



Exploration & Production

GENERAL SPECIFICATION

PIPELINES - RISERS

GS EP PLR 422

Welding of Duplex and Super duplex stainless steel Pipelines & Risers
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01	01/2011	Revised § 9-2
00	10/2009	First issue
Rev.	Date	Notes

Owner: EP/TDO/TEC	Managing entity: EP/TDO/TEC/PLR
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1. Scope

This specification summarises basic requirements for fabrication, welding, inspection and control of duplex (typically 22Cr - 05Ni) and super duplex (typically 25Cr - 07Ni) stainless pipeline.

It applies to butt-welding (including ties-in), fillet welding and welding of lines pipes, bends, flanges and other fittings.

Branches made of pipes directly welded to main pipeline are not used and shall be subject to specific agreement of Company).

This specification is to be considered as a supplement to Pipeline standard ([API RP 1104](#)) and respective associated standards.

This specification shall be used in conjunction with a Particular Project Specification (to be made for purpose) detailing the additional tests and requirements or the possible modifications to the present specification, based on the particular design conditions of the pipelines project.

This specification applies to all welding activities on pipeline including prefabrication, site and field installation of lines pipes, fittings, flanges and other equipment installed in the pipeline systems (valves, etc.).

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.

The work shall satisfy the requirements of [ASME B31.8](#), where applicable.

Should omissions or ambiguity or incorrect information exist, they shall be notified as soon as possible by Contractor to Company. Company shall have the right of the final decision.

All codes, specifications, standards and other documents which are referenced in this specification are listed hereafter.

The order of precedence of the applicable documents shall be:

- The Contract
- This Specification
- The codes and standards in reference.

Unless otherwise specifically indicated in writing by Company, Contractor shall work in accordance with the requirements specified herein and the applicable requirements of the latest editions at date of contract award of the referenced Codes and Standards, whenever requested in the present specification.

Standards

Reference	Title
ASTM A 370: 2005	Mechanical testing of steel products
ASTM A 578	Standard Specification for Straight-Beam Ultrasonic Examination of Rolled Steel Plates for Special Applications
ASTM E 384	Standard Test Method for Micro Indentation Hardness of Materials
ASTM E 562: 2002	Standard Test Method for Determining Volume Fraction by Systematic Manual point Count
ASTM E 709	Standard Guide for Magnetic Particle Testing
ASTM E 747: 1997	Standard practice for design, manufacture, and material grouping classification of wire image quality indicators (IQI) used for radiology
ASTM G 48	Test Method for Pitting and Crevice Corrosion Resistance of Stainless Steel
EN 462-1	Non-destructive testing - Image quality of radiographs - Part 1: Image quality indicators (wire type) - Determination of image quality value
EN 462-5	Non-destructive testing - Image quality of radiographs - Part 5: Image quality indicators (duplex wire type) - Determination of image unsharpness value
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 films system for industrial radiography
EN 10204 (2004)	Types of inspection documents
ISO 9001: 2000	Quality systems - Model for quality assurance in design, development, production, installation and servicing
ISO 9002	Quality systems-Model for quality assurance in production, installations and servicing
ISO 10005	Quality management - Guidelines for quality plans
ISO 17636	Non-destructive testing of welds - Radiographic testing of fusion-welded joints

**Professional Documents**

Reference	Title
API RP 1104: 19 th Ed. (1999)	Standard for Welding Pipelines and Related Facilities
ASNT SNT-TC-1A: 2001	American Society for Non-destructive Testing - Personnel qualification and certification in non-destructive testing
AWS A5.01: 1993	Filler metal procurement guidelines
COFREND	Certification Scheme for Personnel
CSWIP	Confédération Française pour les essais non destructifs
SNT-TC-1A	American Society for Non-destructive Testing Recommended Practice

Regulations

Reference	Title
Not applicable	

Codes

Reference	Title
ASME B31.4	Liquid Transmission and Distribution Piping Systems
ASME B31.8	Gas Transmission and Distribution Piping Systems
ASME II-C	Specifications for Welding Rods, Electrodes, and Filler Metals-Non-Interfiled
DNV-OS-F101	Submarine pipeline systems

Other documents

Reference	Title
Not applicable	



Total General Specifications

Reference	Title
GS EP COR 560	Physical and chemical treatment of hydrostatic test water
GS EP PLR 242	Fabrication of duplex & superduplex stainless steel in seamless pipes for pipelines in Sweet service
GS EP PVV 175	Cleaning of piping and vessels

3. Definitions

Company	Total or agents acting on its behalf, shall be referred to herein as the "Company".
Contractor	Shall be the company appointed by Company to carry out the work but shall also include his sub-Contractors and Vendors.
Contract Documents	The material requisitions material specifications, etc. issued by the Company and attached to the contract or the purchase order shall be referred to herein as the "Contract Documents".
Work	Means all and any part of the obligations to be performed by Contractor under the Contract Documents or purchase order and contract amendments.
Site	This term designates the sites, workshops, worksites, barges, ship or other locations where the prefabrication, welding and installation of the pipeline is performed complete or in part.
Inspection Agency	An independent inspection body (other than any inspection department of the Contractor or any Inspection Agency subcontract by him), or its members, who shall be appointed by Company and thus notified to Contractor.
Inspector	The Company's representatives or members from the Company's elected Inspection Agency for the time being or from time to time duly appointed in writing by the Company to act as its representatives for the purpose of the contract shall be referred to herein as the "Inspector".
Approval	Authorisation in writing given by Company to Contractor to proceed with the performance of a specific part of the work without releasing in any way Contractor from any of its obligations or liabilities under the contract or at law; Approve, Approved and
PPS	Used to designate the Project Particular Specification.
Approval shall be constructed accordingly.	
May	Used to indicate that a provision is optional.
Shall	Used to indicate that a provision is mandatory.



Should	Used to indicate that a provision is not mandatory but is recommended as good practice.
Duplex	Is the generic name about stainless steel based on 22% of Chromium.
Super duplex	Is the generic name about stainless steel based on 25% of Chromium.

4. Quality Assurance and Quality Control

The Contractor shall maintain an effective Quality System that complies with the requirements of [ISO 9002](#) and associated guides.

Responsibility for quality control shall be rest with the Contractor aided by such staff as may require.

The Contractor shall work to a Company approved quality plan for the systematic control of the construction, inspection and testing, as dictated by the overall contract quality programme.

Regarding inspection, the Quality Control Plan shall include:

- A flow chart illustrating each inspection point and its relative location in the procedure cycle, where conformance of characteristics is verified
- The characteristics to be inspected at each inspection point, the procedures and acceptance criteria to be used. The procedures shall be provided to the Company, as requested
- Copies of specific forms used by Contractor to record the results of each inspection.

The Contractor shall maintain quality records as documentary evidence of compliance with quality requirements. Quality records shall be available to the Company for analysis and review.

All Contractor inspection system shall be subject to evaluation and checks by the Company to ensure that the system is effectively applied and meets the requirements of this specification and the Contract Documents.

The Contractor shall employ competent supervisors to ensure that both the standard of workmanship and the quality of materials used comply with the requirements of this specification.

5. Proposal submission file

Upon submission of his proposal Contractor shall provide Company with the following information and documents as a minimum requirement:

- The specification data for the equipment used in the production welding line:
 - Layout and make up of the production welding line
 - Maximum and minimum pipe lengths which are acceptable for welding with the welding installation
 - Welding set technical data for main line, double joints, etc.
 - Technical characteristics of preheating and post-weld heat treatment equipment (where applicable)



- Alignment clamp type and technical data
- Beveling machine for main line, double joints, etc.
- The proposed Welding Procedure Specifications for welds, with execution sequence of the various passes in relation to the welding stations used
- The welder qualification scheme
- The procedures for non-destructive inspections together with data sheets on the equipment used
- Upon Contractor's judgement of what is pertinent, any other technical information concerning the work to be carried out, such as previous references from similar work performed successfully, welding procedure test certificates previously used in production, etc.

6. Production fabrication and welding requirements

6.1 General

Manufacture shall not commence until the Company has reviewed and approved the Contractor's Quality Plan and the Manufacture and Inspection Procedure Specification. The Manufacturing and Inspection Procedure Specification shall include all factors, which influence the quality and reliability of the pipe line.

The Contractor shall transmit all fabrication procedures to the Company for review. A tentative list of documents is defined in Appendix 9 of this specification.

Materials shall be, also, inspected after delivery on site. All damage shall be reported to the Company representative.

Correlation between marking on materials and materials certificates shall be checked by the Contractor, prior to fabrication commences.

6.2 Particular precaution

Contact between stainless steel and carbon steel is prohibited.

Contractor shall issue a specific monitoring procedure for the access of material to the shop floor / site dedicated to welding of stainless steel. This procedure shall receive Company approval prior starting of fabrication.

The site, which shall be clean and free from oil and grease, shall be dedicated for fabrication of stainless steel only. The site shall be sufficiently draught free to ensure adequate gas shielding. A reception site certificate shall be filled-in before the start of fabrication and shall be periodically reviewed to follow the fabrication quality. A form of document is proposed in Appendix 10 of the present specification.

All the tools, except machining tools, shall not have been used on either carbon steel or any other grade of stainless steel. The following precautions shall be implemented:

- Grinding disks shall be free from iron and carbon
- Brush shall be stainless steel

- Lines pipes; tees, fittings shall be cleaned internally and all foreign material shall be removed by means of special tools
- Earth connection of welding and cutting equipment shall be stainless steel
- Cutting shall be carried out only by plasma or by mechanical sawing*.

In case of condensation on materials, humidity shall be eliminated by using hot air blowers and/or by controlled induction heating. To prevent any oxidation the use of air/gas torch is prohibited.

Oil, moisture, rust, scale, paint or other foreign matter shall be removed from the weld surface and at least 50 mm of adjacent base metal prior welding.

Contamination of surface, weld bevel and surrounding areas with low melting point metals such as Copper, Zinc, etc., are not acceptable.

Inner and outer surface of weld preparation shall be thoroughly:

- Cleaned by wire brushing using a stainless steel wire brush
- Followed by de-greasing with solvent free from chloride and in accordance with local health and safety regulations.

Paint and markers containing zinc or chloride are prohibited.

Stringer beads shall be used. Minor arc oscillation to ensure side-wall fusion is permitted.

Correction of deflexion by **flame straightening is prohibited**.

Grinding of all start/stop is required.

The bevels shall be prepared by machining, but a preparation by automatic plasma cutting is acceptable. The heat-affected zone shall then be removed by grinding.

6.3 Welding process

Only the following welding processes are authorised:

- Shield Metal Arc Welding (SMAW) for **fillet weld only**
- Manual and automatic Gas Tungsten Arc Welding (GTAW)
- Automatic Submerged Arc Welding (SAW).

Any other process that a Contractor would intend to use shall receive Company approval. This approval would be based on the submission of a complete file detailing past experience and quality achieved with the process.

Autogenous welding (e.g. welding without the addition of filler metal) is forbidden except tack welding.

Whichever the welding process used for filling on no back welding sequence, the two first passes shall be carried out using the GTAW process.

All manual GTAW shall use a high frequency start and a post-purge gas flow for the torch. Whenever the welder stops welding, the welding current shall be gradually decreased by use of

* Chloride content in machining oil shall be limited to 1.0 ppm.



the remote current control. The torch shall be held in position close to the weld pool until the gas shielding post-purge flow is completed to prevent oxidation.

Permanent backing material is not allowed.

For automatic welding process, the following shall be specified:

- Amplitude of weave
- Frequency of weave
- Dwell time.

6.4 Backing gas protection

The back purge shall be made with argon or appropriate mixture approved by the Company before starting qualification tests.

The oxygen level in the backing gas protection shall be less than 500 ppm.

Backing gas protection during qualification tests as well as during fabrication shall be maintained until completion of the first three passes or a minimum of 5 mm of deposited weld metal.

The oxygen level in the backing gas protection shall be checked and recorded during the qualification tests until the end of weld performance.

Duration of backing gas application before welding shall be recorded during qualification time and monitored during production.

During the fabrication, the oxygen level shall be checked until completion of the first three passes or of 5 mm of deposited metal or the weld metal thickness recorded during qualification test for which a backing gas protection was maintained.

In production, the oxygen level shall not be higher than the level obtained during the qualification tests. The oxygen level, taken as a reference for the qualification and fabrication, will be the oxygen level measured at the beginning of the qualification weld.

Internal checking point of oxygen level shall be located in the upper quadrant (12 o'clock position) of the pipe, unless proved technically impossible.

Before starting production, the Contractor shall send relevant back purging and oxygen level measurement methods for Company approval. These proposed methods could be continuous or discontinuous with a minimum frequency to be agreed by Company.

The addition of hydrogen in shielding and backing gas is prohibited.

Gas bottles for duplex and super duplex stainless steel shall be clearly identified, and hoses shall be checked to ensure that all connections are tight and there are no leaks.

Contractor shall obtain Manufacturer gas analysis certificate for each batch used for the job.

Requirements for gas supplying:

- Purity of the single or composed gas > 99.999%
- Dew point shall not be higher than 30°C
- Humidity < 40 ppm



- Oxygen < 2 ppm
- Hydrocarbon < 1 ppm.

6.5 Filler metal

6.5.1 General

1. Welding consumable shall be purchased from recognised well-known Manufacturers
2. All welding consumables shall conform to [ASME/AWS, Section II, Part C](#), DNV or approved equivalent standard.
3. SAW flux procurement, packing, storage and use shall comply with the requirements of the relevant appendix attached to the present specification.
4. Each heat, lot (or so called batch herein) of consumables shall be supplied in 3.2 certification according to [EN 10204 Std](#). Mill test certificates from consumables Manufacturers showing test results actually obtained on the said lot shall be submitted to the Inspector for approval. Mill certificates shall include the following minimum information:

- Chemical composition
- Mechanical properties
- Granulometry and particle size distribution for flux.

The lot and the level of testing shall conform the following requirement as specified in [AWS A5.01: 1993](#):

- Bare solid electrodes and rods: class S3
- Flux for submerged arc welding: class F2.

The level of testing shall be as per [AWS A5.01: 1993](#) - § 6.5 - Schedule-I as a minimum.

Note: For SAW, re-cycling of flux is not permitted.

5. All welding consumables shall be supplied in sealed, dirt and moisture proof containers.
6. All welding consumables shall be, as a minimum, stored and handled in accordance with the written Manufacturer's recommendations. Contractor's procedure relative to storing, handling, drying, recycling and traceability of consumables shall be approved by the Inspector before starting production welding.
7. Each tin or packet of electrodes, or reel of filler wire and bag of flux shall be clearly marked with the respective batch no. In the event of consumables being unmarked or showing signs of deterioration or other damage, they shall be discarded.
8. Each batch of welding consumables shall be tested as for a PQR. Tests shall address the weld metal only (Lot(s) tested during PQR shall be considered as tested).
No retests shall be permitted unless an explanation for the failure is accepted by the Company.
9. The weld deposits obtained from these consumables shall satisfy the requirements of this specification.
10. Super duplex consumables shall not be used for weld filling and capping on duplex base metal.



6.5.2 Consumables storage

Welding consumables shall be stored with care on a specific separate area, under dry conditions in their original unopened packing. After opening of containers, storage and handling of electrodes, fluxes and other welding materials shall be as specified in the Manufacturer's recommendations.

Electrode, filler wire or fluxes that are damaged, damped, with grease or oxidised must not be used.

Temperature and humidity shall be controlled and recorded on a daily basis in welding consumable storage room.

Unopened containers shall be stored in a dry location where a temperature of 20°C and humidity of less than 40% are monitored.

Flux shall be stored in calibrated ovens at the temperature between 120°C and 150°C after opening of the packing. Submerged arc flux shall not be recycled.

All welding consumable, which has been in direct contact with water, shall be definitively rejected.

All in coming and outgoing consumables shall be recorded on specific data log on a daily basis.

7. Base materials

Pipes fittings supplied by Company are defined in Company General Specifications listed in § 2 of this specification, and in relevant PPS.

Unless otherwise stated in PPS, pipes and fitting supplied by Company will be finished with bevelled ends and with internal reinforcement of the longitudinal weld (if any) removed for a minimum distance of 50 mm from the ends. If the Contractor elects to weld the pipes using a bevel design different from the one supplied, then any cost in re-bevelling shall be for Contractor account.

8. Welding documents

8.1 Welding Book

The welding book including repair procedures shall be submitted as soon as possible after the award of work, prior to any fabrication or any parts of pipelines and sufficiently ahead before welding activity takes place for Company's approval.

Only the WPS signed by Company shall be used for fabrication.

Welding procedure qualification record shall be a part of the welding book.

The welding book shall be re-issued to Company upon any new revision issuance.

8.2 Welding Procedure Specifications (WPS)

Applicable welding procedure specifications shall make reference to the relevant pipeline reference and shall indicate the diameter and thickness range as appropriate.

A welding procedure is defined as the method and sequences to be adopted to achieve a satisfactory welded joint when carried out by a competent workman under the expected conditions of manufacture. All welding procedures submitted to the Company shall include the



actual welding details including all of the essential and non-essential variables and in particular the weld preparation including dimensional and tolerances and the beads sequence.

In case of automatic or automatised processes, the oscillation width, dew time and frequency shall be indicated.

The actual welding parameters shall remain within the qualified ranges (PQR).

Weld procedures shall mention the actual consumable or flux trade name and type as well as the AWS designation and batch number.

The welding procedure shall be issued on **API RP 1104** basis or equivalent.

9. Welding Procedure Qualification

9.1 General

All welding procedures shall be qualified in accordance with the requirements of **API RP 1104**, the present General Specification and relevant PPS.

Existing welding qualifications shall not be accepted, and all welding procedures shall be qualified for the present job unless previously agreed by Company.

All welding procedure qualification tests shall be conducted in the presence of the Inspector.

The Contractor shall notify the Company of the date and location of the welding procedure qualification tests at least seven (7) working days before the start of the tests.

Disregarding the welding process or combination applied, a minimum of 3 consecutive welds are required. Those tests welds shall be inspected with the same NDT methods as for WPQ (see § 9.3.1.1) without any rejectable indications.

9.2 Essential variables

The following additional changes in the qualified procedure shall also require re-qualification of the procedure:

- Any change in company which performed the qualification test or site where the qualification test weld was produced.

For on-line barge welding (automatic welding), procedure approval test welds shall be made on the pipelay barge. Each pass shall be deposited at the welding station intended to be the normal location for it in production welding.

However, this requirement may be waived and qualification tests may be carried out under simulated site conditions if the same equipment are used and if the specified welding procedure is fully reproduced and representative of site work (removal of line-up clamp, time lapse between passes, pipe movement, etc.) to the satisfaction of Company. This shall be clarified by Contractor and agreed with Company at the bid stage.

- Test welds shall be made between full pipe lengths. The use of less than full pipe lengths requires the prior agreement of Company. Anyway, the minimum length of each pipe to be used shall not be less than three (3) metres.
- Any internal high-low exceeding 2.0 mm (refer to § 8.1).