



161Thorn Hill Road  
Warrendale, PA 15086-7527

## Program Document CPBOK

PD 6103

CPBoK-004/OW-3

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### BODY OF KNOWLEDGE:

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

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 Inspection / 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 (CP-ERB) for the development of eQualified examinations
- Candidates taking eQualified examinations who wish to prepare in advance

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## 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		
<b>Descriptors</b>	<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>
<b>Etch Inspection Specific Criteria</b>	<b>See Definition Above</b>	<b>See Definition Above</b>	<b>See Definition Above</b>
<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 ones 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.		

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

**TABLE 1**

**ROLE DESCRIPTION: ETCH INSPECTOR OWNER**

**SPECIAL PROCESS: CHEMICAL PROCESSING**

**SCOPE / METHOD: ETCH INSPECTION / 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)	OW Weight (1,3,7,10)	Exam Type Gen/Specific /Practical	Reference Guidelines
1	<b>KNOWLEDGE: The basic knowledge of the special processes, methods and tools</b>				
2	<b>GENERAL KNOWLEDGE:</b>				
3	Understand how to perform the inspection necessary to detect any damage that may have been caused	OW	10	GEN	General Industry
4	Full and complete understanding of Internal Work Instructions	OW	10	GEN	General Industry
5	Knowledge how to access customer specifications and requirements (i.e. where to find them).	OW	10	GEN	General Industry
6	<b>Understand how to interpret customer specifications and requirements in the context of the inspection carried out</b>	OW	10	GEN	
7	Understanding of Industry Standards (see Addendum 1 of this document)	OW	10	GEN	Addendum 1
8	Knowledge and understanding of the Accept/Reject Criteria	OW	10	GEN	General Industry
9	Knowledge of Surface Preparation procedures	OW	10	GEN	
10	Knowledge and Understanding of the Post Bake Requirements and other Post Inspection operation/procedures	OW	10	GEN	MIL-STD-867
11	<b>Basic understanding of control and calibration requirements of Post Bake Ovens</b>	OW	7	GEN	
12	Water Break Free Cleanliness Verification	OW	10		
13	Knowledge and understanding in mathematics, including decimals and fractions	OW	10	GEN	General Industry
14	Use of precision measuring instruments and equipment.	OW	10	GEN	General Industry
15	Knowledge and Understanding of Job Documentation including Fixed / Frozen Process	OW	10	GEN	AS9100, AC7108/2 3.1, 3.1.1, General Industry
16	Knowledge and Understanding of proper chemistry usage and application	OW	10	GEN	AC7108/2
17	Knowledge and Understanding of the General Cleaning, Mechanical Cleaning and Chemical Cleaning prior to Etching	OW	10	GEN	
18	Knowledge and Understanding of Etch Rate and Stock Removals	OW	10	GEN	AC7108/2 4.16 & 4.17
19	<b>Knowledge and Understanding of how to correct or adjust Etch Rate and Stock Removals</b>	OW	10	GEN	
20	<b>Knowledge and Understanding of Local Etch Stock Solutions and correct chemistry application and removal</b>	OW	10		
21	Knowledge and Understanding of Laboratory Procedures	OW	10	GEN	AC7108/2
22	Knowledge and Understanding of Analytical requirements & limits	OW	10	GEN	
23	<b>Knowledge and Understanding to review and act on analytical data &amp; limits</b>	OW	10	GEN	
24	Understand the need for pre-process checks (such as calibration status, temperatures & light levels)	OW	10	GEN	
25	Understanding of Racking and part set-up	OW	10	GEN	
26	Thorough understanding of the appropriate etch process	OW	10	GEN	
27	<b>Knowledge and Ability to write and review internal procedures and practices</b>	OW	10	GEN	
28	<b>Knowledge to recognize unsafe and/or inappropriate work practices</b>	OW	10	GEN	
29	<b>Knowledge and Understanding of the effect of all aspects of the etching process on different alloys and materials (including masking materials, tanks, work environment etc).</b>	OW	10	GEN	
30	<b>Understand how to deal with incorrect or in appropriate etch processing</b>	OW	10	GEN	
31	<b>Knowledge and Understanding of the selection of appropriate plant and equipment for use in etch inspection</b>	OW	10	GEN	

32	Understanding of the significance pH and grades of water purity and their measurement	OW	7	GEN	
33	Knowledge and Understanding of appropriate lighting levels and their measurement	OW	10	GEN	
34	General Knowledge and Understanding of all the etch inspection processes (including their strengths and weaknesses)	OW	7	GEN	
35	Knowledge and Understanding to select appropriate inspection methods	OW	10	GEN	
36					
37	<b>NITAL AND TEMPER ETCH:</b>				
38	Accept / Reject Criteria	OW	10		
39	Understanding the effects of heat being applied to metal during the cutting, grinding and forming	OW	10	GEN	General Industry
40	A conforming etched surface will exhibit a matte gray etched surface	OW	10	GEN	Addendum 1
41	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	OW	10	GEN	MIL-STD-867
42	Understand the importance of proper equipment set-up and use	OW	10	GEN	MIL-STD-867 / AMS 2649
43	Understand the use and control of known defect samples	OW	10	GEN	MIL-STD-867 / AMS 2649
44	<b>Knowledge and Understanding to review known defect data</b>	OW	10		
45	Understand surface preparation techniques and requirements	OW	10	GEN	General Industry
46	Understand process requirements	OW	10	GEN	General Industry
47	Understand post process requirements	OW	10	GEN	General Industry
48	Understand Local Swab Etch Process	OW	10	GEN	General Industry
49	<b>Knowledge and Understanding to identify susceptibility of parts to corrosion and/or embrittlement</b>	OW	10	GEN	
50	<b>Knowledge and Understanding of sampling plans</b>	OW	10	GEN	
51	<b>Understanding of defects, their causes and their appearance after etching</b>	OW	10	GEN	
52	<b>Knowledge and Understanding to create and sign off Process Technique Sheets and Data Cards</b>	OW	10	GEN	
53	<b>Knowledge and Understanding of the significance of indications and etched appearance</b>	OW	10	GEN	
54					
55	<b>BLUE ETCH ANODIZE AND ANODIC ETCHING:</b>				
56	Accept / Reject Criteria – Uniform color and appearance, segregation, laps, folds, cracks, inclusions, arc outs, pitted areas, inconclusive macrostructure, microstructure evaluation	OW	10	GEN	SAE AMS 2642
57	Thorough understanding of the Blue Etch Anodize or Anodic Etch processes used	OW	10	GEN	SAE AMS 2642
58	Acid salt immersion time and required stock removal	OW	10	GEN	
59	Anodize rectifier parameters, voltage, amperage, time, ramp rate	OW	10	GEN	
60	Thorough understanding of the significance of rack construction and size, location and cleanliness of contact points	OW	10	GEN	SAE AMS 2642
61	Back strip immersion time and acceptable color range	OW	10	GEN	SAE AMS 2642
62	<b>Thorough understanding of handling and processing Titanium</b>	OW	10	GEN	
63	<b>Understanding of defects, their causes and their appearance after BEA or anodic etching</b>	OW	10	GEN	
64	<b>Knowledge and Understanding to create and sign off Process Technique Sheets and Data Cards</b>	OW	10	GEN	
65	<b>Knowledge and Understanding of the significance of indications and etched appearance</b>	OW	10	GEN	
66	<b>MACROSTRUCTURE ETCH:</b>				
67	Accept / Reject Criteria	OW	10	GEN	General Industry
68	Thorough understanding of the Macrostructure Etch process	OW	10	GEN	General Industry
69	Wet inspection and temporary marking	OW	10	GEN	General Industry
70	Definition of a detectable and rejectable indications	OW	10	GEN	General Industry
71	Understand Local Swab Etch Process	OW	10	GEN	General Industry
72	<b>Understanding of Metallographic structure (grains, boundaries, phases etc.)</b>	OW	10	GEN	
73	<b>Understanding of defects, their causes and their appearance after etching</b>	OW	10	GEN	
74	<b>Understand the use of classification charts</b>	OW	10	GEN	
75	<b>Knowledge and Understanding of etch solutions and processes and the appropriate selection of etch processes</b>	OW	10	GEN	
76	<b>Knowledge and Understanding to create and sign off Process Technique Sheets and Data Cards</b>	OW	10	GEN	
77	<b>Knowledge and Understanding of the significance of etched appearance</b>	OW	10	GEN	
78	<b>PRE-PENETRANT ETCH:</b>				

79	Determine an acceptable etch.is presented to NDT	OW	10	GEN	
80	Understand Qualified Materials for etch process	OW	10	GEN	
81	Thorough understanding of the Pre-Penetrant Etch process.	OW	10	GEN	
82	Understands the effects of the etch processes	OW	10	GEN	
83	Understands visual appearance results of the etch process	OW	10	GEN	
84	Understands proper handling of solutions and parts	OW	10	GEN	
85	Understand Local Swab Etch Process	OW	10	GEN	
86	<b>Understands the effects of etch rate on different alloys</b>	OW	10	GEN	
87	<b>Knowledge and Understanding of Fluorescent Penetrant Inspection</b>	OW	7	GEN	
1	<b>SKILLS:</b> Defined within these rolls describes the range of skills. The skills required to perform a particular special process task				
2	<b>READ AND UNDERSTAND WRITTEN INSTRUCTIONS:</b>	OW	10		General Industry
3	Ability to understand specification requirements and customer flow-down requirements	OW	10	GEN	General Industry / AC7108/2
4	Apply Inspection Techniques appropriately	OW	10	GEN	General Industry
5	Verify and validate the accuracy of the results	OW	10	GEN	General Industry
6	Properly document nonconformance's	OW	10	GEN	General Industry
7	Apply technical knowledge in a skillful way in solving problems	OW	10	GEN	General Industry
8	Familiar with the scope and limitations of the method.	OW	10	GEN	General Industry
9	Use appropriate equipment for inspection of process	OW	10	GEN	General Industry
10	Ability to follow instructions	OW	10	GEN	General Industry
11	<b>Ability to write Work Instructions and procedures</b>	OW	10		
12	Interpretation of an acceptable etch process	OW	10	GEN	General Industry
13	Must be able to read drawings and specification	OW	10	GEN	General Industry
14	Must be able to interpret specification requirements	OW	10	GEN	General Industry
15	Must be able to understand and interpret shop traveler	OW	10	GEN	AC7108/2
16	<b>Ability to identify training needs and plan their correction</b>	OW	10		
17	<b>Ability to identify strengths and weaknesses in the personnel that report to them</b>	OW	10		
18					
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	OW			
3	Have a high degree of integrity	OW			
4	Attentive to details	OW			
5	Flexibility	OW			
6	Stress Tolerance	OW			
7	Conflict Resolution	OW			
8	Decision making	OW			
9	Team Work	OW			
10	Ethical Behavior	OW			
	<b>Leadership</b>	OW			
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	OW			NAS410
4	High School Diploma or GED	OW			
5	Apprenticeship	OW			
6	Secondary Education	OW			
7		OW			
8	<b>TRAINING / HANDS-ON EXPERIENCE:</b>	OW			
9	Complete on the job training (Minimum # of hours required) <b>Level 2</b> <b>PT - Level 1 + 270 hours = 400 hours total</b> <b>MT - Level 1 + 400 hours = 530 hours total</b> <b>RT/UT/ET - Level 1 + 1200 hours = 1600 hours total</b>	OW			NAS410
10	Experience or Basic understanding of the potential hazards / damage that the process can cause to parts	OW			General Industry
11	Training must include Practical Examination according to Industry requirements	OW			NAS410
12	Temper Etch Inspection personnel shall pass a physical, written and practical test.	OW			MIL-STD-867C & ARP1923

13	Pre-Penetrant Etch (Level 2) Formal Training <b>32 hours total (Level 1 + 16 hours)</b>	OW			NAS410
14	Pre-Penetrant Etch (Level 2) Experience <b>400 hours total (Level 1 + 270 hours)</b>	OW			NAS410
15	Trained and certified in accordance with ARP 1923 (or equivalent)	OW			
16					
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)	OW	7	GEN	General Industry
3	Capability to deal with repetitive bending and stooping	OW	7	GEN	General Industry
4	General understanding of Quality Systems (AS9100) or equivalent	OW	10	GEN	General Industry
5	Vision Examination Pre-requisite: Jaeger No. 1 or equivalent, not less than 30 cm/12 inches in at least one eye, natural or corrected	OW	10	GEN	NAS410
6	Color Perception: Able to adequately distinguish / differentiate colors used in the process involved	OW	10	GEN	NAS410
7	<b>SAFETY &amp; ENVIRONMENTAL REQUIREMENTS:</b>	OW		GEN	General Industry
8	Knowledge and understanding of safety and handling of hazardous materials, chemicals, UV light etc. <b>including safe storage, interpretation of Health &amp; Safety Data Sheets and Regulatory Requirements</b>	OW	10	GEN	Environmental laws and regulations
9	Understand SDS and PPE Requirements: When and How to use appropriate personal protective equipment (PPE) (goggles, gloves, rubber boots, aprons, etc.)	OW	10	GEN	Occupational Safety and Health Administration (OSHA)
10	<b>Ability to prepare and administer appropriate safety and environmental procedures and controls</b>	OW	10		
1	<b>PORTFOLIO REQUIREMENTS (for OWNER LEVEL Qualification Only) Portfolio must include the following components for consideration</b>				
2	Planner Exam Score <i>(Must receive at least 80%)</i>	OW			
3	Planner Exam Validity <i>(Must be within 6 months of requalification)</i>	OW			
4	Experience Survey	OW			
5	Resume of Experience <i>(Description of Current and Previous Jobs)</i>	OW			
6	Employer / Client Verification <i>(Signed Statement of Corroboration by either current employer or client)</i>	OW			
7	NOTE: The above components will be scored accordingly	OW			



## 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