



161 Thorn Hill Road  
Warrendale, PA 15086-7527

## Program Document CPBOK

PD 6103

CPBoK-001/OP-1 REV. (N/A)

Issued 20-DEC-13

Revised: N/A

Superseding N/A

### BODY OF KNOWLEDGE:

**ROLE DESCRIPTION:** ETCH OPERATOR  
**SPECIAL PROCESS:** Chemical Processing  
**SCOPE:** Etch  
**METHOD:** Nital, Temper, Blue Etch Anodize, Anodic Etching, Macrostructure, Pre-Penetrant  
**LEVEL:** Operator

All eQualified examinations are created using the applicable eQualified Body of Knowledge (BoK), which defines the baseline knowledge and experience required to be considered competent to perform the specified job role in aerospace special process manufacturing.

All eQualified BoKs are created by subject matter experts through an exhaustive job analysis process as detailed in the eQualified Program Document 6100: Industry Managed Special Process Bodies of Knowledge. All eQualified BoKs are updated periodically according to the requirements of the current eQualified PD6100 document to ensure they are consistent with current industry practice.

**Editorial change made to formatting and to add sequencing on 11-Nov-14**

## 1. INTRODUCTION

This document has been created by the eQualified Chemical Processing Body of Knowledge Review Board (CP BoKRB) according to the requirements of eQualified Program Document PD6100 Industry Managed Special Process Bodies of Knowledge.

This document constitutes the eQualified BoK for Chemical Processing Etch / Nital Etch, Temper Etch, Blue Etch Anodize, Macrostructure and Pre-Penetrant Etch, Operator. It defines the baseline knowledge and experience required to be considered competent to perform this role.

Unless otherwise stated, the CP BoKRB has followed guidelines as detailed in the current version of IAQG Guidance PCAP 001 (Competence Management Guideline) to develop this BoK.

The information in this BoK will provide guidance for the following:

- Training providers who wish to develop training courses intended to support eQualified examination candidate preparation
- Chemical Processing Examination Review Board (SP-ERB) for the development of eQualified examinations
- Candidates taking eQualified examinations who wish to prepare in advance

PRI operating procedures provide that "This report is published by PRI to advance the state of technical, engineering, and quality sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising there from, is the sole responsibility of the user."

PRI values your input. To provide feedback on this document, please contact us at [eQualified@sae.org](mailto:eQualified@sae.org).  
Copyright 2012 Performance Review Institute. All rights reserved.

---

## 2. REFERENCES

eQuaLified documents:

PD6000	Governance & Administration of eQuaLified Program
PD6100	Industry Managed Special Process Bodies of Knowledge
PD6200	Industry Managed Special Process Examinations System

IAQG documents:

IAQG Guidance PCAP 001 Competence Management Guideline

## 3. DEFINITIONS

**Definitions described within are specific to the Special Process BoK. For program-specific definitions, please refer to either the PD 6000 or the eQuaLified Dictionary.**

**BODY OF KNOWLEDGE (BoK):** Baseline knowledge and experience required to be considered competent for a target position.

**GENERAL EXAMINATION:** The General Examination is designed to ascertain the candidate's general knowledge required for a particular job, role or activity. All of the questions will be derived from the corresponding BoK.

**EXPERIENCE:** The accumulation of knowledge or skill that results from direct participation in events or activities over a period of time.

**KNOWLEDGE:** Information / understanding acquired over a period of time. Information acquired through study and retained over that period of time (education, training, experience etc.) The combination of data and information, to which is added expert opinion, skills and experience, to result in a valuable asset which can be used to aid decision making and problem solving.

**LEVEL:** A class or division of a group based on education, training and experience. There are 3 levels: Operator, Planner and Owner. Please refer to the current version of PD 6000 for definitions

**METHOD:** A well-defined division of a SPECIAL PROCESS widely recognised by industry. A specific area of a special process for example anodizing within Chemical Processing

**NON-SPECIAL PROCESS RELATED REQUIREMENTS:** Miscellaneous requirements such as Health and Safety, Environmental, etc.

**PERSONAL ATTRIBUTES:** A quality or characteristic expected and required for a particular job, role or activity.

**PRACTICAL EXAMINATION:** The Practical Examination shall consist of a demonstration of proficiency in performing tasks that are typical of those to be accomplished in the performance of the candidate's duties. The examination content is derived from the corresponding BoK.

**SKILL:** Ability to perform a particular task. The quality of being able to do something that is acquired or developed through training or experience.

**SPECIFIC EXAMINATION:** The Specific Examination shall cover requirements and use of the specifications, codes, equipment, operating procedures and test techniques the candidate may use in the performance of his/her duties with the employer. Examination content will be derived from the corresponding BoK where applicable.

**WEIGHTING:** The "weighting" of each line item, using a scale of 1, 3, 7, 10, (1 being least important; 10 being most important) indicates the relative importance of that aspect of the BoK and will determine the likelihood and frequency of a question on that topic appearing in the examination

#### 4. GUIDANCE TO EXAMINATION CANDIDATES

All eQualified examination candidates are recommended to read all documents referenced in section 2 of this document.

As stated in eQualified PD6200, every eQualified exam question shall relate directly to and be derived from the information as detailed in the current version of the BoK.

Re-assessment to this BoK is required every 5 years, unless otherwise specified.

**NOTE:** Industry Standards require various intervals of reassessment (3-5 years)

- Per MIL-STD-867C re-cert shall not exceed 3 years
- Physical tests (eye exam) are required annually
- However ARP1923 states at qualification and each year thereafter, inspection personnel shall pass physical, written and practical examinations.

Candidates are therefore advised to ensure familiarity with all aspects of the BoK as detailed in Table 1. This can be done through:

- Self-study
- Completion of internal training
- Completion of external training (a list of eQualified approved providers can be found at [www.eQualified.com](http://www.eQualified.com))

Records of all qualified personnel (per MIL-STD-867C) shall be maintained and include:

- Date of qualification
- Results of Physical (as required)
- Results of Written
- Results of Practical
- Results of Experience

5. LEVELS

	Level		
Descriptors	<b>Operator (OP)</b> <i>Understand and perform the hands-on operations of the special process for which qualification is sought.</i>	<b>Planner (PL)</b> <i>Capable of selecting manufacturing processes and interpreting process procedures to conform to customer specification and requirements.</i>  <i>Capable of problem solving and resolving day to day issues.</i>	<b>Owner (OW)</b> <i>Capable of writing, reviewing and approving processes, procedures and qualifications of Operators and Planners. Capable of designing new processes and resolving issues among other levels.</i>
Etch Operator Specific Criteria	<b>See Definition Above</b>	<b>See Definition Above</b>	<b>See Definition Above</b>
Technical Knowledge	Basic knowledge of the special process, its main processes, methods and tools.	Good level of knowledge in all aspects of the special process, all its processes, methods and tools.  Ability to coach others on contents and methods in the context of their workplace.	High or extensive knowledge in all aspects of the special process, all its processes, methods and tools to assess and validate improvements.  Able to contribute to set externally recognized standards.  Ability to define contents and methods for using knowledge effectively in influencing and developing international processes. Ability to influence the process with ones knowledge.
Experience	Sufficient experience to deal with recurrent activity.	Has enough experience to deal with unforeseen issues.	Wide proven experience of the subject. Is recognized specialist within the special process.
Personal Attributes	Takes into consideration behavioral characteristics such as but not limited to: team working, communication, direction and purpose, innovation and problem solving, mutual trust and respect, confidentiality and trustworthiness.		
Skills	Describes the activities necessary to perform each level of job function to comply with the Body of Knowledge		
Non-Special Process Related Requirements	Health & Safety, Environmental, Quality System Requirements.		

**Special Process Bodies of Knowledge Review Boards must complete Table 1 to form the BoK**

**TABLE 1**

**ROLE DESCRIPTION: ETCH OPERATOR**

**SPECIAL PROCESS: CHEMICAL PROCESSING**

**SCOPE / METHOD: ETCH / Nital, Temper, Blue Etch Anodize, Local Swat Etch, Macrostructure, Pre-Penetrant**

**REFERENCE GUIDELINES: Addendum 1 is a list of the International Standards applicable to Etch and Etch Inspection**

Row #	COMPETENCE	Level (e.g. OP, PL, OW, T1)	Weight (1,3,7,10)	Exam Type Gen/Specific /Practical	Reference Guidelines
1	<b>KNOWLEDGE:</b> The basic knowledge of the special processes, methods and tools				
2	<b>GENERAL KNOWLEDGE:</b>				
3	Understand how to perform the inspection necessary to detect any damage that may have been caused	OP	10	GEN	General Industry
4	Full and complete understanding of Internal Work Instructions	OP	10	GEN	General Industry
5	Knowledge how to access customer specifications and requirements (i.e. where to find them).	OP	7	GEN	General Industry
6	Knowledge and understanding of the Accept/Reject Criteria	OP	3	GEN	General Industry
7	Knowledge of Surface Preparation procedures	OP	10	GEN	
8	Knowledge and Understanding of the Post Bake Requirements and other Post Inspection operation/procedures	OP	10	GEN	MIL-STD-867
9	Water Break Free Cleanliness Verification	OP	10	GEN	Addendum 1 List of Standards
10	Knowledge and understanding in mathematics, including decimals and fractions	OP	3	GEN	General Industry
11	Use of precision measuring instruments and equipment.	OP	7	GEN	General Industry
12	Knowledge and Understanding of Job Documentation including Fixed / Frozen Process	OP	10	GEN	AS9100, AC7108/2 3.1, 3.1.1, General Industry
13	Knowledge and Understanding of proper chemistry usage and application	OP	7	GEN	AC7108/2
14	Knowledge and Understanding of the General Cleaning, Mechanical Cleaning and Chemical Cleaning prior to Etching	OP	7	GEN	
15	Knowledge and Understanding of Etch Rate and Stock Removals	OP	7	GEN	AC7108/2 4.16 & 4.17
16	Knowledge and Understanding of Local Etch Stock Solutions and correct chemistry application	OP	7	GEN	AC7108/2 4.16 & 4.17
17	Knowledge and Understanding of Laboratory Procedures	OP	1	GEN	AC7108/2
18	Knowledge and Understanding of Analytical requirements & limits	OP	1	GEN	
19	Understand the need for pre-process checks (such as calibration status, temperatures & light levels)	OP	7	GEN	
20	Understanding of Racking and part set-up	OP	10	GEN	
21	Thorough understanding of the appropriate etch process	OP	7	GEN	
22				GEN	
23	<b>NITAL AND TEMPER ETCH:</b>			GEN	
24	Understanding the effects of heat being applied to metal during the cutting, grinding and forming	OP	3	GEN	General Industry
25	Temper Etch Inspection is used for inspection of Low Alloy Steels (Group A), Tool Steels (Group B), Limited Access or Swab Etch, Ammonium Persulfate Swat Etch	OP	7	GEN	MIL-STD-867
26	Understand the importance of proper equipment set-up and use	OP	7	GEN	MIL-STD-867 / AMS 2649
27	Understand the use and control of known defect samples	OP	7	GEN	MIL-STD-867 / AMS 2649
28	Understand surface preparation techniques and requirements	OP	10	GEN	General Industry
29	Understand process requirements	OP	10	GEN	General Industry
30	Understand post process requirements	OP	10	GEN	General Industry
31	Understand Local Swat Etch Process	OP	7	GEN	General Industry
32				GEN	
33	<b>BLUE ETCH ANODIZE AND ANODIC ETCHING:</b>			GEN	
34	Accept / Reject Criteria – Uniform color and appearance, segregation, laps, folds, cracks, inclusions, arc outs, pitted areas, inconclusive macrostructure, microstructure evaluation	OP	3	GEN	SAE AMS 2642

35	Thorough understanding of the Blue Etch Anodize or Anodic Etch processes used	OP	10	GEN	SAE AMS 2642
36	Acid salt immersion time and required stock removal	OP	7	GEN	SAE AMS 2642
37	Anodize rectifier parameters: voltage, amperage, time, ramp rate	OP	7	GEN	SAE AMS 2642
38	Thorough understanding of the significance of rack construction and size, location and cleanliness of contact points	OP	10	GEN	SAE AMS 2642
39	Back strip immersion time and acceptable color range	OP	10	GEN	SAE AMS 2642
40				GEN	
41	<b>MACROSTRUCTURE ETCH:</b>			GEN	
42	Accept / Reject Criteria	OP	3	GEN	General Industry
43	Thorough understanding of the Macrostructure Etch process	OP	7	GEN	General Industry
44	Wet inspection and temporary marking	OP	3	GEN	General Industry
45	Rinsing restrictions after etching and before desmutting	OP	7	GEN	General Industry
46	Understand Local Swab Etch Process	OP	7	GEN	General Industry
47				GEN	
48	<b>PRE-PENETRANT ETCH:</b>			GEN	
49	Determine an acceptable etch.is presented to NDT	OP	10	GEN	General Industry
50	Understand Qualified Materials for etch process	OP	7	GEN	General Industry
51	Thorough understanding of the Pre-Penetrant Etch process.	OP	7	GEN	ASTM E 1417
52	Understands the effects of the etch processes	OP	7	GEN	General Industry
53	Understands visual appearance results of the etch process	OP	7	GEN	General Industry
54	Understands proper handling of solutions and parts	OP	7	GEN	General Industry
55	Understand Local Swab Etch Process	OP	7	GEN	General Industry
1	<b>SKILLS:</b> Defined within these rolls describes the range of skills. The skills required to perform a particular special process task			GEN	
2	<b>READ AND UNDERSTAND WRITTEN INSTRUCTIONS:</b>	OP	3	GEN	General Industry
3	Ability to understand specification requirements and customer flow-down requirements	OP	3	GEN	General Industry / AC7108/2
4	Apply Inspection Techniques appropriately	OP	10	GEN	General Industry
5	Verify and validate the accuracy of the results	OP	10	GEN	General Industry
6	Properly document nonconformance's	OP	7	GEN	General Industry
7	Apply technical knowledge in a skillful way in solving problems	OP	7	GEN	General Industry
8	Familiar with the scope and limitations of the method.	OP	7	GEN	General Industry
9	Use appropriate equipment for inspection of process	OP	7	GEN	General Industry
10	Ability to follow instructions	OP	10	GEN	General Industry
11	Interpretation of an acceptable etch process	OP	3	GEN	General Industry
12	Must able to Interpret an acceptable etch process	OP	7	GEN	General Industry
13	Must be able to set up operations (equipment, levels, timer and temperature) including alternate procedures as appropriate	OP	10	GEN	General Industry
14	Must be able to understand and interpret shop traveler	OP	10	GEN	AC7108/2
15	Mass Loss	OP	7	GEN	
1	<b>Sequencing</b>				
2	Has an appropriate understanding of where this process falls in the sequence of events.	OP	10	GEN	
1	<b>PERSONAL ATTRIBUTES:</b> Are statements that will enable judgment of the person's personal attributes				
2	Must be able to work independently with minimum supervision	OP			
3	Have a high degree of integrity	OP			
4	Attentive to details	OP			
5	Flexibility	OP			
6	Stress Tolerance	OP			
7	Conflict Resolution	OP			
8	Decision making	OP			
9	Team Work	OP			
10	Ethical Behavior	OP			
1	<b>EXPERIENCE:</b> Are the minimum experience requirement expected to demonstrate their competence.				
2	<b>EDUCATION:</b>				
3	16 hours of classroom training, as applicable	OP			NAS410
4	High School Diploma or GED	OP			
5	Apprenticeship	OP			
6	Secondary Education	OP			
7		OP			
8	<b>TRAINING / HANDS-ON EXPERIENCE:</b>	OP			
9	Complete on the job training (Minimum # of hours required) Level 1 (trainee) PT/MT 130 hours RT/UT/ET – 400 hours	OP			NAS410
10	Experience or Basic understanding of the potential hazards / damage that the process can cause to parts	OP			General Industry

11	Training must include Practical Examination according to Industry requirements	OP			NAS410
12	Temper Etch Inspection personnel shall pass a physical, written and practical test.	OP			MIL-STD-867C & ARP1923
13	Pre-Penetrant Etch (Level 1) Formal Training 16 hrs.	OP			NAS410
14	Pre-Penetrant Etch (Level 1) Experience 130 hrs	OP			NAS410
15	Trained and certified in accordance with ARP 1923 (or equivalent)	OP			
1	<b>NON-SPECIAL PROCESS RELATED REQUIREMENTS: Defined within these rolls are other general or pre-requisite needed</b>				
2	Capability to lift up to 50 lbs. (23 kg)	OP	7	GEN	General Industry
3	Capability to deal with repetitive bending and stooping	OP	7	GEN	General Industry
4	Vision Examination Pre-requisite: Jaeger No. 1 or equivalent, not less than 30 cm/12 inches in at least one eye, natural or corrected	OP	3	GEN	NAS410
5	Color Perception: Able to adequately distinguish / differentiate colors used in the process involved	OP	3	GEN	NAS410
6	<b>SAFETY &amp; ENVIRONMENTAL REQUIREMENTS:</b>				
7	Knowledge and understanding of safety and handling of hazardous materials, chemicals, etc. Regulatory Requirements	OP	7	GEN	General Industry Environmental laws and regulations
8	Understand SDS and PPE Requirements: When and How to use appropriate personal protective equipment (PPE) (goggles, gloves, rubber boots, aprons, etc.)	OP	10	GEN	Occupational Safety and Health Administration (OSHA)
1	<b>PORTFOLIO REQUIREMENTS (for OWNER LEVEL Qualification Only) Portfolio must include the following components for consideration</b>				
2	Planner Exam Score (Must receive at least 80%)	N/A			
3	Planner Exam Validity (Must be within 6 months of requalification)	N/A			
4	Experience Survey	N/A			
5	Resume of Experience (Description of Current and Previous Jobs)	N/A			
6	Employer / Client Verification (Signed Statement of Corroboration by either current employer or client)	N/A			
7		N/A			
8	NOTE: The above components will be scored accordingly	N/A			

## ADDENDUM 1

## LIST OF INTERNATIONAL STANDARDS FOR CHEMICAL PROCESSING / ETCH

<b>SPECIAL PROCESS</b>	<b>DOCUMENT TITLE</b>	<b>DOCUMENT NUMBER</b>
Chemical Process	Temper Etch Inspection	MIL-STD-867 C
Etch Inspection	Qualification & Certification of Etch Inspector	SAE ARP 1923 A
Etch Inspection	Structural Examination of Titanium Alloys Etch-Anodize Inspection Procedure	SAE AMS2642D
Etch Inspection	Method for the Etch Inspection of Metallic Material and Components	BSI SS M 37
Etch Inspection	Structural Examinations of Titanium Alloys Chemical Etch Inspection Procedure	SAE AMS2643E
Etch Inspection	Acid Etch Inspection for Steel Parts	HB7717
Chemical Process	Liquid Penetrant Testing	ASTM E 1417
Chemical Process	Standard Methods of Analysis of Sulfochromate Etch Solution Used in Surface Preparation of Aluminum	ASTM D2674
Chemical Process	Paints for Steel Structures Part 17: Etch Primers (Single Pack and Two Pack) – Supersedes AS 3884: 1991	SAI AS/NZS 3750.17
Chemical Process/Etch	Audit Criteria For Etch Processes	AC7108/2
NDT	Etch Inspection of High Strength Steel Parts	AMS 2649C
NDT	Nital Etch	MIL-STD-867