ENGINEERING SOURCE APPROVAL

1. **SCOPE**
   
   This specification provides P&WC’s requirements for Engineering Source Approval (ESA). CPW 135 is referenced on P&WC drawings. Supplementary Material Data (SMD) and Supplementary Product Data (SPD) sheets identify the reasons for ESA, the types of ESA applied, and the sources subject to ESA and their status. CPW 135 is also referenced on Equipment Specifications.

   The requirements of this document also apply in those cases where documentation (including SPDs and SMDs) refer to superseded types of ESA. Superseded ESA types and the requirements for them are identified in 5.2 of this specification.

1.1 **Types of ESA**

   The types of ESA currently applied at P&WC are:

1.1.1 **Process Sheet Approval Required (ESA-PSAR)**

   The ESA source must define the processes used for an item or specific features of an item and submit this definition for review and approval by P&WC Engineering. Once the process definition is submitted the source is not allowed to make ESA Significant Changes without approval by P&WC Engineering.

1.1.2 **Summary of Operations Required (ESA-SOR)**

   The ESA source must define the sequence of operations used for an item or specific features of an item and submit this definition for review and approval by P&WC Engineering. Once the sequence of operations is submitted the source is not allowed to make ESA Significant Changes without approval by P&WC Engineering.

1.1.3 **Process Sheet Approval Not Required (ESA-PSANR)**

   Does not require any ESA approval or review of process sheets, summary of operations, or subsequent changes. The designation is used to identify specific sources that must be used because they possess a particular expertise, unique capability or proprietary process or material.
2. APPLICABLE DOCUMENTS
The following documents form a part of this specification to the extent specified herein; unless otherwise specified, the latest issue shall apply.

2.1 Pratt & Whitney Canada Corp. Documents
Available from Pratt & Whitney Canada Corp. (P&WC), 1000 Marie-Victorin, Longueuil, Québec, J4G 1A1

2.1.1 P&WC Publications
- CPW 32 Finishing of Compressor and Turbine Parts
- CPW 100 Control of Materials, Processes and Parts - Laboratory Requirements for Tests, Controls and Reports and Procedures for Source Qualification
- CPW 103 Supplier Responsibilities - SFI Coordinated Control Assemblies and Details
- CPW 138 ENSIP Critical Parts
- CPW 154 Supplier Responsibilities - SFI Coordinated Control Assemblies With Source - Special Repair Services
- CPW 370 Bevel Gear (Straight and Spiral) and Face Coupling Requirements
- CPW 906 Control of Turbine Blade Castings

2.1.2 P&WC Materials Quality Assurance NDT Methods
- CEIM-1 Etch Inspection Method - Anodic
- CEIM-3 Etch Inspection Method - Etch Anodize Titanium Alloy

3. DEFINITIONS
As used in this specification:

3.1 Accepted for Substantiation
The identification used in communication with suppliers that a process submission has been reviewed by P&WC and found to be sufficient to allow substantiation to proceed.

3.2 Approval
The identification that a source has demonstrated the capability to perform specific processing on a particular item, or in the case of ESA-PSANR that the source is capable of providing a specific item or material.

3.3 Approved Source
A source identified on the SPD/SMD as "Approved". The identification applies to processes, materials or components identified on the SPD/SMD.

3.4 Approved Process
A frozen process that has been substantiated. An approved process is under Process Change Control.

3.5 Complete Manufacturing Process
The total processing required to manufacture an item as defined by a P&WC drawing. Any item defined by a P&WC drawing has a starting condition: defined by a specification form and
condition, or by a semi-finished drawing definition, such as a forging; and a finishing condition such as a finished part. Complete Manufacturing Process includes all the operations to move from the starting to finished conditions.

3.6 Designated Source
A source identified on the SPD/SMD as "Designated". The designated status identifies that the source is judged to have the capability to perform processes or to provide material or components identified on the SPD/SMD, but substantiation testing is not complete.

3.7 Engineering Design Intent
The form, fit and function characteristics of an item.

3.8 Engineering Source Approval (ESA)
The business process that makes the processes used by a source a part of the approved product definition for an item or material.

3.9 ESA Non-significant Process Change
A change in the manufacturing process of an item, material or process that has no practical effect on the quality, durability or performance of the item, and does not affect subsequent processing.

3.10 ESA-Significant Process Change
A change in the manufacturing process of an item, material or process that could degrade or improve the quality, durability or performance of the item, or that could affect subsequent processing.

When "ESA-Summary of Operations" is required (ESA-SOR and ESA-PSAR), this is to be interpreted as being any change in the sequence of operations, including addition or deletion of operations, or change in manufacturing location for any of the operations subject to ESA.

3.11 Essential Control Factor
See Key Process Parameter.

3.12 Feature Process Approval (FPA)
A superseded designation found on some existing documentation which applies ESA to specific features of an item rather than the complete item. The affected features are identified "FPA" on the part drawing.

3.13 Frozen Process
A process that is sufficiently developed that items produced to this process can be included in a substantiation exercise. A frozen process is under Process Change Control.

When ESA-Summary of Operations is applied, frozen process is interpreted as applying to the defined sequence of operations.

3.14 Generic Change
A change to a specific operation that affects several items, for example the change of a machine across a number of different items, or the use of a different coolant on a specific machine on which a number of different items are processed.
3.15 **History of Change**
A document that identifies the series of process changes; changes in the summary of operations and in individual process operations, that have taken place including ESA Non-significant Process Changes not submitted to P&WC for approval.

3.16 **Item**
Includes the terms: detail, part, forging, casting, semi-finished part assembly, assembly-of, component, module, set, kit and sub-assembly.

3.17 **Key Process Parameter**
A process parameter that has an impact on the quality, durability or performance, or on the subsequent processing of an item. Appendix A contains guidelines on key process parameters.
For most of the processes performed using a P&WC CPW Specification, the key process parameters are identified in the specification.

3.18 **Manufacturing of Assembly and Control of Sub-tiers**
The processing required by the source to construct an assembly as defined by a P&WC drawing and the identification and control of all sub-tiers used in the manufacture of the item.

3.19 **P&WC Buyer**
The P&WC Purchasing agent, or the Process Planner in the P&WC Manufacturing unit.

3.20 **P&WC Process Identification**
The unique process identification assigned by P&WC, to all process and process change submissions, to standardize the process identification and facilitate tracking of changes to an approved process.

3.21 **Parts Per Grind (PPG)**
The maximum number of items that are made with a new or newly ground tool before the tool must be replaced. A modified definition of PPG may be used based on the methodology for tool change control that is agreed with P&WC Engineering.

3.22 **Process Change Control**
A section of the ESA Process that controls ESA-Significant Process Changes to frozen or approved processes and summaries of operations. It is control applied by P&WC to ensure that any ESA-Significant Process Change to an approved or frozen process or summary of operations is reviewed and substantiated before the change is incorporated.

3.23 **Process Change Information Package**
A package of information that identifies an ESA-Significant Process Change for which approval is requested.

3.24 **Process Information Package**
A package of information required to approve the process for the specific characteristic to which ESA is applied.
3.25 **Process Sheets (also known as "Manufacturing Operation Sheets")**
Documents that define the chemical, metallurgical, manufacturing and quality control operations involved in the specific method of manufacture of an item or material, and that identify the location where the operations are performed. These operations include those performed by subcontractors.

3.26 **Rough Machining**
Machining to a position at least 0.050 inches (1.28 mm) from the nominal surface defined on an Engineering drawing.

3.27 **Significant Process Parameter**
See Key Process Parameter.

3.28 **Source**
An entity that provides items, materials or processing subject to ESA. A source is not necessarily a supplier to P&WC. A source may be a sub-tier to a P&WC supplier or to another sub-tier. ESA sources are identified on the SPD or SMD whether or not they are suppliers to P&WC.

3.29 **Subcontractor**
A sub-tier producer, at any level, who furnishes items, materials or processes requiring ESA to a supplier to P&WC.

3.30 **Substantiation**
Testing required by P&WC to demonstrate that an item, process or material meets the Engineering Design Intent.

3.31 **Substantiation Plan**
A detailed plan identifying the testing required by P&WC to substantiate an item, process or material. Details of the plan requiring action by the ESA source are prepared by P&WC Engineering and provided by procurement to the supplier.

3.32 **Sub-tier**
A source, who is not a supplier, who manufactures an item or material, or performs processing. Also referred to as a subcontractor.

3.33 **Summary of Operations (Also known as Manufacturing Operation Summary)**
A list of all operations in the process subject to ESA, in the sequence in which they are performed, and that identifies the location where the operations are performed. These operations include those performed by subcontractors, including any operations that do not require process sheets per 5.3.5.1, and any operations that may be processed out-of-sequence and any alternative operations.

3.34 **Supplier**
Entities, including P&WC Manufacturing units, that deal directly with P&WC for the provision of items, material and processing. External suppliers receive Purchase Orders from P&WC. A supplier does not necessarily provide items, material or processing subject to ESA but he is responsible for submitting ESA Process Information and Process Change Information Packages to P&WC from any sub-tier that is subject to ESA, except those subject to

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CAGE CODE 00198

EXPORT CLASSIFICATION: ECL N/A, P-ECCN 9E991
Export Classification Date:2010-12-06
ESA-PSANR. Suppliers are not identified on the SPD or SMD if they do not provide items, materials or processing subject to ESA.

4. PROCEDURE
The ESA Process (system) is a procedure for identifying and approving suitable sources for processes or items subject to ESA. The steps to be followed (4.1 through 4.7) are identified against the specific types of ESA. Sections that apply to all ESA types are identified as ‘General’. There may be exceptions to the procedures and requirements for ENSIP Critical parts as noted in 5.1.

The main steps in the process for the approval of a new source are:
• Placement of Purchase Orders - General applicability
• Process Development- Applicable to ESA-PSAR and ESA-SOR
• Freezing a Process- Applicable to ESA-PSAR and ESA-SOR
• Submission of a Process Information Package - Applicable to ESA-PSAR and ESA-SOR
• Review of submission - Accept process - Applicable to ESA-PSAR and ESA-SOR
• Substantiation Testing - General applicability
• Approval of Source - General applicability

The ESA Process also addresses changes to ESA frozen and approved processes, and the retention or removal of ESA approvals.
• Changes to Frozen and Approved Processes - Applicable to ESA-PSAR and ESA-SOR:
  ° Development
  ° Freezing
  ° Submission
  ° Review
  ° Substantiation
  ° Approval
• Retention of ESA Approval - General Applicability
• Removal of ESA Approval - General Applicability

4.1 Placement of Purchase Orders - General
P&WC Purchase Orders are placed with a supplier that may not be subject to any form of ESA and therefore not identified on the SPD/SMD. Suppliers may have sub-tier sources with which they place Purchase Orders.

Sources subject to any type of ESA are identified on the SPD/SMD sheets.

4.2 Process Development - ESA-PSAR and ESA-SOR
Suppliers and sub-tier sources are expected to develop stable, robust and reliable processes that provide items, processing and materials meeting P&WC requirements. A satisfactory process should be developed by the time that P&WC has to start process substantiation.

4.3 Freezing the Process - ESA-PSAR and ESA-SOR
P&WC intends to substantiate only items and materials that are the product of developed processes that will be used for Production.
Prior to the start of process substantiation P&WC requests that suppliers freeze their processes and the processes of their sub-tier sources.

A frozen process is subject to Process Change Control, and no ESA-Significant Process Changes can be made to the process without approval by P&WC Engineering.

### 4.4 Submission of Process Information Package - ESA-PSAR and ESA-SOR

Process Information Packages are submitted when a process is frozen and also when a source wants to make an ESA-Significant Process Change to a frozen or approved process. Appendix B provides guidelines for the content and procedure for submissions.

### 4.5 Review by P&WC of Process Information Package - ESA-PSAR and ESA-SOR

P&WC will review the Process Information Package and if it is found acceptable will proceed with substantiation of the process. Any editorial correction or clarification required will be requested by P&WC. Appendix B provides details.

If the initial Process Information Package is rejected, any items produced to this process will be dispositioned by P&WC Engineering.

### 4.6 Substantiation - General

Substantiation is intended to demonstrate that the item, processing or material meets the P&WC Engineering Design Intent. Substantiation requirements are assembled into a Substantiation Plan. For Coordinated Control items, the substantiation requirements imposed on the supplier may be defined in the Equipment Specification of the item.

P&WC Purchasing will inform the supplier if substantiation requires testing by the supplier or the producing source.

#### 4.6.1 Unsatisfactory Substantiation

The supplier is informed of any unsuccessful substantiation testing. Based on a root cause analysis of the unsuccessful substantiation, P&WC will decide further action, including the disposition of any items. Such action may include revision to the product definition, a request for the supplier to modify the process, or a change in supplier or producing source for this item.

### 4.7 Approval of Source - General

When substantiation is satisfactory the status of a "designated" source is changed to "approved" on the SPD/SMD.

### 4.8 Approval by P&WC of a Change - ESA PSAR and ESA-SOR:

After freezing or approving a process or summary of operations, the producing source must not make any ESA-Significant Process Changes without approval by P&WC Engineering. These changes include significant process changes, changes in the sequence of operations and changes in sources subject to ESA. The change provisions, however, are not intended to preclude further process improvements or economies.

The ESA procedure for the approval of ESA-Significant Process Changes to an approved or frozen process or summary is similar to that for initial approval except that the source status on the SPD/SMD is not changed by the submission of a Request for Process Change.
4.9 Identification of Items as to Process Information - ESA-PSAR and ESA-SOR

All ESA sources are expected to maintain an internal identification system that provides traceability of an item, material or processing to a specific process or summary of operations, and provides a detailed History of Change for the process or summary. ESA sources are also expected to use, in all communications with P&WC, the P&WC Process Identification given by P&WC to a process submission.

5. ESA TECHNICAL REQUIREMENTS

The following are requirements applied by P&WC to suppliers and sources providing items or processing subject to ESA.

5.1 ENSIP Critical Parts

Some requirements of CPW 135 are modified in the case of ENSIP critical parts. The ESA requirements contained in CPW 138 apply to ENSIP critical parts and take precedence over those of this specification.

5.2 Superseded Types of ESA

Different names were used in the past to indicate various types of ESA. These names are still used on some SPD/SMD. The following shows the type of ESA to be applied when an SPD or SMD identifies one of the superseded designations:

- ESA-FPA, ESA-PA and ESA-PC are replaced by ESA-PSAR.
- ESA-SS is replaced by ESA/PSANR.

Contact P&WC for instructions related to any other types of ESA.

5.3 Processing Subject to ESA-PSAR and ESA-SOR

5.3.1 Sourcing

Only the ESA sources identified on the SPD or SMD for the processes, materials and items shown can be used.

All sources, including sub-tier sources, used for processing, material and items subject to ESA must be identified on the SPD or SMD. If additional sources are required in the supply chain for processing subject to ESA, the supplier must request the addition of these sources to the SPD/SMD.

All sub-tier sources used for processing, material and items subject to ESA must be identified in the process sheets and summary of the supplier or the next higher tier source.

When there are multiple suppliers and multiple sub-tier sources, the sub-tier applicable to a specific supplier is not shown on the SPD/SMD; the applicable sub-tier is identified in the process sheets and summary of operations of the supplier.

Suppliers must flow-down the applicable ESA requirements to their sub-tier sources and must ensure the flow-down through the supply chain.

5.3.2 Process Development

Suppliers of an item must develop, and ensure that their sub-tier sources develop, suitable processes for manufacture. Processes must be reliable and robust, definable and auditable. The process must be feasible for the production quantities envisaged by P&WC. Exception: The supplier has no responsibility with respect to the process development of raw material sources (such as ingot and conversion sources) subject to ESA-PSANR.

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EXPORT CLASSIFICATION: ECL N/A, P-ECCN 9E991
Export Classification Date:2010-12-06
The processes developed must not conflict with any written product definition, drawings or specification identified by P&WC.

When a drawing identifies an option, such as 'in-process stress relief may be used', it is to be interpreted to mean that it is an option for the process. That is, the process may be developed and approved with or without an in-process stress relief. It is not an option within the process for different batches or different items within a batch. In the event that a source needs an alternative in the process, P&WC will accept the alternatives if they are equivalent. If needed alternatives are not clearly equivalent then P&WC will include each alternative in the substantiation of the process.

Descriptions of operations in Process Sheets and Summaries of Operations must include reference to any applicable CPW, AMS or other appropriate specification.

5.3.3 Process Identification

Items, material and processing must be identifiable to the specific process or summary of operations used. The source should use a two level identification system with one level showing the process revision for the initial process or ESA-Significant Process Changes and the second level indicating minor or ESA Non-significant Process Changes. In the absence of a two level system the supplier must demonstrate how ESA-Significant and ESA Non-significant Changes are tracked.

Suppliers must ensure that a suitable identification system is in-place throughout the supply chain that allows the recording of all changes in the History of Change, and permits the traceability of items, materials and processing to these changes.

P&WC will provide a P&WC Process Identification for all process packages submitted. The P&WC Process Identification is applied to all the ESA processes in the supply chain. The supplier must use this P&WC identification in Certificate of Compliance (C of C) for shipments of items to P&WC, in Supplier Statement of Non-conformance (SSON) or electronic Quality Notification (eQN), in the History of Change and in Requests for Process Change.

Total identification must consist of the P&WC Process Identification and the internal identification used by the producing source.

Items may be segregated and the process identification provided by separate item marking, packaging, or tagging. Process identification must be by reference to the item serial number where applicable.

5.3.3.1 Critical Parts and Critical Rotating Part Material

Critical parts and critical rotating part material, subject to ESA, must carry marking to ensure full traceability at all times during manufacture. Transfer of identification during manufacture must ensure complete traceability.

5.3.4 Freezing a Process

Suppliers must freeze the processes and summary of operations for themselves and all sub-tiers when requested to do so by P&WC. Suppliers must ensure that subsequent production by themselves or by their sub-tiers is to the frozen process.

Suppliers must ensure that no ESA-Significant Process Changes are made to the processes performed by themselves or by their sub-tiers following the freezing of the process, until written approval of the change is received from P&WC.

P&WC intends to require the freezing of a process at the time that items produced to the process are required for substantiation. The supplier should inform P&WC if he believes that the process to be frozen is not sufficiently well developed to make the process technically and commercially suitable for production use.
5.3.5 Process Submission

Suppliers must provide Process Information Packages to P&WC for all the frozen processes for themselves and their sub-tiers in the supply chain, as soon as practicable after the processes are frozen. Each part number must have an individual process, and each process must apply to only one part number; generic processes are not allowed.

5.3.5.1 Unless otherwise specified the following are operations for which process sheets do not have to be submitted for approval by P&WC Engineering.

5.3.5.1.1 Rough machining operations including machining of the sonic shape. However, changes in sequence of roughing operations and changes in location or subcontractor for any roughing operations are considered ESA-Significant Process Changes.

5.3.5.1.2 NDT processes not affecting finished machining surfaces:
  - Ultrasonic
  - Microstructure test
  - Etch prior to final machining
  - Fluorescent Penetrant Inspection (FPI)
  - Magnetic Particle Inspection (MPI)
  - Radiography
  - Alloy Type Test
  - Bond Test
  - Eddy current

5.3.5.1.3 Although process sheets are not required for the operations listed above, the position of these operations must be identified in the summary of operations, and subcontractors, if used, must be identified.

5.3.5.2 The detail requirements for a submission are contained in Appendix B.

Although the submission of key process parameters or procedures is required by this specification, the source may exclude this information from its Process Information Package submitted to P&WC due to the proprietary nature of the information only on the condition that the source identifies this information by a code or reference which can be traced back to the internal documentation of the source. This internal document must be referenced within the Process Information Package submitted to P&WC using an identifier which allows for traceability and discussion in the event of any change or discrepancy. For P&WC technical evaluation and audit purposes, P&WC personnel are required to have access to such proprietary data.

P&WC will review the Process Information Package, and if they are acceptable proceed with substantiation of the processes.

The process package must be written and submitted against the drawing level, such as a semi-finished, finished or assembly level drawing, at which ESA is applied. When permitted by P&WC Engineering, a process may be written against a higher level drawing provided the process and the process submission clearly identify the drawing level at which ESA is applied.

Separate processes must be written for different levels of manufacture when these levels have separate P&WC Engineering product definition. For example, a semi-finished machined shape with a unique identity (such as an ultrasonic inspection shape 5M3xxxxxx) made from a uniquely identified raw material (such as a forging 5F3xxxxxx) must have separate processes for the 5M and the 5F.
In the case of 'inseparable assembly drawings without detail part definition' the ESA requirements for details or sub-assemblies are identified on the inseparable assembly drawing against an item number. Process submissions must be made against the inseparable assembly number with the item numbers clearly identified in the process and the submission.

5.3.5.3 Critical Parts

Process sheets subject to ESA of critical parts must be identified as "Critical Part".

5.3.6 Substantiation

Usually substantiation is conducted by P&WC at P&WC facilities. However, in certain cases substantiation is performed by suppliers or processing sources. P&WC Purchasing will inform suppliers of any substantiation they are required to perform at the time of placing a Purchase Order.

Unless otherwise specified by P&WC all items subject to ESA-PSAR or ESA-SOR and used for substantiation must be produced to the process intended to be used for production delivery. The process must be frozen and Accepted for Substantiation prior to the start of substantiation.

5.3.7 Approval

Sources identified on the SPD/SMD that are identified as DESIGNATED and that were included in a satisfactory substantiation are changed to APPROVED. The processes and process summaries used in the substantiation are approved.

The processes continue to be 'Frozen'.

5.4 Items Subject to ESA-PSANR

All suppliers and sub-tier sources must use the ESA sources identified on the SPD or SMD for the items shown.

5.4.1 CPW 103 and CPW 154 Items

Suppliers are governed by the requirements set-out in CPW 103 and CPW 154, and the Equipment Specification produced by P&WC. For certain items subject to CPW 103 and CPW 154 the supplier is approved on the initial issue of the SPD. Designated suppliers for items subject to CPW 103 and CPW 154 are approved following satisfactory substantiation. Approved suppliers are governed by the Purchase Performance Specification (PPS) generated for the item.

5.4.2 Ingot and Conversion Sources

Ingot and conversion sources subject to ESA-PSANR must comply with the Supplier Agreement between the source and P&WC. The Supplier Agreement in effect is identified in the relevant P&WC CPW Specification, or on the appropriate raw material drawing for those materials defined by AMS Specification.

The supplier to P&WC to whom the ingot and conversion source is a sub-tier is not responsible for the processing at the source subject to ESA-PSANR beyond informing the source that the material to be provided to him is intended for P&WC use.
5.4.3 Unless otherwise specified by P&WC all materials and items subject to ESA-PSANR and used for substantiation must be identical to the materials and items intended to be used for production.

5.5 **Fulfillment of Purchase Orders**

Unless otherwise specified on the Purchase Order, only items that have been manufactured by a supply chain of approved sources for ESA items, material or processing can be shipped to P&WC or to another source in the supply chain.

With each shipment the supplier must provide the P&WC Process Identification and documentation giving the specific process and revision identification used to manufacture the items in the shipment. If items in a shipment have not all been manufactured to the same specific approved process, they must be segregated and suitably identified to the specific process used.

5.5.1 For Items, Material and Processing subject to ESA-PSAR or ESA-SOR

Suppliers must ensure that any deviation, including in-process dimensions, to a frozen or approved process by themselves or by their sub-tiers is reported to P&WC using the SSON or eQN system (see CPW 100).

Suppliers must seek approval for a change to the frozen process by the submission of a Request for Process Change and a Process Change Information Package (see below and Appendix B for details).

5.6 **Changes to an Approved or Frozen Process - ESA-PSAR and ESA-SOR**

5.6.1 All changes to the summary of operations or to individual process operations must be recorded in the History of Change relative to the original approved process. When a source incorporates an ESA Non-significant Process Change, the supplier is responsible for maintaining the integrity of the product at the level prior to the change. These ESA Non-significant Changes must be documented on the History of Change Document and be available for review by P&WC. All ESA Non-significant Process Changes must be incorporated in the next process submission.

5.6.2 ESA-Significant Process Changes or changes to the sequence of operations cannot be made to an approved or frozen process without the approval of P&WC Engineering.

To obtain approval for a proposed change the supplier must submit a Process Change Information Package as detailed in Appendix B. Except in the case of a generic change, (see 5.6.3), a full version of the process must be submitted. Typically the approval of a change requires substantiation testing, (see 5.6.4). Suppliers should discuss with the ESA Specialist the substantiation needed prior to preparing the Process Change Information Package. In the case of certain processing, there are some standard tests, (see B.3.1.1), that will be required in the substantiation. Suppliers are encouraged to provide the results of these tests with the Process Change Information Package, wherever practicable.

5.6.2.1 A change in any key process parameter is to be considered as an ESA-Significant Process Change by the source and a Process Change Information Package must be submitted. However, after review of the change, the appropriate ESA Specialist may identify the change as an ESA Non-significant Change.

Changes to other process parameters must be evaluated as to their effect on the quality, durability or performance, or on the subsequent processing of the item. If it is considered that the change is an ESA-Significant Process Change, or if there is any doubt of the effect of a change, the process change shall be submitted for approval.
5.6.2.2 A change in manufacturing location is considered an ESA-Significant Process Change. A change in location within a plant may be an ESA-Significant Process Change. Sources should seek P&WC input. A change in the name or address of a sub-tier source for any ESA operation is considered an ESA-Significant Process Change. Changing an ESA sub-tier source in the supply chain, including those sources subject to ESA-PSANR (such as raw material sources), is considered an ESA-Significant Process Change. Changing the source for any operation is considered an ESA-Significant Process Change when ESA is applied to 'Complete Manufacture'. This applies to operations that are transferred on a temporary basis, and to operations that are not subject to ESA in the summary of operations; for example, roughing operations. Changing the source for any operation is considered an ESA-Significant Process Change when the operation is part of the specific processing subject to ESA. For example, the change in the finishing source for a coating subject to ESA for application and finishing.

5.6.2.3 The process parameters identified in the approved process may be more tightly controlled than the requirements specified on the drawing or in specifications. In those cases the approved process parameter limits apply and the use of parameters outside these limits must be identified as ESA-Significant or ESA Non-significant and handled accordingly, regardless of the drawing or specification limits. When CPW or AMS Specifications make reference to "Essential Control Factors" or "Significant Process Parameters", these shall be interpreted as being "Key Process Parameters."

5.6.2.4 A Request for Process Change and a Process Change Information Package must be submitted for any ESA-Significant Process Change to an approved process, including changes resulting from a P&WC Engineering Change or request for processing change. If a source is not certain that a change is not significant it should be discussed with P&WC either by direct discussion with an ESA Specialist or through P&WC Purchasing.

5.6.3 Generic Change

The supplier must submit the list of items that the generic change applies to. All approved process revision letters affected must be listed together with the process identification. See Appendix B for instructions.

5.6.4 Approval by P&WC of a Process Change - ESA-PSAR and ESA-SOR

Upon receipt of a Process Change Information Package, P&WC will determine the substantiation testing required in order to be able to approve the proposed process change. When items are required for substantiation testing, and depending upon the nature and location of substantiation, P&WC may require re-identification by a part number change or some temporary designation, such as the application of a CIFER (Configuration Identification For Experimental Requirements) number to the existing part number.

5.6.4.1 Regardless of any P&WC directed item identification change, the supplier must ensure the segregation of all items made to a non-approved process. Upon satisfactory substantiation of the process change, P&WC will provide a new approved P&WC Process Identification and notify the supplier that the process is approved.
5.7 Changes to an Approved Item - ESA-PSANR
Requests for changes to the design of an item subject to ESA-PSANR must be addressed to the relevant P&WC Design group through P&WC Purchasing.

5.7.1 Material subject to ESA-PSANR
Changes in the source for a material subject to ESA-PSANR is managed as an ESA process change for the item utilizing the material. As an example: A forging may be subject to ESA-PSAR for forging and the material used to make the forging may be subject to ESA-PSANR. A change in the source of the material is managed as an ESA process change for the forging. Requests for change should be submitted as in 5.6.

5.8 Retention of Approval Status - General
The following conditions must be met by the supplier and all sub-tier sources for the retention of an ESA approval:

5.8.1 Consistent satisfactory business relations, including evidence of the source's compliance with the requirements of this specification and related quality control requirements.

5.8.2 Evidence of the source's ability to consistently furnish production items, materials and processing of satisfactory quality.

5.8.3 Continuing satisfactory development experience on approved items, materials and processes.

5.8.4 Maintenance by the source of the level of excellence of his facilities, skills and controls on which ESA approval was initially predicated.

5.8.5 Following the freezing of a process or approval of an item, the source must inform the P&WC Buyer of changes in the location of production, the company name, the cognizant personnel (Chief Inspector, Plant Superintendent, Responsible Engineer, Head of Laboratory, or equivalent positions), or the important organizational aspects (senior reporting relationships, ownership changes, policy changes, quality control surveillance changes or equivalent) relative to the execution or control of the work.

5.9 Continuity of Production - General
Although P&WC may have ordered production quantities prior to the granting of process approval, approval is a pre-requisite for continued production orders.

5.9.1 Inactivity
Except as indicated in section 5.9.1.1, inactivity by a source for a period of two years, or longer, in the manufacture of an item or material, or the performance of a process may be the cause for the loss of approval. The period of inactivity must be measured between the performances of the same operation (e.g. forging operation to forging operation), or in the case of ESA-PSANR items the manufacture of the completed item, and not the dates of deliveries.

The source shall obtain approval to restart the process by submitting a Process Information Package clearly stating that it is a submission due to inactivity of the part, including the actual or estimated period of inactivity, and indicating any differences between the previously approved process and the current process.
5.9.1.1 Raw Material - ESA-PSANR
In the case of a material subject to ESA-PSANR that is used in a process subject to ESA-PSAR, inactivity for a period of three years, or longer, may be the cause for the loss of approval. The period of inactivity applies to the use of the material in the process. For example, the use of ingot to make a critical rotating part forging: A gap of three years in the use of ingot from a particular approved source may require re-substantiation of the use of that ingot source in the process to make the specific forging. The process to make the specific forging from another approved ingot source is not affected.

5.10 Supplier Requirements Regarding Subcontractors - General
Each source or supplier to P&WC that receives any item, material or process requiring ESA under a P&WC Purchase Order is responsible for imposing the requirements of this specification on all subcontractors. The source or supplier must maintain a file of the process approval records for each such subcontractor.

5.11 Process Maintenance - ESA-PSAR and ESA-SOR
The source and supplier is responsible for the continued maintenance of their process and process capability, and that of any subcontractors.

5.12 Document Retention - ESA-PSAR and ESA-SOR
The source or supplier is responsible for maintaining a file of all Process Information Packages and Process Change Information Packages. This documentation must be retained for 40 years unless a longer retention period is required by other P&WC documentation.

This information must be made available for review by P&WC upon request.

6. ACKNOWLEDGEMENT
The supplier must mention this specification number and its revision letter in all quotations and when acknowledging Purchase Orders.

7. REJECTION
Unless prior written agreement has been concluded, items not approved in accordance with this specification will be subject to rejection.

8. NOTES
Procedural supplement SPS-CPW 135 is for P&WC internal use only.

The (|) symbol is used to indicate technical and major editorial changes from the previous issue of this specification.
APPENDIX A: 
KEY PROCESS PARAMETERS

A.1. KEY PROCESS PARAMETERS
The table below provides a list of key process parameters for certain processes. Some P&WC CPW Specifications for specific processing, such as CPW 32, also identify key process parameters.

A.1.1 When practical process sheets should include reasonable tolerances for parameters such as temperatures, cooling rates, dimensions, etc.

A.1.2 Tolerances must be provided for those parameters annotated with * in Table A1. Tolerances should be provided for other parameters if practicable.

A.1.3 When manual processing is used in lieu of automated processing, the key process parameters identified in Table A1 which are controlled by the numerical control programs must be included in the submitted process.

Table A1: Key Process Parameters

<table>
<thead>
<tr>
<th>Process</th>
<th>Key Process Parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>BALANCING, HIGH SPEED</td>
<td>• Balance speed* and deflection measurement location*</td>
</tr>
<tr>
<td></td>
<td>• Deflection vs. speed plot of final balance</td>
</tr>
<tr>
<td></td>
<td>• Final balance rotor deflection requirement</td>
</tr>
<tr>
<td></td>
<td>• Shaft wall thickness measurements</td>
</tr>
<tr>
<td>BALANCING, LOW SPEED</td>
<td>• Drawing of balance machine set-up showing balance planes and support positions</td>
</tr>
<tr>
<td></td>
<td>• Balancing speed*</td>
</tr>
<tr>
<td></td>
<td>• Initial unbalance limit in each plane</td>
</tr>
<tr>
<td></td>
<td>• Residual (final) unbalance limit in each plane</td>
</tr>
<tr>
<td></td>
<td>• Axial and radial runout measurement limits</td>
</tr>
<tr>
<td></td>
<td>• Machine type and manufacturer</td>
</tr>
<tr>
<td>BRAZING</td>
<td>• Surface preparation</td>
</tr>
<tr>
<td></td>
<td>• Cleaning procedure for all details</td>
</tr>
<tr>
<td></td>
<td>• Tack welding (where used)</td>
</tr>
<tr>
<td></td>
<td>• Mechanical fixturing</td>
</tr>
<tr>
<td></td>
<td>• Braze form, quantity and location</td>
</tr>
<tr>
<td></td>
<td>• Stop-off material and location</td>
</tr>
<tr>
<td></td>
<td>• Furnace load, atmosphere and cycle</td>
</tr>
<tr>
<td></td>
<td>Use the appropriate parameters from HEAT TREATMENT in this Table.</td>
</tr>
</tbody>
</table>
CASTING, SAND

- Pattern identification
- Core Fabrication: Type and size distribution of sand, binder, injection pressure, venting, etc.
- Mould Fabrication: Type and size distribution of sand, binder, ratio recycling / new sand.
- Mould preparation
  Mould assembly procedure, chill and filter location, sprue, gating and riser design and placement. Usage of mould wash. Mould venting
- Melt preparation
  Melt make-up: ingot, melt constituents, revert, etc.
  Ingot source when P&WC approved source requirement
  Melting furnace: type, size
  Crucible: type, size
  Melting atmosphere: air, controlled atmosphere*, vacuum*
  Melt treatment: fluxing, de-oxidation, degassing
- Pouring
  Atmosphere for pouring: air, controlled atmosphere*, low pressure*, vacuum*, etc.
  Mould temperature*
  Metal pouring temperature*
  Treatment during pour: additions, filtration, etc.
  Pouring time*
- Mould Treatment after Pour
  Exothermic hot-topping
  Cooling*: Ambient air cooling, additional insulation, controlled cooling
  Time until break-out*
- Cooled Mould Treatment
  Preparation for HIP process if applicable - see HIP section below
  Break-out procedure
  Application of additional identification
  Cut-off and cleaning of casting
- Heat treatment
  Atmosphere*
  Time/Temperature cycle*
  Cooling*
| CASTING, SAND (continued) | • Casting treatment  
Machining  
Pressure Testing  
Targeting  
• Plug welding procedure:  
Repair welding cycle: cleaning, welding, cleaning inspection  
Straightening procedures  
Preservation: identification and procedure  
Packaging for shipment |
| --- | --- |
| CASTING, INVESTMENT | • Injection die identification  
• Cores: type, identification  
• Injection material: type and identification  
• Injection machine identification  
• Injection procedure: core placement, fixturing, temperature*  
• Cluster design: arrangement of cavities, sprue and riser placements, chill placement and gating  
• Cluster assembly procedure  
• Investment procedure  
Identification of slurries  
Identification of coating materials  
Dip and coat procedures: manual, robotic  
Drying procedure between coats  
Drying procedure after final coat  
Injection material removal procedure  
• Mould preparation  
Pre-heat furnace identification and type  
Pre-heat procedure: time and temperature  
Back-up or support of cluster for pouring  
Insulation (wrapping)  
• Melt preparation  
Melt make-up: ingot, melt constituents, revert, etc.  
Ingot source when P&WC approved source requirement  
Melting furnace: type, size  
Crucible: type, size  
Melting atmosphere: air, controlled atmosphere*, vacuum*  
Melt treatment: fluxing, de-oxidation |
| CASTING, INVESTMENT (continued) | • Pouring  
Atmosphere for pouring: air, controlled atmosphere*, vacuum*, etc.  
Mould temperature*  
Metal pouring temperature*  
Treatment during pour: additions, filtration, etc.  
Pouring time*  
• Mould Treatment after Pour  
  Exothermic hot-topping  
  Cooling*: Ambient air cooling, additional insulation, controlled cooling (withdrawal rate)  
  Time until break-out*  
• Cooled Mould Treatment  
  Preparation for HIP process if applicable - see HIP section below  
  Break-out procedure  
  Application of additional identification  
  Cut-off and cleaning of casting  
• Heat treatment  
  Atmosphere*  
  Thermal cycle*  
  Cooling*  
• Casting treatment  
  Machining and Finishing  
  Welding required by P&WC product definition:  
  Repair welding cycle: cleaning, welding, cleaning inspection  
  Straightening procedures  
  Preservation: identification and procedure  
  Packaging for shipment  
| CASTING, Hot Isostatic Pressing (HIP) of | • Pressure, temperature, time cycle for HIP run  
• Atmosphere*  
• Heat-up rate*  
• Cooling rate* |
| COATING, THERMAL SPRAY | • Cleaning  
|                        | • Masking procedure: masking material, form and location of masking  
|                        | • Surface preparation: Grit blasting  
|                        | • Type of blasting equipment: gravity feed, direct pressure, etc.  
|                        |   Automatic or manual control  
|                        |   Material, particle / grit size  
|                        |   Fixturing  
|                        |   Pressure and time cycle  
|                        | • Thermal Spraying equipment: type, identification  
|                        |   Motion control program number, and revision letter as applicable.  
|                        |   Powder specification and source  
|                        |   Shielding gas / fuel  
|                        | • Post spraying  
|                        |   Procedure to remove masking  
|                        |   Any specified heat treatment: atmosphere, time and temperature and cooling cycle.  
|                        | • Finishing: Grinding, lapping, etc.  
|                        |   Use the appropriate parameters from MACHINING or GRINDING in this Table  

| ETCHING, per CEIM-1 | • Fixturing and electrical contact arrangement  
|                     | • Electrical Charge (Ampere-minutes), or  
|                     |   Amperage* and time*  

| ETCHING, per CEIM-3 | • Fixturing and electrical contact arrangement  
|                     | • Surface preparation (if vapour blast is used)  
|                     |   Equipment identification  
|                     |   Automatic or manual control  
|                     |   Slurry concentration  
|                     |   Type of abrasive, particle / grit size  
|                     |   Fixturing  
|                     |   Pressure* and time cycle  
|                     |   Stand-off distance*  
|                     |   Blast angle*  

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CAGE CODE 00198
EXPORT CLASSIFICATION: ECL N/A, P-ECCN 9E991
Export Classification Date:2010-12-06
### FORGING AND FORGING HEAT TREATMENT

<table>
<thead>
<tr>
<th><strong>• Billet</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ingot and conversion sources, and the Process Outline or Method of Manufacture Identity for all forgings where P&amp;W mandates an approved ingot or conversion source by specification or forging drawing requirement.</td>
</tr>
<tr>
<td>Shape and size* of forging stock</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>• Mult treatment</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Machining or grinding method (including edge preparation)</td>
</tr>
<tr>
<td>Input weight*</td>
</tr>
<tr>
<td>Coating (e.g. for oxidation protection, or lubrication), if applicable</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>• Forging pre-heat</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number, type and identification of furnaces used</td>
</tr>
<tr>
<td>Atmosphere*</td>
</tr>
<tr>
<td>Loading pattern and sequence of loading</td>
</tr>
<tr>
<td>Temperature*, or procedure for determining pre-heat temperature</td>
</tr>
<tr>
<td>Minimum and maximum times at temperature</td>
</tr>
<tr>
<td>Procedure in the event that maximum time may be exceeded due to forging disruption</td>
</tr>
<tr>
<td>Unloading sequence for forging</td>
</tr>
<tr>
<td>FORGING AND FORGING HEAT TREATMENT (continued)</td>
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<td>----------------------------------------------</td>
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</tbody>
</table>
| FORGING AND FORGING HEAT TREATMENT (continued) | Forging removal and cooling procedure: ambient air, quench, controlled gas cooling, etc.  
| | Ambient air: Forging arrangement  
| | Quench: Media, temperature*, transfer time*, and agitation, if applicable  
| | Controlled gas cooling: gas, transfer time*, forging and fan arrangement  
| | Flash removal method, process, and tooling used, if applicable  
| | **Heat Treatment**  
| | Any machining to a pre heat treat shape per 1F or 5F drawing definition  
| | Refer to HEAT TREATMENT in this Table for key process parameters  
| | **Identification**  
| | **Source used for mechanical testing of Critical Rotating Part material**  
| FORMING | **Type of forming process**: cold forming, hot forming, superplastic forming, etc.  
| | **Press type and identification**  
| | **Tool identification for die and ram, including material definition**  
| | **Blank identification**: size, shape and material  
| | **Procedure to set-up die and work piece.**  
| | **Sequence of forming and heat treatment operations**  
| | **For each forming operation**  
| | Die identification  
| | Temperature*, time*, load* and stroke* parameters  
| | Identification of lubricant and method of application  
| | **For each in-process heat treatment operation**  
| | Atmosphere*, time* and temperature* cycle and cooling operation  
| | **Final heat treatment operation:**  
| | Atmosphere, time and temperature cycle and cooling operation  

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CAGE CODE 00198

EXPORT CLASSIFICATION: ECL N/A, P-ECCN 9E991

Export Classification Date: 2010-12-06
| HEAT TREATMENT | • Heat Treatment  
Furnace identity  
Item loading scheme / instructions  
Atmosphere*  
Thermal cycle*  
Load thermocouple arrangement  
Cooling procedure:  
  Cooling rate limits  
  Ambient air (for critical parts only): item arrangement  
  Controlled gas cooling (for critical parts only): gas, item and fan arrangement, transfer times*  
  Quench: Quench delay*, media, temperature*, agitation |
| LASER DRILLING | • Machine Identification  
• Fixture Identification  
• Nozzle Identification (which is aimed to control aperture type and orifice size)  
• Lens Identification (which is aimed to control focal length and focal point position)  
• Part Probing Method  
• Deburring Method, if applicable  
• Process Type (e.g., Percussion, Trepanning)  
• Laser Type  
• Laser numerical control program number and revision as applicable, which is aimed to control:  
  Pulse Energy  
  Pulse Frequency / Repetition Rate  
  Pulse Width  
  Number of Shots / Pulses  
  Pulse ON/OFF time (i.e., delay time between pulses)  
  Beam Size Diameter  
  Assist Gas (Type and Pressure)  
  Drilling Angle  
  Position of focal point to work surface*  
  Stand-off distance* (nozzle to part distance)  
• Drilling Angle Inspection Methodology |
| MACHINING | • Numerical control program number and revision as applicable (which is aimed to control feed, speed, depth of cut and tool path)  
• Speed and feed range  
• Type of machine (turning, milling, etc.)  
• Machine identification  
• Fixture identification  
• Tool holder identification  
• Machining tool (which is aimed to control tool size, geometry, grade and coating)  
• Cutting fluid / Coolant  
• Parts per Grind - ppg. Different methodologies for tool changes must be agreed with P&WC Engineering and defined in the applicable process sheets.  
• Inspection Methodology  

   Tooth bearing photograph file number for items that require CPW 370 |
| MACHINING, DEBURRING | • Numerical control program number and revision as applicable (which is aimed to control feed, speed, depth of cut and tool path)  
• Tool Identification (which is aimed to control media type, size, hardness, and grit) if applicable  
• Machining tool (which is aimed to control tool size, geometry, grade and coating) if applicable |
| MACHINING, GRINDING | • Numerical control program number and revision as applicable (which is aimed to control item speed & direction, grinding wheel speed & direction, dwell time, and feed)  
• Speed and feed range  
• Machine Identification  
• Fixture Identification  
• Grinding Wheel Identification (which is aimed to control abrasive type, grade and size, and bonding agent)  
• Grinding Wheel Dressing Interval  
• Cutting fluid / Coolant  
• Inspection Methodology |
| MACHINING, HONING                           | • Feed rate* (which is aimed to control stroke rate & stroke length)  
|                                           | • Rotative speed*  
|                                           | • Material Removal Amount  
|                                           | • Machine Identification  
|                                           | • Fixture Identification  
|                                           | • Tool Identification (which is aimed to control abrasive type, grade and size, and bonding agent)  
|                                           | • Cutting fluid / Coolant or compound  
|                                           | • Inspection Methodology  

| METAL INJECTION MOULDING (MIM)            | • Raw Material Control  
|                                           |   Metal powder concentration* (solid loading) in feedstock mix  
|                                           |   Binder product(s) and concentration(s)* in feedstock mix  
|                                           |   Minimum mixing time  
|                                           |   Mixing temperature*  
|                                           |   Feedstock shelf life  
|                                           |   Maximum number of heating cycles for recycled feedstock  
|                                           |   Maximum total heating time for recycled feedstock  
|                                           | • Injection Process  
|                                           |   Press Identification  
|                                           |   Mould Identification  
|                                           |   Injection Temperature*  
|                                           |   Mould Temperature*  
|                                           |   Injection Pressure*  
|                                           | • Debinding Process  
|                                           |   Type of debinding process (e.g., solvent, thermal, wicking)  
|                                           |   Furnace identification  
|                                           |   Debinder media (type of solvent or powder, and composition*)  
|                                           |   Atmosphere & Pressure*, if applicable  
|                                           |   Gas flow*, if applicable  
|                                           |   Thermal cycle (temperature* & time*), if applicable  
|                                           |   Post debinding cleaning method  
|                                           | • Sintering Process  
|                                           |   Furnace Identification  
|                                           |   Thermal cycle (time*, temperature*)  
|                                           |   Atmosphere* & Pressure*  
|                                           |   Gas flow*  

THE INFORMATION CONTAINED ON THIS PAGE IS SUBJECT TO THE NOTICE SET FORTH ON THE TITLE PAGE.
<table>
<thead>
<tr>
<th>METAL INJECTION MOULDING (MIM) (continued)</th>
<th>POLYMER INJECTION MOULDING</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Hot Isostatic Pressing</td>
<td>• Thermal / heating control method for the feed, barrel, mould, tool</td>
</tr>
<tr>
<td>Atmosphere*</td>
<td>• Clamping pressure, screw speed</td>
</tr>
<tr>
<td>Pressure*</td>
<td>• Set-up procedure</td>
</tr>
<tr>
<td>Thermal cycle (time*, temperature*)</td>
<td>• Injection pressure, temperature and speed</td>
</tr>
<tr>
<td>Heat-up rate*</td>
<td>• Mould temperature</td>
</tr>
<tr>
<td>Cooling rate*</td>
<td>• Holding time and pressure</td>
</tr>
<tr>
<td>• In-Process Joining</td>
<td>• Ejection method</td>
</tr>
<tr>
<td>Joining method</td>
<td>• Final heat treatment operation:</td>
</tr>
<tr>
<td></td>
<td>Atmosphere, time and temperature cycle and cooling operation</td>
</tr>
<tr>
<td></td>
<td>• Mould identification number</td>
</tr>
<tr>
<td></td>
<td>• Molding Machine specifications</td>
</tr>
<tr>
<td></td>
<td>Type of machine (hydraulic of electric), tonnage and identification</td>
</tr>
<tr>
<td></td>
<td>Screw diameter</td>
</tr>
<tr>
<td></td>
<td>L/D screw ratio</td>
</tr>
<tr>
<td></td>
<td>Stroke/D ratio</td>
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<tr>
<td></td>
<td>Stroke volume</td>
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<tr>
<td></td>
<td>Injection rate</td>
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<tr>
<td></td>
<td>Intensification ratio</td>
</tr>
<tr>
<td></td>
<td>Barrel capacity</td>
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<tr>
<td></td>
<td>Press maximum injection pressure</td>
</tr>
<tr>
<td></td>
<td>Nozzle orifice type and diameter</td>
</tr>
</tbody>
</table>

THE INFORMATION CONTAINED ON THIS PAGE IS SUBJECT TO THE NOTICE SET FORTH ON THE TITLE PAGE.
<table>
<thead>
<tr>
<th>POLYMER INJECTION MOULDING (continued)</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>• Temperature control*</td>
<td></td>
</tr>
<tr>
<td>Material drying temperature</td>
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<tr>
<td>Drying time / Dew point</td>
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<tr>
<td>Hopper temperature</td>
<td></td>
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<tr>
<td>Temperature for all zone, nozzle to rear</td>
<td></td>
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<tr>
<td>Melt temperature</td>
<td></td>
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<tr>
<td>Hot sprue temperature</td>
<td></td>
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<tr>
<td>Coolant temperature for each cooler</td>
<td></td>
</tr>
<tr>
<td>Mold surface temperature (core &amp; cavity)</td>
<td></td>
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<tr>
<td>• Force and Pressure*</td>
<td></td>
</tr>
<tr>
<td>Clamp tonnage</td>
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<tr>
<td>Peak hydraulic pressure</td>
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<tr>
<td>Nozzle pressure</td>
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<tr>
<td>Pack pressure</td>
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<tr>
<td>Hold pressure</td>
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<tr>
<td>Back pressure</td>
<td></td>
</tr>
<tr>
<td>Cavity pressure (if mold equipped)</td>
<td></td>
</tr>
<tr>
<td>• Speed / Time / Position*</td>
<td></td>
</tr>
<tr>
<td>Screw rotation speed (rpm)</td>
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<tr>
<td>Injection speed (in/sec)</td>
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<tr>
<td>Switchover position (mm)</td>
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<tr>
<td>Injection time</td>
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<td>Pack time</td>
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<tr>
<td>Hold time</td>
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<tr>
<td>Cooling time</td>
<td></td>
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<tr>
<td>Mold open time</td>
<td></td>
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<tr>
<td>Overall cycle time</td>
<td></td>
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<tr>
<td>Shot length (mm)</td>
<td></td>
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<tr>
<td>Transfer position (mm)</td>
<td></td>
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<tr>
<td>Cushion (mm)</td>
<td></td>
</tr>
</tbody>
</table>
### POLYMER INJECTION MOULDING (continued)

- Drying Conditions / Parameters and Final Moisture Content per Production Run
- Flash removal method, process, tooling used
- Fixtures
- Post-Heat Treatment
  
  Refer to HEAT TREATMENT in this Table for key process parameters.

Injection parameters (equipment information, injection temperature, mould temperature, pressure)

- Set Temperature
- Actual Temperature
- Moisture Content
- Post-Moulding Polishing Technique (type of media, grit size, technique)

- Destructive testing / cross-sectioning plan for Porosity and Void determination

### WELDING, FUSION (AUTOMATIC)

- Machine identification - type and model number
- Electrode: material, size and form
- Type of welding control
- Preparation of pieces to be welded: cleaning, mechanical abrasion
- Filler metal - material, form, feed rate, feed mechanism
- Composition* of shielding and back-up gas
- Fixturing
- Settings - voltage, amperage, weld speed
- Post weld finishing operations, for example rolling or burnishing

### WELDING, FUSION (MANUAL)

- Welding method: TIG, MIG, etc.
- Preparation of pieces to be welded: cleaning, mechanical abrasion
- TIG electrode identification
- Filler metal: material and form
APPENDIX B:
SUBMISSION OF ESA INFORMATION PACKAGES

Questions regarding these instructions should be addressed to the P&WC Buyer or to the P&WC ESA Specialist for the appropriate manufacturing process. The P&WC Buyer can identify the appropriate ESA Specialist for external sources.

This appendix deals with the submission of information packages for ESA-PSAR and ESA-SOR, and for both initial approval and for requests for change to a process or identity of the source. ESA-PSANR is not included in this appendix because no ESA submissions are required.

B.1. GENERAL
The definitions in section 3 of the specification apply.

B.1.1 Submissions
Submissions are required for ESA-PSAR and ESA-SOR. A submission for ESA-PSAR must also include a submission of the summary of operations for the processing.

B.1.2 Language
All submission must be made in English or French. A translation (in English or French) must be included for any documents contained in the submission that are written in any other language.

B.1.3 Units
All process information must be presented using Imperial (British) or US customary (inch-pound) units as prime. SI (metric) units should be included in parentheses if these are the operating units of the source. In the case of liquid volume the use of Imperial (4.546 litre) or US gallon (3.785 litre) must be clearly identified.

B.1.4 Identification of Product
Unless otherwise specified by P&WC Engineering each page of a submission must identify by P&WC part number and part revision letter of the item to which the submission applies. When there is also a source's item identification, the source's part number and revision level must also be shown.

B.1.5 Identification of Source
All submissions must clearly identify the source of manufacture for the item, material or processing operation, including:

- The legal name of the source.
- The address at which production is performed.
- The vendor code must be used in place of the name and address when a vendor code is used on the SPD/SMD.

The name and address of the source (or vendor code) in the submission must be identical to those shown on the SPD/SMD. Any errors found on the SPD/SMD must be reported to the P&WC Buyer for correction.
B.1.6 Process Identification
Each page of a submission must show the source’s process identification.
P&WC prefers that a two-level identity system is used: the first level indicating an initial process or an ESA-Significant Process Change revision; the second level indicating an ESA Non-significant Process Change revision. Example: Process P2.3, which would be the third minor change to the process that is in its second major revision. In the absence of a two-level identity system, sources must explain to P&WC Engineering in writing how ESA-Significant and ESA Non-significant Process Changes are identified in their identification system.

B.1.7 Boundaries of the process
The submission must identify the input to the process and the product of the process.

B.1.7.1 Input to the process:
Items or material used as the starting point for processing subject to ESA. For complete manufacture this is normally a bar stock or a P&WC raw material definition, such as a 5M (ultrasonic shape for forging) or a casting definition. For individual processes such as coating or peening, the input material for the sub-tier is defined in the process and summary of operations of the source for which the sub-tier is working, and recorded in the sub-tier's process.

B.1.7.2 Output from the process:
When ESA applies to 'Complete Manufacture' the output is normally a finished item as defined by a P&WC drawing. For individual processes such as coating or peening, performed by a sub-tier, the output is defined by the source for which the sub-tier is working.

B.1.8 Critical Part
Ensure that each operation sheet for the processing of a critical part carries the notation 'CRITICAL PART'.

B.1.9 ENSIP Critical Part
Submissions for ENSIP Critical Parts must ensure that the specific requirements for ENSIP parts are satisfied, reference 5.1.

B.1.10 Page Numbering
Except for numbered operation sheets, each page in a submission must be numbered sequentially.

B.2 CONTENT OF THE SUBMISSION

B.2.1 ESA-SOR
In the submission:
• Identify the starting point of the process subject to ESA.
• Identify the finishing point of the process subject to ESA.
• Identify all the operations that are part of the process subject to ESA and indicate those operations that require submission.
• Identify the sequence in which operations occur - identify the operation by name and number, and identify the location at which the operation is performed.
• Identify all sub-tier sources used by name and location at the appropriate operation.

THE INFORMATION CONTAINED ON THIS PAGE IS SUBJECT TO THE NOTICE SET FORTH ON THE TITLE PAGE.
• Identify any operations that may be performed 'out-of-sequence'.
• Identify any alternative operations.
• Provide a History of Change for the summary of operations.

Note: P&WC discourages the use of 'out-of-sequence' and 'alternative' operations, and may have to extend substantiation in order to validate all possible sequences and alternatives.

B.2.2 ESA-PSAR

There are two parts to the submission: a summary of operations and the detailed process sheets (operation sheets).

B.2.2.1 Summary of Operations

Provide a summary of operations as in B.2.1, and identify in the sequence of operations those operations that are subject to ESA-PSAR.

B.2.2.2 Process Sheets

Process sheets are the Manufacturing Operation Sheets, unless otherwise agreed with the ESA Specialist. They detail how an item is produced (Complete Manufacture) or how a specific process or group of processes are performed.

B.2.2.3 Operations Subject to ESA/PSAR

Generally all operations of a process subject to ESA/PSAR must be covered by a process sheet in the ESA submission. However, certain operations do not require an operation sheet to be submitted: these operations are identified in paragraph 5.3.5.1. However, the summary of operations must include these operations (flagged as ESA-No) and the sources for performing them.

The operations include those such as non-destructive testing when the method of testing does not affect the dimensions or properties of the item or material. For example - Fluorescent Penetrant Inspection (FPI) is not normally subject to ESA/PSAR, while an etch inspection normally is. The sources for operations not subject to ESA/PSAR may require the use of an Approved or Qualified Source - for example FPI must be performed by a source approved by the NDT Technology group of P&WC.

B.2.2.3.1 Process Detail Required

The product of all manufacturing subject to ESA-PSAR is tested to demonstrate that it performs as intended (substantiation). This substantiation is over and above verifying compliance to drawing and specification requirements, such as dimensions or hardness. The approval of a process is intended to provide a substantiated manufacturing method that will continue to provide items and material that, if tested, would satisfy all the substantiation requirements.

The amount of detail provided to P&WC must be such that the source could, at some future date, perform the manufacture using only the submitted process and referenced procedures. That is, successful manufacture should not depend upon non-referenced procedures, notes or memos, or upon operator memory of the 'actual process'.

The process submitted must be an accurate record of the process used to make substantiation items or material. Normally all the details contained on the shop floor operation sheets should form part of the submission, unless otherwise agreed with the appropriate ESA Specialist.
The source’s internal procedures can be referenced in the process. These procedures must be viewable by P&WC during visits to the source’s facility if they are not included in the process submission.

In the submission:

• Provide a process sheet for each operation, unless otherwise agreed with P&WC Engineering that a number of operations can be identified on one sheet.

• Identify the process by the source’s process identity.

• Identify the date of the operation sheet.

• Identify the department, group, or sub-tier performing the operation.

• Include the operation sheets for processing performed by a sub-tier.

• Identify the applicable key parameters from those listed in CPW 135 Appendix A for the specific process and the key process parameters listed in the relevant CPW or AMS Specification.

• Identify any other parameters the source believes are necessary to fully define the process.

• When practicable, identify the working tolerances for all parameters.

• In some cases P&WC Engineering will agree to the use of different pieces of the same or similar equipment as alternatives; identify all optional equipment or tools that may be used in the operation.

Additional detail may be required to ensure that a process audit can demonstrate that the manufacture is in accordance with the written process, and that future changes to the process can be easily and accurately described and documented with reference to the frozen or approved process.

B.3. SUBMISSION FOR REQUEST FOR CHANGE

B.3.1 Process Change for ESA-PSAR or ESA-SOR

Typically a submission is made because a source wants to make an ESA-Significant Process Change that will improve the process or result in a cost saving in the frozen or approved process. Sometimes an ESA-Significant Process Change to the process is made necessary by a change in the P&WC product definition (drawing or specification). In all cases a change to a frozen or approved process cannot be incorporated before written approval is obtained from P&WC Engineering.

NOTE: The approved status of a source on the SPD/SMD is not changed due to a request for process or summary change. Consequently, the SPD/SMD provides no indication of when a request for change has been approved or when it can be incorporated.

While process changes may be necessary to improve process viability and process cost, the source should appreciate that some requests may not be approved. Changes cannot normally be approved without substantiation, and some substantiation may be too expensive or difficult to perform. For example, some substantiation requires engine testing: there may be no suitable engine available at P&WC. Similarities to other approved processes and changes will be taken into account by P&WC, and the source should provide such relevant information.

Suppliers, who want to make a submission to obtain a revised approval for a process that consolidates a number of ESA-Significant Process Changes, should first discuss the matter with either the P&WC Buyer or the P&WC ESA Specialist.
The supplier must submit a Request for Process Change including a revised process or summary as detailed in B.2.1 and B.2.2.

B.3.1.1 Request for Process Change

The request must clearly indicate the nature and reasons for the proposed ESA-Significant Process Change, and the supplier must also identify to the P&WC Buyer the effects of the proposed change upon the delivery and cost of the item. In the case of a P&WC initiated change, the supplier should also identify the consequences of the P&WC change on the process.

In the case of changes that the source cannot avoid, such as a sub-tier stopping operation, or equipment becoming obsolete, the source must provide as much advanced notice of the change as possible, so that P&WC and the source can take appropriate action to safe-guard delivery until the change is approved.

In the Process Change Information Package:

- Include a revised process and summary submission as appropriate.
- Identify the nature of the change.
- Identify the reason for the change.
- Identify the consequences of the change.
- Provide the History of Change.
- Provide the results of any testing on the product of the process development program and the testing identified in B.3.1.1.

B.3.1.1.1 Certain processing requires standard substantiation test. Some of these tests are identified below, while others can be identified by the ESA Specialist prior to the submission of the Process Change Information Package. If practicable the results of these tests should be included in the Information Package.

- A saturation curve for a peening process change.
- A grain flow photograph for a forging process change in comparison with a grain flow photograph for the approved process.
- Strain rate profiles for a computer controlled forging process change in comparison with the strain rate profiles of the approved process.
- Testing required by P&WC Process Control Specifications, such as CPW 906.

B.3.1.1.2 Generic Changes

A generic change applies the same change to the approved processes for a number of items. Non-approved processes or processes containing designated sources are not permitted as part of a generic change.

In addition to the information required by B.3.1.1, a request for a generic change must include the list of item part numbers and revision letters to which the change is intended to apply. For each part number, the supplier shall indicate the currently approved supplier identity, the current P&WC Process Identification, and the revised supplier process identity.

Only the affected operations for one part number, which will act as the master part number for all the items affected by the change, are to be submitted in the Process Change Information Package. The first part number in the submitted list of item part numbers mentioned above is to be the master part number.

The submission of the History of Change required by B.3.1.1 is waived for generic changes, however the History of Change for each part number included in the generic change must be
updated to reflect the changes of the generic change submission and be submitted in the next individual process change submission.