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## Program Document CPBOK

PD 6103

CPBoK-001/OP-1 REV. A

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### BODY OF KNOWLEDGE:

ROLE DESCRIPTION: ETCH OPERATOR

SPECIAL PROCESS: Chemical Processing

METHOD: Nital, Temper, Blue Etch Anodize Electrolytic (Anodic), Macrostructure, Pre-Penetrant

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 latest revision of eQualified PD6100 to ensure consistency with current industry practice.

## 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, Temper, Blue Etch Anodize, Electrolytic (Anodic), Macrostructure and Pre-Penetrant, 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 International Aerospace Quality Group (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 (CP-ERB) for the development of eQualified examinations
- Candidates taking eQualified examinations who wish to prepare in advance

## 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/Technician, Planner and Owner. Please refer to the current revision of PD 6000 for definitions of these levels.

**METHOD:** A well-defined division of a SPECIAL PROCESS widely recognized 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 revision of the BoK.

Re-assessment of candidates 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.org](http://www.eQualified.org))

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 Exam
- Results of Practical Exam (if applicable)
- Summary of Experience

5. LEVELS

Descriptors	Level		
	Operator (OP) / Technician (T)	Planner (PL)	Owner (OW)
	<i>For descriptions, please refer to current version of PD6000</i>	<i>For descriptions, please refer to current version of PD6000</i>	<i>For descriptions, please refer to current version of PD6000</i>
<b>Etch Operator Specific Criteria</b>	N/A	N/A	N/A
<b>Technical Knowledge</b>	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 one's knowledge.
<b>Experience</b>	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.
<b>Personal Attributes</b>	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.		
<b>Skills</b>	Describes the activities necessary to perform each level of job function to comply with the Body of Knowledge.		
<b>Non-Special Process Related Requirements</b>	Health & Safety, Environmental, Quality System Requirements.		

6. TABLE 1

**ROLE DESCRIPTION: ETCH OPERATOR**

**SPECIAL PROCESS: CHEMICAL PROCESSING**

**METHOD: ETCH / Nital, Temper, Blue Etch Anodize, Electrolytic (Anodic), Macrostructure, Pre-Penetrant**

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

Row #	COMPETENCE	Weight (1,3,7,10)	Exam Type Written / Practical	Reference Guidelines
	<b>KNOWLEDGE:</b> The basic knowledge of the special processes, methods and tools			
1	<b>GENERAL KNOWLEDGE:</b>			
2	Understand how to perform the inspection necessary to detect any damage that may have been caused	10	W/P	General Industry; AC7108/2: 3.1.1.6.1, 4.4.2, A.5
3	Full and complete understanding of Internal Work Instructions	10	W	General Industry; AC7108/2: 3.1, 4.4
4	Knowledge how to access customer specifications and requirements (i.e. where to find them).	7	W	General Industry; AC 7108/2:4.4.3, A7.1.1.1, A7.1.1.3, A71.1.4, A7.1.1.5, A71.1.2
5	Knowledge and understanding of the Accept/Reject Criteria	3	W	General Industry; AC7108/2: 3.1.1.6.9, A5, A7.1.2.5.3, A7.1.4
6	Knowledge of Surface Preparation procedures	10	W	AC7108/2 3.1.1.6.2, 3.1.1.6.7, 4.6, 4.7, A1
7	Knowledge and Understanding of the Post Bake Requirements and other Post Inspection operation/procedures	10	W	MIL-STD-867; AC 7108/2: 4.9, 4.10, A6, A7.2.2.7, A7.2.4
8	Water Break Free Cleanliness Verification	10	W/P	Addendum 1 List of Standards: AC7108: 3.1.1.6.5, A1
9	Knowledge and understanding in mathematics, including decimals and fractions	3	W	General Industry; AC 7108/2:4.4.2
10	Use of precision measuring instruments and equipment.	7	W	General Industry: AC 7108/2: 4.8, 4.9, 4.10, 5.1.1.3, A2, A5.2
11	Knowledge and Understanding of Job Documentation including Fixed / Frozen Process	10	W	AS9100, AC7108/2 3.1, 3.1.1.2 General Industry
12	Knowledge and Understanding of proper chemistry usage and application	7	W	AC7108/2: 4.3.2.3, 4.3.6, 4.3.9, 5.1.4.6
13	Knowledge and Understanding of the General Cleaning, Mechanical Cleaning and Chemical Cleaning prior to Etching	7	W/P	AC 7108/2: 3.1.1.6.2, 4.5, 4.6
14	Knowledge and Understanding of Etch Rate and Stock Removals	7	W	AC7108/2 5.1 – 5.1.13
15	Knowledge and Understanding of Local Etch Stock Solutions and correct chemistry application	7	W/P	AC7108/2 5.1.3, 5.1.4.4 – 5.1.13
16	Knowledge and Understanding of Laboratory Procedures	1	W	AC7108 4.1, AC7108/2: 5.1, 5.1.3
17	Knowledge and Understanding of Analytical requirements & limits	1	W	AC 7108/2: 5.1.4.8
18	Understand the need for pre-process checks (such as calibration status, temperatures & light levels)	7	W	AC7108 3.10, AC 7108/2: 4.5.1, 4.8.1, A7.1.3.12
19	Understanding of Racking and part set-up	10	W/P	AC 7108/2: 3.1.1.6.4
20	Thorough understanding of the appropriate etch process	7	W	AC 7108/2: A7.1.2, A7.1.2.5.2
	<b>NITAL AND TEMPER ETCH:</b>			
22	Understanding the effects of heat being applied to metal during the cutting, grinding and forming	3	W	General Industry; AC 7108/2: D7.1
23	Temper Etch Inspection is used for inspection of Low Alloy Steels (Group A), Tool Steels (Group B), Limited Access or Swab Etch, Ammonium Persulfate Swab Etch	7	W	MIL-STD-867; AC 7108/2: D7.1
24	Understand the importance of proper equipment set-up and use	7	W/P	MIL-STD-867 / AMS 2649
25	Understand the use and control of known defect samples	7	W	MIL-STD-867 / AMS 2649
26	Understand surface preparation techniques and requirements	10	W	General Industry; AC 7108/2: D7.1 – D7.5
27	Understand process requirements	10	W	General Industry; AC 7108/2: D4, D5
28	Understand post process requirements	10	W	General Industry; AC 7108/2: D6, D71.1
29	Understand Local Swab Etch Process	7	W/P	General Industry; AC 7108 3.3.1.6
	<b>BLUE ETCH ANODIZE AND ELECTROLYTIC (ANODIC) ETCHING:</b>			
31	Accept / Reject Criteria – Uniform color and appearance, segregation, laps, folds, cracks, inclusions, arc outs, pitted areas, inconclusive macrostructure, microstructure evaluation	3	W	SAE AMS 264
32	Thorough understanding of the Blue Etch Anodize or Anodic Etch processes	7	W/P	SAE AMS 2642; AC 7108/2: B

	used			
33	Acid salt immersion time and required stock removal	7	W	SAE AMS 2642
34	Anodize rectifier parameters: voltage, amperage, time, ramp rate	7	W	SAE AMS 2642; AC 7108/2: B2, B3
35	Thorough understanding of the significance of rack construction and size, location and cleanliness of contact points	10	W	SAE AMS 2642; AC 7108/2: B3.1
36	Back strip immersion time and acceptable color range	10	W	SAE AMS 2642
37	<b>MACROSTRUCTURE ETCH:</b>			
38	Accept / Reject Criteria	3	W	General Industry; AC 7108/2: C7.1.4
39	Thorough understanding of the Macrostructure Etch process	7	W/P	General Industry; AC 7108/2: C, ASTM E 340
40	Wet inspection and temporary marking	3	W	General Industry
41	Rinsing restrictions after etching and before de-smutting	7	W	General Industry
42	Understand Local Swab Etch Process	7	W	General Industry; AC 7108/2: C4
43	<b>PRE-PENETRANT ETCH:</b>			
44	Determine an acceptable etch is presented to NDT	10	W/P	General Industry; AC 7108/15:5.2
45	Understand Qualified Materials for etch process	7	W	General Industry; AC 7108/15: 3.2, 4.3.2.4, 4.14
46	Thorough understanding of the Pre-Penetrant Etch process.	7	W/P	ASTM E 1417; AC 7108/15:3.1, 4.4, 4.5, 4.6, 4.9, 4.15, 5.2
47	Understands the effects of the etch processes	7	W	General Industry; AC 7108/15: 4.3.4, 4.3.5
48	Understands visual appearance results of the etch process	7	W/P	General Industry; AC 7108/15: 5.2
49	Understands proper handling of solutions and parts	7	W	General Industry; AC 7108/15: 4.1, 5.1
50	Understand Local Swab Etch Process	7	W	General Industry; AC 7108/15: 4.15
	<b>SKILLS:</b> Defined within these rolls describes the range of skills. The skills required to perform a particular special process task			
51	<b>READ AND UNDERSTAND WRITTEN INSTRUCTIONS:</b>	3	W	
52	Ability to understand specification requirements and customer flow-down requirements	3	W	AC7108 :2.4, 3.1.2, 3.4.1, General Industry
53	Apply Inspection Techniques appropriately	10	W	General Industry; AC7108 3.2, AC 7108/2:4.4, 5, 7.1.4, 7.2.2
54	Verify and validate the accuracy of the results	17	W	General Industry; AC7108 3.3.1.11
55	Properly document nonconformance's	7	W	General Industry; AC7108 3.8,
56	Apply technical knowledge in a skillful way in solving problems	3	W	General Industry; AC71083.1, 3.2
57	Familiar with the scope and limitations of the method.	3	W	General Industry; AC 7108/2: A7, B7, C7, D7
58	Use appropriate equipment for inspection of process	7	W	General Industry; AC 7108/2: 5, 7.1.4, 7.2.2
59	Ability to follow instructions	10	W/P	General Industry, AC7108 3.3.1.6, AC 7108/2: 3.1.2
60	Interpretation of an acceptable etch process	3	W	General Industry; AC 7108/2: 4.1, 4.4.2.5
61	Must able to Interpret an acceptable etch process	7	W	General Industry; AC 7108/2: 4.4.2.5, AC7108 4.2
62	Must be able to set up operations (equipment, levels, timer and temperature) including alternate procedures as appropriate	10	W/P	General Industry; AC 7108/2: 4, 4.2
63	Must be able to understand and interpret shop traveler	10	W/P	AC7108 3.3, AC7108/2:4.4
64	Mass Loss	7	W	AC7108 4.3
	<b>Sequencing</b>			
65	Has an appropriate understanding of where this process falls in the sequence of events.	10	W	AC7108 3.3, 3.4
	<b>PERSONAL ATTRIBUTES:</b> Are statements that will enable judgment of the person's personal attributes			
66	Must be able to work independently with minimum supervision	7	P	General Industry
67	Have a high degree of integrity	7	P	General Industry
68	Attentive to details	7	P	General Industry
69	Flexibility	3	P	General Industry
70	Stress Tolerance	7	P	General Industry
71	Conflict Resolution	3	P	General Industry
72	Decision making	3	P	General Industry
73	Team Work	7	P	General Industry
74	Ethical Behavior	7	P	General Industry
	<b>EXPERIENCE:</b> Are the minimum experience requirement expected to demonstrate their competence.			
75	<b>EDUCATION:</b>			
76	16 hours of classroom training, as applicable	10	P	NAS410 or Training to gain the

				necessary knowledge (General Industry)
77	High School Diploma or GED	7		
78	Apprenticeship	7		
79	Secondary Education	3		
80	<b>TRAINING / HANDS-ON EXPERIENCE:</b>			
81	Complete on the job training (Minimum # of hours required) Level 1 (trainee) PT/MT 130 hours RT/UT/ET – 400 hours	10	P	NAS410; or Training to gain the necessary knowledge (General Industry)
82	Experience or Basic understanding of the potential hazards / damage that the process can cause to parts	7		General Industry
83	Training must include Practical Examination according to Industry requirements	10	P	NAS410
84	Temper Etch Inspection personnel shall pass a physical, written and practical test.	10	W / P	MIL-STD-867C & ARP1923
85	Pre-Penetrant Etch (Level 1) Formal Training 16 hrs.	10	W / P	NAS410
86	Pre-Penetrant Etch (Level 1) Experience 130 hrs.	7	P	NAS410
87	Trained and certified in accordance with ARP 1923 (or equivalent)	3	P	ARP 1923
	<b>NON-SPECIAL PROCESS RELATED REQUIREMENTS: Defined within these rolls are other general or pre-requisite needed</b>			
88	Capability to lift up to 30 lbs. (e.g. up to 14 kg)	7	W P	General Industry
89	Capability to deal with repetitive bending and stooping	7	W P	General Industry
90	Vision Examination Pre-requisite: Jaeger No. 1 or equivalent, not less than 30 cm/12 inches in at least one eye, natural or corrected	3	W P	NAS410
91	Color Perception: Able to adequately distinguish / differentiate colors used in the process involved	3	W P	NAS410
92	<b>SAFETY &amp; ENVIRONMENTAL REQUIREMENTS:</b>			
93	Knowledge and understanding of safety and handling of hazardous materials, chemicals, etc. Regulatory Requirements	7	W	General Industry Environmental laws and regulations
94	Understand SDS and PPE Requirements: When and How to use appropriate personal protective equipment (PPE) (goggles, gloves, rubber boots, aprons, etc.)	10	W	Occupational Safety and Health Administration (OSHA)

7. DOCUMENT REVISION HISTORY

REVISION DATE	SUMMARY
11 Nov 14	Editorial change made to formatting and to add sequencing
03 Jun 16	Editorial change made to update BoK with new template revisions
06 Mar 17	Updated reference paragraphs for AC7108 and AC7108/2 in reference columns – all line items Added document NAS410 to Addendum 1 Added document AS9100 to Addendum 1 Change Anodic Etch to Electrolytic Etch – all line items

ADDENDUM 1

LIST OF INTERNATIONAL STANDARDS & REFERENCE DOCUMENTS FOR CHEMICAL PROCESSING / ETCH

SPECIAL PROCESS	DOCUMENT TITLE	DOCUMENT NUMBER
Chemical Process	Audit Criteria for Chemical Processes	AC 7108
Chemical Process/Etch	Audit Criteria for Etch Inspection Processes for Anodic, Blue Etch Anodize, Macrostructure, Nital/Temper (Appendix A, B, C, D)	AC 7108/2
Chemical Process/Etch	Audit Criteria for Pre-Penetrant Etch	AC 7108/15
NDT	Etch Inspection of High Strength Steel Parts	AMS 2649C
NDT	Pyrometry	AMS 2750
Chemical Process	Standard Methods of Analysis of Sulfochromate Etch Solution Used in Surface Preparation of Aluminum	ASTM D2674
Chemical Process	Liquid Penetrant Testing	ASTM E 1417
Macroetch	Standard Practice for Macroetching Metals and Alloys	ASTM E 340
Etch Inspection	Method for the Etch Inspection of Metallic Material and Components	BSI SS M 37
Etch Inspection	Acid Etch Inspection for Steel Parts	HB7717
NDT	Nital Etch	MIL-STD-867
Chemical Process	Temper Etch Inspection	MIL-STD-867 C
Etch Inspection	Structural Examination of Titanium Alloys Etch-Anodize Inspection Procedure	SAE AMS2642D
Etch Inspection	Structural Examinations of Titanium Alloys Chemical Etch Inspection Procedure	SAE AMS2643E
Etch Inspection	Qualification & Certification of Etch Inspector	SAE ARP 1923 A
Chemical Process	Paints for Steel Structures Part 17: Etch Primers (Single Pack and Two Pack) – Supersedes AS 3884: 1991	SAI AS/NZS 3750.17