

TD-201 Rev No. 00 Form No.		<h1 style="text-align: center;">PRODUCT STANDARD</h1> <h2 style="text-align: center;">HYDERABAD</h2>				Prod Std. No. GT10160
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VISIBLE DYE PENETRANT TESTING

1. SCOPE

1.1 This specification establishes the minimum requirements for the visible dye penetrant inspection method which is used for the detection of surface discontinuities.

1.2 Liquid penetrant inspection shall be performed in accordance with one of the testing methods listed below:

1.2.1 Water-washable visible dye penetrant

1.2.2 Post-emulsifiable visible dye penetrant

1.2.3 Solvent-removable visible dye penetrant

1.3 This specification is intended to define testing parameters which meet the requirements of ASTM E-1 65. In the event of conflict between this specification and ASTM E-1 65, this specification shall be the governing document.

2. APPLICABLE DOCUMENTS

2.1 The following documents shall form an integral part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue shall apply.

2.1.1 American Society for Nondestructive Testing

SNT-TC-1A
Personnel Qualification and Certification in Nondestructive Testing

2.1.2 American Society for Testing and Materials


ASTM E165
Standard Test Method for Liquid Penetrant Examination

ASTM E1220
Standard Test Method for Visible Liquid Penetrant Examination Using the Solvent-Removable Process

ASTM E1316
Standard Terminology for Nondestructive Examinations

ASTM E1417
Standard Practice for Liquid Penetrant Examination



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ASTM E1418 Standard Test Method for Visible Penetrant Examination
Using the Water-Washable Process

2.1.3 International Specifications

EN 473 European Standard for Qualification and Certification of NDT
Personnel

* 97/23/EC Pressure Equipment Directive

3. DEFINITIONS

3.1 Personnel

3.1.1 Purchaser - BHEL or its Business Associate.

3.1.2 External Supplier (Including Sub-Tier) - The corporation, company,
partnership, sole proprietorship or individual contracted by the purchaser
to perform the process covered by this specification.

3.1.3 Internal Supplier (Including Farm-Out) - Any BHEL Manufacturing
Department.

3.1.4 Supplier - As used herein, unless specifically designated, refers to either
an External or an Internal Supplier.

3.2 Specification Deviation Documents

3.2.1 Applicable to External Supplier

3.2.1.1 Supplier Deviation Request (SDR) - A method for the documentation,
approval and control of a waiver for materials, processes or dimensions
which deviate from the Purchase Order documents (drawing, specification,
Engineering instruction, etc.).

3.2.2 Applicable to Internal Supplier

3.2.2.1 Quality Control Report (QCR) or Quality Report (QR) -BHELManufacturing
Department non-conformance report initiated during processing through
the factory. Used by Manufacturing to document non-conformance to
governing documents and request corrective action.

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COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED, It must not be used directly or indirectly in any way detrimental to the interest of the company.	<div> <h3>3.3 <u>Technical Terms</u></h3> </div> <div> <div> <p>3.3.1 <u>Characteristic</u> - The dimensional, visual, functional, mechanical, and material features or properties which describe and constitute the design of an item and can be measured, observed, or identified to determine conformance to the design requirements.</p> </div> <div> <p>3.3.2 For standard terminology used in nondestructive testing, refer to ASTM E1316.</p> </div> </div> <div> <h2>4. <u>ENGINEERING REQUIREMENTS</u></h2> </div> <div> <h3>4.1 <u>Personnel Qualification</u></h3> </div> <div> <p>* 4.1.1 Tests shall be performed by personnel qualified and certified to a minimum of Level I in the PT method through an established program that reflects the intent of the recommended guidelines provided in ASNT document SNT-TC-1A or EN 473. Where PED 97/23/EC applies, according to PED Annex 1 § 3.1.1, tests must be carried out by suitable qualified personnel who must be approved by a third-party organization recognized by a Member State pursuant to PED Article 13.</p> </div> <div> <h3>4.2 <u>Written Procedure/Method</u></h3> </div> <div> <div> <p>4.2.1 Liquid penetrant inspection shall be performed in accordance with a written procedure/method. This procedure may be either a master procedure which covers details common to a variety of components or a specific individual procedure or a combination of both.</p> </div> <div> <p>4.2.2 The procedure/method shall be capable of detecting the smallest rejectable discontinuities specified in the acceptance requirements.</p> </div> <div> <p>4.2.3 All written procedures shall be approved by a Level III individual. This person shall be qualified and certified in accordance with the local written practice.</p> </div> <div> <p>4.2.4 External suppliers' procedures shall be submitted to the purchaser for approval prior to use.</p> </div> </div>		

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<div style="display: flex;"> <div style="writing-mode: vertical-rl; transform: rotate(180deg); padding: 5px; font-size: small;"> COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED, It must not be used directly or indirectly in any way detrimental to the interest of the company. </div> <div style="flex-grow: 1; padding: 10px;"> <p>4.2.5 The written procedure/method shall include at least the following elements, either directly or by reference to the applicable document:</p> <ul style="list-style-type: none"> 4.2.5.1 Procedure identification with revision number and date written 4.2.5.2 Details of the pre-cleaning and etching (where applicable) process, including materials used, drying parameters and processing times. 4.2.5.3 Complete processing parameters for the penetrant materials including concentrations, application methods, dwell times, drying times, temperatures, and controls to prevent excessive drying of penetrant or overheating of component 4.2.5.4 Complete examination requirements including light intensities and method and location of marking 4.2.5.5 Identification of components or areas within a component requiring inspection in accordance with the procedure 4.2.5.6 Acceptance requirements to be used for evaluating indications and disposition of parts after evaluation 4.2.5.7 Post-inspection cleaning requirements <p>4.3 <u>Examination Sequence</u></p> <ul style="list-style-type: none"> 4.3.1 Liquid penetrant inspection shall be performed after the completion of all operations that could cause surface connected discontinuities or operations that could expose discontinuities not previously open to the surface. These operations include, but are not limited to, heat treating, welding, grinding, straightening, and machining. 4.3.2 Final penetrant inspection shall be performed prior to treatments that can smear the surface but not by themselves cause surface discontinuities. Such treatments include, but are not limited to, vapor blasting, deburring, sanding, buffing, sandblasting, lapping, or peening. 4.3.3 All coatings and other surface conditions, such as paint, plating, corrosion, etc., shall be removed from the area to be inspected prior to penetrant inspection, except when performing penetrant inspections of coatings themselves. </div> </div>			
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5.4.2.6 In cases where a water supply of known pressure and temperature are not available, the water rinse may be performed using a rinse bottle and clean, absorbent towels to blot off (not wipe off) the part surface.

5.4.2.7 For special cases only (i.e. where water rinse facilities are not available or where uncontrollable rinse water is potentially harmful to surrounding components) penetrant removal may be performed by wiping the excess penetrant from the surface with a clean, dry, lint-free cloth or absorbent toweling. Then the remainder of the surface penetrant shall be removed by careful wiping with a water-dampened cloth or towel. The surface shall not be flushed with water and the cloth or towel shall not be saturated with water.

5.4.2.8 After rinsing, drain water from the part and utilize repositioning, suction, blotting with clean, absorbent materials, or filtered shop air at less than 25 psi to prevent pooling in cavities, recesses, and pockets. Use air blow-off sparingly in order to avoid redepositing of unwashed penetrant on clean surfaces. Manual siphoning may also be used.

5.4.3 Removal of Post-Emulsifiable Penetrants by Hydrophilic Emulsifiers

5.4.3.1 The water pressure of the hydrophilic pre-rinse system shall be 40 psi maximum. The water temperature shall be maintained between 50 and 100 degrees F.

5.4.3.2 The drain time after water pre-rinsing of hydrophilic post-emulsifiable penetrants should be 30 minutes maximum.



5.4.3.3 Emulsifier concentration shall be in accordance with manufacturer's recommendations relative to the mode of application (immersion vs. spraying).

5.4.3.4 Immersion emulsification processing systems must provide scrubbing (kinetic) action between the emulsifier and the part. This can be accomplished by mild mechanical motion, air agitation, or submerged recirculation through multiple nozzles when the part is in contact with the emulsifier. Immersion emulsifier bath shall be maintained between 50 and 100 degrees F.

5.4.3.5 The part shall not be immersed in the emulsifier for longer than 120 seconds.



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		<p>5.4.4 <u>Removal of Post-Emulsifiable Penetrants by Lipophilic Emulsifiers</u></p> <p>5.4.4.1 The mode of application of the emulsifier shall be by dip and dwell only. The part must be drained in such a manner that prevents emulsifier from pooling in the part.</p> <p>5.4.4.2 The maximum dwell time of lipophilic emulsifier on the part surface shall be 30 seconds for visible dye penetrants or as recommended by the manufacturer.</p> <p>5.4.4.3 Effective post-rinsing of the emulsified penetrant from the surface can be accomplished using either manual, semi-automated, or automated water immersion or spray equipment or combinations thereof.</p> <p>5.4.4.4 For immersion post-rinsing, parts shall be immersed in the water bath with air or mechanical agitation. The time and temperature should be kept constant. The maximum dip-rinse time should not exceed 120 seconds. The temperature of the water should be relatively constant and should be maintained between 50 and 100 degrees F. A touch-up rinse may be necessary after immersion.</p> <p>5.4.4.5 If manual or automated water spray is used, the rinse water temperature shall be between 50 and 100 degrees F. Spray rinse pressure should be in accordance with the emulsifier manufacturer's recommendations. The maximum spray time should not exceed 120 seconds.</p> <p>5.4.4.6 If the emulsification and final rinse steps are not effective, as evidenced by excessive residual surface penetrant after emulsification and rinsing, dry and re-clean the part and reapply the penetrant for the prescribed dwell time.</p> <p>5.4.5 <u>Solvent-removable Penetrant Removal</u></p> <p>5.4.5.1 Solvent-removable penetrant shall be removed by first wiping the excess penetrant with a clean, lint-free, dry cloth or absorbent towel, repeating the wiping operation until most traces of penetrant have been removed.</p> <p>5.4.5.2 A clean, lint-free material shall then be lightly moistened with solvent and used to wipe the remaining penetrant from the surface of the part. The part surface shall not be flushed with solvent and the cloth or towel shall not be saturated with solvent.</p>	



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5.6.3.3 Non-aqueous developer shall be thoroughly agitated prior to being applied to the part surface.

5.6.3.4 Non-aqueous developer shall be applied to the part by conventional and aerosol spraying only. The developer shall be applied to provide a thin, even coating over the entire area being inspected. The coating shall be applied as uniformly as possible. This coating shall not be so thick as to mask any potential light indications.

5.6.3.5 This type of developer evaporates very rapidly at normal room temperature and does not, therefore, require the use of a dryer.

5.6.3.6 Dipping or flooding of parts with non-aqueous developer is prohibited, since it may flush or dissolve the penetrant from within the discontinuities because of the solvent action of this type of developer.

5.6.3.7 The minimum development time is 10 minutes and the maximum development time is 60 minutes.

5.6.3.8 After the development time, and before evaluation, a light pink background shall be considered acceptable. A white or red background is not acceptable.

5.7 Evaluation

5.7.1 After the minimum development time (and before the maximum development time) has elapsed, the part shall be examined for indications. It is recommended that the surface of the part be observed during the entire development time, when possible, to observe the formation of indications. This will aid in interpretation of indications.

5.7.2 A focused or LED light source shall never be held at a distance of less than 6 inches to the surface being evaluated. The light source may be used at a distance of less than 6 inches to the surface being evaluated only with approval from MPE-NDE.

5.7.3 When required, the location of all rejectable indications shall be marked on the part.

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<div style="display: flex; justify-content: space-between;"> <div style="width: 30%;"> <p style="writing-mode: vertical-rl; transform: rotate(180deg);"> COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED, It must not be used directly or indirectly in any way detrimental to the interest of the company. </p> </div> <div style="width: 65%;"> <p>5.7.4 Indications which are not acceptable in accordance with the applicable acceptance standards require submittal of the appropriate request for deviation document (SDR or QCR) in accordance with Para. 3.2.</p> <p>5.8 <u>Post-Inspection Cleaning</u></p> <p>5.8.1 Post-inspection cleaning is necessary in those cases where residual penetrant or developer could interfere with subsequent processing or service requirements. It is particularly important where residual penetrant inspection materials might combine with other factors in service to produce corrosion. A solvent soak or ultrasonic cleaning may be employed. In the case of developers, it is recommended that if post-inspection cleaning is necessary, that it be carried out as soon as possible after inspection so that the developer does not fix on the part. Water spray rinsing is generally adequate.</p> <p>6. <u>PROCESS/QUALITY CONTROLS</u></p> <p>6.1 <u>System Performance</u></p> <p>6.1.1 <u>System Performance Verification</u></p> <p>6.1.1.1 The following system performance verification checks apply to inspection "systems" only and do not apply to work performed from portable packaging (i.e. spray cans).</p> <p>6.1.1.2 The overall performance of the liquid penetrant inspection system shall be checked daily for performance. The check shall be made with known defect standards. The system performance check can be accomplished by comparing the indications obtained by processing of the known defect standard through the system to either of the following:</p> <p style="padding-left: 40px;">6.1.1.2.1 Indications obtained from the same or a similar defect standard processed with unused samples of the same materials.</p> <p style="text-align: center;">or</p> <p style="padding-left: 40px;">6.1.1.2.2 Photographs of the same or a similar defect standard processed with unused samples of the same materials.</p> <p>6.1.2 <u>Other Required Verification Intervals</u> - For a more detailed description of the verification checks contained below, refer to ASTM EI 417.</p> </div> </div>				
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6.1.2.1 For inspection systems which are not portable, white light intensity shall be checked at least once per day. For inspections using portable materials, flashlight or drop light illumination of the part surface shall be considered adequate.

6.1.2.2 Penetrant contamination check shall be performed at least once per day (for penetrant systems using bulk immersion systems only).

6.1.2.3 Water wash temperature shall be checked at least every 8 hours or every shift change.

6.1.2.4 Water wash pressure shall be checked at least every 8 hours or every shift change.

6.1.2.5 Hydrophilic emulsifier concentration shall be checked weekly.

6.1.2.6 Penetrant sensitivity shall be checked weekly for penetrant systems using bulk immersion systems only.

6.1.2.7 Lipophilic emulsifier water content shall be checked monthly.

6.1.2.8 Drying oven calibration shall be checked quarterly.

6.1.2.9 Light meter calibration shall be checked semi-annually.

6.1.3 System Performance Records

6.1.3.1 A record of all verifications described in Para. 6.1.2 is required. Records shall be maintained for the time period specified in the contract.

7. EVALUATION OF INDICATIONS

7.1 All indications in weld craters shall be considered relevant and shall be evaluated in accordance with applicable acceptance standards.

7.2 If indications are believed to be non-relevant, at least 10 percent of each type of indication shall be explored by removing the surface roughness or other condition believed to have caused the type of indication to determine if actual defects are present.

7.3 The absence of indications upon re-testing by liquid penetrant inspection after removal of the surface roughness, or other condition, shall be considered to prove that the indications were of non-relevant origin.

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7.4 If a re-test again reveals indications, these and all of the original indications shall be considered to be relevant and shall be evaluated in accordance with applicable acceptance standards.

8. ACCEPTANCE REQUIREMENTS

8.1 Acceptance requirements applicable to the part or group of parts shall be incorporated as part of the written procedure either specifically or by reference to other applicable documents containing the necessary information.

8.2 Applicable drawings and/or specifications, etc., must specify the acceptance size and concentration of discontinuities for the component, with zoning of unique areas as required by design requirements, and as determined by Design Engineering.

8.3 If an acceptance criteria is not specified in the applicable drawing and/or specification, the following acceptance criteria shall apply:

8.3.1 Any individual indication which cannot be totally contained within a .125" diameter circle is not acceptable.

9. RECORD OF TEST

9.1 The following information shall be supplied by the Supplier:

- 9.1.1 Supplier name
- 9.1.2 Part identification
- 9.1.3 Shop order or purchase order number
- 9.1.4 Part drawing number
- 9.1.5 Final disposition of part
- 9.1.6 Date of test and name of person performing the test



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RECORD OF REVISIONS

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