



161 Thorn Hill Road  
Warrendale, PA 15086-7527

## Program Document WLDBoK

PD 6103

WLDBoK-004/PL-2 REV. N/A

Issued: 13 March 2023

Revised: N/A

Superseding: PD 6103

### BODY OF KNOWLEDGE:

**ROLE DESCRIPTION:** Planner

**SPECIAL PROCESS:** Welding

**METHOD:** Performance of Laser Beam Welding Requirements

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

This document constitutes the PRI Qualification program BoK for (Welding, Laser Beam Welder, Planner). 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.
- Welding Examination Review Board (WLD-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](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

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

**METHOD:** Laser Beam Welding

**REFERENCE GUIDELINES:** *Addendum 1 is a list of the International Standards and Reference Documents applicable to Laser Welding 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.	Definition & fundamentals of fusion welding including Laser Beam Welding (LBW)	10	W	AWS WHB-1, AWS C7.2
2.	Fundamentals of laser beam welding processes including heat source, power density, focal point, focal spot size, keyhole vs conduction mode welding, power curves, etc.	10	W	AWS C7.2, AWS WHB-3
3.	Laser beam welding beam equipment including characteristics of different types, beam focus, beam quality, essential variables etc.	10	W	AWS C7.2, AWS WHB-3
4.	Safety	7	W	AWS C7.2
5.	Advantages and limitations of Laser Beam Welding process	7	W	AWS C7.2, AWS WHB-3
6.	Basic process variables and qualitative effect on weld including beam quality, power density, working distance, pulse characteristics, travel speed, spot size, beam focus, beam upslope/downslope, preheat, method of preheat, shielding gas, etc.	10	W	AWS C7.2
7.	Commonly welded materials and their properties	7	W	AWS WHB-1, AWS WHB-3, AWS WHB-4, AWS WHB-5, AWS C7.2
8.	Basic (Qualitative) Weld Metallurgy including parts of weld, terms such as HAZ, general effects of heat & effect on properties including defects	7	W	AWS WM 1.4 AWS WHB-1, AWS WHB-4, AWS WHB-5, AWS C7.2
9.	Standard terms and definitions	7	W	AWS A3.0, AWS WHB-1, AWS C7.2
10.	Welding symbols – drawing interpretation	7	W	AWS WHB-1, AWS A2.4, ISO 2553
11.	Basic joint configurations	7	W	AWS WHB-1, AWS C7.2, AWS D17.1, AWS A2.4, AWS DPW, ISO 17927-1, ISO 17927-2
	<b>LASER BEAM WELDING EQUIPMENT</b>			
12.	Monitoring & Control of LBW including beam control, beam characteristics, beam oscillation, beam movement, etc.	7	W	AWS WHB-1, AWS C7.2
13.	Basics of Mechanized, Semi-Automated, Automated, and Robotic Welding, (workpiece/gun movement, seam trackers, wire feeders, alignment, rotation, fixturing, etc.)	3	W	AWS WHB-1, AWS C7.2
14.	Welding equipment qualification – purpose, scope, qualification procedure, equipment qualification record	10	W	AWS C7.4, AWS C7.2
15.	Calibration of equipment (machine and power source) – purpose, scope, calibration procedure, laser beam diagnostic devices	10	W	AWS D17.1, AWS C7.4, AWS C7.2, ISO 17927-1
16.	Control of electronic programs and data	7	W	AWS C7.4
17.	Procedures & practice for equipment preventive maintenance including tooling, fixtures, inspection for suitability of use, optic systems, gases, laser power, alignment inspection, rotational and mechanical acceptability, records.	7	W	AWS WHB-4, AWS C7.4, AWS C7.2
18.	Fixturing – design, materials, calibration or verification	7	W	AWS WHB-1, AWS D17.1, AWS C7.2, AWS C7.4

Row #	COMPETENCE	Weight (1,3,7,10)	Exam Type Written/ Practical	Reference Guidelines
	<b>WELDING OPERATOR QUALIFICATION</b>			
19.	Performance qualification requirements, including equipment operation, visual acuity, record keeping, acceptance criteria, experience (OJT), training, testing, and oversight, etc.	7	W	AWS WHB-1, AWS WHB-3, AWS D17.1, AWS B2.1, AWS C7.2, AWS C7.4
20.	Welding operator qualification – test weld conditions (thickness, base metal groups, procedure qual. variables, etc.) vs. qualified scope	7	W	AWS WHB-1, AWS WHB-3, AWS D17.1, AWS C7.2, AWS C7.4, ISO 24394
21.	Welding operator qualification – special applications, inspection requirements, other welding conditions	7	W	AWS WHB-1, AWS WHB-3, AWS D17.1, AWS C7.2, AWS B2.1, ISO 24394
22.	Welding Operator qualification test records	3	W	AWS WHB-1, AWS WHB-3, AWS D17.1, AWS C7.2, AWS C7.4, ISO 24394
23.	Re-qualification requirements	3	W	AWS D17.1, AWS C7.2, AWS C7.4, ISO 24394
24.	Disqualification criteria	3	W	AWS D17.1, ISO 24394
	<b>PRE-WELD PREPARATION</b>			
25.	Joint design	7	W	AWS WHB-1, AWS WHB-3, AWS C7.2, AWS D17.1
26.	Part and tooling surface preparation (including cleanliness, reflectivity, and effect on weld quality)	10	W	AWS WHB-1, AWS WHB-3, AWS C7.2, AWS D17.1, ISO 17927-1
27.	Selection of cleaning materials, methods, cleaning tool types & materials of tools used to remove contaminants and oxides on the part and consumables	7	W	AWS WHB-1, AWS WHB-3, AWS C7.2, AWS D17.1, ISO 17927-1
28.	Part surface fit-up/gaps and effect on weld quality	7	W	AWS WHB-1, AWS WHB-3, AWS C7.2, AWS D17.1
29.	Effect of time lapse between cleaning and welding	3	W	AWS WHB-1, AWS WHB-3, AWS C7.2
30.	Process sequence between welding and heat treatment when welding heat treatable alloys	3	W	AWS WHB-1, AWS WHB-3, AWS C7.2
	<b>WELDING PROCEDURE QUALIFICATION</b>			
31.	Purpose & process of welding procedure qualification including data to be recorded such as laser power, speed, tooling / fixtures, preheat, post heat etc.	7	W	AWS WHB-1, AWS WHB-3, AWS C7.2, AWS B2.1, AWS D17.1, ISO 17927-1 ISO 15609-04
32.	Classification of welds	7	W	AWS C7.4, AWS D17.1, ISO 17927-1 ISO 15609-04
33.	Procedure qualification testing - test methods	3	W	AWS WHB-1,

Row #	COMPETENCE	Weight (1,3,7,10)	Exam Type Written/ Practical	Reference Guidelines
				AWS WHB-3, AWS B2.1, AWS C7.2, AWS D17.1 ISO 15609-04
34.	Acceptance criteria	10	W	AWS WHB-1, AWS WHB-3, AWS C7.2, AWS D17.1 ISO 15609-04
35.	Procedure qualification test reports (WPQR) - examination data and test results	7	W	AWS WHB1, AWS WHB-3, AWS B2.1 AWS D17.1 ISO 15609-04
36.	Conditions requiring procedure re-qualification	3	W	AWS WHB-1, AWS WHB-3, AWS B2.1, AWS D17.1 ISO 15609-04
<b>FABRICATION</b>				
37.	Tack welds including qualified vs. unqualified procedures, etc.	3	W	AWS WHB-3, AWS C7.2, AWS D17.1
38.	Weld start and run-off tabs including purpose, control, allowed material, size, attachment mechanism, cleanliness, qualification if needed, etc.	3	W	AWS C7.2, AWS D17.1
39.	Filler materials if used: reason for use, form, selection/specification, etc.	7	W	AWS WHB-3, AWS D17.1
40.	Filler materials control if used: purchasing, storage, use, and disposal	3	W	AWS WHB-3, AWS C7.2, AWS D17.1
41.	Weld settings – Welding Procedure Specification (WPS) Ranges or parameter listings	7	W	AWS WHB-3, AWS C7.2, AWS D17.1
42.	Post-weld cleaning including removal of discolored surfaces and spatter, material compatibility of tools, etc.	10	W	AWS WHB-3, AWS C7.2, AWS D17.1
43.	Post-weld processing, including weld metal removal, heat treatment, documentation with respect to weld procedure, etc.	10	W	AWS WHB-3, AWS C7.2
44.	Rework vs. Repair	3	W	AWS D17.1, ISO 17927-1
45.	Record requirements	7	W	AWS D17.1, ISO 17927-1
<b>WELD INSPECTION AND TESTING</b>				
46.	Test methods used to evaluate weld quality - Visual, other NDE methods, mechanical, metallography	10	W	AWS WHB-1, AWS C7.2, AWS D17.1
47.	Common Laser weld metallurgy, defects and cause including lack of fusion, missed joint, porosity, cracking, etc.	10	W	AWS WHB-1, AWS C7.2, AWS D17.1
48.	Inspection equipment requirements including calibration, inspection for viability, timing of inspections, record, etc.	3	W	AWS WHB-1, AWS C7.2, AWS D17.1
49.	Calibration of dimensional measurement equipment	3	W	AWS WHB-1, AWS C7.4, AWS D17.1
50.	Weld classes and the differences in the acceptance criteria	7	W	AWS WHB-1, AWS C7.4, AWS D17.1, ISO 17927-1, ISO 17927-2
51.	Understanding of qualification requirements for Visual Weld Inspectors	7	W	AWS WHB-1, AWS C7.4, AWS D17.1
52.	NDT – understanding of principles and advantages & limitations of Penetrant Inspection of laser beam welds	3	W	AWS WHB-1, AWS C7.4, AWS D17.1
53.	NDT – understanding of principles and advantages & limitations of Magnetic Particle Inspection of laser beam welds	3	W	AWS WHB-1, AWS C7.4, AWS D17.1
54.	NDT – understanding of principles and advantages & limitations of Radiographic Inspection of	3	W	AWS WHB-1,



Row #	COMPETENCE	Weight (1,3,7,10)	Exam Type Written/	Reference Guidelines
	laser beam welds			AWS C7.4, AWS D17.1
55.	Measurement of laser beam weld features including reinforcement, underfill, undercut, penetration, misalignment, etc.	10	W	AWS WHB-1, AWS C7.4
56.	Laboratory testing and inspection equipment requirements as applicable to LBW	3	W	AWS WHB-1, AWS C7.4, AWS D17.1
57.	Calibration of laboratory testing equipment	3	W	AWS WHB-1, AWS C7.4, AWS D17.1
58.	Lab and NDT personnel qualification - general knowledge	3	W	AWS WHB-1, AWS C7.4, AWS D17.1
<b>SKILLS:</b> The skills required to perform a particular special process task				
59.	Ability to read, understand and interpret drawings, specifications and customer flow-down requirements	NA	NA	
60.	Ability to convey complete and through work instructions and procedures	NA	NA	
61.	Ability to verify, validate, and certify the qualification and witness test results	NA	NA	
62.	Apply technical knowledge when solving problems	NA	NA	
63.	Ability to identify training needs and coordinate the training	NA	NA	
64.	Good communicator at all levels	NA	NA	
<b>PERSONAL ATTRIBUTES:</b> Are statements that will enable judgment of the person's personal attributes				
65.	Be able to work independently with a minimum of supervision	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	NA	NA	
<b>EXPERIENCE:</b> 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	
<b>NON-SPECIAL PROCESS RELATED REQUIREMENTS:</b> Defined within these rows are other general duties or pre-requisites needed to perform the role described in this BoK				
78.	Thorough understanding of Quality Systems per AS9100 or equivalent	NA	NA	
79.	Thorough understanding of Control of Non-Conformance for equipment and product including Containment, Customer notification and disposition	NA	NA	
80.	Thorough understanding of Root Cause and Corrective Action (RCCA) tool	NA	NA	
81.	Responsible for conducting periodic self-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:				
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

8. DOCUMENT REVISION HISTORY

REVISION DATE	SUMMARY
XXX March 2023	Initial publication

Uncontrolled if Printed

## ADDENDUM 1

## LIST OF INTERNATIONAL STANDARDS &amp; REFERENCE DOCUMENTS FOR LASER BEAM WELDING

\*\*\*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
Welding	Nadcap Audit Criteria for Quality Management System	AC 7004
Welding	Certification for Aerospace Quality Management	AS 9100
Welding	Standard Symbols for Welding, Brazing, and Nondestructive Examination	AWS A2.4
Welding	Standard Welding Terms and Definitions	AWS A3.0/A3.0M
Welding	Specification for Welding Procedure and Performance Qualification	AWS B2.1/B2.1M
Welding	Recommended Practices for Laser Beam Welding, Cutting, and Allied Processes	AWS C7.2M
Welding	Process Specification and Operator Qualification for Laser Beam Welding	AWS C7.4/C7.4M
Welding	Specification for Fusion Welding for Aerospace Applications	AWS D17.1/D17.1M
Welding	Design and Planning Manual for Cost-Effective Welding	AWS DPW
Welding	Welding Handbook - Volume 1, Welding and Cutting Science and Technology	AWS WHB-1
Welding	Welding Handbook - Volume 3, Welding Processes, Part 2	AWS WHB-3
Welding	Welding Handbook - Volume 4, Materials and Applications, Part 1	AWS WHB-4
Welding	Welding Handbook - Volume 5, Materials and Applications, Part 2	AWS WHB-5
Welding	Welding Metallurgy, Vol. 1: Fundamentals	AWS WM1.4
Welding	Safety in Welding, Cutting and Allied Processes	AWS Z49.1
Welding	Welding for aerospace applications — Fusion welding of metallic components — Part 1: Process specification	ISO 17927-1
Welding	Welding for aerospace applications — Fusion welding of metallic components — Part 2: Acceptance criteria	ISO 17927-2
Welding	Welding for aerospace applications — Qualification test for welders and welding operators — Fusion welding of metallic components	ISO 24394

## 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 Welding processes. \*\*\*

SPECIAL PROCESS	DOCUMENT TITLE	DOCUMENT NUMBER
Welding	Guide for the Nondestructive Examination of Welds	AWS B1.10/B1.10M
Welding	Guide for the Visual Examination of Welds	AWS B1.11/B1.11M
Welding	Specification for the Qualification of Weld Inspector Specialists and Welding Inspector Assistants	AWS B5.2
Welding	Guide for Components of Robotic and Automatic Arc Welding Installations	AWS D16.2/D16.2M
Welding	Recommended Safe Practice for Electron Beam Welding and Cutting	AWS F2.1
Welding	Standard for AWS Certification of Welding Inspectors	AWS QC1