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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 PRI QualificationSM program examinations are created using the applicable PRI QualificationSM program 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 BoKs are created by subject matter experts who participate in the PRI QualificationSM Body of Knowledge Review Boards. All BoKs are updated periodically according to the latest revision of PRI QualificationSM program documentation (PD6100: Industry Managed Special Process Bodies of Knowledge) to ensure consistency with current industry practice.

1. INTRODUCTION

This document has been created by the PRI QualificationSM program Chemical Processing Body of Knowledge Review Board (CP BoKRB) according to the requirements of PD6100.

This document constitutes the PRI QualificationSM program 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 PRI QualificationSM program examination candidate preparation
- Chemical Processing Examination Review Board (CP-ERB) for the development of PRI QualificationSM program examinations
- Candidates taking PRI QualificationSM program examinations who wish to prepare in advance

2. REFERENCES

PRI QualificationSM program documents:

PD6000	Governance & Administration of PRI Qualification SM 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 PRI QualificationSM 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 PRI QualificationSM program examination candidates are recommended to read all documents referenced in section 2 of this document.

As stated in PRI QualificationSM program document PD6200, every 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 Approved Training Providers can be found at <https://p-r-i.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>
Etch Operator Specific Criteria	N/A	N/A	N/A
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 one's 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.		

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
	KNOWLEDGE: The basic knowledge of the special processes, methods and tools			
1	GENERAL KNOWLEDGE:			
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
21	NITAL AND TEMPER ETCH:			
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
30	BLUE ETCH ANODIZE AND ELECTROLYTIC (ANODIC) ETCHING:			
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

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32	Thorough understanding of the Blue Etch Anodize or Anodic Etch processes used	7	W/P	SAE AMS 2642; AC 7108/2: B
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	MACROSTRUCTURE ETCH:			
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	PRE-PENETRANT ETCH:			
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
	SKILLS: Defined within these rolls describes the range of skills. The skills required to perform a particular special process task			
51	READ AND UNDERSTAND WRITTEN INSTRUCTIONS:	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
	Sequencing			
65	Has an appropriate understanding of where this process falls in the sequence of events.	10	W	AC7108 3.3, 3.4
	PERSONAL ATTRIBUTES: 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
	EXPERIENCE: Are the minimum experience requirement expected to demonstrate their competence.			

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75	EDUCATION:			
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	TRAINING / HANDS-ON EXPERIENCE:			
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
	NON-SPECIAL PROCESS RELATED REQUIREMENTS: Defined within these rolls are other general or pre-requisite needed			
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	SAFETY & ENVIRONMENTAL REQUIREMENTS:		W	General Industry
93	Knowledge and understanding of safety and handling of hazardous materials, chemicals, etc. Regulatory Requirements	7	W	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 November 14	Editorial change made to formatting and to add sequencing
3 June 16	Editorial change made to update BoK with new template revisions
6 March 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
3 December 2019	Editorial revision to update program name from eQualified to PRI Qualification SM .

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

ADDENDUM 2

ADDITIONAL SAFETY & ENVIRONMENTAL REQUIREMENTS

REACH REGULATION INFORMATION

Several metal finishing processes (painting, anodize, chromate conversion, passivate, electroplating) may have REACH regulated substances that are either used as process chemicals or are contained within the finished product after a process is completed. Chemical suppliers are obliged to provide a legislatively compliant safety data sheet.

Below are topics of concern that a chemical processing owner should be aware of and have adequate understanding if products are produced within or shipped to the European Union.

- REACH (Regulation on Registration, Evaluation, Authorization and Restriction of Chemicals)
- Affects raw materials/substances that go into products either produced within or shipped to the European Union.
- Under EU REACH regulation, substances that are one of the following can be regarded as substance of very high concern (SVHC):
 - carcinogenic, mutagenic or toxic to reproduction (CMRs);
 - persistent, bio-accumulative and toxic (PBTs);
 - very persistent and bio-accumulative (vPvBs);
 - seriously and / or irreversibly damaging the environment or human health, as substances damaging the hormone system;
- The SVHC candidate list is a moving target that will continue to grow with 168 substances as of January 2016. This list is reviewed nominally twice a year by ECHA.
- Some typically used SVHC's contained in or used but not limited to during chemical processing are;
 - Cadmium
 - Strontium Chromate
 - Chromium trioxide
 - Sodium dichromate
- SVHC content is allowable up to 0.1% of an article produced within or shipped to the EU.
- Additionally, SVHC's may at some time be added to the Authorization List known as Annex 14 or XIV which contains a sunset date for each SVHC in this list.
- Owner needs to be aware of sunset dates for SVHC's contained in the Authorization list. Once an SVHC from the Authorization List reaches the sunset date, it can no longer be used in the EU without specific authorization from ECHA (European Chemicals Agency).
- Manufacturing sites either located within or if shipping product to the EU must comply with all aspects of REACH. Chemical suppliers in the EU must provide safety data sheets that reflect any conditions of an authorization.
- Further information/current SVHC and Authorization list with sunset dates can be obtained by accessing (<http://www.echa.europa.eu/web/guest/candidate-list-table>)