



161 Thorn Hill Road
Warrendale, PA 15086-7527

Program Document CPBOK

PD 6103

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Superseding N/A

BODY OF KNOWLEDGE:

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

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 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

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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	International Aerospace Quality Group

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)

- Physical tests (eye exam) are required annually
- 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)

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	Operator (OP) <i>Understand and perform the hands-on operations of the special process for which qualification is sought.</i>	Planner (PL) <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>	Owner (OW) <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	See Definition Above	See Definition Above	See Definition Above
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 & ETCH INSPECTOR PLANNER

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

37	Accept / Reject Criteria	PL	10	GEN	
38	Understanding the effects of heat being applied to metal during the cutting, grinding and forming	PL	10	GEN	General Industry
39	A conforming etched surface will exhibit a matte gray etched surface	PL	10	GEN	Addendum 1
40	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	PL	10	GEN	MIL-STD-867
41	Understand the importance of proper equipment set-up and use	PL	10	GEN	MIL-STD-867 / AMS 2649
42	Understand the use and control of known defect samples	PL	10	GEN	MIL-STD-867 / AMS 2649
43	Knowledge and Understanding to review known defect data	PL	7		
44	Understand surface preparation techniques and requirements	PL	10	GEN	General Industry
45	Understand process requirements	PL	10	GEN	General Industry
46	Understand post process requirements	PL	10	GEN	General Industry
47	Understand Local Swab Etch Process	PL	10	GEN	General Industry
48	Knowledge and Understanding to identify susceptibility of parts to corrosion and/or embrittlement	PL	7	GEN	
49	Knowledge and Understanding of sampling plans	PL	7	GEN	
50	Understanding of defects, their causes and their appearance after etching	PL	7	GEN	
51	Knowledge and Understanding to create and sign off Process Technique Sheets and Data Cards	PL	7	GEN	
52	Knowledge and Understanding of the significance of indications and etched appearance	PL	7	GEN	
53	BLUE ETCH ANODIZE AND ANODIC ETCHING:				
54	Accept / Reject Criteria – Uniform color and appearance, segregation, laps, folds, cracks, inclusions, arc outs, pitted areas, inconclusive macrostructure, microstructure evaluation	PL	10	GEN	SAE AMS 2642
55	Thorough understanding of the Blue Etch Anodize or Anodic Etch processes used	PL	10	GEN	SAE AMS 2642
56	Acid salt immersion time and required stock removal	PL	10	GEN	SAE AMS 2642
57	Anodize rectifier parameters: voltage, amperage, time, ramp rate	PL	10	GEN	SAE AMS 2642
58	Thorough understanding of the significance of rack construction and size, location and cleanliness of contact points	PL	10	GEN	SAE AMS 2642
59	Back strip immersion time and acceptable color range	PL	10	GEN	SAE AMS 2642
60	Thorough understanding of handling and processing Titanium	PL	10	GEN	
61	Understanding of defects, their causes and their appearance after BEA or anodic etching	PL	7	GEN	
62	Knowledge and Understanding to create and sign off Process Technique Sheets and Data Cards	PL	7	GEN	
63	Knowledge and Understanding of the significance of indications and etched appearance	PL	7	GEN	
64	MACROSTRUCTURE ETCH:				
65	Accept / Reject Criteria	PL	10	GEN	General Industry
66	Thorough understanding of the Macrostructure Etch process	PL	10	GEN	General Industry
67	Wet inspection and temporary marking	PL	10	GEN	General Industry
68	Rinsing restrictions after etching and before desmutting	PL	10	GEN	General Industry
69	Definition of a detectable and rejectable indications	PL	10	GEN	General Industry
70	Understand Local Swab Etch Process	PL	10	GEN	General Industry
71	Understanding of Metallographic structure (grains, boundaries, phases etc.)	PL	7	GEN	
72	Understanding of defects, their causes and their appearance after etching	PL	7	GEN	
73	Understand the use of classification charts	PL	7	GEN	
74	Knowledge and Understanding of etch solutions and processes and the appropriate selection of etch processes	PL	7	GEN	
75	Knowledge and Understanding to create and sign off Process Technique Sheets and Data Cards	PL	3	GEN	
76	Knowledge and Understanding of the significance of etched appearance	PL	7	GEN	
77	PRE-PENETRANT ETCH:				
78	Determine an acceptable etch is presented to NDT	PL	10	GEN	General Industry
79	Understand Qualified Materials for etch process	PL	10	GEN	General Industry
80	Thorough understanding of the Pre-Penetrant Etch process.	PL	10	GEN	ASTM E 1417
81	Understands the effects of the etch processes	PL	10	GEN	General Industry
82	Understands visual appearance results of the etch process	PL	10	GEN	General Industry
83	Understands proper handling of solutions and parts	PL	10	GEN	General Industry
84	Understand Local Swab Etch Process	PL	10	GEN	General Industry
85	Understands the effects of etch rate on different alloys	PL	7	GEN	General Industry
1	SKILLS: Defined within these rolls describes the range of skills. The skills required to perform a particular special process task			GEN	
2	READ AND UNDERSTAND WRITTEN INSTRUCTIONS:	PL	10	GEN	General Industry
3	Ability to understand specification requirements and customer flow-down requirements	PL	10	GEN	General Industry / AC7108/2
4	Apply Inspection Techniques appropriately	PL	10	GEN	General Industry

5	Verify and validate the accuracy of the results	PL	10	GEN	General Industry
6	Properly document nonconformance's	PL	10	GEN	General Industry
7	Apply technical knowledge in a skillful way in solving problems	PL	7	GEN	General Industry
8	Familiar with the scope and limitations of the method.	PL	10	GEN	General Industry
9	Use appropriate equipment for inspection of process	PL	10	GEN	General Industry
10	Ability to follow instructions	PL	10	GEN	General Industry
11	Ability to write Work Instructions and procedures	PL	7		
12	Interpretation of an acceptable etch process	PL	7	GEN	General Industry
13	Must be able to read drawings and specification	PL	10	GEN	General Industry
14	Must able to Interpret specification requirements	PL	10	GEN	General Industry
15	Must be able to set up operations (equipment, levels, timer and temperature) including alternate procedures as appropriate	PL	10	GEN	General Industry
16	Must be able to understand and interpret shop traveler	PL	10	GEN	AC7108/2
17	Understand Mass Loss	PL	10	GEN	General Industry
18	Ability to identify training needs and plan their correction	PL	3	GEN	General Industry
19	Ability to identify strengths and weaknesses in the personnel that report to them	PL	3	GEN	General Industry
1	Sequencing				
2	Has an appropriate understanding of where this process falls in the sequence of events.	OP	10	GEN	
1	PERSONAL ATTRIBUTES: Are statements that will enable judgment of the person's personal attributes				
2	Must be able to work independently with minimum supervision	PL			
3	Have a high degree of integrity	PL			
4	Attentive to details	PL			
5	Flexibility	PL			
6	Stress Tolerance	PL			
7	Conflict Resolution	PL			
8	Decision making	PL			
9	Team Work	PL			
10	Ethical Behavior	PL			
11	Leadership	PL			
1	EXPERIENCE: Are the minimum experience requirement expected to demonstrate their competence.				
2	EDUCATION:				
3	16 hours of classroom training, as applicable	PL			NAS410
4	High School Diploma or GED	PL			
5	Apprenticeship	PL			
6	Secondary Education	PL			
7	TRAINING / HANDS-ON EXPERIENCE:				
8	Complete on the job training (Minimum # of hours required) Level 2 PT - Level 1 + 270 hours = 400 hours total MT - Level 1 + 400 hours = 530 hours total RT/UT/ET - Level 1 + 1200 hours = 1600 hours total	PL			NAS410
9	Experience and understanding of the potential hazards / damage that the process can cause to parts	PL			General Industry
10	Training must include Practical Examination according to Industry requirements	PL			NAS410
11	Temper Etch Inspection personnel shall pass a physical, written and practical test.	PL			MIL-STD-867C & ARP1923
12	Pre-Penetrant Etch (Level 2) Formal Training 32 hours total (Level 1 + 16 hours)	PL			NAS410
13	Pre-Penetrant Etch (Level 2) Experience 400 hours total (Level 1 + 270 hours)	PL			NAS410
14	Trained and certified in accordance with ARP 1923 (or equivalent)	PL			
1	NON-SPECIAL PROCESS RELATED REQUIREMENTS: Defined within these rolls are other general or pre-requisite needed				
2	Capability to lift up to 50 lbs. (23 kg)	PL	7	GEN	General Industry
3	Capability to deal with repetitive bending and stooping	PL	7	GEN	General Industry
4	General understanding of Quality Systems AS/EN/JISQ 9100 or equivalent	PL	7	GEN	General Industry
5	Vision Examination Pre-requisite: Jaeger No. 2 or equivalent, not less than 30 cm/12 inches in at least one eye, natural or corrected	PL	10	GEN	NAS410
6	Color Perception: Must be able to adequately distinguish and differentiate between the colors used in the method process involved.	PL	10	GEN	NAS410
	SAFETY & ENVIRONMENTAL REQUIREMENTS:				
7	Knowledge and understanding of safety and handling of hazardous materials, chemicals, etc. including safe storage, interpretation of Health & Safety Data Sheets and Regulatory Requirements	PL	7	GEN	Environmental laws and regulations
8	Understand Safety Data Sheets (SDS) and Personal Protective Equipment (PPE) Requirements: When and How to use appropriate personal protective equipment	PL	10	GEN	Occupational Safety and Health Administration

	(PPE) (goggles, gloves, rubber boots, aprons, etc.)				(OSHA)
9	Ability to prepare and administer appropriate safety and environmental procedures and controls	PL	7	GEN	Occupational Safety and Health Administration (OSHA)

ADDENDUM 1

LIST OF INTERNATIONAL STANDARDS FOR CHEMICAL PROCESSING / ETCH

SPECIAL PROCESS	DOCUMENT TITLE	DOCUMENT NUMBER
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
Chemical Process	Liquid Penetrant Testing	ASTM E 1417
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