



Standard Guide for Directed Energy Deposition of Metals¹

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1. Scope

1.1 Directed Energy Deposition (DED) is used for repair, rapid prototyping and low volume part fabrication. This document is intended to serve as a guide for defining the technology application space and limits, DED system set-up considerations, machine operation, process documentation, work practices, and available system and process monitoring technologies.

1.2 DED is an additive manufacturing process in which focused thermal energy is used to fuse materials by melting as they are being deposited.

1.3 DED Systems comprise multiple categories of machines using laser beam (LB), electron beam (EB), or arc plasma energy sources. Feedstock typically comprises either powder or wire. Deposition typically occurs either under inert gas (arc systems or laser) or in vacuum (EB systems). Although these are the predominant methods employed in practice, the use of other energy sources, feedstocks and atmospheres may also fall into this category.

1.4 The values stated in SI units are to be regarded as standard. All units of measure included in this guide are accepted for use with the SI.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 The latest version of the specifications referenced below should be used, unless specifically referenced otherwise in the main document.

2.2 ASTM Standards:²

¹ This test method is under the jurisdiction of ASTM Committee F42 on Additive Manufacturing Technologies and is the direct responsibility of Subcommittee F42.05 on Materials and Processes.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

B214 Test Method for Sieve Analysis of Metal Powders
C1145 Terminology of Advanced Ceramics
D6128 Test Method for Shear Testing of Bulk Solids Using the Jenike Shear Tester
E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves
E1316 Terminology for Nondestructive Examinations
E1515 Test Method for Minimum Explosible Concentration of Combustible Dusts
F327 Practice for Sampling Gas Blow Down Systems and Components for Particulate Contamination by Automatic Particle Monitor Method
F2971 Practice for Reporting Data for Test Specimens Prepared by Additive Manufacturing

2.3 ISO/ASTM Standards:³

52900 Additive Manufacturing—General Principles—Terminology
52921 Standard Terminology for Additive Manufacturing—Coordinate Systems and Test Methodologies

2.4 ASQ Standard⁴

ASQ C-1 Specification of General Requirement For A Quality Program

2.5 AWS Standards:⁵

A3.0/A3.0M Standard Welding Terms and Definitions
A5.01/A5.01M Procurement Guidelines for Consumables—Welding and Allied Processes
A5.02/A5.02M Specification for Filler Metal—Standard Sizes Packaging and Physical Attributes
A5.14/A5.14M Specification for Nickel and Nickel-Alloy Bare Welding Electrodes and Rods
A5.16/A5.16M Specification for Titanium and Titanium-Alloy Welding Electrodes and Rods

2.6 DIN Standard:

DIN 4188 Screening Surfaces; Wire Screens for Test Sieves, Dimensions

³ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

⁴ Available from American Society for Quality, P.O. Box 3005, Milwaukee, WI 53201-3005.

⁵ Available from American Welding Society (AWS), 8669 NW 36 St., #130, Miami, FL 33166-6672, <http://www.aws.org>.