



BUREAU OF MATERIALS MATERIALS PROCEDURES

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APPROVAL: Eileen Sheehy

STRUCTURAL STEEL NONDESTRUCTIVE TESTING AND INSPECTION DUTIES

PURPOSE:

To establish standard procedures for the nondestructive testing and inspection of structural steel, aluminum and specialty items.

SUPERSEDES:

Materials Procedure Number 14 – Dated 10/01/2001

REFERENCES:

Special Provisions, Supplementary Specifications, Standard Specifications, Addenda and Attachments
Project Plans
Approved Shop Drawings
American Welding Society Structural Welding Code D1.5, D1.2
AASHTO – Standard Specifications for the Construction of Highway Bridges
Materials Procedure MP-06 – Visual Inspection of Structural Steel
ASTM – E165 Dye Penetrant Testing
ASTM – E109 Magnetic Particle Testing
ASTM – E376 – Coating Thickness
American Society for Nondestructive Testing, Recommended Practice No. SNT-TC-1A

FORMS

LB-14 - Analysis of Miscellaneous Materials
LB-88 - Sample Envelope
LB-142 - Structural Steel Paint System Information Form
LB-276 - Structural Steel Inspector's Daily Report

- LB-278 - Nondestructive Test Report
- LB-279 - Report of Ultrasonic Test
- LB-296 - Notice of Material Rejection
- T-485 - Monitoring Inspection Report
- LB-T-792 - Record of Structural Steel Inspection
- T-577 - Record of Structural Steel Heat Numbers

INSTRUCTIONS

I. Assignment Procedures

The Inspector shall receive from, his/her Supervisor the following:

- A. Project designation and job code, RE's phone number, Contractor
- B. Plant and/or Project Location and starting time, phone number and contact person.
- C. All required nondestructive test methods, specifications, equipment and other pertinent data and instructions.

NOTE: The inspector in charge must be qualified in accordance with the ASNT Recommended Practice No. SNT-TC-1A, Level I & II

II. Duties

Under the direction of the inspector in charge, performs and/or monitor's -Nondestructive Tests. The inspector is responsible for performing Quality Assurance, Q.A. Testing and Quality Control. Q.C. is the responsibility of the Fabricator/Contractor. Q.A testing will be performed as required in the contract documents and as needed to assure a quality product.

Q.A. visual and dimensional functions are performed on a random priority basis. These inspections/verifications are based on critical areas of the item/material being *manufactured*, production schedule of the *manufacturer* and manpower available. The Material's inspector assigned to the location/facility will evaluate and determine what areas and functions require Q.A. verification or testing.

The assigned Material's inspector will consult with his supervisor when any questionable areas or products arise.

- A. Visual
- B. Magnetic Particle
- C. Dye Penetrant
- D. Ultrasonics
- E. Dry film thickness gauge

The following construction items are to be tested by N.D.T. Methods as listed above:

- A. Structural Steel - A, B, C, D, *E*
- B. Aluminum Signs, GA & GO Sign Structures and Highway - A, C
- C. Steel O.H.S.S.-A, B, D
- D. Specialty Items – A, additional testing as required in the specifications

III. Procedures

- A. Review mill test reports, welder certifications, and welding procedures, approve, disapprove, date and initial. Document on daily report.
- B. Visual Inspection
 - 1. Before Welding inspect for:
 - a. Weld preparation, dimensions and base metal finish
 - b. Alignment and fit up of the pieces being welded
 - c. Verification of cleanliness
 - 2. During Welding, inspect for:
 - a. Welding Process and approved welding procedure
 - b. Cleaning
 - c. Preheat and interpass temperature
 - d. Joint Preparation
 - e. Filler Metal
 - f. Flux or Shielding Gas
 - g. Chipping, grinding or gouging
 - h. Distortion Control
 - i. Postheating Temperature and time, when required
 - 3. Post Welding inspection shall be performed for:
 - a. Dimensional accuracy of weldments and perform visual inspection for discontinuities
 - b. Conformity to drawing requirements

- c. Acceptability of Welds concerning appearance as per D1.2, *D1.1* and D1.5 (includes such items as *weld spatter, weld size & profile*).
- d. The presence of unfilled craters, pock marks, undercuts, overlaps, and cracks, porosity, slag inclusions.
- e. Evidence of mishandling and excessive grinding.

C. Magnetic Particle Inspection In accordance with A.W.S. D1.5 Section 6.7.2 (ASTM E709)

1. Surface Preparation

The surface to be tested should be clean and dry. It shall be free from paint, oil, sand, and loose rust or loose scale. Thin paint films, 1 to 2 mils do not generally interfere with the formation of indications but paint must be removed at points where electrical contact is to be made. If the surface is unusually rough, such as occurs with a very rough weld bead, interpretation may be difficult because the powder is being trapped mechanically in surface irregularities. In case of doubt, a light grind may be necessary to determine if actual indications are present.

2. Inspection Medium

Dry power is used as the inspection medium. This material has high permeability and low retentivity. The color used should provide adequate contrast with the background of the surface being inspected. The powder is applied by lightly dusting a small quantity over the surface and then removing the excess with a gentle stream of air. The air stream shall be controlled so that it does not disturb or remove lightly held powder patterns. In order to recognize the broad, fuzzy, lightly held powder patterns produced by sub-surface discontinuities, it is essential to observe carefully the formation of indications while the powder is being applied. Adequate lighting should be provided for easy observation of the indications.

3. Magnetization

- a. Magnetizing technique: The area to be inspected is circularly magnetized by the means of contact electrodes or prods. A prod spacing between 6 inch and 8 inch is maintained except where the geometry of the part does not permit it. In such cases, prod spacing of 2 inch to 4 inch and over 4 inch but less than 6 inch may be used as indicated in Table I of ASTM E109, Art. 307. The current shall not be turned on until the prods are properly positioned in contact with the

surface, and the current shall be turned off before the prods are removed. The Yoke method is to be used.

- b. Direction of Magnetization: Since poor indications are produced when the discontinuities are perpendicular to current flow, the prods should be initially positioned so that the current flows essentially parallel to the direction of possible or expected discontinuities. Unless otherwise specified, two separate inspections are made in each area. The second inspection is performed with the prods positioned so that the current flows approximately at right angles to the current flow used for the first inspection in that area.
- c. Magnetizing Current: A source of direct or rectified current is used for magnetization. Use an average magnetizing current according to the section thickness and prod spacing as shown in ASTM E-109, Art. 307, Table I. If the geometry of the part does not permit the use of the 6 inch to 8 inch prod spacing, use the average magnetizing current that is also shown in this table.
- d. Sequence of Operation: The inspection is performed by the continuous method; i.e., leave the magnetizing current on during the period the inspection medium is being applied and also while excess inspection medium is being removed with a gentle air stream. Examine medium for indications.
- e. Testing Pattern on Fillet Weldments: Ten percent of each continuous weldment, that is, one foot out of every ten feet of continuous weldment, is tested by magnetic particle inspection. This includes web to flange weldments and bearing stiffener to web weldments.

D. Dye Penetrant – According to D1.5 Section 6.7.7 (ASTM E165)

- 1. Clean the surface to be inspected.
- 2. Apply Penetrant.
- 3. Allow sufficient penetrant dwell time.
- 4. Remove excess penetrant.
- 5. Apply developer to indicate retained penetrant.
- 6. Examine and inspect for discontinuities.
- 7. Clean up after operation.

E. Ultrasonics

Calibration for Testing

Calibration and Testing Procedures shall be performed in accordance with AWS Structural Welding Code D1.5 or D1.1 Section 6 Part C (6.13). The edition of the code to be followed will be as noted in the Supplementary Specifications.

F. Dry Film Thickness Gauge

1. The gauge measures all types of non-magnetic dry coatings including plated, painted or galvanized coatings that have been applied to a steel base. It operates on the attractive power of a permanent magnetic through a non-magnetic coating to the magnetic base metal.
2. Operate the gauge as per manufacturer's recommendations. Document the results on the Daily Report.

IV. Additional Duties

The inspector shall:

- A. Complete the appropriate report and submit a copy to Bureau Headquarters at the completion of the fabrication/inspection.
- B. Submit all written communications to the Engineer for distribution to the fabricator, RE and supervisor.

V. Authorities and Responsibilities

The Inspector shall:

Notify Plant Foreman and order corrective action when any minor defects or questionable fabricating procedures are discovered. When defects of a serious nature are found, this notification must be in writing. Documentation of corrective action shall be included on the daily report and in the diary. The Supervisor and/or Bureau Headquarters must be notified immediately. A corrective action proposal must be submitted and approved by the appropriate authority.