

SCOPE

- I 1.1 This **practice covers** the design, installation and inspection of integral bonded cladding and weld overlay for pressure vessels, piping, and other equipment. (This practice does not apply to built-up pads and other geometries consisting of material having the same nominal chemical composition as the base metal.)
- I 1.2 An **asterisk (*)** indicates that a decision by the Purchaser is required or that additional information is furnished by the Purchaser.

SUMMARY OF ADDITIONAL REQUIREMENTS

- I 2.1 **IP 18-7-1, Welding Procedures**, shall be used with this practice.
- I ↕ *2.2 **Table 1** lists the codes, standards, and specifications which shall be used with this practice, **as specified** by the Purchaser.

TABLE 1

CODES, STANDARDS, AND SPECIFICATIONS	
ASME	
Section VIII, Div. 1	Pressure Vessels
Section VIII, Div. 2	Pressure Vessels - Alt. Rules
SA-578	Straight-Beam Ultrasonic Examination of Plain and Clad Steel Plates for Special Applications
ANSI / AWS	
A4.2	Standard Procedures for Calibrating Magnetic Instruments to Measure the Delta Ferrite Content of Austenitic and Duplex Austenitic-Ferritic Stainless Steel Weld Metal
A5.X Series	Welding Filler Metals Specifications

DEFINITIONS

- I 3.1 **Integral bonded cladding** represents composite materials produced by roll bonding or explosion welding (EXW).
- I 3.2 **Weld overlay** (surfacing) is produced by weld depositing a dissimilar material on a base metal surface.
- I 3.3 **Back cladding** is a localized weld overlay operation between two integrally clad or weld overlaid sections. This process is also known as "clad restoration."
- I 3.4 **Total depth** is the total thickness of weld overlay or back cladding.
- I 3.5 **Effective depth** is the thickness of weld overlay or back cladding having the specified chemical composition.
- I 3.6 **Connections** include nozzles, manways, inspection openings, equipment connections, and similar openings in the pressure-containing parts.
- I 3.7 **Sleeve lining** refers to installation of a cylindrical sleeve of alloy material on the inside diameter of a connection.
- I 3.8 **Inspector** refers to an Owner's Representative appointed to carry out shop or field inspection.

WELDING PROCESSES AND MATERIALS

- R ↕ 4.1 Welding processes and filler metals shall be approved by the Owner's Engineer.
 - a. Processes which use **nontransferred arcs** are **not acceptable** (e.g., plasma non-transferred arc or series submerged arc).
 - b. Vendor's proposal to use weld overlay deposited by **electroslag welding** shall be submitted to the Purchaser for approval by the Owner's Engineer.
- R ↕ 4.2 Filler metal selection for the first layer of weld overlays and for weld metal in contact with the base steel in back welding shall be based on consideration of the effect of weld dilution on the composition and properties of the first layer and the desired composition of the final overlay or weld surface.
- R ↕ 4.3 Filler metal for subsequent and/or final layers of overlays and back cladding shall be compatible with the underlying weld deposit and shall provide the desired composition for the final surface.

IP 19-2-1		Weld Overlay and Integrally Bonded Cladding	EXXON INTERNATIONAL PRACTICE
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(This practice is appropriate for attachment to Inquiry or Purchase Document)

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THICKNESS OF WELD OVERLAY AND BACK CLADDING

- R *5.1 The **"total depth" of overlay and back cladding** shall be 1/8 in. (3 mm) or greater in thickness, unless otherwise specified.
- R *5.2 The **"effective depth" of overlay and back cladding** shall be the uppermost 1/16 in. (1.5 mm) of the top layer, as a minimum, unless otherwise specified. This material shall meet the specified chemical composition where chemical analysis of the production overlay or back cladding is required.

WELD OVERLAY AND BACK CLADDING COMPOSITION AND TESTING

- R ♦ 6.1 The chemical composition of the "effective depth" of the overlay or back cladding shall be reported as follows:
- Welding procedure qualification tests.
 - Production welding, when specified.
- R ♦ *6.2 Depending on the alloy type, chemical analyses shall report the following:
- Austenitic stainless steel: C, Cr, Ni, plus other critical elements specified in the filler metal specification (i.e., Mo, Cu, Cb[Nb]).
 - Nickel-copper [Alloy 400 (Monel)] and copper-nickel (70 Cr-30 Ni or 90 Cu-10 Ni): Ni, Cu, Fe (for information only).
 - Nickel-base alloys, other than Ni-Cu: Ni, Fe, plus other critical elements specified in the filler metal specification (e.g., Mn, Cu, Cr, Cb[Nb], Mo, W) (for information only).
 - Ferritic chromium steel: Cr plus other critical elements specified in the filler metal specification.
- R ♦ 6.3 The content of individual elements reported in the chemical analysis shall be within the range specified either for the filler metal or for equivalent alloy base metal, whichever is less restrictive, except for the following:
- For low-carbon austenitic stainless steel deposits (e.g., 308L, 316L), the carbon content shall not exceed 0.04 percent.
 - For austenitic stainless steel deposits containing Cb(Nb) (e.g., Type 347 or Type 309Cb), the Cb(Nb) ratio (Cb/C) shall not exceed 16:1.
 - For Type 316 and 316L deposits the Mo content shall not be less than 2.25%.
 - * For other overlay and backcladding materials the composition shall be as specified by the Owner's Engineer.
- R ♦ 6.4 Austenitic stainless steel ferrite number:
- The ferrite content of the first and final layers of Type 308, 308L, 316 and 316L overlays and backcladding shall be in the range of ferrite number (FN) 4-10. For Type 347 the FN range shall be 5-11. The ferrite content shall be determined either: (1) from the actual, as-deposited chemical composition and the WRC-1988 or the DeLong (FN) Diagram for Stainless Steel Weld Metal (AWS A5.9, Figures A1 and A3), or (2) by use of a Magnetic Instrument as listed in AWS A4.2.
 - The magnetic gage shall be calibrated and certified per AWS A4.2. An annual calibration certification shall be available to the Inspector. Prior to use in production, instrument calibration shall be verified on at least two standards (calibration test blocks) with a minimum ferrite spread of 5 FN. At least one of these standards shall have a FN of 4-10. These standards shall be either (1) primary or secondary weld metal standards described in AWS A4.2, (2) samples with certified chemical analyses referenced to the WRC-1988 (FN) Diagram or the DeLong(FN) Diagram, or (3) samples with ferrite content measured by metallographic techniques.
 - If magnetic gages are used, ferrite measurements of weld overlays and back cladding subjected to postweld heat treatment (PWHT) shall be made both before and after **PWHT**.
- R 6.5 Nickel-copper [Alloy 400 (Monel), 67 Ni-30 Cu] and copper-nickel (70 Cu-30 Ni, 90 Cu-10 Ni) alloys.
- Ferricyanide tests** shall be performed on 100% of finished nickel-copper or copper-nickel overlays and back cladding deposits, and the results shall not indicate the presence of free iron. The test procedure shall be as follows:
- Surface Preparation. The surface to be examined shall be prepared by a method which will not cause contamination by free iron. Use a solvent or detergent solution to remove oil, grease and dirt. A pickling solution may be used to remove oxides. Rinse the surface thoroughly after pickling or detergent cleaning, using distilled or de-ionized water. If mechanical surface preparation is required use new emery paper or grinding wheels and non-ferritic buffing wheels and brushes.