

GENERAL SPECIFICATION

PIPING VALVES VESSELS

GS EP PVV 610

Welding of piping and pressure containing equipment
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General Specification		GS EP PVV 610
Welding of piping and pressure containing equipment		
Rev.: 00	Effective date: 12/2019	Page: 2 of 78

Contents

1. Scope	5
1.1 Welding activities	5
1.2 Weld inspection methods	6
2. Normative references	6
3. Definitions	11
4. General Welding Requirements	13
4.1 Structural (non-pressure boundary)	13
4.2 Prequalified welding procedures	13
4.3 Welding book	13
4.4 Weld maps	13
4.5 Pressure boundary welds	14
4.6 Health and Safety	14
4.7 Quality	14
4.8 Weld Equipment	15
4.9 Welding Procedures	15
4.10 Welders and welding operators	17
4.11 Production welding	18
5. Welding processes	18
5.1 Acceptable welding processes	18
5.2 Limitations of Fusion Welding Processes	18
5.3 Single-sided Welded Joints	21
5.4 Combining Welding Processes	21
5.5 Mechanized and Automated Welding Processes	21
6. Welding Consumables (Filler Metal and Flux)	21
6.1 General	21
6.2 Dissimilar welding	22
6.3 Low-alloy Steel Welding (P-No. 3 to P-No. 5 and P-No. 15E)	23
6.4 Stainless Steel Welding (P-No. 6, P-No. 7 and P-No. 8)	23
6.5 Duplex and Super Duplex Stainless Steel Welding	23

6.6	SAW	23
6.7	Electroslag Welding (for Corrosion Resistant Weld Overlay).....	23
6.8	Consumable Storage and Handling	23
6.9	Alloy Consumable Controls.....	23
7.	Shielding and Purging Gases	24
8.	Preheating and Interpass Temperature.....	24
9.	Post Weld Heat Treatment.....	25
10.	Cleaning and Surface Preparation	27
11.	Special Procedure Qualification Requirements/Testing	29
11.1	General.....	29
11.2	Tube-to-tubesheet Welding.....	29
11.3	Additional Procedure Qualification Requirements for Duplex and Super Duplex Stainless Steels 29	
11.4	Material Specific Procedure Qualification Requirements.....	29
12.	Other Items.....	30
12.1	Backing Materials	30
12.2	Peening	30
12.3	Weld Overlay and Clad Restoration (Back Cladding).....	30
12.4	Temporary attachments.....	31
12.5	Stud Welding	31
12.6	Hardness Testing – Welding Procedure Qualification and Production Testing	31
12.7	Single-pass Welds	32
12.8	Additional Production requirements for Welding Duplex and Super Duplex Stainless Steel 32	
12.9	Material Specific Production requirements.....	32
13.	Non Destructive Examination	33
13.1	Non Destructive Examination Execution	33
13.2	Non Destructive Testing Extent.....	33
13.3	Qualification of NDT personnel	33
13.4	Procedures	34
14.	Positive Material Identification	37

General Specification		GS EP PVV 610
Welding of piping and pressure containing equipment		
Rev.: 00	Effective date: 12/2019	Page: 4 of 78

15. Bibliography.....39

- ANNEX A - Welding Consumables for Shielded Metal Arc Welding (SMAW)
- ANNEX B - (Normative) - Weld Overlay and Clad Restoration (Back Cladding)
- ANNEX C - (Normative) - Additional welding construction provisions
- ANNEX D - Positive Material Inspection
- ANNEX E - Oxidation acceptance criteria for Stainless Steels, High Nickel and Titanium Alloys
- ANNEX F - Additional requirements for Carbon and Low Alloy Steels welding in sour and Amine/Alkalis services
- ANNEX G - Additional requirements for Chromium-Molybdenum Alloy Steels Welding
- ANNEX H - Additional requirements for 3 ½% Nickel Steel welding
- ANNEX I - Additional requirements for Austenitic Stainless Steels welding
- ANNEX J - Additional requirements for SuperAustenitic Stainless Steels welding
- ANNEX K - Additional requirements for Ferritic Austenitic Stainless Steels welding
- ANNEX L - Additional requirements for High Nickel Alloys welding
- ANNEX M - Additional requirements for Copper Nickel Alloy welding
- ANNEX N - Additional requirements for Titanium Alloy welding

General Specification		GS EP PVV 610
Welding of piping and pressure containing equipment		
Rev.: 00	Effective date: 12/2019	Page: 5 of 78

1. Scope

This specification defines for onshore and offshore facilities, the Company general requirements for welding, welding related topics for shop and field fabrication and weld inspection methods of the following:

- Process and utilities piping
- Process and utilities pressure vessels
- Heat exchangers / coolers
- Thermal equipment
- Steam generation system
- Atmospheric Storage tanks
- Pressure boundaries of rotating equipment
- Skids, packages
- Structural attachments welded to pressure containing parts.

This specification applies to all welding of following materials:

- Carbon and low temperature carbon steels
- High-strength low-alloy Steels
- Low Alloy Nickel Steels
- Chromium-Molybdenum Alloy Steels
- Ferritic-Austenitic Stainless Steels
- Austenitic Stainless Steels
- Super austenitic Stainless Steels
- Nickel-Chromium-Molybdenum alloys
- Copper-Nickel alloys
- Titanium alloys.

1.1 Welding activities

The specification applies to pressure containing piping and equipment, which are designed, manufactured and tested according to parent design codes as listed in Table 1.

This specification shall be read in conjunction with [API RP 582](#) THIRD EDITION, May 2016 which supplements the welding requirements of these codes and standards.

General Specification		GS EP PVV 610
Welding of piping and pressure containing equipment		
Rev.: 00	Effective date: 12/2019	Page: 6 of 78

Table 1 - Applicable welding codes and standards

Parent design code	ASME B31.3 piping ASME BPVC Section VIII Div. 1 & 2 equipment API STD 650 storage tanks	PD 5500 pressure vessels
Parent welding code	ASME BPVC Section IX	For WPS: ISO 15609-1 For PQR: ISO 15614 (All parts) For WPQ: ISO 9606-1

Modifications to [API RP 582](#) defined in this specification are identified as:

- Add (add to section or add new section)
- Replace (part of or entire section)
- Delete (deletion of a sentence or section, which is not applicable to above scope).

1.2 Weld inspection methods

This specification supplements the codes and standards mentioned in Table 2.

Table 2 - Applicable weld inspection codes and standards

Parent design code	ASME B31.3 ASME BPVC Section VIII Div. 1 & 2 API STD 650	PD 5500
Non Destructive Testing	ASME BPVC Section V ISO 9712 or ASNT SNT-TC-1A	PD 5500 ISO 9712 or ASNT SNT-TC-1A

2. Normative references

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

This specification does not address any additional requirements necessary to meet local regulation.

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 apply.

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.

General Specification		GS EP PVV 610
Welding of piping and pressure containing equipment		
Rev.: 00	Effective date: 12/2019	Page: 7 of 78

External Documents

Reference	Title
ANSI Z 49.1	Safety in Welding, Cutting and Allied Processes (ANSI/AWS)
API RP 2009	Safe Welding, Cutting, and Hot Work Practices in the Petroleum and Petrochemical Industries
API RP 582	Welding Guidelines for the Chemical, Oil, and Gas Industries
API RP 583	Corrosion Under Insulation and Fireproofing
API RP 945	Avoiding Environmental Cracking in Amine Units
API STD 650	Welded Tanks for Oil Storage
ASME B31.3	Process Piping
ASME BPVC Section II	ASME Boiler and Pressure Vessel Code (BPVC), Section II- Materials
ASME BPVC Section IX	ASME Boiler and Pressure Vessel Code (BPVC), Section IX- Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators
ASME BPVC Section V	ASME Boiler and Pressure Vessel Code (BPVC), Section V- Nondestructive Examination
ASME BPVC Section VIII Div. 1 & 2	ASME Boiler and Pressure Vessel Code (BPVC), Section VIII- Rules for Construction of Pressure Vessels - Division 1&2
ASNT CP-189	ASNT Standard for Qualification and Certification of Nondestructive Testing Personnel
ASNT SNT-TC-1A	Personnel Qualification and Certification in Nondestructive Testing
ASTM A380	Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
ASTM A578/A578M	Standard Specification for Straight-Beam Ultrasonic Examination of Rolled Steel Plates for Special Applications

General Specification		GS EP PVV 610
Welding of piping and pressure containing equipment		
Rev.: 00	Effective date: 12/2019	Page: 8 of 78

Reference	Title
ASTM A923	Standard Test Methods for Detecting Detrimental Intermetallic Phase in Duplex Austenitic/Ferritic Stainless Steels
ASTM E140	Standard Hardness Conversion Tables for Metals Relationship Among Brinell Hardness, Vickers Hardness, Rockwell Hardness, Superficial Hardness, Knoop Hardness, Scleroscope Hardness, and Leeb Hardness
ASTM E562	Standard Test Method for Determining Volume Fraction by Systematic Manual Point Count
ASTM E747	Standard Practice for Design, Manufacture and Material Grouping Classification of Wire Image Quality Indicators (IQI) Used for Radiology
ASTM E999	Standard Guide for Controlling the Quality of Industrial Radiographic Film Processing
ASTM G48	Standard Test Methods for Pitting and Crevice Corrosion Resistance of Stainless Steels and Related Alloys by Use of Ferric Chloride Solution
AWS A 2.4	Standard Symbols for Welding, Brazing, and Nondestructive Examination
AWS A 4.2M	Standard Procedures for Calibrating Magnetic Instruments to Measure the Delta Ferrite Content of Austenitic and Duplex Ferritic-Austenitic Stainless Steel Weld Metal
AWS A 5.11	Specification for Nickel and Nickel-Alloy Welding Electrodes for Shielded Metal Arc Welding
AWS A 5.14	Specification for Nickel and Nickel-Alloy Bare Welding Electrodes and Rods
AWS A 5.16	Specification for Titanium and Titanium Alloy Welding Electrodes and Rods
AWS A 5.32/A 5.32M	Welding Consumables - Gases and Gas Mixtures for Fusion Welding and Allied Processes
AWS A 5.4	Specification for Stainless Steel Electrodes for Shielded Metal Arc Welding

General Specification		GS EP PVV 610
Welding of piping and pressure containing equipment		
Rev.: 00	Effective date: 12/2019	Page: 9 of 78

Reference	Title
AWS A 5.6	Specification for Copper and Copper-Alloy Electrodes for Shielded Metal Arc Welding
AWS A 5.7	Specification for Copper and Copper-Alloy Bare Welding Rods and Electrodes
AWS D 10.10	Recommended Practices for Local Heating of Welds in Piping and Tubing
AWS QC1	Specification for AWS Certification of Welding Inspectors
CSWIP 3.1/3.2	Preparatory courses, Seminar Examination program
EN 1011-2	Welding - Recommendations for welding of metallic materials - Part 2: Arc welding of ferritic steel
EN 10204	Metallic Products - Type of inspection documents
EN 12668-1	Non-destructive testing - Characterization and verification of ultrasonic testing equipment - Part 1: Instruments
IEC 60974 (All parts)	Arc welding equipment
IIW IWIP	IIW Guideline International Welding Inspection Personnel
ISO 11611	Protective clothing for use in welding and allied processes
ISO 11699-1	Non-destructive testing - Industrial radiographic film - Part 1: Classification of film systems for industrial radiography
ISO 14114	Gas welding equipment - Acetylene manifold systems for welding, cutting and allied processes - General requirements
ISO 14175	Welding consumables - Gases and gas mixtures for fusion welding and allied processes
ISO 14344	Welding consumables - Procurement of filler materials and fluxes
ISO 14731	Welding Coordination - Tasks and responsibilities
ISO 148-1	Metallic materials - Charpy pendulum impact test - Part 1: Test method

General Specification		GS EP PVV 610
Welding of piping and pressure containing equipment		
Rev.: 00	Effective date: 12/2019	Page: 10 of 78

Reference	Title
ISO 15156 (Parts 2; 3)	Petroleum and natural gas industries - Materials for use in H ₂ S-containing environments in oil and gas production - Parts 2; 3
ISO 15609-1	Specification and qualification of welding procedures for metallic materials - Welding procedure specification - Part 1: Arc welding
ISO 15614 (All parts)	Specification and qualification of welding procedures for metallic materials - Welding procedure test - All parts
ISO 17025	General requirements for the competence of testing and calibration laboratories
ISO 17636-1	Non-destructive testing of welds - Radiographic testing - Part 1: X- and gamma-ray techniques with film
ISO 17781	Petroleum, petrochemical and natural gas industries - Test methods for quality control of microstructure of ferritic/austenitic (duplex) stainless steels
ISO 18265	Metallic materials - Conversion of hardness values
ISO 19232-1	Non-destructive testing - Image quality of radiographs - Part 1: Determination of image quality value using wire-type image quality indicators
ISO 2553	Welding and allied processes - Symbolic representation on drawings - Welded joints
ISO 3834-2	Quality requirements for fusion welding of metallic materials - Part 2: Comprehensive quality requirements
ISO 5172	Gas welding equipment - Blowpipes for gas welding, heating and cutting - Specifications and tests
ISO 6507-1	Metallic materials - Vickers hardness test - Part 1: Test method
ISO 9001	Quality management systems - Requirements
ISO 9606-1	Qualification testing of welders - Fusion welding - Part 1: Steels
ISO 9712	Non-destructive testing - Qualification and certification of NDT personnel

General Specification		GS EP PVV 610
Welding of piping and pressure containing equipment		
Rev.: 00	Effective date: 12/2019	Page: 11 of 78

Reference	Title
NACE MR 0175	Petroleum and natural gas industries - Materials for use in H ₂ S-containing environments in oil and gas production
PD 5500	Specification for unfired fusion welded pressure vessels
WRC 452	Recommended Practices for Local Heating of Welds in Pressure Vessels

Total General Specifications

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

Reference	Title
GS EP COR 170	Materials for upstream sour service application. Specification for selection and design
GS EP PVV 175	Cleaning of piping systems
GS EP PVV 630	TOFD (Time Of Flight Diffraction) Inspection
GS EP PVV 631	Phased Array Inspection (PAUT)

3. Definitions

3.1

Section 3.1 of [API RP 582](#) is fully applicable.

3.2

Section 3.2 of [API RP 582](#) is fully applicable.

3.3

Section 3.3 of [API RP 582](#) is fully applicable.

3.4

Section 3.4 of [API RP 582](#) is fully applicable.

3.5

Section 3.5 of [API RP 582](#) is fully applicable.

3.6

Replace section 3.6 of [API RP 582](#) with:

Purchaser

The purchaser is the **Company** that is responsible for the plant operation.

3.7

Section 3.7 of [API RP 582](#) is fully applicable.

3.8

Section 3.8 of [API RP 582](#) is fully applicable

3.9 Abbreviations

For the purpose of this document, the following terms and definitions apply.

AI	Authorized Inspection	NDE	Non Destructive Examination
AUT	Automated Ultrasonic Testing	MT	Magnetic Testing
AWS	American Welding Society	PAW	Plasma Arc Welding
Ceq	Carbon Equivalent calculated using the IIW formula $Ceq = C + Mn/6 + (Cr+Mo+V)/5 + (Ni+Cu)/15$	PMI	Positive Material Inspection
CLAS	Carbon and Low Alloy Steel	PQR	Procedure Qualification Record
CRA	Corrosion Resistant Alloys	PREN	Pitting Resistant Equivalent Number
EGW	Electro Gas Welding	PT	Penetrant Testing
ESW	Electro Slag Welding	PWHT	Post Weld Heat Treatment
FCAW	Flux Cored Arc Welding	RT	Radiographic Testing
FCAW-G	Flux Cored Arc Welding with Gas	SAW	Submerged Arc Welding
FCAW-S	Flux Cored Arc Welding Self Shielded	SMAW	Shielded Metal Arc Welding
FN	Ferrite Number	TMCP	Thermo-Mechanical-Control Process
GMAW	Gas Metal Arc Welding	TPI	Third Party Inspection
GMAW-P	Gas Metal Arc Welding Pulsed	TOFD	Time Of Flight Diffraction
GTAW	Gas Tungsten Arc Welding	Ug	Unsharpness

General Specification		GS EP PVV 610
Welding of piping and pressure containing equipment		
Rev.: 00	Effective date: 12/2019	Page: 13 of 78

GTAW-P	Gas Tungsten Arc Welding Pulsed	UNS	Universal Numbering System
HAZ	Heat Affected Zone	UT	Ultrasonic Testing
H2S	Hydrogen Sulphide	VT	Visual Testing
IQI	Image Quality Indicator	WM	Weld Metal
IWE	International Welding Engineer	WPQ	Welding Performance Qualification
IWT	International Welding Technician	WPS	Welding Procedure Specification
MCAW	Metal Core Arc Welding	22Cr	22%Cr Duplex Stainless Steel
MDT	Minimum Design Temperature	25Cr	25%Cr Duplex Stainless Steel

4. General Welding Requirements

4.1 Structural (non-pressure boundary)

Section 4.1 of [API RP 582](#) is fully applicable.

4.2 Prequalified welding procedures

Section 4.2 of [API RP 582](#) is not applicable.

4.3 Welding book

Replace section 4.3 of [API RP 582](#) with:

Prior fabrication, a welding book shall be submitted to the Company for review and approval prior to start of fabrication or construction, the welding book including as a minimum:

- Weld maps, similar guides and fabrication drawings which clearly identify the application of each WPS, indicating where and how these WPSs will be used
- Summary list of WPSs detailing associated PQRs references, qualified ranges and scope of application
- Welding and welding repair procedures specifications (WPSs)
- Respective supported procedure qualification records (PQRs)
- All necessary fabrication sequences for specific critical welding application.

4.4 Weld maps

Section 4.4 of [API RP 582](#) is fully applicable.

General Specification		GS EP PVV 610
Welding of piping and pressure containing equipment		
Rev.: 00	Effective date: 12/2019	Page: 14 of 78

4.5 Pressure boundary welds

Section 4.5 of [API RP 582](#) is not applicable.

4.6 Health and Safety

Welding, cutting and examination activities shall comply with the relevant local safety legislation pertaining to the location where these activities take place.

As a minimum, the following requirements shall apply:

- [ANSI Z 49.1](#) or [API RP 2009](#) is adopted by default for ensuring safe Welding, cutting and hot working activities.
- Protective clothing for use in welding and allied processes are conform to [ISO 11611](#).
- Equipment for oxygen and acetylene are conform to [ISO 14114](#) and [ISO 5172](#).
- Welding equipment are conform to [IEC 60974 \(All parts\)](#).
- Ventilation of welding and cutting fumes is conform to [ANSI Z 49.1](#).
- Trichloroethylene that produce toxic gases upon welding are not used as degreasing agents.
- A risk assessment is required for confined space when welding.
- Welding close to live plant facilities requires specific risk assessment.
- Thoriated tungsten electrodes not to be used in production welding.
- All equipment are maintained with records to support its ongoing safe operation.
- Equipment used to hold and support process equipment, vessels, piping, are capable of bearing the load whilst maintaining the stability required for working in both the vertical and horizontal planes.

4.7 Quality

4.7.1 Welding organization and quality system

Each Fabricator shall have in place a quality management system meeting the requirements of [ISO 9001](#) and [ISO 3834-2](#) including:

- A material control and verification programme to manage the receipt, storage, segregation, issuance of components, welding filler materials and gases.
- A specific management plan for CRA fabrication to avoid any detrimental contamination.
- A traceability and verification scheme to ensure each pressure retaining weld and direct attachment weld are traceable to:
 - The relevant component inspection documents
 - WPS(s) and PQR(s) used
 - Responsible welder(s) or welding operator(s)

General Specification		GS EP PVV 610
Welding of piping and pressure containing equipment		
Rev.: 00	Effective date: 12/2019	Page: 15 of 78

- PWHT records (if applicable)
- NDE and production test records
- Responsible NDE and production test personnel
- Repairs (if applicable) and associated WPS/PQR, NDE and production tests, and responsible personnel.
- A certification scheme for welding inspection personnel meeting the requirements of the [CSWIP 3.1/3.2](#), [IIW IWIP](#) or [AWS QC1](#) programmes.
- A certification scheme for NDE personnel, including personnel for techniques covered by [ASME BPVC Section V](#), Mandatory Appendix II, meeting the requirements of either:
 - An industry-recognised central personal certification scheme meeting the requirements of [ISO 9712](#) or
 - Employer-based certification scheme meeting the requirements of [ASNT SNT-TC-1A](#) or [ASNT CP-189](#) wherein relevant Level III personnel hold certification from an industry-recognised central personal certification scheme meeting the requirements of [ISO 9712](#).
- A competency assessment scheme for specified fabrication production testing.

4.7.2 Welding coordination

All welding coordination shall be according to [ISO 14731](#).

The manufacturer shall point out a responsible authorized welding coordinator for the contract/project/fabrication site.

The responsible welding coordinator shall be qualified as an IWE or as otherwise accepted in [ISO 14731](#).

Depending on the scope of work, an IWT qualification may be accepted upon Company approval.

4.7.3 Test laboratories

Laboratory tests shall be performed in an official laboratory approved by the Company and certified [ISO 17025](#).

4.8 Weld Equipment

All welding equipment indicators shall have a current calibration certificate at time of use.

4.9 Welding Procedures

All Welding procedures shall be qualified in accordance with the requirements of [ASME BPVC Section IX](#), for piping and ASME pressure vessels or [ISO 15614](#) / [ISO 15609](#) relevant part for [PD 5500](#) pressure vessels supplemented by this specification.

General Specification		GS EP PVV 610
Welding of piping and pressure containing equipment		
Rev.: 00	Effective date: 12/2019	Page: 16 of 78

Qualification made by others is not authorized by Company.

4.9.1 Procedures Qualification Records (PQR)

All supporting PQRs shall be certified, by an Inspection Authority or an Independent Third Party recognized by the Company.

The PQR shall follow the format proposed by the selected code:

Form QW-483 of the ASME BPVC Section IX	Annex B of the ISO 15614-1
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4.9.2 Essential variables

In addition to the parent welding code, a separate procedure qualification is required as soon as there is:

- Any change in the degree of mechanization
- Any change in current, polarity and pulse characteristics
- Any change of shielding and backing gases composition
- Any change from double-sided welding to single-sided welding without backing strip.

Where the thickness range of a weld procedure extends past a threshold where additional or more severe testing would be required, the qualification range shall be limited to that threshold unless the additional testing is performed.

4.9.3 Testing

In addition to the selected Code requirements, the procedure qualification test shall include:

- PT/MT examination of the completed weld
- Photo macrograph.

4.9.3.1 Macro Examination

Macro sections shall:

- Contain the whole cross section of the weld, HAZ and adjacent parent material
- Be etched to reveal individual passes and the full extent of the HAZ.

Macro examination shall be free from cracks, lack of fusion (root, sidewall or interrump) or volumetric defects (slag, porosity, etc.) outside the acceptance criteria of the applicable equipment or piping code.

4.9.3.2 Surface examination

PT/MT shall be carried out according to section 13 of this specification, with acceptance criteria based on the applicable equipment or piping code.

General Specification		GS EP PVV 610
Welding of piping and pressure containing equipment		
Rev.: 00	Effective date: 12/2019	Page: 17 of 78

4.9.3.3 Impact testing

For PQR involving two different materials and for which impact testing is required, specimens shall be taken from both sides.

4.9.4 Welding Procedure Specification (WPS)

The WPS shall follow the format proposed by the selected Code:

Form QW-482 of the ASME BPVC Section IX	Annex A of the ISO 15609-1
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All WPS shall be supported by PQR(s) in accordance with the selected Code and this Specification.

Each WPS shall be identified by a unique reference.

The WPS shall detail the weld preparation and the bead sequence (i.e. for root pass, hot pass, filling passes, and capping passes).

When heat input control is required by the parent design code and this specification, welding parameters for root, fill and cap passes shall be grouped separately.

4.9.5 Repair Welding Procedures Specifications (WPS)

Separate WPSs shall be prepared for repair welding.

The repair WPS shall detail:

- The method of defect excavation
- The shape and size of excavation prior to re-welding
- Inspections prior to re-welding to confirm the defect removal.

4.10 Welders and welding operators

Welders and welding operators shall be qualified in accordance with [ASME BPVC Section IX](#) for ASME piping and pressure vessels or [ISO 9606-1](#) relevant part for [PD 5500](#) pressure vessels.

The Welder Performance Qualification certificate shall follow the format proposed by the selected code:

Form QW-484A or QW-484B of the ASME BPVC Section IX	Annex A of the ISO 9606-1
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Welding operators and welder qualifications shall be valid for a period of one year. 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 disqualification when the quality of their work, during fabrication, appears to be below the requirements of this Specification.

Welding performance qualification records and a welder register detailing the material group, welding process, positions and thickness ranges in which they are qualified, together with the identification number for each welder shall be made available upon Company request during the whole fabrication.

4.11 Production welding

Additional Welding provisions for construction are detailed in Annex C.

5. Welding processes

5.1 Acceptable welding processes

Section 5.1 of [API RP 582](#) is applicable except items e) and i).

5.2 Limitations of Fusion Welding Processes

Section 5.2 of [API RP 582](#) is replaced by following subsections

Downhill welding direction is not authorized by Company.

5.2.1 SMAW

Basic coatings shall be used for all CLAS piping and pressure equipment all pressure boundary welds.

For atmospheric storage tanks in Carbon Steel, basic coating shall be used, except for roof and bottom where rutile coating could be accepted.

5.2.2 GTAW

GTAW welding power sources shall be fitted with high frequency arc striking, slop down, pre-gas and post -gas devices.

GTAW-P shall be performed with the same make and model of equipment using the same parameters settings as those used in the procedure qualifications.

5.2.3 SAW

SAW procedures shall be requalified whenever the welding flux is changed from one manufacturer's trade name to another.

General Specification		GS EP PVV 610
Welding of piping and pressure containing equipment		
Rev.: 00	Effective date: 12/2019	Page: 19 of 78

Equivalence under [ASME BPVC Section II](#) Part C, or AWS filler metal specifications shall not be considered adequate for substitution without requalification.

5.2.4 FCAW

FCAW-S is prohibited by Company on pressure containing piping and equipment.

FCAW-G may be used for carbon, high strength low alloy and austenitic stainless steels (3XX series) on either groove or fillet welds for pressure boundary or structural welding.

Then the following restrictions shall apply:

- Demonstration and experience from manufacturer on similar type of joints, materials and working environment (workshop, site) is assessed by Company.
- Weld deposit thickness is 10 mm minimum.
- Outside diameter is above or equal to 6 inches.
- Application to branch on piping and nozzle to shell/head connection is subject to specific Company approval.
- Wire diameter is limited to 1.2 mm max.
- Production welding is limited to the same consumable trade mark and wire diameter as used during WPQR.
- When ceramic backing strip is used, penetrant testing is performed on the root pass.
- In case of post weld heat treated condition, additional reception requirement are mandatory on cored wires: mechanical properties (Yield strength, Tensile Strength, Elongation and Impact tests at minimum design temperature) are to be verified per batch on a groove weld after a representative simulated post weld heat treatment (based on nominal soaking temperature and maximum holding time to be used in production).

5.2.5 GMAW

GMAW may be used for structural welding and Corrosion Resistant Alloys (CRA) overlay application provided that demonstration and experience from manufacturer, materials and working environment are assessed by Company.

GMAW shall not be used on:

- Pressure containing welds of pressure vessels
- Piping branch connections welds
- Any welds subject to cyclic/vibratory services.

GMAW-P shall be performed with the same make and model of equipment using the same parameters settings as those used in the procedure qualifications.

General Specification		GS EP PVV 610
Welding of piping and pressure containing equipment		
Rev.: 00	Effective date: 12/2019	Page: 20 of 78

GMAW may be used on piping girth welds, then the following restrictions shall apply:

- Demonstration and experience from manufacturer on similar type of joints, materials and working environment (workshop, site) is assessed by Company.
- Outside diameter is above or equal to 6 inches.
- Root pass is carried out with an adaptive GMAW process such as STT (Surface Tension Transfer), RMD (Regulated Metal Deposition), CMT (Cold Metal Transfer), QSET (Optimal Short Arc Parameters settings). Adaptive GMAW process is performed with the same make and model of equipment using the same parameters settings as those used in the procedure qualifications.
Downhill direction may be accepted by Company for root pass only.
- When fill and cap passes are welded with GMAW, the material thickness is above 10 mm and a pertinent ultrasonic flaw detection is performed on the whole weld.

5.2.6 MCAW

Metal Core Arc Welding is prohibited by Company on pressure containing piping and equipment.

5.2.7 PAW

PAW may be used for butt welds and overlay application. Then the following restrictions shall apply:

- Demonstration and experience from manufacturer on similar application is assessed by Company.
- Welding is performed with the same make and model of welding equipment and using the same program setting as those used in the procedure qualification.

5.2.8 ESW

ESW may be used for overlay application. Then the following restrictions shall apply:

- Demonstration and experience from manufacturer on similar application is assessed by Company.
- Welding is performed with the same make and model of welding equipment and using the same program setting as those used in the procedure qualification.
- Parameters controlling magnetic field/control of the process are included in the WPS.
- Production welding is limited to the same consumable trade mark and strip width as used during PQR.

General Specification		GS EP PVV 610
Welding of piping and pressure containing equipment		
Rev.: 00	Effective date: 12/2019	Page: 21 of 78

5.3 Single-sided Welded Joints

Section 5.3 of [API RP 582](#) is replaced by with:
GTAW process shall be used for root pass when:

- Corrosion or purity is a concern
- Components to be butt welded are with an internal diameter smaller than 100 mm
- Slag, debris could damage surrounding process equipment.

Other welding processes using coatings or fluxes may be used in lieu of GTAW if slag can be removed from the process side of root passes and area inspected for slag removal.

5.4 Combining Welding Processes

Section 5.4 of [API RP 582](#) is fully applicable.

5.5 Mechanized and Automated Welding Processes

5.5.1

Section 5.5.1 of [API RP 582](#) is fully applicable.

5.5.2

Section 5.5.2 of [API RP 582](#) is fully applicable.

5.5.3

Each specific programming weld schedules detailing ranges of validity of PQR shall be submitted to Company for approval prior to qualification.

6. Welding Consumables (Filler Metal and Flux)

6.1 General

6.1.1

Replace section 6.1.1 of [API RP 582](#) with:

Filler metals shall conform to an [ASME BPVC Section II](#) Part C/AWS specification as detailed in mandatory Annex A.

Autogenous welding is prohibited unless previously agreed by Company.

6.1.2

Section 6.1.2 of [API RP 582](#) is not applicable.

6.1.3

Replace section 6.1.3 of [API RP 582](#) with:

Groove and/or fillet welds shall be made with filler metals producing low hydrogen deposits.

SMAW Cellulosic coating electrodes are not permitted by the Company.

General Specification		GS EP PVV 610
Welding of piping and pressure containing equipment		
Rev.: 00	Effective date: 12/2019	Page: 22 of 78

Specified Minimum Tensile Strength for Carbon and Low Alloy Steels	Maximum Diffusible Hydrogen Designation as per relevant ASME SFA/AWS designation as stated in Annex A
≤ 483 MPa	H16
> 483 MPa and ≤ 587 MPa	H8
> 587 MPa	H4

6.1.4

Replace section 6.1.4 of [API RP 582](#) with:

Unless otherwise specified in the parent design code, for carbon steel, if the base metal is exempt from impact testing the weld metal shall have a toughness equal to or greater than 27J at either -29°C or the Minimum Design Metal Temperature (MDMT), whichever is lower.

The weld metal toughness shall be certified by the filler metal manufacturer according to [ASME BPVC Section II](#), Part C/AWS filler metal specifications, or by the PQR.

6.1.5

Section 6.1.5 of [API RP 582](#) is fully applicable.

6.1.6

Section 6.1.6 of [API RP 582](#) is fully applicable.

6.1.7

Section 6.1.7 of [API RP 582](#) is fully applicable.

6.1.8

Replace section 6.1.8 of [API RP 582](#) with:

Filler metal selection for welds joining similar materials shall be in accordance with Annex A.

6.2 Dissimilar welding

6.2.1

Section 6.2.1 of [API RP 582](#) is fully applicable.

6.2.2

Section 6.2.2 of [API RP 582](#) is not applicable

6.2.3

Filler metals for combination of materials other than stated in Annex A shall be submitted to the Company for approval.

The use of dissimilar metal welds to join carbon or low alloy steel to Corrosion Resistant Alloys is not authorized by company in case of sour and amine/alkalis services.

General Specification		GS EP PVV 610
Welding of piping and pressure containing equipment		
Rev.: 00	Effective date: 12/2019	Page: 23 of 78

6.3 Low-alloy Steel Welding (P-No. 3 to P-No. 5 and P-No. 15E)

Section 6.3 of [API RP 582](#) is fully applicable.

6.4 Stainless Steel Welding (P-No. 6, P-No. 7 and P-No. 8)

6.4.1

Replace section 6.4.1 of [API RP 582](#) with:

Filler metals shall conform to an [ASME BPVC Section II](#) Part C/AWS specification as detailed in mandatory Annex A.

6.4.2

Section 6.4.2 (including subsections) of [API RP 582](#) is not applicable.

6.5 Duplex and Super Duplex Stainless Steel Welding

Section 6.5 of [API RP 582](#) is replaced with Annex K.

6.6 SAW

Section 6.6 of [API RP 582](#) is fully applicable.

6.7 Electro slag Welding (for Corrosion Resistant Weld Overlay)

Section 6.7 of [API RP 582](#) is fully applicable.

6.8 Consumable Storage and Handling

6.8.1

Section 6.8.1 of [API RP 582](#) is fully applicable.

6.8.2

Section 6.8.2 of [API RP 582](#) is fully applicable.

6.8.3

Section 6.8.3 of [API RP 582](#) is fully applicable.

6.8.4

For CRA materials, GTAW wires shall be cleaned with solvent immediately before use.

6.8.5

All non-identified, damaged, wet, partially used, greased, rusted, size changing or otherwise contaminated consumables shall be discarded.

6.9 Alloy Consumable Controls

Section 6.9 of [API RP 582](#) is not applicable

General Specification		GS EP PVV 610
Welding of piping and pressure containing equipment		
Rev.: 00	Effective date: 12/2019	Page: 24 of 78

7. Shielding and Purging Gases

7.1

Section 7.1 of [API RP 582](#) is fully applicable.

7.2

Section 7.2 of [API RP 582](#) is fully applicable.

7.3

Section 7.3 of [API RP 582](#) is replaced with:

Back purging is required for the GTAW and GMAW processes for welding materials having a nominal chromium content greater than 2-1/4% and non-ferrous materials, unless the joint is ground or back gouged to sound metal.

When a back purge is used, the WPS shall state the gas used, including composition of the gas mixture and the flow rate.

Whenever a back purging gas is selected to prevent oxidation or scale formation on the underside of the weld, the purge shall be maintained until at least 6.5 mm depth of weld metal has been deposited.

For socket, seal, and any other attachment welds on base materials less than 6.5 mm thick, the back purging shall be maintained throughout the welding operation.

7.4

Back purging shall be demonstrated during welding procedure qualification and production welding by means of internal inspection as per Annex E or suitable oxygen meter.

A back purging procedure shall be issued for Company approval.

8. Preheating and Interpass Temperature

8.1

Section 8.1 of [API RP 582](#) is replaced with:

Preheating, where required, applies to all welding, tack welding, arc-gouging and thermal cutting.

Minimum preheat requirements shall follow the applicable code and recommended guidance such as Appendix R of [ASME BPVC Section VIII Div. 1](#), Table 330.1.1 of [ASME B31.3](#) or [EN 1011-2](#).

8.2

Section 8.2 of [API RP 582](#) is fully applicable.

8.3

Section 8.3 of [API RP 582](#) is fully applicable.