

Non-Destructive Test (NDT) and Non-Destructive Evaluation (NDE) Requirements

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1.0 Purpose/Scope/Timing

1.1 Scope

This specification provides the requirements for qualification of nondestructive testing processes for both internal and external suppliers

1.2 Communication

- 1.2.1 The Energy Connections (EC) Supplier Quality Engineer (SQE) is the authorized interface for all communication between EC and the external supplier. All questions or requests for additional information shall be submitted to EC SQE for clarification. Conflicts between applicable specifications or drawings shall be submitted to EC for resolution by engineering.
- 1.2.2 All communication with internal suppliers, including questions or requests for additional information, shall be submitted to Materials and Processes Engineering or the appropriate EC representative.

1.3 Compliance Date

- 1.3.1 Full compliance from all organizations within scope is expected at the time of issuance of this document. This document replaces and simplifies the former GE Energy specification P28A-AL-0203 Rev D, Non-Destructive Testing Process Qualification and Approval.
- 1.3.2 Requests for deviation to the requirements of this specification shall be submitted as follows:
- Requests for deviations from external suppliers shall be submitted to the SQE by a Supplier Deviation Request (SDR).
 - Requests for deviation from internal suppliers shall be submitted to the appropriate engineering personnel by business specific nonconformance notification practice.

2.0 Procedure / Quality Record Requirements

2.1 General Requirements

- 2.1.1 Each supplier performing NDT per EC process specifications must be qualified and approved in accordance with this process specification and other EC NDT process specifications identified by the purchase order (PO) documents.
- a. The qualification and audit requirements for Category 1 NDT processes are defined in this document.
 - b. The qualification and audit requirements for Category 2 NDT processes include the



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- requirements of this document and the requirements specified in the EC NDT process specification.
- c. Once the qualification program has been completed to the satisfaction of the purchaser and the supplier has received the purchaser-supplier approval form, the supplier is then qualified to inspect production parts to the specific EC NDT process specification.
- 2.1.2 Inspections shall be performed by personnel qualified and certified through an established program that incorporates all the recommended guidelines provided in ASNT Document SNT-TC-1A or European EN 473.
- a. The supplier may use an outside agency for performing qualification and certification services for NDT personnel.
 - b. Other qualification and certification guidelines may be used with the prior approval of the purchaser.
- 2.1.3 The training for Level 1 and 2 inspectors shall meet or exceed the minimum requirements for the NDT method recommended in the certification guidelines used by the supplier.
- 2.1.4 The experience level for Level 1, 2, and 3 inspectors shall meet or exceed the minimum requirements for the NDT method recommended in the certification guidelines used by the supplier.
- a. Level 3 inspectors performing NDT procedures on production parts are required to meet or exceed both the Level 2 and Level 3 experience levels recommended in the certification guidelines used by the supplier.
- 2.1.5 Documentation showing the NDT qualification and certification requirements, inspector certification, inspector training records and course description, and inspector experience levels shall be made available to the purchaser upon request.
- 2.1.6 If the supplier's purchaser-certified Level 3 inspector leaves the employment of the supplier, the supplier shall replace the Level 3 inspector within a time period of six months. The replacement Level 3 inspector shall also be purchaser-certified and may be either on staff at the supplier or contracted from an outside agency.
- 2.1.7 The change or replacement of the NDT equipment that could affect the capability of the inspection process shall be reported to the purchaser. Approval of the new equipment by the purchaser shall be required prior to the use of the new equipment for the inspection of production parts to EC process specification.
- 2.1.8 Unless otherwise documented in the EC NDT process specification, the supplier shall be qualified for inspecting production parts by the successful completion of the requirements specified in this document and the continued satisfactory performance inspecting production parts to the EC NDT process specification for an unlimited time



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period.

- a. If the supplier has not performed testing on production parts to the EC process specification within the previous three years, the supplier shall lose the qualification to perform testing to the EC NDT process specification on production parts. To requalify after a period of no testing to the EC NDT process specification the supplier shall meet the requirements of this document plus any additional qualification requirements specified in the EC NDT process specification.
- b. The purchaser has the right to change the qualification period of validity through modification of this document, through modification of the EC NDT process specification, or by written communication with the supplier.

2.1.9 The supplier shall retain the documentation described in this specification in accordance with EC-SRC-0002.

2.2 Requirements for Qualification of NDT Processes

2.2.1 The supplier shall prepare a revision controlled inspection procedure based upon the requirements of the NDT process specification. Purchaser approval of the procedure is required prior to the use of the procedure to evaluate production parts.

2.2.2 Unless otherwise noted in the NDT process specification, the inspection procedure shall include as a minimum the following items:

- a. The specific equipment, probes, cabling, or materials used for the test
- b. The calibration or performance checks for the equipment and material to be performed prior to examination of production parts
- c. The sensitivity adjustment procedures and settings for the test equipment
- d. The setup and equipment operation procedures for performing the evaluation on production parts
- e. Any calculation tables or performance charts used to set the operating parameters for the test equipment
- f. The reporting requirements or screening limits for classifying indications found during the test
- g. The reporting procedures for production parts that are either acceptable or not acceptable to the process specification requirements
- h. Specific details or requirements defined in the process specification
- i. Approval of the supplier Level 3 or supplier outside agency Level 3
- j. Signature block for purchaser approval



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- 2.2.3 When required by the NDT process specification the supplier shall prepare a technique sheet that provides the inspector with the detailed information needed for evaluating a specific part.
- a. Unless otherwise noted in the NDT process specification the technique sheet shall include as a minimum the following items:
 - A sketch of the part with pertinent dimensions shown
 - Clear identification of the inspection surfaces or exposures which show areas that will be tested by each individual test
 - NDT specification number
 - Material specification number
 - Equipment used
 - Equipment and process settings for sensitivity adjustment or exposure
 - Requirement for acceptance of production parts
 - Approval of the supplier Level 3 or supplier outside agency Level 3
 - Signature block for purchaser approval
 - b. Examples technique sheets can be found in Figure 1 for radiographic testing and Figure 2 for contact ultrasonic testing.
- 2.2.4 The supplier shall provide documented evidence of qualification to perform the inspections as described in the NDT process specification. This evidence shall include the certification documentation for the inspection personnel and the supplier's written practice.
- 2.2.5 The supplier shall provide a list of the equipment including the manufacturer and model number that will be used for the inspection process and calibration certificates for this equipment if applicable.
- 2.2.6 The supplier shall provide to the purchaser the inspection data in the form of inspection reports, ultrasonic or radiographic images, photographs of penetrant or magnetic particle inspections of test panels or inspection quality indicators, or other applicable documents as required by the NDT process specification.
- 2.2.7 The purchaser shall perform a detailed on-site review of the supplier's quality system and NDT processes. The purchaser shall review the quality system for compliance with the supplier's written practice and the recommended certification guidelines used by the supplier. The purchaser shall review the supplier's NDT processes for compliance to NDT process specification and adherence to accepted industry practices.



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- a. Unless otherwise noted in the NDT process specification, the purchaser review of the supplier's quality system shall include as a minimum a check of the following items:
 - Inspection personnel certification documents
 - Recertification intervals
 - Recertification method
 - Required training hours for Level 1 and 2 inspectors
 - Content of examinations
 - Training materials and outline
 - Experience level in months for each level
 - Use of EC specifications in training materials
 - Use of EC specification in examinations
 - Calibration of NDT equipment
 - NDT equipment meets requirements of process specification
 - Record retention system
 - b. A checklist for the review of the supplier's quality system can be found in Figure 3.
 - c. Unless otherwise noted in the NDT process specification, the purchaser review of the supplier's NDT processes shall include item contained in the checklists found in Figures 4-8.
- 2.2.8 The purchaser may require inspection personnel to pass a general, specific, and practice examination administered by the purchaser or an outside agency working for the purchaser.
- a. The requirements for inspector examinations administered by the purchaser are documented in the NDT process specification.
 - b. The general examination administered by the purchaser shall cover basic knowledge in the NDT method. The test shall consist of a series of multiple-choice questions.
 - c. The specific examination administered by the purchaser shall cover detailed knowledge in the NDT method, inspection procedure, and process specification. The test shall consist of a series of multiple-choice questions.
 - d. The practical examination administered by the purchaser shall cover the candidate's skill in performing NDT evaluations to the requirement of the inspection procedure and process specification. The supplier's Level 3 inspector may receive assistance from a Level 1 or Level 2 inspector for operation of equipment and collection of



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inspection data. Whenever possible, the parts examined by the candidate should be purchaser- or service-related defects. If purchaser-supplied specimens are not available, production hardware may be used for examination. The examination shall consist of a series of major checkpoints during the inspection process. Unsatisfactory performance by the candidate on any major checkpoint will result in a failing grade for the practical test. The purchaser shall define the time allowed for candidates to complete this test.

- e. The number of questions in the general, specific, and practice examinations shall meet or exceed the minimum number of questions listed in the table below for each examination.

Minimum Number of Questions for NDT Qualification Examinations			
Method	General	Specific	Practical
Acoustic Emission Testing	40	20	10
Electromagnetic Testing	40	20	10
Liquid Penetrant Testing	40	20	10
Magnetic Particle Testing	40	20	10
Radiographic Testing	40	20	10
Thermal/Infrared Testing	40	20	10
Ultrasonic Testing	40	20	10
Visual Testing	40	20	10

- f. The general examination may be waived by the purchaser based upon the certification documentation of the inspector.
- g. Examinations administered by the purchaser for qualification of NDT processes shall result in a passing composite grade of at least 80 percent with no individual examination having a passing grade of less than 70 percent. The composite score for the qualification examination shall be calculated using a score of 80 percent for the waived general examination.
- h. All incorrect answers on examinations shall be reviewed and clarified by the purchaser with the supplier.
- i. Re-examination following failure of a qualification examination is required for only the general, specific, or practical examination that was failed.
 - Suppliers must provide written testimony of additional self-study and preparation to the purchaser prior to being allowed to re-test.
 - An individual who has failed a qualification examination for the second time shall not be allowed to attempt to pass a qualification examination for a minimum



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period of three months. In order for a supplier to qualify an individual during his three month time period, the qualification process must be restarted with an individual other than the person who has failed two times.

2.2.9 Audits of supplier NDT processes and quality system

- a. The purchaser shall perform audits of the supplier's quality system and NDT processes used on parts supplier to the purchaser.
- b. The interval between NDT audits shall not exceed 3 years. Additional requirements on the time interval between audits and content of the audits may be found in the NDT process specification.
- c. All audit findings shall be reviewed with the supplier prior to the purchaser leaving the supplier's inspection facility.
- d. The purchaser shall use the qualification review checklists found in Figure 3-8 as a guideline for the audit of the supplier's quality system and NDT processes.
- e. The purchaser shall review qualification documents for automated systems qualified to P28D-AG1 and P28D-AG2. The time interval between system performance tests should be in accordance with the qualification specification requirements. System performance data shall meet the requirements of the appropriate qualification specification.

2.3 Disqualification

2.3.1 The supplier shall be disqualified from performing an NDT process if a re-inspection of material or a recheck of NDT data shows significant variation from the supplier's inspection as determined by the purchaser.

- a. In cases where the NDT inspection data has been stored or archived, the supplier shall recheck the NDT data collected from the approved process for a period agreed to by the purchaser. The purchaser may overview this recheck.
- b. The supplier shall arrange for re-inspection of material using an inspection source approved by the purchaser. The two inspection reports shall be compared for variation by the purchaser. The re-inspection of material shall continue until the supplier is requalified and no significant variation between the two inspections is noted for a time period agreed to by the purchaser.
- c. The supplier shall meet the requirements of this document plus any additional qualification requirements specified in the EC NDT process specification.

2.3.2 The supplier shall be disqualified from performing a NDT process requiring equipment approved to with P28D-AG1 or P28D-AG2 if the equipment no longer meets the requirements for approved usage.



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- a. If the supplier plans to return the equipment to service, the supplier shall have the equipment maintained or repaired to achieve proper working condition. The supplier shall verify that the equipment meets the qualification requirements of P28D-AG1 or P28D-AG2. The supplier shall then notify the purchaser that the equipment meets the requirements for approved usage. The supplier will then be qualified to perform NDT processes requiring the equipment. The repair or maintenance of the equipment will not be considered a requalification or audit of the NDT process.
 - b. If the supplier replaces the equipment, the supplier shall qualify the replacement equipment for use if the equipment requires qualification to either P28D-AG1 or P28D-AG2. The supplier shall also update inspection procedures and technique sheets as needed for the replacement equipment. The purchaser may require additional qualification testing, demonstration of the replacement equipment capability, or documentation.
- 2.3.3 The supplier shall be disqualified from performing an NDT process if a significant discrepancy or issue is noted during the NDT process audit. The supplier shall correct the discrepancy or issue prior to requalification to perform the NDT process.
- a. The supplier shall be requalified to perform the NDT process by successfully completing the NDT process audit and correcting the identified audit discrepancies and issues. requiring equipment approved to with P28D-AG1 or P28D-AG2 if the equipment no longer meets the requirements for approved usage.
- 2.3.4 The supplier shall be disqualified from performing an NDT process if the supplier's purchaser-approved Level 3 inspector has changed and the supplier does not replace the Level 3 inspector with a purchaser-approved Level 3 inspector within 6 months as outlined earlier in this document.
- a. The supplier shall be requalified to perform the NDT process by successfully meeting the requirements of this document plus any additional qualification requirements specified in the EC NDT process specification in order to be requalified.

2.4 Applicable Documents

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

2.4.1 General Electric Company

EC-SRC-0002	Supplier Quality Requirements
P28D-AG1	Automated Ultrasonic Testing System Qualification
P28D-AG2	Radioscopic System Qualification

2.4.2 American Society for Non-Destructive Testing (ASNT)



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

2.4.3 European Standard

EN 473 Nondestructive Testing – Qualification And Certification of NDT Personnel – General Principles

2.5 Quality Records (if applicable)

2.5.1 Documentation

Quality and product records may include, but are not limited to:

- NDT technique sheets
- NDT process and work instructions
- NDT inspector test records, examinations, and experience documentation
- Product quality or inspection and test plans and results
- Other specific component record requirements specified in POs or contracts

2.5.2 Record retention must meet the requirements outlined in EC-SRC-0002.

3.0 Definitions, Acronyms and References

3.1 General Definitions

- Purchaser - EC or its business associates.
- External supplier - The corporation, company, partnership, sole proprietorship, or individual engaged to provide nondestructive testing services.
- Internal supplier - Any EC manufacturing department or an external supplier engaged by the purchaser to provide nondestructive testing services on a farm-out basis. Farm-out refers to a manufacturing process or service that is typically performed by an EC facility and is temporarily outsourcing through EC Sourcing.
- Supplier - As used herein, unless specifically designated, refers to both external and internal suppliers.
- Supplier Deviation Request (SDR) - A method for the documentation, approval, and control of a waiver for materials, processes, or dimensions that deviate from purchase order (PO) documents (drawings, specifications, engineering instructions, etc.)



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3.2 Technical Terms

- Category 1 NDT process – An EC NDT process specification that has no additional qualification or audit requirements beyond the requirements specified in this document.
- Category 2 NDT process – An EC NDT process specification that contains additional qualification or audit requirements beyond the requirements specified in this document.
- General examination – A written examination relating to fundamentals and principles of the test method.
- Inspection procedure – A document prepared by the supplier that provides a detailed description of the supplier's inspection process. This procedure should identify the specific equipment, instrument settings, step by step operating instructions and reporting and acceptance criteria.
- Outside agency - A company or individual that provides NDT Level 3 services and whose qualifications the supplier has found to meet the requirements imposed by the purchaser.
- Practical examination – Demonstration of proficiency in application of the process specification including interpreting and evaluating results on one or more samples or production hardware.
- Quality system – The supplier's internal procedures and documentation that control the inspection process.
- Specific examination – A written examination relating to the specific process specification and acceptance standards.
- Technique sheet – A summary that provides all detailed inspection information required to inspect a specific drawing number or part geometry.
- Written practice – The supplier's document that describes the control and administration of NDT personnel training, examination, and certification. The document shall also describe the work functions for each level of inspector qualification.



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4.0 Document Revisions and Approvals

The following chart lists the revisions made to this document tracked by version. Use this to describe the changes and additions each time this document is re-published. The description should include as many details of the changes as possible.

Records of Reviewers and Approvers may be found within the DMS (Document Management System).

Version	Section Modified and Revision Description	Date	Author
1.0	New Issue. Replaces P28A-AL-0203 Rev D.	11/11/2013	Tiffany Shomo
1.1	Fix blank pages	01/08/2014	Tiffany Shomo
2.0	Replace Energy Management with Energy Connections	07/08/2016	Arianto Lawardi

Title: Non-Destructive Test (NDT) and Non-Destructive Evaluation (NDE) Requirements
Reference: EC-SRC-0003
Revision: 2.0
Application Date: 07/08/2016
Expiration Date: 07/08/2019



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5.0 Figures

GE Energy		RADIOGRAPHIC TECHNIQUE CHART GE Specification:				
VENDOR:			GE Material Specification:			
Part Drawing Number:		Purchase Order No.		Part Name:		
Acceptance Requirements:						
ITEM						
1. Kilovoltage						
2. Milliamperage						
3. Time (Sec)						
4. Focal Spot						
5. Film Type						
6. Film Size						
7. No. of Film						
8. Lead Screens						
9. Processing Time						
10. Penetrameter Type						
11. Penetrameter Size						
12. Material						
13. Source to Film Distance						
14. Material Thickness						
15. AQL application for subsequent lot/part acceptance, i.e. 100%, 1.0%, 65%, etc						
Procedure:						
Remarks:				GENERAL ELECTRIC APPROVALS		
				Date:		
Vendor Quality Control Sign.						

Figure 1: Sample Technique Sheet for Radiographic Testing



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Checklist for Reviewing Supplier's Quality System			
COMPANY:			
DATE OF REVIEW:			
LOCATION:			
LEAD PERSON REVIEWED:			
REQUIREMENTS	Satisfactory	Unsatisfactory	Comments
Inspection Personnel Certification Documents			
Recertification Intervals			
Recertification Method			
Required Training Hours for Level 1 and 2 Inspectors			
Content of Examinations (# of questions, difficulty level)			
Training Materials and Outline			
Experience Level in months for each Level			
Use of GE specifications in training material			
Use of GE specifications in examination questions			
Calibration of NDT Equipment			
NDT Equipment meets requirements of process specification			
Record Retention System			
Corrective Actions Needed:			
Name of Reviewer (Please Print): _____			
Signature of Reviewer: _____			
Reviewer's Company and Job Title: _____			

Figure 3: Checklist for Reviewing Supplier's Quality System



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Checklist for Reviewing Magnetic Particle Inspection			
COMPANY:			
DATE OF REVIEW:			
LOCATION:			
LEAD PERSON REVIEWED:			
REQUIREMENTS	Satisfactory	Unsatisfactory	Comments
Inspector properly qualified for the assigned task			
Written procedures available to the inspector			
Equipment displays current calibration stickers			
Use of field indicator for establishing current requirements			
Black light intensity checked on an established time interval			
Black light intensity meets industry standards (ASTM E709 = 1000 uW/cm ²)			
Inspection conditions (darkened booth, adequate white light)			
Concentration of suspension checked daily and concentration with proper limits			
Parts are properly cleaned before and after inspection			
Parts are demagnetized after inspection and checked with residual meter			
Records conform to Purchaser requirements			
Parts evaluated to acceptance criteria			
Rejectable parts are identified and separated from acceptable parts			
Equipment is well maintained and areas are well kept			
Corrective Actions Needed:			
Name of Reviewer (Please Print): _____			
Signature of Reviewer: _____			
Reviewer's Company and Job Title: _____			

Figure 4: Checklist for Reviewing Magnetic Particle Inspection



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Checklist for Reviewing Liquid Penetrant Inspection			
COMPANY:			
DATE OF REVIEW:			
LOCATION:			
LEAD PERSON REVIEWED:			
REQUIREMENTS	Satisfactory	Unsatisfactory	Comments
Inspector properly qualified for the assigned task			
Written procedures available to the inspector			
Penetrant materials as specified in the procedure			
Halogen and sulfur content certified to be less than 1% wt. Volume			
Penetrant materials of each group from the same manufacturer			
Surface condition and cleanliness of part in accordance with approved procedure			
Temperature of part and penetrant materials in accordance with approved procedure			
For P. E. materials, emulsification time is specified			
For solvent removable penetrant, excess penetrant is removed in accordance with procedure			
Warm water spray is regulated to 40 psi air pressure and 120 degF max. (Gauges calibrated)			
Wet developers are agitated prior to use and mixed according to manufacturer's instructions			
Black light intensity meets industry standards (ASTM E709 = 1000 uW/cm ²)			
Parts evaluated to acceptance criteria			
Rejectable parts are identified and separated from acceptable parts			
Equipment is well maintained and areas are well kept			
Corrective Actions Needed:			
Name of Reviewer (Please Print): _____			
Signature of Reviewer: _____			
Reviewer's Company and Job Title: _____			

Figure 5: Checklist for Reviewing Liquid Penetrant Inspection



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Checklist for Reviewing Visual Inspection			
COMPANY:			
DATE OF REVIEW:			
LOCATION:			
LEAD PERSON REVIEWED:			
REQUIREMENTS	Satisfactory	Unsatisfactory	Comments
Inspector properly qualified for the assigned task			
Written procedures available to the inspector			
Lighting is adequate for proper visual inspection			
Measuring devices such as fillet gauges, scales, and templates are properly calibrated			
Weld sizes are compared to drawing requirements			
Surface conditions, weld attributes, etc. are compared to acceptance criteria			
Rejectable parts are identified and separated from acceptable parts			
Records conform to Purchaser requirements			
Parts evaluated to acceptance criteria			
Equipment is well maintained and areas are well kept			
Reference standards are available and used properly			
Corrective Actions Needed:			
Name of Reviewer (Please Print): _____			
Signature of Reviewer: _____			
Reviewer's Company and Job Title: _____			

Figure 6: Checklist for Reviewing Visual Inspection



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Checklist for Reviewing Ultrasonic Inspection			
COMPANY:			
DATE OF REVIEW:			
LOCATION:			
LEAD PERSON REVIEWED:			
REQUIREMENTS	Satisfactory	Unsatisfactory	Comments
Inspector properly qualified for the assigned task			
Written procedures available to the inspector			
Calibration procedures and records of calibration maintained			
Equipment displays current calibration stickers			
UT instrument is calibrated daily			
Surface finish or parts and calibration blocks in accordance with procedure and drawings			
Test sensitivity is established in accordance with approved procedure			
Correct transducer available in accordance with approved procedure			
Parts are scanned with proper overlap in accordance with the approved procedure			
Operator monitors CRT at all times			
Indications are evaluated at optimum response and to the approved acceptance criteria			
Areas are mapped to assure 100% volumetric inspection			
Parts evaluated to acceptance criteria			
Rejectable parts are identified and separated from acceptable parts			
Equipment is well maintained and areas are well kept			
Corrective Actions Needed:			
Name of Reviewer (Please Print): _____			
Signature or Reviewer: _____			
Reviewer's Company and Job Title: _____			

Figure 7: Checklist for Reviewing Ultrasonic Inspection



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Checklist for Reviewing Radiographic Inspection			
COMPANY:			
DATE OF REVIEW:			
LOCATION:			
LEAD PERSON REVIEWED:			
REQUIREMENTS	Satisfactory	Unsatisfactory	Comments
Inspector properly qualified for the assigned task			
Written procedures available to the inspector			
Densitometer is in use and calibrated with a step wedge film that is traceable to a national standard			
Radiography is performed in accordance with an approved RSS			
Radiation source is appropriate for the thickness of material being examined			
Penetrameters used show evidence of calibration			
Proper penetrameters used for the thickness being radiographed			
Film-side penetrameters are identified with lead letter "F"			
Radiography is performed single wall to the greatest extent possible			
Film density is maintained in accordance with the approved procedure			
Proper source to film distance is maintained			
Film identification shows organization making exposure, date, part, repair number, etc.			
Images evaluated to acceptance criteria and reference radiographs as required			
Rejectable parts are identified and separated from acceptable parts Rejected areas are marked			
Radiographic records are in accordance with the approved procedure			
Corrective Actions Needed:			
Name of Reviewer (Please Print): _____			
Signature or Reviewer: _____			
Reviewer's Company and Job Title: _____			

Figure 8: Checklist for Reviewing Radiographic Inspection

