

14153 QAP-CSI012169853  
DTD 8 JULY 08

**DEFENSE SUPPLY CENTER PHILADELPHIA  
QUALITY ASSURANCE PROVISION**

**NSN: 5306-01-216-9853**

**P/N: 4053915**

This Quality Assurance Provision (**QAP**) is to be used in conjunction with any orders/contracts for the cited **NSN**

# CONTRACT DATA REQUIREMENTS LIST

(1 Data Item)

Form Approved  
OMB No. 0704-0188

The public reporting burden for this collection of information is estimated to average 110 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing the burden, to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0701-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provisions of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. Please DO NOT RETURN your form to the above address. Send completed form to the Government Issuing Contracting Officer

<b>A. CONTRACT LINE ITEM NO.</b>	<b>B. EXHIBIT</b>	<b>C. CATEGORY:</b> TDP _____ TM _____ OTHER _____
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<b>D. SYSTEM/ITEM</b> 4053915	<b>E. CONTRACT/PR NO.</b>	<b>F. CONTRACTOR</b>
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<b>1. DATA ITEM NO.</b> A001	<b>2. TITLE OF DATA ITEM</b> FIRST ARTICLE TEST PLAN	<b>3. SUBTITLE</b> NOUN: Bolt – Shoulder, .190-32 X 1.090 NSN: 5306-01-216-9853
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<b>4. AUTHORITY (Data Acquisition Document No.)</b> DI-NDTI-80809	<b>5. CONTRACT REFERENCE</b>	<b>6. REQUIRING OFFICE</b>
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<b>7. DD 250 REQ</b> YES	<b>9. DIST STATEMENT REQUIRED</b>	<b>10. FREQUENCY</b> ONCE	<b>12. DATE OF FIRST SUBMISSION</b> SEE BLOCK 16	<b>14. DISTRIBUTION</b>		
<b>8. APP CODE</b>	A	<b>11. AS OF DATE</b> SEE BLOCK 16	<b>13. DATE OF SUBSEQUENT SUBMISSION</b>	<b>a. ADDRESSEE</b>		<b>b. COPIES</b>
						Draft
					Reg	Repro

<p><b>16. REMARKS</b></p> <p>Contractor shall provide a plan that ensures all drawing requirements are met for each first article submitted. The plan shall include the equipment and facilities used to verify all drawing requirements. As a minimum, the plan shall address the following:</p> <ul style="list-style-type: none"> <li>a. A list of all drawing dimensions, surface texture, etc. to be inspected and the equipment to be used to verify each dimension, surface texture, etc. An actual drawing shall be submitted that correlates the dimensions on the drawing to those identified on the list.</li> <li>b. A plan to verify that all non-destructive inspections are met.</li> <li>c. A plan to verify that all visual inspections requirements are met.</li> <li>d. A plan to verify material properties to include mechanical properties, metallurgical properties, and chemical compositions.</li> <li>e. A plan to ensure that manufacturing processes are performed by sources that are currently approved/certified by the OEM (PWA) or the CEA (448 PSS/GBEAR, formerly OC-ALC/LPFR).</li> <li>f. A plan to ensure that the forging or casting sources are currently approved/certified by the OEM (PWA) or the CEA, if this is applicable.</li> </ul> <p>Additional guidelines for first article test plans are contained in LPF-QAR-003.</p> <p>The test plan must be approved by the CEA prior to delivery of test report as required by the contract.</p> <p>The test plan shall be received by the PCO no later than 30 calendar days after contract award date.</p>	
<b>15. TOTAL</b> →	

17. PRICE GROUP

18. ESTIMATED TOTAL PRICE

<b>G. PREPARED BY</b> Aaron Friesenhahn	<b>H. DATE</b> 13 Mar 06	<b>I. APPROVED BY</b> Jolly C. Sartor, Jr.	<b>J. DATE</b> 13 Mar 06
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<b>A. CONTRACT LINE ITEM NO.</b>	<b>B. EXHIBIT</b>	<b>C. CATEGORY:</b> TDP _____ TM _____ OTHER _____
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<b>D. SYSTEM/ITEM</b> 4053915	<b>E. CONTRACT/PR NO.</b>	<b>F. CONTRACTOR</b>
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<b>1. DATA ITEM NO.</b> A002	<b>2. TITLE OF DATA ITEM</b> FIRST ARTICLE TEST REPORT	<b>3. SUBTITLE</b> NOUN: Bolt – Shoulder ..190-32 X 1.090 NSN: 5306-01-216-9853
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<b>4. AUTHORITY (Data Acquisition Document No.)</b> DI-NDTI-80809	<b>5. CONTRACT REFERENCE</b>	<b>6. REQUIRING OFFICE</b>
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<b>7. DD 250 REQ</b> YES	<b>9. DIST STATEMENT REQUIRED</b>	<b>10. FREQUENCY</b> ONCE	<b>12. DATE OF FIRST SUBMISSION</b> SEE BLOCK 16	<b>14. DISTRIBUTION</b>		
<b>8. APP CODE</b>	A	<b>11. AS OF DATE</b>	<b>13. DATE OF SUBSEQUENT SUBMISSION</b>	<b>a. ADDRESSEE</b>	<b>b. COPIES</b>	
		SEE BLOCK 16			<b>Draft</b>	<b>Final</b>
					<b>Reg</b>	<b>Repro</b>

<b>16. REMARKS</b> <p>The First Article Test Report shall satisfy all requirements in the First Article Test Plan. All drawing requirements must be satisfied including dimensions, visual inspections, non-destructive inspections, manufacturing processes and material requirements. The test report shall indicate that any sources used to perform significant manufacturing processes are approved/certified by the OEM (PWA) or the CEA (448 PSS/GBEAR, formerly OC-ALC/LPFR). A copy of the process sheets used to manufacture the First Articles shall be included in the report. A Government representative must coordinate on the Test Report.</p> <p>Additional guidelines for the Test Report are contained in LPF-QAR-003.</p> <p>The First Article Test Report shall be received by the PCO 175 calendar days after award date or 120 calendar days after receipt of First Article Test Plan Approval, whichever occurs first.</p>	
<b>15. TOTAL</b> →	

<b>G. PREPARED BY</b> Aaron Friesenhahn	<b>H. DATE</b> 13 Mar 06	<b>I. APPROVED BY</b> Jolly C. Sartor, Jr.	<b>J. DATE</b> 13 Mar 06
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**17. PRICE GROUP**

**18. ESTIMATED TOTAL PRICE**

FIRST ARTICLE REQUIREMENTS			1. DATE
<i>(AFMCI 64-110, AFMCI 23-102 AND FAR Part 9, Sub Part 9.3) (Additional instructions on page 3)</i>			13 Mar 06
2. PR/MIPR NUMBER	3. PART NUMBER 4053915	4. NSN 5306-01-216-9853	
5. FIRST ARTICLE QUANTITY THE FIRST ARTICLE IS <u>3</u> UNIT(S) OF LOT/ITEM <u>1</u> AND WILL BE: <input type="checkbox"/> PART OF PRODUCTION QUANTITY <input checked="" type="checkbox"/> IN ADDITION TO PRODUCTION QUANTITY			
6. ARTICLES <input type="checkbox"/> WILL <input checked="" type="checkbox"/> WILL NOT SERVE AS MANUFACTURING STANDARD		7. LONG LEAD TIME ITEMS <input type="checkbox"/> REQUIRED <input checked="" type="checkbox"/> NOT REQUIRED <i>(See FAR 52.209-3 or -4, alternate I)</i>	
8. SPECIAL REQUIREMENT/PRODUCTION FACILITIES <i>(See FAR 52.209-3 or -4 Alternate I)</i> <input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED "The First Article offered must be manufactured at the facilities in which that item is to be produced under contract, or if the First Article is a component not manufactured by the contractor, such component must be manufactured at the facilities in which the component is to be produced for the contract. A certification to this effect must accompany each First Article which is offered."			
9. TEST/INSPECTION REQUIREMENTS		F. FIRST ARTICLE DELIVERY:	
A. <input checked="" type="checkbox"/> CONTRACTOR TESTING <input type="checkbox"/> GOVERNMENT TESTING Performance or other characteristics which the First Articles must meet are <u>identified in drawing 4053915 and specifications identified therein.</u>		(1) Due within _____ calendar days from date of contract.	
B. The detailed technical requirements for First Article approval tests are contained in <u>Block 12 of this form and LPE-QAR-003.</u> <i>(Cite Spec and Para number)</i>		(2) Notify _____ calendar days prior to shipment.	
C. <input checked="" type="checkbox"/> TEST PLAN REQUIRED (1) DD Form 1423 ELIN <u>A001</u> (2) Delivery due <u>30</u> calendar days from date of contract. (3) Number of days for government approval/disapproval <u>45</u> days.		(3) Delivered to government at _____ <i>(Set Forth Consignee and Address)</i>	
D. Contractor's notification to ACO and <u>PCO</u> <i>(Requesting Activity)</i> of test time and location due <u>10</u> days prior to start of testing.		(4) Government written notice of approval/disapproval within _____ days after receipt of first article package.	
E. <input checked="" type="checkbox"/> TEST REPORT REQUIRED (1) DD Form 1423 ELIN <u>A002</u> (2) Due <u>175</u> calendar days from date of contract. (3) Forward to <u>PCO and 448 MSUG/GBMUED, 3001 Staff Dr., Suite 1AB85A, Tinker AFB, OK 73145-3041 Attn: FA Monitor</u> (4) Government written notice of approval/disapproval due <u>60</u> days after receipt of contractor's report.		G. Estimated cost of government testing/inspection evaluation. \$ <u>800</u>	
10. DISPOSITION OF FIRST ARTICLES		DODAAC: FA8111	
<input checked="" type="checkbox"/> Approved First Articles will be forwarded to Air Force Supply.		<input type="checkbox"/> Disapproved First Articles will be returned to the contractor/ <input type="checkbox"/> will be retained by _____ pending disposition instructions from the contractor.	
<input checked="" type="checkbox"/> <u>1</u> <i>(insert quantity)</i> First Articles will be expended in testing. Residual components of disapproved First Articles <input type="checkbox"/> will be returned to the contractor/ <input type="checkbox"/> will be retained by _____ pending disposition instructions from the contractor.		<input type="checkbox"/> On purchase requests designated as direct shipments, the following disposition will apply. (NOTE: Always applicable on Foreign Military Sales (FMS)). a. Approved First Articles will be returned to the contractor for shipment with production item. b. Disposition of disapproved First Articles will remain the same as marked above.	
<input type="checkbox"/> First Articles will be installed on aircraft/equipment to determine Proper fit/function. Approved article will remain on the aircraft/equipment and will not be forwarded to USAF Supply, but will be considered part of the contract quantity.		<input checked="" type="checkbox"/> Other Disposition: <u>See Block 12 of this Form.</u>	

2. PR/MIPR NUMBER

3. PART NUMBER

4053915

4. NSN

5306-01-216-9853

11. CONDITION(S) FOR WAIVER OF FIRST ARTICLE APPROVAL

- a.  Offerors who have previously furnished production quantities of the same or similar article to the prime contractor for delivery to the  X  Government,  X  DoD,  X  Air Force.
- b.  Offerors currently in production of the same or similar article for a \_\_\_\_\_ Government, \_\_\_\_\_ DoD, \_\_\_\_\_ Air Force contract and who have received First Article approval under the existing contract.
- c.  Offerors who have previously furnished production quantities of the same or similar article to the  X  Government,  X  DoD,  X  Air Force, provided articles thus furnished, have exhibited satisfactory performance in service in the opinion on the Air Force.
- d.  Provided not more than  36  months have elapsed since completion of the contract.
- e.  First Article testing will not be waived.
- f.  See Remarks in block 12 below.

NOTE TO BUYER: UNDER CONDITIONS A AND C ABOVE, THE COGNIZANT ENGINEERING ACTIVITY WILL DECIDE WHETHER OR NOT THE ITEM HAS EXHIBITED SATISFACTORY PERFORMANCE IN SERVICE AND PREPARE AND RETAIN SUPPORTING DOCUMENTATION TO FULLY JUSTIFY THE DECISION. The buyer must solicit dual prices *that is, both with and without requirement for first article approval* AND MUST FURNISH THE COGNIZANT ENGINEER ACTIVITY WITH THE FOLLOWING INFORMATION ON THE PREVIOUSLY SUPPLIED ARTICLE:

A. PROCURING OFFICE                      B. CONTRACT NUMBER                      C. DATE OF CONTRACT                      D. SPECIFICATION NUMBER AND REVISION

\_\_\_\_\_

12. REMARKS

9.B. First article test requirements shall be per LPF-QAR-003 and the following:

- a. All three first articles shall be inspected in accordance with the requirements of paragraphs 3.1, 3.2, 3.3, 3.4, and 3.5 of LPF-QAR-003.
- b. After completion of inspections per 9.B.a above, one article shall be destructively tested/evaluated in accordance with the requirements of paragraph 3.6 of LPF-QAR-003.

10. Disposition of first Articles:

- a. Approved first article(s) will be retained at the contractor's facility for reconditioning (if necessary) with final acceptance the same as for production items. If a first article is expended in testing, approval of first article will constitute acceptance.
- b. Disapproved first article(s) shall be retained at the contractor's facility, unless specified otherwise by the PCO.

11. The cognizant Government engineering authority shall be the final authority for determining if a contractor meets the conditions of waiver identified in 11.a or 11.c.

First article testing is waived if the offeror is the prime contractor, Pratt & Whitney.

This is a critical part used in the F100 series turbine engine. Poor quality parts will have an adverse effect on mission capability and system safety. For this reason, First Article Testing is required to insure first time manufacturers or manufacturers that have not produced the item within three years manufacture parts in accordance with the drawing and specification requirements.

13. COGNIZANT ENG ORGANIZATION RESPONSIBLE FOR CONDUCTING AND/OR APPROVING TEST (Name, Organization, Phone)

Dan Deloria, 448 P'SS/GBEARB, (405)734-8720, 3/13/06

14. PR INITIATOR (Name, Organization, Phone)

ATTACHMENT 1  
448 PSS/GBEAR Approved Source List  
Applicable to  
MS Aerospace (CAGE 0UCY9) for Manufacture of PN 4053915

**REQUIREMENT**

**APPROVED SOURCE**

Heat Treating per AS7468

Bodycote Thermal Processing – Tarzana, CA or  
Bodycote Thermal Processing – Huntington Park, CA or  
MS Aerospace – Sylmar, CA

FPI per FPM CODE 1

MS Aerospace – Sylmar, CA

PROPULSION  
QUALITY PLAN REQUIREMENTS  
QPR-1

## SECTION 1: OVERVIEW

1. **Purpose:** Quality plans are required to prevent failure or premature deterioration which would result in a significant maintenance burden to the USAF. A quality plan is required to assure that effective process control is established and maintained by all suppliers to insure component reliability.
  - 1.1. The government Design Control Authority (DCA) defines quality as the conformance of a component to its part number drawing and all technical requirements called out on that drawing as well as sub-tier drawings. An overhauled/repared component may vary from the part number drawing only in a manner permitted by the applicable Air Force Technical Orders.
  - 1.2. This document establishes the minimum documentation required for a quality plan to be approved by the DCA. Company Quality Assurance Manuals alone are not acceptable in lieu of specific quality plans. The plan shall be identified by document number, issue date, and revision date.
  - 1.3. Section 2 of this document lists the General Requirements which must be addressed in all quality plans.
  - 1.4. Section 3 contains Process Specific Requirements which must be addressed if these processes are utilized in the manufacture, overhaul, or repair of the component.
  - 1.5. If a supplier accomplishes both manufacture and overhaul/repair of a component on the same production line, the manufacturing quality plan is acceptable for the overhaul of the component. However, if different processes are introduced to accomplish the overhaul, then they must be addressed by the quality plan.
  - 1.6. All documentation provided as evidence of compliance with requirements shall be in English.

## SECTION 2: GENERAL REQUIREMENTS

1. **Statistical Process Control (SPC):** SPC shall be used to establish and maintain processes that produce parts with critical and major characteristics as well as Key Part Characteristics (KPC) as defined by the part number drawing or by the DCA through the contract. The DCA considers any process with a process-sigma value less than 4 to be unacceptable for critical and major characteristics or Key Part Characteristics (KPC). Additional evaluation and inspection is required to evaluate root cause and implement corrective actions necessary to return the process to a controlled state.
2. **Calibration:** All calibration system procedures for testing and production instrumentation must comply with **ISO 10012-1** (formerly MIL-STD-45662A) and calibration standards must be traceable to the National Institute of Standards and Technology (NIST).
3. **Laboratories:** All laboratories must be substantiated as an OEM or DCA approved laboratory for the specific testing required. Laboratories utilized for overtesting shall be autonomous from the source responsible for production acceptance testing. For testing performed by subvendors, orders to the laboratory shall, as a minimum, include provisions for assuring the following:
  - 3.1. Specification to which material is to be tested.
  - 3.2. Specific testing required. i.e., chemical composition, tensile testing, stress rupture testing, hardness, etc.
  - 3.3. Specific acceptance/rejection criteria.
  - 3.4. Certification results from the laboratory shall include acceptance/rejection criteria used to evaluate material, specific test methods used, test specimen identification, numerical data for chemical and mechanical testing, photomicrographs for metallography, and a statement of conformance or nonconformance to the specification.
  - 3.5. Metallography results are certified by a degreed metallurgist and **not a technician**.
4. **Overtesting:** A detailed test plan shall be included for specific overtesting to be conducted by or under the direction of the Offeror. Overtesting shall be conducted in addition to the production acceptance testing by material and process suppliers. Specific test plan requirements are addressed in the following sections, however, as a minimum, test plans shall address the following:
  - 4.1. The specific testing to be conducted on each specimen and acceptance/rejection criteria.
  - 4.2. Identification of test specimen type (specimens machined from a production article or a representative test piece), position, orientation, and description (configuration and dimensions) of test specimens within the test article, and heat treat condition.
  - 4.3. Frequency of overtesting/in-process testing. An actual component shall be tested the first time produced and after each authorized significant process change. This may include parts which are tested in conjunction with first article approvals conducted by DCA. Thereafter, parts or representative test pieces of each process specification and method of joining shall be tested on an appropriate and DCA approved schedule for the type and number of parts being produced. If representative test pieces are used, the test

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results shall be correlated with testing conducted on actual components on an annual basis. Frequency of overtesting and/or in-process testing pertaining to raw material and significant processes are to be agreed upon between the Offeror and DCA.

- 4.4. When a grain flow requirement and/ or microstructure requirement is imposed by a drawing or material specification, the Offeror shall maintain photographs documenting the grain flow and/or microstructure of a cross sectioned and etched forging from each heat/part number combination. The grain flow requirement does not apply to components where testing of a representative test piece is permitted. In these cases, the grain flow shall be documented during the annual correlation of the representative test piece with actual components or with each new die configuration. Grain flow photographs shall reference the magnification, part number, supplier, process number and revision, material specification, heat code, die number, and stock size. A scale shall be placed in each photograph.
- 4.5. Identity and qualifications of personnel responsible for reviewing the results of laboratory testing including metallographic and radiographic inspection.
- 4.6. Procedures for identification of test pieces, retention of test pieces, and retention of test data.
- 4.7. Provisions for correlating test results from in-house laboratories with independent approved laboratories on an annual basis.
5. **Audits.** Specific procedures shall be provided for performing on-site audits of processes and materials including the Offeror which shall as a minimum identify:
  - 5.1. The specific procedures, guidelines, checklists, and frequency for conducting on-site process audits.
  - 5.2. Identification of personnel conducting the audits including their specific background and experience relative to the processes and products to be reviewed.
  - 5.3. Procedures for promptly notifying DCA of major deficiencies noted during audits.
6. **Processing Non-conforming Material:** Procedures shall be provided for processing nonconforming or questionable components and materials of all types. The procedures shall include provisions for prompt notification of the DCA of all non-conformances and excessive scrap due to metallurgical and mechanical property non-conformances, questionable NDT indications, excessive cropping of billet, excessive scrap of ingot, billet, forgings, or parts.
7. **Traceability:** Provide a plan for assuring traceability of the finished part or assembly to the production batch number or lot number. This plan must include traceability to all subvendor materials, processes, services, and finished components. For Fracture Critical forgings, finished components must be traceable by serial number to the original mill heat, heat treat lot, and location of the forging within the billet.
8. **Record Retention:** Records described under Traceability shall be maintained for a minimum of 8 years.
9. **Waivers & Deviations:** No waiver or deviation from these practices and procedures or those authorized or implied by the referenced specifications and standards shall be permitted without specific written approval of the DCA.

## SECTION 3: PROCESS SPECIFIC REQUIREMENTS

1. The specific quality system procedures for each process required in the inspection of the approval item shall be provided. In cases where the required process is performed by a subvendor, procedures shall be provided for assuring that an adequate Quality System is maintained with the subvendor shall be provided.

### 2. Peening Processes

- 2.1. **Qualification and Control of Peening Processes.** The Offeror shall provide:

- 2.1.1. Master peening schedules.

- 2.1.2. Certification procedures for process including identification of test specimen type (actual production part or representative test piece), heat treat condition, configuration of test specimens, the specific testing performed, and the acceptance/rejection criteria for each test.

- 2.1.3. Peening equipment qualification procedures.

- 2.1.4. Peening control procedures including but not limited to in-process testing and monitoring, location of test specimens within the peening booth and control of media used.

### 3. Heat Treat

- 3.1. **Qualification and Control of Heat Treat Processes.** The Offeror shall:

- 3.1.1. Master heat treat process procedures, which as a minimum include the establishment, qualification, and control of heat treat operation sheets and schedules, and in-process inspections for assuring process control.

- 3.1.2. Heat treat furnace qualification procedures.

- 3.1.3. Certification procedures including identification of test specimen type (actual production part or representative test piece), heat treat condition, configuration of test specimens, the specific testing performed, and the acceptance/rejection criteria for each test.

- 3.1.4. Furnace control procedures including but not limited to surveys, instrumentation, parameter checks, furnace burnout processes, and in-process testing.

- 3.2. **Overtesting** shall be performed where heat treat is not performed in conjunction with brazing.

- 3.2.1. An actual part shall be tested the first time produced, after each heat treat operation sheet or process schedule change, and after any furnace alteration which may have changed the thermal characteristics.

- 3.2.2. Heat treat test specimens shall be a representative test piece of the parts being heat treated and shall be of the same parent material.

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- 3.2.3. Test specimens shall be tested for hardness consist with the requirements specified on the **component blueprint**.
- 3.2.4. Test specimens shall be overtested monthly per material/furnace number combination and shall be processed with actual production parts.
- 3.2.5. Heat treat test specimens shall be identified by part number, operation sheet with revision, heat treat specification, and heat treat furnace run number.

#### 4. **Brazing**

##### 4.1. **Qualification and Control of Braze Processes.** The Offeror shall:

- 4.1.1. Master braze process procedures which as a minimum include the method and materials for cleaning each material group, establishment, qualification, and control of operation sheets and braze schedules for induction and furnace brazing, in-process inspections for assuring process control, control of brazing alloys and fluxes, and maximum number of rebraze cycles.
- 4.1.2. Certification procedures for braze schedules including grouping of materials and joint types for certification purposes, identification of test specimen type (actual production part or representative test piece), heat treat condition, configuration of test specimens, the specific testing performed, and the acceptance/rejection criteria for each test.
- 4.1.3. Braze equipment qualification procedures.
- 4.1.4. Furnace control procedures for brazing and heat treatment.

##### 4.2 **Overtesting.** An actual part shall be overtested the first time produced (for each part number), after each braze schedule change, and after any furnace alteration which may have changed the thermal characteristics of the furnace.

- 4.2.1. Representative braze joint test specimens shall be a representative test piece of the parts being brazed and shall be overtested monthly per each braze schedule/material specification/furnace combination.
- 4.2.2. A diagram shall be included in the quality plan showing the location and direction of test samples within actual parts and representative samples
- 4.2.3. Representative braze joint specimens shall be of the same parent material, honeycomb material, honeycomb cell size, honeycomb height, and joint type.
- 4.2.4. Braze joint test specimens shall be identified by part number (when actual part is tested), braze specification, braze schedule number and revision, date sample produced, furnace run number, and furnace number.
- 4.2.5. Micro-examinations shall be performed on braze joints for voids, oxides and contamination at the braze alloy/parent metal interface, and depth of erosion into parent material. Micro-examinations shall be performed at a magnification to be agreed upon with the DCA in accordance with criteria to be agreed upon with the DCA and specified in the qualification plan.

- 4.2.6. Non-destructive inspections specified on the OEM Quality Assurance Document (QAD) referenced on the component blueprint, e.g., gravity leak test, ultrasonic inspection, visual inspections shall be performed on the braze joints.

## 5. Electro-Chemical and Electro-Discharge Machining

### 5.1 Certification and Control of ECM/EDM Processes. The Offeror shall provide:

- 5.1.1 Master ECM/EDM process procedures.
- 5.1.2 Certification procedures for process including identification of test specimen type (actual production part or representative test piece), heat treat condition, configuration of test specimens, the specific testing performed, and the acceptance/rejection criteria.
- 5.1.3 ECM/EDM equipment qualification procedures, including qualification of replacement cathodes and power supplies.
- 5.1.4 ECM/EDM control procedures including but not limited to electrolyte testing and monitoring, and in-process product testing. As a minimum, the Offeror shall perform microexamination on one ECM/EDM test specimen the first time processed, one specimen per schedule weekly, and whenever changes are made to process parameters occur or significant maintenance is performed on the equipment such as power supply replacement.
- 5.2. **Overtesting.** An actual part shall be tested the first time produced and after any change in process schedule, change in power supply, or maintenance on equipment or controls. Thereafter, overtesting of a representative test specimen shall be conducted monthly per **alloy/process schedule/furnace number combination.**
- 5.2.1. ECM representative test specimens shall be fabricated of the same backing material, honeycomb material, cell size, and height.
- 5.2.2. EDM representative test specimens shall be of the same material and thickness.
- 5.2.3. ECM/EDM test specimens shall be identified by part number (when actual part is tested), process schedule number and revision, specification, date sample produced, and machine number.
- 5.2.4. Overtesting for ECM shall consist of the following micro-examinations at **400X magnification using the specified acceptance rejection criteria:**
- 5.2.4.1. Surface irregularity – 0.003 in. max.
  - 5.2.4.2. Intergranular attack – 0.0015 in. max.
  - 5.2.4.3. Selective attack - .00005 in. max. per side providing min. 2/3 wall thickness is retained.
  - 5.2.4.4. Selective attack - .040 in. max. down honeycomb sides adjacent to the **ECM surface.**
  - 5.2.4.5. Inspection of node bonds for weld coverage in accordance with 3.10 of **PWA 123.**
- 5.2.5. Overtesting for EDM shall consist of the following micro-examinations using the specified acceptance rejection criteria:

- 5.2.5.1. Surface irregularity – 0.003 in. max.
- 5.2.5.2. Remelt layer – 0.0015 in. max.
- 5.2.5.3. Heat affected zone - None

## 6. Welding

- 6.1. **General.** AWS D17.1, Specification for Fusion Welding for Aerospace Applications and applicable OEM weld specification shall be used for performance, procedure personnel qualification. AWS D17.1 Section 3, Design of Welded Connections, and Section 8, Welding for Non-flight Hardware, are not applicable. Where conflicts occur, the most stringent requirement shall apply.
- 6.2. **Purchasing.** Specific purchase order requirements to be imposed on subvendors of welding, weld filler material, heat treatment, cleaning, radiographic inspection, fluorescent penetrant inspection, and laboratory testing to control processing and production acceptance testing. The requirements shall address certification and control of weld processes, control of weld filler rod, certification of welders and NDT personnel, processing of significant process changes, maintenance of heat identification, production acceptance testing to be performed, acceptance/rejection criteria, and testing frequency.
- 6.3. **Overtesting.** Addition to the General Requirements, the plan for welds shall specify frequency per weld process, material group and joint type. Also, overtesting and in-process inspection shall include microexamination of weld cross sections including the heat-affected zone, per applicable OEM weld specification and AWS D17.1 Class B. Where conflicts occur, the most stringent requirement shall apply.
- 6.4. **Audits.** In addition to the General Requirements, the specific procedures, guidelines and checklists for conducting on-site process audits of sources of cleaning, welding, heat treatment, radiographic inspection, and fluorescent penetrant inspection must be identified. This plan must include furnace control and the frequency at which they will be conducted. For fracture critical parts, process audit procedures shall also be provided for laboratory testing.
- 6.5. **Certification and Control of Weld Processes.** The Offeror shall provide the following procedures:
  - 6.5.1. A Procedure Qualification Record (PQR) per AWS B2.1 and the master weld process procedures, which as a minimum include the method and materials for cleaning each material group, establishment, qualification, and control of operation sheets and weld schedules, in-process inspections for assuring process control, calibration of welding equipment, control of weld filler rod, repair of welds, and maximum number of passes allowed. The welders must be certified per AWS D17.1, to the specific materials, specific thickness, specific joint type (groove, fillet, etc.), and position. When Class A welds are specified by class or equivalent inspection criteria, the welder must be certified to Class A inspection criteria.
  - 6.5.2. Specific procedures for training of welders.
  - 6.5.3. Certification procedures for welders per AWS D17.1 (including recertification) and a PQR per AWS B2.1 and Welding Procedure Specification (WPS), including, for the grouping of materials and joint types for certification purposes, identification of test specimens (representative test pieces, scrapped parts, etc.), configuration of

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test specimens, number of passes, maximum number of qualification tests the operator is allowed to fail before becoming ineligible, the specific testing performed, and the acceptance/rejection criteria for each test.

- 6.5.4. Welder certification procedures shall identify the time between certifications, the organization responsible for the certification, the agency to which the certification is traceable.

## 6.6. STANDARD PRACTICES

### 6.6.1. Welding Wire.

6.6.1.1. **Certification.** All welding wire must be received into each shop shall be logged into Welding Wire Data Sheet. The Data Sheet shall contain Alloy, Lot #, Date Received, Manufacturer, Quantity (lbs.), Wire Dia., Tag or Paint marked, Date to Chem. Lab, and Date Approved by Chem. Lab. Shop lot #'s shall be assigned to lots received with no documentation and must be verified.

6.6.1.2. **Labeling.** All weld wire shall be color coded or tagged to reflect the proper alloy, IAW AMS 2815 or 2816. All welding wire received that is not "flag tagged" with the material spec # shall be color coded.

### 6.6.1.3. Storage.

6.6.1.3.1. **Material in use.** Welding wire must be stored in a clean dry cabinet. All welding wires must be clearly separated by material, size and lot #, and then clearly labeled with Spec, noun, and lot #. Only one (1) Lot # or Batch # shall be kept in the bin. Only one lot # per alloy and wire diameter shall be stored in bin. The lot # in the bin must be disbursed before another lot# package is opened. Welding wire daily quantities shall be disbursed to the welder along with a spec and lot number label. Wire disbursed may not be returned to the storage location under any circumstance. All stubs remaining at the end of the day shall be discarded in accordance with local regulations.

6.6.1.3.2. **Material in inventory.** Welding wire in inventory shall be kept in a separate cabinet and wire must be kept in original package and labeling.

6.6.1.3.3. **Workstation Log.** Welders shall maintain a Workstation log book of work, including the Date, Part Number #, S/N, Alloy wire used, Size, and Weld wire Lot #, WPS #.

6.6.1.3.4. **Workstation Wire Storage Canisters.** Welding wire in a booth shall be limited to the wire to be used in working day. Wire shall be stored in sealed canisters with lids. The "spec # and lot# label" shall be affixed to the canisters for the specific wire. Mixing of alloys or sizes is not allowed.

SAMPLE WELDING PROCEDURE SPECIFICATION (WPS)

WPS- PROCESS SHEET #: \_\_\_\_\_

DATE: \_\_\_\_\_

REVISION: \_\_\_\_\_

SUPPORTING PQR #: \_\_\_\_\_

Welding process (es) \_\_\_\_\_

TYPE            Manual: ( )            Machine ( )            Semi-Automatic: ( )

Automatic: ( )

EQUIPMENT TYPE AND MODEL #: \_\_\_\_\_

BACKING:            Yes ( )            No ( )

**Base Material "A"**

**To Base Material "B"**

Material # \_\_\_\_\_ Group \_\_\_\_\_

Material # \_\_\_\_\_ Group \_\_\_\_\_

Material spec and grade: \_\_\_\_\_

Material spec and grade: \_\_\_\_\_

Base Material thickness range:            Groove: \_\_\_\_\_            Fillet: \_\_\_\_\_

JOINT DESIGN: \_\_\_\_\_

WELD INCREMENT SEQUENCE: \_\_\_\_\_

Deposited weld material thickness range: \_\_\_\_\_

Filler Material Specification: \_\_\_\_\_

Position(s) of joint: \_\_\_\_\_

Welding progression: \_\_\_\_\_

Up ( )    Down ( )

**GAS:**

Shielding gas (es): Argon    % composition: 99.99

Root shielding gas: \_\_\_\_\_

Trailing gas composition: \_\_\_\_\_

Flow rate: \_\_\_\_\_

Flow rate: \_\_\_\_\_

Flow rate: \_\_\_\_\_

**FIXTURES:**

Holding: \_\_\_\_\_

Root shielding: \_\_\_\_\_

**PROGRAM NAME OR NUMBER:**

**WELDING PARAMETERS:**

Electrode diameter: \_\_\_\_\_

Torch type/ orifice/ cup size / angle \_\_\_\_\_

Electrode standoff distance: \_\_\_\_\_

Amp range: \_\_\_\_\_

Polarity \_\_\_\_\_

Volt range \_\_\_\_\_

Travel speed: \_\_\_\_\_

**POSTWELD HEAT TREATMENT:**

**NDI PROCEDURES:**



**SPECIMENS**

Type: \_\_\_\_\_

Tensile specimen size: \_\_\_\_\_

Tensile test results:  
UTS \_\_\_\_\_

Specimen #	Width, in.	Thickness, in.	Area in <sup>2</sup>	Max load, lbs.	UTS, psi	Type of failure & location

**GUIDED BEND TEST SPECIMENS**

Specimen size:

Type	Result	Type	Result

**MACRO-EXAMINATION**

1

3

2

4

**SHEAR TESTS**

1

3

2

4

**IMPACT TEST**

Specimen Location

Type:

WM = Weld Metal

Size:

BM = Base Metal

Test Temp.

HAZ = Heat Affected Zone

Welding Position

Specimen Location

Energy absorbed (ft-lb)

Ductile Fracture Area (%)

Lateral Expansion (mils)

**HARDNESS TEST**

VALUES

**VISUAL**

ACCEPTABLE

UNACCEPTABLE:

**CHEMICAL ANALYSIS**

ACCEPTABLE

UNACCEPTABLE:

**NON DESTRUCTIVE ANALYSIS**

METHOD

ACCEPTABLE

UNACCEPTABLE

**MECHANICAL TESTING BY:**

QUALIFIER: \_\_\_\_\_

DATE: \_\_\_\_\_

## 7. PLASMA SPRAYED COATINGS

- 7.1. This requirement shall also apply to all detail parts, either repaired or purchased from a sub-vendor. When a sub-vendor is used to provide coatings or coated parts, the Supplier shall be responsible for the quality of these coatings and these sub-vendor processes shall be subject to the requirements of this QPR.
- 7.2. **Purchasing.** Specific purchase order requirements to be imposed on subvendors of plasma spray coating, plasma powders, cleaning and laboratory testing to control processing and production acceptance testing. The requirements shall address certification and control of plasma spray processes, control of plasma powders, certification of plasma spray operators (operators), processing of significant process changes, production acceptance testing to be performed, acceptance/rejection criteria, and testing frequency.
- 7.3. **Testing.** The process supplier shall provide a detailed plan for production acceptance testing of coatings, coupons and powders. The plan shall include the specific testing/inspection to be conducted and as a minimum shall include the following:
- 7.3.1. Frequency of testing. The plan shall specify frequency per plasma process. This shall include for regular production and for special occurrences. For continuous production, the minimum frequency of microexamination shall be weekly.
- 7.3.2. The specific testing to be conducted on each specimen and the acceptance/rejection criteria. Overtesting and in-process inspection shall include microexamination of coating, interface and base material and bond strength testing.
- 7.3.3. Plasma spray coating per PWA 53-1 shall be tested for thickness, chemical composition (of the powder), interface, bond strength, microexamination and hardness, per PWA 53, and the part drawing or T.O. 2J-F100-13-10 and T.O. 2-1-111, as applicable. Microexamination and hardness shall be over tested, certifications will not be an acceptable substitute. Hardness testing shall be IAW ASTM E92. The minimum coating thickness for testing coupons shall be 0.0033". Note: This minimum thickness requirement is intended to lead the testing laboratory to a minimum load of 100 grams.
- 7.3.4. Procedures to ensure that coupons used for the evaluation of plasma spray coatings are a true representation of the coating on the parts. Coupons shall be of the same base material alloy and a thickness within the range listed on the part drawing. These procedures shall include sketches describing the locations to be cut-up and sketches describing coupon placement within the plasma spray set-up.
- 7.4. **Overtesting.** In addition to the General Overtesting Requirements, the test plan(s) as a minimum shall include the following:
- 7.4.1. Identification of test specimen type (actual production article, scrapped parts, integral test piece, or separate representative test piece), description (configuration and dimensions), and heat treat condition.
- 7.4.2. Frequency of overtesting. The plan shall specify frequency per plasma process. The minimum frequency of overtesting shall be every 6 months.

- 7.4.3. The specific testing to be conducted on each specimen and the acceptance/rejection criteria. Overtesting and in-process inspection shall include microexamination of coating, interface and base material and bond strength testing.
- 7.5. **Audits.** In addition to the General Requirements, the specific procedures, guidelines and checklists for conducting on-site process audits of sources of cleaning, abrasive blasting and plasma spray coatings and the frequency at which they will be conducted.
- 7.6. **Certification and Control of Plasma Spray Coating Processes.** The Offeror shall provide the following procedures:
- 7.6.1. Plasma spray process procedures which as a minimum include the method and materials for cleaning each material group, establishment, qualification, and control of operation sheets and spray schedules, in-process inspections for assuring process control, calibration of plasma equipment and grit blast equipment, control of plasma powders and abrasives.
- 7.6.2. Specific procedures for training of plasma spray operators.
- 7.6.3. Certification procedures for operators (including recertification) and spray schedules including grouping of coating types for certification purposes, identification of test specimens (coupons, representative test pieces, scrapped parts, etc.), configuration of test specimens, number of passes, maximum number of qualification tests the operator is allowed to fail before becoming ineligible, the specific testing performed, and the acceptance/rejection criteria for each test.
- 7.6.4. Operator certification procedures shall identify the time between certifications, the organization responsible for the certification, the agency to which the certifying laboratory is traceable.
- 7.6.5. Production testing requirements which as a minimum shall consist of one test piece per coating station per airfoil lot for quality, bond strength, microexamination, hydrogen content, thickness, composition, cubic boron nitride uniformity, and hardness.
- 7.6.6. Each powder lot shall be tested by the coating source for composition, particle size and distribution, and quality. The method of determination shall be included in the Offeror's Quality Plan.
- 7.7. **Process & Equipment Qualification.**
- 7.7.1. Booth Qualification: Compliance of the manual or automated (robotic) equipment will be demonstrated by spraying test specimens or jet engine components that meet the Technical Order (T.O.) requirements. The compliance will be recorded and documented by process sheets and procedure qualification record.
- 7.7.2. Process Sheet (PS): The PS is considered controlled data. See Figure 1.
- 7.7.3. The PS parameter(s) must be updated if the process parameters or robotic programming is changed more than 10%.

- 7.7.4. The PS may have an attachment, which defines how the part is to be setup on the thermal spray system.
- 7.7.5. Procedure Qualification Records (PQR). Contractor/supplier shall gather all the information and data to construct the PQR. All important process steps will be documented either by video, or digital or film photographs. The PQR will be submitted to the Cognizant Engineering Organization for coordination and include the following:
- 7.7.5.1. PS – appropriate settings.
  - 7.7.5.2. Part router, T.O. Reference, part noun, part number(s), and part print  
The T.O. reference will include the T.O. front two pages, and pages for specific repair paragraph including the figure(s).
  - 7.7.5.3. Contractor shall have a plan for maintenance of technical documentation.
  - 7.7.5.4. Contractor shall prototype the repair, create the part motion program, and conduct necessary testing to validate the T.O. requirements.
  - 7.7.5.5. Contractor shall create the PQR folder. The PQR folder will contain the following elements:
    - 7.7.5.5.1. Final Process Sheet.
    - 7.7.5.5.2. Metallurgical Test or Analysis Report by OEM approved laboratory
    - 7.7.5.5.3. Certification of Conformance for Blasting Media and Coupon Material.
    - 7.7.5.5.4. Robotic Program or Written Instruction.
    - 7.7.5.5.5. Cognizant Engineering Approval or Approval Certificate or OEM approval
    - 7.7.5.5.6. Summary of the elements and the repair sequence is optional.
    - 7.7.5.5.7. Coordinated and Final Procedure Qualification Record.
    - 7.7.5.5.8. Contractor retains and archives the PQR.
    - 7.7.5.5.9. The PQR's will be maintained for 5 years. PQR resubstantiation shall be accomplished when major changes occur, including but not limited to change in facility location, equipment move, and equipment major maintenance.
    - 7.7.5.5.10. Contractor shall maintain a list of all PQRs for each repair per jet engine component.

**Figure 1.**

Document control # , Date of issue, Revision, Reaffirm Date:

Booth:	Part Router Document #:	
Part Name:	Engine:	
Part Number:	T.O. Reference:	
	Gun Type:	
Spraying Spec:	Gun Model No.:	
Coating Spec:	Robot Program:	
Powder Name:	Recipe Number:	
PREPARATION:	TEST PIECE MATERIAL:	
Method of Cleaning:	POWDER FEEDER:	
Fixturing Type:	Manufacturer:	
Masking Information:	Model No:	
Spray Area:	Type of Carrier Gas:	
Blast Nozzle to Work Distance ("):	Regulator (psi):	Console (psi):
Grit Type:                      Size:	Pressure (psi):	Flow (SCFH):
Blast Pressure (Dyn psi):	Powder Feed Rate:	lb/hr
g/min		
Blast Nozzle Size ("):	Disk (RPM):	Stirrer (RPM):
Blast Angle (Degrees):	Gun Feed Hose Inside Diameter ("):	
SPRAY EQUIPMENT SUPPLEMENTS:	Feed Hose to Gun Length ("):	
Controller Type:	Feed Worm Pitch (OPTIONAL):	
Nozzle Anode Type No.:	COATING DATA:	
Nozzle Cathode Type No.:	Powder Injection Port Angle (Degrees):	
Primary Gas (1):	Internal/ External:	
Secondary Gas (2):	Injection Nozzle ID (mm):	
ARC GAS SETTINGS:	Plasma Gun to Work Distance ("):	
Primary Gas (psi):	Min Gun to Work Angle (Degrees):	
Secondary Gas (psi):	Turntable Speed (rpm):	
	Surface Speed (m/min):	
Console Flow (SLPM):	Console Pressure PSI or Setting:	Coating Thickness:
Gas (1):                      Gas (1):	As Sprayed ("):	
Gas (2):                      Gas (2):	After Finishing ("):	
POWER:	Min      Mid      Max	Preheat Temp (Deg F):
Voltage DC Operating:		Number of Passes:
Amperes DC Operating:		Method of Cooling:
PART MATERIAL DATA:		

Process/Methods Engineer Signature \*      \* Parameters may vary +/- 10 percent in order to maintain coating quality. Process/Methods Engineering coordination required for adjusting parameters.

## **8. NONDESTRUCTIVE INSPECTION**

### **8.1. REFERENCE DOCUMENTS.**

#### **8.1.1. Industry Standards and Specifications.**

- 8.1.1.1. NAS 410, Certification and Qualification of Nondestructive Test Personnel
- 8.1.1.2. SAE AMS 2644, Inspection Material, Penetrant
- 8.1.1.3. QPL-SAE-AMS 2644, Qualified Products List
- 8.1.1.4. ASTM E 1316, Terminology for Nondestructive Examinations
- 8.1.1.5. ASTM E 1417, Standard Practice for Liquid Penetrant Examination
- 8.1.1.6. ASTM E 1444, Standard Practice for Magnetic Particle Examination
- 8.1.1.7. ASTM E 1742, Standard Practice for Radiographic Examination
- 8.1.1.8. ASTM E 2104, Standard Practice for Radiographic Examination of Advanced Aero and Turbine Materials and Components
- 8.1.1.9. ISO 9002, Quality Systems - Model for Quality Assurance in Production, Installation and Servicing Second Edition

#### **8.1.2. United States Air Force Technical Orders.**

- 8.1.2.1. TO 2J-F100-9
- 8.1.2.2. TO 33B-1-1
- 8.1.2.3. TO 2-1-111

#### **8.1.3. Order of Precedence.**

- 8.1.3.1. In the event of conflict between this QPR and above referenced documents, the instructions in this QPR take precedence.
- 8.1.3.2. In the event of conflict between United States Air Force Technical Orders and Industry Standards and Specifications, the Technical Orders take precedence.
- 8.1.3.3. In the event of conflict between documents in paragraph 8.1.2, T.O. 2J-F100-9 takes precedence, followed by T.O. 33B-1-1.
- 8.1.3.4. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

#### **8.1.4. Terminology.**

8.1.4.1. Terms such as Nondestructive Testing (NDT) and Nondestructive Evaluation (NDE) shall be considered synonymous as Nondestructive Inspection (NDI).

8.1.4.2. Definitions relating to NDI, which appear in Terminology ASTM E 1316, shall apply to the terms used in this QPR unless otherwise stated in this QPR.

## 8.2. REQUIREMENTS.

8.2.1. **Purchasing.** Specific requirements to be imposed on sub-vendors of NDI services, materials, cleaning, and laboratory testing to control processing and production acceptance testing shall be specified on the purchase order. The requirements shall address certification and control of NDI processes, NDI materials, certification of NDI personnel, and approval process for significant NDI process changes, production acceptance testing to be performed, acceptance/rejection criteria and testing frequency.

8.2.2. **Personnel.** Personnel performing NDI shall be qualified and certified in accordance with (IAW) NAS 410 with the exception that inspectors must be recertified every three years with a general, specific and practical examination. The three year recertification requirement may be waived if Performance Review Institute audits are successfully accomplished at 18 month maximum intervals. NDI methods include penetrant, magnetic particle, eddy current, ultrasound, radiography, neutron radiography, thermal infrared, and laser holography and shearography.

8.2.3. **Visual Inspection.** Visual inspectors shall receive documented training necessary to perform required visual inspection tasks. Visual inspectors shall meet vision requirements of NAS 410. Formal qualification and certification of visual inspectors per NAS 410 is not required.

### 8.2.4. Penetrant Inspection (PT or FPI).

8.2.4.1. For new manufacture, inspection shall be conducted IAW OEM requirements, drawings and ASTM E 1417.

8.2.4.2. For overhaul and maintenance, inspection shall be accomplished IAW Air Force technical order, T.O. 33B-1-1. Where Air Force technical orders do not identify specific parameters for the inspection, the Supplier or sub-vendor shall establish a written procedure which includes the necessary information identified in ASTM E 1417 and is of sufficient detail for a Level I to accomplish the task. The procedure shall be approved by the Supplier Level III. The Supplier Level III shall attach the procedure to an AFMC Form 202 and submit it to DCA for final approval.

Note: The primary focus of paragraphs 8.2.4.3 – 8.2.4.5 is prevention of penetrant mix-ups in multiple line facilities. Alternate processes may be proposed to the DCA to accomplish this objective.

8.2.4.3. The following is required for penetrant lines having more than one penetrant removal method or more than one sensitivity level available during part processing:

- 8.2.4.3.1. Baskets or carriers of parts processed as groups or single large parts shall be tagged clearly indicating the proper penetrant removal method and sensitivity level, or the system shall have built-in computer controls (such as deactivation of improper sensitivity level spray guns) to ensure proper penetrant materials are applied.
- 8.2.4.3.2. Parts may be processed together provided the same penetrant materials are required.
- 8.2.4.3.3. Technicians applying the penetrant shall verify that the tag on the basket or parts matches the sensitivity in the tank, gun, or applicator used to apply the penetrant to the parts.
- 8.2.4.3.4. Technicians removing back ground penetrant shall check the tag to ensure the correct removal method is used.
- 8.2.4.4. Where penetrant is drawn directly from closed containers:
  - 8.2.4.4.1. On a daily basis, the supervisor or designee shall verify the proper penetrants are connected to the appropriate lines on the system. This shall be documented in a log book including the name, date, penetrant part number and batch number.
  - 8.2.4.4.2. On a weekly basis, the responsible Supplier/subvendor Level III shall verify the proper penetrants are connected to the appropriate lines on the system. This shall be documented in a log book including the responsible Level III's signature, date, penetrant part number, and batch number. In the event the Level III is unavailable, this may be accomplished by a designee and verified by the Level III at next opportunity.
- 8.2.4.5. Whenever penetrant is added to a system (immersion or spray), the supervisor shall record the material, batch number and approximate quantity added. The supervisor shall notify the Level III that this has been accomplished. The Level III shall verify that the correct material was added to the system at next opportunity. This shall be documented in a log book including the responsible Level III signature, date, penetrant part number, batch number, and volume added.
- 8.2.4.6. The F100-PW-229 engine is Engine Structural Integrity Program (ENSIP) certified. For ENSIP covered fracture critical parts requiring penetrant system probability of detection (POD)/confidence level (CL) rating, each individual penetrant inspector of such hardware shall meet 90/50 or 90/95 POD/CL requirements in T.O. 2J-F100-9 and shall not have any more than ten (10) false calls total. The POD test shall be repeated at three (3) year intervals. The specimen set used for the POD test shall meet MIL-HNBK-1823 guidelines, consist of a minimum of 80 cracks spread over a minimum of 40 specimen. The set shall have a variety of crack sizes necessary to establish compliance with T.O. 2J-F100-9 requirements. The entire set shall be used to evaluate

each inspector on the Supplier/subvendor penetrant system. The POD data shall be processed using DCA approved POD software.

#### **8.2.5. Magnetic Particle Inspection (MT or MPI).**

8.2.5.1. For new manufacture, inspection shall be conducted IAW OEM requirements, drawings and ASTM E 1444. Unless otherwise specified, the wet continuous method of magnetization, direct current, and fluorescent magnetic particles shall be used.

8.2.5.2. For overhaul and maintenance, inspection shall be accomplished IAW Air Force technical orders. Where Air Force technical orders do not identify specific parameters for the inspection, the Supplier or sub-vendor shall establish a written procedure which includes the necessary information identified in ASTM E 1444 and is of sufficient detail for a Level I to accomplish the task. The procedure shall be approved by the Supplier Level III. The Supplier Level III shall attach the procedure to an AFMC Form 202 and submit it to DCA for final approval.

#### **8.2.6. Radiography (X-ray or RT).**

8.2.6.1. For new manufacture, radiography shall be conducted in accordance with OEM requirements, drawings, and ASTM E 2104. Where OEM requirements and drawings do not identify the specific parameters for radiographic inspection, the Supplier or sub-vendor shall establish a written procedure, including the information in Figure 2 and digital photographs or sketches of the setup necessary for a Level I to accomplish the task. The procedure shall be approved by the Supplier Level III. The Supplier Level III shall attach the procedure to an AFMC Form 202 and submit it to DCA for final approval.

8.2.6.2. For maintenance and overhaul, radiography shall be conducted using procedures per Air Force technical orders. Where Air Force technical orders do not identify specific parameters for radiographic inspection, the Supplier or sub-vendor shall establish a written procedure in accordance with ASTM E 1742 or ASTM E 2104. The procedure shall include the information in Figure 2 and digital photographs or sketches of the setup necessary for a Level I to accomplish the task. The procedure shall be approved by the Supplier Level III. The Supplier Level III shall attach the procedure to an AFMC Form 202 and submit it to DCA for final approval.

#### **8.2.7. Eddy Current (EC, ECI, or ET).**

8.2.7.1. For new manufacture, eddy current inspection shall be conducted in accordance with OEM requirements and drawings.

8.2.7.2. For overhaul and maintenance, eddy current inspection shall be accomplished IAW Air Force technical orders. Where Air Force technical orders do not identify specific parameters for the inspection, the Supplier or sub-vendor shall establish a written procedure, including the necessary information (equipment, tooling, standard, calibration signal, rejectable signal, post-calibration signal, acceptance

criteria, etc.) for a Level I to accomplish the task. The procedure shall be approved by the Supplier Level III. The Supplier Level III shall attach the procedure to an AFMC Form 202 and submit it to DCA for final approval.

**8.2.8. Ultrasonic (UT).**

8.2.8.1. For new manufacture, ultrasonic inspection shall be conducted in accordance with OEM requirements and drawings.

8.2.8.2. For overhaul and maintenance, ultrasonic inspection shall be accomplished IAW Air Force technical orders. Where Air Force technical orders do not identify specific parameters for the inspection, the Supplier or sub-vendor shall establish a written procedure, including the necessary information (equipment, tooling, standard, calibration signal, rejectable signal, post calibration signal, acceptance criteria, etc.) for a Level I to accomplish the task. The procedure shall be approved by the Supplier Level III. The Supplier Level III shall attach the procedure to an AFMC Form 202 and submit it to DCA for final approval.

**8.2.9. Other Methods.** These include neutron radiography, thermal infrared, and laser holography and shearography.

8.2.9.1. For new manufacture, inspection shall be conducted in accordance with OEM requirements and drawings.

8.2.9.2. For overhaul and maintenance, inspection shall be accomplished IAW Air Force technical orders. Where Air Force technical orders do not identify specific parameters for the inspection, the Supplier or sub-vendor shall establish a written procedure, including the necessary information (equipment, tooling, standard, calibration signal, rejectable signal, post-calibration signal, acceptance criteria, etc.) for a Level I to accomplish the task. The procedure shall be approved by the Supplier Level III. The Supplier Level III shall attach the procedure to an AFMC Form 202 and submit it to DCA for final approval.

  
SHANNON CUSTARD, Chief  
F100 Technical Management Flight  
448 Propulsion Sustainment Squadron

# Radiographic Inspection Technique

**Part Number:** \_\_\_\_\_

**Serial Number:** \_\_\_\_\_

**Noun:** \_\_\_\_\_

**End Item:** \_\_\_\_\_

**Materials:** \_\_\_\_\_

**Inspection Area:** \_\_\_\_\_

**Applicable Technical Orders & Specifications:**

Repair T.O. 2J- \_\_\_\_\_ SWP \_\_\_\_\_, Para \_\_\_\_\_

Inspection Limit T.O. \_\_\_\_\_, SWP \_\_\_\_\_, Para \_\_\_\_\_

NDI T.O. 2J-F100-9, SWP \_\_\_\_\_, Para \_\_\_\_\_

Other \_\_\_\_\_

Control/Material:	Requirement
KV	
mA	
Time minutes:seconds	
Source Object Distance (Inches)	
Object Film Distance (Inches)	
Focal Spot (2mm or less)	
Film Type	
Screens	
Filters	
Film Density Range (Desired)	
Thickness	
Material	
IQI/Type	
Shims	
Blocks	
NDT Facility	
Tubehead	
Film Processor	
Film Processor Temperature	
Film Processor Cycle (minutes)	

**Figure 2 (Sheet 1 of 2). Radiographic Inspection Requirements.  
Shots (Sketch and Quantity):**

---

**Procedure Approved:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**NAS 410 NDI Level III**

**Printed Name:** \_\_\_\_\_

**Vendor:** \_\_\_\_\_

**Address:** \_\_\_\_\_

**City:** \_\_\_\_\_, **State:** \_\_\_\_\_, **Zip Code:** \_\_\_\_\_ - \_\_\_\_\_

**Voice Phone:** \_\_\_\_\_, **Fax:** \_\_\_\_\_

**E-Mail:** \_\_\_\_\_

**Figure 2 (Sheet 2 of 2). Radiographic Inspection Requirements.**