Quick Review on Essential Variables

1-Guide (Preheat)

The need for and the temperature of preheat are dependent upon a number of factors such as chemical analysis, degree of restraint of the parts being joined, elevated temperature mechanical properties, and material thicknesses.

When welding two different P-Number materials, the minimum preheat temperature required shall be the higher temperature for the material to be welded. Also, thickness referred to for the minimum preheat is the greater of the nominal thicknesses at the weld of the parts to be joined.

2-Guide (Postweld Heat Treatment)

When pressure parts of two different P-Number groups are joined by welding, the PWHT shall be that specified according to ASME Table and applicable notes for the material requiring the higher PWHT temperature. When a non-pressure part is welded to a pressure part, the maximum PWHT temperature shall not exceed the maximum temperature acceptable for the pressure retaining part.

The term thickness governing PWHT, as shown in ASME Tables, is the thickness of the weld or the thinner of the sections being joined, whichever is least.

For fillet welds, the nominal thickness is the throat thickness, and for partial penetration and material repair welds, the nominal thickness is the depth of the weld groove or preparation. For combination groove and fillet welds, nominal thickness is:

(a) ASME Section I, PW-39.3; the total combined thickness of the deposited weld, groove depth plus fillet weld throat.

(b) ASME Section VIII-Division 1, UW-40 (f); the nominal thickness is the depth of the groove or the throat dimension, whichever is greater.

3-Guide (Heat input)

ASME Section IX, QW-400: An increase in heat input, over that qualified, is Supplementary Essential variable, and therefore needs re-qualification for impacted test applications only.

The increase may be measured by the following:
Heat input [J /in. (J/mm)] =
(Voltage x Amperage x 60)/ Travel Speed [in./min (mm/min)]

The requirement for measuring the heat input does not apply when the WPS is qualified with a PWHT above the upper transformation temperature or a solution anneal after welding austenitic materials.

4-Guide (Joints)

Sketches, Production Drawings, Weld Symbols or Written Description should show the general arrangement of the parts to be welded. Where applicable, the root spacing and the details of weld groove may be specified. At the option of the Manufacturer, sketches may be attached to illustrate joint design, weld layers and bead sequence, e.g., for notch toughness procedures, for multiple process procedures, etc.

ASME Section IX, QW-250: A change in the type of groove (Vee groove, U-groove, single-bevel, double-bevel, etc.) is not essential.

Groove Design of Test Coupon for PQR:

ASME Section IX, QW-212: Except as otherwise provided in QW-250, the type and dimensions of the welding groove are not essential variables.

For combination qualifications, the deposited weld metal thickness shall be recorded for each filler metal or process used.

5-Guide (Position)

ASME Section IX, QW-212: Vertical-uphill progression (e.g., 3G, 5G, or 6G position) for PQR, qualifies WPS for all positions.

ASME Section IX, QW-203: Unless specifically required otherwise by the welding variables (QW-250), a qualification in any position qualifies the procedure for all position.

6-Guide (Filler Metal)

ASME Section IX, QW-250: Filler metal categories, F-No. and A-No., are essential variables. For Non-impacted test applications only, AWS or SFA specification classifications with the same F-No. and the same A-No. and the same minimum tensile strength and the same nominal chemical composition can be used with the same WPS.

7-Guide (Thickness of Base Metal Range)

T: Thickness of Test Coupon Welded

T less than 1/16 in. (1.5 mm):
Qualified Thickness Range: T **Min.**, 2T **Max.**

T from 1/16 in. to 3/8 in. (1.5 mm to 10 mm), incl.:
Qualified Thickness Range: 1/16 in. (1.5 mm) **Min.**, 2T **Max.**

T over 3/8 in. (10 mm), but less than 1-1/2 in. (38 mm):
Qualified Thickness Range: 3/16 in. (5 mm) **Min.**, 2T **Max.**

T from 1-1/2 in. (38 mm) and over:
Qualified Thickness Range: 3/16 in. (5 mm) **Min.,** 8 in. (200 mm) **Max.**

See Notes of Table QW-451.1 of ASME Section IX, for restriction on qualified thickness range for short-circuiting transfer mode of GMAW process, etc.; also when testing longitudinal-bend tests only 2T Max. for all of the above T ranges, See Table QW-451.2

QW-211 of ASME Section IX:
Qualification in plate also qualifies for pipe welding and vice versa.

Qualified Diameter Range: All Nominal Pipe (Tube) Sizes.

FILLET-WELDS Qualified Range is all fillet sizes on all base metal thicknesses and all diameters as per **Table QW-451**

8-Guide (Thickness of Weld Metal Range)
T: Thickness of Test Coupon Welded

T less than 3/4 in. (19 mm):
Qualified Deposited Weld Metal Thickness t: 2 t

T from 3/4 in. (19 mm) to less than 1-1/2 in. (38 mm):
Qualified Deposited Weld Metal Thickness t:
2 t when t < 3/4 in. (19 mm) and 2T when t >= 3/4 in. (19 mm)

T from1-1/2 in. (38 mm) and over:
Qualified Deposited Weld Metal Thickness t:
2 t when t < 3/4 in. (19 mm) and 2T when t >= 3/4 in. (19 mm)

See Notes of Table QW-451.2 of ASME Section IX, for restriction on qualified thickness range for short-circuiting transfer mode of GMAW process, etc.; also when testing longitudinal-bend tests only 2 t for all of the above T ranges, See Table QW-451.2

FILLET-WELDS Qualified Range is all fillet sizes on all base metal thicknesses and all diameters as per **Table QW-451**