

GENERAL SPECIFICATION

PIPELINES - RISERS

GS EP PLR 405

In-Service Welding and Hot-Tapping

Rev.	Date	Purpose of the revision
06	12/2016	General review
05	05/2015	Organisation change - January 2015
04	10/2012	General review Addition of mechanical hot tap and grouted tee
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1. Scope

This specification covers the recommended practices and minimum requirements to perform a subsea hot tap operation onto a pipeline either for onshore, offshore or subsea pipeline. This specification does not aim to cover hot tap on sour service pipeline.

This specification covers hot tapping operation either using welding tees or mechanical saddles with sealing element bolted onto the main pipeline or grouted saddle.

Qualification for in-service welding and hot tapping operation shall be done in accordance with [API STD 1104](#) and [API RP 2201](#), and requirements as stipulated in this specification.

2. Reference documents

The reference documents listed below form an integral part of this General Specification.

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.

External Documents

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and addendums, is the latest revision published at the effective date of this document.

Reference	Title
API RP 2201	Safe Hot Tapping Practice in the Petroleum & Petrochemical Industries
API STD 1104	Welding of Pipelines and Related Facilities
ASME B31.8	Gas Transmission and Distribution Piping Systems
ASME BPVC Section VIII Div 2	Rules for Construction of Pressure Vessels Division 2: Alternative Rules
BS 4515-1	Specification for welding of steel pipeline on land and offshore. Carbon and carbon manganese steel pipelines
NORSOK U-001	Subsea Production Systems

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Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and addendums, is the latest revision published.

Reference	Title
GS EP COR 102	Design of cathodic protection of submarine pipelines by galvanic anodes
GS EP COR 350	External protection of offshore and coastal structures and equipment by painting
GS EP PLR 100	Submarine pipeline systems
GS EP PVV 154	Ball valves
GS EP PVV 155	Gate, Globe and Check Valves
GS EP PVV 611	Welding of pressure containing piping and equipment
GS EP STR 101	Design of offshore jacket and subsea structures

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: the datasheet and pipe mill certificate of the existing line pipe shall be provided
- 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
- Branch orientation
- Water depth at hot tap location
- Soil data
- Meteocean data
- Trawling / fishing activities and protection requirements.

3.1.2 Tie-in arrangement

Hot tap tee branch should preferably be located at the 12 O'clock position.

The hot tap pipe arrangement shall be made in such a way to avoid loads and moment from the existing line and the new line to be transmitted to the tee branch.

3.1.3 General requirements for welded hot tap tee

The tie in welding arrangement shall be designed as shown on Figure 1, Figure 2 (for normal connection) and Figure 3 (for oblique connection).

The encirclement tee or encirclement saddle shall be made with hot extrusion process or sweepolet or with insert weldolet.

Branch design with reinforcing pad (Figure 4), encirclement sleeve (Figure 5) shall not be acceptable for normal connection.

Figure 1 - Encirclement Tee

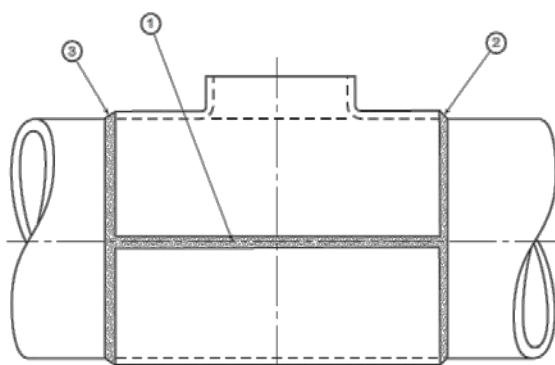


Figure 2 - Encirclement Saddle

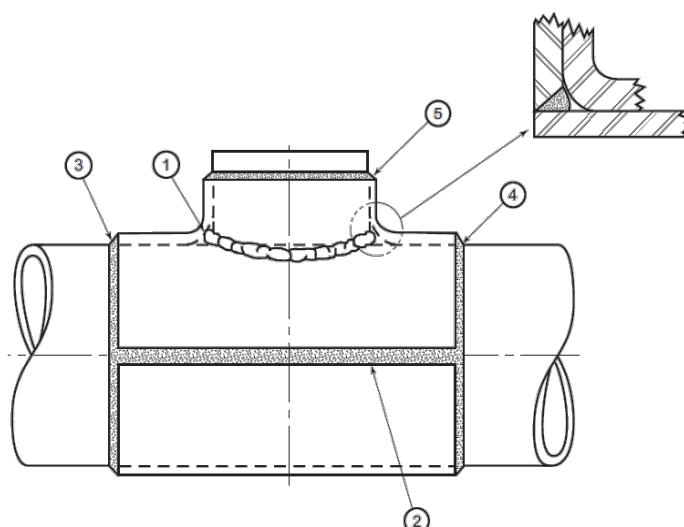
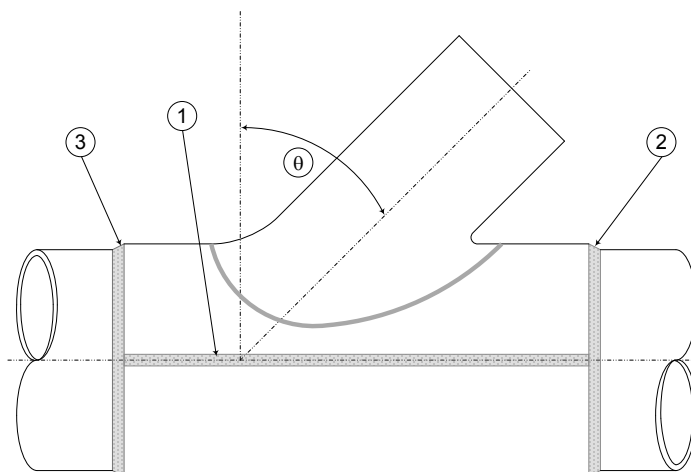
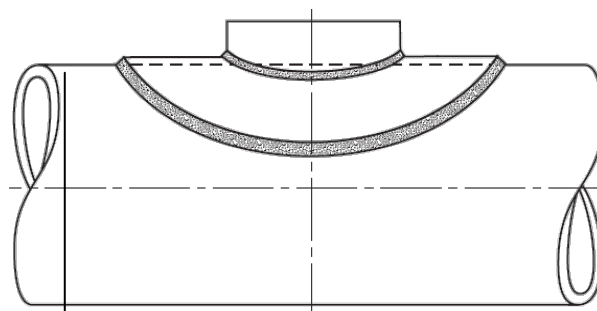
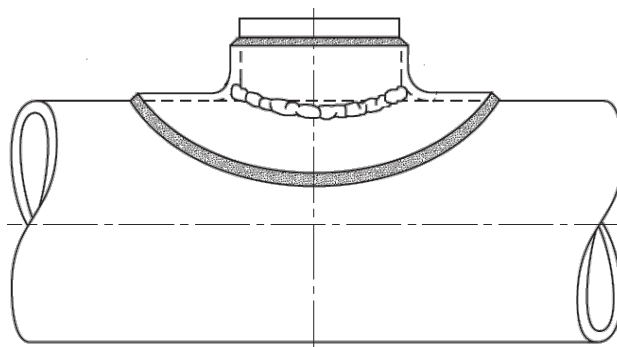


Figure 3 - Encirclement Lateral Tee for oblique connection

(**Note:** The numbers indicated the welding sequence)


Figure 4 - Branch with Reinforcing Pad

Figure 5 - Branch with Reinforcing Saddle


The use of weldolet for normal connection (Figure 6) and welded encirclement tee (Figure 7) for oblique connection shall be with prior approval from Company technical authority "Pipeline and Risers Department".

Figure 6 - Branch with Weldolet (Integrally Reinforced Forged Branch Outlet Fitting)

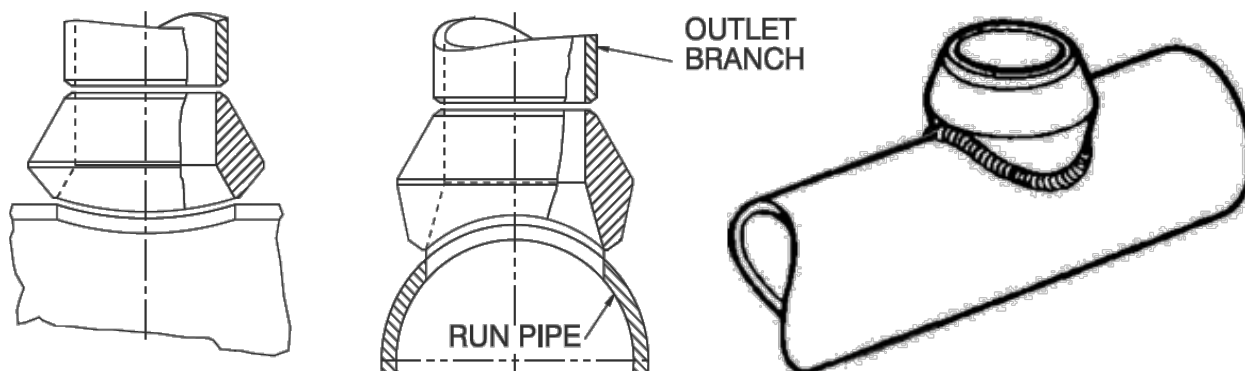
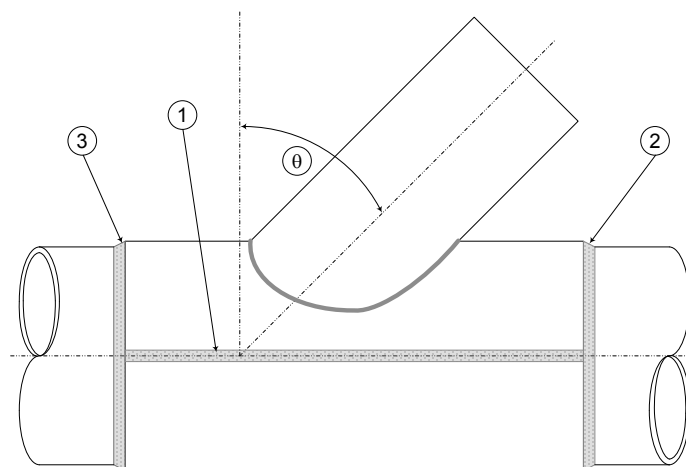


Figure 7 - Encirclement Lateral Welded Tee for oblique connection

(Note: The numbers indicated the welding sequence)



The welding requirements shall comply to section 3.3.1.

3.1.4 General requirements for mechanical hot tap tee

Mechanical Hot Tap clamp shall be designed to allow an annulus test once the clamp is actuated on the pipeline.

When the transported fluid is corrosive, the mechanical clamp shall include a seal on the branch to prevent circulation of the fluid in the volume comprised between the clamp and the existing pipe. The clamp shall be designed to allow a leak test of the branch seal.

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3.1.5 General requirements for grouted tee

Grouted tee shall be designed and equipped with sufficient fittings to allow for:

- Seawater removal from the annulus. The tee annulus shall be flushed with clean potable water to remove salts and foreign bodies
- Annulus test to verify sealing capacity (for both external & internal pressure)
- Annulus drying
- Grout injection
- Grout sampling (after curing) for mechanical tests.

3.1.6 Wall thickness requirement

For welded tee, 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 B31.8 Appendix E](#) Stress intensification factors for in-plane out-of-plane bending shall be applied in the stress calculations.

Mechanical Hot Tap clamp shall be designed in accordance with [ASME BPVC Section VIII Div 2](#).

Grouted Tee clamp shall be designed following the governing Pipeline Code.

3.2 Finite Element Analysis

A 3D Finite Element Analysis (FEA) of the as-designed hot tap connection shall be carried out to verify the integrity of the existing pipeline and of the hot tap tee arrangement. The analysis shall also verify that the determined test pressure will not create over stress in the complete assembly or buckling of the mother pipeline wall.

As a minimum, this analysis shall 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/sleeve dimensional tolerances that affect the fit between the sleeve 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
- External loads and moment (valves weight, force and moment applied by the connected pipeline during installation, and operation...).

The FE model shall be validated during onshore prequalification tests. During this test, calibrated strain gauges shall be located at appropriate locations on the trial pieces 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.