

Table PW-39-1
Mandatory Requirements for Postweld Heat Treatment of Pressure Parts and Attachments — P-No. 1

(21)

Material	Holding Temperature, °F (°C)	Minimum Holding Time at Normal Temperature for Weld Thickness (Nominal)		
		Up to 2 in. (50 mm)	Over 2 in. (50 mm) to 5 in. (125 mm)	Over 5 in. (125 mm)
P-No. 1 Group No. 1, 2, 3	1,100 – 1,300 (595 – 705)	1 hr/in. (1 h/25 mm), 15 min minimum	2 hr plus 15 min for each additional inch (25 mm) over 2 in. (50 mm)	2 hr plus 15 min for each additional inch (25 mm) over 2 in. (50 mm)

GENERAL NOTES:

- (a) Postweld heat treatment is not mandatory for P-No. 1 Group 1 materials under the following conditions:

(1) when the nominal thickness as defined in PW-39.3 is 1 in. (25 mm) or less.

(2) when the nominal thickness as defined in PW-39.3 exceeds 1 in. (25 mm), postweld heat treatment is not required when the calculated carbon equivalent, CE, of each base metal in the weld joint is less than or equal to 0.45 using the following formula, and a minimum preheat of 200°F (95°C) is applied.

$$CE = C + \frac{Mn}{6} + \frac{(Cr + Mo + V)}{5} + \frac{(Ni + Cu)}{15}$$

NOTE: The maximum chemical composition limit from the material specification or the actual values from a chemical analysis or material test report shall be used in computing the CE. If the chemistry values required for the last two terms are not available, 0.15% shall be substituted for those two terms as follows:

$$CE = C + \frac{Mn}{6} + 0.15$$

(3) electroslag welds shall follow the postweld heat treatment requirements in PW-27.3 and PW-39.7.

(4) for stays welded in accordance with PW-19, the diameter of the stay is not used to determine the preheat requirement.

- (b) Postweld heat treatment is not mandatory for P-No. 1 Groups 2 and 3 materials under the following conditions:

(1) when the nominal thickness of a weld as defined in PW-39.3 is $\frac{3}{4}$ in. (19 mm) or less.

(2) when the nominal thickness of the weld as defined in PW-39.3 exceeds $\frac{3}{4}$ in. (19 mm) but does not exceed 1 in. (25 mm) and the calculated CE of each of the base metals in the weld joint is less than or equal to 0.45 using the formula in General Note (a)(2). ~~For stays welded in accordance with PW-19, the diameter of the stay is not used to determine preheat requirements.~~

(3) For stays welded in accordance with PW-19, the diameter of the stay is not used to determine preheat requirements.

(4) when the nominal thickness of a weld as defined in PW-39.3 is greater than 1 in. (25 mm) but does not exceed $1\frac{1}{2}$ in. (38 mm), and:

(a) the calculated carbon equivalent, CE, of each of the base metals in the weld joint is less than or equal to 0.45, using the formula in

General Note (a)(2)

(b) a minimum preheat of 250°F (120°C) is applied

(c) no individual weld pass thickness exceeds $\frac{1}{4}$ in. (6 mm)

(5) for welds used to attach extended heat-absorbing surface to tubes and insulation attachment pins to pressure parts

(6) for studs welded to pressure parts, provided preheat to a minimum temperature of 200°F (95°C) is applied when the thickness of the pressure part exceeds 1 in. (25 mm)

- (c) Postweld heat treatment is not mandatory for P-No. 1 Groups 1, 2, or 3 under the following conditions:

(1) for corrosion-resistant weld metal overlay cladding of pipe or tube materials, provided that all of the following conditions are met:

(a) the thickness of the overlay cladding is $\frac{1}{4}$ in. (6 mm) or less

(b) preheat to a minimum temperature of 200°F (95°C) is applied when the thickness of the pressure part exceeds $\frac{3}{4}$ in. (19 mm)

(c) the pipe or tube material

(-1) does not exceed NPS 5 (DN 125) outside diameter

(-2) is not used as a drum or shell

(2) for welds attaching nonload-carrying studs not exceeding $\frac{1}{2}$ in. (13 mm) in diameter when using an automatic arc stud welding or automatic resistance stud welding process

(3) for attaching bare wire thermocouples by capacitor discharge welding or electric resistance welding, provided the following requirements are met:

(a) the requirements of PW-39.8

(b) the minimum wall thickness shall be 0.200 in. (5.0 mm) or greater

(4) electroslag welds shall follow the postweld heat treatment requirements of PW-27.3 and PW-39.7

- (d) When it is impractical to postweld heat treat at the temperature specified in this Table, it is permissible to carry out the postweld heat treatment at lower temperatures for longer periods of time in accordance with Table PW-39.1.

Table PW-39-5
Mandatory Requirements for Postweld Heat Treatment of Pressure Parts and Attachments — P-No. 15E

(21)

Material	Holding Temperature, °F (°C) [Notes (1)–(4)]	Maximum Holding Temperature, °F (°C) [Notes (2) and (3)]	Minimum Holding Time at Normal Temperature for Weld Thickness (Nominal)	
			Up to 5 in. (125 mm)	Over 5 in. (125 mm)
P-No. 15E Group No. 1	1,300 – 1,445 (705 – 785)	1,445 (785)	1 hr/in. (1 h/25 mm), 30 min minimum	5 hr plus 15 min for each additional inch (25 mm) over 5 in. (125 mm)

GENERAL NOTES:

- (a) Postweld heat treatment is not mandatory for electric resistance welds used to attach extended heat-absorbing requirements are met:
- (1) a maximum pipe or tube size of NPS 4 (DN 100)
 - (2) a maximum specified carbon content (SA material specification carbon content, except when further limited by the Purchaser to a value within the specification limits) of not more than 0.15%
 - (3) a maximum fin thickness of $\frac{1}{8}$ in. (3 mm)
 - (4) prior to using the welding procedure, the Manufacturer shall demonstrate that the heat-affected zone does not encroach upon the required minimum wall thickness
- (b) Postweld heat treatment is not mandatory for attaching bare wire thermocouples by capacitor discharge welding or electric resistance welding, provided the following requirements are met:
- (1) The requirements of PW-39.8.
 - (2) The maximum carbon content of the base material is restricted to 0.15%.
 - (3) The minimum wall thickness shall be 0.20 in. (5.0 mm)

NOTES:

- (1) If the nominal weld thickness is ≤ 0.5 in. (13 mm), the minimum holding temperature is 1,250°F (675°C).
- (2) For welds made with nickel-based filler metals, or with Grade 91 filler metal (e.g., AWS B9 or B91, ISO CrMo91, etc.) that has Ni + Mn content less than or equal to 1.0%, the maximum holding temperature can be increased to 1,470°F (800°C). However, if the PWHT encompasses multiple welds and any one of those welds was made with Grade 91 filler metal that has a Ni + Mn content greater than 1.0%, but not greater than 1.2%, or if the Ni + Mn content of the filler metal is unknown, the maximum PWHT temperature shall be 1,445°F (785°C). *Explanatory Note to (2) Above:* The lower transformation temperature for matching filler material is affected by alloy content, primarily the total of Ni + Mn. The maximum holding temperature has been set to avoid heat treatment in the intercritical zone.
- (3) If a portion of the component is heated above the heat treatment temperature allowed above, one of the following actions shall be performed:
 - (a) The component in its entirety must be renormalized and tempered.
 - (b) If the maximum holding temperature in the table or [Note (2)] above is exceeded, but does not exceed 1,470°F (800°C), the weld metal shall be removed and replaced.
 - (c) The portion of the component heated above 1,470°F (800°C) and at least 3 in. (75 mm) on either side of the overheated zone must be removed and be renormalized and tempered or replaced.
 - (d) The allowable stress shall be that for Grade 9 material (i.e., SA-213-T9, SA-335-P9, or equivalent product specification) at the design temperature, provided that the portion of the component that was heated to a temperature exceeding the maximum holding temperature is subjected to a final heat treatment within the temperature range and for the time required above. In order to apply the provisions of this paragraph, the Manufacturer must have qualified a WPS with representative test specimens that accurately simulate the thermal history of the production part. Specifically, the qualification specimens first must be heat treated at a similar temperature for a similar time that violated the maximum holding temperature limit and then must receive a final heat treatment for the required time within the temperature range specified by this table. The use of this provision shall be noted in the Manufacturer's Data Report in accordance with PG-5.6.1(c)(1).
- (4) For welds made with weld consumables of nominally matching chemistry to the base metal (e.g., AWS B9, B91, B92, ISO CrMo91), after the completion of welding and prior to any postweld heat treatment the weld metal shall be cooled to below 400°F (205°C). Measurement and documentation of temperature are required during this cooling step.