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## Program Document BRZBOK

PD 6103

BRZBok-002/PL-2 REV. (N/A)

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### BODY OF KNOWLEDGE:

**ROLE DESCRIPTION:** PLANNER

**SPECIAL PROCESS:** BRAZING

**METHOD:** TORCH BRAZING

All PRI Qualification<sup>SM</sup> program examinations are created using the applicable PRI Qualification 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 Qualification Body of Knowledge Review Boards. All BoKs are updated periodically according to the latest revision of PRI Qualification 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 Qualification program Brazing Body of Knowledge Review Board (BRZ BoKRB) according to the requirements of PD6100.

This document constitutes the PRI Qualification program BoK for Brazing: Torch Brazing for Planner level. It defines the baseline knowledge and experience required to be considered competent to perform this role.

The information in this BoK will provide guidance for the following:

- Training providers who wish to develop training courses intended to support the PRI Qualification program examination candidate preparation
- Brazing Examination Review Board (BRZ-ERB) for the development of PRI Qualification program assessments, both written and practical.
- Candidates taking PRI Qualification program assessments who wish to prepare for their assessment(s) independently

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## 2. REFERENCES

PRI Qualification program documents:

PD6000	Governance & Administration of PRI Qualification Program
PD6100	Industry Managed Special Process Bodies of Knowledge
PD6200	Industry Managed Special Process Examinations System

## 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 Qualification Dictionary.**

**BODY OF KNOWLEDGE (BoK):** Baseline knowledge and experience required to be considered competent for a target position.

**CONTRACT REVIEW WORDING:** The process of reviewing the purchase order for defined quality, processing, delivery and handling requirements prior to accepting the order.

**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 definition of these levels.

**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.

**REQUIRED READING (ADDENDUM 1):** A list of international standards and reference documents for the special process described in the Body of Knowledge. Questions on the associated PRI Qualification theory assessment are based on the documents listed in this list, and the PRI Qualification exam candidate should be familiar with them before taking the theory assessment.

**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.

SUPPLEMENTAL READING LIST (ADDENDUM 2): Documents listed in the Supplemental Reading Addendum are not required documents and will not be the basis of any questions on the PRI Qualification theory assessment associated with this Body of Knowledge. Documents listed here are only included as they may be of interest to individuals who perform the special process described in this Body of Knowledge.

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

As stated in PRI Qualification program PD6200, every exam question shall relate directly to and be derived from the information as detailed in the current revision of the corresponding BoK.

Re-assessment of candidates to this BoK is required every **5 years**, unless otherwise specified.

Candidates are strongly 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 PRI Qualification Approved Providers can be found at [www.p-r-i.org](http://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

For more information on data retention, please see [PRI's privacy statement.](#)

5. LEVELS

<i>Descriptors</i>	<b>Level</b>		
	<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>
<b>Brazing Specific Criteria</b>	<b>No additional criteria for the Torch Brazing process.</b>	<b>No additional criteria for the Torch Brazing process.</b>	<b>No additional criteria for the Torch Brazing process.</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 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:** Planner

**SPECIAL PROCESS:** Brazing

**METHOD:** Torch Brazing

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

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			
	<b>GENERAL KNOWLEDGE</b>			
1	Fundamentals of brazing and torch brazing processes	10	Written	AWS BH, AWS C3.4
2	Knowledge of torch brazing's advantages and limitations	10	Written	AWS BH, AWS C3.4
3	Knowledge of torch brazing's basic process variables	10	Written	AWS BH, AWS C3.4
4	Commonly torch brazed base metals and their properties	10	Written	AWS BH, AWS B2.2, AWS C3.4
5	Standard brazing terms and definitions	10	Written	AWS A3.0
6	Brazing symbols, drawing interpretation	10	Written	AWS A2.4, ISO 2553
7	Basic braze joint configurations and brazing positions	10	Written	AWS A3.0, AWS C3.4, AWS B2.2, ISO 2553
8	Manual, Mechanized, Semi-Automated and Automated Brazing	10	Written	AWS BH, AWS A3.0, AWS B2.2
	<b>EQUIPMENT AND MATERIALS</b>			
9	Gas cylinders, oxygen / hydrogen generators, pressure gauges, gas delivery hoses, regulators, torches, safety equipment, etc.)	10	Written	AWS BH
10	Equipment for non-manual torch brazing (turntables, conveyors, shuttles, brazing filler metal and flux dispensers, etc.)	10	Written	AWS BH
11	Procurement, identification, storage, use, and disposal of filler materials, gases and fluxes	7	Written	Manufacturer's Manual
12	Equipment preventive maintenance	7	Written	Manufacturer's manual, AWS BH
	<b>BRAZER / BRAZING OPERATOR QUALIFICATION</b>			
13	Performance qualification requirements, e.g., by visual inspection or specimen testing	10	Written	AWS B2.2, ISO 11745, ISO 13585
14	Test joint conditions vs. qualified scope	10	Written	AWS B2.2, ISO 11745, ISO 13585
15	Special applications, inspection requirements, other brazing conditions or limitations	10	Written	AWS B2.2, ISO 11745, ISO 13585
16	Qualification test records (BPQ)	10	Written	AWS B2.2, ISO 11745, ISO 13585
17	Additional qualification requirements (experience, OJT/training, testing, and oversight)	7	Written	AWS B2.2, ISO 11745, ISO 13585
18	Continued qualification or re-qualification provisions and requirements	10	Written	AWS B2.2, ISO 11745, ISO 13585
19	Dis-qualification provisions and requirements	10	Written	AWS B2.2, ISO 11745, ISO 13585
	<b>PRE-BRAZING PREPARATION</b>			
20	Part surface preparation (cleanliness) and effect on brazed joint quality	10	Written	AWS BH, HHBB
21	Selection of cleaning materials and methods used to remove contaminants and oxides on the part and filler materials	10	Written	AWS BH, HHBB
22	Part surface condition and fit-up/gaps and effect on braze joint quality	10	Written	AWS BH, HHBB
23	Effect of time lapse or exposure between cleaning and brazing	10	Written	AWS BH, HHBB
24	Process sequence of brazing and pre- or post-brazing heat treatment(s)	10	Written	AWS BH, HHBB
	<b>BRAZING PROCEDURE QUALIFICATION</b>			
25	Purpose of brazing procedure qualification	10	Written	AWS B2.2
26	Classification of braze joints; qualification vs. production	10	Written	AWS B2.2

27	Required test/inspection methods for qualification joints	10	Written	AWS B2.2
28	Test joint acceptance criteria	10	Written	AWS B2.2
29	Procedure qualification test reports (BPS and BPQR) - examination data and test results	10	Written	AWS B2.2
30	Changes in joint design or brazing process requiring procedure re-qualification	10	Written	AWS B2.2
<b>FABRICATION</b>				
31	Equipment and process parameters – Brazing Procedure Specification (BPS) values and ranges	10	Written	AWS B2.2
32	Flux - type, application locations and method(s)	10	Written	AWS BH, AWS C3.4, EN1045, HHBB
33	Assembly methods, tooling/fixtures, tack welding	10	Written	AWS BH, AWS C3.4, HHBB
34	Fuel Gases - type(s), composition, specification(s), flame temperatures	10	Written	AWS BH, AWS C3.4, HHBB
35	Torch - body type, mixer/injector, tip size(s) and shape	10	Written	AWS BH
36	Brazing filler metals - type, specification, form, size	10	Written	AWS A5.8, AWS C3.4, ISO 17672
37	Type of flame, e.g. neutral, oxidizing or carburizing	10	Written	AWS BH, AWS C3.4, HHBB
38	Method(s) and location(s) of introducing filler metal to the joint	10	Written	AWS BH, AWS C3.4, HHBB
39	Heating the joint – sequence, techniques, limitations, etc.	10	Written	AWS BH, HHBB
40	Post-brazing cleaning, including flux removal procedure and materials	10	Written	AWS BH, AWS C3.4, HHBB
41	Post-cleaning inspection/testing for flux removal	10	Written	AWS BH, AWS C3.4, HHBB
42	In-process corrections vs. Rework vs. Repair	7	Written	AWS B2.2, AWS C3.4
43	Record requirements	10	Written	AWS B2.2, AWS C3.4, ISO 9001
<b>BRAZE JOINT INSPECTION AND TESTING</b>				
44	Test methods used to evaluate brazed joint quality - Visual, NDT, mechanical, metallography	10	Written	AWS B2.2, AWS C3.2, AWS C3.4, AWS C3.8
45	Braze joint Classes and their acceptance criteria by each test method	10	Written	AWS B2.2, AWS C3.4
46	Advantages of Radiographic and Ultrasonic Inspection of brazed joints	7	Written	AWS BH, AWS C3.8
47	Limitations of Penetrant Inspection of brazed joints	7	Written	AWS BH
48	Measurement and calculation of brazed joint imperfection(s), external and internal joint areas	7	Written	AWS BH, AWS B2.2
49	Brazed joint imperfections/defects and possible causes	10	Written	AWS BH, HHBB
<b>SAFETY</b>				
50	Health and safety issues related to torch brazing	10	Written	ANSI Z49.1, ISO 15012
51	Local safe working requirements	10	Written	Local regulations
<b>SKILLS</b>				
Defined within these roles describes the range of skills. The skills required to perform a particular special process task				
52	Ability to read, understand and interpret drawings, specifications and customer flow-down requirements	NA	NA	
53	Ability to convey complete and through work instructions and procedures	NA	NA	
54	Ability to verify, validate, and certify the qualification and witness test results	NA	NA	
55	Apply technical knowledge when solving problems	NA	NA	
56	Ability to identify training needs and coordinate the training	NA	NA	
57	Good communicator at all levels	NA	NA	
<b>PERSONAL ATTRIBUTES:</b>				
Are statements that will enable judgment of the person's personal attributes				
58	Be able to work independently with a minimum of supervision	NA	NA	
59	Ability to train and mentor	NA	NA	
60	Writing work instructions and procedures in accordance with top level quality requirements	NA	NA	
61	Ability to responsibly review and approve documents and records	NA	NA	
62	Ability to administer a continuous preventative maintenance plan	NA	NA	
63	Good communicator at all levels	NA	NA	
64	Must have a high degree of integrity	NA	NA	
65	Be attentive to details	NA	NA	
66	Be flexible	NA	NA	
67	Tolerate stress	NA	NA	

68	Exhibit conflict resolution	NA	NA	
69	Decision making ability	NA	NA	
70	Team Worker	NA	NA	
71	Ethical Behavior	NA	NA	
72	Exhibit Leadership			
<b>EXPERIENCE:</b>				
Are the minimum experience requirement expected to demonstrate their competence.				
73	High School Diploma or GED or Secondary Education	NA	NA	
74	Apprenticeship	NA	NA	
75	Industry Training or Courses	NA	NA	
<b>NON-SPECIAL PROCESS RELATED REQUIREMENTS:</b>				
Defined within these rolls are other general or pre-requisite needed				
76	Understanding of Quality Systems	NA	NA	AS9100
77	Understanding of Control of Non-Conformance for equipment and product, including Containment, Customer notification and disposition	NA	NA	
78	Understanding of Root Cause and Corrective Action (RCCA)	NA	NA	
79	Ability to conduct periodic process audits	NA	NA	
<b>CONTRACT REVIEW</b>				
Knowledge of the Quality Management Contract Review process as required for participating in, and contributing to, the following tasks:				
80	Determining the requirements of the product or service	10	W	AS9100 or AC7004
81	Establishing criteria for accepting and performing a process or service	7	W	AS9100 or AC7004
82	Implementing process controls in accordance with the criteria	1	W	AS9100 or AC7004
83	Creating and managing documentation to validate process compliance and define conformance of product characteristics	7	W	AS9100 or AC7004
84	Identifying suitable monitoring and measuring resources implementing them at appropriate stages	7	W	AS9100 or AC7004
85	Validating and controlling the performance of Special Processes	3	W	AS9100 or AC7004
86	Determining the methods of measuring variable data	1	W	AS9100 or AC7004
87	Identifying in-process inspection/verification points	7	W	AS9100 or AC7004
88	Controlling equipment, tools, and software programs	7	W	AS9100 or AC7004
89	Reviewing and controlling changes to the provision of a product or service	10	W	AS9100 or AC7004

7. DOCUMENT REVISION HISTORY

REVISION DATE	SUMMARY
27-May-20	Initial Issue

**ADDENDUM 1**

**LIST OF INTERNATIONAL STANDARDS & REFERENCE DOCUMENTS FOR TORCH BRAZING**

**\*\*\*It is the responsibility of the PRI Qualification Exam Candidate to ensure they are using the most recent revision of the documents listed below. \*\*\***

SPECIAL PROCESS	DOCUMENT TITLE	DOCUMENT NUMBER
Quality	Audit Criteria for Aerospace Management System	AC7004
Brazing	Safety in Welding, Cutting and Allied Processes	ANSI Z49.1
Quality	Quality Management Systems	AS9100
Brazing	Standard Symbols for Welding, Brazing, and Nondestructive Examination	AWS A2.4
Brazing	Standard Welding Terms and Definitions	AWS A3.0
Brazing	Specification for Filler Metal for Brazing and Braze Welding	AWS A5.8
Brazing	Specification for Brazing Procedure and Performance Qualification	AWS B2.2
Brazing	AWS Brazing Handbook	AWS BH
Brazing	Standard Method for Evaluating the Strength of Brazed Joints	AWS C3.2
Brazing	Specification for Torch Brazing	AWS C3.4
Brazing	Specification for the Ultrasonic Pulse-Echo Examination of Brazed Joints	AWS C3.8
Brazing	Brazing - Fluxes for brazing. Classification and technical delivery conditions	EN 1045
Brazing	"The Brazing Book" (Handy & Harman)	HHBB
Brazing	Brazing for aerospace applications - Qualification test for brazers and brazing operators - Brazing of metallic components	ISO 11745
Brazing	Brazing - Qualification test of brazers and brazing operators	ISO 13585
Brazing	Health and Safety in Welding and Allied Processes	ISO 15012
Brazing	Brazing - Filler Metals	ISO 17672
Brazing	Welding and allied processes - Symbolic representation on drawings - Welded joints	ISO 2553
Quality	Quality Management Systems - Requirements	ISO 9001



