

Guide for the Nondestructive Examination of Welds



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Guide for the Nondestructive Examination of Welds

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Prepared by the
American Welding Society (AWS) B1 Committee on Methods of Inspection

Under the Direction of the
AWS Technical Activities Committee

Approved by the
AWS Board of Directors

Abstract

This guide acquaints the user with the nondestructive examination methods commonly used to examine weldments. The standard also addresses which method best detects various types of discontinuities. The methods included are visual, liquid penetrant, magnetic particle, radiographic, ultrasonic, electromagnetic (eddy current), and leak testing.



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Foreword

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

The *Guide for the Nondestructive Inspection of Welds* was first prepared by the AWS B1 Committee on Methods of Inspection in 1977. The next edition was published in 1986, with updates to current industry practices. The 1999, 2009 and this current edition incorporate an overall edit and improvements to the figures. This fifth edition, B1.10M/B1.10:2016, *Guide for the Nondestructive Examination of Welds*, includes the above referenced changes and others notated with a vertical line along the side of the page.

The purpose of this guide is to give the reader an overview of the more common examination methods available without unnecessary detail and to provide an aid in deciding which method is generally best suited for the examination of a given weld.

The words examination, evaluation, inspection, and testing are considered synonymous when describing various nondestructive examination methods.

This guide has been prepared by the AWS B1 Committee on Methods of Inspection to serve as a simple but reliable source of general information. It is not intended that this document provide complete and comprehensive coverage of the subject. There are many reference manuals available. For more comprehensive coverage of the activities of the welding inspector, this guide should be used in conjunction with the *AWS Welding Inspection Handbook*, which provides a more thorough description of the duties and responsibilities of welding inspectors, the techniques and characteristics of the usual nondestructive examination methods, and the major aspects of sampling and documentation required for an adequate quality control system. For other references on the subject of inspection, refer also to the technical documents suggested in Clause 2, Normative References, and Annex E, Informative References. Annex A summarizes the required equipment, applications, advantages, and limitations of each of the seven examination methods covered in the document. Annex B is adapted from Part C—Nondestructive Examination Symbols of AWS A2.4, *Standard Symbols for Welding, Brazing, and Nondestructive Examination*. Annex C provides a list of typical application standards and the addresses of the standards developers. Annex D provides guidelines for requesting an official interpretation of an AWS standard.

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Guide for the Nondestructive Examination of Welds

1. General

1.1 Scope. This standard provides a reference guide for the kinds of nondestructive examination methods that are used to verify that welds meet the requirements of a code or specification. The nondestructive examination methods described are:

- (1) Visual (VT)
- (2) Liquid Penetrant (PT)
- (3) Magnetic Particle (MT)
- (4) Radiographic (RT)
- (5) Ultrasonic (UT)
- (6) Electromagnetic (Eddy Current) (ET)
- (7) Leak (LT)

The types of discontinuities detected with each method and their causes are discussed. Acceptance criteria are not addressed in this standard. Requirements for nondestructive examination and acceptance criteria should be specified in procurement documents prior to the award of contracts.

Principal factors to consider when choosing an examination method are the advantages and limitations of the method, anticipated type and size of discontinuity, acceptance standards, and cost. Annex A is a guide to process selection.

1.2 Advantages and Limitations of the Examination Method. The advantages and limitations of the examination method help to determine which method(s) is (are) best for detecting discontinuities of a particular size, shape, and orientation. For example, radiography can detect discontinuities with major planes aligned parallel with the radiation beam, such as cracks oriented normal to material surfaces. Radiography, however, usually cannot detect laminations in material or cracks oriented parallel to the plate surface. Conversely, ultrasonic examination can detect cracks oriented in any direction provided the sound beam is oriented essentially perpendicular to the major axis of the crack.

1.3 Acceptance Standards. The statement “the weld shall be radiographically examined” is incomplete unless acceptance standards are specified. Acceptance standards define characteristics of discontinuities. They also establish upper and lower limits that determine the acceptance or rejection of a given discontinuity in conformance with the applicable acceptance standard. Discontinuities may be acceptable providing their size and distribution are within specified limits. Some acceptance standards are shown in Annex C.

1.4 Cost. Costs of the various examination methods depend on the particular situation. Two factors that should be considered in selection of a nondestructive examination method are the cost of performing the examination and of the equipment.

Visual examination is usually the least expensive, but it is limited to the detection of surface discontinuities. In general, the cost of radiography, ultrasonic, or eddy current examination is higher than the cost of visual, magnetic particle, or liquid penetrant examination. To determine the method(s) that will best satisfy the intended purpose and minimize cost, qualified personnel should be consulted.

1.5 Procedures. It should be recognized that all NDE methods must be performed in accordance with an approved procedure which is available to the technician performing the test or examination. This is almost always a requirement of the applicable code. Only by following a documented (written) procedure can the NDE technician ensure adherence to codes and specifications applicable to the fabrication under test. These procedures should be documented to provide all details of test preparation, performance, and interpretation to ensure reliability and reproducibility of results.