PG-5.6.1 Data Report requirements for CSEF material

PG-5.4.2 Pipe having a tolerance of ±1% on either the O.D. or the I.D., rather than the tolerance specified in the material specification, may be used, provided the material complies with all other requirements of the specifications. When used under external pressure, such pipe shall be limited to a maximum of 24 in. (600 mm) in diameter. The pipe shall include the designation 1% O.D. or 1% I.D., as appropriate, in any required documentation and marking of the material.

PG-5.5 The use of austenitic alloy steel is permitted for boiler pressure parts that are steam touched in normal operation. Except as specifically provided in PG-9.1.1, PG-12, PEB-5.3, and PFE-4, the use of such austenitic alloys for boiler pressure parts that are water wetted in normal service is prohibited.1

PG-5.6 P-No. 15E, Group 1 Materials.

PG-5.6.1 If during any phase of manufacturing or erection any portion of the component that does not contain a weld is heated to a temperature greater than 1,470°F (800°C), one of the following actions shall be performed:

(a) The component shall be reaustenitized and retempered in its entirety in accordance with the specification requirements.

(b) That portion of the component heated above 1,470°F (800°C), including the heat-affected zone created by the local heating, must be replaced or must be removed, reaustenitized, and retempered in accordance with the specification requirements and then replaced in the component.

(c) If the allowable stress values to be used are less than or equal to those provided in Section II, Part D, Subpart 1, Table 1A for Grade 9 (e.g., SA-213 T9, SA-335 P9, or equivalent product specifications) at the design temperature, then the requirements stated above may be waived, provided that the portion of the component heated above 1,470°F (800°C) is retempered in accordance with the specification requirements. The use of this provision shall be noted on the Manufacturer’s Data Report.2

PG-5.6.2 If during any phase of manufacturing or erection of the component, any portion that does contain a weld is heated above 1,445°F (785°C), then the requirements of Notes (3) and (4) of Table PW-39-5 for P-No. 15E, Group 1 Materials, shall apply for reheat treatment.

PG-6 PLATE

PG-6.1 Steel plates for any part of a boiler subject to pressure, whether or not exposed to the fire or products of combustion, shall be of pressure vessel quality in accordance with one of the following specifications:

SA-285, Pressure Vessel Plates, Carbon Steel, Low- and Intermediate-Tensile Strength
SA-299, Pressure Vessel Plates, Carbon Steel, Manganese-Silicon
SA-302, Pressure Vessel Plates, Alloy Steel, Manganese-Molybdenum and Manganese-Molybdenum-Nickel
SA-387, Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum
SA-515, Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service
SA-516, Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
SA/AS 1548, Fine Grained, Weldable Steel Plates for Pressure Equipment
SA/EN 10028-2, Flat Products Made of Steels for Pressure Purposes
SA/GB 713, Steel Plates for Boilers and Pressure Vessels
SA/JIS G3118, Carbon Steel Plates for Pressure Vessels for Intermediate and Moderate Temperature Service

PG-7 FORGINGS

PG-7.1 Seamless steel drum forgings made in accordance with SA-266 for Carbon Steel and SA-336 for Alloy Steel may be used for any part of a boiler for which pressure vessel quality is specified or permitted.

PG-7.2 Forged flanges, fittings, nozzles, valves, and other pressure parts of the boiler shall be of material that conforms to one of the forging specifications as listed in PG-9.

PG-7.3 Drums, shells, or domes may be of seamless drawn construction, with or without integral heads, provided the material conforms to the requirements of the Code for shell material.

PG-8 CASTINGS

PG-8.1 Except for the limited usage permitted by PG-8.2 and PG-8.3, cast material used in the construction of vessels and vessel parts shall conform to one of the specifications listed in PG-9 for which maximum allowable stress values are given in Section II, Part D, Subpart 1, Table 1A, and the use of this provision shall be noted on the Manufacturer’s Data Report.3

(c) The use of this provision shall be noted in the Remarks section on the Manufacturer’s Data Report. Information to be noted shall describe the affected component, its design condition, and location in sufficient detail so as to be able to positively locate it after assembly in the boiler.

ASME B16.1, Gray Iron Pipe Flanges and Flanged Fittings
ASME B16.4, Cast Iron Threaded Fittings

Material conforming to ASTM A126 may be used subject to all requirements of the particular standard. Such usage is subject also to all the requirements for the use of cast iron given in PG-8.2 and other paragraphs of this Section.
### Table PG-20

**Post Cold-Forming Strain Limits and Heat-Treatment Requirements**

<table>
<thead>
<tr>
<th>UNS Grade Number</th>
<th>Limitations in Lower Temperature Range</th>
<th>Limitations in Higher Temperature Range</th>
<th>Required Heat Treatment When Design Temperature and Forming Strain Limits Are Exceeded</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>For Design Temperature</td>
<td>But Less Than or Equal to Strains</td>
<td>For Design Temperature</td>
</tr>
<tr>
<td>91</td>
<td>°F</td>
<td>°C</td>
<td>°F</td>
</tr>
<tr>
<td>1,000 (540)</td>
<td>1,115 (600)</td>
<td>1,115 (600)</td>
<td>1,115 (600)</td>
</tr>
</tbody>
</table>

**GENERAL NOTE:** The limits shown are for cylinders formed from plates, spherical or dished heads formed from plate, and tube and pipe bends. The forming strain limits tabulated in the table shall be divided by two if PG-19.1 is applied. For any material formed at 1,300°F (705°C) or above, and for cold swages, flares, or upsets, normalizing and tempering is required regardless of the amount of strain.

**NOTES:**

1. Normalization and tempering shall be performed in accordance with the requirements in the base material specification, and shall not be performed locally. The material shall either be heat treated in its entirety, or the cold strained area (including the transition to the unstrained portion) shall be cut away from the balance of the tube or component and heat treated separately or replaced.

2. Postbend heat treatments shall be performed at 1,350°F to 1,445°F (730°C to 785°C) for 1 hr/in. (1 h/25 mm) or 30 min minimum. Alternatively, a normalization and temper in accordance with the requirements in the base material specification may be performed.

3. For materials with greater than 5% strain but less than or equal to 25% strain with design temperatures less than or equal to 1,115°F (600°C), 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. 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 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 in [Note (2)]. The use of this provision shall be noted on the Manufacturer’s Data Report.

4. If a longitudinal weld is made to a portion of the material that is cold strained, that portion shall be normalized and tempered, prior to or following welding. This normalizing and tempering shall not be performed locally.

Some permissible material specifications allow the supply and use of tube and pipe material in the unheat treated condition, corresponding to the material condition as produced by the tube or pipe manufacturer, often referred to as the hot-finished heat-treated condition. Allowable cold strain for this starting material is restricted to the smaller 5% strain before postforming heat treatment.

**PG-20.1.1** The cold-formed carbon-molybdenum tube and/or steam shall be heat treated as defined below.

(a) When the tube and pipe are located external to the boiler membraned wall or boiler metal encased enclosure.

(b) When the design temperature of the cold-formed areas is between 620°F (327°C) and 750°F (399°C).

(c) When strain developed in the cold-formed areas exceeds 12 1/2% when the straight tube or pipe starting material is to be formed is in the subcritical annealed, full annealed, or normalized heat treated condition. Alternatively, when strain developed in the cold-formed areas exceeds 5% when the straight tube or pipe starting material is to be formed is in the unheat treated condition as defined below.

The following paragraphs define requirements based on boiler location, strain, and material condition and shall be considered.

**PG-20.1.2** The postforming heat treatment of carbon steel only, meeting all the conditions specified in PG-20.1.1, may be avoided when all of the following conditions are met:

(a) The tube or pipe material in the area to be cold formed had been subjected to an anneal or normalize heat treatment (see SA-941 for definition of heat treatments) prior to forming, and

(b) The entire bend area is subjected to a magnetic particle examination over 100% of the bend region between the bend tangents in accordance with Nonmandatory Appendix A, A-260, except that the following acceptance standard applies. Any relevant linear indication found
Table PW-39-5
Mandatory Requirements for Postweld Heat Treatment of Pressure Parts and Attachments — P-No. 15E

<table>
<thead>
<tr>
<th>Material</th>
<th>Minimum Holding Temperature, °F (°C) [Note (1)] and [Note (2)]</th>
<th>Maximum Holding Temperature, °F (°C) [Note (3)] and [Note (4)]</th>
<th>Minimum Holding Time at Normal Temperature for Weld Thickness (Nominal) Up to 5 in. (125 mm) Over 5 in. (125 mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-No. 15E Group No. 1</td>
<td>1,300 (705)</td>
<td>1,445 (785)</td>
<td>1 hr/in. (1 h/25 mm), 30 min minimum</td>
</tr>
</tbody>
</table>

**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 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.

*in accordance with PG-5.6.1(c)(1).*

(Note to publisher, add to end of sentence)