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KLM Technology Group #03-12 Block Aronia, Jalan Sri Perkasa 2 Taman Tampoi Utama 81200 Johor Bahru Malaysia	PIPING FABRICATION, INSTALLATION, FLUSHING AND TESTING (PROJECT STANDARDS AND SPECIFICATIONS)	

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SCOPE

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

This Project Standard and Specification does not cover the following:

- all instrument control piping downstream of first piping block valve;
- subsea pipe work and risers;
- flexible hoses;
- GRP piping;
- marine systems in hulls of vessels and floating platforms and land based plants.

REFERENCES

Throughout this Standard the following dated and undated standards/codes are referred to. These referenced documents shall, to the extent specified herein, form a part of this standard. For dated references, the edition cited applies. The applicability of changes in dated references that occur after the cited date shall be mutually agreed upon by the Company and the Vendor. For undated references, the latest edition of the referenced documents (including any supplements and amendments) applies.

1. ASME B31.3 Process Piping
2. ASME B1.20.1 Pipe Threads, General purpose, Inch
3. ASME PCC2 Repair of Pressure Equipment and Piping
4. ASME VIII Boiler and Pressure Vessel Code, Section VIII – Rules for construction of Pressure Vessels, Division 1
5. API 6A API standard 6A
6. NS 813 Piping systems – Identification colours for the content
7. NS 4054 Colours for identification
8. ISO 4406 Hydraulic fluid power – Fluids – Method for coding the level of contamination by solid particles
9. ISO 9095 Steel tubes – Continuous character marking and colour coding for material identification
10. ASME PCC-1 Guidelines for Pressure Boundary Bolted Flange Joint Assembly
11. EN 1591 Flanges and their joints

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12. ISO 19900 Petroleum and natural gas industries – General requirements for offshore structures

SYMBOLS AND ABBREVIATIONS

<u>SYMBOL/ABBREVIATION</u>	<u>DESCRIPTION</u>
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
N ₂	nitrogen
N ₂ He	nitrogen helium
NCR	non conformance request
NDE	non destructive examination
NPT	National Pipe Thread Taper
O ₂	oxygen
OD	outside diameter
P&ID	pipng and instrument diagram
PAS	pressurised air shock blowing
PVC	polyester vinyl chloride
UV	ultra violet

MATERIALS

Color Marking of Materials

Color marking shall be according to ISO 9095.
If possible, gaskets shall be marked to be visible after installation.

Material Storage, Handling, Receiving and Identification Control

Procedures for off-loading, storage, receiving, control, traceability and inspection of piping material supplied for fabrication and installation shall be worked out.
In general, the following applies:

- storage of piping and piping equipment shall be under cover and protected against contact with the ground;

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- 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, beveled 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.

FABRICATION OF PIPEWORK

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 and shall be carried out according to documented procedures.

Welding and NDE

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.

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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.

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.

Dimensional Tolerances for Pre-Fabricated Piping Assemblies

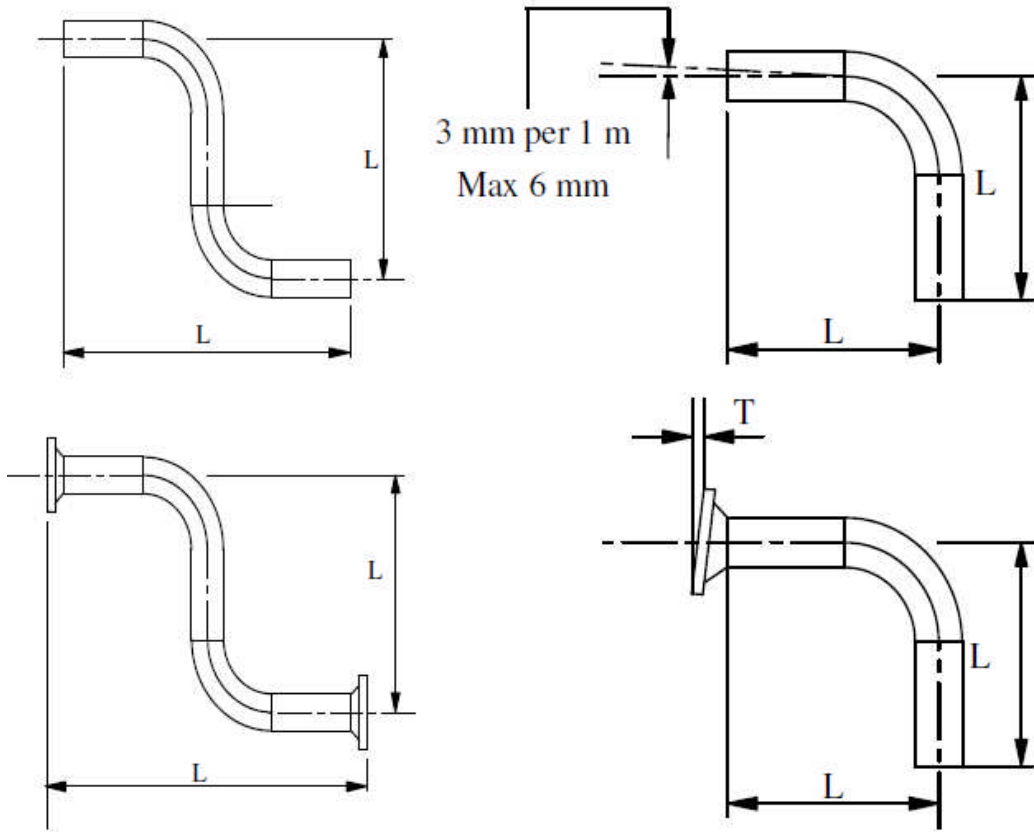
Dimensional control of prefabricated piping spools shall be performed in a systematic manner, assuring that the final installation will be correct. Prefabricated spools for offshore installation shall be 100 % dimensionally controlled. The tolerances on linear dimensions (intermediate or overall) are 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.

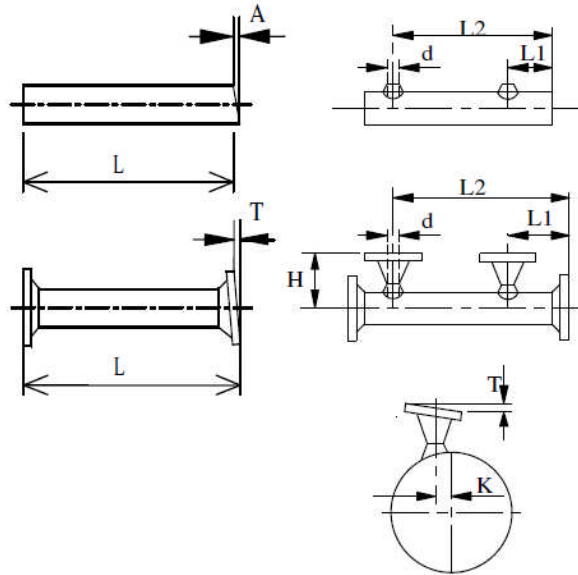
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L [m]	ΔL	T
Tolerances [mm]		
≤ 6	± 5	$\pm 1,5$
> 6	± 10	$\pm 1,5$

Figure 1 - Tolerances for prefabricated piping assemblies

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L [m]	L	A	T		2 in ≤ d ≤ 10 in	12 in ≤ d ≤ 20 in	d > 20 in
	Tolerances [mm]				Tolerances [mm]		
≤ 6	± 3	± 1,5	± 1,5	L1	± 3	± 5	± 5
> 6	± 5	± 1,5	± 1,5	L2	± 3	± 5	± 5
d = nominal diameter				H	± 3	± 3	± 3
				T	± 1,5	± 1,5	± 1,5
				K	± 2	± 3	± 3

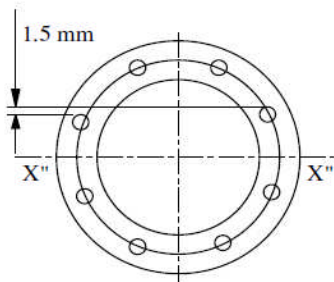


Figure 2 - Tolerances for prefabricated piping assemblies

Note:

- 1) Before reworking any spools contact engineering department in order to check complete isometric.
- 2) Cut to fit requirement to be stated on fabrication isometrics (typically 100 mm).
- 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.

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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 shall be according to ASME B31.3. Branch reinforcement pads or each segment thereof shall be provided with a minimum 3,0 mm drilled and tapped hole prior to fitting to the pipe, to ensure leak detection, venting and testing facilities. Whenever possible, pad should be made in one piece before fitting onto pipe. After welding and testing the hole shall be permanently plugged, e.g. welded or metal plug in piping material.

Pipe Flanges, Mechanical Hub and Clamp Coupling

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

INSTALLATION OF PIPING

Pipe work Erection

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

Pipe work 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. Tubing shall not be used inside walls or other enclosed compartments without access.

The weldolets shall be fully welded to the extent needed to conform with the design requirements in ASME B31.3. 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.

All valves shall be protected against ingress of dirt during any temporary storage.

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Flanged Joints

Before assembly, flanges shall not have any damage that will interfere with the integrity of the joint. The flanges shall be clean and free from any 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.

With the piping flange fitted and prior to bolting-up the joint, the following 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.

Compact flange heel are one of two sealing surfaces and are vulnerable to damage from corrosion and rough handling and need special attention. For work on flanges, OLF guideline 118 gives a practical view on flange work.

Strain sensitive equipment with 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. Unacceptable forces transferred on to the nozzles shall be prevented.

To achieve this true alignment, full advantage shall be taken of the 'cut to fit' allowances and loose flanges provided. In general, flange connections to strain sensitive equipment shall be the last connection made on completion of a line or interconnecting system of lines.

Connections to strain sensitive equipment shall always be subject to stress analysis with true misalignment.

As a minimum the following shall be evaluated:

- the stiffness of the system;
- sufficient tightening force for flange connections;
- allowable nozzle loads for the equipment.

With the piping flange fitted and prior to bolting-up the joint, the tolerances shown in Figure 3 shall be maintained.

Maximum angular misalignment: