid accumulation in the lines shall be considered.

6.5 Sizing of Gas Relief Lines

6.5.1 Flare headers and subheaders

The maximum velocity for flare headers and subheaders shall not exceed 0.6 mach and the value of ρv^2 shall not exceed 200 000 kg/ms². (ρ is the fluid density kg/m³).

6.5.2 Pressure safety valve lines

The upstream line shall be sized so that the pressure loss is below 3% of valve set pressure. The value of ρv^2 shall be below 200 000 kg/ms². In any case the upstream line size should be at least equal to the PSV inlet nozzle size.

Maximum back pressure shall be less than 10% of the set pressure for conventional (spring loaded) and less than 30 to 50% for balanced (pilot operated) safety relief valves (PSVs).

Maximum flowing velocity in the lines downstream of the PSVs shall in general be less than 0.7 mach. For the PSVs where the outlet velocity is higher, a reducer shall be

installed adjacent to the PSV to increase line size and hence limit the velocity to max 0.7 mach downstream of the reducer. Nevertheless, the actual back pressure at the PSV outlet and in the block valve shall be checked to be consistent with back pressure limitations.

6.5.3 *Controlled flaring lines*

Flaring lines downstream of control valves shall be designed for a maximum velocity of 0.5 mach and a maximum value of $\rho v^2 = 200\,000\text{ kg/ms}^2$, in order to prevent acoustic fatigue.

6.5.4 *Depressurisation lines*

In the lines, upstream or downstream of the blowdown valve, the value of ρv^2 shall not exceed $200\,000\text{ kg/ms}^2$. Velocity shall be limited to 0.8 mach. The maximum flowing velocity in the line downstream the reducer shall be 0.7 Mach.

The pressure loss shall be so as to not impose any restrictions on the depressurisation objectives.

6.5.5 *Two/multiphase relief lines*

Two/multi phase relief lines shall be sized based on the following criteria:

Potential slug/plug flow: $V < 50\text{ m/s}$.

Homogenous flow: $\rho V^2 < 200,000$

6.5.6 *Vent lines*

Maximum backpressure shall be 0.05 barg .

7. SYSTEM AND EQUIPMENT ISOLATION

7.1 System and Equipment Isolation

7.1.1 General

Requirements for isolation shall be implemented based on an assessment of safety, system availability, and frequency of regular production and maintenance operations.

In general single block and bleed shall be used on all systems. Double block and bleed shall only be used for safety reasons, systems/equipment critical for the overall reliability and systems/equipment with high maintenance frequency, such as:

- pig launchers and receivers
- process compressors and crude oil pumps which are maintained when the process system is pressurized.

Illustrations of different isolation arrangements are given in Annex A figures 1 and 2.

7.1.2 Isolation of pressure vessels

All vessel nozzles shall be equipped with spectacle blinds, or blinds/spacers. The relief valve nozzle shall have a spectacle blind. See Annex A, figure 3.

7.1.3 Isolation of control valves

Control valves shall be equipped with isolation and bleed valves. See Annex A, figure 4.

If tight shut-off is required, an isolation valve shall be installed upstream the bypass throttling valve. See Annex A, figure 5.

On non essential equipment, single control valve is acceptable. See Annex A figure 6.

7.1.4 Isolation of pressure and level instruments, chemical injection and sample points

Generally, the same requirements applies to instruments as to system and equipment isolation.

All pressure instruments shall have an isolation valve at the point where pressure is tapped off on a process line, vessel, etc.

7.2 Connections to Vents and Drains

7.2.1 General

The philosophy for connections to flare, vents and drains is described in this section:

1. Closed drain system
Intended for draining of liquid after depressurisation from vessels, piping and other equipment due to maintenance work etc. All pressure drain connections shall be equipped with a blind to avoid accidental draining of pressurized liquids/gas.
2. Flare system
Process relief system. Also used during maintenance to blow down equipment to flare header pressure.
3. Vent system
System for venting of hydrocarbon gas to an atmospheric vent at a safe location. Used during maintenance before equipment is opened. If a vent system is not present, alternatively a blinded nozzle is acceptable for connections of high pressure hoses to a safe location.

7.2.2 Detailed requirements

All pressure vessels shall be provided with an arrangement venting to atmosphere. Remaining hydrocarbons shall be vented to safe area.

1. All pump casing vents and drains not permanently connected to the flare/drain system shall be blinded off downstream of the valves.
2. Connections to the closed drain system shall have a double block valve and bleed arrangement. A spectacle blind shall be located between the block valves. See Annex A, figure 7.
3. A single block valve with blind flange/plug shall be used for level transmitters and level gauges for connections to closed drain and flare systems. If permanently connected to the flare or closed drain system, the blind is not necessary.
4. The drain pipe should be designed for the same pressure as the system to be drained up to the block valve. One drain valve should be a slow opening valve or alternatively an orifice to prevent too high pressure ratio/flow.
5. Connections to the vent system require single isolation, valve or blind.

6. Vents and drains in hydrocarbon service not permanently hooked up to flare or closed drain systems shall be provided with double block valve and blind for pressure ratings 300 lbs. (ANSI class) and above. Pressure ratings 150 lbs. and below shall be equipped with single block valve and blind.
7. Single relief valves shall be equipped with a block valve upstream and downstream and a single blinded bleed valve upstream of the relief valve. See Annex A, figure 8.
8. Mechanically interlocked relief valves shall be equipped with a block valve upstream and downstream and a single blinded bleed valve, upstream of each relief valve.
9. See Annex A, figure 9.
10. Blow down shall be arranged with one blow down valve, orifice and a block valve. See Annex A, figure 10.

7.3 Isolation Devices

7.3.1 General

It shall be possible to isolate equipment or process sections during maintenance work to obtain safe working conditions.

Provisions necessary to facilitate isolation are:

- ESD valves, shut off valves or manual block valves on all connections to equipment or the process section to be isolated.
- Vent/drain (bleed) between isolation valves, or between a valve and a blind.
- Flange pair with blind at the point of isolation.

The actual blinding is accomplished through one of the following arrangements:

- Spectacle blind
- Spade and spacer
- Spool piece and blind flange

8. INSULATION AND HEAT TRACING OF PIPING AND EQUIPMENT

8.1 Insulation and Heat Tracing Requirements

8.1.1 General

Due to corrosion under insulation being a general problem on insulated equipment, the philosophy shall be to avoid insulation where possible. Appropriate coating systems shall be selected to minimize the above problem when insulation is required.

The insulation and heat tracing requirements shall be determined with due consideration to safety aspects as well as to process aspects and with the objective to minimize Life Cycle Cost. All operating modes shall be considered.

Insulation and heat tracing shall be avoided on spectacle blinds and flanges.

The insulation classes are designated as follows:

Code Description Abbreviation

1.	Heat Conservation	HC
2.	Cold Medium Conservation	CC
3.	Personel Protection	PP
4.	Frost Proofing	FP
5.	Fire Proofing (Insulation)	FI
6.	Acoustic 10 d	BAI
7.	Acoustic 20 d	BAI
8.	Acoustic 30 d	BAI
9.	External Condensation Protection	EP
10.	No Insulation	NI

Design requirements and criteria for the respective insulation classes are specified in the following sections.

8.1.2 Heat conservation

Insulation/Heat tracing for this purpose shall be used where heat losses from the piping and equipment to the surroundings are to be minimized for the following reasons:

- Maintain a proper heat balance for optimum operation of the process and utility systems.

- Limit heat losses in heat exchangers and heater systems to minimize required heat input and thereby reduce equipment size and weight.
- To avoid internal condensation in gas systems (e.g. fuel gas system).
- To maintain sufficient liquid temperature and avoid increased liquid viscosities.

If sufficient (waste) heat is available, consideration shall be given to possibly avoid insulation.

8.1.3 Cold medium conservation

This insulation type shall be used for piping and equipment including valves and instruments which normally operate below ambient temperature and where heat transfer from the surroundings shall be minimized for the following reason:

- Maintain a proper heat balance and low temperature in the process system.
- Limit heat input to piping, and thereby reduce equipment size and weight.

8.1.4 Personnel protection

Shields are the preferred option for personnel protection against hot and cold surfaces, unless insulation is required for other purposes.

Where shields are not a practical solution, insulation for personell protection shall be considered on surfaces that can be reached from workareas, walkways, ladders, stairs or other passageways and where the surface temperature exceed 70 °C or is below -10 °C (see NORSOK S-DP-002).

8.1.5 Frost proofing

Insulation/Heat tracing for external low temperature protection shall only be used for safety reasons or where a positive effect on regularity can be demonstrated.

Equipment and piping should be protected for purposes such as:

- To avoid freezing
- To avoid fluid depositions, i.e. hydrate, wax, asphaltenes, etc.
- To protect instruments against maloperation.
- To protect standby equipment.

No winterization is required for water lines (seawater, fresh water and completion fluid) where continuous flow occur.

Stagnant conditions shall be avoided by design, but where this cannot be done, provisions must be made to drain or flush out the system, i.e. winterization bleeds.

Where such provisions can not be made, heat tracing and/or insulation shall only be applied based on a critical evaluation of:

- Location/Environmental conditions.
- Ambient conditions.
- System criticality.

8.1.6 *Fire proofing*

Fireproofing insulation shall be applied on equipment and piping where passive protection against a hydrocarbon fire is required, and on equipment which is required to be operable during a fire.

8.1.7 *Acoustic insulation*

Acoustic insulation comprise Insulation Classes 6, 7 and 8. The respective requirements for these classes are 10, 20 and 30 dB linear average attenuation between 500 and 2000 Hz.

The philosophy and criteria for application of such insulation are detailed in NORSOK Standard S-DP-002.

8.1.8 *External condensation and icing protection*

This type of insulation shall be used to prevent external condensation and icing on piping and equipment in order to protect personnel and equipment.

Normally, insulation for external condensation and icing protection shall not be installed.

ANNEX A
FIGURES
(Normative)

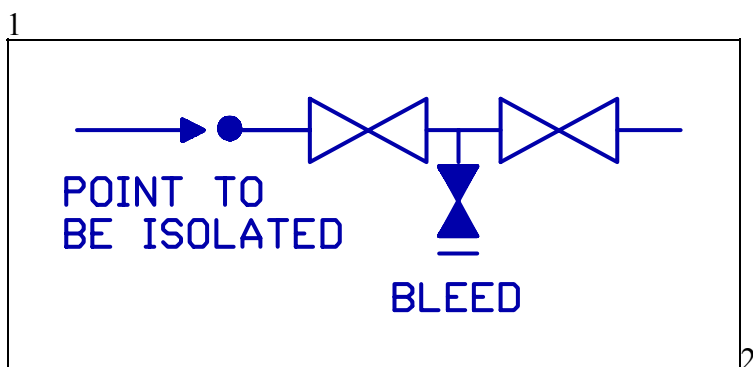
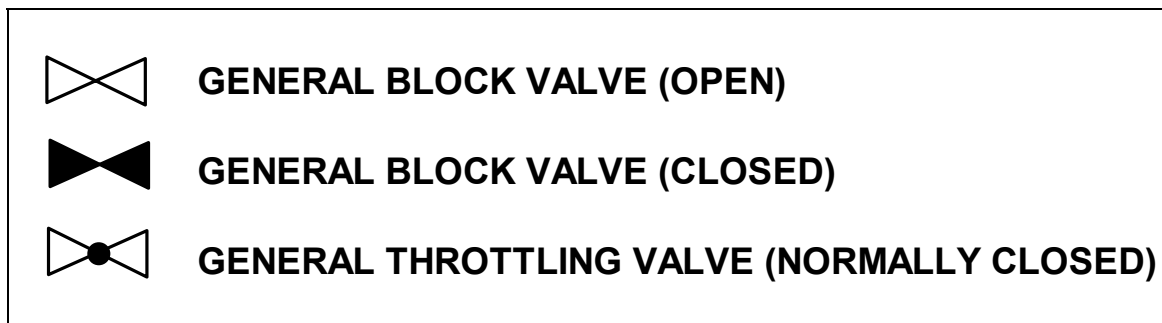
ANNEX A Figures (Normative)**Legend**

Figure A-1: Double block and bleed for process systems.

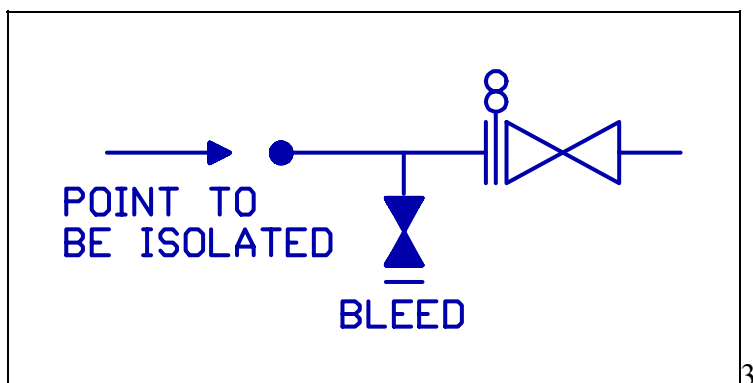


Figure A-2: Single block and bleed for process systems.

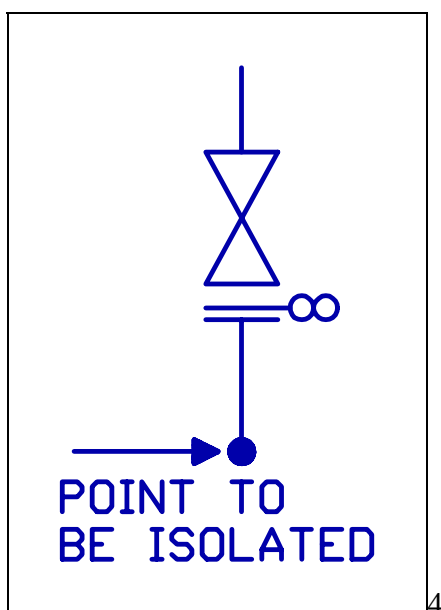


Figure A-3: Single block for pressure vessel isolation.

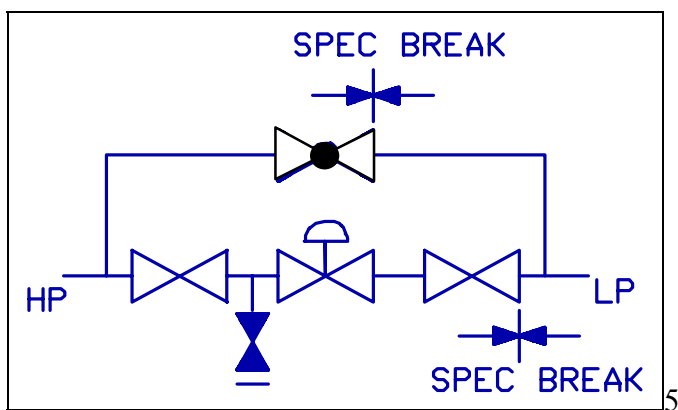


Figure A-4: Isolation of control valve having bypass.

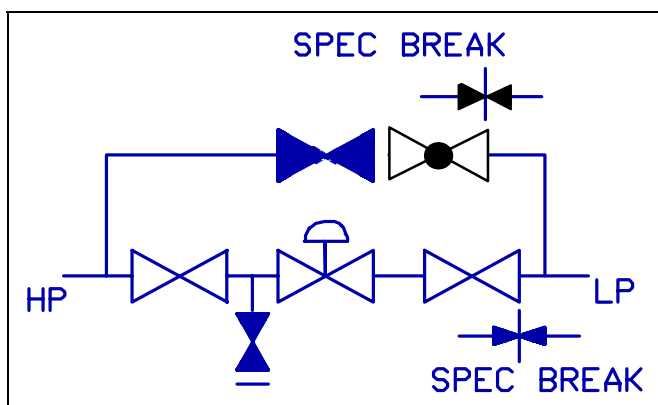


Figure A-5: Isolation of control valve having bypass when tight shut-off is necessary.

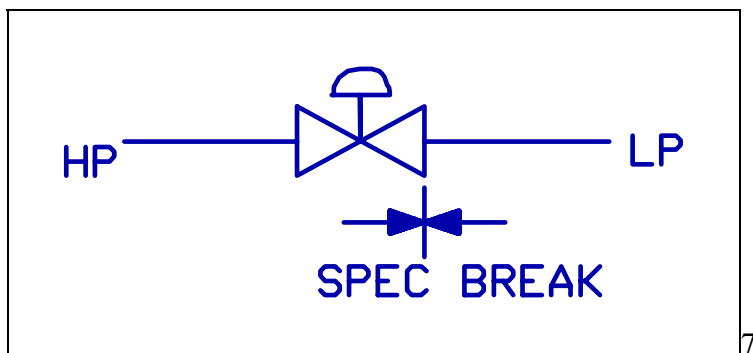


Figure A-6: Single control valve on non essential system (no isolation)

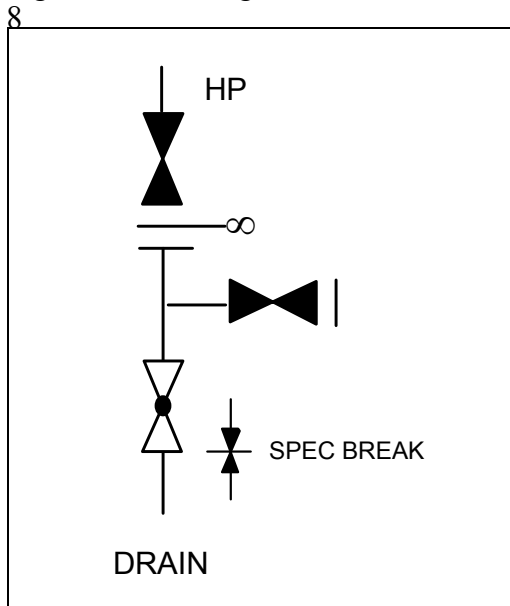


Figure A-7: Double block for connections to closed drains.

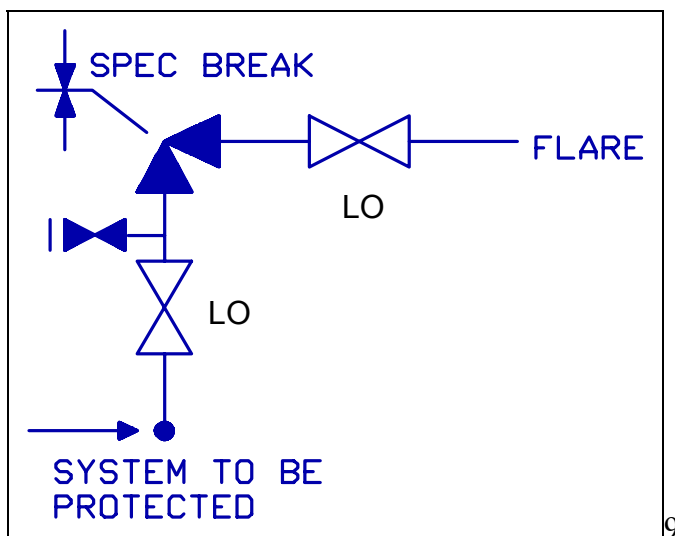


Figure A-8: Arrangement for single relief valve (PSV).

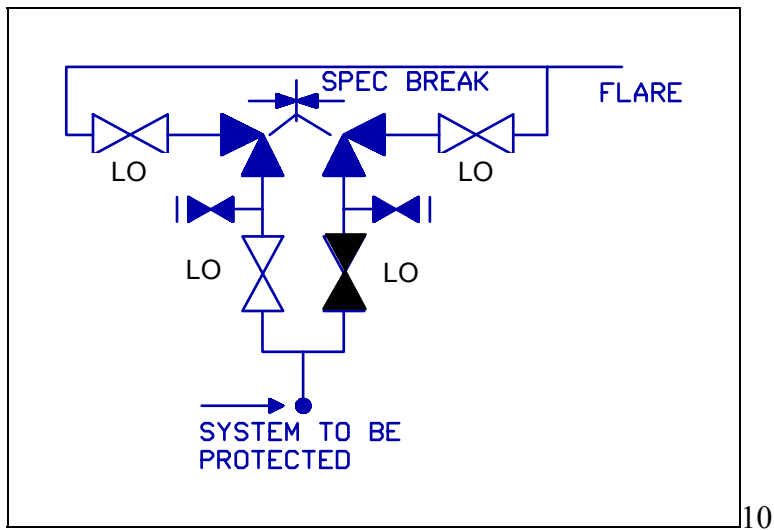


Figure A-9: Arrangement for mechanically interlocked relief valves (PSV's).

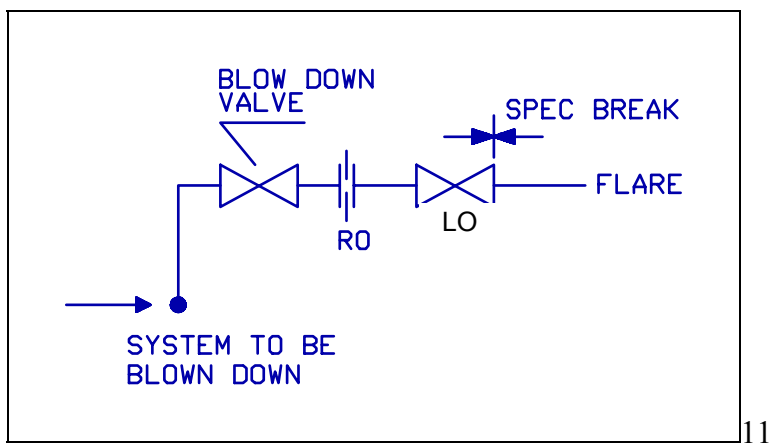


Figure A-10: Blow down valve.