



Document No.	GIS 42-102
Applicability	Group
Date	3 May 2005

Guidance on Industry Standard for Fabrication, Assembly, Erection, and Inspection of Austenitic and Duplex Stainless Steel, Cupro-Nickel, Nickel Base Alloy, Titanium, and Zirconium Pipework (ASME B31.3)

GIS 42-102

BP GROUP
ENGINEERING TECHNICAL PRACTICES

Foreword

This is the first issue of Engineering Technical Practice (ETP) BP GIS 42-102. This Guidance on Industry Standard (GIS) is based on parts of heritage documents from the merged BP companies as follows:

British Petroleum

GS 118-7 The Fabrication, Assembly, Erection and Inspection of Austenitic and Duplex Stainless Steel, Cupro-Nickel, Nickel Base Alloy, Titanium and Zirconium Pipework to ASME B31.3.

Amoco

A PN-PLT-31.3-C Piping—Plant—ASME B31.3—Construction Specification.
A PN-PLT-31.3-CG Piping—Plant—ASME B31.3—Construction and Fabrication Guide.
A PN-PLT-31.3-P Piping—Plant—ASME B31.3—Fabrication Specification.

ARCO

Std 200 Piping Design.

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Introduction

- a. Guidance for fabrication, assembly, erection, and inspection of austenitic and duplex stainless steel, cupro-nickel, nickel base alloy, titanium, and zirconium pipework is based on American Society of Mechanical Engineers (ASME) B31.3, Process Piping, 2002:
 - 1. Chapter I Scope and definitions.
 - 2. Chapter V Fabrication, assembly, and erection.
 - 3. Chapter VI Inspection, examination, and testing.
- b. Guidance statements of this GIS are modifications to ASME B31.3.
- c. Modifications to ASME B31.3 are identified as Add, Modify to Read, or Delete.
- d. Paragraph numbers in this ETP correspond to ASME B31.3.
- e. Paragraphs of ASME B31.3 that are not revised remain applicable.



Chapter I Scope and definitions

300 General statements

300.1 Scope

300.1.3 Exclusions

Add

- (e) Sea transport.
- (f) Transmission pipelines in land or subsea locations, including risers.
- (g) Pipelines of significant length and diameter, e.g., transfer lines between processing units, storages, and jetties that are specified by BP to be engineered as main pipelines.
- (h) Production piping systems, as designated by BP.

Production piping is covered by BS EN 14161 and ASME B31.4.

- (i) Underground drainage systems.
- (j) Steam piping systems within plot limits of power stations and steam generating stations outside process areas.

Steam piping is covered by ASME B31.1 and BS EN 13480.

There is no ETP currently available to cover this category. However, guidance on these systems can be found in ACES A PN-BLR-31.1-E and BP OUS RP 5-5-4.

- (k) Heating, ventilating, and domestic water systems within buildings, including offshore accommodation modules.
- (l) Hydraulic systems.

300.4 Status of appendices

Table 300.4 Status of appendices in B31.3

Add

N	Fabrication requirements for 22%Cr and 25%Cr duplex stainless steel pipework	Requirements
O	Fabrication requirements for titanium and zirconium	Requirements



Chapter V Fabrication, assembly, and erection

327 General

Add

327.1 Quality assurance and positive material identification

327.1.1 Initial documentation

- a. Before commencing fabrication of pipework, fabricator shall prepare:
 1. Quality plan.
 2. Set of design documents.
- b. Both documents shall be subject to BP approval.
- c. These documents should normally include:
 1. Procedures for:
 - a) Storage and control of materials and welding consumables (Refer to GP 18-02).
 - b) Welding and nondestructive testing.
 - c) Mechanical working, heat treatment, and leak testing.
 2. Supporting qualification records.
 3. Illustration of proposed areas of application.
- d. Previously qualified welding procedures may be considered for use if they comply with this GIS document and are appropriate to proposed scope of work.
- e. Simplified welder instruction cards based on qualified welding procedures should be prepared for each welding process/material combination and issued to each welder.
- f. Quality plan shall include brief details and sequence of examinations that will be performed for fabricator.
- g. Names of individuals responsible for implementation of quality assurance and quality control functions shall be included.

Fabricators involved in simultaneous fabrication of carbon steel and alloy piping should submit positive material identification (PMI) document setting out how they maintain and verify identification of materials during fabrication. GIS 36-103 sets out requirements for a PMI system.

327.1.2 Production documentation

- a. Fabricator shall maintain production records using recording system approved by BP.
- b. Production records shall include:
 1. Material and welding consumable certificates.
 2. Post weld heat treatment records.
 3. Visual and dimensional inspection.
 4. NDT and pressure test records.



5. Isometric drawings marked up with weld numbers.
 6. Welder and welding operator qualification test records.
 7. Authenticated copies of NDT operators' certificates.
 8. Records of agreed concessions to fabrication standards.
- c. Upon completion of fabrication programme, records shall either be passed to BP or stored by fabricator, as directed by engineering design or fabrication contract.

327.2 Material control

- a. Fabricator shall inspect materials upon receipt and ensure that correct grade of material has been supplied and that identification, dimensions, material quality, and end preparation are in accordance with the requisite standards and specifications.
- b. Different materials shall be kept in discrete sections of storage area, and material shall be marked in a manner that allows it to be related to original manufacturer's certification.
- c. Procedures for transfer of material identification marks shall be agreed with BP prior to commencement of fabrication.
- d. Materials shall be stored above ground and kept free from dirt, grease, and other contaminants.
- e. Material that is not readily identifiable shall be removed from worksite and quarantined until material grade and source can be confirmed.

Positive identification and segregation of materials is an important issue.

327.3 Pipework marking

- a. Pipework shall be identified by indelible marking that is free from sulphur, chloride, and other halogens.
- b. If spools are subject to postweld heat treatment, suitable heat resisting paint shall be used.
- c. Vibroetching techniques may be used for identification transfer, but adhesive tapes or hard stamping, other than that with low stress stamps, shall not be used.
- d. Marking shall have minimum life of 1 year in covered, unheated, storage.
- e. Marking shall identify material and fabricator and include item number, enabling spool to be traced to relevant isometric drawing.

Guidance on suitable colours for identification of piping materials is in BS 5383.

327.4 Fabrication facilities

- a. Area used for fabrication shall be totally separate from that used for carbon and low alloy steel.
 1. Each alloy type shall be segregated during fabrication.
 2. Precautions shall be taken to prevent surface contamination by contact with jigs and fixtures manufactured in non compatible materials.
 3. Separate sets of clearly identified cleaning and grinding equipment shall be provided for each material.
- b. Shop layout, equipment, and production procedures shall be subject to BP approval, particularly if fabrication of titanium or zirconium is involved.



328 Welding**328.2 Welding qualifications****328.2.1 Qualification requirements**(a) Add

1. Welding procedure specifications and procedure qualification test results shall be subject to BP approval before commencement of fabrication.
2. Each procedure qualification record (PQR) shall be certified by recognised independent inspectorate.

SMAW, GTAW, and SAW processes are frequently employed for pipework fabrication and are considered to be acceptable welding techniques if used in accordance with this ETP. GMAW and FCAW processes are also often applied to piping fabrication. However, there are many variants of these two processes. In addition to ensuring adequate procedure qualification, it is important to ensure that the particular welding technique proposed for a given application is well proven and will only be used by qualified and experienced welders.

(d) Add

1. Unless specified otherwise by engineering design, duplex stainless steel piping materials, fittings, and weldments for design temperatures below 0°C (32°F) shall be subject to Charpy V notch impact testing, as detailed in Appendix N.
2. Minimum design temperature for duplex stainless steels shall be -50°C (-58°F).
3. Austenitic stainless steels shall not generally require Charpy V notch impact testing if minimum design temperatures greater than -196°C (-320°F).
4. If the possibility of toughness degradation as a result of post weld heat treatment exists (see 331.1.1), Charpy V notch impact testing is required for austenitic stainless steels.
5. Required impact energy for austenitic stainless steels is 40 J (30 ft-lb) at minimum design temperature.
6. If impact testing is required weld metal, fusion line, and HAZ shall be tested.
7. Charpy specimens shall be cut transverse to weld with axis of notch perpendicular to surface of test piece.
8. Specimen and notch locations shall be as shown in Figure 1.
9. If only subsize charpy specimens can be taken, the following standard energy reduction factors shall be applied:

Specimen Size (mm)	Specimen Size (in)	Reduction Factor
10 x 7.5	0.394 x 0.295	0.833
10 x 5	0.394 x 0.197	0.667

10. If welding procedure requiring impact testing is to be used in all positions, separate 2G and 5G qualifications shall be performed.

(e) Modify to Read

Backing rings are not permitted.

(f) Add

P-Numbers (also F-Numbers)



1. Extension of welding procedure qualification from material on PQR to material of different specification, even if it has same P-Number, shall be subject to BP approval.
2. New welding procedure qualification is required for nonimpact tested procedures, if there is a change of consumable classification.
3. Unless agreed otherwise, new welding procedure qualification is required for impact tested procedures if there is a change of consumable brand name.
3. New welder performance test is required if there is a change of SMAW electrode brand name, unless brand characteristics do not differ sufficiently to affect performance. Such change shall be subject to BP approval.

Add

- (g) Welding procedure specification (WPS) shall require requalification if any of the following changes are made:
1. Change outside welding parameter tolerance ranges specified in qualified welding procedure specification.
 2. Increase of more than 1 gage number in electrode size from that used in qualified welding procedure.
 3. Change in type of current, e.g., ac to dc or, in dc welding, change in electrode polarity, except where these changes are within electrode manufacturer recommendations.
 4. For impact tested procedures, increase in either maximum electrode diameter or weave width or if maximum interpass temperature is raised above that originally qualified (refer to 330.1.5).
 5. For critical applications, as directed by the engineering design.
- (h) If a limitation on weldment hardness is specified in engineering design, macrographic examination and hardness measurements shall also form part of welding procedure qualification (WPQ).

Service conditions requiring restrictions to hardness levels are identified in GP 06-20.

- (i) In addition to mechanical testing, welding procedure test samples shall be subjected to dye penetrant and radiographic examination.
- (j) Nondestructive examination shall be completed prior to machining of test pieces.
- (k) Ideally, welder performance tests for positional welding should be performed in both 2G and 5G positions. However, subject to agreement of BP, welder performance test may be undertaken in 6G position. In that case, each welder shall also demonstrate his ability to deposit acceptable root runs in both 2G and 5G positions. With the agreement of BP, this may be achieved by radiography of welder's first production welds in 2G and 5G positions.
- (l) Welders and welding operators shall be qualified by visual examination and radiography, except in case of titanium or zirconium, which also require mechanical testing in accordance with Appendix O. In the case of 25% Cr duplex stainless steels (Appendix N) corrosion testing may be required.

Subject to provision of authenticated CV and with agreement of BP, welders and welding operators may be qualified on their initial production welds for materials other than 25% Cr duplex stainless steels, titanium and zirconium.

- (m) Welder and welding operator qualification tests shall be witnessed by inspector.



The above additions and modifications to qualification requirements have been made on basis of fabrication experience and allow welding to proceed with improved level of confidence in both procedural qualification and welder skill.

Ultrasonics may be used in lieu of radiography if material thickness restricts suitability of radiography due to decreased sensitivity or extended exposure time.

Add

328.2.5 Test joints

- a. Welding procedure qualification tests shall be performed on pipe.
- b. On sizes greater than DN 20 (NPS 8), plate qualified welding procedures may be approved by BP.
- c. Welder performance tests shall be performed on pipe.
- d. Performance testing shall utilise pipes of nominally same chemical analysis as production material, unless agreed otherwise by BP.
- e. The test shall use filler metal of the same chemical composition and manufacturer as those to be used in production.

Change in type or even manufacturer of filler metal can alter fluidity of weld pool and affect ability of welder to successfully complete a weld. This must be recognised in extent of qualification testing required.

328.3 Welding materials

328.3.1 Filler metal

Add

- a. GTAW filler wires shall be degreased prior to use and shall subsequently be handled with clean gloves.
- b. Degreasing agents shall leave no chloride or sulphide containing residues on the surface.

Filler metals will be selected with due regard to need for weld metal to, as a minimum, match physical properties and corrosion resistance of parent material.

In the case of the 300 series austenitic stainless steels, ferrite content of deposited weld metal should normally lie in range 3%-8%. However, under certain service conditions, it may be necessary to further limit ferrite content. In critical applications, it may also be necessary to measure ferrite content.

Stress relieving heat treatments in range 900°C/950°C (1650°F/1740°F) usually result in a reduction of notch toughness in 300 series austenitic stainless steel weld metals. If PWHT is specified for pipework in low temperature service or if the piping design code includes notch toughness requirements, welding procedure tests should ensure that PWHT does not result in unacceptable embrittlement. This is especially relevant for filler metals containing niobium or molybdenum.

Higher alloy austenitic stainless steels, such as those containing 20% or greater Ni and/or 4% or greater Mo often require use of nickel base weld metals to ensure sound weld metal of adequate corrosion resistance.

Some specific guidance on filler metal selection is provided in the appendices. Final guidance concerning any special requirements, including selection of filler metal composition for dissimilar metal joints or fabrication of corrosion resistant alloy clad components, should be provided by engineering design.



328.3.2 Weld backing material**Modify to Read**

As stated in 328.2.1(e), backing rings shall not be used.

328.3.3 Consumable inserts**Modify to Read**

Consumable inserts may only be used with BP approval.

328.4 Preparation for welding**328.4.1 Cleaning****Add**

- a. Working practices shall be designed to minimise contamination.
- b. Before welding, internal and external surfaces shall be cleaned for distance of at least 50 mm (2 in) from fusion face.
- c. Surfaces to be joined by welding shall be stainless steel wire brushed and degreased immediately prior to welding.
- d. On small pipes, for which it is not possible to wire brush internal surface, an approved chemical cleaning material shall be used.
- e. Degreasing agents shall leave no chloride or sulphide containing residues on the surface.

328.4.2 End preparation**(a) General****(1) Add**

- (a) Except for zirconium and titanium, materials shall be cut to size and bevelled by plasma arc cutting, cold cutting, machining, or an appropriate grinding technique. Zirconium and titanium shall be subject to requirements of Appendix O.
- (b) If plasma arc cutting is used, surfaces adjacent to cut shall be cleaned before cutting by light grinding or wire brushing to bright metal.
- (c) Immediately prior to cutting, prepared surfaces shall be further cleaned by suitable degreasing agent.
- (d) After plasma arc cutting, surfaces shall be ground smooth and returned to bright metal finish.

(b) Circumferential welds**(4) Modify to Read**

Weld metal buttering shall not be deposited to assist alignment or provide sufficient material for machining without BP approval.

Add

- (6) Prior to fitup, weld bevels shall be visually inspected, supplemented by dye penetrant or, if appropriate, magnetic particle examination, if considered necessary by fabricator or BP inspection or welding personnel.

