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Guidance on Industry Standard for Integral Cladding, Weld Overlay, and Limited Loose Lining of Pressure Vessels and Components

GIS 36-107

BP GROUP
ENGINEERING TECHNICAL PRACTICES

Foreword

This revision of Engineering Technical Practice (ETP) BP GIS 36-107 consists of the addition of clause 5.5 to cover integral cladding with reactive metals including titanium and zirconium. This Guidance on Industry Standard (GIS) is based on parts of heritage documents from the merged BP companies as follows:

BP OUS

RP 7-1-4 Metal Lining and Cladding.

Amoco

A MM-GEN-00-G Metallic Materials—General—Guide.

A MM-GEN-00-E Metallic Materials—General—Selection Specification.

PTA FE-VE-TI-P Fabricated Equipment—Pressure Vessels—Ti Clad—Procurement Specification.

PTA FE-HE-TI-P Fabricated Equipment—Heat Exchangers—Titanium Fixed Tubesheet—Procurement Specification.

PTA FE-VE-LINE-P Fabricated Equipment—Pressure Vessels—Corrosion Resistant Liners—Procurement Specification.

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1. Scope

This GIS contains requirements for providing a metallic barrier on equipment, such as but not limited to pressure vessels, exchangers, exchanger tubesheets, nozzles, valve bodies, subsea components, and other appropriate equipment.

Typically, a high cost alloy barrier is applied over a low cost base metal, such as carbon or low alloy steels, as a low cost option to solid alloy construction. However, many combinations of barrier and base metals have been used to meet specific design needs. The barrier may be desired for numerous reasons, such as corrosion resistance, wear resistance, prevent product contamination (from corrosion products from a low alloy base metal), or make repairs to or improve existing assets. Alloy materials include ferritic stainless steel, austenitic stainless steel, nickel and cobalt base alloys, titanium, and zirconium.

Integral cladding or weld overlay is preferred. However, loose lining is permitted for some applications, specifically nozzles, wear plates, and in-service repairs.

2. Normative references

The following normative documents contain requirements that, through reference in this text, constitute requirements of this technical practice. For the purpose of this document, only information related to materials selection and application is intended for reference. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. Parties to agreements based on this technical practice are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies.

BP

GIS 36-103	Guidance on Industry Standard for Positive Material Identification.
GIS 43-316	Guidance on Industry Standard for the Manufacture of CRA Clad or Lined Steel Pipe.
GIS 46-010	Guidance on Industry Standard for New Pressure Vessels.
GP 36-10	Guidance on Practice for Materials Selection.
GP 46-01	Guidance on Practice for New Pressure Vessels.
GP 18-02	Guidance on Practice for Storage and Control of Welding Consumables.

American Petroleum Institute (API)

API Spec 6A	Specification for Wellhead and Christmas Tree Equipment.
API Spec 17D	Specification for Subsea Wellhead and Christmas Tree Equipment.

American Society of Mechanical Engineers (ASME)

ASME (BPVC)	Boiler and Pressure Vessel Code
Section II	Materials
ASME SA-264	Specification for Stainless Chromium-Nickel Steel-Clad Plate, Sheet, and Strip.
ASME SA-578	Specification for Straight-beam Ultrasonic Examination of Plain and Clad Steel Plates for Special Applications.
Section V	Nondestructive Examination
ASME SE-165	Standard Test Method for Liquid Penetrant Examination.



Section VIII

Rules for Construction of Pressure Vessels, Divisions 1 and 2.

American Society for Testing and Materials (ASTM)

ASTM A380	Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
ASTM B898	Specification for Reactive and Refractory Metal Clad Plate.

3. Terms and definitions

For the purposes of this GIS, the following terms and definitions apply:

Corrosion barrier

General term used for adding a metallic layer onto a base metal to improve corrosion, erosion, or wear resistance, add hard facing, or to add base metal thickness to maintain mechanical thickness requirements or corrosion allowance. In most cases, the corrosion barrier is of higher alloy than the base metal.

A metal barrier may also be added for hard facing, to prevent mechanical wear, such as on mixer, valve, pump shafts, and similar applications. Although this is not technically a corrosion barrier, as the two are identified separately in ASME Section IX, it is included in this category so it gets the same quality control requirements of corrosion barriers.

Integral cladding

Refers to metallic lining material that forms a metallurgical bond with the base metal during manufacture. This is typically accomplished using hot roll bonding or explosion bonding techniques.

Weld overlaying

Refers to the application of a metallic lining material using a weld deposition process that forms a metallic bond with the base metal. Typical processes include ESW, SAW, SMAW, GMAW, strip overlaying, and similar techniques. ESW overlaying or SAW strip overlaying techniques should be used for large surface areas whilst hot wire GTAW should be used for precision components. SAW wire or SMAW processes may be used for intermediate areas. The use of GMAW or FCAW processes shall be subject to BP approval.

Loose lining

Refers to the application of a metallic lining material that is not integrally bonded with the base metal. These lining are typically attached to the base metal by fillet welds and possibly some plug welds.

Back cladding

Term used for weld overlaying the exposed base metal at weld joints, such as circumferential and longitudinal seams and nozzles, of integrally clad equipment. The weld overlay provides the corrosion barrier over the base metal joints. Back cladding is typically not applicable for reactive metals, such as titanium, zirconium, and tantalum. Back cladding generally follows the same requirements as weld overlaying.

4. Symbols and abbreviations

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

AWS	American Welding Society
CRA	corrosion resistant alloy



ESW	electro slag welding
FCAW	flux cored arc welding
FN	ferrite number
GMAW	gas metal arc welding
GTAW	gas tungsten arc welding
HAZ	heat affected zone
HRC	hardness Rockwell C
PMI	positive materials identification
PWHT	post weld heat treatment
PT	liquid dye penetrant testing
PTA	purified terephthalic acid
SAW	submerged arc welding
SCC	stress corrosion cracking
SMAW	shielded metal arc welding
TEMA	Tubular Exchanger Manufacturers Association
UT	ultrasonic testing

5. General considerations

Integral clad plate and weld overlay are generally acceptable alternatives to solid alloy construction if they reduce the cost of equipment or provide other agreed upon benefits for the application.

5.1. General

- a. In service environments with pitting as a probable damage mechanism for the selected material, the use of a corrosion barrier shall be approved by BP.

In some pitting environments, such as the PTA process, localized pitting penetration rates can be quite rapid. This could lead to early and unexpected penetration of the corrosion barrier followed by rapid and large area damage of base metals with low corrosion resistance. CRA cladding with near immunity to pitting or solid alloy construction is preferred. Solid alloy generally allows for full wall penetration without affecting mechanical integrity. Thus, detectability and repair are more probable before a leak occurs.

- b. The corrosion barrier thickness shall not be considered in pressure boundary calculations unless approved by BP.
- c. For clad pipeline applications, refer to GIS 43-316.
- d. Any deviation from this GIS shall be approved by a BP materials specialist.

