



Exploration & Production

GENERAL SPECIFICATION

PIPELINES - RISERS

GS EP PLR 405

Design and installation of hot tapping on subsea pipelines

03	10/08	Extension to all subsea pipelines
02	10/05	Addition of "EP" root to GS identification
01	10/03	Change of Group name and logo
00	02/01	First issue
Rev.	Date	Notes

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1. Scope

This specification covers the recommended practices and minimum requirements to perform a hot tap operation by divers onto a subsea carrier pipeline.

2. Reference documents

The reference documents listed below form an integral part of this General Specification. Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the EFFECTIVE DATE of the CONTRACT.

Where national regulations exist, their provisions and those of the standards and codes to which they refer shall apply, supplementing or amending the provisions of this document.

If there are no national regulations covering all or part of the subject of this document, the reference documents shall be strictly applied, as supplemented by the provisions of this document.

Only the main reference documents are mentioned. Compliance with all secondary reference documents dealing with the subject of this document must be done.

Unless otherwise indicated in the detailed contractual conditions, all the reference documents to be used, as well as their supplements shall be the latest editions.

Standards

Reference	Title
API SPEC 5L	Specification for Line Pipe
ASME B 16.34	Valves - Flanged and Butt welding End
ASME B 31.3	Refinery piping
ASME B 31.4	Pipeline Transportation Systems for liquid Hydrocarbons and Other Liquids
ASME B 31.8	Gas Transmission and Distribution Piping Systems
BS 8010 part 3	Pipeline subsea: design, construction and installation
BS 4515	Welding of Steel Pipeline on land and Offshore
DIN 17102	Specification for Material
ISO 13623	Petroleum and Natural gas Industries- Pipeline Transportation Systems

Professional Documents

Reference	Title
DNV	Rules for Planning and Execution of Marine Operations
EEMUA 185	Guide for Hot Tapping on Piping and Other Equipment
API RP 2201	Procedure for Welding or Hot Tapping on Equipment in Service
API STD 1104	Standard for Welding Pipelines and Related Facilities

Regulations

Reference	Title
Not applicable	

Codes

Reference	Title
Not applicable	

Other documents

Reference	Title
NORSOK Standard U-001	Subsea Production Systems

Total General Specifications

Reference	Title
GS EP PVV 142	Valves

3. Design

3.1 Branch connection design and arrangement

3.1.1 Design data

As a minimum, the following data are required in order to design the branch connection:

- Process data (Operating and design pressures and temperatures, nature of the fluid, Low Explosivity Level (LEL), etc.)
- Location of the hot tap
- Actual wall thickness of the pipe at the location of the hot tap
- Line pipe material designation and characteristics

- Mechanical data (nominal thickness, diameter, corrosion allowance, etc.)
- Information relative to the pipeline configuration (curve, free spanning, etc.) where residual laying stress could be expected.

3.1.2 Tie-in arrangement

The tie in welding arrangement shall be designed as shown on the figure 1 attached in Appendix 1.

3.1.3 General welding requirements

The general welding requirements listed hereafter shall be adhered to:

- Hot tap tee branch located at the 12 o'clock position
- The branch weld shall be a full penetration weld onto a buttering layer
- A fillet weld between the reinforcing saddle and the branch nipple
- Two longitudinal seam welds on the reinforcing saddle half shells shall incorporate backing strips
- Circumferential fillet welds have not to be performed at the reinforcing saddle extremities to seal the pipeline to the sleeve annulus. This sealing can however be performed using approved Retrowrap system impregnated with an Amojel gel type or equivalent anti corrosion product. The Retrowrap system or similar shall be applied in a dry environment to prevent bacterial and crevice corrosion taking place between pipeline and saddle. The sleeves shall be designed to be effective for the duration of the design life of the pipeline. Retrowrap installation guidelines and Amojel data sheets are in Appendix 2.

3.1.4 Wall thickness requirement

The branch pipe wall thickness shall be sufficient to ensure that the governing Pipeline Code allowable stress criteria are satisfied under the design loads. [ASME B 31.8](#) Appendix E Stress intensification factors for in-plane out-of-plane bending shall be applied in the stress calculations.

3.2 Finite Element Analysis

A 3D Finite Element Analysis (FEA) of the as-designed hot tap connection shall be carried out to determine the test pressure required, prior to trepanning, to verify the integrity of the full penetration branch weld. The analysis shall verify that the pressure determined will not create over stress in the complete welded assembly or buckling of the mother pipeline wall.

The analysis shall also take into consideration the following parameters:

- Pressure in the line at the time of the offshore operation
- Components shape and dimensions
- Existing pipeline as built dimensions (ovality, wall thickness, etc.)
- Pipeline/branch/saddle dimensional tolerances that affect the fit between the saddle and the pipeline/branch. If appropriate, the effect of injecting epoxy resin grout or similar into the annulus between the saddle and the pipeline/branch shall be determined
- Misalignment due to welding tolerances

- Welding procedures
- Mechanical characteristics of the welded components.

The FE model shall be validated by an hydrotest on a trial arrangement during onshore prequalification tests. During this test, calibrated strain gauges shall be located at appropriate locations on the trial piece in order to confirm the correlation between computer model and actual findings. Strain gauges shall be cycled to ensure they are calibrated.

The FE analysis of the hot tap branch shall be performed using an industry recognised software program such as ANSYS, ABAQUS or ALGOR.

3.3 Material and components selection

3.3.1 Branch nipple

The branch nipple material grade shall be the same as the pipeline's in order to minimise the size of the hyperbaric welds.

The branch butt to mother pipe shall be bevelled to allow full penetration weld onto the pipeline buttering layer.

3.3.2 Reinforcing Saddle

The design of the reinforcing saddle shall be in accordance with the "Replacement area method" for the reinforcement of welded branch connections given in the [ASME B 31.8](#) Code: Gas transmission and distribution piping systems.

When there is no requirement for resin injection, the reinforcing saddle shall be manufactured in order to minimise the gap/void between the pipeline and saddle to be no greater than 2 mm. An equivalent specification such as [DIN 17102](#) may be used.

The material grade shall be selected to offer the nearest characteristics and chemical composition possible to the pipeline material.

The branch reinforcement shall be full encirclement with a two or three piece saddle fabricated to meet the pipeline and branch installation tolerances at the selected tie-in location.

3.4 Hyperbaric welding

Hyperbaric welding shall be in accordance with Total particular project specification for hyperbaric welding or if not applicable, [BS 4515](#) Annex A shall be followed.

In case of Welding Heat Treatment (WHT) requirement and if heat losses are such that heating mattresses are not suitable, electromagnetic induction heating can be used on live pipelines to maintain the specified range of temperature required during the welding process.

3.5 Protection structure

The protection structure shall be designed to protect the subsea equipment from the following possible sources of damage:

- Dropped objects
- When the subsea facilities are located in a region where fishing activities are taking place, fishing gears (trawlers) impact load shall be considered. The fishing intensity and type shall be assessed and data collected from a recognised competent source. The impact and pullover energies shall then be assessed through a design activity.