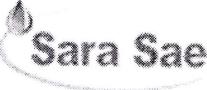
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QUALITY CONTROL REQUIREMENTS FOR STEEL CASTINGS
(WITH WELD REPAIRS)

Rev	Reason of Change	Date	Made By	Reviewed By	Approved By	Status
0		29-08-2013	USR	J Gulati	KKD	Released



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**QUALITY CONTROL REQUIREMENTS FOR STEEL CASTINGS
(WITH WELD REPAIRS)**

0.0 VOLUMETRIC NON-DESTRUCTIVE EXAMINATION

0.1 Method:

0.1.1 Radiographic examination of castings shall be in accordance with Sara Sae RT Procedure SES-26-703.

0.2 Sampling:

0.2.1 Production castings:

0.2.1.1 One casting out of each production lot of that casting

0.2.1.2 For production lots of less than 10 one out of every 10 production castings shall be volumetric examined in all critical areas as identified on the critical area drawings.

0.2.1.3 For low production castings, less than 10 , a minimum of one production casting shall be volumetrically examined

0.2.2 If any casting shows any indications outside the acceptance criteria as defined , two more castings from that production lot shall be examined by the same method(s).

0.2.3 If the additional castings are acceptable, the remainder of the batch may be accepted and the initial non-conforming casting shall be repaired or scrapped.

0.2.4 Should either of these castings be found to be non-conforming, all castings of the production lot shall be examined.

0.3 Acceptance criteria

0.3.1 Radiographic examination:

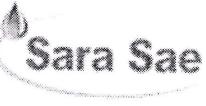
0.3.1.1 The acceptance criteria are based on the Standard Reference Radiographs of ASTM E 446, ASTM E 186 or ASTM E 280 depending on the wall thickness examined.

0.3.1.2 In all cases cracks, hot tears and inserts (defect types D, E and F, respectively) are not permitted.

0.3.1.3 All of the other indication types shall meet Severity level 2 in all critical areas and Severity Level 3 in non-critical areas.

0.3.1.4 If there is no critical area or critical areas are not identified on the drawing of the applicable part, than all areas shall be considered critical.



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1.0 CASTING FINISH

- 1.1 Castings made in accordance with this specification shall be subjected to visual examination and dimensional inspection.
- 1.2 Casting finish in all areas not subsequently machined shall be compared with the photographs of MSS SP 55. Acceptable irregularities for the different defect types are listed in Table 4.
- 1.3 Any casting found to be dimensionally inaccurate when compared to the applicable drawing revision provided by Sara or to the dimensions predicted by the pattern will not be accepted without prior approval being specified on accepted First Article Report or on the purchase order.
- 1.4 The surface of the castings shall be free of scale, adhering sand and other irregularities that could hinder the detection of indications at the MPI.

2.0 WELDING REQUIREMENTS FOR CASTING UPGRADE AND REPAIR

2.1 Welding Qualifications

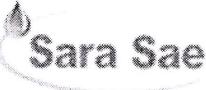
The welding procedure specification and welders used in the repair of castings shall as minimum meet the qualification requirements of:

- 2.1.1 ASTM A 488, AWS D1.1, EN 288 and or ASME IX.
- 2.1.2 Welding shall only be carried out by welders or welding operators who are qualified in accordance with aforementioned standards.
- 2.1.3 Criteria for permitted repairs:
 - 2.1.3.1 Definition of Major/Minor Repairs
 - 2.1.3.1.1 Major Repair: A repair whose depth exceeds 25% of the original wall thickness or 1 inch (25.4 mm) whichever is less.
 - 2.1.3.1.2 Minor Repair: A repair not otherwise classified as a major repair.

3.0 NON-DESTRUCTIVE EXAMINATION OF CASTING UPGRADE AND REPAIR WELDS

- 3.1 Completed repair/upgrade welds, including a minimum of $\frac{1}{2}$ inch (12.7 mm) of the surrounding base metal, shall be examined in accordance with the requirements of this section.
- 3.2 The non-destructive examination required by this section shall be carried out after final post weld heat treatment.
- 3.3 Weld preparation examination:
 - 3.3.1 All excavations for upgrade/repair welds shall be examined by the magnetic particle method .
 - 3.3.2 Acceptance criteria shall be as already defined .
- 3.4 Finished repair/upgrade weld examination:



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- 3.4.1 All finished repair/upgrade welds shall be visually examined in accordance with the requirements of ASME Section V, Article 9
- 3.4.2 All finished repair/upgrade welds shall be magnetic particle examined
- 3.5 Acceptance requirements for finished repair/upgrade welds

Visual examination: Undercuts shall not reduce the thickness in the affected area to below the minimum thickness required per the drawing of the part and shall be ground smoothly into the surrounding material

4.0 QUALITY CONTROL REQUIREMENTS

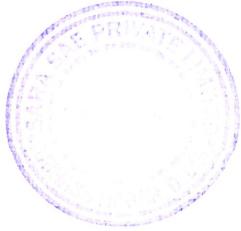
- 4.1 All quality control work shall be controlled by the foundry or subcontractor's documented instructions, which shall include appropriate methodology, quantitative, and qualitative acceptance criteria.
- 4.2 **TRACEABILITY:**
 - 4.2.1 The foundry shall have a documented traceability procedure
 - 4.2.2 The traceability procedure shall include provisions for maintenance and replacement of identification marks and identification records
 - 4.2.3 All castings shall be traceable by heat and heat treatment lot identification
 - 4.2.4 Identification shall be maintained on all castings through all stages of manufacture.
- 4.3 Instructions for nondestructive examination (NDE) activities shall be detailed regarding the requirements of this specification and all the applicable referenced specifications, and shall be approved by an ASNT TC-1A Level III examiner or an examiner qualified to an equivalent standard.
- 4.4 The status of all castings shall be indicated either on the castings or in the records traceable to the castings

4.5 QUALITY CONTROL PERSONNEL QUALIFICATIONS:

- 4.5.1 NDE personnel shall be qualified and /or certified in accordance with ASNT TC-1A or an equivalent standard
- 4.5.2 Personnel performing visual inspection of welding operations and completed welds shall be qualified and certified by AWS QC1 or an equivalent standard or the foundry or subcontractor's documented procedures.
- 4.6 Equipment used to inspect, test or examine castings shall be identified, controlled, calibrated and adjusted .

4.7 TEST REPORTS TO BE SUPPLIED WITH THE CASTINGS

- 4.7.1 A report showing the chemical analysis of each heat used by the foundry to manufacture subject castings shall be submitted with the castings ..
- 4.7.2 Certified test reports of mechanical properties shall be supplied for each casting or heat lot of castings



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- 4.7.3** Heat treatment certifications listing time/temperature/Brinell hardness. Groups of castings/range of hardness may be listed on one certification. Heat treatment furnace charts or copies of these charts. The charts will be identified to show the casting part numbers and quantity of each casting heat treated in the load, heat numbers, casting serial/code number, furnace number and the date of heat treatment.
- 4.7.4** Tests reports of the results of MPI(where applicable) shall be supplied for each casting or a certificate of conformity stating that castings meet the requirements shall be supplied. Groups of castings may be listed on 1 certificate.

5.7 FIRST ARTICLE INSPECTION

- 5.7.1** The requirements of first article inspection apply under the following conditions:
 - 5.7.1.1** The pattern for the part is new or has never been used by the foundry producing the casting.
 - 5.7.1.2** A change or modification has been made in the pattern gating or rising since last approved.
 - 5.7.1.3** The qualified foundry procedure to produce the casting has been changed since last approved by Sara.
 - 5.7.1.4** Castings from the previous production run failed to meet the requirements

5.8 ACCEPTANCE CRITERIA FOR FIRST ARTICLE CASTINGS

In addition to the acceptance criteria requirements of this specification the following shall apply:

- 5.8.1** Each first article casting shall be submitted to Sara with a complete dimensional report, showing full dimensional compliance with the casting drawing as supplied by Sara with the purchase order.
- 5.8.2** Patterns, delivered through Sara (if applicable) to the foundry shall be inspected by the foundry to verify compliance of the pattern to latest drawing revision, before starting the first article procedure. Noncompliance of the pattern shall be reported to Sara.
- 5.8.3** Each first article casting shall be subject to 100% radiographic examination. This examination is to be used by the foundry to verify the integrity of the casting and the production process and procedure of the applicable casting. Cost of this examination is to be negotiated between the foundry and Sara.
- 5.8.4** Rejected castings shall be replaced by the foundry at no charge

