

GENERAL SPECIFICATION

PIPELINES - RISERS

GS EP PLR 244

Fabrication of Duplex & Super-Duplex Stainless Steel Seamless Hot Bend for Pipeline
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1. Scope

This specification defines the Company's general requirements for the manufacture, supply and inspection of bare Duplex and Super-duplex stainless steel butt welding bends that are shop fabricated by induction bending for use in the construction of onshore or underwater pipelines for crude oil, gas, multiphase or condensate effluents, using seamless pipes or longitudinally submerged arc welded pipes operating in:

- Sweet Service
- Sour service environments in compliance with paragraph 10.3 of [GS EP COR 170](#)
- It applies to bends in Grade 22Cr Duplex (UNS 31803 / [API SPEC 5LC](#) LC65-2205) and Grade 25Cr Duplex (UNS 35750 / UNS 32760 / [API SPEC 5LC](#) LC80-2507).

This specification shall be used in conjunction with a so-called Project Particular Specification (PPS) detailing the additional tests and requirements or the possible modifications to the present specification, based on the particular design conditions of the pipeline Project (see paragraph 3.2 in this specification).

Applicable Standards are:

- [API SPEC 5LC](#) for onshore pipeline
- [API SPEC 5LC](#) and [DNV-OS-F101](#) for offshore pipeline.

The present specification shall also apply to mother pipes whatever they are free issued by the Company to the Supplier, or they are directly procured by the Supplier.

Mother pipe and bends shall not be dissociated from main line pipe order (i.e. unique Supplier for main line pipes, mother pipes and bends).

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 order of precedence of the applicable documents shall be:

- The Purchase Order/Requisition
- The Project Particular Specification (PPS see paragraph 3.2)
- The present General Specification
- The Codes and Standards in reference.

Applicable Codes and Standards, which are to be used in conjunction with this specification, are stated in tables hereafter.

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

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Where this specification states no overriding requirements, the referenced Codes and Standards shall apply in full.

Standards equivalent to those referred to herein shall not be substituted without written Approval from the Company.

The Supplier shall equip himself with copies of all the reference specifications referred to in this specification and shall make them readily available to all fabrication, testing and inspection personnel involved on the work.

Note: The specification **GS EP COR 170** is mentioned herein for amendment of **ISO 15156-3** paragraph 10.3 Table A.24.

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 5L1	Recommended Practice for Railroad Transportation of Line Pipe
API RP 5LW	Recommended Practice for Transportation of Line Pipe on Barges and Marine Vessels
API SPEC 5LC	Specification for CRA Line pipe
API SPEC 6A	Specification for wellhead and Christmas tree equipment
ASME BPVC Section V	ASME Boiler and Pressure Vessel Code, Section V: Nondestructive Examination
ASTM A923	Standard Test Methods for Detecting Detrimental Intermetallic Phase in Duplex Austenitic/Ferritic Stainless Steels
ASTM A991	Standard Test Method for Conducting Temperature Uniformity Surveys of Furnaces Used to Heat Treat Steel Products
ASTM E562	Standard Test Method for Determining Volume Fraction by Systematic Manual Point Count
BS 7448-1	Fracture mechanics toughness tests. Method for determination of K _{Ic} , critical CTOD and critical J values of metallic materials
DNV-OS-F101	Submarine pipeline system
DNV-RP-F112	Design of duplex stainless steel subsea equipment exposed to cathodic protection
EN 10160	Ultrasonic testing of steel flat product of thickness equal or greater than 6 mm (reflection method)
EN 10204	Metallic products - Types of inspection documents
ISO 10893-4	Non-destructive testing of steel tubes - Part 4: Liquid penetrant inspection of seamless and welded steel tubes for the detection of surface imperfections

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Reference	Title
ISO 11699-1	Non-destructive testing - Industrial radiographic film - Part 1: classification of film for industrial radiography
ISO 15156-3	Petroleum and natural gas industries - Materials for use in H ₂ S-containing environments in oil and gas production - Part 3: Cracking-resistant CRAs (corrosion resistant alloys) and other alloys
ISO 15590-1	Petroleum and Natural gas Industries - Induction bends, fittings and flanges for pipeline transportation systems - Part 1: Induction bends
ISO 9712	Non-destructive testing - Qualification and certification of NDT personnel
ISO/TS 29001	Sector-specific quality management systems - Requirements for product and service supply organizations
NORSOK M-650	Qualification of manufacturers of special materials

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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 170	Materials for upstream sour service application. Specification for selection and design
GS EP PLR 242	Fabrication of Duplex & Super-Duplex Stainless Steel Seamless Pipe for Pipeline
GS EP PLR 243	Fabrication of Duplex & Super-Duplex Stainless Steel Seam Welded Pipe for Pipeline
GS EP PLR 425	Site welding of carbon steel pipelines (sweet and sour service, onshore and offshore) according to API STD 1104
GS EP PLR 426	Site welding of carbon steel pipelines (sweet and sour service, onshore and offshore) according to API STD 1104
GS EP PVV 175	Cleaning of piping and vessels

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3. General

3.1 Definitions

Company	TOTAL E&P or agents acting on its behalf, shall be referred to herein as the "Company".
Supplier	The Companies, or their agents including steel and pipe Manufacturers, designated on the Purchase Order form or Contract as being. The selected supplier of the said materials and pipes shall be referred to herein as the "Supplier".
Inspection Agency	An independent inspection body (other than any inspection department of the Supplier or any Inspection Agency subcontract by him), or its members, who shall be appointed by Company and thus notified to Supplier.
Inspector	The Company's inspector(s) or the inspector(s) from an independent Inspection Agency duly appointed by the Company to act on its behalf for the purpose of the Contract shall be referred to herein as the "Inspector".
Mill	The plants, Mills, workshops, laboratories or other locations where the fabrication, inspection and testing of materials and products are to be performed complete or in part, shall be referred to herein as the "Mill".
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".
Approval	Authorization in writing given by the Company to the Supplier on a procedure or to proceed with the performance of a specific part of the work without releasing in any way the Supplier from any of his obligations or liabilities under the Contract or at law. The words Approve, Approved and Approval shall be construed accordingly.
Mother Pipe	The original pipe or base pipe used for fabricating the bend or any portion of it shall be referred to herein as the "mother pipe".
PPS	Used to designate the Project Particular Specification.
Checking	Means that inspection consists to verify that the said dimension is within the permitted tolerances (exact dimension is not required) e.g., go - no go gauge check.
Measurement	Means that a real measurement is carried out and a precise figure is obtained as a result of it.
Recording	Means the value of actual measurement as above is recorded and filed.
SCC/SSC	Stress Corrosion Cracking / Sulfide Stress Cracking

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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.

3.2 Project Particular Specification (PPS)

The Project Particular Specification (PPS) shall define:

1. Applicable Standard
2. Steel Grade
3. Type of processing (seamless, JCO, Press bending, Roll bending...)
4. Required as-delivery condition/heat treatment of plates / pipes
5. The sour service severity and pipeline effluent to clarify the H₂S test conditions (see paragraph 9.4.11)
6. The type(s) of pipeline(s) onshore or offshore
7. Specified minimum wall thickness of bends to be supplied
8. Nominal Inside Diameter and minimum bore (or gauge) of pipeline and bends
9. Radius of curvature and angle of bends
10. Minimum length of tangential ends. Minimum length to be not less than 500 mm in the general case. However, in fatigue sensitive areas, tangent length requirements might have to be increased (to be stated in the PPS) to allow excluding girth weld from fatigue sensitive areas
11. Profile and dimensions of beveled ends (refer to paragraph 9.3.8)
12. Routine test temperature for impact tests (refer to paragraph 9.4.4, Appendix 6 and Appendix 5)
13. Maximum operating temperature
(**Note:** Should the MOP be 50°C or more then, additional tensile tests shall be performed see paragraph 9.4.2)
14. Any other information or particular tests to be carried out with related requirements (e.g. weldability tests, bending tests, etc.)
15. Number of originals and copies of Mill certificates and final production report (refer to paragraph 14.2).

The PPS shall include the Data Sheet of bends (see Appendix 6).

Note: Angles and number of bends should also be defined in the Requisition.

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3.3 Approval of Supplier's Procedures

The Supplier shall submit the following documentation for review and approval by the Company one month, at least, before production commences:

- a) A detailed Manufacturing Procedure Specification (MPS), describing all proposed fabrication and inspection operations in their correct sequence.
- b) The Bending Procedure shall include the essentials parameters and the associated methods of controlling, monitoring and recording, not limited to, such as:
 - Nominal OD of mother pipes
 - Nominal WT of mother pipes
 - Minimum WT of mother pipes
 - Steel grade
 - Intrados and extrados temperatures during bending sequence
 - Distance in between HF inductor and pipe body (Extrados/Intrados)
 - Bending Heat Inputs (Volts, Amps, Frequency)
 - Travelling speed for bending
 - Induction heating to tangent lengths (if any).

The Manufacturing Procedure shall also mention the characteristics of equipment used to carry out above-mentioned operations.

- c) Detailed Post Bending Heat Treatment (PBHT) procedures shall include not limited to, loading sketches, location of thermocouples, transfer time, temperature before quenching, etc.
- d) Non-destructive testing procedures (including inspection procedures to be used on bend body, weld seam and bend ends).
- e) Proposals for mechanical testing, namely on trial bends and/or on production bends.
- f) Dimensional procedures.

Once the Bending Procedure Specification (BPS) is approved by Company, that procedure shall be qualified. Finally, Vendor shall issue the relevant Bending Procedure Qualification (BPQ) for Company approval prior to start with fabrication.

Once a procedure is qualified, Vendor will not be allowed to modify those qualified procedure without the written Approval of the Company.

The Supplier shall submit, at the bid stage, to Company's prior approval any deviations to requirements specified in applicable technical specifications

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3.4 Quality Assurance/Quality Control

3.4.1 Company approval

Supplier(s) shall be qualified by Company (HQ Pipeline & Riser Department). Non-approved Supplier(s) shall not be considered on Company projects.

All sub-Contractors (e.g. mother pipes for bends, etc, machining, non destructive examination, etc.) shall be clearly identified at the bid stage and shall also be approved by Company.

3.4.2 Quality Control

1. The Supplier shall operate a Quality Management System (QMS) in accordance with [ISO/TS 29001](#), approved by a recognized authority to ensure the requirements within this specification can be reliably and consistently satisfied.
2. Supplier shall take full responsibility to ensure the quality of sub-contracted works to their sub-Contractors.
3. The Quality Manual (QM) shall be submitted prior to the start of work. The Supplier's quality system shall include provision for the QM of raw materials, intermediate products, manufacturing process, and final inspections.
4. Four weeks prior to commencement of the bends manufacture, the Supplier shall prepare and submit a Quality Control Plan which describes the inspections to be performed during the supply of bends. The Quality Control Plan shall set forth "Witness", "Hold", "Review", and "Monitor" points and as minimum shall include:
 - All principal production, inspection and testing activities
 - Location of each activity
 - Associated procedure or specification including acceptance criteria governing the activity
 - Verifying document to be used for recording inspection and test results
 - Intervention point of all involved bodies (e.g. Contractor, Supplier, Third Party Inspection / Certifying Authority, Company...).
5. At bending mills: offices, workshops, laboratory, storage yards, etc., information on paper and/or in computers (procedures, working instructions, data, records, tracking system, etc.) concerning the order manufacturing and inspection, shall be made fully available and comprehensible to Inspector reading. Where the mill country language is not English, all these information shall be written in double language, i.e. mill country language and English language.
6. Just before production starting, mill QA Representative accompanied by Inspector shall check at every production and inspection station, that the relevant working instructions and procedures are available, complete, conform to the procedures agreed by Company or to Company specification requirements. A report shall be issued by Supplier, signed by Inspector and enclosed with the final dossier.

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4. Inspection by the Company

1. All procedures shall have prior approval of the Company. All qualification tests shall take place under the supervision of the Inspector.
2. The Supplier shall notify the Inspector sufficiently in advance to enable him to be present at qualification tests and at all other tests or stages of manufacture subject to acceptance in accordance with this specification.
3. The Supplier shall ensure that the Inspector has full and free access to all parts of the Mill during all fabrication stages.
4. The Inspector shall ensure that materials and pipes are fabricated in accordance with all the specified requirements and Company's approved procedures.
5. The Inspector shall be provided with facilities/equipments for sending and receiving faxes, communicating by @mails and fast Internet access.
6. Inspection by the Inspector shall be carried out during bends production in order to avoid any special or additional handling. Inspection will be made in such a manner to avoid delay in pipe production insofar as the bends which are presented to him meet the specified requirements.
7. The Inspector shall finalize (when required) its inspection by the application of a special stamp (or indelible paint marking, when so previously agreed). Die stamping is permitted only on the bevel surface.
8. The Inspector shall notify the Company without delay of any difficulty, irregularity, problem or delay likely to occur during pipe production.
9. The Company reserves the right to check tests carried out by the Supplier. For this purpose, the Company may request the delivery of the corresponding samples or specimens to be analyzed in an independent laboratory chosen by the Company.
10. The clause G4 of Appendix G of [API SPEC 5LC](#) shall fully apply.

5. Materials

Mother pipes for bends shall be supplied following requirements with appropriate wall thickness (refer to Company General Specification [GS EP PLR 242](#) or [GS EP PLR 243](#) and related Project Particular Specifications). Any deviations to line pipe specifications shall be submitted to Company.

A full definition of mother pipes shall be as follows:

- Chemical composition (including weld seam if any)
- As-delivery condition (pipes, plates, welds seam...)
- I.D & OD
- WT
- Manufacturing process
- Mother pipe Supplier

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- Mechanical properties
- NDT results.

In all cases, the Supplier shall submit the material Mill test certificates of mother pipes for review and Approval by the Company prior to commencing bend manufacture.

For sour service application, SSC/SCC tests are not required on mother pipes. However, those tests are required on finished bends refer to paragraph 9.4.11 & Appendix 6.

Mother pipe microstructure shall not exhibit carbides segregation or detrimental phases. Micrography X 100 in longitudinal direction shall be made available to Company before starting of production.

Wall thickness of mother pipes shall be selected so that to compensate for the thinning produced by the bending operation and also to avoid any internal misalignment in excess of ± 1.6 mm between bend and matching pipe.

No girth weld shall be present in mother pipes.

Welded pup pieces are not permitted.

6. Particular precautions

Contact between stainless steel and carbon steel is prohibited during all stage of bends fabrication (including stages before pickling and passivation).

All the tools, except machining tools, shall not be cause of pollution by carbon steel or other grade of alloy steel. The following precautions shall be implemented:

- Dedicated grinding disk for stainless or duplex steel shall be used
- Wires of brush shall be stainless steel
- Lines pipes shall be cleaned internally and all foreign material shall be removed by means of special tools
- Cutting shall be carried out only by plasma or by mechanical sawing*.

In case of condensation on materials, humidity shall be eliminated before starting the heating.

To prevent any oxidation the use of any flame heating device is prohibited.

Oil, moisture, rust, scale, paint or other foreign matter shall be removed from the entire bend surface prior bending.

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

Paint and markers containing zinc or chloride are prohibited.

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

The bevels shall be prepared by machining. In case of thermal cutting, heat-affected zone shall then be removed by machining.

* Chloride content in machining oil shall be limited to 10 ppm.