

SCOPE

- I 1.1 This practice governs welding qualifications for the welding of:
 - a. Materials used in the construction of tankage, piping assemblies, pressure containing equipment, and attachments welded thereto.
 - b. Internals for pressure vessels and piping systems.
 - c. Static castings and centrifugal castings for fired heaters.
 - d. Structural items built in accordance with AISC or AWS Structural specifications.
 - e. Support structures, platforms, stairs, handrails, etc.
 - f. Any other component when referenced by an applicable purchase document.
- I 1.2 An asterisk (*) indicates that a decision by the purchaser is required or that additional information is furnished by the purchaser.
- I ↕ 1.3 The following references are synonymous: BP and IP.

SUMMARY OF ADDITIONAL REQUIREMENTS

- I ↕ *2.1 **Table 1** lists the practice, codes and specifications which shall be used with this practice as specified by the purchaser.

TABLE 1

PRACTICE	
IP 19-2-1	Weld Overlay and Integrally Bonded Cladding
CODES AND SPECIFICATIONS	
ASME Codes	
Section II	Material Specifications, Part C - Welding Rods, Electrodes and Filler Metal
Section VIII	Pressure Vessels, Division 1
Section VIII	Pressure Vessels, Alternative Rules, Division 2
Section IX	Welding and Brazing Qualifications
B31.3	Chemical Plant & Petroleum Refinery Piping
ANSI / AWS Specifications	
A5.XX	Series Filler Metal Specifications
D1.1	Structural Welding Code - Steel

- I 2.2 The requirements of this practice augment those in:
 - a. **ASME Code Section IX** for pressure vessels and piping built in accordance with ASME Codes listed in **Table 1**.
 - b. **ANSI/AWS D1.1** for carbon and low alloy steel structures built in accordance with AWS D1.1 or AISC specifications.
 - c. **Either ASME Section IX or ANSI/AWS D1.1** for noncode structures and components.
- I *2.3 All Welding Procedure Specifications (**WPSs**) and Procedure Qualification Records (**PQRs**) shall be submitted to purchaser for approval prior to the start of fabrication or construction. Weld maps or similar guides indicating where and how these WPSs will be used shall be included in the submittal. Basis for rejection shall be noncompliance with this practice, failure to meet applicable codes, or violation of industry practice.
- I 2.4 The **Supplementary Essential Variables** in ASME Code Section IX shall apply to all impact tested welding procedure specifications (even if impact testing is not a code requirement).
- I 2.5 Weld overlay and back cladding operations shall also meet the requirements of **IP 19-2-1**.
- I 2.6 The concept of **prequalified procedures** provided in ANSI/AWS D1.1 is acceptable for structural components and nonpressure items unless otherwise specified by the purchaser. In this case, no PQR must be submitted.

IP 18-7-1		Welding Procedures	 INTERNATIONAL PRACTICE
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(This practice is appropriate for attachment to Inquiry or Purchase Document)

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DEFINITIONS

- I 3.1 **A Welding Procedure Specification (WPS)** is a document prepared for each weld or group of welds presenting:
 - a. **Instructions** to the welders including both essential and nonessential variables.
 - b. **Sketches** with bead sequence, electrical variables, gas flow requirements, etc.
 - c. **Procedure Qualification Record(s) (PQR)** (however, these shall not constitute a substitute for subpar. a. and b. above).
- I 3.2 The term **Inspector**, used in this practice, refers to the Owner's representative.

BASE METAL

- I *4.1 **Base metals not listed in ASME Section IX, QW-422 or Appendix C** but having equivalent chemical and mechanical properties as listed materials may be classified in a listed P-Number or S-Number and, where applicable, Group Number subject to the approval of the Owner's Engineer.
- R 4.2 **Each base metal** within a given P-Number or Group Number **having** nominally **different chemical or mechanical properties** (as designated in QW-422 of ASME Code Section IX) requires:
 - a. A separate WPS. This requirement does not apply to different grades of P-No. 8, Groups 1 and 2, base metal provided the WPS specifies the filler metal required for each different base metal type.
 - b. Separate PQRs whenever a welding related operation satisfactory for one base metal is, in the opinion of the Owner's Engineer, unsatisfactory for another base metal within the same P or Group Number.
- R 4.3 **Backing strip material** specification or its nominal chemistry must be recorded in the WPS or the applicable fabrication drawing. For joints between similar materials, the backing strip chemistry shall match the base metal chemistry.

WELDING PROCESSES

- R 5.1 **Fusion welding processes** may be used with the following limitations:
 - a. **Short circuiting gas metal arc welding (GMAW-S or short arc)** shall be limited to any of the following conditions:
 - 1. The **root pass** for any material thickness and complete butt or fillet welds provided the wall thickness of **no member exceeds 3/8 in. (10 mm)**.
 - 2. **Complete butt or fillet welds** provided the wall thickness of no member exceeds 1 in. (25 mm) and either of the following conditions is met:
 - (a) Welding is done in any position except vertical-down and the current is not less than 170 A.
 - (b) Welding is done in the vertical-up position (3G) and the heat input is not less than 35,000 Joules/inch (14,000 Joules/cm). Heat input is defined as:

$$\frac{\text{amperage} \times \text{voltage} \times 60}{\text{travel speed (inches or cm per minute)}}$$
 - 3. This process shall **not** be used **for branch connections** (e.g., **Figure 327.3.3 of B31.3**).
 - b. **Flux cored arc welding (FCAW)** either with or without external gas shielding may be used for either groove or fillet welds. For pressure boundary welds and welds with impact test requirements, only electrode classifications or types which are identified as multipass and which have specified minimum impact test requirements shall be used.
 - c. **Single pass butt welding** of pressure containing joints in ferritic steel exceeding 1/4 in. (6 mm) thickness is acceptable only when the joint receives a subsequent grain refining (austenitizing) heat treatment.
 - d. **Manual GTAW (TIG)** welding must be used with the addition of filler metal and high frequency starting equipment or equal.
 - e. For **GTAW (TIG)**, the addition or deletion of consumable inserts for single welded butt joints (without backing devices) requires separate WPS(s) and PQR(s).