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<div style="display: flex; justify-content: space-between;"> <div 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. </div> <div style="text-align: center;"> <u>FLUORESCENT PENETRANT TESTING</u> </div> </div> <p><u>1. SCOPE</u></p> <p>1.1. This specification establishes the minimum requirements for the fluorescent penetrant inspection method which is used for the detection of surface discontinuities.</p> <p>1.2. Fluorescent penetrant inspection shall be performed in accordance with one of the testing methods listed below:</p> <p>1.2.1. Water-washable fluorescent penetrant</p> <p>1.2.2. Post-emulsifiable fluorescent penetrant</p> <p>1.2.3. Solvent-removable fluorescent penetrant</p> <p>1.3. This specification is intended to define testing parameters which meet the requirements of ASTM E165. In the event of conflict between this specification and ASTM E165, this specification shall be the governing document.</p> <p><u>2. COMMUNICATION</u></p> <p>2.1. External Supplier (See Definition) – BHEL GT PURCHASE is the authorized interface for all communication between BHEL and the External Supplier. All questions or requests for additional information shall be submitted to BHEL for clarification. Conflicts between applicable Specifications or drawings shall be submitted to BHEL for resolution by Engineering.</p> <p>2.2. Internal Supplier (See Definition) - All communication, including questions or requests for additional information, shall be submitted to Materials and Processes Engineering.</p> <p>2.3. Requests for Deviations - Requests for deviations to the requirements of this specification shall be submitted as follows:</p> <p>2.3.1. External Supplier - To BHEL Supplier deviation request by SDR</p> <p>2.3.2. Internal Supplier - To the appropriate Engineering personnel by Quality control Report (QCR.)</p>				
Ref Doc P3A-AG4	Revision: Refer Revision Record	Prepared: RSR	Checked & Approved NVS MURTHY	Date 19.10.11


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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.		<p>3. <u>APPLICABLE DOCUMENTS</u></p> <p>3.1. The following documents shall form an integral part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue shall apply.</p> <p>3.1.1. American Society for Nondestructive Testing SNT-TC-1A Personnel Qualification and Certification in Non-destructive Testing</p> <p>3.1.2. American Society for Testing and Materials ASTM E165 Standard Test Method for Liquid Penetrant Examination ASTM E1316 Standard Terminology for Nondestructive Examinations ASTM E1417 Standard Practice for Liquid Penetrant Examination</p> <p>4. <u>DEFINITIONS</u></p> <p>4.1. <u>PERSONNEL</u></p> <p>4.1.1. Purchaser - BHEL.</p> <p>4.1.2. External Supplier - The corporation, company, partnership, sole proprietorship or individual engaged to perform the process covered by this Specification.</p> <p>4.1.3. Internal Supplier - NA</p> <p>4.1.4. Supplier - As used herein, unless specifically designated, refers to either an External or an Internal Supplier.</p> <p>4.2. <u>Specification Deviation Documents</u></p> <p>4.2.1. Applicable to External Supplier</p> <p>4.2.1.1. 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 (drawings, specifications, engineering instructions, etc.).</p> <p>4.2.2. Applicable to Internal Supplier</p> <p>4.2.2.1. Quality Control Report (QCR) - BHEL Manufacturing Department non-conformance report initiated during processing through the factory. Used by Manufacturing to document non-conformance to governing documents and request corrective action.</p> <p>4.3. <u>Technical Terms</u></p> <p>4.3.1. Characteristic - 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> <p>4.3.2. Critical to Quality Characteristic (CTQ) - Those characteristics of a non-destructive test of a component which, if non-conforming, may prevent or seriously affect the unit performance, reliability, production, or customer</p>	
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<p>satisfaction with a component.</p> <p>4.3.3. Linear Indication - An indication whose length is more than 3 times its width.</p> <p>4.3.4. Relevant Indication - An indication which is due to a discontinuity in the material. Non-relevant indications are due to conditions other than discontinuities, such as, geometry, key holes, press fit, etc.</p> <p>4.3.5. TAM Panel - Standard used in penetrant testing; contains star shaped defects of various sizes. Used as a system performance check to verify nominal results over time.</p> <p>4.3.6. For standard terminology used in non-destructive testing, refer to ASTM E1316.</p> <p>5. <u>ENGINEERING REQUIREMENTS</u></p> <p>5.1. Critical To Quality Characteristics (CTQs) - The following Critical Quality Characteristics have been identified for the fluorescent penetrant testing and shall be monitored by the supplier</p> <p>5.1.1. System performance verification (see Para. 7.1.1)</p> <p>5.1.2. Black light intensity at the inspection surface</p> <p>5.1.3. Ambient white light in the inspection area</p> <p>5.1.4. Part temperature</p> <p>5.1.5. Wash water temperature (if applicable)</p> <p>5.1.6. Wash water pressure (if applicable)</p> <p>5.1.7. Emulsifier dwell time (if applicable)</p> <p>5.1.8. Drying oven temperature (if applicable)</p> <p>5.1.9. Development time</p> <p>5.2. <u>Acceptance Requirements</u></p> <p>5.2.1. The acceptance requirements applicable to the part or group of parts shall be incorporated as part of the supplier’s written procedure either specifically or by reference to other applicable documents containing the necessary information.</p> <p>5.2.2. Applicable drawings and/or specifications used by the supplier to perform the test must specify the acceptance size and concentration of discontinuities for the component.</p> <p>5.2.3. Specific acceptance requirements for nickel based superalloy forgings are provided in Para. 9.2.</p> <p>5.3. <u>Personnel Qualification</u></p> <p>5.3.1. All tests shall be performed by personnel qualified and certified through an established program that reflects the intent of the recommended guidelines provided in ASNT document SNT-TC-1A.</p> <p>5.3.2. If the requirements of SNT-TC-1A have been modified to meet the needs of the</p>			
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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.		<p>5.6.2. Final fluorescent 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, and peening.</p> <p>5.6.3. All coatings and other surface conditions, such as paint, plating, corrosion, etc., shall be removed from the area to be inspected prior to fluorescent penetrant inspection, except when performing fluorescent penetrant inspections of coatings themselves.</p> <p>5.7. <u>Process Limitations</u></p> <p>5.7.1. Fluorescent penetrant inspections shall not be performed subsequent to visible dye penetrant inspections of the same surface (i.e. when no machining or other surface removal has taken place between inspections).</p> <p>5.7.2. Intermixing of penetrant materials from different manufacturers is strictly prohibited in accordance with this specification.</p> <p>5.8. <u>Penetrant Materials</u></p> <p>5.8.1. All penetrant materials used in accordance with this process specification shall meet the requirements for Type I (fluorescent dye) penetrants contained in MIL-I-25135.</p> <p>5.8.2. All penetrant materials used in BHEL Plants shall be approved by Plant Environmental Health and Safety.</p> <p>5.9. <u>General Requirements</u></p> <p>5.9.1. Fluorescent penetrant examinations shall be performed in a darkened area with a maximum ambient visible light level of 2 foot candles (20 lux) measured at the part surface. Ambient White light shall be checked per Paragraph 7.1.2.2 or when any changes, or construction, both, in the inspection area are made. These changes include, but not limited to, damage to the inspection area, Re-Lamping/Lighting area external to inspection area.</p> <p>5.9.2. Minimum acceptable black light intensity is 1000 microwatts/cm² (10 W/m²) at a minimum distance of 15 inches (38.1 cm) unless otherwise specified in a component's product acceptance specification. Black lights shall be checked at the interval specified herein and after bulb replacement, for output intensity. Black light reflectors and filters shall be checked daily for cleanliness and integrity. Damaged or dirty reflectors or filters shall be replaced or otherwise corrected.</p> <p>5.9.3. Black Light Intensity Procedure</p> <p>5.9.3.1. An intensity check is required for each black light used for evaluation.</p>		
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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.	<p>5.9.3.2. Intensity check shall be accomplished with the black light in a fixed position pointing toward a flat surface.</p> <p>5.9.3.3. The face of the black light filter shall be a minimum of 15 inches (38.1 cm) from the sensing element of the light intensity meter when verifying light intensity.</p> <p>5.9.3.4. The sensor shall be moved around on the flat surface until the maximum reading on the meter is obtained. The black light shall not be moved during an intensity check of the blacklight.</p> <p>5.9.3.5. A Black Light Intensity Log/Record shall be kept and shall include as a minimum the date, identification of person taking reading, black light intensity, identification of black light meter/sensor, and the date the meter and sensor were last calibrated/certified.</p> <p>5.9.4. The temperature of the penetrant materials and the surface of the part to be inspected shall be in the temperature range of 50 - 100°F (10° - 37.78°C). When it is not possible to comply with these temperature limits, the procedure must be qualified using the temperature to be used.</p> <p>5.9.5. When drying ovens are used during the inspection process, the oven temperature shall not exceed 160°F (71.11°C).</p> <p>6. PRACTICE</p> <p>6.1. Surface Preparation</p> <p>6.1.1. All surfaces to be inspected shall be clean, dry, and free of soil, oil, grease, paint - and other coatings, corrosion products, scale, smeared metal, welding flux, chemical residues or any other materials that could prevent the penetrant from entering discontinuities, suppress dye performance, or produce unacceptable background.</p> <p>6.1.2. Solvent cleaning, including ultrasonic cleaning, or aqueous based cleaning solutions shall be used for removal of oils, grease and wax. Cleaning solvents shall not have more than 100 ppm of chlorine or 5000 ppm of sulfur. Use of aqueous or alkali cleaners can significantly degrade the effectiveness of FPI inspections. Cleaning parts using alkali or aqueous cleaners are only permitted if followed by a post cleaning rinse to remove all residual alkali or aqueous cleaning materials from the part. Alkaline cleaners shall not be allowed to dry on the part prior to being rinsed. Parts cleaned by the alkaline or aqueous cleaning process must be rinsed completely free of cleaner and thoroughly dried prior to the penetrant testing process. The preferred method of post alkali or aqueous cleaning is using Deionized water (DI) at 150 - 160°F (65.55° - 71.11°C) with ultrasonic agitation.</p> <p>6.1.3. Chemical cleaning (such as use of paint strippers, pickling baths, etc.) shall be used for the removal of paint, varnish, scale, carbon or other contaminants</p>		
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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.	<p>which are not removed by solvents. Purchaser approval is required prior to use of any of these processes.</p> <p>6.1.4. Etching is required where evidence exists that a previous condition or operation has produced a surface condition that degrades the effectiveness of the penetrant examination.</p> <p>6.1.5. Parts shall be thoroughly dried after cleaning. Drying may be accomplished by warming the parts using drying ovens, infrared lamps, forced hot air, blotting/wiping, or exposure to ambient temperature in still air. The minimum drying time is 5 minutes. The part temperature shall not exceed 125°F (51.67°C).</p> <p>6.2. <u>Penetrant Application</u></p> <p>6.2.1. After the part has been cleaned, dried, and cooled to an acceptable temperature, 50 to 100°F. (10° - 37.78°C), apply the penetrant to the surface to be inspected so that the entire part or area to be inspected is completely covered with penetrant.</p> <p>6.2.2. Various modes of application of penetrant are effective and acceptable, including immersion, brushing, flooding, conventional, aerosol spraying, dipping, the use of electrostatic spray guns, and high volume low pressure (HVLP) atomizing.</p> <p>6.2.3. After application, allow the excess penetrant to drain from the part (taking care to prevent pooling of penetrant on the part) while allowing for the proper dwell time. The minimum penetrant dwell time shall be 10 minutes. The maximum penetrant dwell time shall be 2 hours. During the penetrant dwell time the penetrant shall not be allowed to dry on the part surface.</p> <p>6.2.4. Areas of the part which are not to be penetrant tested may be masked or otherwise protected during penetrant inspection.</p> <p>6.3. <u>Penetrant Removal</u></p> <p>6.3.1. After the required penetrant dwell time, remove the excess penetrant as described in:</p> <ul style="list-style-type: none"> - Para. 6.3.3 for water-washable penetrants, - Para. 6.3.4 for post-emulsifiable penetrants using hydrophilic emulsifiers, - Para. 6.3.5 for post-emulsifiable penetrants using lipophilic emulsifiers, and - Para. 6.3.6 for solvent-removable penetrants. <p>6.3.2. Adequate penetrant removal has been accomplished when all interfering background is removed, without causing penetrant to be washed out of discontinuities. The adequacy of penetrant removal shall be verified using a blacklight</p> <p>6.3.3. Water-washable Penetrant Removal</p>		
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Ref Doc P3A-AG4	<div>6.3.3.1. Water-washable penetrant shall be removed with a manual or automated water spray, by careful manual wiping, by dip with agitation, or by a combination of these techniques.</div> <div>6.3.3.2. For rinses using a manual or automated spray, a coarse water spray which does not exceed a pressure of 40 psi (2.812 kgf/cm2) shall be used. The water pressure shall remain constant. The spray nozzle shall be held a minimum distance of 12 inches from the part.</div> <div>6.3.3.3. The water temperature shall be maintained relatively constant and shall be in the temperature range of 50 to 100°F (10° - 37.78°C). If hydro-air spraying is used, air pressure shall not exceed 25 psi (1.758 kgf/cm2) maximum.</div> <div>6.3.3.4. Washing off of penetrant from the part surface shall be conducted under proper black light illumination to ensure that over washing does not occur.</div> <div>6.3.3.5. The duration time for the water rinse will depend on the removal characteristics of the penetrant, the surface condition of the part, and the water spray temperature and pressure. The optimum rinse time may need to be determined experimentally, but shall not exceed 120 seconds. An adequate rinse will be evident when no interfering background remains on the part surface.</div> <div>6.3.3.6. For special cases approved by the purchaser (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 gently wiping the excess penetrant from the surface with a clean, dry, lint-free cloth or absorbent towel. Then the remainder of the surface penetrant shall be removed by careful wiping with a water-dampened cloth or towel. Adequate penetrant removal shall be determined by examination under black light. The surface shall not be flushed with water and the cloth or towel shall not be saturated with water.</div> <div>6.3.3.7. After rinsing, excess water shall be drained from the part. Utilize repositioning, suction, blotting with clean, absorbent materials, or filtered shop air at less than 25 psi (1.758 kgf/cm2) to prevent pooling in cavities, recesses, and pockets. Use air blow-off sparingly in order to avoid re-depositing of unwashed penetrant as fluorescent specks on clean surfaces.</div> <div>6.3.4. Removal of Post-Emulsifiable Penetrants by Hydrophilic Emulsifiers</div> <div>6.3.4.1. The water pressure of the hydrophilic pre-rinse system shall be 40 psi (2.812 kgf/cm2) maximum. The water temperature shall be maintained between 50 -100°F (10° - 37.78°C).</div> <div>6.3.4.2. The drain time after water pre-rinsing of hydrophilic post-emulsifiable penetrants shall be 30 minutes maximum.</div>			


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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.		<p>6.3.4.3. Emulsifier concentration shall be in accordance with manufacturer’s recommendations relative to the mode of application (immersion vs. spraying).</p> <p>6.3.4.4. 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 re-circulation through multiple nozzles when the part is in contact with the emulsifier. Immersion emulsifier bath shall be maintained between 50 - 100°F (10° - 37.78°C).</p> <p>6.3.4.5. The part shall not be immersed in the emulsifier for longer than 120 seconds.</p> <p>6.3.4.6. The emulsifier drain time begins immediately after the parts have been withdrawn from the emulsifier tank and continues until the parts are washed in the final rinse station (post-wash). The draining process shall be kept to a minimum to avoid over-emulsification and shall not exceed 90 seconds.</p> <p>6.3.4.7. For spray application of the emulsifier after the pre-rinse, all part surfaces shall be evenly and uniformly sprayed to effectively emulsify the residual penetrant.</p> <p>6.3.4.8. The temperature of the sprayed emulsifier solution shall be maintained between 50 -100°F (10° - 37.78°C). The spray pressure shall be 25 psi (1.758 kgf/cm2) maximum for air and 40 psi (2.812 kgf/cm2) maximum for water.</p> <p>6.3.4.9. The contact time between sprayed on emulsifier and the part surface shall not exceed 120 seconds.</p> <p>6.3.4.10. Verification of the emulsifier concentration in water shall be accomplished using a refractometer.</p> <p>6.3.4.11. Penetrant contamination in the emulsifier shall be monitored by the presence of excessive background on the parts. The emulsifier shall be changed if evidence of penetrant contamination is noted.</p> <p>6.3.4.12. Post-rinsing of emulsified penetrant from the part surface can be accomplished by using either manual, semi-automated, or automated water immersion or spray equipment or combinations thereof.</p> <p>6.3.4.13. If parts are to be completely immersed in a post-rinse water bath with air or mechanical agitation, the temperature of the water shall be relatively constant and shall be maintained within the range of 50 -100°F (10° - 37.78°C). The maximum dip rinse time shall not exceed 120 seconds. A touch-up rinse may be necessary after immersion.</p> <p>6.3.4.14. Parts may be post-rinsed by water spray rinsing using rinse water</p>	
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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.	<p>between 50 -100°F (10° - 37.78°C) at a maximum pressure of 40 psi (2.812 kgf/cm2). The maximum spray rinse time shall not exceed 120 seconds.</p> <p>6.3.5. Removal of Post-Emulsifiable Penetrants by Lipophilic Emulsifiers</p> <p>6.3.5.1. 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>6.3.5.2. The maximum dwell time of lipophilic emulsifier on the part surface shall be 3 minutes for fluorescent penetrants or as recommended by the manufacturer.</p> <p>6.3.5.3. 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>6.3.5.4. For immersion post-rinsing, parts shall be immersed in the water bath with air or mechanical agitation. The time and temperature shall be kept constant. The maximum dip-rinse time shall not exceed 120 seconds. The temperature of the water shall be relatively constant and shall be maintained between 50 -100°F (10° - 37.78°C). A touch-up rinse may be necessary after immersion.</p> <p>6.3.5.5. If manual or automated water spray is used, the rinse water temperature shall be between 50 -100°F (10° - 37.78°C). Spray rinse pressure shall be in accordance with the emulsifier manufacturer’s recommendations. The maximum spray time shall not exceed 120 seconds.</p> <p>6.3.5.6. 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>6.3.6. <u>Solvent-removable Penetrant Removal</u></p> <p>6.3.6.1. 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>6.3.6.2. 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> <p>6.4. <u>Drying After Penetrant Removal</u></p> <p>6.4.1. Drying of the part is necessary either following application of the aqueous wet developer or to dry the rinse water preceding the application of dry or non-</p>		
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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.	<p>aqueous developers.</p> <p>6.4.2. During water-washable and post-emulsifiable penetrant tests, parts can be dried using a hot air re-circulating oven, by exposure to ambient temperature, using hot or cold air blasts, or by wiping/blotting with clean, absorbent cloth or paper. When a hot air re-circulating oven is used, the oven temperature shall not exceed 160°F (71.11°C). In addition, the part temperature shall not exceed 125°F (51.66°C). Monitoring of the part temperature shall performed on a random sampling basis provided that the results of the sampling are documented.</p> <p>6.4.3. The maximum time allowed between the final rinse and drying of the part shall be 30 minutes.</p> <p>6.4.4. In order to speed up drying, pooled water in blind areas shall be siphoned out, drained, or blown off with clean, dry shop air as per 6.3.3.7.</p> <p>6.4.5. Parts shall not be allowed to remain in the drying oven any longer than is necessary for the surface to dry. Excessive time in the dryer may cause evaporation of the penetrant, thereby causing fluorescent indications to fade and a reduction in the sensitivity of the inspection.</p> <p>6.4.6. During solvent-removable penetrant tests where the excess penetrant is removed with the solvent wipe-off technique, drying of the surface shall be accomplished by normal evaporation.</p> <p>6.5. <u>Developer Application</u></p> <p>6.5.1. <u>Dry Developer</u></p> <p>6.5.1.1. Application of dry developer requires that the area to be developed must be dry prior to application.</p> <p>6.5.1.2. Developer shall be applied immediately after the part has dried, while it is still hot.</p> <p>6.5.1.3. Dry powder developer may be applied by immersion of the part into a container of developer, dusting with a hand bulb, powder gun, or in a dynamic or swirl cloud chamber. It may also be applied by conventional or electrostatic powder spray, or sprinkling.</p> <p>6.5.1.4. Excess powder may be removed by shaking, lightly tapping, or blowing with low-pressure (not exceeding 5 psi (0.3515 kgf/cm2)) clean, dry air.</p> <p>6.5.1.5. The developing time for dry powder developers shall be 10 minutes minimum and 4 hours maximum.</p> <p>6.5.2. <u>Non-Aqueous Developer</u></p> <p>6.5.2.1. Application of non-aqueous developer requires that the area to be developed must be dry prior to application.</p>		
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Ref Doc P3A-AG4	<p>6.5.2.2. Parts shall be allowed to cool to room temperature prior to applying non-aqueous wet developer.</p> <p>6.5.2.3. Non-aqueous developer shall be thoroughly agitated prior to being applied to the part surface.</p> <p>6.5.2.4. 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. The coating shall not be so thick as to mask any potential light indications.</p> <p>6.5.2.5. A dryer may not be used for this type of developer. Dipping or flooding of parts with non-aqueous developer is prohibited</p> <p>6.5.2.6. The minimum development time is 10 minutes and the maximum development time is 60 minutes.</p> <p>6.5.3. <u>Aqueous Developer</u></p> <p>6.5.3.1. The concentration of aqueous developers shall be verified by hydrometer reading. The concentration shall be in accordance with the manufacturer’s recommendations.</p> <p>6.5.3.2. Aqueous developers shall be applied to the part immediately after the excess penetrant has been removed from the part and prior to drying.</p> <p>6.5.3.3. Apply aqueous developers by flowing the developer onto the part or by immersing the part in the mixture. Spray application may be used for developing solvent-removable penetrants only. Atomized spray is not authorized.</p> <p>6.5.3.4. Only approved water-suspendible developers shall be used with water-washable fluorescent penetrants.</p> <p>6.5.3.5. The area of the part to be inspected must be completely covered with developer. The part shall be immersed only long enough to coat all of the part surface with developer.</p> <p>6.5.3.6. All excess developer shall be drained from recesses and trapped sections to eliminate any potential pooling of developer.</p> <p>6.5.3.7. The part shall be air or oven dried. When oven drying is used, the part shall not remain in the oven any longer than is required for it to adequately dry. The minimum and maximum development times, after the part is dry, are 10 minutes and 2 hours, respectively.</p> <p>6.6. <u>Test Evaluation</u></p> <p>6.6.1. After the minimum development time (and before the maximum development</p>		

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		7.1.2. Other Required Verification Intervals - For a more detailed description of the verification checks contained below, refer to ASTM E1417. Suppliers who wish to deviate from any of the verification intervals listed below must submit a written request for the deviation. In addition, the Supplier must provide documentation which supports this request for deviation and obtain written approval from MPE.	
		7.1.2.1. Black light intensity shall be checked and the results recorded at least once per day.	
		7.1.2.2. Ambient white light intensity shall be checked and the results recorded at least quarterly or as specified in Paragraph 5.9.1.	
		7.1.2.3. Penetrant contamination check shall be performed at least once per day (for penetrant systems using bulk immersion systems only.)	
		7.1.2.4. Aqueous developer contamination check shall be performed at least once per day.	
		7.1.2.5. Dry developer condition shall be checked at least once per day.	
		7.1.2.6. Water wash temperature shall be checked at least every 8 hours or every shift change.	
		7.1.2.7. Water wash pressure shall be checked at least every 8 hours or every shift change.	
		7.1.2.8. Hydrophilic emulsifier concentration shall be checked weekly.	
		7.1.2.9. Penetrant sensitivity shall be checked weekly (for penetrant systems using bulk immersion systems only.)	
		7.1.2.10. Lipophilic emulsifier water content shall be checked monthly.	
		7.1.2.11. Drying oven calibration shall be checked quarterly.	
		7.1.3. <u>System Performance Records</u>	
		7.1.3.1. A record of all verifications described in Para. 7.1.2 is required. Records shall be maintained for the time period specified in the contract.	
		7.2. <u>Equipment Calibration</u>	
		7.2.1. Black light and white light intensity meters shall be calibrated annually.	
		7.3. <u>Eye Glasses</u>	
		7.3.1. When using fluorescent materials, inspectors shall not wear eyeglasses that are	
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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.	<p>photochromic or that have permanently darkened lenses.</p> <p>7.3.2. Eyeglasses with lenses treated to absorb ultraviolet light are permitted.</p> <p>7.4. <u>Safety</u></p> <p>7.4.1. The safe handling of liquid penetrant materials is governed by the suppliers' Material Safety Data Sheets.</p> <p>7.4.2. Cracked or broken ultraviolet filters shall be replaced immediately. Broken bulbs can continue to radiate ultraviolet energy and must be replaced immediately.</p> <p>7.5. <u>Dark Adaptation</u></p> <p>7.5.1. Personnel shall wait at least 1 minute after entering a darkened area for their eyes to adjust to the low-level lighting before performing fluorescent penetrant examination.</p> <p>8. <u>EVALUATION OF INDICATIONS</u></p> <p>8.1. All indications in weld craters shall be considered relevant and shall be evaluated in accordance with applicable acceptance standards.</p> <p>8.2. 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.</p> <p>8.3. 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.</p> <p>8.4. 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.</p> <p>8.5. The following method of evaluating indications is permitted in order to verify that an indication was caused by a surface discontinuity or to interpret the type of surface discontinuity causing the indication and to measure the defect size:</p> <p>8.5.1. Wipe the surface once with a light application of fast drying solvent using a camel's hair brush or equivalent. After the solvent has dried, redevelop the surface with dry powder developer. Indications which reappear within 2 minutes developing time shall be considered to be caused by surface discontinuities. They shall be evaluated under black light and dispositioned in accordance with the applicable acceptance standard. If the indication does not reappear, it shall be accepted at fluorescent penetrant inspection.</p> <p>8.6. Purchaser approval must be obtained prior to removal of any indications.</p>		
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9. ACCEPTANCE CRITERIA

- 9.1. All relevant indications must be recorded and reported to the purchaser for resolution by Engineering via SDR.
- 9.2. For all super alloy rotor forgings the following acceptance criteria shall apply:
- 9.2.1. All relevant indications 0.062 inches (1.6 mm) or longer are rejectable and must be reported.
- 9.2.2. Two adjacent indications are considered to be interactive and part of a given group when they are closer than three times the maximum dimension of the smaller indication. Once established, a given group shall be considered the same as a single indication regardless of the number of individual indications in the group. Single indications and groups greater than 1/16" in length are unacceptable.

10. RECORD OF TEST

- 10.1. The following information shall be supplied by the Supplier:
- Supplier name
 - Part identification
 - Shop order or purchase order number
 - Part drawing number
 - Final disposition of part
 - Date of test and name of person performing the test
- 10.2. Copies of the fluorescent penetrant test report shall be submitted to the appropriate Quality group through BHEL Purchase group.

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RECORD OF REVISIONS

Rev.No	Date	Revisions Details	Revised	Approved
00	19.10.11	First Made	--	--
01	03.07.21	Re-typed in Word and revised as per latest Rev.	CNK	KDG