AWS C7.4/C7.4M:2017
An American National Standard

Process Specification and Operator Qualification for Laser Beam Welding

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American National Standards Institute
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Process Specification and Operator Qualification for Laser Beam Welding

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Prepared by the
American Welding Society (AWS) C7 Committee on High Energy Beam Welding and Cutting

Under the Direction of the
AWS Technical Activities Committee

Approved by the
AWS Board of Directors

Abstract

This specification on laser beam welding discusses applicable specifications, safety, requirements, fabrication, quality examination, equipment calibration and maintenance, approval of work, and delivery of work.

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Foreword

This foreword is not part of this standard but is included for informational purposes only.

In the year 2010 the laser industry celebrated the 50th Anniversary of the invention of the laser. Since its introduction, the output power of lasers has increased to the level where the use of lasers for material processing has become widespread worldwide. Lasers are accepted as industrial tools for various materials processing applications. The main subjects of this document are process specifications for laser welding and welding operator qualifications.

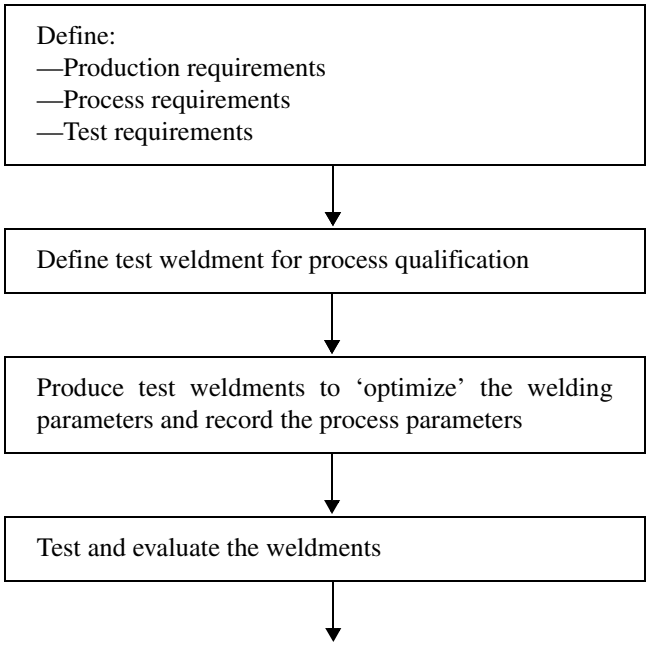
This is the second edition of the C7.4/C7.4M. This update was prepared recognizing the technological changes in lasers, beam delivery optics, laser beam diagnostic technology, and real time process monitoring. Furthermore, the Committee also recognized the need for formal training and qualification of the technical staff that is necessary to qualify the welding equipment and the laser welding process. With this document, the C7 Committee and the C7C Subcommittee hope to provide a working document for manufacturing professionals and educators involved in industrial laser welding.

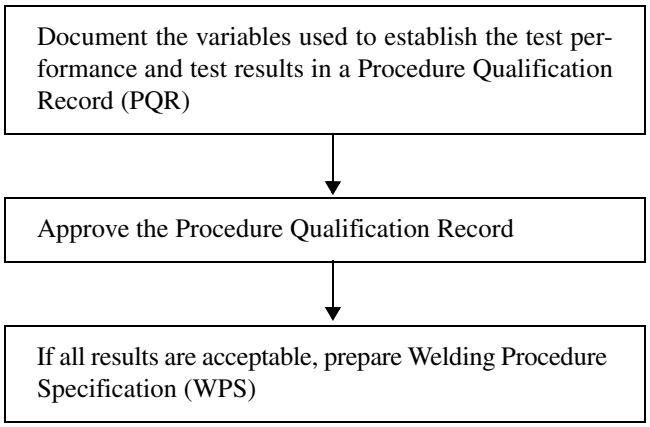
The information contained in this *Process Specification and Operator Qualification for Laser Beam Welding* has been compiled and reviewed by the C7C Laser Beam Welding and Cutting Subcommittee of the American Welding Society, which includes representatives from manufacturers and users of laser beam welding equipment.

Flow Diagrams below are provided as guidelines* to the reader.

Laser Weld Procedure Qualification

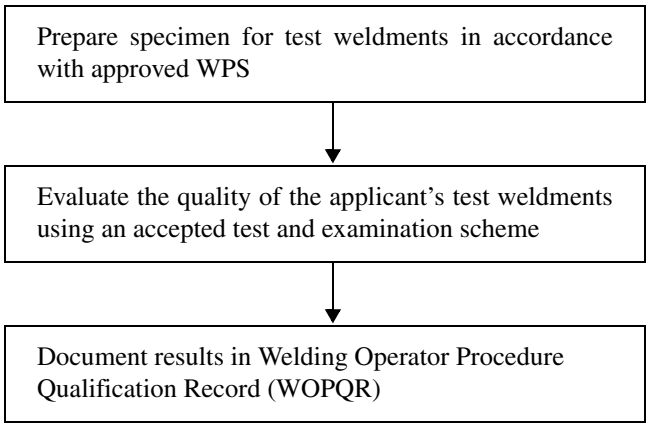
The 'Employer' or the 'Manufacturer' using Engineering and Production Resources should follow this suggested procedure for a laser welding program:





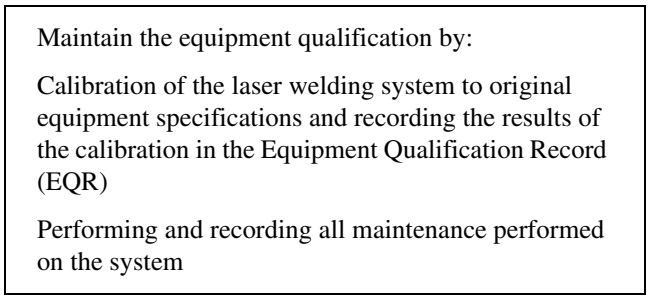
Laser Welding Operator Qualification

To qualify a person (Applicant) as a laser 'Welder' or the 'Welding Operator,' the Test Site Administrator (TSA) of the AWS Accredited Testing Facility (ATF), or a Certified Welding Inspector (CWI), should follow this suggested procedure:



Laser Welding Equipment Qualification

To qualify the laser welding equipment for engineering, production welds, or Welding Operator Qualification, the 'Employer,' the 'Manufacturer,' or the 'Test Site Administrator' should follow this suggested procedures and maintain the corresponding records:



*Reference: AWS B2.1/B2.1M:2009-ADD1, *Specifications for Welding Procedure and Performance Qualification*.

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Process Specification and Operator Qualification for Laser Beam Welding

1. General Requirements

1.1 Scope. This specification covers the preparation, the process control, and quality control requirements for laser beam welding. Welding equipment includes Gas Lasers (CO_2) and Solid-State Lasers (Nd:YAG, Yb:YAG, Nd:Glass, Diode, Ruby, Disk and Fiber) in pulsed, continuous wave (CW), and quasi-continuous wave (QCW) output as defined in AWS A3.0M/A3.0, *Standard Welding Terms and Definitions*.

Tutorial information regarding techniques of welding or details of equipment setup or operation is beyond the scope of this specification. For more information on this subject and recommended practices, refer to the latest published version of AWS C7.2, *Recommended Practices for Laser Welding, Cutting, and Allied Processes*.

1.1.1 Materials. This specification covers all major engineering alloys including:

(1) Ferrous Alloys (e.g., Carbon steels, stainless steels, etc.);

(2) Nonferrous Alloys (e.g., Alloys of Al, Ni, Ti, etc. and Super-alloys);

(3) Heat-Resisting and Refractory Metal Alloys (e.g., Alloys of Mo, Ta, W, etc.);

(4) Other Alloys (e.g., Be and Cu alloys, precious metals);

(5) Nonmetals (Plastics, polymers, etc.).

1.1.2 Qualification Categories. There are three categories to which welds may be qualified: Class A, B, or C. Classification levels are intended to delineate inspection level and process control. Examples of acceptance criteria, which may be applied to the classification levels, are presented in Annex D.

1.1.2.1 Class A—Critical Applications. Critical weldments include those where a failure of any portion of a weldment would cause loss of system, loss of major component, loss of control, unintentional release of critical stores, such as fuel or cargo, or endangerment of personnel.

1.1.2.2 Class B—Semicritical Applications. Semicritical weldments include those where a failure of any portion of a weldment would reduce the overall efficiency of the system, but loss of the system or endangerment of personnel would not be experienced.

1.1.2.3 Class C—Noncritical Applications. Noncritical weldments include those where a failure of any portion of a weldment would not affect the efficiency of the system or endanger personnel.

1.2 Units of Measure. This standard makes use of both U.S. Customary Units and the International System of Units (SI). The latter are shown within brackets [ ] or in appropriate columns in tables and figures. The measurements may not be exact equivalents; therefore, each system must be used independently.

1.3 Safety. Safety and health issues and concerns are beyond the scope of this standard; some safety and health information is provided, but such issues are not fully addressed herein.

Safety and health information is available from the following sources:

American Welding Society:

(1) ANSI Z49.1, *Safety in Welding, Cutting, and Allied Processes*

(2) AWS Safety and Health Fact Sheets

(3) Other safety and health information on the AWS website