

**BHARAT HEAVY ELECTRICALS LIMITED
TIRUCHIRAPALLI 620 014**

QUALITY ASSURANCE

SIP:PP:02/ 01

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VISUAL INSPECTION OF PRESSURE PARTS EXCEPT TUBULAR PRODUCTS

REV	DATE	PREPARED	REVIEWED	APPROVED
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RECORD OF REVISIONS

Rev. No.	Clause No.	Details of Revision	Remarks
00	--	This procedure has been made from the document PR: QE:017/03 with total modification.	
01	--	Totally revised in line with the latest changes in IBR and ASME Section I.	

1.0 SCOPE

1.1 This procedure is applicable for visual inspection and blending of base metal surfaces at welds on drums, headers, piping and fittings.

1.2 This is also applicable for repair of deficient surface areas on the base materials as well as on welds.

2.0 MATERIALS

2.1 All materials of P1, P2, P3, P4 and P5 as per ASME Section IX and Steel 20 & 12X1MØ of GOST specification will be covered by this procedure.

3.0 SURFACE EXAMINATION BEFORE POST WELD HEAT TREATMENT

3.1 Prior to post weld heat treatment, the base metal surfaces and surfaces at welds in drums, headers, nozzles, nipples, pipes and fittings shall be visually examined for surface quality.

3.2 The following criteria shall be met:

3.2.1 Base metal surfaces

3.2.1.1 Minor local surface imperfections noted by visual examination may be accepted without grinding or weld repair, provided they are less than 4 mm in depth (2 mm for fittings). However, the sides shall not be closer than 2 mm.

3.2.1.2 In case they don't comply, the depression should be ground so that the contours comply with the requirements of 1:4 taper with the adjoining surfaces.

3.2.1.3 The surface imperfections shall in all cases be free of tears or cracks. The thickness at the depression shall not encroach on the minimum design thickness.

3.2.2 Surface at welds

3.2.2.1 The surface of all welds shall be free from coarse ripples, grooves, overlaps, abrupt ridges and valleys to avoid stress raisers. Imperfections such as cracks, cavities, lack of fusion, lack of penetration, slag/flux/oxide/metallic inclusions, overlaps, burnthroughs, underflushing, root porosity and poor restart are not permitted. Undercuts shall not exceed 0.8 mm or 10% of the wall thickness of the adjoining surface, whichever is less, and shall not encroach on the required section thickness. Torn surfaces and grinding/chipping marks shall be ground to have a smooth transition. Spatters (except isolated spatters which may be permitted) and stray arcs shall be ground and removed. Stray arc areas shall be examined with LPI or MPI after grinding followed by thickness measurement. In case of fillet welds, the welds shall also merge smoothly with the surfaces being joined. Concavity of the fillet weld face is permissible, provided it does not encroach on the required weld thickness.

3.2.2.2 Reinforcement requirements

3.2.2.2.1 The maximum permitted reinforcement on the butt welds shall be as follows:

<u>Nominal thickness in mm</u>	<u>Maximum reinforcement in mm</u>	
	Circum. jt. in pipes & tubes	Other welds
Upto 3.2	2	2
over 3.2 to 4.8 incl.	3	2
over 4.8 to 13 incl.	4	2
over 13 to 25 incl.	4	2
over 25 to 51 incl.	6	3
over 51 to 76 incl.	*	4
over 76 to 102 incl.	*	5
over 102 to 127 incl.	*	6
over 127	*	8

* The greater of 6 mm or 1/8 times the weld width.

4.0 SURFACE EXAMINATION AFTER POST WELD HEAT TREATMENT

- 4.1 When the surface becomes marred after the final post weld heat treatment, the affected area shall be reconditioned by grinding and blending to remove all tears and upset metal. The contour of the ground and blended depression shall be flared to have a 1:4 taper and to have a minimum bottom radius of three times the depth.
- 4.2 Such reconditioned areas may be left without weld repair if the depression does not encroach on the required minimum wall thickness at that region. The length and width is limited by the requirements of slope of the flared out area.
- 4.3 When the marred area cannot be reconditioned within the dimensional requirements given above, the area shall be repaired by welding in accordance with the following.

5.0 REPAIR TO WELDS

- 5.1 Parts not meeting the requirements shall be weld repaired and non-destructively tested as per the original requirement. It is the intent that necessary weld repairs be accomplished prior to heat treatment. It is mandatory however to meet the requirements listed in the Cl. 6.0.

- 5.2 When unacceptable indications are detected in weld joints by visual or by Non destructive examination, the unacceptable indication shall be removed by mechanical means or by thermal grooving. When thermal grooving is used, the excavated area shall be ground as necessary to assure removal of surface carbides. The excavated areas shall be free of any irregularities that might trap slag. These areas shall be magnetic particle examined to assure complete removal of the defect in case of crack, lack of fusion or ICP and visually inspected in case of other defects, and shall then be rewelded.
- 6.0 **REPAIR TO BASE MATERIALS**
- 6.1 The welding electrodes, preheat and post weld heat treatment requirements to base materials shall be in accordance with the relevant WPS.
- 6.2 The holding time when post weld heat treatment is required shall be based on the depth of the groove after preparation for welding.
- 6.3 Weld repairs may be made to "nipple to header/pipe" or "nipple to drum" weld joints after post weld heat treatment without subsequent post weld heat treatment [except for P5 Group 2, X20 & 12X1M ϕ materials], provided the following conditions are met:
- 6.3.1 The depth of any rework area ground out shall not exceed the smaller of 10% of the thickness of the drum/pipe/ header or 50% of the wall thickness of the tube. The rework shall be limited to P1 (Except SA 106 Gr. C, SA 299 & SA 515 Gr. 70) and P4 materials only if it is on the drum/header/pipe surface adjacent to the fillet.
- 6.3.2 The nipples shall not exceed 102 mm in OD except for P1 material which shall not exceed 168 mm in OD.
- 6.3.3 The number of rework welds allowed on the base header material shall not exceed the lesser of 10% of the nipples on the header or eight (8) rework welds on any P1 or P4 header. Rework of this type shall be kept to an absolute minimum by careful examination prior to post weld heat treatment.
- 6.3.4 The number of rework welds on the nipple side for any single header is not limited.
- 6.3.5 The welding procedure used for repair shall have been qualified for the omission of post weld heat treatment.
- 6.4 P5 material need not be post weld heat treated provided all of the following apply:
- 1) The outside diameter is 102 mm or less.
 - 2) The wall thickness is 13 mm or less.
 - 3) The specified carbon content is 0.15% or less.
 - 4) A preheat of 150 deg. C or higher is applied.
 - 5) Chromium content does not exceed 3.0%.
 - 6) The maximum throat size, in case of fillet welds, is 13 mm or less.

- 6.5 P4 material need not be post weld heat treated provided all of the following apply:
- 1) The outside diameter is 127 mm or less.
 - 2) The wall thickness is 13 mm or less.
 - 3) The specified carbon content is 0.15% or less.
 - 4) A preheat of 125 deg. C or higher is applied.
 - 5) The maximum throat size, in case of fillet welds, is 13 mm or less.
- 6.6 Welds or repairs to welds in P1 material need not be post weld heat treated subjected to the following conditions:
- 1) Thickness \leq 19 mm for carbon content \leq 0.25%.
 - 2) Thickness \leq 9 mm for carbon content $>$ 0.25% and \leq 0.3%.
 - 3) The maximum throat size, in case of fillet welds, is 13 mm or less.
- 6.7 Post weld heat treatment is not required after welding attachments to P1 pressure parts, in situations where welding after PWHT is unavoidable, provided all of the following apply:
- 1) Maximum specified carbon content of the pressure part does not exceed 0.3%.
 - 2) A minimum preheat of 125 deg. C is applied prior to the start of welding and is maintained throughout welding when the thickness of the pressure part at the weld exceeds 19 mm.
 - 3) Fillet weld throat thickness does not exceed 13 mm.
 - 4) Pressure part thickness does not exceed 100 mm.
 - 5) An extended preheat of 300 ± 15 deg. C is maintained for 4 hours after welding in the case of SA 106 Gr. C material.
- 7.0 **DOCUMENTATION**
- 7.1 The details of weld repair carried out, if any, shall be recorded.

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