

Part I

APPENDIX E. SUPPLEMENTARY ULTRASONIC TECHNICIAN TESTING

Scope

This appendix supplements Part I, Section 6.3.3 and provides procedures to be used to demonstrate proficiency in ultrasonic testing. The Quality Assurance (QA) Agency shall require ultrasonic testing (UT) personnel to demonstrate proficiency by satisfactory performance in a prequalification examination. The examination shall consist of practical tests that have been developed by the Agency's UT Level III Specialist, or an organization approved by the Agency, and shall incorporate the specific requirements of the Agency's procedures and the acceptance standards contained in Part I, Sections 5.8.3 and 5.8.4 as applicable. The practical examination shall also test the ability of UT personnel to complete correctly the relevant reports associated with the examination.

Test Specimens

The QA Agency shall have test coupons prepared that are of the type and number required to represent the details of the steel moment frame welded joints to be examined. Suitable test pieces should be full mock-ups of welded joints, with and without backing bars. Typical joint geometries of butt, corner and tee configurations shall be utilized. A minimum of 20 flaws shall be embedded in the test samples to provide an adequate test of ability.

Test coupons may contain natural discontinuities, artificial reflectors consisting of non-metallic inserts in the weld deposit, slots or holes machined in the weld, or thin steel inserts welded to bevel preparations to simulate incomplete fusion.

Test specimens to be employed in repetitive examinations shall be fabricated to produce intentional reflectors and to minimize natural flaws. These test pieces shall subsequently be examined by an ultrasonic specialist to confirm the detectability of the implant and the absence of unintentional reflectors. The UT Level III Specialist should characterize each reflector in the test plates into one of the categories defined herein. The characterization, size, and placement of the reflectors may be discussed with the candidate following completion of the examination. If the test pieces are to be used for later examinations, the examiner shall not reveal the exact details of the individual test pieces to avoid compromising the results of the subsequent examinations.

All materials to be employed for test specimen fabrication shall be examined by longitudinal wave techniques to ensure the absence of lamination and/or inclusions that might render the test pieces unacceptable for test purposes. Materials with laminations and inclusions may intentionally be incorporated into selected coupons to evaluate the candidate's performance on these imperfections. Plates for tee joints should be produced from steels with enhanced through-thickness properties to minimize lamellar tearing within the test coupon.

The size of discontinuities inserted or induced into the test coupons shall be consistent with the range of flaw size acceptance criteria set forth in Part I, Sections 5.8.3 and 5.8.4, as appropriate.

Candidate Scoring – Flaw Detection

Candidates shall submit a written report of all detected discontinuities found during the examination. The report shall include the characterization of each flaw type (spherical, cylindrical, or planar), the size (length and width, but not height unless flaw sizing is to be employed), the location along the weld, and the relative position within the weld cross-section.

For UT technicians who will perform flaw detection in accordance with Part I, Section 5.8.3, the following numerical system shall be employed in evaluating the UT technician candidate:

The rate of flaws detected, based upon reporting of the flaw and its location, irrespective of the indication rating recorded, is:

$$D = \text{detected flaws} / \text{total flaws}$$

The rate of false indications, based upon a recorded indication that also exceeds the indication rating defined in Part I, Section 5.8.3, is:

$$F = \text{false indications} / \text{total indications}$$

The UT technician rating R is:

$$R = \frac{n-2}{2(n-1)}(1+D-F) \times 100\% \quad (\text{E-1})$$

where n is the total number of flaws in the test specimens.

For technicians who will perform flaw detection in accordance with Part I, Section 5.8.3, the minimum UT technician rating is 80.

Candidate Scoring – Flaw Sizing

For technicians being qualified to perform flaw sizing in accordance with Part I, Section 5.8.4, the UT technician rating is established by the following equations:

$$P = \frac{L_c}{L_a} \times 100\% \quad (\text{E-2})$$

$$R = \frac{L_c}{L_i} \left(1 - \frac{L_f}{L_i} \right) \times 100\% \quad (\text{E-3})$$

where:

- P = percentage of actual reflectors correctly detected and sized.
- R = overall rating including penalty for false alarms, 0 to 100.
- L_a = length of actual reflector contained in the test specimen.
- L_c = indicated length of actual discontinuities that have been correctly sized and located. (Credit is given for the lesser of the reported length or actual length of the reflector).
- L_i = total length of call by the candidate, right or wrong.
- L_f = length of call to where discontinuity exists.

For flaw sizing ratings, each linear inch of test specimen weld shall be considered independently in the compilation of the candidate's performance. Identification of the discontinuity is considered correct when the size and location of the reflector have been determined with sufficient accuracy to rate the discontinuity in accordance with the acceptance criteria. For ultrasonic examination, a dimension indicated within a factor of two of true dimensions (one-half to twice the actual dimension) is considered accurate within the limits of the examination technique.

Equation E-2 indicates the ability of the candidate to locate and size discontinuities that exist in the test pieces. A candidate must achieve a score of 70 or above on Equation E-2 as minimum performance.

Equation E-3 indicates the ability of the candidate to accept the areas of welds in the test pieces where no flaws exist. A low score indicates the candidate may call for a large number of unnecessary repairs during the course of the actual construction work. The Agency should consider, in evaluating the required performance, the consequences of unnecessary repairs, including the fact that weld repairs are made under less-favorable conditions than the original weld, thereby increasing the potential for a defective repair weld. Consequently, a score of 50 or above on Equation E-3 is minimum performance.

Reexamination

Previously qualified personnel shall be reexamined when they have not performed nondestructive UT examination of steel moment frame construction for a period not to exceed six months, when a specific cause to question performance arises, or more frequently when required by the QA Agency as a part of their Written Practice. Technicians shall be tested under this system, as a minimum, every three years.