



Alcoa Power and Propulsion

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SUPPLIER QUALITY MANUAL

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1. GENERAL REQUIREMENTS

This document establishes the minimum quality system requirements for suppliers to ensure that purchased products, materials and services meet the required quality level for the Alcoa business unit 'Alcoa Power and Propulsion'. This business unit is comprised of businesses within the Howmet Corporation group of companies as well as Alcoa's Forged Products division. The Alcoa Power and Propulsion business unit will be referred to as "APP" throughout the remainder of this document.

This document supersedes and replaces all prior Supplier Control Manual (SCM) flowdown documents (including, but not limited to: SCM 501, SCM 502, SCM 503, SCM 104).

When APP purchase order requirements differ from those defined herein, the purchase order requirements shall prevail. The order of precedence shall be:

- a) Purchase order or contractual agreement (excluding this document);
- b) Applicable purchaser's drawing;
- c) Specifications referenced on drawings;
- d) This document;
- e) Specifications referenced in this document.

The requirements of this document are generic and are intended to be applicable to all organizations doing business with APP operations, regardless of the type, size or product provided. Exclusions or exceptions to these requirements shall be submitted in writing and accepted in writing by the APP Procurement and Supplier Quality Assurance organizations. Verbal authorizations shall not be permitted. Requirements that cannot be applied due to the nature of an organization and its product will be considered for exclusion, providing such exclusions do not affect the organization's ability or responsibility to provide product that meets APP and regulatory requirements.

Notification of Changes - The Supplier shall notify the APP facility procurement representative of changes that affect the operational proficiency of a facility; alterations in upper management or organization restructuring; alterations in the business name, location or ownership; processing capabilities, and any other pertinent changes that could hinder the capacity to conduct customary business activities or the quality of products and services.

Confidentiality - The supplier shall treat all product(s), material(s) and specification(s) received from APP as confidential in nature. Depending on the type of product or process, suppliers may be required to sign a nondisclosure agreement prior to doing business with APP. No Howmet or Howmet customer material is to be viewed or provided to subcontractors without prior written authorization from Howmet.

Right of Entry - APP, APP's customers, and regulatory authorities reserve the right to perform audits and/or inspections at the Supplier's and/or supplier's subcontractor's facility, when necessary, to determine and verify the quality of contracted work, records, and product. All supplier material, records, routers, inspection and test facilities shall be subject to review. Suppliers shall provide equipment, facility and necessary personnel for all on-site verifications of contract/purchase order compliance.

APP Plant to APP Plant Orders – The supplying facility shall process product and /or material in accordance with their own Quality System and internal procedures which have been assessed for compliance to APP requirements.



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2. SPECIFICATIONS

Supplier shall reference the Alcoa Power and Propulsion Supplier Website:
http://www.alcoa.com/howmet/en/info_page/procurement_overview.asp for a listing of applicable internal and external specifications, forms, and pertinent documents.

3. QUALITY MANAGEMENT SYSTEM REQUIREMENTS

All suppliers that provide product, materials and services shall be responsible for maintaining quality system compliance to the applicable quality system requirements defined below in Table A. Suppliers shall be certified/registered and receive routine system evaluations by their certification body or be subject to periodic compliance audits by APP or an APP-approved 3rd party at the supplier's expense.

Table A

Supplier Type (see Appendix B for definition of supplier types)	Certification Required
Component supplier or outside processor	AS/EN/JISQ 9100
Special process supplier (see section 6.0 for definition of a special process supplier)	AS/EN/JISQ 9100 or meet the requirements of SAE AS9003. Compliance to AS9003 is demonstrated by satisfactory audit to National Aerospace and Defense Contractors Accreditation Program (Nadcap) AC7004. Audit is to be performed by PRI.
Raw material & process material supplier	ISO 9001 or an industry equivalent standard
Distributor	AS/EN/JISQ 9120, ISO 9001 or an industry equivalent standard
Laboratory / Test Facility*	ISO/IEC 17025*, AC7101 (Nadcap)
Tooling Suppliers	AS9003 - Inspection and Test Quality System, ISO 9001 or an industry equivalent standard
Non-Product Related Services	ISO 9001:2000 or an industry equivalent standard.
Brokers / Traders	At a minimum, meet the requirements of SQ-01 – APP Supplier Quality System Requirements
Pass-through Distributor Manufactured to Alcoa Howmet specs.	At a minimum, meet the requirements of SQ-01 – APP Supplier Quality System Requirements

* The ISO/IEC 17025 accreditation requirement will not go into effect until March 31, 2009.

Suppliers are required to provide evidence of a certificate of registration from an IAF accredited Certification Registration Body to the industry standard listed above**. Suppliers are required to notify APP Supplier Quality Assurance (SQA) of any changes regarding quality system certification(s). This includes additional certifications awarded, suspension of certification, and mergers and acquisitions. Quality Certifications include, but are not limited to, AS 9100, ISO 9001, ISO/IEC 17025, AS 9003 and TS 16949. To submit Quality Certifications or provide notification of changes, e-mail all documentation to APP SQA at APPSupplierQuality@alcoa.com or fax to (231)894-7607.

** The certification/compliance requirement will be verified by the approved 3rd party at the supplier's next scheduled APP assessment date.



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4. DRAWING AND SPECIFICATION CONTROL

It is the supplier's responsibility to conduct timely reviews and incorporate the latest engineering specifications, and drawings, as specified in the APP purchase order.

The appropriate revision level of the APP technical specification(s) stipulated in the APP purchase order shall be incorporated within 30 days, or as otherwise specified, from the "Issued" date of the related "Table of Contents" in which the specification(s) is listed. All product and material arriving at the APP purchasing facility immediately following incorporation of the specification and the supplier/ APP agreed upon effectivity date shall be configured to the appropriate specification revision level. Select specifications and the "Table of Contents" with specification revision levels are located on the Supplier Quality Website at http://www.alcoa.com/howmet/en/info_page/procurement_specs.asp. **The supplier shall be responsible for verifying that all specifications are current prior to use.**

Table B

Specification Type	Specification Name	Specification Type	Specification Name
AC Specifications	Advanced Core Manual	MS Specification	Mono-Shell Manual
CM Specifications	Cleaning Manual	PM Specifications	Process Materials Manual
CD Specifications	Coating Manual	SR Specifications	Shell Room Manual
CP Specifications	Core Manual	TBM Specifications	Test Bar Manual
MC Specifications	Crucible Manual	WM Specifications	Wax Manual
DS Specifications	DS Manual		
<i>HA Specifications</i>	<i>Alloy Manual</i>	<i>HAA Specifications</i>	<i>Aluminum Alloy Manual</i>
<i>MP Specifications</i>	<i>Ti-Ingot Technical Manual</i>	<i>PC</i>	<i>Product Criteria</i>
<i>TM Manual</i>	<i>Tooling Manual</i>	<i>AI</i>	<i>Activity Instructions</i>
<i>Various</i>	<i>Customer Specifications</i>	<i>Various</i>	<i>Customer B/Ps and Drawings</i>

Note 1: For the current revision level/date of an APP specification, refer to the appropriate Table of Contents (referenced above) on the Supplier Quality Website. Locate a specification by associating the first two digits of the specification number to the appropriate APP specification manual; i.e., specification AC1100 would be found in the Advanced Core manual. This web page does not contain copies of any of the specifications listed on APP's web site as many are deemed proprietary and require non-disclosure agreements (NDA) prior to release. Contact the Procurement representative listed on the APP purchase order to obtain a copy of an APP specification.

Note 2: For those specifications and/or manuals in table B that are in bold italics, APP will continue to list the revision level and/or revision date on the purchase order.



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5. ETHICS

APP is committed to dealing fairly with its suppliers. APP will emphasize competition, without discrimination or deception, in a manner consistent with long-lasting relationships. APP will purchase all equipment, supplies, and services based on merit. APP suppliers and subcontractors will be treated with fairness and integrity.

Suppliers and subcontractors shall adhere to the same high standards of behavior and excellence required of every APP employee. They shall not act on behalf of the Company in any manner that is inconsistent with the APP Code of Ethics and Standards of Business Conduct, policies, or any applicable laws or regulations. **Suppliers shall have a documented ethics program in place and implemented within their company.** At a minimum, an ethics program shall contain commitment from top management, a formal ethics training program and a method to report unethical issues anonymously and without consequences. This method may, at supplier discretion, be set up through an independent agency, through calls to a Howmet representative, or through an internal system.

6. CONTROL OF PURCHASES

∅ **Flowdown of Requirements** – The supplier shall have a process in place to flowdown APP requirements to sub-tier suppliers. When applicable, the supplier shall ensure that any APP requirements that are associated to items that are procured or outsourced in order to meet an APP purchase order are flowed down to the applicable sub-tier suppliers.

Special Processes - When special processes are outsourced, the supplier shall only utilize APP and APP's customer-designated Approved Suppliers. If the purchase order does not specify the sub-tier supplier to be used, the APP Procurement or site Quality representative shall be contacted to obtain a list of approved sources, including APP customer-approved sources.

Note: Special Processes are those processes and services that have the potential to directly influence the quality of products manufactured by APP and whose conformance to contract requirements cannot be fully determined upon receiving inspection. These processes may require a demonstration of operator or equipment capability or proficiency, and require special controls for monitoring, per specifications. Special Processes include the following:

- Chemical Processing (including core/shell removal and grain etching)
- Coatings
- Composites
- Thermal Processing (including heat treatment, brazing, and HIP)
- Materials Testing Laboratory Services
- Non-Destructive Testing
- Non-conventional Machining and Surface Enhancement
- Welding

Right of Entry – The supplier shall include right-of-entry provision in any subcontract. These provisions shall allow the supplier, its customers, and regulatory agencies to determine and verify the quality of work, records, and material at any place, including the plant of the subcontractor.

Control of Confidential Information – The supplier shall establish nondisclosure agreements with subcontractors that receive or process APP product, blueprints or specifications, confidential proprietary technical data or other APP intellectual property prior to doing business with them.



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7. QUALITY ASSURANCE PLANNING

Quality Planning – For new projects and/or programs with APP, the supplier shall engage in effective quality planning that embodies critical concepts of defect prevention and continuous improvement, i.e. contract review, resource planning, early change management, cost reduction, etc. Project/program management timelines shall be used to track critical project/program events, key dates and assigned responsibilities.

Key Product and Process Characteristics – A key characteristic is an attribute or output of a product or manufacturing process that has a significant influence on product fit, performance, service life, or manufacturability. At a minimum, the supplier shall identify the characteristics defined in Appendix A as key for those products / processes they supply and/or perform. These key characteristics shall be flowed down to sub-tier supplier(s). Suppliers shall identify these characteristics as key in the control plan.

Control Plans – A detailed control plan (or equivalent method) shall be documented to record the 1) inspection plan for a part to ensure that all engineering drawing characteristics and notes are subject to inspection or control, 2) controls used within a process to ensure process parameters and process related characteristics are maintained within appropriate limits and 3) the ongoing inspection frequency (independent of the FAI) for each characteristic, for example 100% inspection, sampling plan, product of the die, etc.

Fixed Process Control Plans – Products or processes requiring fixed process control plans will be defined as such in the APP purchase order. A fixed process control plan requires the supplier manufacturing process to be approved by APP, in writing, prior to processing or production of APP products or materials. The designated fixed process shall be documented with methods of control in a technical plan format. The control plan shall be submitted with First Article parts for approval by APP prior to submitting the first production order. Once approved by APP, revisions or variations to this fixed process shall not occur unless APP has approved the revisions in writing.

Sampling – Ongoing product acceptance inspection shall be performed on specified characteristics per an agreed upon inspection plan with APP. This plan shall be defined in the detailed control plan.

When using sampling plans:

- Inspection personnel shall be trained in the application of sampling methods.
- All plans shall have a “zero acceptance” number.
- The lot shall be rejected if a nonconformance is discovered in the sample. If a nonconformance is found in the sample, inspect all pieces in the lot for the nonconformance that had been noted and remove all nonconforming pieces from the lot.
- Sampling plans shall be an industry approved C=0 plan or an alternate plan approved by APP SQA.
- Sampling inspection is not permitted for characteristics that are affected by repair and rework Material Review Board (MRB) dispositions.
- Sample(s) shall be randomly selected and representative of the population.
- Additions or exchanges shall not be made to the original sample.



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First Article Inspection Requirements – If required by the APP purchase order, the supplier shall submit a first article sample(s) with report for first build, revisions, and after a two (2) year lapse in production. AS9102 First Article Inspection (FAI) is the preferred format. The supplier shall furnish a first article sample(s) produced using the material, tooling, processes, and planning to be used for subsequent deliveries. The first article samples(s) shall be identified and submitted with a FAI report. The FAI report shall include the APP drawing with numbered characteristics corresponding to an itemized layout reflecting actual readings, and shall show compliance with all drawing characteristics, blueprint notes, and specifications. The method of measurement for dimensional characteristics shall be included with gage identity. A photograph of the gage(s) that were used may be requested. For subsequent revisions to the drawing, only those characteristics, notes, or specifications affected by the revision are required to be reported. A copy of the raw material C of C (or C of A) is required for an initial build first article, and a first article submitted after a two year lapse in production (see section 10.0- Certificates).

8. PROCESS CONTROL

Product or Service Acceptance – Product shall be inspected per the inspection plan or specification. Records that the product meets the defined requirements shall be maintained including the identity of the equipment or gage that was used to inspect each characteristic.

Control of APP Owned / Supplied Equipment and Tooling – APP owned/supplied equipment and tooling includes gages, test equipment and tooling supplied by APP for use in production or maintenance or made by the Supplier and paid for by APP.

Supplier shall:

- Use APP Supplied Gages, Special Test Equipment, and Special Tooling on APP purchase orders only and for only those purchase orders for which the items were supplied.
- Identify all tools and test equipment, unless size or use prohibits, with an identification tag(s) ensuring legibility and permanency, which states the ownership designation as “Property of Alcoa Power & Propulsion” upon receipt or fabrication.
- Obtain written approval from APP prior to making modifications or changes to gages, test equipment or tooling.
- Maintain, protect and preserve tooling, test equipment, and gages. Tooling and gauging shall be maintained for 3 years after the APP purchase order is complete unless APP directs otherwise.
- Contact the APP Buyer before the transfer of gages, test equipment or tooling among supplier facilities (address location) or to other suppliers.
- Supplied gages, test equipment or tooling that become excess to the needs of the purchase order shall be reported to APP.
- Obtain written approval from APP before the disposal or destruction of APP-supplied gages, test equipment or tooling.
- Report all cases of loss, damage or destruction of APP’s property in possession or control or property located at Supplier’s second-tier suppliers to the APP Buyer within 72 hours as such facts become known.
- Maintain a record (Tool List) of all APP supplied gages, test equipment or tooling. The list shall be traceable back to the APP tooling purchase order and job number.



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APP Purchase Orders for U.S. Government Contracts

U.S. Government owned gages and tooling supplied by APP are Government Property and are subject to the provisions of the Federal Acquisition Regulation (FAR) 52.245-2 (FP) or 52.245-5 (CP), or 52.245-1. U.S. Government owned gages shall be clearly identified with a tag that states the ownership.

U.S. Government-owned gages/tooling/test equipment shall be treated as APP owned and follow the same requirements identified above.

The Supplier shall keep property records as shown in Federal Acquisition Regulation (FAR) 45.505-5 or 52.245-1.

- ∅ **Control of Software** – The supplier shall have a process in place to control software that is used in design, manufacture, inspection, test acceptance or calibration and has a direct effect on delivered product.
- ∅ The software control process shall include, at a minimum:
- A method to verify and validate the software with documented test procedures;
 - Objective evidence that the software performs the required function;
 - A method to maintain version control;
 - A change control process that includes re-verification and re-validation to ensure the modified software meets the requirements and/or function;
 - Limited access to software masters and edit functions;
 - A method to archive, backup and recover software programs;
 - An internal audit or review process to ensure compliance to maintained.

Product Serialization – If required by the product drawing and/or specification, product shall be serialized with unique serial numbers or number series for the product and shall be referenced on the C of C form (see section 10.0- Certificates).

Product Traceability - Traceability shall be maintained from receipt of raw material through finished product. Records and material shall be identified by lot number, material type, specification and applicable revision identifier or date of issue, heat number, serial number, etc., as required to maintain traceability. Records shall be maintained at the supplier's facility or a storage facility approved by APP, and shall be available upon request within two business days.

Marking Requirements - Marking shall not be applied directly to any product manufactured for APP, or any investment cast consigned components(s) unless contractually authorized and approved in writing by the procuring APP facility. This includes marking materials such as ink, wax, pencil, pen, etchants, etc., and methods such as vibropeen, laser marking, etch marking, etc. All marking materials and methods shall be approved by the procuring APP facility. Once approved, changes to marking material source and/or method require written approval of APP.

Change Management - In addition to change management requirements in the Alcoa Howmet product specification(s) applicable to the product being supplied, the supplier shall notify in writing APP SQA (APPSupplierQuality@alcoa.com) and the APP Plant Procurement representative prior to making a change in the:



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- process materials critical to the chemical and physical characteristics of the applicable product;
- manufacturing process that may affect the chemical or physical characteristics of the product;
- changes in manufacturing location, subcontractors or significant process flow of the product;
- changes in product verification sampling plan and/or test methods

For changes to fixed processes, changes must be approved in writing by APP prior to implementation by the supplier.

9. INSPECTION AND TEST

Eye Examinations - Individuals that inspect product for final acceptance shall receive the following:

- Color Vision Eye Examination every 12 months
- Near Vision Eye Examination every 12 months

A medical professional shall perform the eye examination (eye clinic, occupational health clinic, onsite health clinic or medical department). The individual(s) shall meet the minimum standards in one eye, corrected with glasses or not corrected. The records of the eye examinations shall be maintained by the Supplier and made available upon request

Near Vision: Snellen 14/18 or better, Jaeger type 1 – 20/25 or Ortho-Rated 8 or equivalent.

Color Vision: Average or normal 4 of 6 responses on Titmus, B+L or American Optical testing machine or a satisfactory response when tested with an Ishihara or Pseudoscopic plate.

NDE Eye Examination Requirements (FPI, X-Ray, N-Ray and Ultrasonic)

- Near-Vision Eye Examination requirements for persons performing Nital / Temper Etch shall be Jaeger type 2 with an acceptance criteria of 20/30 or equivalent.
- For Inspectors certified to the requirements of NAS410 (NDT) or Mil-STD-867 (Nital / Temper Etch), and for personnel performing visual inspection of welds, suppliers may administer their own eye examinations per the standard.

10. CERTIFICATES

All product, material, services and processes supplied or provided to APP shall be accompanied by an appropriate Certificate of Conformance (C of C), Certificate of Analysis (C of A), Certificate of Test or Certificate of Calibration, etc. The supplier shall be responsible for maintaining and supplying this certification documentation as objective evidence of meeting purchase order and drawing/specification requirements. The supplier shall provide an appropriate certificate for each lot (shipment) of product supplied to APP. Failure to provide proper certification may result in payment being withheld until proper certification has been received.



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Certificates shall contain, at a minimum (or as defined in the applicable APP technical specification):

1. Supplier's name, address and, if applicable, supplier's product identification;
2. The APP purchase order number;
3. The APP product identification and drawing or specification with revision level;
4. Quantity supplied/shipped;
5. Statement that product, material, service or process conforms to the purchase order requirements;
6. Authorized signature and date of quality representative or company official with title listed.

As applicable, the certificate shall also contain:

- Serial numbers, lot number and/or batch number, as applicable;
- Verifiable results (usually numerical results or observed visual criteria) of all testing/inspections required by PO, drawing or specifications for raw materials, special processes and other applicable products;
- Certification of 100% inspection or Cpk data when required on the PO;
- If outsourced processes are performed on APP product, the subcontractor's name, location and the specific process(es) that were subcontracted.

Shelf Life - For limited shelf life (age/environmental sensitive materials) items, the certificate shall contain the specification number, if applicable, lot or batch number of the material, date of manufacture and/or cure date (month/year or quarter/year), the shelf life expiration date and any environmental storage conditions that apply. Materials shall not be shipped with less than 75% of the required remaining shelf life to APP facilities unless approved in writing by the APP facility or as otherwise stipulated in the Purchase Order.

Chemical and Metallurgical Analysis - For Chemical and Metallurgical Analysis, the material certification (i.e., Certificate of Analysis) shall contain the specification number of the material being supplied as it appears on the purchase order, revision letter, lot code of heat number, and shelf life if applicable. Actual test results that are required by the specification, such as mechanical test data, chemical properties, hardness, etc., shall be included on the certification.

Calibration – For suppliers of calibration services, the supplier shall provide a certificate that states the accuracy of the subject item(s), the source performing the calibration, traceability of calibration to NIST, date of last calibration, test or report number(s), calibration method (ANSI, federal standard, etc.) and the environmental conditions during the calibration actions. In addition, documentation must show the “as received” condition of subject devices prior to adjustment.

Distributors – All material/product supplied by a distributor requires a copy of the sources certification to be supplied with each lot/shipment. If additional verification testing is performed by the distributor, copies of both certifications are required and shall accompany each lot/shipment.

- Ø **APP Supplied Raw Material** - For APP Supplied Material, a certification shall be provided with the shipment stating the material type, the material heat/lot number, and the quantity received as it appears on the purchase order. Material substitutions are prohibited without written approval by APP.



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Catalog Items - For standard "off-the-shelf" (catalog) items, a packing list is acceptable provided a signed statement is included. A reference to the APP purchase order number, manufacturer name and product number (no revision level required) is required for each item listed.

Qualified Products List - For Qualified Products List (QPL) items, the supplier shall state the manufacturer of items ordered and certify that the manufacturer is on the U.S. Government Qualified Products List.

11. PREPARATION FOR SHIPMENT

Source Inspection and Surveillance - When specified on the APP purchase order, APP source inspection and system surveillance of procedures, facilities, and products covered by the purchase order are mandatory prior to shipment of purchased items. Use of supplier's equipment, gages and measuring and testing devices shall be made available at the supplier's facility for the APP designated Source Inspectors, when required, to determine conformance to contractual requirements. The supplier's personnel shall be made available for operation of such devices and for verification of their accuracy and condition. Product acceptance does not imply supplier's product will not be rejected upon receipt at APP, should a deviation be found.

Government Source Quality Assurance Inspection - When specified on the APP purchase order, Government Source Quality Assurance Inspection is required prior to shipment from the supplier's plant. Upon receipt of the purchase order or a letter of delegation, the supplier shall promptly furnish a copy to the Government Inspector who services the supplier's plant. In the event that delivery of the items will be delayed due to inspection requirements, the supplier shall contact the APP buyer immediately. Evidence of the inspection shall be indicated on all shipping documents.

Packaging & Crating - Material packaging shall be properly identified to include the name of the manufacturer; product nomenclature, commercial and/or APP specification product designation identification; lot or batch designation number; gross and tare or net weight, and shelf life expiration date. In situations where returnable packaging or carts are in place, the supplier shall label containers as defined by the procuring APP facility. If applicable, regional requirements for hazardous material shipments shall be adhered to. When stipulated in the APP purchase order, all wood products used in packaging, crating and pallets shall be in compliance with the International Standard for Phytosanitary Measure (ISPM15) guide for regulatory wood and wood packaging in international trade. All products shall be labeled with the applicable Country of Origin.

Delivery - The supplier shall ensure that the accompanying shipping documents are protected from damage, i.e. enclosed in a weather-protected envelope and marked "Shipping Documents" or facsimile.

Contractually Provided Technical Data - Suppliers to APP shall be responsible for obtaining all necessary International Traffic in Arms Regulations (ITAR) or Export Administration Regulations (EAR) export approvals and for maintaining compliance with all export control requirements. If it is not clear whether this provision applies, contact the APP Procurement representative. All APP documents and / or technical data, electronic or otherwise, furnished by APP as a provision of the purchase order shall be returned to the appropriate APP facility upon completion or termination of the purchase order, or at the purchaser's discretion.



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12. RECORDS AND RETENTION

Part, material, product and service related tooling records, purchase orders and amendments are to be maintained for the length of time that the contract is active plus one calendar year. Product related manufacturing and inspection records are required to be maintained for 10 years unless otherwise specified in the contract. Records shall be maintained in an appropriate environment and shall be available upon request within two business days.

Quality system administrative records, such as internal audits and nonconformances, shall be retained for seven years unless otherwise stated in the contract.

External suppliers that generate X-Ray, N-Ray and other NDT records on product purchased by APP, are required to provide those records to the procuring APP facility with shipment of the product.

13. NONCONFORMING MATERIAL

Material that departs from drawing, specification or maintenance requirements shall be properly identified, segregated and controlled to prevent unauthorized use or delivery to APP or other designated destinations.

Material Review Authority - The Supplier shall not use dispositions of 'use as is' or 'repair' without written approval by APP's Quality organization. Action shall not be taken on any nonconformance which could affect safety of personnel; adversely affect performance durability, interchangeability or reliability, materially affect weight; or otherwise result in failure of the end article to perform its intended function. All doubtful cases shall be submitted to APP for review. APP reserves the right to reject the decision of the Supplier's Material Review Board.

Concessions - The Supplier may request concession consideration for nonconforming material that cannot be reworked to fully conform to drawing or purchase order requirements. Suppliers shall use the Supplier Discrepancy Action Request (SDAR) form to obtain disposition from the applicable APP location quality representative. The SDAR form shall be complete and concise and accompanied with supporting information such as: dimension(s) affected, drawing locations(s), photographs, sketches, chemistry or physical analysis for material deviations, etc. The SDAR form can be located from the following website:

http://www.alcoa.com/howmet/en/info_page/procurement_overview.asp.

Escapes to APP - The supplier shall provide prompt notification to both the APP Buyer and the site Supplier Quality Representative if nonconforming product or process escapes are identified after shipment to APP has taken place. The notification shall include part numbers, traceability (lot, serial, manufacturer numbers), ship dates, quantities, and a description of the nonconformance. This applies to any nonconformance that departs from the drawing, specifications, purchase order requirements, etc. Once the initial notification is complete, the supplier shall initiate the corrective action process per section 14.0- Corrective Action.



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Containment of Nonconforming Material - When a nonconformance is discovered or the Supplier is notified of a discrepancy, the Supplier shall take immediate action to determine if the condition exists on any other work in process, in Stores at the Supplier's facility, or in prior shipments. Containment action shall be taken and documented prior to the next shipment of the part number involved. Product identified on a Partial Shipment as source inspection accepted shall be re-inspected prior to shipment. The Supplier shall not wait for the discrepant product to be returned to begin an investigation.

Return Purchase Orders for Replacement, Reworked or Repaired Product - Product that is supplied to APP on a return purchase order shall either fully comply with all drawing requirements or have APP MRB approval through a signed Return Material Authorization for any repairs. Product that cannot be reworked to full drawing compliance, or where repair authorization will not be granted, shall be scrapped at the supplier's facility.

Return of APP Consigned Material - APP may supply material or component product for inclusion in product manufacturing. If the material or component product that were supplied by APP are discrepant, or in excess quantity, they shall be returned by the Supplier. The Supplier shall not return component product without authorization from the APP Buyer. The Supplier shall clearly identify the reason for the return on the packing slip.

Cost Recovery – APP reserves the right to recover all incurred costs related to nonconforming product produced from the responsible supplier(s).

14. CORRECTIVE ACTION

If nonconforming product escapes to APP, the supplier shall take corrective action immediately regardless of where the nonconformance was identified, i.e., the supplier's facility, at APP, in transit, at an APP customer, etc. This is to ensure nonconforming product is contained, root cause of the problem is identified and proper actions are put in place to prevent the recurrence in the process.

If nonconforming product has been identified, the supplier shall place their operations on immediate containment to protect APP from receiving additional defective material. Incidents of defective material may also require supplier containment at the APP facility. In such cases, the supplier shall be responsible for performing the sort inspection on-site (if possible). Some supplier related problems may require the use of a 3rd party source inspection at the cost of the supplier to ensure containment of the problem.

When performing a corrective action investigation, at a minimum, the supplier shall perform the following actions:

- Identify the problem
- Quarantine all suspect material, including raw material
- Establish a clear break point for the nonconforming material
- Review all suspect product to determine a disposition
- Identify root cause of the nonconformance
- Implement appropriate corrective actions
- Validate the effectiveness of the implemented corrective actions
- Update all appropriate documents to include the new controls implemented
- Apply corrective actions to all like and similar processes to prevent a recurrence of the issue



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Corrective action plans shall be reviewed with the APP facility SQA. Initial supplier response shall be submitted in writing within 48 hours of problem notification to the facility SQA or as directed on the Supplier Corrective Action Request (SCAR). Suppliers will be measured on the timeliness of their response. An adequate corrective action plan shall be submitted to APP within 10 business days, including responsibilities and planned completion dates. APP will track completion of the action plan with the supplier.

If required, the 3rd party inspection shall remain in place until the root cause of the problem has been identified and APP SQA is satisfied that the corrective action has been implemented and verified that it eliminates the problem.

Preventive actions shall be implemented to protect APP from receiving nonconforming product. If an escape to an APP facility is identified, the supplier shall not only correct the issue as identified above and provide APP with acceptable product, but also identify the deficiency in the quality planning process that allowed the nonconformance to occur and escape to APP.

15. CONTAMINATION CONTROL

Foreign Object Contamination Control and Detection - Processors performing primary or secondary manufacturing or non-destructive testing (NDT) operations on APP product shall ensure all open cavities subject to ingestion of foreign objects and debris are free of any foreign matter (e.g., machining chips and dust particles, blasting materials, shot, weld and braze splatter, coatings, process solutions, maskants, etc.). Prior to the return of all cast components to APP, the processor shall confirm the absence of foreign matter, objects, debris and process solutions.

Cross Contamination – All products (including raw materials) must be kept safe from any potential cross-contamination that may occur when processing similar or dissimilar products on the same manufacturing equipment. When switching from one manufacturing process or product to another, the entire relevant manufacturing system must be purged as necessary to prevent material(s) from the previous production run to enter into the next production run.

Lot Control – In a continuous manufacturing system lot control must be maintained to a level that a nonconformance can be traced back to additional material that could be affected, including adjacent lots.

Prohibited Materials - Unless otherwise specified on the contract or APP technical specification, the use of any silicon carbide materials is strictly prohibited for use in the manufacturing processes of superalloy investment castings.

Materials known to contain greater than trace levels of lead, bismuth, silver, antimony, zinc, tin, iron, arsenic, and selenium and/or other harmful impurities such as tellurium, thallium, indium, sulfur, boron and cadmium should not be utilized in product for APP. The supplier shall also preclude contamination, contact, or processing APP product in the same equipment as other product(s) that contains greater than trace elements of these materials, unless authorized by APP SQA.

Suppliers shall notify the APP facility Procurement and Quality representatives, immediately, if contamination with any of the materials listed above is suspected.

APP product shall not be processed in thermal treatment equipment or with fixtures that are used to process materials that exceed the above contaminant limits or are used for processing braze materials.



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16. GENERAL

Supplier Performance Reviews - Active and approved organizations that supply critical product, materials and services that directly influence the quality of APP manufactured products are subject to quarterly performance reviews. Organizations with less than adequate performance will be required to take immediate corrective and preventive action. A failure to adequately address APP performance issues in a timely manner may result in disqualification and loss of business.

Preference for Domestic Specialty Materials - Supplier shall agree to comply with Defense Federal Acquisition Regulation Supplement DFAR 252.225-7014 and Alternate I, Preference for Domestic Specialty Metals when this clause is specified in the purchase order. Use of foreign specialty metals may only be used with written authorization from APP Corporate Procurement. Material substitutions are prohibited without formal approval by APP.

MSDS - Material Safety Data Sheets are required for raw materials.

∅ - Denotes change from previous issue



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Appendix A

PRELIMINARY KEY PROCESS CHARACTERISTICS INDEX

The processes and subsequent process key characteristics contained in this directory are the process variables (input variables) that have a cause and effect relationship with one or more Howmet Castings product characteristics. As such each of these special process characteristics must be listed in the control plan and, routinely monitored to ensure control of the process.

1. Abrasive Blasting

- a) Pressure (air or liquid)
- b) Nozzle distance from part
- c) Nozzle angle to the surface of the part
- d) Blasting cycle
- e) Range of rotational speed if a work-table is used
- f) Abrasive material, size and type
- g) Masking material and procedure
- h) Pre- and post-cleaning procedure

2. Furnace Brazing

- a) Heat rate(s) (e.g., power percentages, ramp rates, degrees F/min.)
- b) Hold time(s) and temperature(s) for out-gassing, stabilization and time at established braze temperature.
- c) Chart speed(s)
- d) Cooling rate(s) - include all times and temperatures for stepped cooling cycles

2.1 Furnace Atmosphere

- a) Inert gas and dew point
- b) Vacuum pressure
- c) Quenching method (vacuum cool, gas cool, fan cool, argon, backfill)
- d) Quenching gas
- e) Furnace manufacturer, type and serial number
- f) Stacking and number of parts per load
- g) Sketch of location and orientation of parts and thermocouples in the furnace
- h) Number and type of thermocouples and method of attachment

2.2 Alloying

- a) Specification of alloying material
- b) Form of alloy (paste, tape, foil, etc.)
- c) Application method and quantity of alloy (e.g., alloy bead size, width, thickness of tape, etc.)
- d) Stop-off location, application method and type.

2.3 Plating

- a) Plating procedure prior to brazing (if applicable)
- b) Pre- and post-cleaning procedures



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3. Casting Process

- a) Melting practice used
- b) Mold or investment constituents used
- c) Number and positions of parts per mold
- d) Pouring temperature used
- e) Mold cooling technique used
- f) Gating and riser location used
- g) Casting method used (permanent mold, sand mold, centrifugal, etc.)
- h) Mold temperature and control used
- i) Melting and casting atmospheres used (vacuum, inert gas, etc.)
- j) Number and location of chilled bars used
- k) Source and kind of raw materials used
- l) Post-casting treatment used (chemical, mechanical, etc.)

4. Chemical Milling

- a) Temperature of chemical solution
- b) Concentration of chemical solution
- c) Etch rate (mils/min/surface)
- d) Time in solution
- e) Chemical agents (type & grade)
- f) Masking material
- g) Materials used for cleaning and benching (if required)
- h) Methods of agitation (air, mechanical, etc.)

5. Ceramic Core Manufacturing (Refer to Specification SCM 504C)

6. Diffusion Coating

- a) Materials:
 1. Source
 2. Type of wax
 3. Type of masking
 4. Material preparation
- b) Part cleaning
- c) Retort design
- d) Coating procedure:
 1. Packing (parts per retort, retorts per level, etc.)
 2. Furnace loading diagram
 3. Furnace design
 4. Thermocouple type and location
 5. Atmosphere
 6. Time at temperature
- e) Post-coating heat treat
- f) Post-coating cleaning



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7. E B (Electron Beam) Welding

- a) Base filler and metal name(s) and specification
- b) Material and position of run-off and run-on tabs
- c) Method of joint tracking (manual or computer)
- d) Computer tracking parameters
- e) E B tack weld parameters
- f) E B welding parameters
- g) Beam stopper material and placement
- h) Weld joint configuration
- i) Maximum allowable gap

8. ECM (Electrochemical Machining)

- a) Machining voltage range
- b) Electrode feed rate
- c) Electrolyte temperature range (at tool inlet or electrolyte supply)
- d) Electrolyte concentration, pH and conductivity range
- e) Electrolyte pressure range at tool inlet and outlet (if closed flow)
- f) Maximum amperage
- g) Electrolyte flow direction
- h) Starting gap
- i) Post-ECM cleaning procedure

9. EDM (Electro-Discharge Machining)

- a) On time
- b) Dielectric used (type/mfr. of oil)
- c) Average time
- d) Electrode material
- e) Peak current
- f) Power supply (solid state or tube type)
- g) Voltage
- h) Wave form (sine or square)
- i) Voltage type (std, hi-pol, lo-pol)
- j) Dielectric flushing method
- k) Microfarads
- l) Post-EDM cleaning procedure

10. Forging Processes

- a) Forging temperature used
- b) Number & temperature of reheats used during forging
- c) Number of strikes or amount of reduction per strike and reheats
- d) Total percentage of reduction during the forging process
- e) Type of forging die used
- f) Forging method used (drop forge, pressure forge, ring rolling, etc.)
- g) Cropping method used
- h) Billet size & shape used
- i) Source and process of ingot to billet conversion process used



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- j) Die insulation and lubricant used
- k) Post-forging treatment used
- l) Forging press rate

11. Heat Treatment

- a) Cycle description, including time (ramp, hold, etc.) temperature, atmosphere & cooling medium
- b) Furnace description (type, manufacturer, serial number)
- c) Assembly and racking instructions, including part orientation if this is controlled (sketches may be used)
- d) Materials that contact parts (e.g., fixturing, supports, protective wraps, etc.)
- e) Location and type of work load thermocouples & the methods used to attach the T/C's to the part
- f) The criteria for when parts are considered at temperature & for start or stop of the time at temperature cycle.
- g) Pre- or post-heat treat cleaning instructions
- h) Location & type of test samples (if applicable)

12. HIP (Hot Isostatic Pressing)

- a) Cycle description including time (ramp, hold, etc.) temperatures, pressures, pressure media
- b) Pressure vessel description including autoclave mfr., model number, serial number & capacity
- c) Part positioning in the pressure vessel
- d) Materials coming in contact with the parts (fixtures, supports, etc.)
- e) The maximum number of parts in the pressure vessel
- f) Location and type of thermocouples
- g) The criteria for start & stop of the time at temperature and pressure cycle
- h) Pre- or post-HIP cleaning procedures
- i) Location and type of getter material (if used)

13. Hot Forming

- a) Ram force (pressure)
- b) Temperature of the hot form press
- c) Time at temperature and alarm set point
- d) Tooling
- e) Die & part lubricant
- f) Die material

14. Laser Drilling, cutting & marking

- a) CNC program number and revision date
- b) Number of shots
- c) Power, energy or voltage
- d) Pulse rate & length
- e) Nozzle air or gas type
- f) Laser type (mfr., model & serial number)
- g) Fixturing



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15. Laser Joining

- a) Laser type (manufacturer & serial number)
- b) Microprocessor type
- c) Pulse rate & length
- d) Fixturing
- e) Program number & revision date
- f) Power, energy or voltage
- g) Mirror or lens focal length
- h) Mirror or lens focal length to part
- i) Traverse speed
- j) Distance between passes
- k) Number of layers
- l) Beam angle to part
- m) Beam mode
- n) Wire filler (size & feed rate)

16. Plasma Arc Welding

- a) Automatic or semi-automatic processes
 - 1. Distance from orifice to work piece
 - 2. Current
 - 3. Arc voltage
 - 4. Orifice diameter
 - 5. Travel speed
 - 6. Sequence of welding
- b) Manual Processes
 - 1. Sequence of welding

17. Plating

- a) Type of bath
- b) Constituent composition
- c) Plating solution pH
- d) Solution temperature
- e) Current density
- f) Plating time
- g) Voltage
- h) Part cleaning & activation procedure
- i) Masking procedure
- j) Strip & replate procedure
- k) Post-plating baking process

18. Resistance (spot or seam) Welding

- a) Welding current
- b) Welding time
- c) Spacing between welds



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- d) Electrode design & dimensions
- e) Electrode material
- f) Weld equipment (manufacturer, model & serial number)

19. Shot Peening

- a) Equipment type
- b) Nozzle size
- c) Nozzle angle & distance from part
- d) Number of nozzles used
- e) Air jet & size
- f) Air pressure
- g) Shot size, hardness & specification
- h) Cycle time
- i) Number of cycles
- j) Almen strip location
- k) Table rotation & oscillation speed & distance
- l) Nozzle oscillation speed & distance

20. STEM Drilling

- a) Electrolyte concentration
- b) Cleaning procedure following stem drilling
- c) Acid used (name & specification)

21. Stress Free Grinding

- a) Speeds & feeds used
- b) Manufacturer of & type of abrasive wheels used
- c) Type and control of coolant used

22. Thermal Spray

- a) Thermal spray parameters
- b) Spray set-up
- c) Masking
- d) Spray gun to part angle orientation
- e) Relative motion of gun to part
- f) Location of cooling air jets
- g) Location of test panels

23. Titanium Chemical Cleaning

- a) Alkaline Cleaning
 1. Alkaline material (specification & mfr.)
 2. Concentration (oz/gal)
 3. Water Temperature
 4. Time



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- b) Descaling / Cleaning
 - 1. Descaling compound (specification & mfr.)
 - 2. Temperature
 - 3. Concentration
 - 4. Time
- c) Acid Etch
 - 1. Nitric acid concentration
 - 2. Hydrofluoric acid concentration
 - 3. Water percentage
 - 4. Temperature
- d) Rinse Cycle
 - 1. Water & air pressure
 - 2. Time
 - 3. Temperature
- e) Minimum resistance in ohms/cm for deionized water
- f) Marking material (if used)

24. TIG (Tungsten Inert Gas) Welding

- a) Automatic or Semiautomatic processes
 - 1. Current
 - 2. Polarity
 - 3. Power supply type
 - 4. Arc voltage
 - 5. Travel speed (automatic TIG weld operation)
 - 6. Electrode type & size
 - 7. Filler material, size & type
 - 8. Sequence of welding
- b) Manual TIG Welding
 - 1. Sequence of welding



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Appendix B

Supplier Types & Products and Services Descriptions	
Brokers / Traders	<ul style="list-style-type: none"> - Base Transition Metals - Earth and Rare Earth Metals - Recycled and Re-processed Scrap Metals
Component Supplier or Outside Processor	<ul style="list-style-type: none"> - Ceramic Core Manufacturing Services - Wax Pattern Production and Assembly Services - Hot Isostatic Pressing (HIP) - Casting Services - Impregnation Services - Machining Services - All types - Mechanical Finishing Services - Metal Fabrication - Airfoils
Laboratory / Test Facility	<ul style="list-style-type: none"> - Calibration Services - non-OEM calibration services - Dimensional Measurement Services - Laboratory Testing Services
Non-Product Related Services	<ul style="list-style-type: none"> - Assessment Services (3rd party) - Imaging Services - document imaging, record retention, etc. - Laboratory Proficiency Testing Admin. Services - Round Robin Testing - Records Retention / Retrieval - full service supplier
Pass-Through Distributor	<ul style="list-style-type: none"> - Product Manufactured to Alcoa Howmet Specifications
Raw Material & Process Material Supplier	<ul style="list-style-type: none"> - Abrasive Products - Adhesives - Alloy - Alloy Services - bar peeling, centerless grinding, drawing, ingot to billet conversion, rolling, shearing, and straightening - Braze materials - powders, alloy, fillers, etc. - Ceramic Core Materials - Ceramic Crucibles and Materials - Ceramic Products - (Non-Spec'd; Crucibles, Cups, Blankets, Dies, etc) - Chemicals - (Non-Spec'd; Acetone, Chloride Solutions, Hydrogen Peroxide, etc) - Cleaning Materials - Fasteners - screws, rivets, nuts, helicoils, pins, etc. - Forging Services - Gas Products - Hot Forming Services - Lubricants - Metals - Mono-Shell Materials - NDT Materials Supplier - X-ray film, solutions, etc. - SLA Prototypes - Thermocouple Manufacture - Wax Materials - Wrought Products



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Special Process Supplier	<ul style="list-style-type: none">- Heat Treat and Brazing Services- Chemical Processing - anodizing, cleaning, milling, plating, stripping, surface treatment, etching- Coating (of parts) - coating, plating, thermal spray, prime/painting, etc- Non-Destructive Testing Services - Liquid Penetrant, Magnetic Particle, Ultrasonic, Radiographic- Surface Enhancement Services - shot peening, peen forming, glass bead peening- Materials Testing Services - including Test Bar Machining- Welding Services- Non-conventional Machining - EDM, ECM, ECG, and LBM
Tooling Suppliers	<ul style="list-style-type: none">- Manufacturers of production dies, fixtures, gages, & design services.- Die Coating & Plating- Pressure Testing Services