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Program Document WLDBOK

PD 6103

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BODY OF KNOWLEDGE:

ROLE DESCRIPTION: Fusion Welding PLANNER

SPECIAL PROCESS: Welding

METHOD: Performance of Fusion Welding Requirements

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 Welding Body of Knowledge Review Board (WLD-BoKRB) according to the requirements of PD6100.

This document constitutes the PRI QualificationSM program BoK for (Fusion Welding Planner). It defines the baseline knowledge and experience required to be considered competent to perform this role.

Unless otherwise stated, the WLD-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
- Welding Examination Review Board (WLD-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.

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 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.

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 www.p-r-i.org)

Records of all qualified personnel shall be maintained and include:

- Date of Qualification
- Results of Written Exam
- Results of Practical Exam (if applicable)
- Summary of Experience (Owner level only)

5. LEVELS

Level			
<i>Descriptors</i>	<i>Operator (OP) / Technician(T)</i> <i>For descriptions, please refer to current version of PD6000</i>	<i>Planner (PL)</i> <i>For descriptions, please refer to current version of PD6000</i>	<i>Owner (OW)</i> <i>For descriptions, please refer to current version of PD6000</i>
Welding Specific Criteria	No additional criteria for the Welding process.	No additional criteria for the Welding process.	No additional criteria for the Welding process.
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: Fusion Welding Planner

SPECIAL PROCESS: Welding

METHOD: Performance of Fusion Welding Requirements

REFERENCE GUIDELINES: *Addendum 1 is a list of the International Standards and Reference Documents applicable to fusion welding processes.*

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	Fundamentals of fusion arc welding processes	10	Written	AWS WHB-1.9
3	Knowledge of GTAW/TIG process, advantages and limitations	10	Written	AWS WHB-2.9, AWS C5.5
4	Knowledge of plasma arc welding (PAW) process, advantages and limitations	10	Written	AWS WHB-2.9, AWS C5.1
5	Knowledge of basic process variables	10	Written	AWS C5.1, AWS C5.5
6	Knowledge of MIG welding process, advantages and limitations	10	Written	AWS WHB-2.9, AWS C5.6
7	Commonly welded materials and their properties	10	Written	AWS C5.5
8	Standard terms and definitions	10	Written	AWS A3.0, ISO 17533
9	Welding symbols – drawing interpretation	10	Written	AWS A2.4, ISO 2553
10	Drawing restrictions for weld repair of castings	7	Written	AMS 2694,
11	Basic joint configurations and Welding positions	10	Written	AWS A3.0, AWS C5.5, AWS D17.1, ISO 2553
12	Mechanized, Semi-Automated, Automated, and Robotic Welding	7	Written	AWS WHC1.11
13	EQUIPMENT			
14	Power sources, torches, and accessories (wire feeders, gas supply equipment, positioners, trailing shields, etc.)	10	Written	AWS D17.1
15	Equipment for mechanized and robotic welding (wire feeders, orbital welding equipment, etc.)	10	Written	AWS D16.2M/D16.2
16	Procedure for calibration of equipment	10	Written	Equipment manufacturer's manual, ISO 17662
17	Equipment preventive maintenance	10	Written	Equipment manufacturer's manual, AWS D17.1, AWS WHB-3.9
18	WELDER / WELDING OPERATOR QUALIFICATION			
19	Responsibility for the following documents:			
20	Performance qualification requirements, including visual acuity.	10	Written	AWS D17.1, ISO 24394
21	Welder / Welding operator qualification – test weld conditions vs. qualified scope	10	Written	ISO 24394
22	Welder / Welding operator qualification – special applications, inspection requirements, other welding conditions	10	Written	AWS D17.1, ISO 24394
23	Welder qualification for weld repair of castings	7	Written	AMS 2694,
24	Welder / Welding Operator qualification test records	10	Written	AWS D17.1, ISO 24394
25	Welding operator qualification procedure - experience (OJT), training, testing, and oversight	10	Written	AWS D17.1, ISO 24394
26	Re-qualification requirements	10	Written	AWS D17.1, ISO 24394
27	Disqualification requirements	10	Written	AWS D17.1, ISO 24394
28	PRE-WELD PREPARATION			
29	Part surface preparation (cleanliness) and effect on weld quality	10	Written	AWS D17.1
30	Selection of cleaning materials and methods used to remove contaminants and oxides on the part and weld wire	10	Written	AWS D17.1
31	Part surface fit-up/gaps and effect on weld quality	10	Written	AWS D17.1
32	Effect of time lapse between cleaning and welding	10	Written	ASM Handbook Vol.5

33	Process sequence between welding and heat treatment when welding heat treatable alloys	10	Written	AWS D17.1
34	WELDING PROCEDURE QUALIFICATION			
35	Purpose of welding procedure qualification	10	Written	ISO 24394, AWS D17.1
36	Classification of welds	10	Written	AWS D17.1, ISO 5817
37	Procedure qualification testing - test methods	10	Written	AWS B2.1
38	Acceptance criteria	10	Written	AWS B2.1
39	Procedure qualification test reports (WPQR) - examination data and test results	10	Written	AWS B2.1
40	Conditions requiring procedure re-qualification	10	Written	AWS B2.1
41	FABRICATION			
42	Tack welds	10	Written	AWS D17.1
43	Preheat and Interpass heating	10		AWS D17.1
44	Weld start and run-off tabs	10	Written	AWS D17.1
45	Gases – Selection of shielding gas and plasma gas	10	Written	AWS A5.30
46	Tungsten electrodes – classification, selection, and tip configurations	10	Written	AWS A5.12, AWS C5.5, ISO 6848
47	Filler materials selection/specification	10	Written	(DIN 65470)
48	Weld repair of castings	7	Written	AMS 2694
49	Filler materials control – purchasing, storage, use, and disposal	10	Written	AWS D17.1
50	Weld settings – Welding Procedure Specification (WPS) Ranges or parameter listings	10	Written	AWS D17.1, ISO 15607
51	Interpass cleaning, including restrictions for removal of titanium discoloration	7	Written	AWS D17.1
52	Post-weld cleaning	7	Written	AWS D17.1
53	Post-weld processing, including weld metal removal	7	Written	AWS D17.1
54	Weld identification	7	Written	AWS D17.1
55	In-process corrections vs. Rework vs. Repair	7	Written	AWS D17.1
56	Record requirements	7	Written	AWS D17.1
57	Weld maps (weld repair of castings)	7	Written	AMS 2694
58	WELD INSPECTION AND TESTING			
59	Test methods used to evaluate weld quality - Visual, NDT, mechanical, metallography	10	Written	AWS WHB-1.9
60	Inspection equipment requirements.	10	Written	
61	Calibration of dimensional measurement equipment	10	Written	ISO 17662
62	Weld classes and the differences in the acceptance criteria	10	Written	AWS D17.1, ISO 5817
63	Understanding of qualification requirements for Visual Weld Inspectors	10	Written	AWS D17.1
64	NDT – understanding of principles and advantages & limitations of Penetrant Inspection of fusion welds	10	Written	AWS WHB-1.9
65	NDT – understanding of principles and advantages & limitations of Magnetic Particle Inspection of fusion welds	10	Written	AWS WHB-1.9
66	NDT – understanding of principles and advantages & limitations of Radiographic Inspection of fusion welds	10	Written	AWS WHB-1.9
67	NDT – understanding of principles and advantages & limitations of Ultrasonic Inspection of fusion welds	10	Written	AWS WHB-1.9
68	Measurement of fusion weld features including throat size, leg length, penetration	10	Written	
69	Weld defects and possible causes	10	Written	AWS WHB-1.9, AWS WHB-2.9
70	Laboratory testing and inspection equipment requirements	7	Written	AWS D17.1
71	Calibration of laboratory testing equipment	7	Written	AWS D17.1
72	Lab and NDT personnel qualification - general knowledge	7	Written	AWS D17.1, ISO 9712
73	SAFETY			
74	Health and safety related to fusion welding equipment	10	Written	AWS Z49.1, ISO 15012, ISO 15011
75	Local safe working requirements	10	Written	Local requirements
	SKILLS Defined within these roles describes the range of skills. The skills required to perform a particular special process task			
76	Ability to read, understand and interpret drawings, specifications and customer flow-down requirements			
77	Ability to convey complete and through work instructions and procedures			
78	Ability to verify, validate, and certify the qualification and witness test results			
79	Apply technical knowledge when solving problems			
80	Ability to identify training needs and coordinate the training			
81	Good communicator at all levels			
	PERSONAL ATTRIBUTES: Are statements that will enable judgment of the person's personal attributes			
82	Be able to work independently with a minimum of supervision	NA	NA	
83	Must have a high degree of integrity	NA	NA	
84	Be attentive to details	NA	NA	
85	Be flexible	NA	NA	
86	Tolerate stress	NA	NA	

87	Exhibit conflict resolution	NA	NA	
88	Decision making ability	NA	NA	
89	Team Worker	NA	NA	
90	Ethical Behavior	NA	NA	
91	Exhibit Leadership			
EXPERIENCE:				
Are the minimum experience requirement expected to demonstrate their competence.				
92	High School Diploma or GED or Secondary Education	NA	NA	
93	Apprenticeship	NA	NA	
94	Industry Training or Courses	NA	NA	
NON-SPECIAL PROCESS RELATED REQUIREMENTS:				
Defined within these rolls are other general or pre-requisite needed				
95	Thorough understanding of Quality Systems per AS9100 or equivalent			
96	Thorough understanding of Control of Non-Conformance for equipment and product including Containment, Customer notification and disposition			
97	Thorough understanding of Root Cause and Corrective Action (RCCA) tool			
98	Responsible for conducting periodic self-audits			

7. DOCUMENT REVISION HISTORY

REVISION DATE	SUMMARY
4 December 2019	Editorial revision to update program name from eQualified to PRI Qualification SM .

ADDENDUM 1

LIST OF INTERNATIONAL STANDARDS & REFERENCE DOCUMENTS FOR FUSION WELDING

SPECIAL PROCESS	DOCUMENT TITLE	DOCUMENT NUMBER
Welding	In-Process Welding of Castings	AMS 2694
Welding	Standard Symbols for Welding, Brazing, and Nondestructive Examination	AWS A2.4
Welding	Standard Welding Terms and Definitions	AWS A3.0M/A3.0
Welding	Specification for Tungsten and Oxide Dispersed Tungsten Electrodes for Arc Welding and Cutting	AWS A5.12M/A5.12
Welding	Guide for the Nondestructive Examination of Welds	AWS B1.10M/B1.10
Welding	Guide for the Visual Examination of Welds	AWS B1.11M/B1.11
Welding	Specification for Welding Procedure and Performance Qualification	AWS B2.1/B2.1M
Welding	Specification for the Qualification of Weld Inspector Specialists and Welding Inspector Assistants	AWS B5.2
Welding	Recommended Practices for Plasma-Arc Welding	AWS C5.1
Welding	Recommended Practices for Gas Tungsten Arc Welding	AWS C5.5/C5.5M
Welding	Recommended Practices for Gas Metal Arc Welding	AWS C5.6
Welding	Guide for Components of Robotic and Automatic Arc Welding Installations	AWS D16.2M/D16.2
Welding	Specification for Fusion Welding for Aerospace Applications	AWS D17.1/D17.1M
Welding	Standard for AWS Certification of Welding Inspectors	AWS QC1
Welding	Welding Handbook Volume 1 - Welding Science and Technology	AWS WHB-1.9
Welding	Welding Handbook - Welding Processes, Part 1 - Volume 2	AWS WHB-2.9
Welding	Welding handbook 9th edition, vol. 3 - welding processes, part 2	AWS WHB-3.9
Welding	Welding handbook volume 4 - materials and applications part 1	AWS WHB-4.9
Welding	Mechanized, Automated, and Robotic Welding	AWS WHC1.11
Welding	Safety in Welding, Cutting and Allied Processes	AWS Z49.1
Welding	Welding and allied processes -- Symbolic representation on drawings -- Welded joints	ISO 2553
Welding	Quality requirements for fusion welding of metallic materials	ISO 3834
Welding	Welding and allied processes -- Nomenclature of processes and reference numbers	ISO 4063
Welding	Destructive tests on welds in metallic materials -- Bend tests	ISO 5173
Welding	Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) — Quality levels for imperfections	ISO 5817
Welding	Welding and allied processes -- Classification of geometric imperfections in metallic materials -- Part 1: Fusion welding	ISO 6520-1
Welding	Welds -- Working positions -- Definitions of angles of slope and rotation	ISO 6947
Welding	Approval testing of welders — Fusion welding — Part 5: Titanium and titanium alloys, zirconium and zirconium alloys	ISO 9606-5
Welding	Welding and allied processes — Types of joint preparation — Part 1: Manual metal arc welding, gas-shielded metal arc welding, gas welding, TIG welding and beam welding of steels	ISO 9692-1
Welding	Welding consumables — Gases and gas mixtures for fusion welding and allied processes	ISO 14175
Welding	Welding consumables — Wire electrodes, strip electrodes, wires and rods for arc welding of stainless and heat resisting steels — Classification	ISO 14343
Welding	Welding coordination -- Tasks and responsibilities	ISO 14731
Welding	Health and safety in welding and allied processes — Laboratory method for sampling fume and gases — Part 3: Determination of ozone emission rate during arc welding	ISO 15011-3
Welding	Specification and qualification of welding procedures for metallic materials — General rules	ISO 15607
Welding	Welding for aerospace applications -- Welding information in design documents	ISO 17533
Welding	Non-destructive testing of welds -- Radiographic testing of fusion-welded joints	ISO 17636
Welding	Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) — Quality levels for imperfections Introduction	ISO 17637
Welding	Welding — Calibration, verification and validation of equipment used for welding, including ancillary activities	ISO 17662
Welding	Welding — Recommendations for welding of metallic materials — Part 1: General guidance for arc welding	ISO/TR 17671-1
Welding	Non-destructive testing of welds -- Penetrant testing of welds -- Acceptance levels	ISO 23277
Welding	Non-destructive testing of welds -- Magnetic particle testing of welds -- Acceptance levels	ISO 23278
Welding	Welding consumables — Solid wire electrodes, solid wires and rods for fusion welding	ISO 24034

	of titanium and titanium alloys — Classification	
Welding	Welding for aerospace applications -- Qualification test for welders and welding operators -- Fusion welding of metallic components	ISO 24394
Welding	Welding and allied processes - Vocabulary - Part 1: General terms	ISO/TR 25901-1
Welding	Welding and allied processes - Vocabulary - Part 3: Welding processes	ISO/TR 25901-3
Welding	Welding and allied processes - Vocabulary - Part 4: Arc welding	ISO/TR 25901-4