



Materials Technology

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Important To Safety

Yes ☒

No ☐

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TUBE/TUBESHEET PLUGGING STANDARD FOR STEAM GENERATORS

AND/OR HEAT EXCHANGERS

CONTROLLED DISTRIBUTION
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1.0 SCOPE & PURPOSE:

To provide a standard which defines the necessary requirements for welded repair plugging of steam generator and/or heat exchanger tube/tubesheet. This procedure is based on utilizing the manual welding technique.

2.0 APPLICABILITY:

- 2.1 When plugging of tube/tubesheet is required to maintain steam generator primary to secondary integrity.
- 2.2 This procedure may be used for manual welding repairs of tube/tubesheets on any heat exchanger with documented evaluation by Materials Technology.

3.0 REFERENCES:

- 3.1 ASME B & PV, Section IX (Latest Edition).
- 3.2 ASME B & PV, Section XI (1980 Edition).
- 3.3 Materials Technology Standard MTWS-012.
- 3.4 Applicable Site Procedure for Control of Welding:
 - 3.4.1 AP-1042 TMI-1
 - 3.4.2 AP-1063 TMI-2
 - 3.4.3 Procedure OC-9-01 Oyster Creek

4.0 DEFINITIONS:

- 4.1 GTAW - Gas Tungsten - Arc Welding
- 4.2 NDE - Non-Destructive Examination
- 4.3 WPS - Welding Procedure Specification
- 4.4 Interpass Temperature - In a multiple pass weld, the temperature (minimum or maximum as specified) of deposited weld metal before

The next pass is started.

- 4.5 Bore Hole - Bore hole is described as the hole that exists after the removal of a tube and/or where a tube has been cut off flush with the tubesheet cladding. Where the tube is cut off flush with the tubesheet. The I.D. shall be chamfered requiring plug to tubesheet contact.
- 4.6 Tube Extensions - The amount of tube extending outside of the tubesheet.
- 4.7 Consumable Insert - Preplaced filler metal which is completely fused into the root of the joint and becomes part of the weld.

5.0 RESPONSIBILITIES/PREREQUISITES:

5.1 Prerequisites:

- 5.1.1 Positive identification of tube/tubesheet bores to be plugged.

TECHNIQUE #1

- 5.1.2 For tubesheet bores identification shall be accomplished through the use of a wooden plug. The plug shall remain in tact to the point of exchanging it with the plug which will be welded in the bore hole.

- 5.1.3 It may be necessary to remove plug during cleaning and fit-up sequence, but care must be taken to insure plug is placed back into its proper location. (Wooden plug may be used as interim marker.)

TECHNIQUE #2

- 5.1.4 For identification of tubes to be plugged specially designed tube markers or a template shall be used.

- 5.1.5 All plant and component condition prerequisites shall be in accordance with the applicable site work package.
- 5.1.6 Responsibilities see GPUN Welding Program.

6.0 REQUIREMENTS:

- 6.1 Materials identification shall be as follows:
- 6.1.1 The materials to be welded under this specification are specified in ASME Welding Qualifications Section IX as P-No. (Base Material) and F-No. (Filler Material). Refer to the applicable WPS assigned by Materials Technology Site Welding Engineering via welding documentation.
- 6.1.2 The plug base materials (P-No.) shall be identified by the serial number and as a minimum require supporting Certified Mill Test Reports. (Record serial number as required by the welding documentation.)
- 6.1.3 The filler materials (F-No.) shall be identified by the applicable Heat Numbers/AWS Classification and controlled in accordance with Materials Technology Standard MTWA-005.
- 6.1.4 Shielding gas shall be Argon commercial welding grade 99.99% pure composition.
- 6.1.5 All materials shall be QA approved/accepted.
- 6.2 Qualification of welders and procedures:
- 6.2.1 Shall be performed in accordance with Materials Technology Standard MTWS-012. This Standard meets the mandatory requirements of ASME Section IX (Latest Edition) and ASME Section XI (1980 Edition).

6.2.2 The essential and non-essential variables (Joint Prep. electrical characteristics, etc.) needed to accomplish the welding shall be identified on the WPS. (Reference MTWS-012).

6.3 Cleaning/Fit-Up Sequence shall be as follows:

6.3.1 The area to be cleaned shall consist of a 1/4" radius around the tubesheet bore hole and the entire extension for tubes. (Extension is the amount of tube extending outside of the tubesheet.)

6.3.2 Cleaning shall consist of the removal of all grease, paint, or other foreign matters present. Oil and grease shall be removed by using one of the following acceptable solvents. (Reference MTWS-007).

6.3.3.1 Denatured alcohol.

6.3.3.2 Acetone.

6.3.3 The tube/tubesheet bore hole shall be wire brushed.

TECHNIQUE #1:

Tubesheet bore hole brushing shall consist as a minimum 360° I.D. to a depth of 1/4" and 1/4" radius on the surface around the O.D. of the bore hole.

TECHNIQUE #2:

Tube brushing shall consist as a minimum 360° I.D. to a depth of 1/4" and the entire O.D. of the tube extension. (Reference 6.3.1)

6.3.3.1 For S/S and Ni Base alloys a S/S wire brush shall be used.

6.3.4 During fit-up verify that burrs do not interfere with the two base materials (Plug/tube and plug/tubesheet) thus preventing contact with each other (360°).

6.3.5 Any grinding performed on S/S or Ni Base alloys shall comply with the following requirements:

6.3.5.1 Rubber or resin bonded grinding wheels shall be aluminum oxide or silicon carbide grinding wheels which are either unused or have been previously used only on S/S or Ni base alloys.

TECHNIQUE #1:

6.3.6 For tubesheet bore hole plugging remove wooden marking plug (Reference paragraph 5.1) and insert tapered plug. Scribe a mark 1/4" up from the tubesheet on the plug. Remove plug and replace with wooden marking plug. Cut off excess above the 1/4" scribe mark. (Reference Attachment #8.2)

6.3.7 Once excess has been removed from the plug, reclean plug with an approved solvent. (Reference paragraph 6.3.2) and verify bore hole was cleaned as in Step 6.3.2.

6.3.8 Insert plug into tubesheet and drive plug with one blow from a four pound mallet to insure a good mechanical seal.

TECHNIQUE #2:

6.3.9 For tube plugging, plug shall be inserted into the tube positively identified to be plugged (Reference 5.1.4). In cases where stabilizers are to be used the applicable manufacturers procedures shall be followed in conjunction

with this procedure. Plug shall be inserted into the tube to the point of intersection between the consumable insert and the tube end surface (Reference Attachment #8.3).

6.3.10 If steam generator and/or heat exchanger has been open for a 48 hour or less time period, or flushed or flooded within that time, a cal rod heater and/or forced hot air shall be used to insure the tube/bore hole and surrounding surface are thoroughly dry. When tube extension has been cut off flush with tubesheet a cal rod heater shall be used prior to welding in order to dry the tube/tubesheet crevice. If usage of cal rod and/or forced hot air are necessary as deemed above, the following sequence/requirements shall be met.

6.3.10.1 Cal rod heater shall be inserted into the tube/bore hole and maintained there for a minimum time period of 15 minutes. Following the drying period the plug shall be inserted as described in Steps 6.3.8 and 6.3.9.

6.3.10.2 Forced hot air shall be blown through the steam generator/heat exchanger for a minimum time period of 12 hours.

6.3.10.3 At the end of drying periods on both of the above methods, a thorough visual check shall be performed to insure the tube/tubesheet area to be welded is moisture free. If moisture still exists,

the drying method used shall be extended until all moisture has been removed.

6.3.10.4 The insertion and welding of the plug shall be accomplished in a five minute maximum time period.

6.4 Welding Requirements:

TECHNIQUES #1 and #2:

6.4.1 Preheat: A minimum preheat of 50° is required prior to striking an arc.

6.4.1.1 Preheat shall be determined by control room temperature indicators or on the component surface. Fifty (50°) degree limit may be lowered with concurrence from Materials Technology.

6.4.2 Interpass temperature: Interpass temperature shall be a maximum of 400°. The procedure joints #1 and #2 are single pass welds with a 10-20% overlap; verification shall only be required if repairs are made within 30 minutes after initial welding. Verification for Interpass Temperature shall be made with a calibrated contact pyrometer.

(Reference 4.4)

6.4.3 Postweld heat treatments: Postweld heat treatment is not required.

6.4.4 Position: The welding procedure is qualified for all positions.

TECHNIQUE #1:

6.4.5 Technique for bore hole plugging shall include the following: (See Attachment 8.2)

- 6.4.5.1 The tungsten electrode to base material arc shall start on the plug material and work its way downward to the point of intersection between the plug material and the tubesheet cladding. This is where the fillet weld will be placed.
- 6.4.5.2 When the point of intersection is reached and the two base materials start to break down, filler material will start to be added. The addition of filler material will continue 360° to 370° around the plug.
- 6.4.5.2.1 The welding process is not to stop until the start and stop point meet with 10% overlay to assure 360° weld length.
- 6.4.5.3 At the point of tie-in (Start meets stop 360°) the arc length shall be gradually lengthened and the arc extinguished on the plug base material. (Do not break arc on the weld).
- 6.4.5.4 Upon arc extinguishment gas coverage shall be maintained on the weld point of completion for approximately 5 seconds.
- 6.4.5.4.1 Replace argon bottles when gas gauge pressure is reduced to 25 psi or less.
- 6.4.5.5 For bore hole plugging only one stringer bead shall be used to complete the fillet weld.

TECHNIQUE #2:

6.4.6 Tube plugging shall include the following: (See Attachment 8.3)

6.4.6.1 The tungsten electrode to base material shall start on the plug material and work its way downward to the consumable insert. (Reference 4.7)

6.4.6.2 Once the arc has reached the consumable insert the angle of the tungsten shall be directed towards the point of intersection between the plug base material and the consumable insert. This step is necessary to prevent tube blow holes created by direct arc contact on the tube wall/end.

6.4.6.3 The breaking down of the consumable and the adjacent base materials is to continue 360° to 370° around the plug/tube extension.

6.4.6.3.1 The welding process is not to stop until the start and stop point meet with a 10% overlap to assure 360° weld length.

6.4.6.4 At the point of tie-in (Start meets stop 360°) the arc length shall be gradually lengthened and the arc extinguished on the plug base material (Do not break the arc on the weld).

6.4.6.5 Upon arc extinguishment gas coverage shall be maintained on the weld point of completion for

approximately 5 seconds.

6.4.6.5.1 Replace argon bottles when gas gauge pressure is reduced to 25 psi or less.

TECHNIQUES #1 and #2:

6.4.7 There shall be no peening allowed.

6.4.8 The completed weld shall blend smoothly into the adjacent base materials.

6.4.9 Gas: The gas used for shielding shall meet the following requirement.

6.4.9.1 Argon Type.

6.4.9.2 99.99% pure composition

6.4.9.3 During welding a flow rate of 15-20 CFH shall be maintained.

6.4.10 Electrical Characteristics: Electrical characteristics shall meet the following:

6.4.10.1 Current shall be direct current

6.4.10.2 Polarity shall be straight.

6.4.10.3 The Amps and volts ranges shall be covered under the applicable WPS.

6.4.10.4 The travel speed range shall be covered under the applicable WPS.

6.4.11 Filler Materials: The filler materials and size to be used shall be addressed on the applicable WPS/weld record sheet.

6.4.12 Joints: The joint designs to be used are shown on attachments 8.2/8.3 of this procedure and the applicable WPS.

6.5 Inspection:

The following inspection requirements shall be met.

- 6.5.1 Lighting shall be sufficient enough to distinguish a 1/32" black line on an 18% neutral gray card.
- 6.5.2 No visual cracks and/or linear indications shall exist in the weld.
- 6.5.3 No visual porosity and/or blow holes shall exist in the weld.
- 6.5.4 No visual cold lap shall exist at the points of intersection between the weld and base materials.
- 6.5.5 Verify the weld is 360° single pass minimum.
- 6.5.6 Any indication proving to be relevant shall be removed and repaired as outlined in Section 6.6.

6.6 Repair welding shall be as follows:

- 6.6.1 Grind out defective area using acceptable grinding wheels as outlined in Section 6.3.5.1. Care shall be taken not to grind into intersecting base materials or surrounding tube welds or tube extensions.
- 6.6.2 Perform visual inspection of grind out to verify defect is removed and that no adjacent tubes or adjacent tubeseal welds were damaged during grinding.
- 6.6.3 Once defective area has been removed filler material shall be uniformly added as described in Section 6.4.
- 6.6.4 Upon completion of welding, repaired area shall be visually inspected as described in Section 6.5.

7.0 RECORDS:

- 7.1 The weld records used to control and document welding shall be considered service life plant records.

7.2 Retention shall be in accordance with appropriate plant record retention procedure.

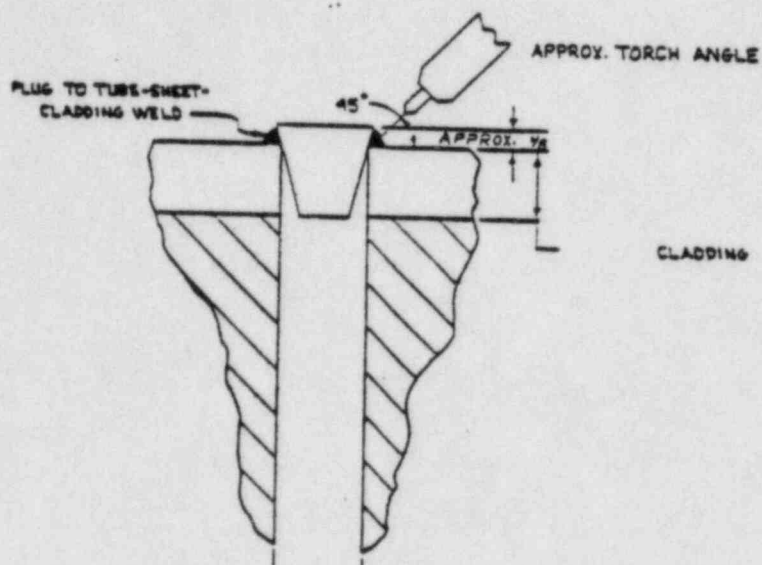
8.0 ATTACHMENTS:

- 8.1 Tube/tubesheet weld record sheet.
- 8.2 Plug to tubesheet joint design. (Technique #1)
- 8.3 Plug to tube joint design. (Technique #2)

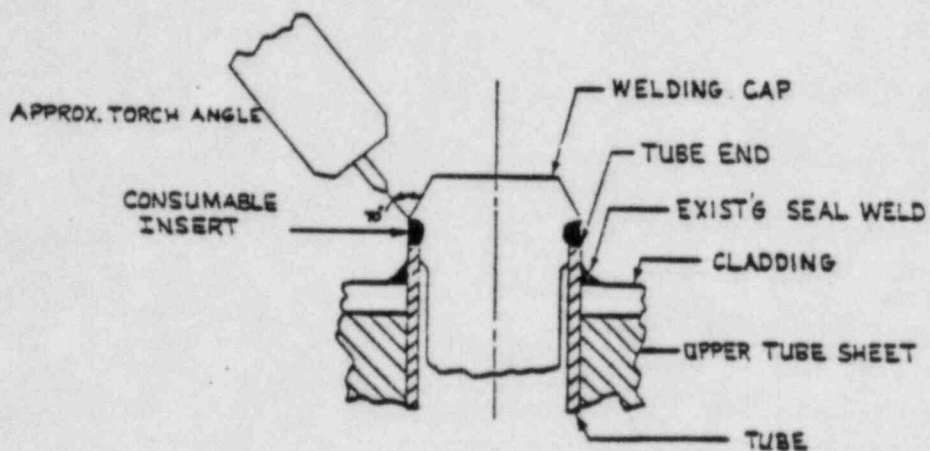
Attachment 8.2

Technique #1

PLUG TO TUBE SHEET



Attachment 8.3

Technique #2PLUG TO TUBE

TUBE/TUBESHEET PLUGGING WELD RECORD

ATTACHMENT 8.1

HEAT EXCHANGER ID _____

PROC. NO. _____

WPS. NO. _____

REFERENCE TUBESHEET MAP NO. _____

STATION _____

UNIT _____

REF. DOC. NO. _____

OTHER _____

TUBE I.D.		PLUG SERIAL NO.	FILLER MAT'L		TECHNIQUE NO.		WELDER I.D.	WELD INSPECTION	REMARKS
ROW	NO.		TYPE	HEAT NO.	#1	#2		Q.C. INSPECTOR / DATE	
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