

Table PW-39-5
Mandatory Requirements for Postweld Heat Treatment of Pressure Parts and

Material	Holding Temperature, °F (°C) [Notes (1)–(4)]	Maximum Holding Temperature, °F (°C) [Notes (2) and (3)]	Minimum Holding for Weld	
			Up to 5 in. (125 mm)	Additional inch (25 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	

fin to pipe and
tube materials,
provided the
following

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.

(19)

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

Material	Minimum Holding Temperature, °F (°C) [Note (1)] and [Note (2)]	Maximum Holding Temperature, °F (°C) [Note (3)] and [Note (4)]	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 (705)	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 fins to pipe and tube materials, provided the following 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 dissimilar metal welds (i.e., welds made between a P-No. 15E Group 1 and another lower chromium ferritic, austenitic, or nickel-based steel), if filler metal chromium content is less than 3.0% or if the filler metal is nickel-based or austenitic, the minimum holding temperature shall be 1,300°F (705°C).
- (3) 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 (3) 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.
- (4) 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 (3)] 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.