



161Thorn Hill Road
Warrendale, PA 15086-7527

Program Document BRZBOK

PD 6103

BRZBok-003/PL-2 REV. (N/A)

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BODY OF KNOWLEDGE:

ROLE DESCRIPTION: PLANNER
SPECIAL PROCESS: BRAZING
METHOD: INDUCTION BRAZING

All PRI QualificationSM 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: Induction 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

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)

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>	Level		
	<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>
Brazing Specific Criteria	No additional criteria for the Induction Brazing process.	No additional criteria for the Induction Brazing process.	No additional criteria for the Induction Brazing 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 a 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: Planner

SPECIAL PROCESS: Brazing

METHOD: Induction Brazing

REFERENCE GUIDELINES: *Addendum 1 is a list of the International Standards and Reference Documents applicable to Induction Brazing 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			
	GENERAL KNOWLEDGE			
1	Fundamentals of brazing and induction brazing processes	10	Written	AWS BH, AWS C3.5
2	Knowledge of induction brazing's advantages and limitations	10	Written	AWS BH, AWS C3.5
3	Knowledge of induction brazing's basic process and essential variables	10	Written	AWS BH, AWS C3.5
4	Commonly induction brazed base metals and their properties	10	Written	AWS BH, AWS B2.2, AWS C3.5
5	Standard brazing terms and definitions	10	Written	AWS A3.0, ISO 857-2
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 C3.5, AWS B2.2, ISO 2553
8	Manual, Mechanized, Semi-Automated and Automated Brazing	10	Written	AWS BH, AWS A3.0, AWS B2.2
	EQUIPMENT AND MATERIALS			
9	Coil size and configuration, coil material and form, turn spacing, number of turns, distance to work surface, conductor diameter.	10	Written	AWS C3.5, AWS BH
10	Type and power capacity of induction generator for producing appropriate heating rates and brazing temperatures	10	Written	AWS C3.5, AWS BH
11	Devices for sensing/monitoring or controlling of temperature	10	Written	AWS C3.5, AWS BH
12	Equipment for water cooling; fixtures and handling equipment	7	Written	AWS C3.5, AWS BH
13	Devices for monitoring/controlling the protective atmosphere	7	Written	AWS C3.5
14	Procurement, identification, storage, use, and disposal of filler materials, gases and fluxes	7	Written	Manufacturer's Manual
15	Equipment preventive maintenance	7	Written	Manufacturer's Manual, AWS BH
	BRAZER / BRAZING OPERATOR QUALIFICATION			
16	Performance qualification requirements, e.g., by visual inspection or specimen testing	10	Written	AWS B2.2, ISO 11745, ISO 13585
17	Test joint conditions vs. qualified scope	10	Written	AWS B2.2, ISO 11745, ISO 13585
18	Special applications, inspection requirements, other brazing conditions or limitations	10	Written	AWS B2.2, ISO 11745, ISO 13585
19	Qualification test records (BPQ)	10	Written	AWS B2.2, ISO 11745, ISO 13585
20	Additional qualification requirements (experience, OJT/training, testing, and oversight)	7	Written	AWS B2.2, ISO 11745, ISO 13585
21	Continued qualification or re-qualification provisions and requirements	10	Written	AWS B2.2, ISO 11745, ISO 13585
22	Dis-qualification provisions and requirements	10	Written	AWS B2.2, ISO 11745, ISO 13585
	PRE-BRAZING PREPARATION			
23	Part surface preparation (cleanliness) and effect on brazed joint quality; requirement for nickel plating	10	Written	AWS BH, AWS C3.5
24	Selection of cleaning materials and methods used to remove contaminants and oxides on the part and filler materials	10	Written	AWS BH

25	Part surface condition and fit-up/gaps and effect on braze joint quality	10	Written	AWS BH
26	Effect of time lapse or exposure between cleaning and brazing	10	Written	AWS BH
27	Process sequence of brazing and pre- or post-brazing heat treatment(s)	10	Written	AWS BH
BRAZING PROCEDURE QUALIFICATION				
28	Purpose of brazing procedure qualification	10	Written	AWS B2.2
29	Classification of braze joints; qualification vs. production	10	Written	AWS B2.2
30	Required test/inspection methods for qualification joints	10	Written	AWS B2.2
31	Test joint acceptance criteria	10	Written	AWS B2.2
32	Procedure qualification test reports (BPS and BPQR) - examination data and test results	10	Written	AWS B2.2
33	Changes in joint design or brazing process requiring procedure re-qualification	10	Written	AWS B2.2
FABRICATION				
34	Equipment and process parameters – Brazing Procedure Specification (BPS) values and ranges	10	Written	AWS B2.2
35	Flux - type, application locations and method(s), time required for drying	10	Written	AWS BH, AWS C3.5, EN1045
36	Assembly methods, tooling/fixtures, tack welding	10	Written	AWS BH, AWS C3.5
37	Controlled Atmosphere – Type/composition, equipment/devices used to create and maintain	10	Written	AWS BH, AWS C3.5
38	Equipment parameter settings - coil position and verification	10	Written	AWS BH, AWS C3.5
39	Brazing filler metals - type, specification, form, size	10	Written	AWS A5.8, AWS C3.5, ISO 17672, ISO 3677
40	Method(s) and location(s) of preplacing filler metal to the joint, requirements for drying of paste and flux	10	Written	AWS BH, AWS C3.5
41	Type and application of stopoff	7	Written	AWS C3.5
42	Post-brazing cleaning, including flux removal procedure and materials	10	Written	AWS BH, AWS C3.5
43	Post-cleaning inspection/testing for flux removal	10	Written	AWS BH, AWS C3.5
44	In-process corrections – Rebrazing vs. Rework vs. Repair	7	Written	AWS B2.2, AWS C3.5
45	Record requirements	10	Written	AWS B2.2, AWS C3.5, ISO 9001
BRAZE JOINT INSPECTION AND TESTING				
46	Test methods used to evaluate brazed joint quality - Visual, NDT, mechanical, metallography	10	Written	AWS B2.2, AWS C3.2, AWS C3.5, AWS C3.8, AWS C3.14
47	Braze joint Classes and the acceptance criteria for external and internal discontinuities by each test method	10	Written	AWS B2.2, AWS C3.5, ISO 18279
48	Advantages of Radiographic and Ultrasonic Inspection of brazed joints	7	Written	AWS BH, AWS C3.8
49	Limitations of Penetrant Inspection of brazed joints	7	Written	AWS BH
50	Measurement and assessment of external and internal brazed joint features -discontinuities and dimensional features	10	Written	AWS B2.2, AWS C3.5, ISO 18279
51	Brazed joint discontinuities and possible causes	10	Written	AWS BH
SAFETY				
52	Health and safety issues related to induction brazing	10	Written	ANSI Z49.1, ISO 15012
53	Local safe working requirements	10	Written	Local regulations
SKILLS				
Defined within these roles describes the range of skills. The skills required to perform a particular special process task				
54	Ability to read, understand and interpret drawings, specifications and customer flow-down requirements	NA	NA	
55	Ability to convey complete and through work instructions and procedures	NA	NA	
56	Ability to verify, validate, and certify the qualification and witness test results	NA	NA	
57	Apply technical knowledge when solving problems	NA	NA	
58	Ability to identify training needs and coordinate the training	NA	NA	
59	Good communicator at all levels	NA	NA	
PERSONAL ATTRIBUTES:				
Are statements that will enable judgment of the person's personal attributes				
60	Be able to work independently with a minimum of supervision	NA	NA	
61	Ability to train and mentor	NA	NA	
62	Writing work instructions and procedures in accordance with top level quality requirements	NA	NA	

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

7. DOCUMENT REVISION HISTORY

REVISION DATE	SUMMARY
00/00/0000	Initial Issue

ADDENDUM 1

LIST OF INTERNATIONAL STANDARDS & REFERENCE DOCUMENTS FOR INDUCTION 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
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 Induction Brazing	AWS C3.5
Brazing	Specification for the Ultrasonic Pulse-Echo Examination of Brazed Joints	AWS C3.8
Brazing	Standard Method for Evaluation of Brazed Joints Using Visual and Metallographic Techniques	AWS C3.14
Brazing	Brazing - Fluxes for brazing. Classification and technical delivery conditions	EN 1045
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
Brazing	Brazing - Imperfections in brazed joints	ISO 18279
Brazing	Welding and allied processes — Vocabulary Part 2	ISO 857-2
Brazing	Filler metal for soldering and brazing — Designation	ISO 3677

ADDENDUM 2

SUPPLEMENTAL READING LIST

***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 below are only included as they may be of interest to individuals who perform Induction Brazing processes. ***

SPECIAL PROCESS	DOCUMENT TITLE	DOCUMENT NUMBER
Brazing	Specification for Fluxes for Brazing and Braze Welding	AWS A5.31
Brazing	Brazing: Destructive Testing of Brazed Joints	EN 12797
Brazing	Brazing: Non-Destructive Examination of Brazed Joints	EN 12799
Brazing	Brazing: Procedure Approval	EN 13134
Brazing	"The Brazing Book" (Handy & Harman)	HHBB