



December 30, 2008

TO: PARTIES INTERESTED IN EVALUATION REPORTS ON NARROW-GAP IMPROVED ELECTROSLAG WELDING (NGI-ESW)

SUBJECT: Proposed Acceptance Criteria for Narrow-gap Improved Electroslag Welding (NGI-ESW), Subject AC411-0209-R1 (DP/BG)

Hearing Information:

Thursday, February 5, 2009

8:00 a.m.

Sheraton Gateway Hotel Los Angeles

6101 West Century Boulevard

Los Angeles, California 90045

(888) 627-7104

Dear Madam or Sir:

The enclosed proposed new acceptance criteria is on the agenda for the Evaluation Committee hearing noted above. The proposed acceptance criteria is based on a proposal submitted by a report applicant. The criteria is intended to address requirements for the Narrow-Gap Improved Electroslag Welding (NGI-ESW) process, for the purpose of welding structural steel members into built-up members or spliced members. Since the NGI-ESW process is not classified as a prequalified process in conformance with Section 3 of AWS D1.1-06, Structural Welding Code, the enclosed proposed criteria sets requirements for qualification of a Welding Procedure Specification (WPS) and a supporting Procedure Qualification Record (PQR).

ICC-ES staff has the following comments in regard to the proposed acceptance criteria:

1. Staff seeks input regarding whether the provisions of the enclosed proposed criteria adequately address General Requirements, Welding Procedure Requirements and Performance Qualification requirements of Parts A, B and C, respectively, of AWS D1.1, as they pertain to the NGI-ESW process.
2. Staff seeks input as to whether the demand-critical CVN toughness requirements of AWS D1.8 should be applied to weld repair testing. The requirements in the enclosed proposal pertain to "all welds." See Section 4.4.2 of the proposed criteria and Annex B of AWS D1.8.

3. Staff seeks input as to whether the weld repair process should be documented as part of a repair Welding Procedure Specification (WPS), and if so, should a repair WPS be added to the evaluation report information in Section 6.0 of the criteria?

You are cordially invited to submit written comments on agenda items, or to attend the Evaluation Committee hearing and present verbal comments. If you wish to contribute to the hearing, please note the following:

1. Written comments that are received by the Los Angeles business/regional office by **January 20, 2009**, will be forwarded to the committee prior to the hearing, and will be posted on the ICC-ES web site shortly after the comment deadline.
2. Written comments received up to ten days before the meeting, and staff memos responding to comments, will be posted to the web site on **January 29, 2009**.
3. ICC-ES is no longer providing printed copies at the meeting of proposed acceptance criteria, staff memos or public comments. These documents will be available on a limited number of CDs at the meeting, for uploading to computers; and ICC-ES will make arrangements with the hotel business center to have hard copies available for photocopying.
4. Written comments that miss the deadline noted in item (1), above, will only be available at the meeting if you provide 35 copies, collated, stapled, and three-hole punched, either at the meeting itself or to the Los Angeles business/regional office by **January 29, 2009**.
5. If you plan to speak for more than 15 minutes, or offer a visual presentation lasting longer, you should notify ICC-ES staff as far as possible in advance. There will be a computer, projector, and screen available at the meeting for anyone wishing to make a visual presentation, and presentations in most cases will need to be in PowerPoint format. Also, ICC-ES will need to be provided with your presentation at least a half-hour before the start of the relevant meeting session (morning or afternoon) on either a CD or a flash card.
6. If you have any special needs related to a presentation, you should contact ICC-ES staff well in advance of the meeting.
7. Any visual aids for viewing at committee meetings (charts, overhead transparencies, slides, videos, electronic presentations, etc.) will be permitted only if a copy is provided to ICC-ES, before the presentation, in a medium that can be retained with other records of the meeting.

8. Any materials submitted for committee consideration are considered nonconfidential and available for public discussion, as noted in Section 2.7 of the ICC-ES Rules of Procedure for the Evaluation Committee.
9. Prior to the meeting, you should refrain from trying to communicate directly with committee members about agenda items, either verbally or in writing. Committee members reserve the right to refuse such communications.

Your cooperation with these guidelines is much appreciated, as is your interest in the deliberations of the Evaluation Committee. If you have any question, please contact the undersigned at (800) 423-6587, extension 3275, or Brian Gerber, S.E., at extension 3260. You may also reach us by e-mail at es@icc-es.org.

Yours very truly,

A handwritten signature in black ink, appearing to read "D Pereg". The letters are stylized and connected.

David Pereg, P.E.
Staff Engineer

DP/BG/gh

Enclosures

cc: Evaluation Committee



ICC EVALUATION SERVICE, INC., RULES OF PROCEDURE FOR THE EVALUATION COMMITTEE

1.0 PURPOSE

The purpose of the Evaluation Committee is to monitor the work of ICC-ES, in issuing evaluation reports; to evaluate and approve acceptance criteria on which evaluation reports may be based; and to sponsor related changes in the applicable codes.

2.0 MEETINGS

2.1 The Evaluation Committee shall schedule meetings that are open to the public in discharging its duties under Section 1, subject to Section 3.

2.2 All scheduled meetings shall be publicly announced.

2.3 Two-thirds ($\frac{2}{3}$) of the voting Evaluation Committee members shall constitute a quorum. A majority vote of members present is required on any action.

2.4 In the absence of the nonvoting chairman-moderator, Evaluation Committee members present shall elect an alternate chairman from the committee for that meeting. The alternate chairman shall be counted as a voting committee member for purposes of maintaining a committee quorum and to cast a tie-breaking vote of the committee.

2.5 Minutes of the meetings shall be kept.

2.6 An electronic audio record of meetings shall be made by ICC-ES; no other audio, video, electronic or stenographic recordings of the meetings will be permitted. Visual aids (including, but not limited to, charts, overhead transparencies, slides, videos, or presentation software) viewed at meetings shall be permitted only if the presenter provides ICC-ES before presentation with a copy of the visual aid in a medium which can be retained by ICC-ES with its record of the meeting and which can also be provided to interested parties requesting a copy. A copy of the ICC-ES recording of the meeting and such visual aids, if any, will be available to interested parties upon written request made to ICC-ES together with a payment as required by ICC-ES to cover costs of preparation and duplication of the copy. These materials will be available beginning five days after the conclusion of the meeting but will no longer be available after one year from the conclusion of the meeting.

2.7 Parties interested in the deliberations of the committee should refrain from communicating, whether in writing or verbally, with committee members regarding agenda items. All written communications and submissions regarding agenda items should be delivered to ICC-ES. All such written communications and submissions shall be considered nonconfidential and available for discussion in open session of an Evaluation Committee meeting, and shall be delivered at least ten days before the scheduled Evaluation Committee meeting if they are to be forwarded to the committee. Materials delivered to ICC-ES at least ten

days before the scheduled meeting will be posted on the ICC-ES web site (www.icc-es.org) prior to the meeting. After this time, parties wishing to submit materials for consideration by the Evaluation Committee must deliver a sufficient number of copies as directed by ICC-ES. Consideration of materials not received by ICC-ES at least ten days before the meeting is at the discretion of the Evaluation Committee. Following the meeting, ICC-ES will make all materials considered by the Evaluation Committee available on the web site for a maximum period of one year following the meeting. The committee reserves the right to refuse recognition of communications which do not comply with the provisions of this section.

3.0 CLOSED SESSIONS

Evaluation Committee meetings shall be open except that the chairman may call for a closed session to seek advice of counsel.

4.0 ACCEPTANCE CRITERIA

4.1 Acceptance criteria are established by the committee to provide a basis for issuing ICC-ES evaluation reports on products and systems under codes referenced in Section 2.0 of the Rules of Procedure for Evaluation Reports. They also clarify conditions of acceptance for products and systems specifically regulated by the codes.

Acceptance criteria may involve a product, material, method of construction, or service. Consideration of any acceptance criteria must be in conjunction with a current and valid application for an ICC-ES evaluation report, an existing ICC-ES evaluation report, or as otherwise determined by the Evaluation Committee.

4.2 Procedure:

4.2.1 Proposed acceptance criteria shall be developed by the ICC-ES staff and discussed in open session with the Evaluation Committee during a scheduled meeting, except as permitted in Section 5.0 of these rules.

4.2.2 Proposed acceptance criteria shall be available to interested parties at least 30 days before discussion at the committee meeting.

4.2.3 The committee shall be informed of all pertinent written communications received by ICC-ES.

4.2.4 Attendees at Evaluation Committee meetings shall have the opportunity to speak on acceptance criteria listed on the meeting agenda, to provide information to committee members.

4.3 Approval of acceptance criteria shall be as specified in Section 2.3 of these rules.

4.4 Actions of the Evaluation Committee may be

appealed in accordance with the ICC-ES Rules of Procedure for Appeal of Acceptance Criteria or the ICC-ES Rules of Procedure for Appeals of Evaluation Committee Technical Decisions.

5.0 COMMITTEE BALLOTING FOR ACCEPTANCE CRITERIA

5.1 Acceptance criteria may be issued without a public hearing following a 30-day public comment period and a majority vote for approval by the Evaluation Committee when, in the opinion of ICC-ES staff, one or more of the following conditions have been met:

1. The subject is nonstructural, does not involve life safety, and is addressed in nationally recognized standards or generally accepted industry standards.
2. The subject is a revision to an existing acceptance criteria that requires a formal action by the Evaluation Committee, and public comments raised were resolved by staff with commenters fully informed.
3. Other acceptance criteria and/or the code provide precedence for the revised criteria.

5.2 Negative votes must be based upon one or more of the following, for the ballots to be considered valid and require resolution:

- a. *Lack of clarity:* There is insufficient explanation of the scope of the acceptance criteria or insufficient description of the intended use of the product or system; or the acceptance criteria is so unclear as to be unacceptable. (The areas where greater clarity is required must be specifically identified.)
- b. *Insufficiency:* The criteria is insufficient for proper evaluation of the product or system. (The provisions of the criteria that are in question must be specifically identified.)
- c. *The subject of the acceptance criteria is not within the scope of the applicable codes:* A report issued by ICC-ES is intended to provide a basis for approval under the codes. If the subject of the acceptance criteria is not regulated by the codes, there is no basis for issuing a report, or a criteria. (Specifics must be provided concerning the inapplicability of the code.)

d. *The subject of the acceptance criteria needs to be discussed in a public hearings.* The committee member requests additional input from other committee members, staff or industry.

5.3 An Evaluation Committee member, in voting on an acceptance criteria, may only cast the following ballots:

- Approved
- Approved with Comments
- Negative: Do Not Proceed

6.0 COMMITTEE COMMUNICATION

Direct communication between committee members, and between committee members and an applicant or concerned party, with regard to the processing of a particular acceptance criteria or evaluation report shall take place only in a public hearing of the Evaluation Committee. Accordingly:

6.1 Committee members receiving an electronic ballot should respond only to the sender (staff). Committee members who wish to discuss a particular matter with other committee members, before reaching a decision, should ballot accordingly and bring the matter to the attention of ICC-ES staff, so the issue can be placed on the agenda of a future committee meeting.

6.2 Committee members who are contacted by an applicant or concerned party on a particular matter that will be brought to the committee will refrain from private communication and will encourage the applicant or concerned party to forward their concerns through the ICC-ES staff in writing, and/or make their concerns known by addressing the committee at a public hearing, so that their concerns can receive the attention of all committee members. ■

Effective March 18, 2008



PROPOSED ACCEPTANCE CRITERIA FOR NARROW-GAP IMPROVED ELECTROSLAG WELDING (NGI-ESW)

AC411

Proposed December 2008

PREFACE

Evaluation reports issued by ICC Evaluation Service, Inc. (ICC-ES), are based upon performance features of the International family of codes and other widely adopted code families, including the Uniform Codes, the BOCA National Codes, and the SBCCI Standard Codes. Section 104.11 of the International Building Code® reads as follows:

The provisions of this code are not intended to prevent the installation of any materials or to prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative has been approved. An alternative material, design or method of construction shall be approved where the building official finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, at least the equivalent of that prescribed in this code in quality, strength, effectiveness, fire resistance, durability and safety.

Similar provisions are contained in the Uniform Codes, the National Codes, and the Standard Codes.

ICC-ES may consider alternate criteria, provided the report applicant submits valid data demonstrating that the alternate criteria are at least equivalent to the criteria proposed in this document, and otherwise meet the applicable performance requirements of the codes. Notwithstanding that a product, material, or type or method of construction meets the requirements of the criteria proposed in this document, or that it can be demonstrated that valid alternate criteria are equivalent to the criteria in this document and otherwise meet the applicable performance requirements of the codes, ICC-ES retains the right to refuse to issue or renew an evaluation report, if the product, material, or type or method of construction is such that either unusual care with its installation or use must be exercised for satisfactory performance, or malfunctioning is apt to cause unreasonable property damage or personal injury or sickness relative to the benefits to be achieved by the use of the product, material, or type or method of construction.

Acceptance criteria are developed for use solely for purposes of issuing ICC-ES evaluation reports.

**PROPOSED ACCEPTANCE CRITERIA FOR
NARROW-GAP IMPROVED ELECTROSLAG WELDING (NGI-ESW)**

1

2 **1.0 INTRODUCTION**

3 **1.1 Purpose:** The purpose of this acceptance criteria is to establish requirements for
4 the Narrow-gap Improved Electroslag Welding (NGI-ESW) process to be recognized in an ICC
5 Evaluation Service, Inc. (ICC-ES), evaluation report under the 2006 *International Building*
6 *Code*[®] (IBC). The bases of recognition are IBC Section 104.11 and Section 4 of AWS D1.1-
7 06, Structural Welding Code.

8 The reason for the development of this criteria is to allow for the recognition of the
9 NGI-ESW process, since the code does not have a prequalified Welding Procedure
10 Specification for this process.

11 **1.2 Scope:** This acceptance criteria sets requirements for qualification testing of a
12 Welding Procedure Specification (WPS) for the NGI-ESW process, which is used for the
13 purpose of welding structural steel members into built-up members or spliced members.

14 **1.3 Codes and Referenced Standards:**

15 **1.3.1** 2006 *International Building Code*[®] (IBC), International Code Council.

16 **1.3.2** AISC 341-05, Seismic Provisions for Structural Steel Buildings, American
17 Institute of Steel Construction.

18 **1.3.3** AWS D1.1-06, Structural Welding Code — Steel, American Welding Society.

19 **1.3.4** AWS D1.8-05, Structural Welding Code — Seismic Supplement, American
20 Welding Society.

21 **1.3.5** ANSI/AWS A5.25/A5.25M 1997 Specification for Carbon and Low-Alloy Steel
22 Electrodes and Fluxes for Electroslag Welding, American Welding Society.

23 **1.3.6** FEMA 353, July 2000, Federal Emergency Management Agency.

24 **1.4 Definitions:**

25 **1.4.1 All-weld-metal Test Specimen:** A test specimen with the reduced section
26 composed wholly of weld metal.

27 **1.4.2 As-welded:** The condition of weld metal, welded joints, and weldments after
28 welding, but prior to any subsequent thermal, mechanical, or chemical treatments.

29 **1.4.3 Consumable Guide Electroslag Welding:** An electroslag welding process
30 variation in which filler metal is supplied by an electrode and its guiding member

31 **1.4.4 Electroslag Welding (ESW):** A welding process that produces coalescence
32 of metals with molten slag that melts the filler metal and the surfaces of the work pieces. The
33 weld pool is shielded by the slag, which moves along the full cross section of the joint as
34 welding progresses. The process is initiated by an arc that heats the slag. The arc is then
35 extinguished by the conductive slag, which is kept molten by its resistance to electric current
36 passing between the electrode and the workpieces.

37 **1.4.5 Faying Surface:** The mating surface of a member that is in contact with or in
38 close proximity to another member to which it is to be joined.

39 **1.4.6 Heat-affected Zone (HAZ):** The portion of the base metal whose mechanical
40 properties or microstructure have been altered by the heat of welding, brazing, soldering or
41 thermal cutting.

42 **1.4.7 Narrow-gap Improved Electroslag Welding (NGI-ESW) Process:** NGI-
43 ESW is characterized by a narrow gap of $\frac{3}{4}$ inch (19 mm) and a tubular metal-powder-cored
44 filler metal. Welding is achieved by resistance-heating a molten conductive slag to a
45 sufficiently high temperature to melt the electrode, consumable guide, and faying surfaces of
46 the base metal.

47 **1.4.8 Welding Procedure Specification (WPS):** The detailed methods and
48 practices, including all joint welding procedures, involved in the production of a weldment.

49 **1.4.9 WPS Qualification:** The demonstration that welds made by a specific
50 procedure can meet prescribed standards.

51 **2.0 BASIC INFORMATION**

52 **2.1 General:** The following information shall be submitted:

53 **2.1.1 Product Description:** Complete information shall be submitted concerning
54 the NGI-ESW process, including consumable guide specifications, dimensions and parameter
55 requirements; welding component specifications including dimensions, and tolerances; and
56 restrictions or limitations on use.

57 **2.1.2 User Instructions:** As a minimum, user instructions shall include a
58 description of how the product or system will be used; procedures establishing quality control
59 at project sites during use; requirements for product handling; and weld installation into
60 structural elements.

61 **2.1.3 Packaging and Identification:** Identification provisions for the connections
62 produced by the NGI-ESW process shall include the evaluation report number and the name
63 or logo of the inspection agency.

64 **2.2 Testing Laboratories:** Testing laboratories shall comply with Section 2.0 of the
65 ICC-ES Acceptance Criteria for Test Reports (AC85) and Section 4.2 of the ICC-ES Rules of
66 Procedure for Evaluation Reports.

67 **2.3 Test Reports:** Test reports shall comply with AC85.

68 **2.4 Product Sampling:** Sampling of the welded member components shall comply
69 with Section 3.1 of AC85. The fabrication of the qualification test assemblies shall be
70 witnessed by or verified by the testing laboratory.

71 **3.0 TEST AND PERFORMANCE REQUIREMENTS**

72 **3.1 Procedure Qualification Records (PQRs) Testing:** Qualification testing in
73 accordance with Sections 4.1 through 4.3 of this criteria shall be performed for each PQR
74 noted in Table 1 of this criteria to be qualified and recognized in an evaluation report. Once a
75 plate thickness range is qualified, further qualification testing is not required for plate
76 thicknesses within the range, provided the essential welding and base-metal variables remain
77 unchanged. See Section 4.7 and Table 4.7 of AWS D1.1 and Section 6.1.3 of this criteria.

78 **3.2 Material Specifications:**

79 **3.2.1 Base Metals:** Base metals must comply with ASTM A 36, ASTM A 572, or
80 ASTM A 992, as specified in Table 3.1 of AWS D1.1. Compliance shall be determined by test
81 reports submitted by the mill or a testing laboratory.

82 **3.2.2 Electrodes:** Electrodes must comply with Section 9.4 of ANSI/AWS A5.25.
83 Compliance shall be determined by chemical analysis of the solid electrode in accordance
84 with Section 6 of ANSI/AWS A5.25. Electrodes must also comply with Section 4.2.5.4 of this
85 criteria.

86 **3.2.3 Weld Metal/flux Combination:** The undiluted weld metal/flux combination
87 shall be determined by preparing a weld ingot as schematically shown in Figure 1 of
88 ANSI/AWS A5.25. Compliance shall be determined by chemical analysis in accordance with
89 Section 9.4 of ANSI/AWS A5.25.

90 **3.3 Steel Moment Connections (Optional):** For recognition of special steel moment
91 connections produced by the NGI-ESW process, the connections must be verified in
92 accordance with the ICC-ES Acceptance Criteria for Steel Moment Frame Connection
93 Systems (AC129).

94 **3.4 Repairs:** Weld repairs, prepared in accordance with the weld repair procedure
95 specifications, shall be subjected to qualification testing in accordance with Section 4.1
96 through 4.3 of this criteria. (See comment 3.)

97 **4.0 TEST METHODS**

98 **4.1 General:** The welded test assemblies shall have test specimens prepared by
99 cutting the test plate as shown in Figures 4.9 and 4.10 of AWS D1.1, as applicable. The test
100 specimens shall be prepared for testing in conformance with Figures 4.13, 4.14 and 4.18 of
101 AWS D1.1, as applicable.

102 **4.2 Nondestructive Testing:** Before preparing mechanical test specimens, the
103 qualification test plate shall be nondestructively tested for soundness as described in Sections
104 4.2.1 and 4.2.2 below.

105 **4.2.1 Radiographic Examination:** A radiographic (RT) examination shall be
106 performed in accordance with ASTM E 142, and evaluated in accordance with Section 10.3 of

107 ANSI/AWS A5.25. The results must comply with Section 10.0 of ANSI/AWS A5.25, as shown
108 in Figure 2 of ANSI/AWS A5.25.

109 **4.2.2 Ultrasonic Examination:** An ultrasonic (UT) examination shall be performed
110 in accordance with Section 4.8.2.1 of AWS D1.1. The results must comply with Table 6.2 of
111 AWS D1.1.

112 **4.3 Mechanical Testing:**

113 **4.3.1 Side Bend Test:**

114 **4.3.1.1 Procedure:** Side bend testing shall be performed in accordance with
115 Section 4.8.3.1 of AWS D1.1.

116 **4.3.1.2 Conditions of Acceptance:** Conditions of acceptance shall be in
117 accordance with Section 4.8.3.3 of AWS D1.1.

118 **4.3.2 Reduced-section Tension Test:**

119 **4.3.2.1 Procedure:** Reduced-section tensile testing shall be performed in
120 accordance with Section 4.8.3.4 of AWS D1.1.

121 **4.3.2.2 Conditions of Acceptance:** The tensile strength shall be no less than
122 the minimum of the specified tensile range of the base metal used. See Table 3.1 and
123 Section 4.8.3.5 of AWS D1.1.

124 **4.3.3 All-weld Tension Test:**

125 **4.3.3.1 Procedure:** All-weld tensile testing shall be performed in accordance
126 with Section 4.8.3.6 of AWS D1.1.

127 **4.3.3.2 Conditions of Acceptance:** Conditions of acceptance shall be in
128 accordance with Table 3 of ANSI/AWS A5.25, as follows, based on the electrode:

AWS A5.25 Electrode Classification ¹	Elongation, %, min. (2-inch gage length)	0.2% Offset Yield Strength, Min. (ksi)	Tensile Stress (ksi)
FES6Z-XXX	24	36.0	60-80
FES60-XXX			
FES62-XXX			
FES7Z-XXX	22	50.0	70-90
FES70-XXX			
FES72-XXX			
FES8Z-XXX	20	60.0	80-100
FES80-XXX			
FES82-XXX			

129 ¹ The letters 'XXX' refer to the electrode classification used.

130 For SI: 1 inch = 25.4 mm; 1 ksi = 6.89 MPa.

131 **4.3.4 Impact Testing:** Charpy V-Notch (CVN) impact testing shall be performed in
132 accordance with the following:

133 **4.3.4.1 AWS D1.8:**

134 **4.3.4.1.1 Procedure:** CVN testing shall be performed in accordance with
135 Annex A of AWS D1.8.

136 **4.3.4.1.2 Conditions of Acceptance:** The CVN toughness shall be determined
137 in accordance with, and comply with, Section A7 of AWS D1.8.

138 The CVN toughness shall be determined in accordance with Section A7 of AWS D1.8 except
139 as follows: The lowest and highest values obtained from the five test specimens shall be
140 disregarded. Two of the remaining three values shall be a minimum of 20 ft. lbs (27 J) at

141 -20° F (-29° C). One of the three values may be lower, but not lower than 15 ft. lbs (20 J) at
142 -20° F (-29° C). The average of the three shall not be less than 20 ft. lbs (27 J).

143 **4.3.4.2 FEMA 353:**

144 **4.3.4.2.1 Procedure:** CVN testing shall be performed in accordance with
145 Sections 2.4.1.1.1 and 2.4.1.1.2 of FEMA 353.

146 **4.3.4.2.2 Conditions of Acceptance:** When tested in accordance with Section
147 2.4.1.1.1 of FEMA 353, the CVN toughness shall be a minimum of 20 ft. lbs (27 J) at 0° F
148 (-18° C); When tested in accordance with Section 2.4.1.1.2 of FEMA 353, the CVN toughness
149 shall be a minimum of 40 ft. lbs (54 J) at 70° F (21° C).

150 **4.3.4.3 AISC 341:**

151 **4.3.4.3.1 Procedure:** CVN testing shall be performed in accordance with
152 Appendix X of AISC 341.

153 **4.3.4.3.2 Conditions of Acceptance:** The CVN toughness shall be a minimum
154 of 40 ft. lbs (54 J) at 70°F (21° C). The CVN toughness of demand-critical electrodes shall be
155 a minimum of 20 ft. lbs (27 J) at -20° F (-29° C); and for non-critical electrodes, a minimum of
156 20 ft. lbs (27 J) at 0 degrees F (-18° C).

157 **4.3.4.4 ANSI/AWS A5.25:**

158 **4.3.4.4.1 Procedure:** CVN testing shall be performed on the electrode in
159 accordance with Section 12.2 and Table 4 of ANSI/AWS A5.25.

160 **4.3.4.4.2 Conditions of Acceptance:** The CVN toughness of the electrode
161 shall be a minimum of 15 ft. lbs (20 J) at -20° F (-29°C).

162 **4.4 Weld Repair Qualification Testing:**

163 **4.4.1 Procedure:** Weld repair test specimens and weld restart specimens shall be
164 prepared in accordance with Sections A.1 and A.2, respectively, of Appendix A of this criteria.
165 CVN testing shall be performed in accordance with Annex B of AWS D1.8.

166 **4.4.2 Conditions of Acceptance:** The CVN toughness shall be determined in
167 accordance with Section B7 of AWS D1.8, except as follows: The lowest and highest values
168 obtained from the five test specimens shall be disregarded. Two of the remaining three
169 values shall be a minimum of 20 ft. lbs (27 J) at -20° F (-29° C). One of the three values may
170 be lower, but not lower than 15 ft. lbs (20 J) at -20° F (-29° C). The average of the three shall
171 not be less than 20 ft. lbs (27 J).

172 **5.0 QUALITY CONTROL**

173 **5.1 Special Inspection:** For jobsite welding, continuous special inspection at the
174 jobsite shall be provided in accordance with IBC Sections 1704.3 and 1707.2, and Section 18
175 and Appendix Q of AISC 341. Jobsite quality assurance shall conform to IBC Sections 1705,
176 1706 and 1708.4, and Section 18 and Appendix Q of AISC 341. For factory welding, the
177 products must be produced at an approved fabricator facility.

178 **5.2** Welding of products by the NGI-ESW process shall be witnessed by a certified
179 AWS inspector, in accordance with Section 6 of AWS D1.1.

180 **5.3** Quality documentation shall comply with the ICC-ES Acceptance Criteria for Quality
181 Documentation (AC10). The quality documentation shall specify quality assurance and
182 process control requirements that ensure the base-metal and welding process essential
183 variables remain consistent with those qualified.

184 **6.0 EVALUATION REPORT RECOGNITION**

- 185 **6.1** The evaluation report shall include the following information:
- 186 **6.1.1** Information described in Section 2.1.
- 187 **6.1.2** Provisions for special inspection as described in Sections 5.1 and 5.2.
- 188 **6.1.3** Sample Welding Procedure Specification (WPS) and Procedure Qualification
189 Record (PQR) for the NGI-ESW process.
- 190 **6.1.4** Specifications for repair of weld imperfections in accordance with Appendix A
191 of this criteria and Section 5.26 of AWS D1.1.

TABLE 1

RANGE DESIGNATION	PQR	PLATE THICKNESS TO BE TESTED (inches)	QUALIFICATION THICKNESS RANGE (inches)
1	ESW-PQR-1.5	1.5	0.75 – 1.65
2	ESW-PQR-3.5	3.5	1.75 – 3.85
3	ESW-PQR-4.0	4.0	2.00 – 4.40
4	ESW-PQR-5.0	5.0	2.50 – 5.50
5	ESW-PQR-6.0	6.0	3.00 – 6.60

For **SI**: 1 inch = 25.4 mm.

Note: The range of nominal base-metal thicknesses within each PQR is 0.5T through 1.1T where 'T' is the nominal base-metal thickness.

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APPENDIX A

A1.0 REPAIR OF WELD IMPERFECTIONS:

A1.1 Excavation of Imperfection: The imperfection shall be excavated by mechanical grinding or machining. Air-carbon arc gouging may also be used, as follows: A minimum preheat of 250° F (120° C) must be applied using direct current reverse polarity in combination with a power supply rated at a minimum of 300 amps. This shall be followed by mechanical grinding at ambient temperature to ensure removal of surface irregularities and any carbon pick-up. Progressive excavation of the imperfection shall be aided where necessary by magnetic particle testing (MT) in accordance with Section 6.14.4 of AWS D1.1, to ensure complete removal. The excavated surfaces must be suitably cleaned prior to the actual repair. Excavated profiles must have a minimum of ¼-inch (6.4 mm) root radius and a minimum 10-degree sidewall angle on each side. A maximum 45-degree slope from the groove root to the plate surface to produce cascaded ends on multiple layer welds is essential for close-end excavations. The groove ends must be radiused to match the nominal groove width at any given depth. A final magnetic particle test shall be conducted to confirm that the entire imperfection has been removed.

A1.2 Weld Repair: Weld fill-in shall be performed by the shielded metal arc welding (SMAW) process using an E 7018 electrode in accordance with AWS A 5.5. The electrode diameter shall be 5/32 inch (4 mm) using direct current electrode positive at 170-180 amps and electrode-positive polarity.

212 Preheat and interpass minimum temperatures of 250°F must be maintained throughout the
213 repair welding. The temperature must be maintained through the thickness and within 6
214 inches (152 mm) in any direction from the location of the repair excavation.

215 **7.0** A stringer-bead technique must be utilized with minimum arc time of 30 seconds and a
216 minimum weld length of 1.5 inches (38 mm). Weld starts and terminations must be suitably
217 arranged to avoid stacking. Arc strikes and aborted welds must be completely removed by
218 grinding before weld continuation. The last weld pass must be placed such that it is entirely on
219 the weld repair weld metal without being in contact with the base metal. The repair weld must
220 be a minimum $\frac{1}{8}$ inch (3.2 mm) proud of the surface such that after grinding back it is flush
221 with the base-metal surface.

222 The integrity of the final repair must be confirmed by post-repair radiographic, ultrasonic and
223 magnetic particle testing.

224 **A2.0: REPAIR OF WELD RESTART IMPERFECTIONS:**

225 The imperfection shall be excavated by mechanical grinding or machining. Air-carbon arc
226 gouging may also be used, as follows: A minimum preheat of 250°F (120°C) must be applied
227 using direct current reverse polarity in combination with a power supply rated at a minimum of
228 300 amps. This shall be followed by mechanical grinding at ambient temperature to ensure
229 removal of surface irregularities and any carbon pick-up. Sufficient weld metal [typically $\frac{1}{8}$ to
230 $\frac{1}{2}$ inch (3.2 to 12.7 mm)] beyond the restart must be removed to ensure freedom from slag.

231 Progressive excavation of the imperfection shall be aided where necessary by magnetic
232 particle testing (MT) in accordance with Section 6.14.4 of AWS D1.1, to ensure complete
233 removal. The excavated surfaces must be suitably cleaned prior to the actual repair.

234 Excavated profiles must have a minimum of ¼-inch (6.4 mm) root radius and a minimum 10-
235 degree sidewall angle on each side. A maximum 45-degree slope from the groove root to the
236 plate surface to produce cascaded ends on multiple layer welds is essential for close-end
237 excavations. The groove ends must be radiused to match the nominal groove width at any
238 given depth. A final magnetic particle test shall be conducted to confirm that the entire
239 imperfection has been removed.

240 Upon resumption of welding, the voltage should be increased by 4 volts from that before the
241 restart. Welding progresses once the slag bath has been established upon restart.

242 The integrity of the restart must be confirmed by radiographic, ultrasonic and magnetic particle
243 testing. Restart repairs if any, must be accomplished by shielded metal arc welding (SMAW)
244 as noted in Section A1.0 for repair of weld imperfections.