NORSOK STANDARD

P-001

Edition 5, Sep. 2006

Process design

This NORSOK standard is developed with broad petroleum industry participation by interested parties in the Norwegian petroleum industry and is owned by the Norwegian petroleum industry represented by The Norwegian Oil Industry Association (OLF) and The Federation of Norwegian Industry. Please note that whilst every effort has been made to ensure the accuracy of this NORSOK standard, neither OLF nor The Federation of Norwegian Industry or any of their members will assume liability for any use thereof. Standards Norway is responsible for the administration and publication of this NORSOK standard.

Standards Norway
Strandveien 18, P.O. Box 242
N-1326 Lysaker
NORWAY

Telephone: + 47 67 83 86 00
Fax: + 47 67 83 86 01
Email: petroleum@standard.no
Website: www.standard.no/petroleum

Copyrights reserved

Provided by Standard Online AS for POGC 2013-12-02

Documents
Document Sharing Hub

Full document details: NORSOK P-001 2006

Provided by Standard Online AS for POGC 2013-12-02

Documents
Document Sharing Hub

Full document details: NORSOK P-001 2006

Foreword **2**

Introduction **2**

1 Scope **3**

2 Normative and informative references **3**
2.1 Normative references 3
2.2 Informative references 3

3 Terms, definitions and abbreviations **3**
3.1 Terms and definitions 3
3.2 Abbreviations 4

4 Design pressure and temperature **5**
4.1 General 5
4.2 Design pressure 5
4.3 Design temperature 6

5 Safety instrumented secondary pressure protection systems **8**
5.1 General 8
5.2 Testing 8

6 Line sizing criteria **9**
6.1 General 9
6.2 Sizing of liquid lines 9
6.3 Sizing of gas lines 12
6.4 Sizing of gas/liquid two-/multiphase lines 13
6.5 Sizing of flare and vent lines 14

7 Detailed requirements for systems and equipment **15**
7.1 System and equipment isolation 15
7.2 Connections to flare, vents and closed drains 16

8 Insulation and heat tracing of piping and equipment **17**
8.1 General 17
8.2 Heat conservation and frost protection 17

Annex A (Normative) Figures **19**

Provided by Standard Online AS for POGC 2013-12-02

Documents Document Sharing Hub

Full document details: NORSOK P-001 2006

Foreword

The NORSOK standards are developed by the Norwegian petroleum industry to ensure adequate safety, value adding and cost effectiveness for petroleum industry developments and operations. Furthermore, NORSOK standards are, as far as possible, intended to replace oil company specifications and serve as references in the authorities' regulations.

The NORSOK standards are normally based on recognised international standards, adding the provisions deemed necessary to fill the broad needs of the Norwegian petroleum industry. Where relevant, NORSOK standards will be used to provide the Norwegian industry input to the international standardisation process. Subject to development and publication of international standards, the relevant NORSOK standard will be withdrawn.

The NORSOK standards are developed according to the consensus principle generally applicable for most standards work and according to established procedures defined in NORSOK A-001.

The NORSOK standards are prepared and published with support by The Norwegian Oil Industry Association (OLF), The Federation of Norwegian Industry, Norwegian Shipowners' Association and The Petroleum Safety Authority Norway.

NORSOK standards are administered and published by Standards Norway.

Introduction

This edition replaces edition 4 from 1999.

Significant changes are made in the following clauses:

- Clause 5 regarding use of instrument based systems for secondary protection replaces the HIPPS (high integrity pressure protection system) clause in edition 4. This clause has been simplified and adapted to governing international standards. However, limitations regarding application of such systems are maintained.
- Clause 6, Table 3: Revised numbers regarding flow capacity in near horizontal pipes.
- Clause 7 regarding isolation principles has been restructured.
- Clause 8 regarding insulation and heat tracing has been simplified to avoid duplication of requirements in NORSOK R-004.

In general, references have been updated to reflect development of international standards.

Requirements specific to drilling systems have been deleted from this NORSOK standard.

Provided by Standard Online AS for POGC 2013-12-02

Documents Document Sharing Hub

Full document details: NORSOK P-001 2006

1 Scope

This NORSOK standard provides requirements for the following aspects of topside process piping and equipment design on offshore production facilities:

- design pressure and temperature;
- safety instrumented secondary pressure protection systems;
- line sizing;
- system and equipment isolation;
- insulation and heat tracing.

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

2 Normative and informative references

The following standards include provisions and guidelines which, through reference in this text, constitute provisions and guidelines of this NORSOK standard. Latest issue of the references shall be used unless otherwise agreed. Other recognized standards may be used provided it can be shown that they meet or exceed the requirements of the referenced standards.

2.1 Normative references

API RP 14 C,	Analysis, Design, Installation and Testing of Basic Surface Safety Systems on Offshore Production Platforms
API RP 520,	Sizing, Selection and Installation of Pressure-Relieving Systems in Refineries
API RP 521,	Guide for Pressure-Relieving and Depressuring SystemsBS MA-18, Salt water piping systems in ships
IEC 61508,	Functional safety of electrical/electronic/programmable electronic safety related systems.
IEC 61511,	Functional safety – Safety instrumented systems for the process industry sector
ISO 10418,	Petroleum and Natural Gas Industries – Offshore Production Installations – Basic Surface Process Safety Systems
NORSOK R-004,	Piping and equipment insulation
NORSOK S-001,	Technical safety
NORSOK S-002,	Working environment

2.2 Informative references

API Std 2000,	Venting Atmospheric and Low-Pressure Storage Tanks
ISO 13703	Petroleum and natural gas industries – Design and installation of piping system on offshore production platforms
OLF GL 070,	Recommended guidelines for the application of IEC 61508 and IEC 61511

3 Terms, definitions and abbreviations

For the purposes of this NORSOK standard, the following terms, definitions and abbreviations apply.

3.1 Terms and definitions

3.1.1
can
verbal form used for statements of possibility and capability, whether material, physical or casual

3.1.2
design pressure
pressure, together with the design temperature, used to determine the minimum permissible thickness or physical characteristic of each component as determined by the design rules of the pressure design code

NOTE The design pressure is selected by the user to provide a suitable margin above the most severe pressure expected during normal operation at coincident temperature.

Provided by Standard Online AS for POGC 2013-12-02

Documents Document Sharing Hub
Full document details: NORSOK P-001 2006

3.1.3
maximum operating pressure
maximum pressure including plant operation at unstable conditions

NOTE Unstable conditions include start-up/shutdown, control requirements and process upsets.

3.1.4
maximum operating temperature
maximum temperature including plant operation at unstable conditions

NOTE Unstable conditions include start-up/shutdown, control requirements and process upsets.

3.1.5
may
verbal form used to indicate a course of action permissible within the limits of this NORSOK standard

3.1.6
minimum operating temperature
minimum temperature including plant operation at unstable conditions

NOTE Unstable conditions include start-up, shutdown and depressurizing.

3.1.7
operating pressure
pressure during normal operation, including normal variations

3.1.8
operating temperature
temperature during normal operation, including normal variations

3.1.9
settle out pressure
pressure equilibrium after a compressor shutdown

3.1.10
shall
verbal form used to indicate requirements strictly to be followed in order to conform to this NORSOK standard and from which no deviation is permitted, unless accepted by all involved parties

3.1.11
should
verbal form used to indicate that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others, or that a certain course of action is preferred, but not necessarily required

3.1.12
shut-in pressure
pressure for pumps and compressors determined by the curves for a “no flow” situation, i.e. blocked outlet

3.2 Abbreviations

CS	carbon steel
FB	full bore
GRP	glass fibre reinforced polyester
ID	internal diameter
LO	locked open
NPSH	net positive suction head
PSV	pressure safety valve
SS	stainless steel

Provided by Standard Online AS for POGC 2013-12-02

Documents Document Sharing Hub
Full document details: NORSOK P-001 2006

4 Design pressure and temperature

4.1 General

Where pressure relief devices are used, set points for these shall be in accordance with the design code applied for the components in the system.

4.2 Design pressure

4.2.1 Maximum design pressure

For systems protected by a PSV, the criteria in Table 1 shall be applied unless the PSV manufacturer guarantees that use of other margins is acceptable. The minimum margin is defined to avoid unintentional PSV opening. The relation between high trip pressure and maximum operating pressure is given in Figure 1.

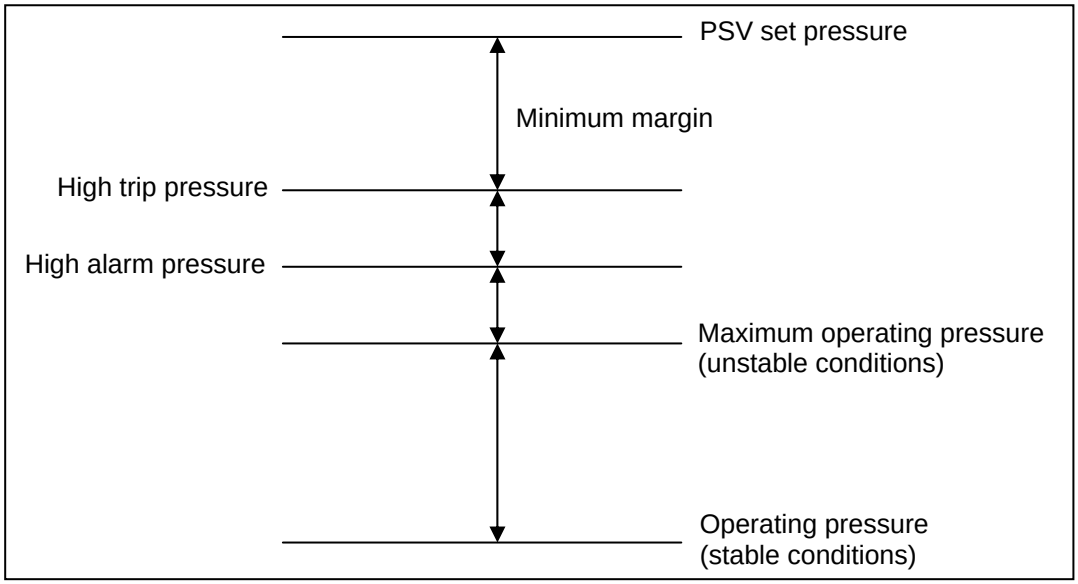

Figure 1 - Pressure relations

Table 1 - Design pressure criteria for pressurised systems

High trip pressure (1),(2) barg	Minimum margin between high trip pressure (1),(2) and PSV set pressure bar
0 to 35	3,5
over 35	10 % of PSV set pressure

(1) For systems without a high pressure trip, the minimum margin shall be applied between the maximum operating pressure and the PSV set pressure.
(2) Maximum operating pressure for compressor suction scrubbers and coolers shall be the maximum settle-out pressure, calculated from coincident high trip pressures on both suction and discharge sides of the compressor, and the minimum margin shall be applied between the maximum operating pressure and the PSV set pressure.

When rupture disks are applied, sufficient margin shall be included to

- prevent unintentional disk ruptures, i.e. margin between the disk set pressure and the operating pressure,
- ensure system pressure protection, i.e. margin between the disk set pressure and the maximum accumulated overpressure.

Reference is made to relevant pressure relieving design codes for further guidance.

When accurate information is unavailable, the shut-in pressure for centrifugal compressors should be determined as the maximum operating suction pressure +1,3 times the normal differential pressure developed by the compressor, to include for pressure rise at surge condition and maximum speed. The

Provided by Standard Online AS for POGC 2013-12-02
Documents Document Sharing Hub
Full document details: NORSOK P-001 2006

maximum operating suction pressure for a compressor shall in this case be determined by the high trip pressure from upstream separators or compressors.

When accurate information is unavailable, the maximum operating pressure (shut-in pressure) for centrifugal pumps should be determined as the suction pressure at relieving conditions +1,25 times the normal differential pressure developed by the pump

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

To minimise the requirements for process relief (full flow) the design pressure should be kept identical for systems with almost identical operating pressures.

For piping, occasional variations in the pressure above the design pressure is permissible in some design codes. This shall be subject to due consideration of all aspects in the relevant piping design code. If such variations are permitted by the project owner, the duration and extent of overpressure that the piping is subjected to, shall be logged. Logging is not considered required when it is evident that overpressure will not occur more frequently than allowed by the piping code.

Atmospheric tanks shall as a minimum be designed to be liquid filled to the highest point of the overflow line, and with an overpressure of 0,07 bar. If the overflow line can be blocked or have reversed flow (e.g. during loading) the atmospheric tank shall be designed for a liquid filled vent line up to the goose neck. Reference is made to API Std 2000 for further guidance.

For flare knock out drums, it is acceptable that the design pressure is equal to the maximum operating pressure. A safety margin shall be added to the maximum operating pressure in the design phase to account for increase due to uncertainties in the calculations. When accurate information is unavailable, Table 1 shall be used to set the safety margin.

4.2.2 Minimum design pressure

For equipment where cooling or condensing vapours (e.g. after steam-out of vessels), drainage or pump out may lead to less than atmospheric pressure, the equipment shall be designed for full vacuum or protected by vacuum relief. Reference is made to API RP 521 for further guidance.

4.3 Design temperature

4.3.1 Maximum design temperature

4.3.1.1 General

Where the maximum operating temperature can be determined accurately, this temperature should be used as maximum design temperature, without adding a safety margin. As an example, this can apply to the use of reservoir temperature as maximum design temperature for platform inlet facilities.

Where the maximum operating temperature can not be calculated accurately, the maximum design temperature should be determined by adding 30 °C to the operating temperature. For equipment operating at ambient conditions, the maximum design temperature should be 50 °C for the North Sea.

A high temperature shut down function, in accordance with ISO 10418 or API RP 14C, can limit the maximum operating temperature. A margin should be included to determine the design temperature.

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

Vessels and instruments subject to steam-out shall be designed for temperature during steam-out operation.

4.3.1.2 Sea water systems

For sea water supply systems a maximum design temperature less than 50 °C can be accepted if documented by calculations.

Provided by Standard Online AS for POGC 2013-12-02

Documents Document Sharing Hub

Full document details: NORSOK P-001 2006