

QW-409.25 A change of more than 10% in the plasma-arc current or voltage recorded on the PQR.

QW-409.26 For the first layer only, an increase in heat input of more than 10% or an increase in volume of weld metal deposited per unit length of weld of more than 10% over that qualified. The increase may be measured by either of the following:

(a) Heat input [J/in. (J/mm)]

$$= \frac{\text{Voltage} \times \text{Amperage} \times 60}{\text{Travel Speed [in./min (mm/min)]}}$$

(b) Volume of Weld Metal = an increase in bead size or a decrease in length of weld bead per unit length of electrode.

QW-409.27 A change in the flashing time of more than 10%.

QW-409.28 A change in the upset current time by more than 10%.

04

QW-409.29

(a) A change in the ratios of heat input or in the volume of weld metal deposited per unit length beyond the following (see figure QW-462.12):

(1) An increase or decrease in the ratio of heat input between the first tempering bead layer and the weld beads deposited against the base metal of more than 20% for P- or S-No. 1 and P- or S-No. 3 metals and 10% for all other P- or S-Number metals.

(2) An increase or decrease in the ratio of heat input between the second tempering bead layer and the first tempering bead layer of more than 20% for P-No. 1 and P-No. 3 metals and 10% for all other P-Number metals.

(3) The ratio of heat input between subsequent layers shall be maintained until a minimum of $\frac{3}{16}$ in. (5 mm) of weld metal has been deposited over the base metal.

(4) For qualifications where the basis for acceptance is impact testing and the filler metal is exempt from temper bead qualification, the heat input may not exceed 50% above the heat input qualified for the remaining fill passes.

(5) For qualifications where the basis for acceptance is hardness testing, a decrease of more than 20% in heat input for the remainder of the fill passes.

(b) Heat input and volume of weld metal per unit length of weld shall be measured using the following methods:

(1) For machine or automatic GTAW or PAW, an increase or decrease of 10% in the power ratio measured as:

$$\text{Power Ratio} = \frac{\text{Amperage} \times \text{Voltage}}{[(WFS/TS) \times A_f]}$$

where

A_f = the cross-section area of the filler metal wire

TS = the welding travel speed

WFS = the filler metal wire feed speed

(2) For processes other than machine or automatic GTAW or PAW, heat input shall be measured by any of the following methods:

(a) see formula

(U.S. Customary Units)

$$\text{Heat Input (J/in.)} = \frac{\text{Voltage} \times \text{Amperage} \times 60}{\text{Travel Speed (in./min)}}$$

(SI Units)

$$\text{Heat Input (J/mm)} = \frac{\text{Voltage} \times \text{Amperage} \times 60}{\text{Travel Speed (mm/min)}}$$

(b) Volume of Weld Metal = an increase in bead size or a decrease in length of weld bead per unit length of electrode.

(3) If manual GTAW or PAW is used for making in-process repairs in accordance with QW-290.5, a record of bead size shall be made.

QW-410 Technique

QW-410.1 For manual or semiautomatic welding, a change from the stringer bead technique to the weave bead technique, or vice versa.

QW-410.2 A change in the nature of the flame, oxidizing to reducing, or vice versa.

QW-410.3 A change in the orifice, cup, or nozzle size.

QW-410.4 A change in the welding technique, fore-hand to backhand, or vice versa.

QW-410.5 A change in the method of initial and interpass cleaning (brushing, grinding, etc.)

QW-410.6 A change in the method of back gouging.

QW-410.7 For the machine or automatic welding process, a change in width, frequency, or dwell time of oscillation technique.

QW-410.8 A change in the contact tube to work distance.

QW-410.9 A change from multipass per side to single pass per side. This limitation does not apply when a WPS is qualified with a PWHT above the upper transformation temperature or when an austenitic material is solution annealed after welding.

QW-410.10 A change from single electrode to multiple electrode, or vice versa, for machine or automatic welding only. This limitation does not apply when a WPS

04