



Exploration & Production

GENERAL SPECIFICATION

PIPING VALVES VESSELS

GS EP PVV 611

Welding of pressure containing piping and equipment

06	10/2009	Update of reference documents - New revision
05	10/2008	New revision
04	10/2005	Addition of "EP" root to GS identification
03	10/2003	Change of Group name and logo
02	10/2002	New revision
01	03/2001	New revision
00	03/2001	First issue
Rev.	Date	Notes

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1. Scope

This Specification covers minimum requirements for welding, heat treatment, and non-destructive examination of pressure containing piping and/or equipment such as: pressure vessels, heat exchangers, etc. These requirements also apply to welds attaching skirts, brackets, lugs and other non-pressure parts to such equipment. It is intended to apply to works on fabrication sites such as construction sites or fabrication yards, as well as in Manufacturer's workshops or for Vendor packages (skid assembly, etc.).

This document is intended to be used together with the applicable codes and standards as listed in the following section "Reference documents".

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.

Any code or Government regulations which may be listed in the Project Specifications, in the requisition, or in the Purchase Order shall have precedence except where this Specification is more stringent.

Any divergence between any of the Contractual Reference Documents, or between this specification and any other Contractual Reference Document, shall be reported to the COMPANY for decision. In such a case, and unless otherwise agreed or decided by the COMPANY, it is understood that the more stringent requirement shall apply.

Pressure containing piping and equipment are designed, manufactured and tested according to one of the following documents which is referred to as "the Code" in the present specification.

In addition, all welding, heat treatment and tooling shall also conform to the applicable provisions of this Specification and to the requirements of Project Specifications.

Standards

Reference	Title
ASTM E 1815	Standard Test Method for Classification of Film Systems for Industrial Radiography
EN 287	Qualification Test of Welders - Fusion Welding
EN 473	Non destructive testing - Qualification and certification of NDT personnel - General principles
EN 584-1	Non destructive testing - Industrial radiographic film - Part 1: Classification of film systems for industrial radiography
EN 10204	Metallic Products - Type of inspection documents
ISO 5579	Non-destructive testing - Radiographic examination of metallic materials by X-rays and gamma rays - Basic rules
ISO 15614	Specification and qualification of welding procedures for metallic materials

Professional Documents

Reference	Title
Not applicable	

Regulations

Reference	Title
Not applicable	

Codes

Reference	Title
ASME B31.3	Process Piping
ASME Section II	Boiler and Pressure Vessel Code. Materials
ASME Section VIII	Boiler and Pressure Vessel Code Divisions 1 and 2
AWS A5.11	Specification for Nickel and Nickel-Alloy Welding Electrodes for Shielded Metal Arc Welding
BSI PD 5500	Unfired fusion welded pressure vessels
CODAP	French Code for unfired pressure vessels

Other documents

Reference	Title
Not applicable	

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Reference	Title
GS EP PVV 612	Piping and Equipment subject to severe sour service. Metallurgical
GS EP PVV 614	Welding of duplex and superduplex stainless steels
GS EP PVV 615	Welding of UNS 31254 alloy
GS EP PVV 616	Welding of titanium pipes and fittings
GS EP PVV 617	Welding of 3 ½% nickel
GS EP PVV 618	Fabrication of alloy UNS 06625 grade 1 materials

Reference	Title
GS EP PVV 620	Specification for fabrication and welding of piping systems in cupronickel and associated materials
GS EP PVV 622	Piping and Equipment subject to intermediate sour service. Metallurgical

3. Welding qualifications

3.1 General

Welds shall have a minimum of two (2) passes whatever are the welding process and the weld geometry.

Welding procedures without filler metal are prohibited.

3.2 Welding Procedures Specifications (WPS)

- a) The Manufacturer shall submit in his tender evidence of his ability to qualify welding procedures for each piping or equipment. This evidence shall be based on previous experience and qualification test results.
- b) All welds including weld repairs shall be supported by a relevant WPS. All WPS shall be in writing and shall be qualified and certified in accordance with the applicable code. All supporting PQR shall be witnessed, or at least certified, by a recognised inspection authority.
- c) All WPS, including their qualification test records (PQR) shall be submitted to the COMPANY for approval prior to starting fabrication. All test results shall be from specimens representative of the final condition of the equipment, including heat treatment(s) where applicable.
- d) Each WPS shall be identified by an unique number. For pressure vessels and other equipment, each WPS shall also be identified on a welding map.
- e) The WPS shall state the actual consumable or flux trade name and type as well as the code designation.
- f) Procedure tests for all welding processes shall be qualified using the same welding consumables and flux as will be used on the actual item. A change from one Manufacturer's consumable or flux to that from another Manufacturer, or change of type or grade from the same Manufacturer, shall require requalification for the following materials:
 - Carbon steel materials in sour wet service
 - Carbon steel materials subject to post well heat treatment with impact test requirements
 - Any materials in cryogenic service (i.e. at temperature below minus 46°C)
 - Duplex stainless steels
 - Nickel alloys.
- g) For inert Gas Tungsten Arc (GTAW) and Inert Gas Metal Arc Welding (GMAW or FCAW), the qualification records shall include the composition and flow rate of inert gas shielding and backing when used. For Submerged Arc Welding (SAW), the qualification record shall include the current arc intensity and voltage, and the travel speed for each weld run.

For Gas Metal Arc process (GMAW or FCAW), the records shall include the power sources, inductance setting, electrode diameter and extension, current and voltage, wire feed rate and travel speed.

- h) Tack welds shall be made to a qualified welding procedure that has been approved by the Engineering Company and by approved welders. Tack welds shall be completely removed prior to welding. Fit-up lugs and strong backs and other temporary attachments shall be attached using a qualified procedure approved by the Engineering Company and shall be welded by approved welders.
- i) Procedure qualifications for weld overlay deposits shall include the complete chemical analysis of the overlay. Specimens for chemical analysis shall be taken on the final weld layer. The weld metal chemistry shall be within the nominal range specified for the alloy.

Qualification of overlays on tubes and fittings shall be made on same materials of the smallest size intended to be qualified and in the same welding position.

The procedure qualification tests shall include:

- Dye penetrant examination of the completed weld
- Side bend tests and longitudinal face bend tests for weld metal soundness examination. Excessive cracking shall be cause for rejection. Cracks shall not exceed four per specimen nor shall they exceed 1.6 mm in each length. Cracks corners are not considered
- Photomacrograph.

3.3 Welders and welding operators

Welders and welding operators shall be qualified in accordance with the applicable Code prior to fabrication. Records shall be submitted to the COMPANY for approval. Alternative qualifications may be accepted subject to the COMPANY approval.

Welding operators and welder qualifications shall be valid for one year from last qualification performance date, beyond which requalification is required.

However, a validity period of two years may be considered if sufficient evidence is shown that the related welder has regularly used the same welding process and materials with no interruption exceeding six months.

Welders and welding operators are subject to requalification when the quality of their work, during fabrication, appears to be below the requirements of this Specification.

3.4 Welding production tests

When required, production tests representative of each material and welding procedure for main seams shall be performed according to contractual documents requirements.

Test coupons shall be of sufficient length to allow for all mechanical tests to be taken.

Test coupons shall be welded attached to the part being welded where possible and shall reflect the actual welding and heat treatment conditions of the piping or equipment.

Mechanical tests and acceptance criteria shall be the same as required for welding procedure qualifications.

4. Welding consumables

4.1 Filler materials and fluxes

4.1.1 Selection of filler materials and fluxes

Welding consumables or combination of them used for the work shall produce welds with strength and ductility properties (especially notch toughness) in the final heat treated condition (if applicable) at least equal to the minimum specified equivalent properties of the base material. For welding carbon steel materials with minimum specified yield strength of 60,000 psi or 420 MPa and above, the selected consumables shall produce welds with tensile strength property not exceeding by more than 25% the specified minimum tensile strength properties, measured at the time of welding procedure qualification tests on an all-weld tensile test specimen taken from the weld metal.

- a) For carbon steel materials, [EN 10204](#) type 2.2 test reports shall be submitted to the COMPANY for all consumables and shall be available at site at the time of welding. For all other materials, [EN 10204](#) type 3.1.B inspection certificates shall be submitted to the COMPANY for all consumables and shall be available at site at the time of welding.
- b) Filler metal for welding similar materials shall be as shown in Table 1. 9% Ni materials shall be welded using filler materials complying with one of the following classifications of the [AWS A5.11](#): ENi Cr Fe - 3, or ENi Cr Mo - 3. Guaranteed strength levels are required for mechanical design.
- c) Filler metals for welds joining dissimilar materials shall be in accordance with Table 2. Filler metals for combination of materials other than those shown in Table 2 shall be submitted to the COMPANY for approval.

Welds joining carbon steel materials of different grades shall give the same strength as that specified for the higher grade of material and shall have ductility and notch toughness properties equal to the higher values specified for the grades of steel being joined.
- d) In welding processes other than SMAW or FCAW, the bare filler wire shall contain all the alloying elements; no elements shall be added via the flux.
- e) All welding products shall be used within the limits recommended by their Manufacturer and the welding variables used for fabrication shall be within the range used for the procedure qualification.

4.1.2 Supply

Low hydrogen electrodes and fluxes shall be supplied in sealed moisture proof containers.

4.1.3 Storage

Electrodes, filler wires and fluxes shall be kept clean, dry and properly stored according to Supplier's recommendations. Storage of open containers shall be in accordance with Supplier's instructions but at a minimum temperature of 75°C in any case. No electrodes, filler wires or fluxes that are damaged, damp, greasy or oxidised may be used.

Manufacturer's facilities shall include a temperature and humidity controlled welding consumable and flux store, including holding and drying ovens.

Low hydrogen electrodes and fluxes shall be placed in a holding oven and held at a minimum temperature of 150°C for at least one hour prior to use. Welding electrodes shall be issued for