



An American National Standard



Recommended Practices for Laser Beam Welding, Cutting, and Allied Processes



American Welding Society



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Recommended Practices for Laser Beam Welding, Cutting, and Allied Processes

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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 document presents recommended practices for laser beam welding, cutting, drilling, and transformation hardening. It is intended to cover common applications of the process. Processes definitions, safe practices, general process requirements and inspection criteria are provided.



American Welding Society

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Foreword

This foreword is not part of AWS C7.2M:2010, *Recommended Practices for Laser Beam Welding, Cutting, and Allied Processes*, but is included for informational purposes only.

The first practical demonstration of a laser occurred in 1960. As laser output power increased through maturing technology, the use of lasers for material processing became widespread by the early 1970s. Currently, lasers are an accepted industrial tool for traditional and nontraditional materials processing operations that benefit from the laser's unique characteristics. While the materials processing applications of lasers in industry are diverse, this document focuses on welding, cutting, drilling, and transformation hardening.

The data contained in this *Recommended Practices* has been compiled and reviewed by the C7C Laser Beam Welding and Cutting Subcommittee of the American Welding Society, which included representatives from manufacturers and users of laser beam welding, cutting, and drilling equipment.

As industrial lasers gain wider acceptance, there is a greater need for skilled process engineers and technicians. The American Welding Society is contributing in this regard, by offering these *Recommended Practices for Laser Beam Welding, Cutting, and Allied Processes*. The intended users of these *recommended practices* are engineers and technicians involved, or planning to become involved, in laser materials processing.

It should be noted that the operating and processing parameters given in this Standard may not be the only parameter combinations that can be employed for successfully processing the materials and thicknesses shown. Changes in material chemistry, dimensional tolerances, laser beam characteristics, machine calibration, and other factors can produce different results. Therefore, the procedures presented here are simply meant to provide a set-up and design guide to help users to organize and learn the process of developing and refining a particular application.

Comments and suggestions for the improvement of this standard are welcome. They should be sent to the Secretary, AWS C7 Committee on High-Energy Beam Welding and Cutting, American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126.

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Recommended Practices for Laser Beam Welding, Cutting, and Allied Processes

1. Scope

These recommended practices present a description of laser beam equipment and procedures that can be used for welding, cutting, drilling, and transformation hardening of various materials. These recommended practices stress the process basics, parameters, and applications. Practical information has been included in the form of figures, tables, and graphs which should prove useful in determining capabilities and limitations in the processing of various materials. Readers who desire additional information about lasers and laser materials processing should consult the Reference Documents shown in Annex A, as well as the various references given throughout this document.

Any specific manufacturer product depicted in any sketch, figure, table, or product description in the document, shall not be construed as an endorsement of that particular manufacturer or product by AWS.

This standard makes sole use of the International System of Units (SI).

Safety and health issues may not be fully addressed by this standard. Users of this standard should consult ANSI Z49.1, *Safety in Welding, Cutting, and Allied Processes*, applicable federal, state, and local regulations, and other relevant documents concerning safety and health issues not addressed herein. ANSI Z136.1, *Safe Use of Lasers*, is another important source for safe operation of laser equipment. Please consult Clause 4 for more information.

2. Normative References

The following standard contains provisions which, through reference in this text, constitute provisions of this AWS standard. For undated references, the latest edition of the referenced standard shall apply. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply.

AWS Documents:¹

AWS A3.0, *Standard Welding Terms and Definitions*

3. Terms and Definitions

The following terms and definitions are specific to laser beam material processing. Terms that are not part of common welding vocabulary are defined and the definitions of some standard welding terms are changed slightly to more accurately describe those terms as they apply to the laser beam process. Common terms pertaining to all welding processes that are not listed in this compilation shall be found in AWS A3.0, *Standard Welding Terms and Definitions*. Some of the Terms and Definitions have been extracted from *The Photonic Dictionary*.

For the purposes of this document, the following definitions apply:

absorption. The transfer of electromagnetic energy to an atom or a group of atoms that may be in a gas, gaseous plasma, liquid, or solid form. This energy may be released as heat (dissipative absorption) or re-emitted as electromagnetic energy. Most laser material processing involves the transfer of energy by dissipative absorption.

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