



Document No.	GIS 43-315
Applicability	Group
Date	30 May 2007

GIS 43-315

22% and 25% Chromium Duplex Stainless Steel Seamless Linepipe - Supplement to API 5LC, 3rd Edition

Guidance on Industry Standard

**BP GROUP
ENGINEERING TECHNICAL PRACTICES**

Foreword

This is the first issue of Engineering Technical Practice (ETP) BP GIS 43-315. This Group Instruction for Supply (GIS) is newly created and not based on heritage documents from the merged BP companies. This document is not to be used as a standalone document. It shall be used in accordance with the requirements of GP 43-31 and PR 43. BP Group Standards (gHSEr, Integrity Management Functional Standard, etc.) dictate requirements which must be satisfied in addition to the requirements of these ETP documents. This GIS shall be used in conjunction with DS 43-315, the Data Sheet for Line Pipe (22% and 25% Chromium Duplex Stainless Steel Seamless), detailing the design conditions and mechanical property requirements.

The fundamental requirements of BP are to insure that the linepipe shall have good weldability and close dimensional tolerances at welding ends to facilitate possible mechanised welding during pipeline installation.

Copyright © 2007, BP Group. All rights reserved. The information contained in this document is subject to the terms and conditions of the agreement or contract under which the document was supplied to the recipient's organization. None of the information contained in this document shall be disclosed outside the recipient's own organization without the prior written permission of BP Group, unless the terms of such agreement or contract expressly allow.



Downloaded Date: 6/17/2008 11:00 AM

The latest update of this document is located in the BP ETP and Projects Library

Page 2 of 40

Documents
Document Sharing Hub

Table of Contents

	Page
Foreword	2
Introduction	7
1 Scope	8
1.1 Coverage	8
1.6 Quality management	8
1.7 Symbols and abbreviations	9
2 Referenced standards	9
2.4 Referenced standards	9
3. Definitions and terms	10
3.7 Manufacturer	10
3.9 Pipemill	10
3.13 Approve	10
3.14 BP	10
3.15 BP Technical Representative	10
3.16 Tenderer	10
3.17 Supplier	10
3.18 Steelmaker	10
3.19 Quality Assurance	10
3.20 Quality Manual	10
3.21 Quality Plan	11
3.22 Quality System	11
3.23 Will	11
5 Process of manufacture and material	11
5.1 Process of manufacture	11
5.2 Cold expansion	11
5.3 Heat treatment	11
6. Chemical properties and tests	12
6.1 Composition	12
6.2 Heat analyses	12
6.3 Product analysis	12
6.4 Recheck analyses	13
6.7 Test reports	13
7 Mechanical properties and tests	13
7.1 Mechanical properties	13
7.2 Tensile tests - General	13
7.3 Tensile tests	13
7.4 Longitudinal tensile tests	13
7.5 Transverse tensile tests	14



7.7	Control tensile tests	14
7.8	Retests	14
7.20	Hardness tests (LC52-1200)	14
7.21	Fracture toughness tests.....	14
7.22	Charpy test frequency	15
7.23	Charpy retests	15
8	Special tests	15
8.1	Ferrite/austenite ratio for duplex stainless steels.....	15
8.3	Sulphide stress cracking (SSC) testing	15
8.4	Stress corrosion cracking (SCC) and pitting corrosion tests	15
9	Hydrostatic tests	16
9.1	Inspection hydrostatic test.....	16
9.2	Verification of test	16
9.3	Test pressures	16
9.4	Supplementary hydrostatic tests	16
10	Dimensions, weights, and lengths.....	16
10.2	Diameter	16
10.5	Length.....	17
10.6	Straightness.....	17
10.7	Jointers	17
10.8	Pipe ends.....	18
11	Non-Destructive Inspection.....	18
11.2	Inspection methods for seamless pipe	18
11.6	Operator certification.....	18
11.16	Ultrasonic and electromagnetic inspection of seamless pipe.....	19
11.18	Dye particle inspection of seamless pipe	20
11.19	Residual magnetism	20
12	Workmanship, visual inspection, and repair of defects.....	20
12.3	Workmanship.....	20
12.4	Visual inspection	20
12.5	Defects	21
12.6	Repair of defects.....	21
13.	Marking and surface treatment	21
13.1	Marking - general.....	21
13.2	Location of markings.....	21
13.3	Sequence of markings	21
13.5	Die stamping.....	22
13.6	Surface treatment	22
13.8	Colour identification	22
14	Pipe handling and storage	22
15	Documents	23
	Appendix B—Minimum elongation values	24
	Table B-1—Minimum elongation values.....	24



Appendix D—Supplementary requirement(s)	25
SR15 Test certificates for CRA linepipe	25
Appendix F—Purchaser inspection	26
F.2 Plant access	26
F.4 Rejection.....	26
Appendix H—Sulphide stress cracking (SSC) test procedure	27
H.1 Introduction	27
H.2 SSC test method.....	27
H.3 Reagents	27
H.4 Gases	27
H.5 Test solution preparation.....	28
H.6 Test vessels and solution volume	28
H.7 Test temperature.....	28
H.8 Test pieces	28
H.9 Number of tests	28
H.10 Applied stress	29
H.11 Test duration.....	29
H.12 Failure appraisal	29
H.13 Data reporting	29
Appendix I—Autoclave stress corrosion cracking (SCC) test procedure	30
I.1 Introduction	30
I.2 SCC test method.....	30
I.3 Reagents	30
I.4 Gases	30
I.5 Test solution preparation.....	30
I.6 Solution volume	31
I.7 Test temperature.....	31
I.8 Test pieces	31
I.9 Number of tests	31
I.10 Applied stress	31
I.11 Test duration.....	31
I.12 Failure appraisal	32
I.13 Data reporting	32
Appendix J—Autoclave corrosion/pitting corrosion test procedure	33
J.1 Introduction.....	33
J.2 Test method.....	33
J.3 Reagents	33
J.4 Gases	33
J.5 Test solution preparation.....	33
J.6 Solution volume	34
J.7 Test temperature.....	34
J.8 Test pieces and specimen preparation.....	34
J.9 Number of tests	34
J.10 Test duration.....	34



J.11	Data analysis	34
J.12	Data reporting	35
Appendix K—	Manufacturing procedure specification checklist.....	36
K.1	Steel supply	36
K.2	Pipe forming.....	36
K.3	Traceability	36
K.4	Non destructive inspection equipment.....	36
K.5	Mechanical testing	37
K.6	General inspection detail.....	37
Appendix L—	Scope of manufacturing procedure qualification testing	38
L.1	Test pipe	38
L.2	Additional tests	38
Appendix M—	Example of data sheet for line pipe (22% and 25% chromium duplex stainless steel seamless)	39

List of Tables

Table 4a:	Chemical requirements for heat analyses of 22% Cr duplex stainless steels, percent ...	12
Table 4b:	Chemical requirements for heat analyses of 25% Cr duplex stainless steels, percent ...	12
Table 4c:	Chemical requirements for heat analyses of 25% Cr super duplex stainless steels, percent.....	12
Table 7.1:	Tensile test requirements	13
Table 7.21:	Fracture toughness test temperature requirements	15



Introduction

- a. Guidance for 22% and 25% chromium duplex stainless steel seamless linepipe is based on API Specification 5LC, Specification for CRA Linepipe, third edition, 1998. References within Spec 5LC to other materials and pipe produced by other manufacturing techniques shall be disregarded.
- b. Guidance statements of this GIS are modifications to API Spec 5LC.
- c. Modifications to API Spec 5LC are identified as Add, Modify to Read, or Delete.
- d. Paragraph numbers in this GIS correspond to API Spec 5LC.
- e. Paragraphs of API Spec 5LC that are not revised remain applicable.
- f. If conflicts arise between the requirements of this GIS and API Spec 5LC, those defined in this GIS shall apply.



1 Scope

1.1 Coverage

Modify Second Paragraph to Read

This specification defines the requirements for seamless 22% and 25% chromium duplex stainless steel linepipe for use in flowlines and export pipelines in oil and gas transmission systems in which CO₂ corrosion is a major concern. References to other materials and pipe produced by other manufacturing techniques shall be disregarded.

These steels have excellent CO₂ corrosion resistance even at high levels of CO₂ and at elevated temperatures.

These steels cannot be considered fully sour resistant. However some grades are resistant to mildly sour conditions (e.g. ISO 15156/ NACE MR0175 quotes a limit of 0.20 bara (3 psia) H₂S partial pressure in the case of 25%Cr super duplex stainless steel. Some grades can be used beyond this for some service conditions).

The sour service suitability must be evaluated on a case-by-case basis; Section 6 and the BP Appendices H to J provide guidance on possible requirements.

This specification may also be used to define the requirements for mother pipe for the subsequent manufacture of hot-formed bends for similar applications.

Add

1.6 Quality management

The Supplier, Steelmaker, and Pipemills shall operate a quality system which ensures that the requirements of this Specification can be met reliably and consistently.

The Supplier's Quality System shall include provision for the QA of raw materials, intermediate products, pipe manufacture, and final inspections. The plan shall be subject to approval by BP before manufacture.

The effectiveness of the QA System shall be subject to monitoring by BP and may be audited following an agreed period of notice.

The linepipe shall be made in accordance with the Manufacturing Procedure agreed and qualified before contract between the Supplier and BP.

If required by the Purchase Order, the Steelmaker and Pipemill shall carry out a Manufacturing Procedure Qualification in accordance with Appendix L. The qualification will be witnessed by an authorised representative of BP. No change shall be made to a successfully qualified Manufacturing Procedure without the approval of the BP Technical Representative. After such approval, BP may require appropriate procedure qualification to be carried out on the new Manufacturing Procedure.

Qualification tests may be taken from a pre-production run or the first day's production as agreed by BP. Pipe made from a successful pre-production run may be supplied as part of the order.

Test certificates and other formal documents shall use either SI or US Customary as defined in the Data Sheet for Line Pipe (22% and 25% Chromium Duplex Stainless Steel Seamless). If necessary, the additional conversion factors listed in Appendix M of API 5L may be used to achieve this. Regardless of the actual units of measurement, measuring and testing equipment shall be calibrated and certified as part of the QA System.

Supporting data shall be supplied, demonstrating the suitability of the linepipe for field welding by either shielded metal arc welding (SMAW), gas tungsten arc welding (GTAW), or mechanized/ semi-automatic welding, typically by the gas metal arc welding (GMAW) process,



both with and without post weld heat treatment. The appropriate post weld heat treatment temperature for material supplied in accordance with this Specification shall be advised. The data supplied shall include the results of testing equivalent to that defined in Appendices H to J.

If such data does not exist, BP may require additional quality management tests to demonstrate the weldability of the steel.

1.7 Symbols and abbreviations

For the purpose of this specification, the following symbols and abbreviations apply:

4PB	Four point bend
HV	Hardness Vickers
DPI	Dye Penetrant Inspection
NDE	Non Destructive Examination
SI	System International d'Unites

2 Referenced standards

2.4 Referenced standards

API Add

API Spec 5L Specification for Line Pipe

ASTM Add

ASTM E165 Standard Test Methods for Liquid Penetrant Examination

ASTM G39 Standard Practice for Preparation and Use of Bent-Beam Stress Corrosion Test Specimens

Add

European Federation for Corrosion (EFC)

EFC Publication No.17 "Corrosion Resistant Alloys for Oil and Gas Production: Guidelines on General Requirements and Test Methods for H₂S Service"

International Organization for Standardization (ISO)

ISO 7539-1 Corrosion of Metals and Alloys – Stress Corrosion Testing – Part 1: General Guidance on Testing Procedures

ISO 10124 Seamless and welded (except sub-merged arc welded) steel tubes for pressure purposes - Ultrasonic testing for the detection of laminar imperfections

ISO 15156 Petroleum and natural gas industries (Oil & Gas) – Materials for use in H₂S-containing environments in oil and gas production (NACE MR0175)

NACE International (NACE)

NACE TM0177 Laboratory Testing Method for Resistance to Sulphide Stress Cracking in H₂S Environments



3. Definitions and terms

3.7 Manufacturer

Modify to Read

A Pipemill accepting a purchase order or Contract from BP to supply linepipe (in which case Manufacturer and Supplier are one and the same entity) or from a trading house or steel merchant to whom BP have awarded a Contract. The duties of a Manufacturer may include responsibility for technical and quality matters relating to steelmaking and the supply of blooms or billets from which the pipe is manufactured.

3.9 Pipemill

Modify to Read

The company manufacturing, testing, finishing, and supplying linepipe to BP and the facilities at which these activities are conducted.

Add

3.13 Approve

As applied to BP, is used if BP wishes an action by the Supplier to be notified and agreed in writing, before the subject action is implemented. This does not imply that all details of a document have been considered by BP and does not mitigate the responsibilities of the Supplier, which are covered separately by BP, as appropriate in the Conditions of Contract.

3.14 BP

BP p.l.c. and their associates.

3.15 BP Technical Representative

A BP specialist engineer, appointed to produce the linepipe specification appropriate for the pipeline design and application and to resolve queries concerning application.

3.16 Tenderer

A Steelmaker, Pipemill or their agent, or trading house acting on behalf of the Manufacturer or Pipemill, to whom an enquiry has been issued.

3.17 Supplier

A Tenderer, whose tender has been accepted and to whom a Purchase Order or Contract to supply linepipe has been awarded.

3.18 Steelmaker

The company manufacturing, refining and casting steel blooms or billets for subsequent pipe manufacture and the premises where these activities are carried out.

3.19 Quality Assurance

The planned and systematic actions necessary to ensure quality and provide confidence that a product or service will be fit for its intended purpose.

3.20 Quality Manual

A document setting out the general quality policies, procedures, and practices of an organisation.



3.21 Quality Plan

A document prepared by the Manufacturer or Supplier, setting out the specific quality practices, resources, and activities relevant to a particular contract or order.

3.22 Quality System

The organisation structure, responsibilities, activities, resources, and events that together provide organised procedures and methods of implementation to ensure the capability of an organisation to meet quality requirements.

3.23 Will

Normally applies to an action by BP.

5 Process of manufacture and material

5.1 Process of manufacture

Add

Only pipe produced by the seamless pipe manufacturing process shall be supplied.

The acceptable steelmaking routes for the production of 22% and 25% chromium duplex stainless steel seamless linepipe shall be either:

- a. Blast furnace refining followed by decarbonisation using both the Argon Oxygen (AOD) and Vacuum Oxygen (VOD) processes. If necessary, final adjustment of molten metal analyses and condition shall be carried out using the Ladle Treatment (LT) process, or
- b. Electric furnace melting and refining followed by AOD (if considered necessary), VOD and LT.

Blooms and billets for pipe rolling shall be produced by a continuous casting process that shall include adequate precautions to minimise the occurrence of centre-line segregation. Other casting processes may be offered for consideration by BP.

Surfaces of the bloom or billet shall be inspected visually for defects and scarfing shall be carried out, if necessary, to produce an acceptable surface for rolling. Pipe shall be rolled and/or heat-treated by processes which produce uniform and consistent mechanical properties and microstructure together with high toughness and good weldability.

If the steel, blooms, billets, and pipe are not processed in an integrated facility, the name and location of each manufacturing plant involved in the bid shall be declared.

a. Seamless and Centrifugally-Cast

Add

Cold sizing shall not be carried out without the prior approval of BP.

5.2 Cold expansion

Add

Unless otherwise approved by BP, seamless linepipe shall not be cold expanded.

5.3 Heat treatment

Add

The soaking time and temperature for the solution annealing treatment shall be agreed with BP. The heat treatment parameters shall be measured and recorded for each production lot.



6. Chemical properties and tests

6.1 Composition

Add

A preferred steel composition (heat and product analyses) for the specific material nominated on the Data Sheet for Line Pipe (22% and 25% Chromium Duplex Stainless Steel Seamless) shall be nominated for approval by the BP Technical Representative. The proposed analysis and the tolerances applied to each element shall also be subject to approval by the BP Technical Representative.

Modify Table 4 to Read

Table 4a: Chemical requirements for heat analyses of 22% Cr duplex stainless steels, percent

Carbon	0.030 max.	Manganese	2.0 max.
Silicon	1.00 max.	Sulphur	0.010 max.
Phosphorus	0.030 max.	Nitrogen	0.08 to 0.20
Nickel	4.5 to 6.5	Molybdenum	2.5 to 3.5
Chromium	21.0 to 23.0	PRE _w ^{*1}	30 to 40.

Table 4b: Chemical requirements for heat analyses of 25% Cr duplex stainless steels, percent

Carbon	0.030 max.	Manganese	1.0 max
Silicon	0.75 max.	Sulphur	0.010 max
Phosphorus	0.030 max.	Nitrogen	0.10 to 0.30
Nickel	5.5 to 7.5	Molybdenum	2.5 to 3.5
Chromium	24.0 to 26.0	Tungsten	0.10 to 0.50
Copper	0.20 to 0.80	PRE _w ^{*1}	30 to 40

Table 4c: Chemical requirements for heat analyses of 25% Cr super duplex stainless steels, percent

Carbon	0.030 max.	Manganese	1.0 max
Silicon	0.8 max.	Sulphur	0.010 max
Phosphorus	0.030 max.	Nitrogen	0.24 to 0.32
Nickel	6.0 to 8.0	Molybdenum	2.5 to 3.5
Chromium	24.0 to 26.0	Tungsten	1.5 to 2.5
Copper	0.20 to 0.80	PRE _w ^{*1}	40 to 45

*1. PRE_w = Cr% + 3.3(Mo% + 0.5W %) + 16 N%.

6.2 Heat analyses

Add

Each required analysis shall include the determination of each of the elements listed in Table 4, together with the analysis for any other elements whose addition has been approved by the BP Technical Representative.

6.3 Product analysis

Add

Product analyses, carried out on a sample representative of the full material thickness, shall be performed at a frequency of two pipes per heat. One of these analyses shall be performed on the first pipe rolled from each individual heat of steel.

Product analysis variation shall be as agreed in the Manufacturing Procedure Specification.

