

Piping fabrication, installation, flushing and testing

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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 Subject to development and publication of international standards, the relevant NORSOK standard will be withdrawn.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.

1 Scope

This NORSOK standard covers the basis for fabrication, installation, flushing, pressure testing, chemical cleaning, hot oil flushing and system colour coding of process, drilling and utility piping for offshore oil and/or gas production facilities.

This NORSOK standard does not cover the following:

- all instrument control piping downstream of first piping block valve;
- subsea pipework and risers;
- flexible hoses;
- sanitary piping systems within living quarters and other domestic areas, see NORSOK H-003;
- GRP piping;
- marine systems in hulls of vessels and floating platforms and land based plants.

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 the requirements of the referenced standards.

2.1 Normative references

ASME B31.3,	Process Piping
ASME B1.20.1,	Pipe Threads, General purpose, Inch
ASME PCC2,	Repair of Pressure Equipment and Piping
ASME VIII,	Boiler and Pressure Vessel Code, Section VIII – Rules for construction of Pressure Vessels, Division 1
API 6A,	API standard 6A
NORSOK L-001,	Piping and Valves
NORSOK L-002,	Piping design, layout and stress analysis
NORSOK L-CR-003,	Piping details
NORSOK L-005,	Compact flanged connections
NORSOK M-601,	Welding and inspection of piping
NORSOK M-630,	Material data sheets and element data sheets for piping
NORSOK Z-DP-002,	Coding system
NORSOK Z-006,	Preservation
NS 813,	Piping systems – Identification colours for the content
NS 4054,	Colours for identification
ISO 4406,	Hydraulic fluid power – Fluids – Method for coding the level of contamination by solid particles
ISO 9095,	Steel tubes – Continuous character marking and colour coding for material identification

2.2 Informative references

ASME PCC-1,	Guidelines for Pressure Boundary Bolted Flange Joint Assembly
EN 1591,	Flanges and their joints
ISO 19900,	Petroleum and natural gas industries – General requirements for offshore structures
OLF guideline 118,	Håndbok for flensarbeid
NORSOK H-003,	Heating, ventilation and air conditioning (HVAC) and sanitary systems
NORSOK N-001,	Integrity of offshore structures

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

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

3.1.2

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

3.1.3

may

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

3.1.4

can

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

3.2 Abbreviations

ABS	absolute
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
EN	European Standard
GRP	glass fiber reinforced plastic
He	helium
HVAC	heating, ventilation and air conditioning
ISO	International Organisation for Standardisation
IX	special metallic seal ring, see NORSOK L-005, clause 5
N ₂	nitrogen
N ₂ He	nitrogen helium
NCR	non conformance request
NDE	non destructive examination
NPT	National Pipe Thread Taper
NS	Norwegian Standard
O ₂	oxygen
OD	outside diameter
P&ID	pipng and instrument diagram
PAS	pressurised air shock blowing
PVC	polyester vinyl chloride
UV	ultra violet

4 Materials

4.1 Colour marking of materials

Colour marking shall be according to ISO 9095.

If possible, gaskets shall be marked to be visible after installation.

4.2 Material storage, handling, recieval and identification control

Procedures for off-loading, storage, recieval, control, traceability and inspection of piping material supplied for fabrication and installation shall be worked out.

In general, the following applies:

- storage and preservation shall adhere to requirements in NORSOK Z-006;
- storage of piping and piping equipment shall be under cover and protected against contact with the ground;

- carbon steel and stainless steel components shall be segregated to avoid any cross contamination.
- all fittings and equipment shall be protected against damage during handling from supplier to fabrication yard and further to final installation plant. Especially focus shall be made to sealing surfaces, bevelled areas, and contact between different material qualities to avoid surface contamination. This also includes protection during erection phase in order to protect against contamination from other activities on site.

5 Fabrication of pipework

5.1 General requirements

Prefabricated pipe spools shall be cleaned, painted (if required) and preserved prior to installation.

Internal cleaning of pipe spools shall be done by hydro flushing or hydro jetting.

The fabrication yard shall be outfitted for work with relevant materials. Intermediate storing, lifting devices and handling equipment shall have a surface not causing contamination of the materials they are used for. All tools shall be restricted to the relevant material group to avoid rust contamination and shall be marked to avoid mixing of tools for different materials. Different grades of stainless steel materials can be handled with the same tools.

Separate tools shall be used for titanium materials.

All welded attachments to piping, including pads and doubler plates, shall be of a material 100 % compatible with the piping material.

Fabrication of high alloy piping shall take place in areas separated from areas where carbon steel piping is fabricated. Titanium fabrication shall also be separated from stainless steel and carbon steel fabrication areas.

Bending and forming of pipe shall be carried out in accordance with ASME B31.3, NORSOK M-630 (EDS NBE1 and EDS NBE2) and shall be carried out according to documented procedures.

5.2 Welding and NDE

All welding and NDE shall be in accordance with NORSOK M-601.

Internals of in-line valves and equipment that could be damaged due to heat transfer shall be removed prior to welding and/or heat treatment.

5.3 Butt welds for orifice runs

When the design of an orifice run necessitates welds, these shall be ground smooth and flush with the inside of the pipe. Pipe-tap connections, where required, shall be drilled through the pipe wall and be smooth inside.

5.4 Screwed pipework

Unless otherwise stated on approved drawing or specifications, pipe threads shall conform to ASME B1.20.1.

All threading shall be carried-out after bending, forging or heat treatment, but where this is not possible, suitable thread protection shall be provided.

NPT threads need special attention to dimensional tolerances due to the conic configuration. Minimum engagement shall be 4.5 for NPT threads.

Tape shall not be used on threads for screwed piping connections.

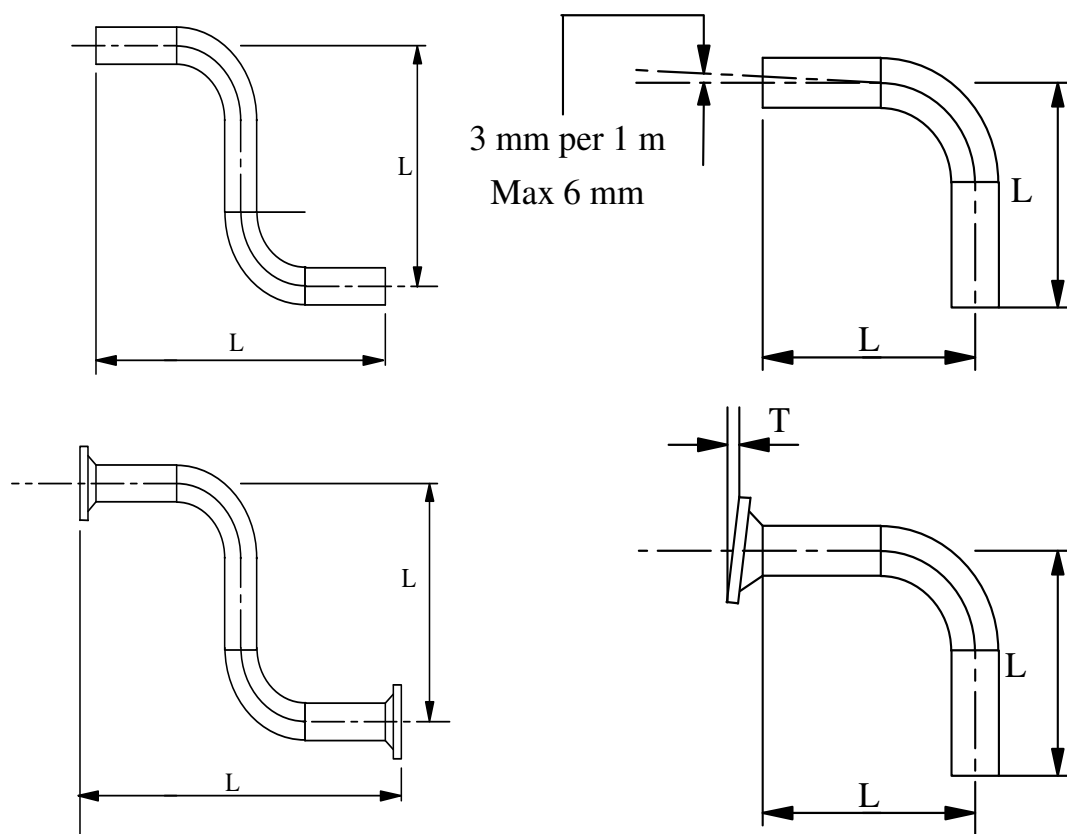
5.5 Dimensional tolerances for pre-fabricated piping assemblies

Dimensional control of prefabricated piping spools shall be performed in a systematic manner, assuring that the final installation will be correct. Prefabricated spools for offshore installation shall be 100 % dimensionally controlled. The tolerances on linear dimensions (intermediate or overall) are illustrated in Figure 1 and Figure 2. These tolerances are not accumulative.

Angularity tolerances across the face of flanges, weld end preparation and rotation of flanges shall be as stated in Figure 1 and Figure 2.

Closer tolerances on weld end preparations than stated in Figure 1 and Figure 2, may be specified in the relevant welding specification for the material in question, and shown on the fabrication isometric(s).

When closer tolerances other than those given above are required, these shall be as specified on the isometric drawing in question.



L [m]	ΔL	T
Tolerances [mm]		
≤ 6	± 5	$\pm 1,5$
> 6	± 10	$\pm 1,5$

Figure 1 — Tolerances for prefabricated piping assemblies