To be qualified to perform flaw detection, the candidate shall achieve all of the following:

(1) An overall rating R of 0.90 or higher

(2) A detection rating D of 0.87 or higher

(3) A false indication rating F of 0.15 or less

F5. Period of Effectiveness

Previously qualified personnel shall be requalified when they have not performed UT of steel construction for a period of 6 months or more.

This page is intentionally blank.

Annex G (Normative)

Supplemental Magnetic Particle Testing Procedures

This annex is part of this standard and includes mandatory elements for use with this standard.

This annex provides procedures, as prescribed in 7.9, to improve the reliability of Magnetic Particle Testing (MT) to locate surface breaking flaws such as cracks and incomplete fusion that should be readily detectable with the yoke method.

This annex is organized as follows:

G1. Procedure Qualification

Written MT examination procedures shall be prepared, considering the geometry of the work to be inspected, yoke application, light levels, accessibility, safety, and other factors.

The following items shall be detailed in the written procedure:

(1) Type of weld to be examined

(2) Type of magnetizing equipment, including type of current employed

(3) Surface preparation

(4) Examination sequence

(5) Magnetization plan

(6) Magnetic particle type and color

(7) Interpretation of indications

(8) Acceptance criteria

(9) Reporting forms and procedures

G2. Visual Inspection

Prior to MT, the weld shall be inspected visually for detection of imperfections. The inspected surface shall be cleaned where necessary.

G3. Surface Condition

The surface shall be cleaned prior to MT by grinding, wire brushing, hand scraping, or a combination of these. Welds shall be dry and free from foreign materials such as dirt, grease, rust, and excessive weld spatter.

G4. Method

The continuous method, using an AC or DC electromagnetic yoke (double-leg or single-leg configuration) with dry, white-light-visible magnetic particles, shall be used.

G5. Yoke

The yoke shall be of the articulating-leg type. A single-leg yoke may be used in areas of tight access. Fixed-leg yokes are not permitted. AC yokes shall have a lifting force of at least 10 lbs [4.5 kg] and DC yokes shall have a minimum lifting force of at least 40 lbs [18 kg] when the legs are spaced at the maximum inspection distance.

G6. Magnetization

A magnetizing current at 50 Hz to 60 Hz AC or DC electromagnetization shall be used for detection of surface-breaking discontinuities.

G7. Particles

The magnetic particles shall be dry, finely divided high-permeability ferromagnetic material with low retentivity and a suitable size range. Their color shall provide high contrast to the background on which applied. Particles shall be free from rust, fillers, or other material that could interfere with their use. Magnetic particle materials shall be used only once. Particle application and removal equipment (powder bulbs, aerosol sprays) shall be such that fine indications are not removed by excessive force.

G8. Equipment Performance Checks

The performance of the magnetic particle inspection system and procedures shall be checked at regular intervals. The yoke lifting force shall be checked each day, prior to performing any MT examination, and shall be documented.

G9. Yoke Placement

G9.1 Extent of Examination. Examination shall be conducted with sufficient overlap to ensure 100% coverage. However, if the geometry of the piece does not permit 100% evaluation of the piece, this shall be stated on the test report.

G9.2 Detection of Longitudinal Discontinuities. For detection of longitudinal discontinuities, the yoke shall be placed astride and approximately perpendicular to the weld. The yoke legs shall be positioned such that the weld is approximately centered between the yoke legs. Sufficient overlap shall be used to ensure 100% coverage when moving along the weld length. Subsequent yoke positions along the weld shall be a maximum of 1/2 of the yoke leg spacing (maximum inspection distance) or 3 in [75 mm], whichever is smaller.

G9.3 Detection of Transverse Discontinuities. For detection of transverse discontinuities, the yoke shall be oriented so that the yoke legs are approximately parallel to the weld, approximately 1/2 in [12 mm] from the toe of the weld. If the yoke has to be placed on top of the weld to gain access, the technician shall ensure the best contact possible of the yoke legs to the weld.

G10. Particle Application and Removal

Dry particles shall be applied in such a manner that a light, uniform, dustlike coating of particles settles on the part while it is being magnetized. Particle indications shall be observed when being formed as the particles are being applied, and while the excess particles are being removed.

Sufficient air velocity for particle removal shall be directed at the area of inspection to remove the excess particles entrapped in areas such as weld undercut, while retaining the particles held primarily by magnetic flux leakage from the discontinuities.

G11. Interpretation and Evaluation of Indications

Relevant MT indications shall be defined as those that result from magnetic flux leakage fields formed by discontinuities that attract and hold magnetic particles.

Testing personnel shall verify indications by performing the following steps:

(1) Retest with the yoke field perpendicular to the discontinuity indication, if not already perpendicular.

(2) Retest, confirming that excess particles are removed. If the suspect indication is removed during the retest, the indication is interpreted as nonrelevant or as a false indication.

(3) If the indication has a light particle buildup and weak particle adhesion, and if doubt exists as to whether the indication is relevant or false, the area of the indication shall be lightly surface-ground and retested.

G12. Acceptance Criteria

All relevant indications, determined by MT to be cracks or incomplete fusion, shall be unacceptable, regardless of length.

This page is intentionally blank.

Annex H (Normative)

Flaw Sizing by Ultrasonic Testing

This annex is part of this standard and includes mandatory elements for use with this standard.

This annex provides procedures and acceptance criteria, as prescribed in Clause 7.10.3, and Ultrasonic Testing technician qualification, to evaluate groove welds that have failed to satisfy the acceptance criteria prescribed in Clause 7.10.2,

This annex is organized as follows:

H1 Flaw Sizing

H2 Acceptance Criteria

H3 UT Technician Qualification for Flaw Sizing

H1. Flaw Sizing

When flaw sizing techniques are implemented, ultrasonic testing and UT technician qualification shall be performed following written procedures as required by AWS D1.1/D1.1M:2020 Annex O. Acceptance criteria shall be in accordance with this clause.

H2. Acceptance Criteria

H2.1 Near-Surface Flaws. If a flaw is at or within 1/8 in [3 mm] of the surface, it shall be rejected and repaired or removed.

H2.2 Embedded Flaw Height. Embedded flaws, defined as those that do not come within 1/8 in [3 mm] of the surface, shall be rejected if their height exceeds 1/4 in [6 mm].

H2.3 Flaws at Steel Backing. When steel backing remains in place, the size of flaws that extend into the weld metal shall be determined. Flaws that extend more than 1/8 in [3 mm] into the thickness of the groove weld shall be rejected.

H2.4 Embedded Flaw Area. Embedded flaws shall be rejected if their area, calculated by multiplying the maximum discontinuity height by the maximum discontinuity length, exceeds the square of the effective weld throat. Embedded flaws, either individually or as a group within a length of weld 12 in [300 mm] or less, shall be rejected if they exceed a total area (the sum of the areas of individual discontinuities) equal to 10% of the effective weld throat multiplied by the weld length. The weld length used for this calculation shall not exceed 12 in [300 mm], with longer welds being evaluated in multiple parts. Discontinuity height and length shall be measured perpendicular to the direction of principal stress.

H2.5 Aligned Discontinuities. Aligned discontinuities of lengths L1 and L2, separated by less than (L1+L2)/2 shall be evaluated as continuous.

H2.6 Parallel Discontinuities. Parallel discontinuities of heights H1 and H2, separated by less than (H1+H2)/2 shall be evaluated as continuous.

H3. UT Technician Qualification for Flaw Sizing

H3.1 Personnel. Ultrasonic testing (UT) personnel shall be qualified in accordance with Annex F and shall demonstrate proficiency by satisfactory performance in an examination as prescribed in H3.2.

H3.2 Examination. The examination shall consist of practical tests that have been developed by the NDT Agency's UT Level III, or an organization approved by the Agency, and shall incorporate the specific requirements of the NDT Agency's procedures and the applicable weld quality acceptance standards contained in Clause H2. The examination shall utilize a UT procedure(s) that conforms to AWS D1.1/D1.1M:2020 Annex O for flaw sizing.

The examination shall also test the ability of UT personnel to correctly calibrate UT equipment and complete the relevant paperwork associated with the examination. Testing procedures and examination results shall be documented and available to the Engineer for review.

Annex I (Informative)

Requesting an Official Interpretation on an AWS Standard

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

I1. Introduction

The following procedures are here to assist standard users in submitting successful requests for official interpretations to AWS standards. Requests from the general public submitted to AWS staff or committee members that do not follow these rules may be returned to the sender unanswered. AWS reserves the right to decline answering specific requests; if AWS declines a request, AWS will provide the reason to the individual why the request was declined.

I2. Limitations

The activities of AWS technical committees regarding interpretations are limited strictly to the interpretation of provisions of standards prepared by the committees. Neither AWS staff nor the committees are in a position to offer interpretive or consulting services on (1) specific engineering problems, (2) requirements of standards applied to fabrications outside the scope of the document, or (3) points not specifically covered by the standard. In such cases, the inquirer should seek assistance from a competent engineer experienced in the particular field of interest.

I3. General Procedure for all Requests

I3.1 Submission. All requests shall be sent to the Director, AWS Standards Development. For efficient handling, it is preferred that all requests should be submitted electronically through standards@aws.org. Alternatively, requests may be mailed to:

Director
Standards Development
American Welding Society
8669 NW 36 St, # 130
Miami, FL 33166

I3.2 Contact Information. All inquiries shall contain the name, address, email, phone number, and employer of the inquirer.

I3.3 Scope. Each inquiry shall address one single provision of the standard unless the issue in question involves two or more interrelated provisions. The provision(s) shall be identified in the scope of the request along with the edition of the standard (e.g., D1.1:2006) that contains the provision(s) the inquirer is addressing.

I3.4 Question(s). All requests shall be stated in the form of a question that can be answered 'yes' or 'no'. The request shall be concise, yet complete enough to enable the committee to understand the point of the issue in question. When the point is not clearly defined, the request will be returned for clarification. Sketches should be used whenever appropriate, and all paragraphs, figures, and tables (or annexes) that bear on the issue in question shall be cited.

I3.5 Proposed Answer(s). The inquirer shall provide proposed answer(s) to their own question(s).

I3.6 Background. Additional information on the topic may be provided but is not necessary. The question(s) and proposed answer(s) above shall stand on their own without the need for additional background information.

I4. AWS Policy on Interpretations

The American Welding Society (AWS) Board of Directors has adopted a policy whereby all official interpretations of AWS standards are handled in a formal manner. Under this policy, all official interpretations are approved by the technical committee that is responsible for the standard. Communication concerning an official interpretation is directed through the AWS staff member who works with that technical committee. The policy requires that all requests for an official interpretation be submitted in writing. Such requests will be handled as expeditiously as possible, but due to the procedures that must be followed, some requests for an official interpretation may take considerable time to complete.

I5. AWS Response to Requests

Upon approval by the committee, the interpretation is an official interpretation of the Society, and AWS shall transmit the response to the inquirer, publish it in the *Welding Journal*, and post it on the AWS website.

I6. Telephone Inquiries

Telephone inquiries to AWS Headquarters concerning AWS standards should be limited to questions of a general nature or to matters directly related to the use of the standard. The *AWS Board Policy Manual* requires that all AWS staff members respond to a telephone request for an official interpretation of any AWS standard with the information that such an interpretation can be obtained only through a written request. Headquarters staff cannot provide consulting services. However, the staff can refer a caller to any of those consultants whose names are on file at AWS Headquarters.