

NORSOK STANDARD

COMMON REQUIREMENTS
**PIPING FABRICATION, INSTALLATION, FLUSHING
AND TESTING**

L-CR-004
Rev 1, January 1996

Please note that whilst every effort has been made to ensure the accuracy of the NORSOK standards neither OLF nor TBL or any of their members will assume liability for any use thereof.

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1 ERRATA: CORRECTED TYPING ERROR IN ANNEX A.3 (APRIL 1998)

1 FOREWORD

NORSOK (The competitive standing of the Norwegian offshore sector) is the industry initiative to add value, reduce cost and lead time and remove unnecessary activities in offshore field developments and operations.

The NORSOK standards are developed by the Norwegian petroleum industry as a part of the NORSOK initiative and are jointly issued by OLF (The Norwegian Oil Industry Association) and TBL (The Federation of Norwegian Engineering Industries). NORSOK standards are administered by NTS (Norwegian Technology Standards Institution).

The purpose of this industry standard is to replace the individual oil company specifications for use in existing and future petroleum industry developments, subject to the individual company's review and application.

The NORSOK standards make extensive references to international standards. Where relevant, the contents of this standard will be used to provide input to the international standardisation process. Subject to implementation into international standards, this NORSOK standard will be withdrawn.

All annexes are normative.

2 SCOPE

This 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 standard does not cover the following:

- All instrument control piping downstream of first piping block valve.
- Sub-sea pipework and risers.
- Flexible hoses.
- Sanitary piping systems within living quarters and other domestic areas (H-CR-002).
- GRP piping.

3 NORMATIVE REFERENCES

The fabrication, installation, flushing, pressure testing, chemical cleaning, hot oil flushing and system colour coding shall be in accordance with all applicable sections of the latest edition of the regulations, codes, standards listed below:

ASME B31.3	Chemical plant and petroleum refinery piping
ASME B2.1	Pipe threads, general purpose
DIN 2505	Flanged joint calculation
Norsok Z-DP-002	Coding system
Norsok L-CR-001	Piping and valves
Norsok M-CR-601	Welding and inspection of piping
NS 813	Piping systems. Identification colours for the content.

NS 4054	Colour for identification.
ISO 4406	Hydraulic fluid power-fluids-method for coding level of contamination by solid particles
ISO 9095	Steel tubes - Continuous character marking and colour coding for material identification

4 DEFINITIONS AND ABBREVIATIONS

4.1 Definitions

Normative references	Shall mean normative in the application of NORSOK standards.
Informative references	Shall mean informative in the application of NORSOK standards.
Shall	Shall is an absolute requirement which shall be followed strictly in order to conform with the standard.
Should	Should is a recommendation. Alternative solutions having the same functionality and quality are acceptable.
May	May indicates a course of action that is permissible within the limits of the standard (a permission).
Can	Can-requirements are conditional and indicates a possibility open to the user of the standard.

4.2 Abbreviations

ABS	Absolute
CTF	Cut To Fit
HVWF	High Velocity Water Flushing
NS	Norwegian Standard
ASME	American Society of Mechanical Engineers
PVC	Polyester Vinyl Chlorid
ID	Inner Diameter
PAS	Pressurised Air Shock Blowing
P&ID	Piping and Instrument Diagram
NDE	Non Destructive Examination
HVAC	Heating, Ventilation and Air-Conditioning
ISO	International Organisation for Standardisation
RAL	Übersichtkarte. Übersicht über die farben des farbregisters RAL 840 HR
RTJ	Ring Type Joint
GRP	Glassfiber Reinforced Plastic

5 MATERIALS

5.1 Colour marking of materials

If colour marking shall be implemented, ISO 9095 shall be used.

5.2 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.

6 FABRICATION OF PIPEWORK

6.1 General requirements

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

6.2 Welding and NDE

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

6.3 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.

6.4 Screwed pipework

Unless otherwise stated on approved drawing or specifications, pipe threads shall conform to ASME B2.1.

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

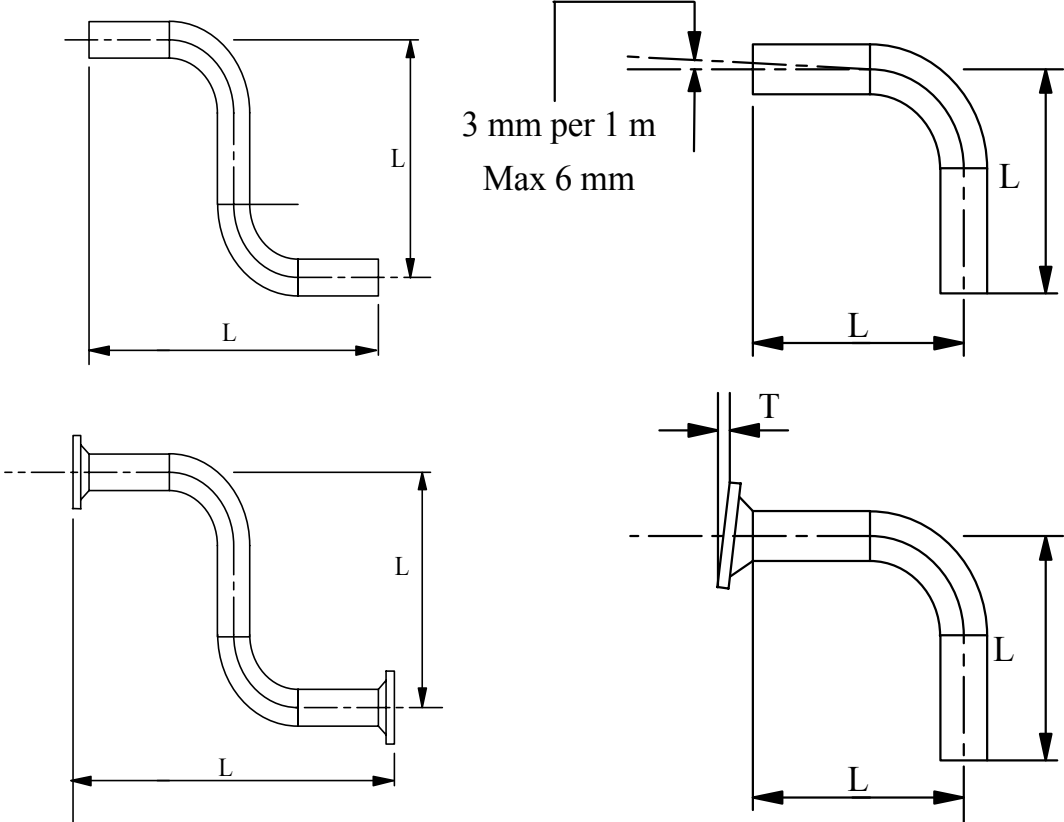
6.5 Dimensional tolerances for pre-fabricated piping assemblies

The tolerances on linear dimensions (intermediate or overall) is illustrated on figures 1 and 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 figures 1 and 2.

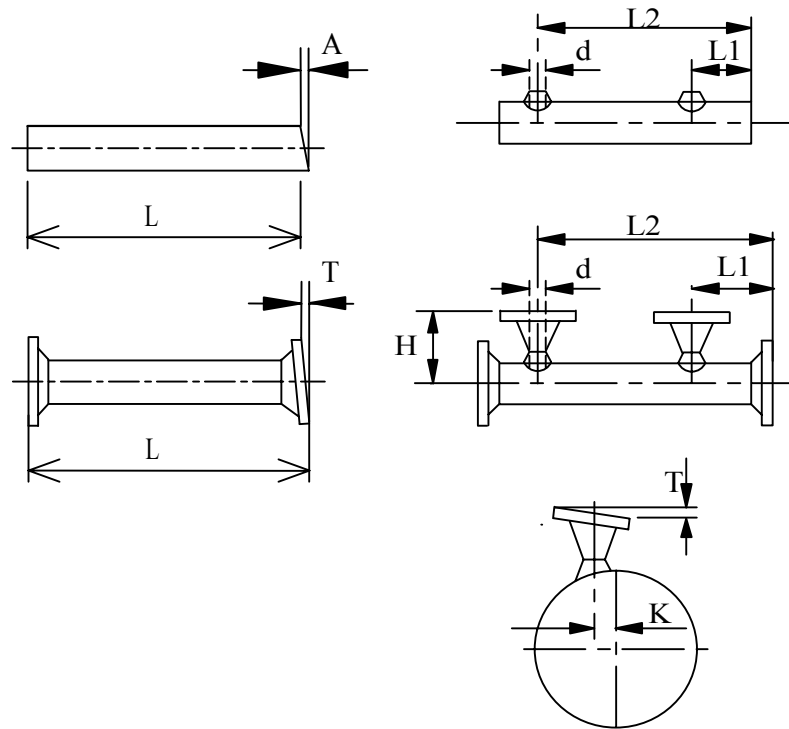
Closer tolerances on weld end preparations than stated in figures 1 and 2, may be specified in the relevant welding specification for the material in question, and shown on the fabrication isometric(s).

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



L (m)	Tolerances (mm)	
	ΔL	T
≤ 6	± 5	± 1.5
> 6	± 10	± 1.5

Figure 1. Tolerances for prefabricated piping assemblies



L (m)	Tolerances (mm)		
	L	A	T
≤ 6	3	1.5	1.5
> 6	5	1.5	1.5

	Tolerances (mm)		
	$2'' \leq d \leq 10''$	$12'' \leq d \leq 20''$	$d > 20''$
L1	± 3	± 5	± 5
L2	± 3	± 5	± 5
H	± 3	± 3	± 3
T	1.5	1.5	1.5
K	2	3	3

d =nominal diameter

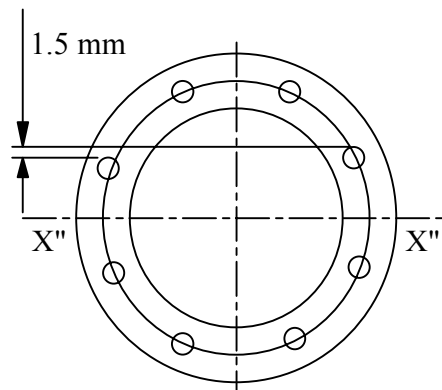


Figure 2: Tolerances for prefabricated piping assemblies

Notes:

1. Before reworking any spools contact engineering department in order to check complete isometric.
2. For spools CTF dimensions the overall length to be approximately 50mm overlength.
3. Bolt holes on flanges shall straddle the horizontal or vertical lines or plant north/south centre lines when orientation is not given on drawings.

6.6 Branch connections and outlets

All welded branch connections shall be jointed to the header with full penetration welds.

Stub-in connections shall be set-on type. Set-in type is not acceptable.

Reinforcement pads or saddles required by specifications and drawings shall be of the same material as the main pipe (unless specified otherwise) and shall be formed and countered to provide a good fit to both main and branch pipe.

Branch reinforcement pads or each segment thereof shall be provided with a minimum 3.0mm drilled and tapped hole prior to fitting to the pipe, so ensuring leak detection, venting and testing facilities. Whenever possible, pad should be made in one piece before fitting onto pipe.

6.7 Pipe coupling

Seal faces of mechanical couplings/hubs and flanges shall be protected during fabrication and storage. Where possible couplings/hubs shall be protected by fitting and hand tightening the complete coupling assembly.

7 INSTALLATION OF PIPING

7.1 Pipework erection

All pipes shall be inspected before erection to ensure that they are free from loose contamination.

Pipework shall be erected on permanent supports designated for the line. Temporary supports shall be kept to an absolute minimum, but to an extent sufficient to protect nozzles and adjacent piping from excessive loads during the erection.

Pipework shall be fitted in place without springing or forcing to avoid undue stressing of the line or strain being placed on a vessel or item of equipment, etc.

All temporary pipe spools and supports that are an aid to erection, testing/flushing, sea fastening, etc. are to be specially marked for removal identification.

7.2 Flanged joints

Before assembly flanges shall be clean and free from any detritus matter (e.g rust, dirt or other contamination). The joints shall be brought up flush and square without forcing so that the entire mating surfaces bear uniformly on the gasket and then mated-up with uniform bolt tension.

7.3 Valve and equipment flange connections

Flange covers shall be retained on all flange connections to valve or equipment, until ready to connect the mating piping.

All equipment shall be blanked, either by pressure test blanks, spades or blinds, to stop the ingress of internal pipe debris.

Flanges connecting to strain sensitive mechanical equipment e.g. pumps, compressors, turbines, etc. shall be fitted-up in close parallel and lateral alignment prior to tightening the bolting.

In general, flange connections to equipment shall be the last connection made on completion of a line or interconnecting system of lines.

With the piping flange fitted and prior to bolting-up the joint, the following tolerances shall be maintained:

- Bolting shall move freely through accompanying bolt-holes at right angle to the flange faces.
- There shall be a clear gap between two flange faces before gasket installation. There shall be sufficient flexibility to install and replace gaskets.

7.4 Gaskets

Gaskets shall be treated in accordance with manufacturers' instructions. Gaskets shall be replaced after opening or dismantling of flange connections.

RTJ gaskets are to be lightly smeared on the mating surface with a propriety anti-friction lubricant prior to fitting between the flange grooves. Anti-friction lubricant, compatible with the flange material and process fluid shall be used.

7.5 Bolting

Bolting shall be in accordance with the requirements in the Piping and valve material standard L-CR-001.

Manually pulled flange bolts and studbolts shall extend fully through their nuts with minimum one, maximum five threads.

All flanged stud bolts shall be progressively controlled to equalise bolt pressure on the gasket. A detailed procedure shall be developed prior to start.

Hydraulic bolt thightening shall be used on all bolts greater than 1" diameter.

Calculation of the required bolt tension value shall be in accordance with the DIN 2505, with the following exeptions:

- Minimum required bolt tension value shall be multiplied with 1.5.
- Maximum bolt tension value shall not exeed 2/3 of the specified yield of the bolt or maximum allowable stress for the gasket.

Nuts and bolts shall have their grade marks visible after installation. Studbolts cut from long lengths of studding shall have material grade stamped on end of each cut.

Bolts larger than 1" shall be protected against mechanical damage and corrosion.

7.6 Pipe support

Pipe supports shall be in accordance with the relevant pipe support detail drawings developed for the project.

Piping shall not be forced to fit with support locations in such a manner that additional stress is introduced.

Where spring support are installed the spring shall locked gagged until commissioning/start up.

All piping shall be arranged to facilitate supporting, and shall be planned for ease of removal of equipment for inspection and servicing. Pipes shall not normally be supported by other pipes, i.e. individual supporting is required.

Vent holes in wear plates and trunnions are generally not required. However, when the wear plate or a trunnion covers a circumferential weld that has not been pressure tested, a vent hole is required for leak detection.

7.7 Global tolerances, installation

Hook-up termination points shall be within $\pm 25\text{mm}$ in all directions. Overlength may be provided where required.

Installation tolerances of piping components shall be as required by the individual service of the piping component including requirements for:

- Maintenance access.
- Position relative to surrounding steelwork, equipment, cable tray and HVAC duct routings.
- Positioning of pipe supports relative to the structural steel.
- Pipe stress.

8 FLUSHING

8.1 General

The initial flushing shall be carried out prior to pressure testing. For austenitic steelwork flushing can be performed after pressure testing, upon agreement.

General requirements for flushing for specific systems are listed in table 1, annex B.

Procedures for flushing shall be developed prior to start.

All pipework shall be free from dirt, grease and temporary protective coating upon completion of flushing.

8.2 Hydro flushing

Items of equipment which would be sensitive to damage during hydro flushing shall be removed, blocked off or isolated. A list shall be prepared and be part of the flush & test procedure.

Ball valves shall be flushed in fully open position.

All piping systems shall be flushed using high pressure jetflushing equipment, such as rotating hose or rotating nozzle. Minimum pressure shall be 600 bar.

Below 4", High Velocity Water Flushing (HVWF) may be used. Water velocity shall be a minimum of 10m/s. On systems where high pressure jet flushing cannot be used due to complicated shapes and/or long runs HVWF may be used.

The flushing medium shall in general be fresh water. When flushing stainless steel lines, the chloride ion content shall be less than 200ppm.

After flushing, the piping systems shall be completely drained and protected against corrosion.

Ball valves shall be flushed fully open.

8.3 Pressurised air shockblowing

This method may be used as an initial cleaning method for instrument air, plant air and as an alternative method for initial cleaning of small bore pipe (less than 2 inch). This method may also be used when there are problems removing trapped liquid in the circuit, or to verify cleanliness of small bore pipe where video inspection is impossible or inadequate due to pipe dimension or configuration.

When using PAS method for cleaning or verification the procedure shall be repeated until cleanliness is acceptable.

The air shocking pressure shall never exceed the working pressure of the system and shall never be more than 8 bar. Safety precaution shall be taken when this method is used.

8.4 Pneumatic flushing

In cases where water is not desirable in the piping system (e.g. instrument/utility air), flushing by pressurised air or PAS shall be carried out. When pressurised air is used, the minimum velocity shall be 35m/s. Procedure covering all safety aspects shall be established.

9 PRESSURE TESTS

9.1 General

The test pressure shall, unless otherwise specified, be in accordance with ASME B31.3.

Testing shall not take place with system temperatures 4°C or less or where the ambient temperature during test falls by 5°C or more, nor during rain or fog unless under suitable cover. Hydrostatic pressure test may however be performed under a lower temperature with a proper frost preventive added to the test water.

The following are excluded from pressure tests:

- All small bore instrument control piping downstream of the first piping block valve.
- Open drains and vents to atmosphere (leak test only).

For alternative testing of tie-in welds, see annex A.

9.2 Test preparation

Pressure, temperature and time recorders shall be used for all hydrostatic tests. The pressure shall be shown in barg. Pressure gauges and recorders used to indicate and record test pressure shall be dead weight tested for accuracy according to a procedure, dependent of type of equipment.

Minimum of one gauge shall be positioned at the highest point and one recorder to be positioned at the lowest point. Accuracy of pressure gauge shall be at least 1-2% at full scale and 1-2% for the recorder. The test pressure shall be within 60% of the gauge range (20% from top and 20% from bottom).

If there is a deviation of more than 2% between gauge and recorder during test, the test shall be stopped and the equipment recalibrated.

Piping joints and welds shall not be insulated or physically covered until satisfactory completion of testing in accordance with this specification, except for painting of prefabricated welds.

All piping shall be adequately supported before the pressure test. Spring or other variable type supports shall be blocked to prevent movement.

Unless otherwise noted, all valves are to be through body tested. First block valve for pressure instruments shall be included in the test.

Piping containing check valves shall have the source of test pressure on the upstream side. If this is not possible, the check valve disc shall be removed or jacked open.

Ball valves shall be pressure tested in the half open position. Other valves shall be tested in the fully open position.

Where the test pressure to be applied to the piping is greater than the maximum allowable test pressure for valves, the valves shall be blinded off on the side to be tested, or removed and replaced by dummy spools.

Turbines, pumps, compressors and vessels shall be blinded off prior to pressure testing.

A list shall be prepared for sensitive equipment that shall be removed, blocked off or isolated during testing, such as relief valves, inline instruments, turbines, pumps, compressors and vessels. This list shall be a part of the test procedure.

9.3 Test media

For hydrostatic testing the test medium shall in general be fresh water, except that other suitable liquid may be used if:

- The piping or inline equipment would be adversely affected by water.
- If the liquid is flammable, its flash point shall be at least 49°C and consideration shall be given to the environment.
- The liquid is approved to be used.

The chloride ion content of the water used for pressure testing stainless steel lines shall be less than 200ppm and the line shall be properly drained soon after testing. Ph value of the water shall be between 6.5 and 7.5.

Carbon steel systems as defined in table 1, annex B shall be tested with an acceptable preservation fluid. The preservation fluid shall be water impellent and emulsifiable rust preventives lubricating oils that contain detergents and inhibitors that have been specially formulated to prevent rust.

For pneumatic testing, the test media shall be oil free, dry air or any inert gas. The use of air for testing shall be limited to a maximum pressure of 7.0 barg. Above this pressure nitrogen shall be used. The extent of pneumatic testing shall be approved.

For instrument/utility air systems, where the introduction of water is undesirable, test media shall be air or inert gas.

9.4 Hydrostatic testing

The test pressure shall be maintained for a sufficient length of time to permit visual examination to be made of all surfaces, welds and connections, but not less than thirty minutes. A one hour test duration shall apply for piping systems with pressure rating class 600# and above. Care shall be taken to ensure that overpressuring due to static head does not take place.

The piping systems shall not show any sign of plastic deformation or leakage.

9.5 Pneumatic testing

The sequence of test pressuring installed systems shall be as follows:

- A pressure of 0.5 barg shall be introduced in the system and a leak test performed. The pressure shall gradually be increased to 50% of the specified test pressure and kept for minimum 10 minutes to equalise strain.
- The pressure shall then be increased in steps of 10% of the specified test pressure, until the specified test pressure is reached. At each step, the pressure shall be kept for 10 minutes minimum to equalise strain.
- The specified test pressure shall be kept for one hour. The pressure shall then be reduced to the design pressure before examining for leakage.

The piping systems shall not show any sign of plastic deformation or leakage.

9.6 After completion of test

The tested systems shall be depressurised by opening the depressurising valve in the test rig. After depressurisation, all vents and low point drain valves shall be opened and the system shall be thoroughly drained where the test medium is water. Where required, blowing by dry air or Pressurised Air Shock Blowing to remove any trapped water to be performed.

Systems with drying requirement as defined in table 1, annex B shall be dried out after hydrotesting with dry oil free air with a dew point of -10°C . Drying can be terminated when the dew point at the outlet is equal to the dew point at the inlet.

Other methods, such as vacuum drying or air shocking, may also be used if the same dryness can be documented.

Requirement for drying as defined in table 2, annex C shall take in to consideration the time for start up of system. If more than 3 months to commissioning, drying shall be followed by preservation with nitrogen to keep the pipe system completely dry and to avoid condense. Other alternatives are subject to agreement.

Reinstallation of the system shall be performed in accordance with the test procedure.

Where permanent or temporary strainers have remained in place for the hydrostatic pressure test, they shall be removed following the test and thoroughly cleaned before reinstalling.

Ends of pipes and nozzles shall be fully protected against the ingress of foreign material by the use of caps, plugs or plate blinds sealed with gaskets. These shall not be removed until just prior to final assembly.

Flange parallelity and alignment to equipment shall be checked prior to reinstatement.

Vent holes in reinforcing pads shall be sealed upon completion of pressure test.

9.7 Verification of cleanliness

All systems shall be internal visual inspected for acceptable cleanliness by spot check. Internal visual inspection includes the use of Boroscope, video etc.

If pipe configuration in critical parts of systems as defined in table 1, annex B is too complicated for visual inspection, the PAS method or other suitable methods shall be used for verification of cleanliness.

10 CHEMICAL CLEANING

Lines to be chemical cleaned shall be identified on the P&ID's and Line Index.

For system overview see table 1, annex B.

A procedure shall describe in detail the steps for chemical cleaning.

Chemical cleaning shall include:

- Degassing.
- Chemical cleaning/descaling.
- Neutralisation.
- Passivation.
- Water flushing.
- Drying.

The end result shall be a clean smooth surface.

Maximum temperatures used during these operations shall not exceed maximum design temperature for the systems as listed in the Line Index.

For equipment such as turbines, generators, pumps and compressors, the piping to be cleaned shall have all sensitive items that can be damaged by the cleaning medium removed or blanked off.

Generally, the following items shall not be chemically cleaned (items shall be identified on chemical cleaning iso):

- All instrument tubing downstream the first piping block valve.
- Piping systems with copper alloy materials.
- Flexible hoses.
- Vessels.
- Exchangers.
- Pumps.
- All bolted/screwed valves and instruments.

Removed or blanked off items shall be cleaned separately prior to reinstallation.

The systems to be cleaned shall have high and low point vents and drains installed. "Dead legs" shall be avoided.

Cleaning shall be carried out after pressure testing unless otherwise specified.

If more than 3 months to start up of commissioning activities, system shall be preserved with nitrogen. Overpressure shall be 0.5 bar.

11 HOT OIL FLUSHING

11.1 General

Required cleanliness for systems subject to hot oil flushing shall be in accordance with table 1, annex B.

A detailed procedure for hot oil flushing shall be developed out prior to start.

Filters used for hot oil flushing shall be:

- 3 μ m ABS for hydraulic systems.
- \leq 10 μ m ABS for lube and seal oil.

Filling of lubricant oil shall take place through filters with 10 μ m ABS.

Flushing and sampling to verify cleanness shall take place at turbulent flow, upstream any filters.

The Reynolds number shall be min. 4000.

The level of cleanness shall be documented from an automatic particle counter or a membrane checked in a microscope before a flushing operation is considered finalised.

A flowmeter shall be installed to verify flow used during flushing operation.

Maximum water content in oil used for flushing shall be less than 500ppm.

11.2 Marking

Piping spools or systems that have been chemical cleaned or hot oil flushed shall be marked in a unique manner.

11.3 Documentation

The compliance to specified ISO 4406 requirements shall be documented by relevant laboratory analysis certificates or other acceptable methods.

12 SYSTEM COLOUR CODING OF PIPING

12.1 Purpose

In addition to line-numbering, the purpose of having a system for colour coding of piping is to ensure quick recognition of medium and flow direction for any system.

12.2 Types of markers

12.2.1 *All piping*

One out of two types of markers shall be used.

- Plastic tape glued to the pipe surface. The required text shall appear in an arrow shaped window.
- Laminated plastic signs, fastened to the pipes by plastic straps and locks. The required text shall appear in an arrow shaped window.

12.2.2 *Insulated lines*

On insulated lines with hidden electrical tracing additional marking band to be according to I-CR-003.

12.2.3 *Plastic/rubber lined piping*

In addition to the markings mentioned here each spool of all plastic or rubber lined piping shall be marked with the warning "Ikke sveis, innvendig belagt". The warning shall be with red letters on a white background.

12.2.4 *Obstructions*

The warning tape shall be yellow with black diagonal stripes. This tape is used in conjunction with a standard marker to indicate special precaution requirements.

12.3 Marker texts

The text shall be in letters and figures of minimum height of 7mm, but size may be adjusted to fit all required information within the arrow. Max. no. of letters in each line = 18; longer words to be abbreviated. Maximum 2 lines can be used. On laminated plastic signs, the size of the letters is to be adjusted to fit the size of the sign.

The marking shall be with Norwegian text only. Exception is potable water, which shall have both Norwegian and English text, thus: "Drikkevann/Potable Water".

12.4 Material of markers

Materials for tape adhesive, text strips or laminated signs with straps shall be polyethylene, polypropylene or PVC. These signs must be resistive for humidity, UV-radiation and temperature changes.

12.4.1 *Tape*

The tape requirements are:

- The tape shall be 160mm wide and made from a suitable plastic film on which the colour is printed on the reverse (adhesive) side in such a way that the printing colour is protected against mechanical and chemical attacks by the plastic film.
- Adhesive tape must not be used on stainless steel and high alloyed materials. Laminated signs as specified in clause 12.4.2 shall be used for all sizes.

- Consideration must be given when determining the length of tape, e.g. "insulation thicknesses", reference shall be made to P&IDs, line index, isometrics and insulation specification. All types must have a 50mm overlap at joints.

12.4.2 Laminated signs

Laminated plastic signs shall be used instead of tape markers in the following instances:

- On all pipes sizes 5" and above in exposed areas.
- On all pipe sizes 18" and above in sheltered areas.
- On all pipe sizes for stainless steel and high alloy materials.

The sizes of the coloured area of signs shall be as follows:

Small pipes below 3/4"	: Size no. 0	(6x15.5cm)
Pipe size 1"-8"	: Size no. 1	(10x15.5cm)
Pipe size 10"-16"	: Size no. 2	(17x30.5cm)
Pipe size 18" and above	: Size no. 3	(26x44cm)

The signs shall be fastened to the bare pipe or over insulated pipe by means of non metallic strapping with a width proportionate to the size of the sign.

The laminated tag shall be soft/elastic in -5°C. Bending tests shall be documented. Minimum bending radius is 10-12 times the thickness of the tag (minimum thickness is 0.9mm).

12.5 Positioning of markers

The length of tape shall extend all the way around the pipe and overlap min. 50mm on itself. On pipes with a surface temperature of more than 60°C, suitable insulation must be used between the identification tape and the pipe surface.

Markers are to be applied with the arrow pointing in the direction of flow. The following special application rules shall be followed:

- Markers shall be positioned specially considering operational aspects of the plant, and shall be easily readable from ground, platform or ordinary access road. Ladders, scaffolding or other temporary equipment shall not be needed for identification of markers.
- A marker is to be placed at each branching point.
- A marker is to be placed on each side of bulkheads, decks and other penetration points.
- A marker shall be positioned on the pipe close to major components of the actual system (vessel, pumps, etc.). (Markers are not required next to each and every valve or pump etc. of a system comprising several identical components adjacent to each other).
- Maximum spacing between markers shall not exceed 10m.
- Special locations as specified.
- Marker shall be positioned by inlet and outlet of process train.
- On elevated pipes, markers shall be positioned adjacent to stairways and platforms.
- Markers shall be positioned at end of piperack.
- To ensure no mistakes in marking, a separate inspection team to control the quality of the job shall be arranged.

12.6 Fluid description/colour code tabulation

Colour coding shall be in accordance with NS 813 (Piping Systems. Identification colours for the content) and NS 4054 (Colour for identification). A detailed coding for systems within oil and gas production is given in NORSOK Z-DP-002, Coding system.

12.7 Colour coding information.

The platform shall have a complete chart (size to be A2) of the colour coding used, signposted approximately 165cm above deck level on the right/left hand side when entering a door to an area, or in other strategically located positions.

ANNEX A ALTERNATIVE TEST METHODS

A.1 SCOPE

This annex defines the alternative test options and methods that may be applied to replace the pressure test requirement for closure welds in hookup spools, and for minor changes and addition in piping system which have already been hydrostatically tested.

A.2 GENERAL

All installed piping shall have been pressure tested at the test conditions and medium as specified in accordance with the requirements laid down in ASME B31.3 Chemical Plant and Petroleum Refinery Piping and this standard.

All integral welds in a hook-up spool shall have been previously pressure tested. Prior to any alternative testing taking place, acceptance shall be obtained.

If allowable stress exceeds 70% of yield, there are no alternative to hydrostatic test.

A.3 ALTERNATIVE TESTING METHOD

In all cases where pressure testing of hook-up spools welds and any minor changes or additions to the piping system will entail an extensive retest, the closure/minor welds may be alternatively tested to the stipulations of this document without being subjected to any leak test requirements.

The qualification of a weld by alternative testing falls into two categories which are determined by service/pressure.

These are as follows:

Alternative I All hook-up spool closure welds and any minor change/additional welds shall be NDE tested in accordance with ASME-B31.3 Para 345.1(a) and visually inspected. Welding and Inspection standard.(M-CR-621). NDE shall not be less than specified in welding and inspection standard (M-CR-621).

Alternative II All hook-up spool closure welds and any minor change/additional welds shall be subject to 100% - radiography, and 100% MPI or dye penetrant as applicable to material. NDE shall not be less than specified in Welding and Inspection standard (M-CR-621).

The above alternatives are clearly depicted in clause A.5 which shall be used as a guideline to define the acceptable alternative testing method.

A.4 DOCUMENTATION

All alternative testing shall be documented with full traceability to the applicable welds.

A.5 ALTERNATIVE TEST MATRIX

Fluids	Alternative Test Method Note (1)
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Normal fluid service (as defined in ASME B31.3).	II
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Category D fluid service (as defined in ASME B31.3).	I
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Note 1: See description clause A3.

ANNEX B REQUIREMENTS FOR INTERNAL TREATMENT OF PIPING AFTER PREFAB AND INSTALLATION BEFORE COMMISSIONING (TABLE 1)

Table 1 Requirements for internal treatment of piping after prefab and installation before commissioning

SYSTEM	SYSTEM DESCRIPTION	PIPE MATR.	FLUSH WATER/AIR	TEST W/ PRESERV. FLUID YES/NO	CHEM. CLEAN.	DRYING	PRESER-VATION	FINAL CLEANING/ REQUIRED CLEANLINESS	REMARKS
10	DRILLING SYSTEMS	C.S	WATER	YES	NO	NO	NORMAL	NO FOREIGN MATERIALS	
11	DRILLING PROCESS SYSTEMS	C.S	WATER	YES	NO	NO	NORMAL	NO FOREIGN MATERIALS	
12	DRILLING WELLCONTROL SYSTEMS	C.S	WATER	YES	NO	NO	NORMAL	NO FOREIGN MATERIALS	
		SSTL	WATER	NO	NO	NO	NORMAL	NO FOREIGN MATERIALS	
13	RISER AND WELL SYSTEM-TOPSIDE	C.S	WATER	YES	NO	NO	NORMAL	NO FOREIGN MATERIALS	
		SSTL	WATER	NO	NO	NO	NORMAL	NO FOREIGN MATERIALS	
15	WELL RELATED PRODUCTION SYSTEMS TOPSIDE	C.S	WATER	YES	NO	NO	NORMAL	NO FOREIGN MATERIALS	
		SSTL	WATER	NO	NO	NO	NORMAL	NO FOREIGN MATERIALS	
16	GAS AND WATER INJECTION WELL SYSTEM TOPSIDE	SSTL	WATER	NO	NO	NO	NORMAL	NO FOREIGN MATERIALS	
20	SEPARATION AND STABILIZATION	C.S	WATER	YES	NO	NO	NORMAL	NO FOREIGN MATERIALS	
		SSTL	WATER	NO	NO	NO	NORMAL	NO FOREIGN MATERIALS	

SYSTEM	SYSTEM DESCRIPTION	PIPE MATR.	FLUSH WATER/AIR	TEST W/ PRESERV. FLUID YES/NO	CHEM. CLEAN.	DRYING	PRESER-VATION	FINAL CLEANING/ REQUIRED CLEANLINESS	REMARKS
21	CRUDE HANDLING	C.S	WATER	YES	NO	NO	NORMAL	NO FOREIGN MATERIALS	
		SSTL	WATER	NO	NO	NO	NORMAL	NO FOREIGN MATERIALS	
23	GAS RECOMPRESSION, COOLING AND SCRUBBING								
23-10	GAS COOLING AND SCRUBBING	C.S	WATER	YES	NO	NO	NORMAL	NO FOREIGN MATERIALS	
23-10	GAS COOLING AND SCRUBBING	SSTL	WATER	NO	NO	NO	NORMAL	NO FOREIGN MATERIALS	
23-20	GAS RECOMPRESSION	C.S	WATER	NO	ACC. TO P&ID	YES	SEE NOTE 4	ISO 4406,17/14	(100% visual insp. on suction side of compressor).
23-20	If no chem.cleaning req.	C.S	WATER	YES	NO	YES	NORMAL	NO FOREIGN MATERIALS	
23-20	GAS RECOMPRESSION	SSTL	WATER	NO	ACC.TO P&ID	YES	SEE NOTE 4	ISO 4406,17/14	(100% visual insp. on suction side of compressor).
23-20	If no chem.cleaning req.	SSTL	WATER	NO	NO	YES	NORMAL	NO FOREIGN MATERIALS	
24	GAS TREATMENT								
24-10	GAS COOLING AND SCRUBBING	C.S	WATER	YES	NO	NO	NORMAL	NO FOREIGN MATERIALS	
24-10	GAS COOLING AND SCRUBBING	SSTL	WATER	NO	NO	NO	NORMAL	NO FOREIGN MATERIALS	
24-20/30	GAS DEHYDRATION/ REGENERATION	C.S	WATER	NO	NO	NO	NORMAL	NO FOREIGN MATERIALS	
24-20/30	GAS DEHYDRATION/ REGENERATION	SSTL	WATER	NO	NO	NO	NORMAL	NO FOREIGN MATERIALS	
26	GAS REINJECTION TO RESERVOIR								

SYSTEM	SYSTEM DESCRIPTION	PIPE MATR.	FLUSH WATER/AIR	TEST W/ PRESERV. FLUID YES/NO	CHEM. CLEAN.	DRYING	PRESER-VATION	FINAL CLEANING/ REQUIRED CLEANLINESS	REMARKS
26-10/30	REINJECTION GAS COOLING AND SCRUBBING / REINJECTION MANIFOLD	C.S	WATER	YES	NO	NO	NORMAL	NO FOREIGN MATERIALS	
26-10/30	REINJECTION GAS COOLING AND SCRUBBING / REINJECTION MANIFOLD	SSTL	WATER	NO	NO	NO	NORMAL	NO FOREIGN MATERIALS	
26-20	REINJECTION GAS COMPRESSION	C.S	WATER	NO	ACC.TO P&ID	YES	SEE NOTE 4	ISO4406,17/14	(100% visual insp. on suction side of compressor)
26-20	If no chem.cleaning req.	C.S	WATER	YES	NO	NO	NORMAL	NO FOREIGN MATERIALS	
26-20	REINJECTION GAS COMPRESSION	SSTL	WATER	NO	ACC.TO P&ID	YES	SEE NOTE 4	ISO4406,17/14	(100% visual insp. on suction side of compressor)
26-20	If no chem. cleaning req.	SSTL	WATER	NO	NO	YES	NORMAL	NO FOREIGN MATERIALS	
27	GAS PIPELINE COMPRESSION, MEETERING AND TRANSFER								
27-10	GAS COOLING AND SCRUBBING	C.S	WATER	YES	NO	NO	NORMAL	NO FOREIGN MATERIALS	
27-10	GAS COOLING AND SCRUBBING	SSTL	WATER	NO	NO	NO	NORMAL	NO FOREIGN MATERIALS	
27-20/30	GAS PIPELINE COMPRESSION / GAS METERING	C.S	WATER	NO	ACC. TO P&ID	YES	SEE NOTE 4	ISO 4406,17/14	(100% visual insp. on suction side of compressor)
27-20/30	If no chem. cleaning req.	C.S	WATER	YES	NO	YES	NORMAL	FOREIGN MAT.	
27-20/30	GAS PIPELINE COMPRESSION / GAS METERING	SSTL	WATER	NO	ACC.TO P&ID	YES	SEE NOTE 4	ISO 4406,17/14	(100% visual insp. on suction side of compressor)
27-20/30	If no chem. cleaning req.	SSTL	WATER	NO	NO	YES	NORMAL	NO FOREIGN MATERIALS	
28	GAS SWEETENING	SSTL	WATER	NO	NO	NO	NORMAL	NO FOREIGN MATERIALS	

SYSTEM	SYSTEM DESCRIPTION	PIPE MATR.	FLUSH WATER/AIR	TEST W/ PRESERV. FLUID YES/NO	CHEM. CLEAN.	DRYING	PRESER-VATION	FINAL CLEANING/ REQUIRED CLEANLINESS	REMARKS
30	OIL PIPELINE,EXPORT STABILIZED OIL-Upstream of Piglauncher	C.S	WATER	YES	NO	NO	NORMAL	NO FOREIGN MATERIALS	
		SSTL	WATER	NO	NO	NO	NORMAL	NO FOREIGN MATERIALS	
31	CONDENSATE EXPORT PIPELINE-Upstream of Piglauncher	C.S	WATER	YES	NO	NO	NORMAL	NO FOREIGN MATERIALS	
		SSTL	WATER	NO	NO	NO	NORMAL	NO FOREIGN MATERIALS	
32	GAS EXPORT PIPELINE-Upstream of Piglauncher	C.S	WATER	YES	NO	NO	NORMAL	NO FOREIGN MATERIALS	
		SSTL	WATER	NO	NO	NO	NORMAL	NO FOREIGN MATERIALS	
34	WATER PIPELINE HIGH PRESSURE-Upstream of Piglauncher	SSTL	WATER	NO	NO	NO	NORMAL	NO FOREIGN MATERIALS	
35	METHANOL PIPELINE-Upstream of Piglauncher	C.S	WATER	YES	NO	NO	NORMAL	NO FOREIGN MATERIALS	
		SSTL	WATER	NO	NO	NO	NORMAL	NO FOREIGN MATERIALS	
36	PIPELINE WELLSTREAM,MULTIPHASE-Upstream of Piglauncher	C.S	WATER	YES	NO	NO	NORMAL	NO FOREIGN MATERIALS	
		SSTL	WATER	NO	NO	NO	NORMAL	NO FOREIGN MATERIALS	
40	COOLING MEDIUM AND REFRIGERATION SYSTEM	C.S	WATER	YES	NO	NO	NORMAL	NO FOREIGN MATERIALS	
		SSTL	WATER	NO	NO	NO	NORMAL	NO FOREIGN MATERIALS	
41	HEATING MEDIUM SYSTEM	C.S	WATER	YES	NO	NO	NORMAL (See	NO FOREIGN MATERIALS	Acceptable preserv, fluid to avoid blockage of heating unit.

SYSTEM	SYSTEM DESCRIPTION	PIPE MATR.	FLUSH WATER/AIR	TEST W/ PRESERV. FLUID YES/NO	CHEM. CLEAN.	DRYING	PRESER- VATION	FINAL CLEANING/ REQUIRED CLEANLINESS	REMARKS
							remarks)		
		SSTL	WATER	NO	NO	NO	NORMAL	NO FOREIGN MATERIALS	
42	CHEMICAL INJECTION SYSTEM	SSTL	WATER	NO	NO	NO	NORMAL	NO FOREIGN MATERIALS	
43	FLARE, VENT AND BLOW-DOWN SYSTEMS	C.S	AIR/N2	N/A	NO	N/A	NORMAL	NO FOREIGN MATERIALS	
		SSTL	AIR/N2	N/A	NO	N/A	NORMAL	NO FOREIGN MATERIALS	
44	OILY WATER TREATMENT	SSTL	WATER	NO	NO	NO	NORMAL	NO FOREIGN MATERIALS	
45	FUEL GAS	C.S	WATER	NO	ACC.TO P&ID	YES	SEE NOTE 4	ISO 4406,17/14	
		SSTL	WATER	NO	ACC.TO P&ID	YES	SEE NOTE 4	ISO 4406,17/14	
50	SEAWATER SYSTEMS (LOW TO MEDIUM PRESSURE)	SSTL	WATER	NO	NO	NO	NORMAL	NO FOREIGN MATERIALS	
51	SEAWATER SYSTEMS (HIGH PRESSURE)	SSTL	WATER	NO	NO	NO	NORMAL	NO FOREIGN MATERIALS	
52	BALLAST SYSTEMS	C.S	WATER	YES	NO	NO	NORMAL	NO FOREIGN MATERIALS	
		SSTL	WATER	NO	NO	NO	NORMAL	NO FOREIGN MATERIALS	
53	FRESH WATER SYSTEM	SSTL	WATER	NO	NO	NO	NORMAL	NO FOREIGN MATERIALS	
55	STEAM, CONDENSATE AND HOT WATER SYSTEM	C.S	WATER	YES	NO	NO	NORMAL	NO FOREIGN MATERIALS	

SYSTEM	SYSTEM DESCRIPTION	PIPE MATR.	FLUSH WATER/AIR	TEST W/ PRESERV. FLUID YES/NO	CHEM. CLEAN.	DRYING	PRESER-VATION	FINAL CLEANING/ REQUIRED CLEANLINESS	REMARKS
		SSTL	WATER	NO	NO	NO	NORMAL	NO FOREIGN MATERIALS	
56	OPEN DRAIN SYSTEM	C.S	WATER	NO	NO	NO	NORMAL	NO FOREIGN MATERIALS	
57	CLOSED DRAIN SYSTEM	C.S	WATER	NO	NO	NO	NORMAL	NO FOREIGN MATERIALS	
60	DRY AND WET BULK LOADING	C.S	WATER	YES	NO	NO	NORMAL	NO FOREIGN MATERIALS	
		SSTL	WATER	NO	NO	NO	NORMAL	NO FOREIGN MATERIALS	
61	JET FUEL SYSTEM	SSTL	WATER	NO	ACC.TO P&ID	YES	LIQUID FILLED	ISO 4406 17/14	
62	DIESEL OIL SYSTEM	C.S	WATER	YES	NO	NO	NORMAL	NO FOREIGN MATERIALS	
		SSTL	WATER	NO	NO	NO	NORMAL	NO FOREIGN MATERIALS	
63	COMPRESSED AIR SYSTEM	SSTL	AIR/N2	N/A	NO	N/A	NORMAL	NO FOREIGN MATERIALS	
64	INERT PURGE SYSTEM	SSTL	AIR/N2	N/A	NO	N/A	NORMAL	NO FOREIGN MATERIALS	
65	HYDRAULIC POWER SYSTEM	SSTL	WATER	NO	ACC.TO P&ID	YES	LIQUID FILLED	HOT OIL FLUSH ISO 4406 15/12	
66	SEWAGE TREATMENT	C.S	WATER	YES	NO	NO	NORMAL	NO FOREIGN MATERIALS	
		SSTL	WATER	NO	NO	NO	NORMAL	NO FOREIGN MATERIALS	
70	FIRE AND GAS DETECTION	SSTL	WATER	NO	NO	NO	NORMAL	NO FOREIGN MATERIALS	
71	FIRE WATER SYSTEM	SSTL	WATER	NO	NO	NO	NORMAL	NO FOREIGN MATERIALS	

SYSTEM	SYSTEM DESCRIPTION	PIPE MATR.	FLUSH WATER/AIR	TEST W/PRESERV. FLUID YES/NO	CHEM. CLEAN.	DRYING	PRESERVATION	FINAL CLEANING/REQUIRED CLEANLINESS	REMARKS
72	MISCELLANEOUS FIRE FIGHTING SYSTEMS	SSTL	WATER	NO	NO	NO	NORMAL	NO FOREIGN MATERIALS	
77	HEATING AND VENTILATION	SSTL	WATER	NO	NO	NO	NORMAL	NO FOREIGN MATERIALS	
	LUBE OIL SYSTEM	SSTL	WATER	NO	ACC.TO P&ID	YES	LIQUID FILLED	HOT OIL FLUSH ISO 4406 17/14	
	SEAL OIL SYSTEM	SSTL	WATER	NO	ACC.TO P&ID	YES	LIQUID FILLED	HOT OIL FLUSH ISO 4406 16/13	
	SEAL GAS SYSTEM	SSTL	WATER	NO	ACC.TO P&ID	YES	SEE NOTE 4	ISO 4406 15/12	

Notes:

1. SSTL means 316, 6MO, duplex etc.
2. Cleanliness to be verified by visual inspection.
3. If commissioning starts later than 3 months after internal treatment, drying, represervation with preservation fluid or other acceptable methods shall be considered. See also Note 4.
4. Where commissioning are later than 3 months after chemical cleaning, system shall be preserved with nitrogen, overpressure 0.5 bar. Other alternatives are subject to agreement.