

BHARAT HEAVY ELECTRICALS LIMITED

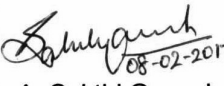
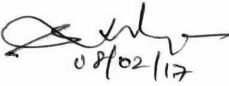
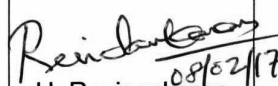
TIRUCHIRAPALLI 620 014

QUALITY ASSURANCE

SIP: PP: 29 / 02

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**General Guidelines for Welding of T22 grade Panel Butt Joints at Sites for Once
Through Supercritical Boilers**

REV	DATE	PREPARED	REVIEWED	APPROVED
00	23.11.2016	A. Sakthi Ganesh	S.Selvarajan	U. Revisankaran
01	27.01.2017	A. Sakthi Ganesh	S.Selvarajan	U. Revisankaran
02	08.02.2017	 08-02-2017 A. Sakthi Ganesh	 08/02/17 S.Selvarajan	 08/02/17 U. Revisankaran

RECORD OF REVISIONS

Rev. No.	Clause No.	Details of Revision
00	--	Fresh issue
01	3.25	New clause added for clarity.
	3.26	Clause introduced to include Hardness measurement by portable hardness testers.
	3.27 & 3.29	Clauses modified to effect the inclusion of hardness testing by portable hardness testers.
	3.27 to 3.30	Clauses renumbered.
02	The following clauses have been modified based on feedback from GE Power, USA	
	3.7	Modified for clarity in operation.
	3.13	Modified to bring clarity w.r.t. welding sequence and to introduce LPI on fin-to-fin weld.
	3.20	Modified to amend the minimum width requirement for PWHT heating band.

1.0 SCOPE

- 1.1 This procedure details out the general guidelines for welding of T22 grade panel butt joints at erection sites for Once Through Supercritical Boilers.

2.0 REFERENCE DOCUMENTS

- 2.1 ASME Sec I & Sec IX
2.2 IBR

3.0 GUIDELINES FOR PROCESSING OF GR. 22 PANEL BUTT JOINTS AT SITE

- 3.1 Welding shall be carried out as per the approved Field Welding Schedules (FWS), employing IBR qualified welders. In case of NTPC projects, the FWSs shall be approved by QSGM (Qualified Steam Generator Manufacturer).
- 3.2 The welding machines, PWHT accessories (PID Controlled/Automatic control panels, K Type thermocouples, temperature recorder, etc.), etc. shall have valid calibration status.
- 3.3 The electrode container should be in sealed condition and shall be free from punctures that may cause exposure to atmosphere.
- 3.4 The Low hydrogen flux coated electrodes shall be baked in a baking oven and kept in a holding oven till issue as per manufacturer's recommendation. The electrodes shall be carried in a preheated portable oven/ heated quiver from place of issue to welding site and held there at temperature between 100 and 150°C. Separate connection for portable oven shall be ensured.
- 3.5 Receipt and issue of consumable shall be recorded in a log by an authorized person in accordance with applicable WPS.
- 3.6 All IBR certified welders shall be retested as per applicable WPS and the same shall be ensured before their deployment on jobs.
- 3.7 The joining ends of the tubes shall be properly cleaned from inside and outside up to at least 50 mm from the weld face. Prior to tube end cleaning, compressed air shall be blown inside the tubes to ensure that there is no water inside the tubes. Welding shall be performed within 4 hours of tube end cleaning.
- 3.8 Fit-up of tubes for butt joint shall be done only by clamps, with a root gap of 2-3 mm and a land of 1-1.5 mm.
- 3.9 There shall be no misalignment and no mismatch.
- 3.10 Preheat shall be carried out by heating coils/ ceramic pads from both the sides of furnace water wall panels and the temperature shall be cross checked by thermal chalk/infrared thermometer/Thermocouples and records shall be maintained. The ceramic pads shall be wrapped uniformly for a width of 200 mm on both sides of the joints. The effect on hardness with/ without preheat or PWHT is represented in **Illustration 1**

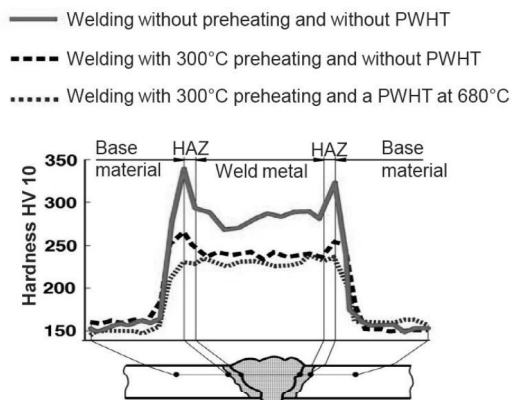


Illustration 1: Effect on hardness with/ without preheat or PWHT on T22 joints

- 3.11 Welding shall be carried out by GTAW process for the root pass and by SMAW process for further passes.
- 3.12 The inter-pass temperature shall not exceed 350°C as per approved WPS.
- 3.13 During fin welding in panels, fin-to-fin welding in transverse direction shall be performed and checked and cleared with LPI prior to the longitudinal welding between the fin and the tube. Fin-to-fin welds in the transverse direction shall be full penetration welds.
- 3.14 The shielding shall be done properly with gas purity greater than 99.95%.
- 3.15 Weaving shall not be greater than three times of the electrode diameter.
- 3.16 For GTAW process, the arc shall be initiated by High Frequency start facility only.
- 3.17 Visual inspection shall be carried out to check the weld surface to ensure that the weld joint is free from undercut, under-fill, lack of fusion, porosity, spatter, weaving etc.
- 3.18 PWHT shall be performed as per approved WPS:1084 (latest revision) and PWHT Instructions (For T22 water wall panel, the PWHT temperature shall be 740+/-10°C for a soaking time of 1 hr/inch of thickness, with a minimum of one hour).
- 3.19 For water wall panels, only resistance heating coils/ceramic resistance pads with PID controlled/ automatic control panels, K-type thermocouples shall be used for PWHT.
- 3.20 The PWHT arrangement shall meet the following conditions-

'When heat treating butt welds, the width of the circumferential heating band on either side of the weld must be at least 3 times the width of the widest part of the weld groove but not less than twice the thickness of the thicker part welded. In no case shall the heating band be less than 150mm. The width of the insulation band beyond the heating band shall be at least twice the total width of the heating band'. (refer **Illustration 2**).

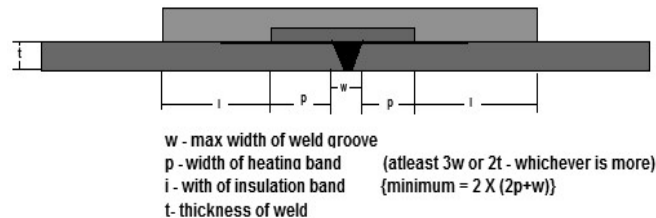


Illustration 2: PWHT bands

- 3.21 The wrapping of heating coils/pads and location of thermocouples shall be ensured before covering with insulation.
- 3.22 PWHT shall be carried out with one thermocouple per two (alternate) joints minimum.
- 3.23 PWHT charts shall be signed during the process by representatives of BHEL and Customer, as required.
- 3.24 PWHT Chart shall be reviewed as per requirement (Soaking temp, time, rate of heating and rate of cooling).
- 3.25 The effectiveness of PWHT may be verified by doing hardness survey on the butt joints selected at random.
- 3.26 Hardness survey may be carried out using portable hardness testers. The maximum hardness value shall be within 260HV.

- 3.27 As an alternative to hardness measurement using portable hardness testers, in-situ MCF (Magnetic Coercive Force) measurement may be performed on these joints. The maximum acceptable MCF measurement value for these joints shall be 10 A/cm. Further, for validation of hardness values, 2 to 3 joints selected randomly shall be tested at lab and acceptable value of hardness shall be maximum 260 HV.
- 3.28 Radiography of the joints shall be performed as per approved Field Quality Plan/Field Welding Schedule. Selection of joints for RT should be at random per welder.
- 3.29 If the hardness using portable hardness tester is more than 260 HV (or MCF value is more than 10A/cm), PWHT procedure shall be repeated (upto a maximum of two more cycles) till the hardness (or MCF value) comes down to the maximum permissible value or below. Otherwise the joint shall be cut and a spool piece shall be inserted and the Steps from Sl. No.3.1 to 3.29 for joints shall be repeated.
- 3.30 PWHT shall be carried after fin welding and completion of all other welding.

4.0 PRECAUTIONS

- 4.1 Welding shall not be started till proper preheat temperature is reached on the weld joint ends of the tubes.
- 4.2 Unqualified welders shall not be employed for the jobs.
- 4.3 Use of unbaked welding consumables shall be avoided.
- 4.4 Welding shall not be commenced without proper fit up of tubes (tube IDs shall match).
- 4.5 There shall not be undue force on the tubes to cover up the mismatch while fit up of joints.
- 4.6 No tack welding is permitted on tubes for fit up.
- 4.7 There shall not be improper weld bead e.g. under fills, excessive reinforcement and poor weld toe blend angle with base material
- 4.8 Hydrostatic test shall not be carried out before PWHT.

5.0 DOCUMENTATION

- 5.1 The details of welding, PWHT and NDE shall be recorded in appropriate job cards/report formats as per the site Welding and Heat Treatment Manuals.

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FIELD WELDING SCHEDULE ENDORSEMENT

Project: NTPC / NTPC, TELANGANA STPP, PHASE-I (2X800 MW)

Reviewed the FWSs submitted within BHEL mail dated 02-04-2019 and found them to be in order and acceptable to follow at site.

The document no. for the circulation system is 1819-07-CIR-EWS rev02

The document no. for the economiser system is 1819-19-ECO-EWS rev01

The document no. for the reheater system is 1819-17-RH-EWS rev02

The document no. for the superheater system is 1819-12-SH-EWS rev02

General guidelines for welding of T22 grade panel butt joints at sites for OTSC boilers SIP:PP:29 / rev.02.S

SIGNED ON BEHALF OF

BHEL BY S. Anand Kumar

**S. ANAND KUMAR
Sr. Dy. General Manager
Pressure Parts and L&I / PE (FB)
BHEL, TRICHY - 620 014**

DATE: 2/4/2019

PLACE: TRICHY-14.

SIGNED ON BEHALF OF

ALSTOM/GE BY [Signature]

DATE: 3rd April 2019

PLACE: Windsor, CT, USA