

<h1>Quality Engineering Instructions</h1>				<b>PCC</b> Minerva Plant	
				<b>Q.E.I. NO.</b>	<b>ISSUE DATE</b>
<b>CUSTOMER</b>	<b>QEI NAME</b>	<b>FR</b>	<b>PART NUMBER</b>	<b>16.16.108</b>	<b>2/3/89</b>
ALL	SUPPLIER REQUIREMENTS	N/A	N/A	<b>PAGE 1 OF 9</b>	
				<b>COPY OF</b>	
<b>WRITTEN BY:</b>		<b>CUSTOMER SPEC.</b>		<b>REVISION: 07</b>	
R. HERRICK		VARIOUS		<b>REVISION DATE: 9/4/15</b>	
<b>DOC CONTROL:</b>	<b>QUALITY APP:</b>	<b>PRODUCT ENG. APP:</b>	<b>PROCESS ENG. APP:</b>		
<i>Electronic Signatures on file in Master Control</i>					

**TITLE: QUALITY ASSURANCE REQUIREMENTS FOR SUPPLIERS**

**1.0 PURPOSE**

1.1 This specification describes the minimum Quality Assurance requirements for suppliers who provide material and/or services to the Minerva/Crooksville Operations of Precision Castparts Corp.

**2.0 SCOPE**

2.1 This specification applies when specifically referenced in the purchase order. Variations to these requirements require prior written approval of the purchaser.

**3.0 REFERENCE DOCUMENTS**

- 3.1 AS 9100C/ISO 9000:2008 Quality Systems Standards
- 3.2 MIL-I-45208 "Inspection System Requirements"
- 3.3 MIL-STD-45662 "Calibration System Requirements"
- 3.4 MIL-Q-9858 "Quality Program Requirements"
- 3.5 DOD-STD-2168 "Software Quality Program"
- 3.6 AMS 2750 "Pyrometry" Applicable to All Thermal Processes
- 3.7 P3316 Applicable to Ceramic Products
- 3.8 Minimum requirements for the Supplier's Quality Assurance and Calibration Systems are described in Section 6.0.

**4.0 DEFINITIONS**

PURCHASER – Precision Castparts Corp.

SUPPLIER – Subcontractor, vendor, et. al., that is performing work for or supplying material or services to Precision Castparts Corp.

CONTROLLED MATERIAL/SERVICES – Material or services considered critical in their application or procurement.

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## 5.0 GENERAL SUPPLIER OBLIGATION

- 5.1 Contractual Intent - This specification requires the establishment of a quality program assuring that all contractual requirements are met. The supplier shall develop and implement a program and procedures in compliance with this specification and documented to, at least, the extent required by Section 6 and subject to purchaser approval.
- 5.2 Relation to Other Contract Requirements – This specification and any other procedure or document intended to accomplish its requirements shall be in addition to, and not in disagreement or conflict with, any other contract requirements.

## 6.0 SUPPLIER MINIMUM QUALITY ASSURANCE REQUIREMENTS

- 6.1 Organization – Effective management for quality shall be clearly prescribed.
- 6.2 Initial Quality Planning – During the earliest practical phase of contract performance, a complete review of the requirements of the contract shall be documented to identify and make timely provision for the special controls, processes, test equipment, fixtures, tooling, and skills required for assuring quality.
- 6.3 Work Instruction – All work affecting quality shall be prescribed in clear and complete documented instruction of a type appropriate to the circumstances.
- 6.4 Records:
- 6.4.1 Records shall be available for review by the purchaser and copies of individual records shall be furnished upon request.
- 6.4.2 Special Requirements - Records of processing, inspection, and test shall be retained for the duration specified in the applicable purchase specification, or for a minimum of 10 years, whichever is greater. When authorized by the Purchaser, records may be submitted with the item/product to the purchaser for the purchaser's retention.
- 6.5 Corrective and Preventative Action – Measures shall be documented to ensure the prompt detection and correction of assignable conditions adverse to quality. Corrective and preventative actions shall include as a minimum:
- a. Analysis of data to determine extent and cause.
  - b. Analysis of trends in processes to prevent the nonconformance; and
  - c. Introduction of required improvements and corrections and monitoring of the effectiveness of corrective/preventative actions taken.
- 6.5.1 When notified of a nonconformance, the supplier is required to report within ten (10) working days to the purchaser the root cause(s) and planned corrective action, and commitment date for ultimate correction.

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## 6.6 Drawing, Documentation and Changes:

6.6.1 System Description – The supplier shall ensure the adequacy, the completeness and the correctness of drawings and specifications, and shall control the effectivity of changes in design and/or contract.

## 6.6.2 Special Requirements:

- a. The supplier is responsible to ensure that all documentation (drawings, specifications, and other) is available and is of the correct revision status.
- b. Government and general industry specifications are to be obtained from applicable sources (reference Society of Automotive Engineers Specification AMS 2350).
- c. Specifications authored by the purchaser and the purchaser's customer can be obtained directly through the purchaser.

## 6.7 Measuring and Test Equipment:

6.7.1 System Description – The supplier shall provide and maintain gages and other measuring and testing devices necessary to assure that the purchased material or service conforms to technical requirements. The calibration of measuring and testing equipment and of measurement standards shall be in conformance to MIL-STD-45662.

6.7.2 Special Requirements – When required, personnel, gages, measuring, and testing devices shall be made available for use by the purchaser to determine conformance with contract requirements.

## 6.8 Purchaser Supplied Tooling and Material (includes Government Furnished Material):

6.8.1 System Description – When gages, tooling or material is furnished by the purchaser, the supplier's procedures shall establish requirements for initial and periodic assessment, adequate storage and protection, calibration, and maintenance of such equipment. Inspection, maintenance, and inventory records must be maintained.

6.8.2 No repair or rework is allowed to Purchaser Supplied tooling, gaging or similar without prior written approval by PCC Minerva Engineering and Quality Assurance.

## 6.9 Production Tooling used as Media of Inspection:

6.9.1 System Description – When supplier owned production jigs, fixtures, tooling masters, templates, patterns and such other devices are used as media of inspection, they shall be qualified and calibrated by the supplier for accuracy prior to release for use. After qualification, these devices shall be re-calibrated periodically by the supplier for accuracy, at intervals established, in a formal manner to cause their timely adjustment, replacement, or repair prior to becoming inaccurate.

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## 6.10 Control of Purchases:

- 6.10.1 System Description – Materials and services procured from the supplier’s subcontractors and suppliers must conform to the contract requirements. It is the supplier’s responsibility to obtain full compliance from sub-tier suppliers.

The supplier shall ensure that raw materials used in fabrication or processing of products conform to the applicable requirements. Laboratory testing shall be employed as necessary. When certifications are required, the actual quantitative test values shall be provided.

## 6.10.2 Special Requirements:

- a. The supplier shall not subcontract work (*the order*) without express permission from both the Purchasing and Quality Departments of the purchaser.
- b. When it is specified by the purchaser that an approved lab must be used for testing, the test lab used must be approved by the purchaser. This in no way reduces or eliminates the supplier’s responsibility for testing performed by supplier’s selected lab.

## 6.11 Process Control:

- 6.11.1 System Description – The supplier shall ensure that special processes and all production operations of any type, shall be accomplished under managed conditions. Managed conditions include documented work instruction, adequate production equipment, any special working environment, and qualification or certification of personnel as may be applicable.

- 6.11.2 Pattern X-Ray Control – When pattern x-ray is specified by the purchaser, the supplier shall maintain process control of pattern core-break through the use of X-bar and R control charts for each specified product. The X-bar chart shall be a plot of the average %-failure at pattern x-ray. The average shall be generated by adding the %-failure at pattern x-ray for each shift in a day and dividing by the number of shifts of x-ray results for that day. The R chart is a plot of the maximum %-failure minus the minimum %-failure for that day. All control charts must be approved by the purchaser. The lower control chart limit shall be 0. The upper control chart limit shall be calculated from historical data if available or 25 data points whichever is greater. Upper control chart limits shall be reviewed and revised on a quarterly basis with any changes in control limits approved by the purchaser. Whenever a control chart has a value that exceeds the upper control limit the purchaser shall be notified within 24 hours.

## 6.12 Handling, Storage and Delivery:

- \*6.12.1 System Description – The supplier shall provide adequate work and inspection instructions for handling, storage, preservation, packaging, and shipping to protect the quality of materials and prevent damage, loss, deterioration, degradation, substitution, or the introduction of Foreign Objects (FO) to said castings or related processes.

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## 6.13 Nonconforming Material:

6.13.1 System Description – The supplier shall establish and maintain an effective system for controlling nonconforming material, including procedures for its positive identification, segregation, and disposition.

## 6.13.2 Special Requirements:

- a. The supplier shall not rework, repair, substitute, or subject material to operations or processes which are not otherwise authorized in the contract.
- b. Nonconforming materials are not to be delivered without the express prior written approval of the purchaser.
- c. On items previously delivered, the supplier is required to notify the purchaser within twenty-four (24) hours of the detection of any nonconformance which exists or may exist.
- d. Unusual conditions (i.e. discoloration at heat treat, etc.) identified during normal processing shall be reported to the purchaser, in writing, prior to shipment of the affected material.

## 6.14 Indication of Inspection Status:

6.14.1 System Description – The supplier shall maintain a positive system for identifying the stage of processing (inspection status) of material and the calibration status of inspection tools and gages.

6.15 The purchaser, customer and regulatory agencies shall have the right of entry to inspect and/or verify the quality of contracted work, records and material at the supplier's facilities.

## 7.0 ADDITIONAL QUALITY ASSURANCE REQUIREMENTS

7.1 Software Quality Assurance – The supplier shall establish and implement a Software Quality Assurance Plan (S.Q.A.P.) to ensure that software used directly for the design, processing, inspection, test or operation of deliverable materials is controlled and complies with the intent of DOD-STD-2168 requirements. The S.Q.A.P. shall be subject to review and disposition by the purchaser.

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## 7.2 Statistical Quality Control:

- 7.2.1 System Description – A program for statistical quality control shall be developed and implemented by the supplier. Statistical methods, planning, analysis, tests and quality control procedures may be used whenever such procedures are suitable to maintain the required control of quality. The purchaser reserves the right to review such procedures and approve or disapprove where reasonable concern for the assurance of quality is given.

Statistical quality control should be demonstrated by analysis of objective quality evidence prior to proposing new or reduced sampling inspection procedures except where:

- a. Final inspection is performed by destructive testing.
- b. Inherent characteristics of the product indicate that sampling inspection will not jeopardize the quality.
- c. Subsequent inspection at a later operation will provide.

## 7.3 Quality Costs:

- 7.3.1 System Description – The supplier shall maintain and use quality cost data as a management element of the quality program.
- 7.3.2 Special Requirements – The supplier's Quality Cost Program shall include identification, documentation, and analysis of the costs of prevention, appraisal, correction and failure.
- 7.4 Marking Requirements – Only PCC Minerva MCL approved items as listed in Addendum A can be used to mark (other than integral marking created by a die) on cores, wax patterns, wax clusters and castings.

## 8.0 SUPPLIER QUALIFICATION

- 8.1 Supplier Evaluation – The purpose of the Supplier Quality Evaluation is to verify that the supplier has the systems and procedures necessary to assure compliance to this document and other contractual requirements. During the appraisal, the purchaser's representative, with assistance from the supplier when required, shall complete the specific items of the Supplier Quality Survey Form.
- 8.2 The appraisal may require a visit to the supplier's facilities to determine if the organization, procedures, techniques, etc., are in effect.
- 8.3 Where deficiencies are noted, the supplier will be required, within ten (10) working days, to initiate statements of cause, corrective action, and effectivity. Approval will be granted, extended, or denied, based upon the acceptability of the statements. The purchaser reserves the right to verify, by survey or other means, that corrective action is effective. (Reference Paragraph 6.5).

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## 9.0 CONTINUING APPROVAL

9.1 The supplier's approval status shall remain in effect provided all of the following apply:

- a. The supplier performs work for the purchaser on a routine basis.
- b. The supplier Quality Rating remains satisfactory.
- c. Quality Surveys are satisfactory.
- d. The supplier performs within the limits of the approval.

9.2 The purchaser may revoke supplier approval status at any time.

9.3 A supplier who is denied continuing approval will be so notified by the purchaser. The notification will specify the reason for denial.

## 10.0 CONTROLLED PROCESSES

10.1 When a material or service is designated, by purchase order or other agreement, as being subject to a controlled process, the supplier shall be required to:

- a. Submit work instructions and applicable procedures to the purchaser for approval.
- b. In the event of proprietary elements, demonstrate to the purchaser a program of configuration management and subsequent assignment of code numbers to the process.
- c. Request, in writing, from the purchaser prior approval for any change to the process, materials, or suppliers/subcontractors used.

10.2 The supplier shall submit the controlled process package to the attention of the purchase agent at the earliest opportunity after order acceptance.

10.3 Upon establishment of an approved controlled process, the supplier shall not modify, substitute, or otherwise change the process without the prior written approval of the purchaser.

10.4 The purchaser reserves the privilege to submit controlled process packages to its customer for approval.

10.5 When requested by the purchaser, the supplier shall supply samples and data for correlation of inspection techniques with those of the purchaser.

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## ADDENDUM A

ID	MARKER ID	COLOR	PCC ID	MET EXAM For Alloy Depletion and Oxidation.					
				Micro #	No Mark	On Weld	On HAZ	Brushed	50 Grit
<b>China Markers</b>									
A2	Prang 64	Neon Red	900-1405	39656	nil-.0004	0.0003	0.0003	nil-.0004	nil-.0004
B2	Prang 64	Neon Red	900-1405	39657	nil-.0005	0.0002	0.0002	nil-.0007	nil-.0005
A4	Sanford 2033	Green	900-1613	39658	nil-.0006	0.0003	0.0003	nil-.0005	nil-.0005
B4	Sanford 2033	Green	900-1613	39659	nil-.0003	0.0002	0.0001	nil-.0003	nil-.0003
A5	Sanford 2059	Red	900-1571	39660	nil-.0005	0.0003	0.0003	nil-.0004	nil-.0004
B5	Sanford 2059	Red	900-1571	39661	nil-.0004	0.0002	0.0001	nil-.0004	nil-.0005
A6	Sanford 2062	Crimson Red	900-1407	39662	nil-.0004	0.0003	0.0003	nil-.0006	nil-.0006
B6	Sanford 2062	Crimson Red	900-1407	39663	nil-.0003	0.0002	0.0001	nil-.0003	nil-.0003
A7	Sanford 2083	Brite Yellow	Not in Supply	39664	nil-.0004	0.0003	0.0002	nil-.0004	nil-.0003
B7	Sanford 2083	Brite Yellow	Not in Supply	39665	nil-.0004	0.0002	0.0001	nil-.0006	nil-.0006
<b>Pencils</b>									
A8	Sanford 741	Indigo Blue	900-1024	39666	nil-.0005	0.0003	0.0003	nil-.0004	nil-.0004
B8	Sanford 741	Indigo Blue	900-1024	39667	nil-.0005	nil	nil	nil	nil
A22	Sanford 745	Crimson Red	900-1474	39668	nil-.0004	0.0002	0.0002	nil-3.0005	nil-.0005
B22	Sanford 745	Crimson Red	900-1474	39669	nil-.0004	0.0002	0.0002	nil-.0006	nil-.0006
A24	Sanford 750	Pale Vermillion	900-1406	39670	nil-.0004	0.0002	0.0002	nil-.0005	nil-.0005
B24	Sanford 750	Pale Vermillion	900-1406	39671	nil-.0004	0.0001	0.0002	nil-.0004	nil-.0003
	Pilot Eno Pencil	Indigo Blue	900-1729	210498	0.0008	0.0005	0.0005	0.0005	0.0008
	Pilot Eno Lead	Indigo Blue	900-1730	201498	0.0008	0.0005	0.0005	0.0005	0.0008
<b>Inks</b>									
A25	Kingmark Z04 A	Black	040-1099	39672	nil-.0003	0.0002	0.0002	nil-.0004	nil-.0002
B25	Kingmark Z04 A	Black	040-1099	39673	nil-.0004	nil	nil	nil-.0004	nil-.0004
A26	Sanford 58701	Black	900-1215	39674	nil-.0004	0.0002	0.0002	nil-.0004	nil-.0002
B26	Sanford 58701	Black	900-1215	39675	nil-.0003	nil	nil	nil-.0004	nil-.0004
A27	Sanford 58702	Red	900-1216	39676	nil-.0003	0.0002	0.0002	nil-.0003	nil-.0002
B27	Sanford 58702	Red	900-1216	39677	nil-.0003	nil	nil	nil-.0005	nil-.0005
A28	Aerobrand #245	Black	900-1411	39678	nil-.0004	0.0002	0.0003	nil-.0002	nil-.0002
B28	Aerobrand #245	Black	900-1411	39679	nil-.0003	nil	nil	nil-.0004	nil-.0003
A29	Clear Print #9SF	White Opaque	040-1001	39680	nil-.0004	0.0002	0.0002	nil-.0004	nil-.0004
B29	Clear Print #9SF	White Opaque	040-1001	39681	nil-.0003	nil	nil	nil-.0003	nil-.0003
<b>Marker</b>									
	Marks-A-Lot	Black	900-1389	210497	0.0006	0.0004	0.0006	0.0006	0.0008
<b>Grease Pencil</b>									
	Listo Grease Pen	Black	900-1400	210499	0.0006	0.0006	0.0008	0.0008	0.0006



**PCC Airfoils**  
**REVISION RECORD**

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REV.	DATE	CHANGE DESCRIPTION	AUTHOR
	3/20/00	Added AS 9000 and ISO 9002; added 6.13.2 d; clarified calibration requirements; editorial changes.	R. Herrick
01	10/29/02	Added right of entry (Para. 6.15).	R. Herrick
02	4/6/04	Changed Quality Systems Standards reference from AS 9000/ISO 9002 to AS9100/ISO 9000:2000; added Para. 6.8.2 regarding no repair/rework to purchaser supplied tooling, etc. without prior approval.	R. Herrick
03	10/20/09	Revised required AS/ISO standard; added requirement for PCC Minerva MCL approved items for marking on cores, wax patterns, wax clusters and castings (note 7.4 and addendum A); change corrective action required in 10 days from 15 days to match QCP 12.0.	G. Keane
04	05/04//10	Added paragraph 6.11.2 Pattern X-ray Control that requires purchaser approved X-bar and R control charts for % failure at pattern x-ray.	J. Burman
05	1/19/14	Revised 6.12.1 to include supplier's responsibility for Foreign Object control.	J. Cua
06	4/7/14	Revised TMFC 20-3450	MJ Winter
07	9/4/15	Updated to reflect latest revision (8/18/15) of TMFC 20-3450.	G. Keane