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Guidance on Industry Standard for the Manufacture of CRA Clad or Lined Steel Pipe

GIS 43-316

BP GROUP
ENGINEERING TECHNICAL PRACTICES



Foreword

This is the first issue of Engineering Technical Practice (ETP) BP GIS 43-316. This Guidance on Industry Standard (GIS) is newly created and not based on heritage documents from the merged BP companies. This GIS 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 these ETP documents. This GIS shall be used in conjunction with DS 43-316, the Data Sheet for Line Pipe (CRA Clad or Lined), detailing the design conditions and mechanical property requirements.

The fundamental requirements of BP are to ensure that the clad/ lined pipe has good corrosion resistance, weldability, and dimensional tolerances at welding ends to facilitate possible mechanised welding during pipe lay.

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Introduction

- a. Guidance for CRA clad or lined steel pipe is based on API Specification 5LD, Specification for CRA Clad or Lined Steel Pipe, second edition, 1998.
- b. Guidance statements of this GIS are modifications to API Spec 5LD.
- c. Modifications to API Spec 5LD are identified as Add, Modify to Read, or Delete.
- d. Paragraph numbers in this GIS correspond to API Spec 5LD.
- e. Paragraphs of API Spec 5LD that are not revised remain applicable.
- f. If conflicts arise between the requirements of this GIS and API Spec 5LD, those defined in this GIS shall apply.



1 Scope

1.1 Coverage

Add to First Paragraph

The pipe may be made by any of the defined processes to provide an internal corrosion resistant alloy layer of guaranteed corrosion resistance and an external carbon steel pipe providing all mechanical integrity requirements for the design.

Add

The grades of CRA for clad or lined pipe may also include stainless steel grades 317L (UNS S31703) and 904L (UNS N08904).

For reference and clarity the material designations used in API Spec 5LD are often referred to in terms of standard stainless steel or high nickel alloy grade nomenclature:

- LC 1812 is equivalent to 316L (UNS S31603)
- LC 2205 is equivalent to 22%Cr duplex (UNS S31803)
- LC 2506 is equivalent to 25%Cr duplex (UNS S39226)
- LC 2242 is equivalent to Alloy 825 (UNS N08825)
- LC 2262 is equivalent to Alloy 625 (UNS N06625)

This Specification may also be used to define the requirements for mother pipe for the subsequent manufacture of hot formed clad bends.

The Purchase Order and the Data Sheet for Line Pipe (CRA Clad or Lined) identify which of the Sections apply to an order or particular items within an order. These also define specific technical details as indicated in this Specification, such as test temperatures for fracture toughness tests.

Add

1.4 Quality assurance

- a. The Supplier, Steelmaker, CRA maker, Plate Mills, and Pipemills shall operate a quality system that ensures that requirements of this Specification can be met reliably and consistently.
- b. 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.
- c. The effectiveness of the QA System shall be subject to monitoring by BP and may be audited following an agreed period of notice.
- d. The clad or lined pipe shall be made in accordance with the Manufacturing Procedure, as defined in Appendix N, agreed, and qualified before contract between the Supplier and BP.
- e. The Steelmaker and Pipemill shall carry out a Manufacturing Procedure Qualification in accordance with Appendix O. 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.
- f. Qualification tests may be taken, as agreed by BP, from a pre-production run or the first day's production. Pipe made from a successful pre-production run may be supplied as part of the order.



- g. Test certificates and other formal documents shall use SI or US Customary units as defined in the Data Sheet for Line Pipe (CRA Clad or Lined). If necessary, the 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.
- h. Supporting data shall be supplied, demonstrating the suitability of the clad/ lined pipe for field welding by either mechanized/ semi-automatic welding, typically by the gas metal arc welding (GMAW) process or by manual gas tungsten arc welding (GTAW) process. If such data does not exist, BP may require additional tests to demonstrate the weldability of the steel.
- i. Via the Manufacturing Procedure Specification and Quality Plan, a satisfactory system for the control, issue, use, and systematic recording of welding consumables used for the production of pipe shall be demonstrated.
- j. Effective QA to ensure consistent quality of incoming welding consumables shall also be demonstrated.

1.5 Symbols and abbreviations

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

CRA	Corrosion Resistant Alloy
DPI	Dye Penetrant Inspection
ERW	Electric Resistance Welded
HAZ	Heat Affected Zone
HFI	High Frequency Induction
HRc	Hardness Rockwell C
HV	Hardness Vickers
MPI	Magnetic Particle Inspection
MPS	Manufacturing Procedure Specification
MPQT	Manufacturing Procedure Qualification Testing
NDT	Non-Destructive Testing
PREN	Pitting Resistance Equivalent (N) = %Cr +3.3 x %Mo +16 x %N
PREW	Pitting Resistance Equivalent (W) = %Cr +3.3 (%Mo +0.5%W) +16 x %N
SAW	Submerged Arc Welded
SCC	Stress Corrosion Cracking
SI	System International d'Unites
WPS	Weld Procedure Specification
WPQT	Weld Procedure Qualification Test



2 Referenced standards

2.4 Normative standards

Add

BP

GIS 43-311	Guidance on Industry Standard for Longitudinal or Helical Seam Submerged Arc Welded Linepipe in Grades up to X80
GIS 43-312	Guidance on Industry Standard for High Frequency Induction or Electric Resistance Welded Linepipe in Grades up to X70
GIS 43-313	Guidance on Industry Standard for Seamless Linepipe in Grades up to X80
GP 18-02	Guidance on Practice for Storage and Control of Welding Consumable

American Society for Testing and Materials (ASTM)

ASTM A265	Specification for Nickel and Nickel-Base Alloy Clad Steel Plate
ASTM A578	Specification for Straight-Beam Ultrasonic Examination of Plain and Clad Steel Plates for Special Applications
ASTM E140	Standard Hardness Conversion Tables for Metals
ASTM E165	Practice for Liquid Penetration Inspection Method
ASTM E562	Practice for Determining Volume Fraction by Systematic Manual Point Count
ASTM E709	Practice for Magnetic Particle Examination
ASTM G28	Standard Test Methods of Detecting Susceptibility to Intergranular Corrosion in Wrought, Nickel-Rich, Chromium-Bearing Alloys

American Petroleum Institute (API)

API RP 5L3	Recommended Practice for Conducting Drop-Weight Tear Tests on Linepipe
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3 Definitions

3.1 Clad

Modify to Read

Refers to a metallurgically-bonded CRA layer produced by roll bonding or explosively cladding carbon steel plate.

3.4 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 supply of plate from which the pipe is manufactured.



3.6 Pipemill**Modify to Read**

The company manufacturing, testing, finishing, and supplying linepipe to BP, and its premises where these activities are conducted.

Add**3.10 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.

3.11 BP

BP p.l.c. and their associates.

3.12 BP Technical Representative

A BP specialist engineer appointed to produce the clad or lined pipe specification appropriate for the pipeline design and application and to resolve queries concerning application.

3.14 Quality assurance

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

3.15 Quality manual

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

3.16 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.

3.17 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.

3.18 Steelmaker

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

3.19 Supplier

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

3.20 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.



3.21 Will

Normally applies to an action by BP.

4 Process of manufacture and material**4.1 Process of manufacture****Modify to Read**

Clad or lined steel pipe furnished to this specification shall be seamless or welded, clad or lined. Welding consumables shall comply with GP 18-02.

4.1.b Base material for clad pipe**4.1.b.2 Centrifugally-cast****Delete**

This production route is not allowed.

4.1.b.3 Welded**Add**

Flat clad plate shall be transformed to clad pipe by forming and longitudinally welding in accordance with GIS 43-311 or an alternative arc welding process or combination of processes accepted by the BP Technical Representative.

If required, it shall be demonstrate that the proposed tack welding technique will not lead to any subsequent cracking of welds and that there will be no melting of the internal cladding layer.

Internal welding methods may include weld overlaying techniques such as strip cladding.

4.1.c Base material for lined pipe**Modify to Read**

Pipe backing material shall be manufactured by the longitudinally SAW, ERW/ HFI or seamless processes in accordance with GIS 43-311, 312, or 313.

4.2 Cold expansion**Add**

If applied, mechanical cold expansion of the finished pipe shall be used to impart a strain not exceeding 1.5% and should, unless otherwise agreed by the BP Technical Representative, be performed over the full pipe length before hydrostatic test.

Cold sizing, by shrinking, re-rolling, or pressing, of the finished pipe is permitted subject to the level of induced strain being less than 1.0%.

4.3 Heat treatment**Add**

Pipe may be supplied from clad plate made by a thermo-mechanically controlled process.

The inner pipe of lined pipe shall be provided in the solution annealed and quenched condition. Heat treatments shall be optimised and controlled to provide finished pipe meeting the full technical requirements.

In order to ensure that satisfactory corrosion properties are consistently achieved in the clad layer it is important to generate a high level of reproducibility in any heat treatment cycle.



Consequently, time and temperature tolerances associated with heat treatments shall be minimised.

Heat treatments shall be monitored for strict conformance to the MPS.

5 Chemical properties and tests

5.1 Composition

Add

The molybdenum content for LC 1812 (UNS S31603) shall be revised to 2.5% minimum.

Cladding or liner materials in addition to those given in Table 1 of API 5LD, for example stainless steels 317L (UNS S31703), or 904L (N08904), may be specified. The minimum molybdenum content of these alloys shall be revised to 3.5% and 4.5% respectively. Also included in the table is a typical composition for super-duplex, a further clad/ liner option that may be specified.

Table 1: Chemical requirements for heat analysis of CRA layer

UNS No.	C % max	Mn % max	P % max	S % max	Si % max	Ni %	Cr %	Mo %	N %	Cu %	W%
S31703	0.03	2.0	0.03	0.03	1.0	11.0 - 15.0	18.0 - 20.0	3.5 - 4.0	-	-	
N08904	0.02	2.0	0.03	0.03	0.50	23.0 - 28.0	19.0 - 23.0	4.5 - 5.0	-	1.0 - 2.0	
S39274	0.03	1.0	0.03	0.02	0.80	6.0 - 8.0	24.0 - 26.0	2.5 - 3.5	0.24 - 0.32	0.2 - 0.8	1.5 - 2.5

If required, the chemical composition of any alloy may be further restricted by specification of a minimum PREN. The limiting value for the appropriate parameter shall be as defined on the Data Sheet for Line Pipe (CRA Clad or Lined) and the actual value reported on the Material Test Certificate.

For super duplex material the minimum value of PREW shall be 40.

5.2 Heat analyses of the CRA layer

Add

The heat analysis of each heat of material used in the Manufacturer of the CRA layer shall be supplied.

5.3 Product analyses of the CRA layer

Add

The product analyses of the CRA layer and also of the backing steel may be taken from finished clad plate before production of welded clad pipe.

The as-deposited weld metal of the longitudinal seam CRA layer shall be analysed at a minimum frequency of two tests per lot of welding consumables.

5.4 Recheck analyses

Add

If the analyses of individual pipe lengths are checked, a full analysis for each of the elements listed in 5.1 shall be carried out.

